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Demographic Influences on Economic Growth, 1968-83*

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This paper describes an econometric investigation of the effects of population growth on the growth of output. A structural model yields an equation expressing output growth as a function of both demographic and nondemographic variables. This equation is estimated from data on 142 six-year growth periods in 85 countries at all levels of per capita output. Higher fertility is found to lower output growth in the short run and raise it in the long run (after twelve years). Nondemographic factors found to stimulate output growth include export orientation, improvements in the terms of trade, human capital formation, and reductions in political violence.

I. Introduction

What is the effect of population growth on the growth of output? The question is of obvious practical importance, but no clear consensus has emerged from the answers that economists have provided. Most of these answers have been based on one or other of three approaches. First, there is the approach of specifying a simple macroeconomic model and obtaining a direct analytical solution for the relationship between population growth and output growth. Models of the "steady-state" type illustrate this approach, and have generally yielded antinatalist results (e.g., Solow (1970)). Second, more complex models are specified, too complex to permit analytical solutions, and simulation techniques are employed to show the effects of alternative population growth rates on output growth. This approach has yielded results which are sometimes antinatalist (Coale and Hoover (1958)) and sometimes pronatalist (Simon (1976)). Third, econometric studies have examined historical correlations between population growth and output growth, using either cross-sectional or time-series techniques. The most common bivariate finding in these studies has been that the rate of population growth is not closely associated with the rate of growth in per capita output (Kelley (1988)).

This paper attempts some more econometric analysis of the relationship between population growth and output growth. Some of the requirements of such analysis are as follows:

1. Multivariate rather than bivariate analysis is called for, since economic growth is evidently influenced by many other factors besides population growth, including economic policy, human capital accumulation, the external economic environment, and the political climate.
2. Different components of population growth - fertility, mortality, and immigration - as well as the absolute size of the population, ought to be recognized, since they may have

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different effects on economic growth.

3. Demographic change may have long-term as well as short-term effects on economic growth. Several studies have met one or two of these requirements, in seeking to explain growth rates of output or per capita output. Studies examining the short-term effect of population growth and simultaneously considering a large number of nondemographic factors include those by Agarwala (1983), Faini *et al*. (1984), and Landau (1986). Studies considering the short-term effects of components of population growth, especially fertility, as well as several non-demographic factors, include those by Plane (1988) and Barro (1997). Studies recognizing both short-term and long-term effects of fertility have been contributed by Blanchet (1991), Brander and Dowrick (1994), Barlow (1994), and Kelley and Schmidt (1995), but in these cases the number of policy and other nondemographic factors recognized has been limited.

Studies meeting all three of requirements are fewer in number. Recent analyses of this type have been contributed by Radelet *et al*. (1996) and Bloom and Williamson (1997). Another is attempted here, although with a time period and set of demographic and other independent variables significantly different from those used by Radelet *et al*. and by Bloom and Williamson.

The paper begins by specifying a general structural model of economic growth in which separate roles are played by fertility variables (lagged and unlagged), net immigration, the absolute size of the population, and several nondemographic factors. From this structural model an equation is obtained in which output growth is expressed as a function of both demographic and nondemographic variables. This equation is then estimated with cross-national data, after adjustments for simultaneity.

The data employed in this estimation relate to 142 six-year periods of output growth observed in 85 countries covering the entire range of per capita output. The earliest six-year period considered is 1968-74 and the latest is 1977-83. A reason for focusing on that particular stretch of time is that bivariate cross-national analyses covering those years tended to show that population growth was uncorrelated with per capita output growth. From these results, some influential anti-Malthusian or “revisionist” inferences were drawn, arguing that population growth was neutral with respect to economic growth (Simon (1981)). Examining those years with the aid of a multivariate model provides a more stringent test of the “neutralist” conclusion than viewing the years since the early 1980s, when the bivariate correlations according to Blanchet (1992) and Kelley and Schmidt (1994) become negative.

The multivariate analysis presented here finds that higher fertility lowers output growth in the short run and raises it in the long run (after twelve years). The net result of these two conflicting effects is that higher fertility lowers output per capita, at least within the 24-year horizon covered by the analysis.

Besides fertility, two other demographic variables are employed here - the rate of immigration and the absolute size of the population. Immigration is not found to have a significant effect on output growth, but there is some indication that countries with smaller populations tend to grow faster.

Among the nondemographic variables employed, positive contributions to growth are made by the country’s orientation towards production for exports, improvements in its terms of trade, and increases in the human capital embodied in the labor force, as measured by education and health variables. The level of per capita GDP at the start of the growth period is negatively correlated with output growth, as is the degree of political violence during the period. Variables with little apparent explanatory power include the rate of capital inflow throughout the period, the within-period increase in the rate of capital inflow, the growth rate of output in the United States, the rate of currency appreciation, the military share of total output, and two tax variables (the average tax rate throughout the period and its within-period change).

II. A General Model of Economic Growth

In this section an estimatable growth equation is derived from a structural model of the macroeconomy, following the "growth components" approach exemplified by Hagen and Hawrylyshyn (1969). This eclectic approach can use elements from neoclassical growth models and from models of endogenous growth. Cross-national empirical work based on these two groups of models has generated good explanations of economic growth. Among the predictors often found to be significant are those representing human capital accumulation, such as education and health; economic policy, such as export orientation, inflation, tax burdens, and income distribution; the political climate, such as the rule of law, democracy, and violence; the external environment, such as the terms of trade; and the initial level of per capita output, which allows for the phenomenon of "conditional convergence". Recent examples of this literature are found in Barro (1997), Asian Development Bank (1997), and Larraín and Vergara (1997).

Using the growth components approach, suppose that actual output Y in year t is a fraction c of potential output Y^*:

$$Y_t = c_t Y_t^*. \tag{1}$$

The annual growth rate of actual output can then be expressed as follows:

$$Y = \hat{c} + Y^* + c\, Y^*, \tag{2}$$

where the superscript $(\hat{})$ represents the variable's rate of increase [e.g., $Y = (dY/dt)/Y$]. Suppose next a general production function expressing the relation between potential output and three input terms: quality-weighted labor (L), quality-weighted capital (K), and an index of total factor productivity (A):

$$Y_t^* = f_1(L_t, K_t, A_t). \tag{3}$$

Natural resources are omitted as an input in this formulation, owing to difficulties of obtaining data on soil characteristics, climatic conditions, mineral discoveries, and other relevant variables.

