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by

Ma. Cristina Fabella, MD, MSPH

Amang Rodriguez Memorial Medical Center

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Ma. Cristina Fabella, MD, MSPH
Amang Rodriguez Memorial Medical Center

and

Raul V Fabella
School of Economics
University of the Philippines

Abstract

The relationship between population growth and economic outcomes is an issue of great policy significance. In the era of the Millennium Development Goals, poverty and its correlates have become the compelling issues. Economic growth may not automatically translate into reductions in poverty and its correlates (may not trickle down) if income distribution is at the same time worsening. We therefore investigate the direct effect of population growth on infant mortality for various income categories of countries. We find that after controlling for other relevant influences, population growth robustly increases infant mortality five years later across income categories. The coefficient for population growth and its significance rise as we move from full sample to lower-income to low-income categories. The adverse effect of population growth on infant survival thus rises as one moves from full sample, to lower-income to low-income categories. For low-income countries, the adverse effect of population growth emerges sooner, i.e., after two years. The study highlights the important, if delayed, contribution of population control programs to reduction in infant mortality and poverty.

I. Introduction

The relationship between population growth and economic outcomes is an issue of significant policy implications. Should governments raise the budget share of population programs in order to improve economic outcomes? This issue is especially contentious when the economic outcome in question is economic growth (see e.g., Kelly, 2001; Mapa, 2008). Every child born is not only another mouth to feed but also another pair of hands to either weed the field or a mind to pioneer an industry. The early certainties inspired by the Solow-Swan model that population growth hampered economic growth essayed by Coale and Hoover (1958) fell into some disfavor in the 1980s when technical change and human capital became the drivers of growth models. When controls for policies and institutions were introduced into the regressions, population growth became insignificant influence in growth performance. A revival of sorts of the Solow-Swan certainties emerged in the 1990s with new empirical evidence and an emphasis on demographic transition and demographic dividend (Barro and Sala-i-Martin, 1995; Bloom, Canning and Sevilla, 2001; Eastwood and Lipton, 2002). The nexus between economic growth and poverty reduction was then claimed to be econometrically established by Dollar and Kraay (2002) who found that the elasticity of the poor's income share with respect to mean income is one. This super-trickle down effect inspired the mantra, "Growth is good for the poor."

There has of course been a backlash to the Dollar-Kraay emphasis on growth and the whole trickle-down outlook, which partly motivated the United Nations Millennium Development Goals (MDGs). And this has something to do with income inequality and the revived Kuznets Curve Hypothesis (Kanbur and Lustig, 2000; Banerjee and Duflo, 2003). If income inequality is rising in tandem with income growth, then the trickle down may not come to pass. Barro (2007) claims that the Kuznets curve is alive and well in low-income countries. Growth usually results from policies such as trade openness that will raise

average income but raise income inequality (Kanbur, 2003). The call for policies that directly impact on MDGs became loud and clear. Studies on the impact of public health expenditure and health outcomes became salient (Filmer and Pritchett, 1997; Castro-Leal et al., 2000; Gupta et al., 2002; M.C. Fabella, 2008). Studies on the effect of policies on poverty incidence also became important (Asra et al., 2005 on the effect of foreign aid; Fabella and Fabella, 2008, on the effect of openness).

This study will focus on the impact on one MDG, infant mortality, of population growth and a priori the impact of population control policies. Infant mortality is often used as a proxy for poverty and, needless to say, the measurement of infant mortality is more straightforward. So, impactors of infant mortality could also be said to impact poverty incidence.

II. The Budget Thinning Effect of Population Growth

A. Within-Household Budget Thinning

A child born today is an additional claim on the consumption budget of the family. The consumption claim of each child increases as the child ages. Thus the average share of other family members declines until the child reaches the age at which he/she starts to contribute to the family income. Before that time, we say that the with-in household dependency ratio has risen. This results in *budget thinning*, that is, the consumption budget is spread more thinly among more mouths. The share of incumbents falls further because with age the additional child's consumption rises. A baby born later will suckle from the mother whose budget share is smaller resulting in milk production of poorer quality and quantity. The expenditure on medicine and hygiene per child may also erode

as a result of budget thinning. These erode a newcomer's probability of survival. The effect is higher infant mortality but with a lag. More affluent families can avoid budget thinning by drawing down other resources (savings, capital assets, borrowing, etc.), but poor households do not have such recourse. Therefore, the budget thinning effect will impact more quickly upon the infant survival of poorer households.

