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ACCOUNTING FOR CROSS-NATIONAL DIFFERENCES IN  
INFANT MORTALITY DECLINE (1965–1991) AMONG LESS  
DEVELOPED COUNTRIES: EFFECTS OF WOMEN'S STATUS,  
ECONOMIC DEPENDENCY, AND STATE STRENGTH

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**ABSTRACT.** The present study tests models derived from four theoretical perspectives: Modernization/free trade theory, gender inequality theory, developmental state theory, and dependency theory. It is based on a sample of 82 less developed countries for the period from 1965 to 1991. We find some support for each theoretical perspective. Foreign trade, investment, and debt dependency have adverse effects on infant mortality, mediated by variables linked to modernization/free trade theory and gender inequality theory. State strength has a beneficial direct effect on infant mortality decline. Women's education and reproductive autonomy have significant direct effects, but also play important roles as mediating variables as does rate of economic growth.

In the developed nations of the world less than 1 percent of births end in death prior to the first birthday; in contrast, in countries like Sierra Leone and Afghanistan, more than 15 percent die during the first year in 1991. Infant mortality rate is one of the best single indicators of a nation's overall health status, particularly among the poor, and it is also a very good indicator of physical quality of life more generally. Cross-national studies of infant mortality typically focus on internal (intranational) factors associated with modernization/free trade theory, such as economic growth, education, fertility, income inequality, and urbanism. Much of prior research has shown that level of economic development is an important determinant of a country's mortality rate including infant mortality (Firebaugh and Beck, 1994; Pritchett and Summers, 1996).

However, prior studies also show that level of economic development, usually measured by GDP (or GNP) per capita, does not account for all or even most variance in infant mortality among less developed countries (LDCs) (Caldwell, 1993). Some



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previous studies have recognized that mortality is most likely to be reduced by pattern of socioeconomic development, rather than levels of economic development (e.g., Moon, 1991). For example, the dependency perspective contends that it is foreign dependence and the world system position, not the internal factors emphasized by modernization/free trade theory, that matter most (Bullock, 1986; Wimberly, 1990; Ragin and Bradshaw, 1992; Wimberly and Bello, 1992). Seeking explanations based on both internal and external factors, the present study examines several possible determinants of infant mortality. In addition to comparing the efficacy of both modernization/free trade and dependency theories, we also consider two other theories which have not been given adequate attention in prior studies of infant mortality – the gender inequality and developmental state perspectives.

Specifically, this study examines the efficacy of the four theoretical perspectives in accounting for cross-national variation in infant mortality decline between 1965 to 1991. There are several reasons for choosing mid-60s data as the initial or lagged dependent variable. Firstly, according to the dependency argument, the detrimental social and economic effects of dependence should require some years to develop and the strength of the effect may increase over time (Bornschieer and Chase-Dunn, 1985), so the longest time lag between dependent and independent variables is desired. However, as a major indicator of economic dependency, foreign investment in 1967 is the earliest data available for this measure. Secondly, many LDCs achieved their independence during the 1960s and the role of state has expanded substantially for many LDCs since then (Evans, 1985). We use state strength and state strength increase between 1965 and 1990 as indicators linked to developmental state perspective. The last reason is data availability. If we chose data of a year before 1965 as the initial year, there would be more missing data for infant mortality and other independent variables. The reason we use 1991 infant mortality data is that we have selected debt increase as one of our indicators of economic dependency. Many developing countries experienced particularly dramatic debt increase between the early 1970s and the early 1990s (Bradshaw and Huang, 1991).

## BACKGROUND

Four theoretical perspectives underlie the research questions and hypotheses considered in this study: modernization/free trade theory, dependency theory, developmental state theory, and gender inequality theory.

*The Modernization/free trade Perspective*

Modernization/free trade theorists emphasize internal factors in their analysis of socioeconomic development of the Third World countries, but they also believe that external linkages such as free trade, foreign capital and technology may play a crucial role during the initial development stage (Rostow, 1971; Firebaugh and Beck, 1994; Pritchett and Summers, 1996). They view development as a bridging of the gap between developed and underdeveloped nations through an imitative process. Economic development is viewed as leading to a higher standard of living and more advanced medical technology which in turn lower both mortality and fertility. This process allegedly requires greater levels of industrialization, education, and urbanization. This process is assumed to require higher levels of industrialization, foreign trade, education, and urbanization.

Modernization/free trade theory was originally formulated on the basis of historical developments in Western industrial countries, but many theorists have been critical of efforts to generalize this perspective to the LDCs today. Some critics claim that modernization/free trade theory fails both to describe the current Third World reality or to interpret its future path. Its dictates could prove to be counterproductive for today's LDCs because it is based upon nineteenth-century theories of unilinear evolution and puts forward a Euro-centric-Western liberal model (Ake, 1988; Pai, 1991). Among other criticisms of the perspective are that it does not give adequate attention to inequality within societies, including gender inequality or to structural relations between the core and non-core countries in the world economy (Pai, 1991).