Differentiation of the production function with respect to time yields the following:

$$Y^* = r_L L + r_K K + r_A A, \tag{4}$$

where r_j is the elasticity of potential output with respect to input j. In order to arrive at an estimatable equation for the growth rate of actual output, each of the six terms on the right-hand side of this equation must be expressed as a function of measurable predictors. To simplify this task, predictors will be sought for the three input growth rates but not for the three input-elasticities. In line with Equation (2), it is also necessary to find predictors for the growth rate of the capacity utilization variable (c). Hence there are four areas where predictors must be sought.

The predictors proposed in the present study have been selected on the basis of theoretical considerations, with due attention paid to findings reported in the empirical literature on economic development. Since our main concern is with the relationship between population growth and economic growth, a special effort is made to include demographic predictors in the model. The mechanisms through which demographic variables affect and are affected by economic variables have been a favorite topic in economics, and there is no shortage of hypotheses to incorporate in a model. Fertile sources for such hypotheses can be found in a number of surveys and syntheses of the field, including those by the World Bank (1984), the National Research Council (1986), Kelley (1988), and Birdsall (1989).

We now consider in turn the four groups of predictors.

Labor Growth

For the growth rate of the quality-weighted labor force, four determinants affecting growth in the number of workers are proposed: the current net birth rate (births minus infant deaths as a percentage of the population, N/P), since child bearing and child care may reduce female participation in the labor force[1]; the net birth rate in two earlier periods, allowing a lag between the arrival of newborns and their eventual entry into the labor force; and the rate of net immigration (I/P) in the current period. In addition, three variables are included which can be hypothesized to represent human capital formation and contribute towards the qualitative improvement of the labor force. These are military spending (E) during the current period in relation to the initial level of output; the growth of lagged school enrolment rates (Q); and the improvement in health conditions, as proxied by the increase in life expectancy at birth (H). That is,

$$L = f_2[\underset{-}{N/P}, \underset{+}{(N/P)_{-2}}, \underset{+}{(N/P)_{-3}}, \underset{+}{I/P}, \underset{+}{E/Y}, \underset{+}{Q}, \underset{+}{H}]. \tag{5}$$

1. The current net birth rate is the sum of all births (minus infant deaths) occurring throughout the growth period (six years in the present analysis), divided by the population at the start of the period. It is assumed that given the net birth rate in earlier periods, a higher net birth rate during the growth period implies a greater increase in fertility (and in female nonparticipation) between the start and end of the period, and hence a smaller increase in the labor force.

The signs under the explanatory variables indicate the hypothesized direction of their effects *ceteris paribus* on the dependent variable (and on the growth rate of output). The lags of two and three periods selected for the net birth rate variable reflect the six-year length of the growth period used in the regression analysis, and the hypotheses proposed for the lagged net birth rate variables in Equation (5) state that labor force growth is affected positively by fertility levels prevailing between 24 and 12 years before the end of the growth period.[2] (Data do not permit lags of more than three periods.)

The sign under the military spending variable represents the Benoit (1978) hypothesis that such spending raises the technical skills of military personnel, who then use these skills in their subsequent civilian careers. The improvement in the educational level of the labor force is represented here by the increase in the secondary school enrollment rate occurring over a six-year period starting seven years before the base year of the output growth period, the length of the lag being dictated by data availability. Other versions of an educational improvement variable are clearly possible. One alternative tried in this study involved estimating the sum of past educational expenditures embodied in the present labor force, but this turned out to be weaker than the enrollment variable as a predictor of economic growth.

Capital Growth

The growth of quality-weighted capital is a function of total domestic saving during the whole growth period in relation to the initial level of output (S/Y), total foreign saving (or capital inflow) during the growth period in relation to the initial level of output (F/Y), and the rate of increase in the index of embodied technology between the beginning and end of the growth period:

$$K = f_3[\underset{+}{S/Y},\ \underset{+}{F/Y},\ \underset{+}{q/k}]. \qquad (6)$$

The domestic saving rate is assumed to have several determinants, among them current and past fertility:

$$S/Y = f_4[\underset{-}{N/P},\ \underset{-}{(N/P)_{-1}},\ \underset{+}{(N/P)_{-2}},\ \underset{+}{(N/P)_{-3}},\ \underset{+}{\dot{Y}},\ \underset{?}{E/Y},\ \underset{?}{Y/P},\ \underset{?}{T/Y},\ \underset{+}{B},\ \underset{-}{\bar{D}},\ \underset{-}{F/Y}]. \qquad (7)$$

Different models of saving behavior generate different hypotheses about the relationships between saving and fertility. With some types of life-cycle model, increases in current fertility (assumed

2. In this analysis the net birth rate is preferred to the crude birth rate or other conventional measures of fertility on the grounds that infants dying before the age of twelve months have relatively small effects on the economy and should therefore be deducted from the total number of births. Similar reasoning could justify the subtraction of "child deaths" occurring between the ages of one and five. Since child deaths are in most cases significantly less numerous than infant deaths, an adjustment for child deaths would not have much effect on the statistical results, and has not been attempted here.

to be exogenously generated) would be expected to change the timing of a worker's lifetime saving, raising current consumption and lowering current saving. Similar results could be expected from higher levels of fertility in the preceding six-year period, since persons born in that interval have not yet entered the labor force. Higher fertility two or more periods back, however, would tend to raise the ratio of workers (savers) to the retired (dissavers), with positive effects on the aggregate saving rate.

In other models of saving behavior, saving and fertility are viewed as jointly determined, with children serving in part as a future source of retirement support and hence as a substitute for current saving. The determinants of both saving and fertility then include such factors as the yields and riskiness of financial investments, the costs of raising children, and the costs of fertility control. In this framework, the current net birth rate in Equation (7) should be replaced by variables representing these factors.

As regards the nondemographic determinants of saving, the development literature provides several well-known hypotheses. Higher rates of output growth $(\dot{Y})$ induce higher rates of domestic saving if the permanent income hypothesis is true. Military spending (E/Y) can either raise or lower public saving, depending on whether the spending is devoted to investment or not.[3] The query under (E/Y) in Equation (7) means that reasonable hypotheses can be advanced for both positive and negative relationships between this variable and the dependent variable. A similar ambiguity exists for the initial level of per capita output (Y/P). Given the distribution of income, higher per capita output implies a higher saving rate if the aggregate consumption function is characterized by a rising marginal propensity to save; however, higher levels of per capita output could over some ranges be associated with increasing equality of income distribution and hence perhaps with lower saving rates. Taxation (T/Y) can either raise or lower saving, depending on relative propensities to save in the private and public sectors.[4] An improvement in the terms of trade index (B) raises the real income associated with a given volume of domestic output, and hence may raise domestic saving. Higher levels of political instability, as measured by an indicator like the average annual per capita number of deaths due to political violence during the growth period $(\overline{D})$, may depress saving.[5] Capital inflows (F/Y) may partially substitute for domestic saving (Mosley (1987)).