Let the likelihood of infant mortality be IM. We assume that IM is a decreasing function of average budget share A and other influences X (one of which may be public health spending):

$$IM = f(A, X), \quad f_A < 0.$$

Average budget share is $A = (B(n) + K(n))/n$ where n is the number of household members, B(n) is the current income flow, $B'(n) > \text{or} = 0$ means that the income contribution of an additional child is positive or zero; K(n) is the drawing from other capital assets used to supplement the income flow with the arrival of another child. For the period before contribution to income, $B'(n) = 0 < A$. For poor households, $K'(n) = K(n) = 0$. The effect of an additional child upon IM of a poor household is:

$$\delta IM / \delta n = f'(dA/dn),$$

(1)

$$dA/dn < 0 \text{ if } B'(n) < B(n)/n, \quad (2)$$

Thus:

$$\delta IM / \delta n > 0. \quad (3)$$

For more affluent households, $K(n)$ and $K'(n)$ will be positive, so $dA/dn = \{(B'(n) - B/n) + (K'(n) - K/n)\}/n$, so even if $(B'(n) - B/n)$ is negative, $(K'(n) - K/n)$ may be positive to fully or partly offset it. We think it is only a partial offset enough to delay the positive effect of n on IM but not completely eliminate it. This is the budget thinning effect within household.

B. Within Country Budget Thinning

How about the relationship within countries? Of the cohort of babies born today, only a fraction will be covered by the relation described above, that is, of mothers who will still have babies in the same household. A fraction of the babies will be “last child” so the budget thinning within this household, though still at work, will not impact on the next child’s survival likelihood. But there could be budget thinning at the national level. Suppose the government maintains a system of public health programs to help infants and mothers (infant and maternal clinics, milk support, vaccination, etc.) with a specified budget which affect IM (via X above). The cohort of babies will form an additional claim on such programs and budget. This will lower the availability of the services for the cohort of babies born later. The national budget thinning comes in the form of public health service erosion. Thus, some babies born later will be impacted by both within-household budget thinning and within-country budget thinning. Others, less challenged, will suffer only the within-country variety. Either way, the likelihood of survival will erode.

Our first hypothesis is that a rise in population growth today raises IM of a country with a lag, e. g., five years hence. Our second hypothesis is that, for a poor country, the adverse impact on infant survival arrives sooner, i.e., two years hence.

III. Data and Empirical Specification

A. Definitions and Measures of Variables

Public health expenditure (PHE) refers to the amount incurred by government for the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. In this paper it is expressed as per capita government health expenditure, which refers to the total public health expenditure divided by the total population in international dollar rate for the current year. Data for 2004 were used, and taken from the Health, Nutrition & Population (HNP) summary profile and comparative data of the World Bank.

Infant Mortality Rate (IMR), also called infant death rate, is the number of newborns dying under a year of age divided by the number of live births during the year. This is reported as number of live newborns dying under a year of age per 1,000 live births.¹

Government Effectiveness (GE) refers to the quality of public and civil services and the degree of independence from political pressures. This also refers to the quality of policy formulation and implementation and the credibility of the government's commitment to

¹ United Nations Development Group (2007). *Indicators for Monitoring the Millennium Development Goals*.

such policies.² Where implementing public institutions breed corruption, policy formulation is usually affected by political pressures. In the end, there is deterioration in the quality of public services. The 2005 data were taken from the Kaufmann-Kraay-Mastruzzi WB World Governance Indicators (WGI), the index score ranging from –2.5 (worst rating) to +2.5 (best).

Gini coefficient is a measure of income inequality. The coefficient varies between 0, which reflects complete equality and 1, which indicates complete inequality (one person has all the income or consumption, all others have none).³ It is a measure of statistical dispersion most prominently used as a measure of inequality of wealth distribution. A low Gini coefficient indicates more equal income or wealth distribution, while a high Gini coefficient indicates more unequal distribution. This coefficient requires that no one has a negative net income or wealth. The *Gini index* is the Gini coefficient expressed as a percentage, and is equal to the Gini coefficient multiplied by 100. Most recently available data for different countries were between 1993 and 2005 and taken from the WB World Development Indicators.

Adult Female Literacy is defined as the ability to read and write with understanding a short simple statement on their everyday life. Female literacy rates are produced by dividing the absolute number of literate female individuals aged 15 and above by the corresponding total population in that age group.⁴ It is a measure of the effectiveness of the primary education system. Adult Female Literacy (AFL) statistics are expressed in

² Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi (2007). *Governance Matters VI: Aggregate and Individual Governance Indicators, 1996-2006*. World Bank Policy Research Working Paper 4280.

³ Damgaard, Christian (2007). *Gini Coefficient*.

⁴ World Bank Definition

percentages. The statistics are taken from the World Bank Health, Nutrition and Population website from 1997-2005, and are based on literacy data collected from national sources, namely population censuses and household surveys.

Country income categories were based on World Bank classification. The WB gives five income categories: low income, lower-middle income, upper-middle income, high income non-OECD and OECD countries. There are three classifications used in this research: low income, lower income, and full sample (all countries). Lower income countries refer to WB's lower-middle income and low income categories.

Secondary data on the internet for the year 2005 were used where available and considered reliable. However, if 2005 data were not available, we retrieved most recently available data from earlier years. Unlike other cross-country studies where OECD countries are usually excluded (since these countries' interactions and dynamics are different and since these countries are seen to have gone beyond a certain threshold where policies are different), they have been included in one run of this particular study. Two hundred one countries were candidates for this study; however, since not all countries have equally efficient registry systems, certain countries with missing data had to be dropped from the study population. After deleting those with missing values list-wise, only 134 countries were included in the final analysis. The countries included in the study are listed in Appendix A.