As mentioned earlier, there is an obvious discrepancy between level of economic development and infant mortality rate. For example, some lower-income LDCs such as Sri Lanka, Costa Rica,

TABLE I  
 Infant Mortality Rate (1965 and 1990) and GDP (1970) (N = 82)

Country	1965	1991	GDP*	Country	1965	1991	GDP*
Sierra Leone	208	146	8.47	Peru	130	68	16.30
Mali	207	108	2.92	Congo	129	83	11.40
Afghanistan	206	165	4.90	Honduras	128	62	12.90
Madagascar	201	113	6.79	Indonesia	128	61	5.12
Malawi	200	144	4.56	South Africa	124	54	27.10
Guinea	191	138	4.28	Myanmar (Burma)	122	85	4.38
Oman	191	32	16.90	Nicaragua	121	58	19.90
Burkina Faso	190	120	3.35	Zambia	121	112	19.30
Chad	183	125	3.87	El Salvador	120	50	14.00
Niger	180	127	4.88	Ghana	120	84	13.20
Mauritania	178	120	8.33	Iraq	119	111	16.90
Liberia	176	131	12.60	Uganda	119	110	6.87
Nepal	171	102	4.83	Syrian Arab Rep.	114	37	12.90
Turkey	169	72	18.40	Botswana	112	62	7.16
Benin	166	89	4.36	Ecuador	112	59	13.10
Ethiopia	165	125	3.96	Guatemala	112	52	17.70

TABLE I  
Continued

Country	1965	1991	GDP*	Country	1965	1991	GDP*
Somalia	165	125	4.61	Kenya	112	52	7.33
Nigeria	162	86	7.44	Dominican Rep.	110	59	17.10
Bolivia	160	89	9.63	Brazil	104	55	23.00
Senegal	160	82	10.90	Chile	98	17	30.80
Sudan	160	102	7.26	Thailand	88	28	9.26
Central African Rep.	157	106	6.64	Colombia	86	18	17.50
Algeria	154	50	15.00	Mexico	82	30	26.00
Gabon	153	97	26.00	Paraguay	73	48	12.50
Togo	153	88	7.07	Costa Rica	72	14	23.30
Iran, Islamic Rep.	152	47	18.40	Philippines	72	34	9.93
India	150	84	6.06	Mauritius	65	22	11.40
Cote d'Ivoire	149	93	15.50	Portugal	65	10	27.10
Pakistan	149	94	9.08	Venezuela	65	34	41.70
Egypt, Arab Rep.	145	62	10.70	Kuwait	64	14	78.30
Morocco	145	72	11.30	Sri Lanka	63	16	9.53
Tunisia	145	45	13.70	Korea South (REP)	62	9	13.70

TABLE I  
Continued

Country	1965	1991	GDP*	Country	1965	1991	GDP*
Bangladesh	144	101	3.99	Argentina	58	22	42.00
Cameroon	143	66	9.31	Lebanon	56	36	24.30
Burundi	142	108	4.07	Panama	56	21	27.90
Lesotho	142	82	3.78	Malaysia	55	15	17.30
Rwanda	141	112	3.39	Jamaica	49	15	27.00
Zaire	141	117	4.94	Uruguay	47	21	35.60
Papua New Guinea	140	55	13.30	Hong Kong	27	7	27.10
Libya	138	72	53.40	Israel	27	10	56.20
Tanzania	138	112	5.27	Singapore	26	8	31.70

\*The variable of GDP in 1970 is the nation's real GDP per capita in 1970 as a percentage of the base value – GDP per capita for U.S. in 1970 – \$4,790.  
For source, see Appendix.

Thailand, have achieved relatively low levels of infant mortality while other higher-income LDCs such as Iran and Iraq have much higher infant mortality rates. Table I lists the data of the most important variables included in this study: infant mortality rates for 1965 and 1991, as well as GDP (as a percentage of per capita of GDP of the United States) in 1970<sup>1</sup> for the 82 LDCs included in this study.

The correlation between 1965 infant mortality and GDP per capita in 1970 is  $-0.71$  ( $p < 0.001$ ,  $N = 82$ ) and the correlation between 1990 infant mortality and GDP per capita in 1991 is  $-0.66$  ( $p < 0.001$ ,  $N = 82$ ).<sup>2</sup> Although a substantial negative association exists between infant mortality and income level as expected, we do find some exceptions. For example, as shown in Table I, South Korea, Sri Lanka, Thailand, and Philippines, countries with relatively low incomes in 1970 also had low infant mortality rates in 1965. In addition, the same countries have experienced substantial changes in infant mortality decline since 1965. In contrast, some countries such as Oman, Iraq, Iran, Gabon, South Africa, Libya had much higher incomes than the countries mentioned above, but in 1965 they had infant mortality rates above 100 per thousand births. Between 1965 and 1991, these countries experienced very different rates of decline. Even in 1991, Iraq and Gabon still had infant mortality rates around 100. To explain the discrepancy between economic development level and infant mortality rate, we need to turn to other perspectives.