Returning to Equation (6), we note that a further determinant of the growth of the quality-weighted capital stock is the rate of change of embodied technology $(\dot{qk})$. This rate is assumed to be determined by the initial level of per capita output, the current net birth rate, the growth rate of the capital stock unweighted for quality $(K' = K/qk)$, and the rate of capital inflow:

$$\dot{qk} = f_5[\underset{?}{Y/P},\ \underset{+}{N/P},\ \underset{+}{K'},\ \underset{+}{F/Y}]. \tag{8}$$

3. This is because public saving is defined as the public sector's revenues minus its noninvestment spending.
4. A tax ratio variable is found by Landau (1986) to have a negative effect on output growth.
5. Political instability variables are found by Wheeler (1984) and Timmerman and Scholing (1986) to have negative effects on output growth.

The query under the per capita output variable is again an indication of competing hypotheses. Richer countries usually devote a larger proportion of their resources to R&D, but poorer countries are able to exploit an extensive backlog of unused technological improvements.

As for the current net birth rate variable, its hypothesized sign reflects the Boserup view that a high rate of population growth creates population density pressures which stimulate technological innovation. (The same view would also justify the use of lagged net birth rates in this equation.) Next, a higher rate of growth of the capital stock unweighted for quality (K') is likely to be associated with larger increases in the index of embodied technology, since in these circumstances the average age of the capital stock will be decreasing.

The rationale for the capital inflow term is that such inflows are often associated with imports of investment goods, which are assumed to possess relatively advanced technology. It can be noted, therefore, that the capital inflow variable (F/Y) is a direct contributor to the growth of the quality-weighted capital stock in line with Equation (6), but also has indirect effects as a result of its assumed influences on the domestic saving rate and on the rate of change of embodied technology.

Growth in Total Factor Productivity

For the rate of increase in the index of total factor productivity (A), six exogenous determinants are suggested:

$$A = f_6[\underset{+}{N/P}, \underset{-}{dD}, \underset{-}{d(T/Y)}, \underset{+}{J}, \underset{-}{X}, \underset{?}{P}]. \tag{9}$$

The sign on the current net birth rate (N/P) reflects another aspect of the Boserup hypothesis about fertility and technology: this time it is disembodied rather than embodied technology which will be stimulated by high fertility. Increases in political instability during the growth period (dD) or in the tax rate [$d(T/Y)$] may reduce allocative efficiency. Countries starting the growth period with a high degree of export orientation (J) may be led by competitive pressures to achieve higher rates of allocative efficiency.[6] Government interventions during the growth period which distort prices may lead to misallocations. Among the price distortions affecting growth, currency overvaluation has been identified in a number of empirical studies

6. Following the methodology of Balassa (1985) and others, export orientation is defined here as the difference in the base year of the growth period between the actual ratio of exports of GDP and the ratio predicted on the basis of nonpolicy variables like population size and mineral endowment. The least-squares regression equation used here for predicting exports as a percentage of GDP (EXP/Y) is as follows:

$$EXP/Y = 27.5 + \underset{(0.0422)}{0.1534}(Y/P) + \underset{(0.1176)}{0.4646}(M/Y) - \underset{(0.0553)}{0.2376}P + \underset{(0.0001)}{0.0003}P^2,$$

where Y/P is per capita GDP in hundreds of US dollars, M/Y is mining output as a percentage of GDP, and P is population in millions. The data are for 1980 and relate to the 85 countries listed in Table A.1. Numbers in parentheses are standard errors, and the R^2 is 0.40.

as being particularly harmful (Agarwala (1983)). The rate of increase in the real exchange rate (X) has therefore been included here as an exogenous determinant of allocative efficiency. Finally, the size of the population (P) has been hypothesized to have both positive and negative effects on output growth: a larger population, for example, may permit the attainment of economies of scale or it may increase the problems of political management (Perkins and Syrquin (1989)).

Capacity Utilization Term

The rate of capacity utilization is assumed to be lowered between the beginning and end of a six-year growth period by a deterioration in the terms of trade (B) or by a decline in foreign capital inflow within the period $[d(F/Y)]$, both of which cause import curtailments and consequent production stoppages; by a reduction in the current net birth rate (N/P), which reduces aggregate demand and hence has Keynesian effects on output; by increasing political instability (dD); and by a worsening of world economic conditions, which reduces demand for the country's exports. World economic conditions can be proxied by the growth rate of real GDP in the United States (U). These hypotheses are represented by the following equation:

$$\hat{c} = f_7[\underset{+}{B},\ \underset{+}{d(F/Y)},\ \underset{+}{N/P},\ \underset{-}{dD},\ \underset{+}{U}]. \tag{10}$$

Deriving and Estimating a Growth Equation

Substituting Equation (4)-(10) into Equation (2) yields the following equation for the rate of output growth:

$$\begin{aligned} Y = f_8[\,&\underset{?}{Y/P},\ \underset{?}{N/P},\ \underset{-}{(N/P)_{-1}},\ \underset{+}{(N/P)_{-2}},\ \underset{+}{(N/P)_{-3}},\ \underset{+}{I/P},\ \underset{?}{E/Y},\ \underset{+}{Q},\ \underset{+}{H},\\ &\underset{?}{F/Y},\ \underset{?}{T/Y},\ \underset{+}{B},\ \underset{-}{\overline{D}},\ \underset{-}{dD},\ \underset{-}{d(T/Y)},\ \underset{+}{J},\ \underset{-}{X},\ \underset{?}{P},\ \underset{+}{d(F/Y)},\ \underset{+}{U}\,]. \end{aligned} \tag{11}$$

Since Y/P, N/P, and F/Y each have hypothesized partial derivatives with respect to Y which possess different signs in different structural equations, their derivatives in this composite equation are of indeterminate sign *a priori*.

Equation (11) provides a framework for estimating the *net* effect of each demographic variable on the rate of output growth, that is, the net outcome of the separate effects identified in the structural Equations (5) - (10). It is these net effects that are our central concern here. Before estimating Equation (11), however, it must be noted that eight of its twenty right-hand-side variables may be significantly affected by the dependent variable, so that an estimation of the equation by ordinary least squares is in danger of yielding biased coefficients. The eight variables where a simultaneity problem can be plausibly argued include the current net birth rate, net immigration, military expenditures, the change in life expectancy, the rate of foreign capital inflow, the within-period change in the rate of foreign capital inflow, the tax rate, and the within-period change in the tax rate. Equation (11) has therefore been estimated by the instrumental variable technique, the actual values of the eight explanatory but endogenous variables listed above being replaced by values estimated from exogenous variables in the system.