B. Empirical Specification

We are interested in the effect of population growth on IMR. Since population growth is also endogenous, we use past values: we use population growth of 2000 (lagged five years). The independent control variables are: (1) public health expenditures per capita, (2) the Gini coefficient, (3) adult female literacy rate, (4) government effectiveness. We use only OLS regression in this paper. The regression model is simply:

$$\text{Logarithm IMR} = \beta_0 + \beta_1(\text{logarithm PHE}) + \beta_2(\text{Gini}) + \beta_3(\text{AFL}) + \beta_4(\text{GE}) + \beta_5(\text{PG}) + \epsilon. \quad (1)$$

C. Data Sources

A summary of data and sources are shown in Table 1 below.

Table 1. List of data and sources.

Data	Sources	Year
Infant Mortality Rate (per 1,000 live births)	UNICEF Child Mortality Data	2005
Per Capita Govt. Health Expend. (at 2004 Int'l \$ rate)	World Bank Health, Nutrition and Population	2004
Country Income Category	World Bank World Development Indicators	2005
Government Effectiveness (-2.5 worst, +2.5 best)	World Bank World Governance Indicators	2005
Population Growth	World Bank Health, Nutrition and Population	2000, 2003
Gini Index (%)	World Bank World Development Indicators	1993-2005
Adult Female Literacy Rate (%)	World Bank Health, Nutrition and Population	1997-2005

IV. Analysis of Results

Table 2 gives the OLS regression results for different income categories with population growth lagged five years. It is clear from all three runs that population growth lagged five years significantly increases IMR for all income categories. The coefficient and significance of population growth rises as we move from All-Countries to Lower- to Low-Income categories. This means that the adverse effect of population on infant survival is most serious in low-income countries. It is equally clear that Government Effectiveness (GE) reduces IMR (is negative and significant) for all income categories. All the other control variables display expected impacts on IMR. PHE is positive and significant, Gini Index is negative and significant, and AFL is negative and significant for IMR for all income categories as the literature suggests.

Table 2: Year 2000 Population Growth: Dependent Variable – Infant Mortality.

Independent Variables	All Countries	Low-Income Countries	Low and Lower Middle-Income Countries
Constant	4.304 (15.101)***	4.058 (13.572)***	4.364 (13.861)***
Per Capita Govt. Health Expenditure	-0.291 (-5.528)***	-0.171 (-2.458)**	-0.242 (-3.579)***
Gini Index	0.019 (4.369)***	0.016 (2.649)**	0.012 (2.232)**
Adult Female Literacy	-0.008 (-3.054)***	-0.006 (-2.783)***	-0.008 (-2.829)**
Government Effectiveness	-0.356 (-4.900)***	-0.098 (-0.866)	-0.318 (-2.629)**
2000 Population Growth	0.087 (2.013)**	0.143 (3.231)***	0.120 (2.347)**
R-Square	.878	0.694	0.683
Number of Observations	134	39	72

Note: t statistics in parenthesis. ***Significant at 99% confidence; **Significant at 95%, *Significant at 90%.

Table 3 gives the regression runs with population growth lagged two years instead of five and the same controls variables. Note that now population growth is not significant for All Countries and Lower-Income Countries. But it remains positive and significant (albeit at a lower level. i.e., 90%) for Low-Income Countries. This is as we hypothesized: the adverse effect surfaces sooner or poorer countries.

Table 3: Year 2003 Population Growth: Dependent Variable – Infant Mortality.

Independent Variables	All Countries	Low-Income Countries	Low and Lower Middle-Income Countries
Constant	4.339 (13.833)***	3.929 (10.345)***	4.353 (12.074)***
Per Capita Govt. Health Expenditure	-0.289 (-5.385)***	-0.104 (-1.382)	-0.215 (-3.022)***
Gini Index	0.021 (4.752)***	0.014 (2.279)**	0.012 (2.105)**
Adult Female Literacy	-0.009 (-3.217)***	-0.006 (-2.742)**	-0.008 (-3.014)***
Government Effectiveness	-0.358 (-4.842)***	-0.165 (-1.294)	-0.351 (-2.853)***
2003 Population Growth	0.059 (1.082)	0.139 (2.014)*	0.099 (1.452)
R-Square	0.875	0.641	0.668
Number of Observations	134	39	72

V. Conclusion

This paper explores the relationship between population growth and infant mortality in cross-country setting. Decrease in infant mortality is one of the UN Millennium Development Goals. Likewise, Infant Mortality Rate is often considered as a proxy for poverty. Determining the policy influences on MDGs is an active research area. The policy question addressed here is the following: Should low-income countries raise their spending on effective population control programs to improve their MDG performance? The question boils down to how population growth reduction affects MDG indices. We showed that higher population growth today will raise infant mortality five years from now and this

is especially acute for low- and low- to low-middle income countries. The adverse effect of population growth on infant survival surfaces sooner in Low-Income countries. Thus, for low-income countries, the hypothesis that more spending on effective population programs improves MDG performance cannot be rejected. Since infant mortality is a proxy for poverty, one can also say that population growth today raises poverty.

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