To permit the use of this technique, and to ensure the proper identification of Equation (11), more exogenous variables are needed beyond those already included, and the following equation for one of the eight endogenous variables, the current net birth rate, is therefore added to the system:

$$N/P = f_9(\underset{?}{Y},\ \underset{?}{Y/P},\ \underset{-}{FSSER},\ \underset{-}{URB},\ \underset{-}{H},\ \underset{+}{LATIN},\ \underset{+}{AFRICA},$$
$$\underset{+}{MIDEAST},\ \underset{+}{S\&EASIA},\ \underset{+}{CATH},\ \underset{+}{MOS}). \qquad (12)$$

This equation adds nine new exogenous variables to the twelve already contained in Equation (11). The new variables are suggested by the demographic literature, and include the female secondary school enrolment rate a few years before the start of the growth period $(FSSER)$, the rate of urbanization (URB) and life expectancy at birth (H) at the start of the growth period, four dummy variable representing region-specific factors like the effort put into public programs of family planning $(LATIN,\ AFRICA,\ MIDEAST,\ S\&EASIA)$,[7] and two religious variables, measuring the percentage of the population who are Catholic $(CATH)$ or Moslem (MOS).

From the set of twenty-one available exogenous variables, five are excluded from the procedure of deriving instrumented variables. The three lagged fertility variables $[(N/P)_{-1},\ (N/P)_{-2},\ (N/P)_{-3}]$ are excluded on the grounds that they do not provide an independent explanation of current fertility but rather reflect underlying socio-economic factors which determine both lagged and current fertility. The two political instability variables ($\overline{D}$ and dD) are excluded because they are only available for a limited number of cases. The remaining sixteen exogenous variables are employed in obtaining instrumented values of the nine endogenous variables mentioned above, the regression equation used in this process being shown in the Appendix (Table A.2).

One final point should be made about the instrumented variables. For at least one of them, current fertility, the case for its actual values being significantly affected by the contemporary growth rate of output is quite weak. A common view among demographers is that expressed by Blanchet (1988) in the following terms: "it is usual to try to explain … birth rates by

7. The four regions are (1) Latin America and the Caribbean, (2) Sub-Saharan Africa, (3) the Middle East and North Africa, and (4) South, Southeast, and East Asia (excluding Japan). For interpreting the values of the four dummy variable coefficients, the reference region is therefore Europe, Canada, Australia, New Zealand, and Japan. (The United States is excluded from the analysis, as explained in Section III.)

the various *levels* of income observed in LDCs, but it is generally considered that taking into account the current *variations* in these levels cannot add much to this explanation" (p. 88).[8] Nonetheless, because the relationship between output growth and current fertility is one of the central concerns of this paper, it seems better to take the conservative approach of assuming that the relationship is a reciprocal one, and hence adopting instrumented values for current fertility.

III. Data

In obtaining country-level data for the estimation of Equation (11), we first exclude for convenience' sake the large number of mini-states, defined here as those with a population under two millions in 1984. We also exclude the United States, since its own growth rate is an explanatory variable in this equation. This leaves 118 countries available for the analysis. For 33 of these countries, data are available for fewer than sixteen of the twenty explanatory variables in Equation (11), and these countries (mostly socialist at the time) are excluded from the subsequent analysis. Among the remaining 85 countries, there are several where no data exist for one or other of four explanatory variables: the two political violence variables and the two tax variables.

This problem of missing data is handled in the usual way by specifying alternative models. Three basic models are used:

Model I:	16 common explanatory variables only (85 countries)
Model II:	16 common variables plus political violence variables (70 countries)
Model III:	16 common variables plus tax variables (35 countries)

To increase further the number of observations for these models, each country is represented by two nonoverlapping growth periods where possible. A growth period of six years is chosen for the analysis, on pragmatic grounds. A longer period would reduce significantly the number of observations in view of data limitations; a shorter period would increase the relative importance of unmeasured short-run factors like climatic fluctuations. No further virtue is claimed for this choice of period length, and it is to be expected that analyses using periods greater than or less than six years will produce somewhat different results, all of which have a right to be considered.

The choice of a particular six-year period for a particular country is determined by a random process. For example, if data on a country are only available for 1971-79, three six-year periods are possible (1971-77, 1972-78, and 1973-79), and the choice between these three is made randomly. As a result of these procedures, 57 of the 85 countries in Model I are represented by two six-year growth periods each, and the remainder by one period each, for a total of 142 cases. The cases are listed in the Appendix (Table A.1). The observations available for Models II and III are similarly augmented. The growth periods range from 1968-74 to 1977-83. Earlier periods are ruled out because of the long eighteen-year lag required for one of the net birth rate variables.

8. The same point is made by Simon (1989, pp. 326-27).

IV. Empirical Results

Least-squares estimates of Equation (11) - or at least estimates of the truncated versions of that equation represented by Models I-III - are shown in Table 1. The explanatory variables are listed under three broad categories - demographic, external environment, and socio-political. Those explanatory variables represented by instrumented rather than actual values are marked by the symbol "@".

Table 1 Determinants of Economic Growth: Regression Results

Independent variables	Regression coefficients					
	Model I				Model II	Model III
	No restrictions on coefficients	Coefficients of net birth rate variables restricted to fit linear lag function				
		All cases	Cases with per capita GDP > $2000	Cases with per capita GDP < $2000	All cases	All cases
	(1)	(2)	(3)	(4)	(5)	(6)
Demographic factors						
$(N/P)@$	-2.824**	-2.406	-2.235	-2.260	-2.146	-3.079
$(N/P)_{-1}$	0.025	-1.119	-1.153	-0.903	-0.863	-1.242
$(N/P)_{-2}$	-0.620	0.168	-0.071	0.454	0.420	0.595
$(N/P)_{-3}$	1.302	1.455	1.011	1.811	1.703	2.432
v_0	...	-2.406**	-2.235**	-2.260**	-2.146**	-3.079**
v_1	...	1.287**	1.082**	1.357**	1.283**	1.837**
$(I/P)@$	1.343	...	...	...	...	...
P	-0.064*	-0.058**	...	...	-0.028	-0.065
External environment						
B	0.066	0.089**	0.091**	0.118*	0.115**	-0.098
$(F/Y)@$	-0.203	...	...	...	...	...
$[d(F/Y)]@$	0.143	...	...	...	...	...
U	0.635	...	...	...	...	...
Socio-political factors						
J	0.169	0.149*	0.174*	...	0.073	0.032
X	-0.065	...	...	...	...	...
$(E/Y)@$	0.216	...	...	...	...	...
Q	0.210	0.686**	...	1.300	0.572	0.102
$H@$	5.090*	7.848**	9.839**	4.587*	2.061	7.253
Y/P	-0.576**	-0.390**	-0.383**	...	-0.458**	-0.470**
$\overline{D}$	...	...	...	...	-0.066	...
dD	...	...	...	...	-0.137**	...
$(T/Y)@$	...	...	...	...	...	0.067
$[d(T/Y)]@$	...	...	...	...	...	3.787

Table 1 (Continued)

Independent variables	Regression coefficients					
	Model I				Model II	Model III
	No restrictions on coefficients	Coefficients of net birth rate variables restricted to fit linear lag function				
		All cases	Cases with per capita GDP > $2000	Cases with per capita GDP < $2000	All cases	All cases
Constant	57.196	43.401	44.166	26.062	52.198	21.611
R^2	0.351	0.354	0.409	0.212	0.443	0.501
# of cases	142	142	73	69	79	43
# of countries	85	85	44	49	70	35

Dependent variable: percentage change in real gross domestic product over six-year period ($\dot{Y}$); observations for periods ranging from 1968-74 to 1977-83 in countries with 1984 population over 2m.

@ = instrumental variable estimated from exogenous variables to avoid simultaneity. See Table A.2.

* = coefficient significant at 90 per cent confidence level.

** = coefficient significant at 95 per cent confidence level.

Definitions of independent variables:

(N/P) NET BIRTH RATE UNLAGGED: Six-year net births (= births - infant deaths) as percentage of base-year population (same period as for dependent variable)

$(N/P)_{-1}$ NET BIRTH RATE LAGGED 1 PERIOD: Six-year net births as percentage of base-year population, lagged one period (e.g., net births in 1970-75 as percentage of mid-1969 population, when growth in dependent variable measured from calendar 1975 to calendar 1981)

$(N/P)_{-2}$ NET BIRTH RATE LAGGED 2 PERIODS: Six-year net births as percentage of base-year population, lagged two periods

$(N/P)_{-3}$ NET BIRTH RATE LAGGED 3 PERIODS: Six-year net births as percentage of base-year population, lagged three periods

υ_0, υ_1 COEFFICIENTS IN LAG FUNCTION FOR NET BIRTH RATE: See Equation (13) in text

(I/P) IMMIGRATION RATE: Six-year net immigration as a percentage of base-year population

P POPULATION: Population at midpoint of base year (millions)

B TERMS OF TRADE IMPROVEMENT: Six-year increase in terms-of-trade index as percentage of index in base year (same period as for dependent variable)

(F/Y) RATE OF CAPITAL INFLOW: Six-year total of real current account deficits (before transfers) as percentage of real GDP in base year (same period as for dependent variable)

$d(F/Y)$	INCREASE IN RATE OF CAPITAL INFLOW: Increase between base year and end year in current account deficit (before transfers) as percentage of GDP
U	GDP GROWTH RATE IN USA: Six-year increase in real US GDP as percentage of base-year US GDP (same period as for dependent variable)
J	EXPORT ORIENTATION: Actual exports in base year of growth period as a percentage of GDP (both in 1980 prices) minus the percentage estimated on the basis of per capita GDP, the mining share of GDP, population, and population squared; for details of the estimating equation, see Note 6 in text
X	INCREASE IN REAL EXCHANGE RATE: Six-year increase in real exchange rate index as percentage of index in base year (same period as for dependent variable)
(E/Y)	MILITARY SHARE OF GDP: Six-year total of real military expenditures as percentage of real GDP in base year (same period as for dependent variable)
Q	INCREASE IN LAGGED ENROLLMENT RATE: Percentage point increase in secondary school enrollment rate from seven years before base year of growth period to one year before base year
H	INCREASE IN LIFE EXPECTANCY: Percentage increase in life expectancy at birth between base year and end year (same period as for dependent variable)
Y/P	GDP PER CAPITA: GDP per capita in base year, expressed in hundreds of US dollars of 1980 purchasing power
$\overline{D}$	DEATH RATE FROM POLITICAL VIOLENCE: Mean annual deaths from political violence per million population during six-year growth period
dD	INCREASE IN DEATH RATE FROM POLITICAL VIOLENCE: Increase between base year and end year in deaths from political violence per million population
(T/Y)	TAX RATE: Six-year total of real taxes as percentage of real GDP in base year (same period as for dependent variable)
$d(T/Y)$	INCREASE IN TAX RATE: Increase between base year and end year in taxes as a percentage of GDP

Data sources:

For X, Wood (1988); for E/Y, Stockholm International Peace Research Institute, *Yearbook of World Armaments and Disarmament*; for Q, UNESCO, *Statistical Yearbook*; for $\overline{D}$ and dD, Lewis and Jodice (1983). For other variables, World Bank, *World Tables*; International Monetary Fund, *International Financial Statistics*; and United Nations, *Statistical Yearbook*, *Demographic Yearbook*, *National Accounts Statistics*, and *Monthly Bulletin of Statistics*.

Estimation of Model 1 with no restrictions on the coefficients of the independent variables yields the results shown in Column 1 of Table 1. Only two of the sixteen independent variables have coefficients which are statistically significant at the 95 per cent confidence level. This result is undoubtedly due to the high degree of multicolinearity existing between several of those variables. The multicolinearity problem is handled here in two ways. First, because of this study's special concern with the effects of fertility on growth, the four fertility variables are retained in the analysis, but their coefficients w_1, w_1, w_2, and w_3 are required to fit the linear lag function

$$w_i = v_0 + v_1 i, \tag{13}$$

where i indicates the number of periods before the current one (i = 0, 1, 2, 3).[9] Second, other variables are discarded from the regression equation in such manner as to maximize the number of significant coefficients. The result is shown in Column 2 of Table 1. This procedure is then repeated in using Model I with high-income and low-income subsets (Columns 3 and 4), and in using Models II and III (Columns 5 and 6).

The results obtained for the demographic variables are considered first.

Fertility and the Growth of Output

Column 2 of Table 1 indicates that higher levels of fertility have a negative impact on output growth in the short run and a positive impact in the long run. Our discussion of the theoretical model of growth suggests that the negative short-run impact is due to some combination of reduced saving and reduced female participation in the labor force. The theoretical model also implies that the positive long-run impact of higher fertility is due to some combination of labor force growth and lagged Boserup effects on the rate of technological progress.

These fertility results are robust, being repeated across the remainder of the analysis. The coefficient v_0, which by itself describes the effect of the current net birth rate on output growth, is significantly negative at the 95 per cent confidence level in all five regressions based on the linear lag function - when Model I is applied to the entire sample, or when it is applied to the high-income subset, or to the low-income subset, or when Models II and III are used. The numbers of cases yielding these results range all the way from modest (43) to ample (142).

All this can also be said about the coefficient v_1, which describes the marginal effect of lagged fertility on output growth, except that it is significantly positive instead of negative. The robustness of the results extends to the absolute values of both v_0 and v_1, which remain in a narrow range across the regression equations - except when Model III with its modest

9. For a discussion of this and other lag functions, see Kmenta (1986, pp. 539-42). A quadratic lag function was also tried in the regression analysis, but was inferior to the linear function in yielding significant coefficients. The linear function is acceptable from a theoretical point of view, generating coefficients which are consistent with the signs hypothesized for the net birth rate variables in Equation (11).

number of cases is used.[10]

There are two important implications of these fertility results. First, since reductions in fertility have short-run positive effects on the growth of output, they have even stronger positive effects on the growth of output *per capita*. Simulations with the regression results show that this rise in the per capita output growth rate persists even when allowance is made for the negative lagged effects of fertility reduction on the growth of output. Second, since the positive effects of fertility reduction on output growth occur before the negative effects, fertility reduction tends to have a large net present value, i.e., when judged as an investment project.

It should be noted that the particular pattern found here between the short-run and long-run effects of fertility change on the growth of output is also reported by Blanchet (1991), Brander and Dowrick (1994), Barlow (1994), and Kelley and Schmidt (1995). But as mentioned above, those statistical models controlled for only a limited number of nondemographic variables. The same pattern of short-run and long-run effects of fertility change is reported by Radelet *et al*. (1996) and Bloom and Williamson (1997), who add to their sets of demographic predictors extensive sets of nondemographic predictors. All of their sets, it might be noted, are significantly different from those used here.

Migration and the Growth of Output

The net immigration variable enters the regression models with instrumented rather than actual values, because of the likelihood of mutual causation between output growth and migration: immigrants contribute to a booming economy, and a booming economy attracts immigrants. The instrumented variable possesses a significant coefficient in none of the regression models estimated. These results, however, can hardly be regarded as conclusive. The equation used for obtaining the instrumented values (Column 2 of Table A.2) provides poor predictions of net immigration ($\bar{R}^2 = 0.24$). A better instrumenting equation is needed before the effects of immigration on the growth of output can be assessed.

Population Size and the Growth of Output

In the full sample of 142 cases, there is a tendency for countries with small populations to grow faster than those with large populations. This result can be explained in terms of the increasing difficulties of political management as population increases. In the smaller subgroups analyzed, however, there is no significant association between population size and output growth. These results therefore provide no confirmation of the positive association

10. The coefficients v_0 and v_1 are significant, and respectively negative and positive, in many other regression models estimated on the same data set but not reported here for reasons of space. These models used various combinations of explanatory variables and observations, with and without outliers. One such model repeated Column (1) of Table 1 with the exception that v_0 and v_1 were substituted for the four net birth rate variables. The resulting coefficients and standard errors on v_0 and v_1 were practically the same as in Column (2), indicating that the dropping of six apparently weak explanatory variables in passing from Column (1) to Column (2) did not bias the coefficients on the fertility variables.

reported by Perkins and Syrquin (1989, p. 1737), which they explain in terms of economies of scale and other factors. The Perkins-Syrquin analysis is bivariate rather than multivariate. The bivariate relationship obtainable from the present study shows no significant correlation between population size and output growth. It is therefore possible that the different findings of the two studies arise from differences in the data sets employed.

Nondemographic Determinants of the Growth of Output

In Models I, II, and III, a total of fourteen nondemographic variables is used. Six of these variables possess, in at least one of the equations of Table 1, a regression coefficient which is significant at the 95 per cent confidence level and has a sign consistent with the hypothesis presented in Equation (11). Further, none of their significant coefficients in Table 1 has the wrong sign. The variables in question include the improvement in the terms of trade, the degree of export orientation, the initial level of GDP per capita, one of the two political violence variables, and the two variables representing human capital formation - the increase in life expectancy at birth and the increase in the lagged secondary school enrollment rate.

For five of these six variables, their coefficients in Equation (11) were hypothesized to have an unambiguous sign. The exception, with an ambiguous hypothesized sign, is the initial level of GDP per capita. This variable turns out to have a consistently negative effect on output growth in the empirical analysis. In line with the theoretical model proposed above, its negative influence may be explained by some combination of the "income distribution" effect (Equation (7)) and the "technological backlog" effect (Equation (8)). This negative influence, causing poor countries to grow faster than rich ones, is often found in empirical work, and has been interpreted by Barro (1997) and others as "conditional convergence".

Three of the nondemographic variables carry coefficients which are significant at the 95 per cent confidence level in none of the regression models, but which nonetheless are consistent with Equation (11) in the sense that no clearcut relationship is necessarily expected. These are the military share of output, the rate of capital inflow, and the tax rate.

The remaining five nondemographic variables have coefficients which are uniformly nonsignificant (at the 95 per cent confidence level) and inconsistent with the expectations expressed in Equation (11): the within-period increases in the tax rate and the rate of capital inflow, the GDP growth rate in the United States, the average death rate from political violence during the growth period, and the change in the real exchange rate. Each of these "surprises" requires some comment. The result for the within-period increase in the tax rate $[d(T/Y)]$ suggests that other hypotheses might be appropriate besides that of increasing inefficiency in the allocation of resources: an increase in the tax rate could be expansionary if, for example, a Keynesian balanced-budget multiplier were operative. The result for the within-period increase in the rate of capital inflow $[d(F/Y)]$ suggests that increases in outside funds tend to be spent-contrary to our hypothesis - less on imports that immediately raise the rate of capacity utilization (industrial raw materials, spare parts) and more on other imports (consumer goods, investment goods). It is also true that both $d(T/Y)$ and $d(F/Y)$ are used here in their instrumented form, and that the instruments available did not permit good predictions in these two cases. (See Columns 6 and 4 of Table A.2.)

For the nonsignificance of the U.S. growth rate and the average death rate from political violence, there appear to be some statistical explanations of a different sort. The former variable possesses little variance, and the latter is highly correlated with the within-period increase in deaths from political violence. When the within-period increase in deaths (dD) is dropped from the equation in Column 5 of Table 1, the average death rate $(\overline{D})$ becomes statistically significant.

The last of the nonsignificant variables is the change in the real exchange rate. This is a variable of substantial policy interest, since reductions in the real exchange rate are a common recommendation of the International Monetary Fund and the World Bank. These institutions back their recommendation by referring to a long series of studies and reports which purport to show that countries avoiding currency appreciation grow faster. Our regression results produce no support for this position. Nor are those results produced by one or two extreme observations. There is no shortage of cases tending to produce a positive correlation between real appreciation and growth. It is not difficult to find instances of rapid growth accompanying rapid appreciation (Indonesia 1968-74, Iran 1969-75, Jordan 1973-79, Taiwan 1968-74), and of slow growth accompanying real depreciation of the currency (Honduras 1968-74, Netherlands 1976-82, Peru 1975-81, Sweden 1976-82).

Finally, it is interesting to note that the nondemographic variables considered together provide a weaker explanation of growth in the group of low-income countries than in the high-income group - in contrast to the fertility variables, which as noted above have strong and similar effects in both groups. One possible explanation for this outcome is a greater dependence in low-income countries on natural resource inputs, which have been omitted from the present analysis. The volatility of many of these inputs (e.g., rainfall) contributes to a high variance in output growth rates in the low-income group.

V. Conclusion

The main finding of this study is that output growth is affected negatively by higher levels of current fertility, and positively by higher levels of past fertility. This finding persists in all of the multivariate models estimated, regardless of the number of explanatory variables employed or subgroup of observations examined. In countries where fertility has not changed much for a long time, the outcome of the short-run and long-run effects is a GDP growth rate averaging about 30 per cent per six-year period (about 4.5 per cent per year). But when fertility changes significantly, there are major departures from this path.

The point is illustrated in Figure 1, where the net birth rate for the current period (the instrumented version of the variable) and for three periods previously are plotted for the 142 cases used in Model I. Given the nature of the estimated short-run and long-run effects of fertility changes on output growth, the larger is the increase in the net birth rate since three periods previously, the smaller is the growth rate of output. The 142 cases are grouped according to their fertility change into five bands, each band being three percentage points wide.

Figure 1 Current & Lagged Fertility & GDP Growth

(142 6-YR Growth Periods in 85 Countries)

Band	Change in net birth rate (% points)	Number of cases	Mean six-year growth of real GDP (%)
A	more than +3	13	21.1
B	0 to +3	25	28.6
C	0 to -3	47	32.3
D	-3 to -6	35	33.4
E	less than -6	22	41.0

At one extreme (Band A) are thirteen cases where the net birth rate rose by more than three percentage points - as a result of declines in infant mortality accompanied in some instances by increases in total fertility rates. In this group, GDP rose on the average by only 3.2 per cent per year, which meant that in some cases there were actual declines in GDP per capita. The thirteen cases are indicated in Table A.1, and it is seen that Sub-Saharan African countries predominate.

At the other extreme (Band E) are twenty-two cases where the net birth rate fell by more than six percentage points. Their GDP growth rate averaged 5.9 per cent per year. Well represented in the group, as noted in Table A.1, are the East Asian tigers: Hongkong, Korea, Singapore, and Taiwan. According to Fund-Bank orthodoxy, an important part of the economic success enjoyed by these countries is attributable to their export orientation. The present study provides some support for that conclusion, but also suggests that an even more important explanation of their success lies in their fertility declines. At the same time, the statistical results suggest that their recent success is not sustainable. As future fertility reductions taper off among the tigers, their GDP growth rates will fall, because of declines in labor force growth resulting from past fertility reductions. A significant decline in fertility provides, as it were, a window of economic opportunity but not a permanently open door. The same point has been made by Dowrick (1992) and Bloom and Williamson (1997), the latter referring to the phenomenon as East Asia's “demographic gift”.

Appendix

Table A.1 Countries, Periods, and Growth Rates Analysed in Model I

Base-year GDP per capita over $2,000 (dollars of 1980 purchasing power)

		Real GDP growth rate (%)	Notes			Real GDP growth rate (%)	Notes
Algeria	1975-81	52.3		Israel	1969-75	52.1	p
Argentina	1968-74	32.8	ap	Israel	1975-81	16.8	pt
Argentina	1974-80	9.4	at	Jamaica	1974-80	-14.7	p
Australia	1970-76	22.3	ept	Japan	1970-76	32.1	p
Australia	1976-82	19.0	et	Japan	1976-82	29.0	
Austria	1970-76	27.8	pt	Korea	1977-83	42.3	e
Austria	1976-82	15.7	t	Libya	1968-74	-29.4	ap
Belgium	1969-75	27.8	p	Libya	1974-80	35.3	
Belgium	1975-81	13.8	pt	Mexico	1968-74	47.5	p
Brazil	1976-82	23.9		Mexico	1974-80	45.8	et
Canada	1969-75	30.8	ep	Netherlands	1970-76	23.0	p
Canada	1976-82	8.9	e	Netherlands	1976-82	5.3	t
Chile	1968-74	10.1	p	New Zealand	1976-82	1.1	e
Chile	1974-80	24.8	pt	Norway	1969-75	28.0	p
Colombia	1974-80	35.8	e	Norway	1976-82	20.1	t
Costa Rica	1970-76	41.5	ep	Panama	1971-77	18.0	p
Denmark	1970-76	17.8	pt	Peru	1969-75	36.2	p
Denmark	1976-82	9.3	t	Peru	1975-81	14.0	
Ecuador	1974-80	44.4	p	Saudi Arabia	1968-74	106.6	p
Finland	1971-77	19.6	p	Saudi Arabia	1974-80	62.1	
Finland	1977-83	24.1	t	Singapore	1969-75	79.2	ep
France	1970-76	27.9	p	Singapore	1975-81	67.2	et
France	1976-82	14.0	t	South Africa	1977-83	16.2	
Germany (W.)	1970-76	16.5	pt	Spain	1970-76	34.8	pt
Germany (W.)	1976-82	12.7	t	Sweden	1970-76	15.4	pt
Greece	1969-75	38.1	p	Sweden	1976-82	5.7	t
Greece	1975-81	22.8	t	Switzerland	1970-76	2.7	pt
Guatemala	1975-81	33.2		Switzerland	1976-82	10.9	t
Hongkong	1969-75	47.5	ep	Taiwan	1975-81	74.8	et
Hongkong	1975-81	101.8	e	UK	1970-76	15.1	pt
Hungary	1970-76	40.3	p	UK	1977-83	6.2	t
Hungary	1976-82	22.0		Uruguay	1974-80	31.6	a
Iran	1969-75	55.0	p	Venezuela	1969-75	18.4	ep
Iran	1975-81	-21.4	t	Venezuela	1975-81	13.4	e
Iraq	1968-74	33.0	p	Yugoslavia	1970-76	40.9	pt
Ireland	1969-75	26.4	p	Yugoslavia	1976-82	29.1	
Ireland	1975-81	22.9	t				

Table A.1 (Continued)

Base-year GDP per capita under $2,000 (dollars of 1980 purchasing power)							
		Real GDP growth rate (%)	Notes			Real GDP growth rate (%)	Notes
Algeria	1969-75	37.0	p	Kenya	1976-82	36.7	t
Bangladesh	1975-81	40.2		Korea	1971-77	79.4	p
Benin	1973-79	26.8		Liberia	1975-81	8.5	
Bolivia	1969-75	32.9	p	Madagascar	1970-76	0.0	ap
Bolivia	1975-81	16.3		Malawi	1971-77	38.7	pt
Brazil	1970-76	80.0	pt	Malaysia	1970-76	57.4	ep
Burkina Faso	1972-78	27.7	a	Malaysia	1976-82	52.9	e
Burma	1969-75	23.4	p	Morocco	1971-77	41.6	p
Burma	1975-81	43.9	t	Nicaragua	1972-78	19.4	p
Cameroon	1973-79	45.6	a	Nigeria	1975-81	4.0	
Centr.Afr.Rep.	1974-80	3.2	a	Pakistan	1971-77	27.8	
Chad	1971-77	11.6	ap	Paraguay	1968-74	43.7	p
Colombia	1968-74	47.3	p	Paraguay	1974-80	75.4	pt
Côte d'Ivoire	1969-74	38.4	p	Philippines	1968-74	37.8	p
Côte d'Ivoire	1975-81	40.9		Philippines	1974-80	44.5	e
Dominic. Rep.	1968-74	79.8	p	Rwanda	1974-80	31.4	
Dominic. Rep.	1974-90	33.3	ept	Sierra Leone	1968-74	26.3	ap
Ecuador	1968-74	76.9	p	Sierra Leone	1974-80	10.2	a
Egypt	1973-79	62.0		Sri Lanka	1968-74	22.1	p
El Salvador	1969-75	34.4	p	Sri Lanka	1974-80	40.6	t
El Salvador	1976-82	-12.5	e	Sudan	1972-78	66.1	a
Ethiopia	1968-74	27.0	p	Syria	1971-77	82.6	p
Ethiopia	1974-80	5.2	t	Taiwan	1968-74	76.7	ept
Ghana	1968-74	28.0	p	Tanzania	1971-77	38.7	ap
Ghana	1974-80	-9.2		Thailand	1968-74	45.5	p
Guatemala	1968-74	42.5	p	Thailand	1976-82	47.4	t
Honduras	1968-74	16.7	p	Tunisia	1968-74	60.5	p
Honduras	1975-81	42.3	p	Tunisia	1974-80	48.1	
India	1969-75	23.8	p	Turkey	1968-74	45.5	p
India	1975-81	25.4	t	Turkey	1974-80	25.0	p
Indonesia	1968-74	65.4	p	Uganda	1971-77	-0.9	p
Indonesia	1975-81	57.5	t	Zaïre	1968-74	33.1	p
Jamaica	1968-74	30.4	p	Zaïre	1974-80	-11.9	t
Jordan	1973-79	59.9		Zambia	1970-76	18.3	p
Kenya	1970-76	62.5	p				

a = current net birth rate [$(N/P)_0$, an instrumental variable] more than three percentage points greater than net birth rate lagged three periods [$(N/P)_{-3}$].

e = current net birth rate more than six percentage points less than net birth rate lagged three periods.

p = included also in Model II ("political model").

t = included also in Model III ("tax model").

Table A.2 Regression Equations Used for Estimating Instrumental Variables

Independent variables	Dependent variables							
	N/P	I/P	F/Y	$d(F/Y)$	T/Y	$d(T/Y)$	E/Y	H
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
P	-0.003	-0.002	-0.058	0.000	0.096	0.008	-0.012	0.001
B	0.014**	0.001	-0.233**	-0.060**	0.306	0.016	-0.033	-0.002
U	0.086	0.080	0.286	-0.138	0.967	0.178	-0.129	-0.039
J	0.009	0.021*	0.301*	-0.021	0.162	-0.027	-0.067	0.006
X	-0.008	-0.003	0.001	-0.029	-0.224	-0.025	-0.017	0.000
Q	0.031	0.012	-0.433	0.037	-0.778	0.025	0.276	-0.042
Y/P	0.016	0.032**	-0.857**	-0.047	0.235	0.023	0.028	0.010
FSSER	-0.035	-0.045*	0.819**	0.010	1.578**	-0.021	0.214	-0.015
URB	-0.077**	0.048**	-0.143	0.014	-0.246	-0.009	0.219	0.003
H	-0.216**	-0.093	0.478	0.160	2.420	0.384	-0.132	-0.135**
LATIN	7.862**	-2.557**	1.859	0.669	-11.652	2.837	9.374	1.086
AFRICA	8.826**	-1.771	11.418	3.937	31.480	7.625	25.343	-1.324
MIDEAST	11.317**	0.301	46.918**	0.391	-12.821	-4.913	103.334**	2.142**
S&EASIA	5.763**	-1.409	-11.948	-0.168	-25.414	3.312	33.491**	1.139
CATH	0.016	0.002	-0.035	0.018	0.141	0.017	-0.049	-0.002
MOS	-0.025	-0.021	-0.127	0.081*	-0.370	0.090	-0.301*	-0.006
Constant	28.566	3.448	1.920	-8.581	-48.069	-29.382	0.772	12.770
R^2	0.890	0.243	0.391	0.306	0.797	0.232	0.500	0.578
# of cases	142	142	142	142	43	43	142	142
# of countries	85	85	85	85	35	35	85	85

* = coefficient significant at 90 per cent confidence level
** = coefficient significant at 95 per cent confidence level

Definitions of variables:

The eight dependent variables and the first seven independent variables are defined in Table 1.

FSSER	Female secondary school enrolment rate seven years before base year of growth period (percentage)
URB	Urban population as a percentage of total population in base year of growth period
H	Life expectancy at birth (in years) in base year of growth period
LATIN	Dummy variable with value of one if country located in Latin America or Caribbean; otherwise zero.
AFRICA	Dummy variable with value of one if country located in Subsaharan Africa; otherwise zero
MIDEAST	Dummy variable with value of one if country located in Middle East or North Africa; otherwise zero.
S&EASIA	Dummy variable with value of one if country located in South, Southeast, or East Asia (excluding Japan); otherwise zero.
CATH	Catholics as percentage of total population, 1988.
MOS	Moslems as percentage of total population, 1983.

Data sources:

For H, World Bank, *World Tables*; for FSSER and URB, World Bank, *Social Indicators of Development*; for CATH, *Catholic Almanac* (1991); for MOS, Weekes (1984).

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