#### *The Dependency Perspective*

According to dependency theorists, the capitalist world system perpetuates a global division of labor which distorts the domestic economies of many LDCs, reduces the rate of economic growth, increases income inequality, and adversely affects well-being for a substantial fraction of the population (Wallerstein, 1983; Wimberly and Bello, 1992). Dependency theorists argue that trade dependence has aggravated the gap between core and periphery countries because the exchange of raw materials for processed goods is inherently unequal (Bunker, 1984) and prices for primary goods have experienced a long-term decline in relation to prices for processed goods (UNICEF, 1989). In addition, specialization in the export of

raw materials leads to a distorted and an unbalanced economy. As a result, the state's ability to raise revenues is weakened and the resulting lack of revenues affects the funding of many health and social services programs.

Many prior studies in this tradition have found harmful effects of trade dependence on mortality (and mortality related quality of life measures) (Cutright and Adams, 1984; Dixon, 1984; London and Williams, 1990; Ragin and Bradshaw, 1992). However, some studies (Evans, 1987; Gereffi and Fonda, 1992), based on the Asian newly rapidly industrialized countries, contend that heavy involvement in foreign trade seems to have greatly enhanced the rate of economic growth and living standards for much of the population

Dependency theorists have found that since the 1960s, investment dependence – multinational corporations (MNCs) penetration – has increased and is becoming a more important form of dependence due to the changing nature of international economic relationship between the core and periphery nations (Bornschier and Chase-Dunn, 1985). They contend that MNC investment promotes underdevelopment in the LDCs because it monopolizes the market and access to capital, displaces local business, slows economic growth, and promotes income inequality. In addition, MNC investment impedes public health and social welfare programs by obstructing host government policies that are beneficial to much of the population but harmful to MNC interests (Wimberly, 1990). Many empirical studies point to the detrimental effects of foreign investment on economic and social development in LDCs (Bornschier and Chase-Dunn, 1985; Boswell and Dixon, 1990; London and Williams, 1988, 1990; Wimberly and Bello, 1992). Some point to the harmful effects of investment dependency on mortality (Lena and London, 1993; London and Williams, 1988; Wimberly, 1990) although a few report no significant effect (Bradshaw et al., 1993; Firebauch and Beck, 1994).

Since the 1970s, many Third World countries have become part of the international debt crises. Foreign debt expansion and concomitant austerity measures dictated by institutions that loan them capital, such as the World Bank and the International Monetary Fund (IMF), have intensified Third World dependency. Debt and interest payments drain already scarce capital and, as a result,



inhibit economic development. This reduces government spending on social, educational, and health programs, slowing any decline in mortality. Some empirical studies suggest that debt incurred from foreign aid programs has a harmful net effect on mortality (Bradshaw and Huang, 1991; Bradshaw et al., 1993; Sell and Kunitz, 1987).

#### THE DEVELOPMENTAL STATE PERSPECTIVE

Free-market theorists, neoconservatives, and the IMF contend any increase in state size (as measured either by government revenues or spending) will impede economic growth, lower the standard of living, and decrease the level of well-being (Friedman and Friedman, 1980; Gilder, 1981; Olson, 1982). Dependency theorists, on the other hand, either neglect the role of the state (because the world system conditions the process of development in the LDCs) or believe economic dependency should weaken the state strength. In contrast, proponents of developmental state perspective emphasize the role of the state in economic and social development in LDCs. (Delacroix and Ragin, 1981; Evans, 1985; London and Williams, 1990; Moon and Dixon, 1985; Pattnayak, 1992). Free market economies have a propensity to generate inequalities, which in turn tend to lower the quality of life for the less affluent. A strong state may use a variety of redistributive social policies to check this tendency and meet the basic human needs relative to aggregate wealth (Moon and Dixon, 1985). The developmental state argument is particularly supported by evidence of rapid economic growth coupled with low income inequality and low rates of mortality in the Asian newly industrialized countries (Evans, 1987; Wade, 1990; Gereffi and Fonda, 1992).

Several prior studies examining the impact of dependency on basic human needs have included state characteristics, but very few (with exception of Bradshaw and Tshandu, 1990) have tested the relationship between dependency and state characteristics. Some studies (Bradshaw and Tshandu, 1990; Bradshaw and Huang, 1991; Lena and London, 1993) have found that state strength, state size, or state intervention have a positive effect on physical quality of life; however, not all studies have come to this conclusion (London and

Williams, 1990). The present study examines the impact of dependency on state strength and also tests the effect of increasing state strength on infant mortality.

#### THE GENDER INEQUALITY PERSPECTIVE

Traditional development theories, including modernization theory as well as, classical and neo-classical economics, have long overlooked the role of women in development. Modernization/free trade theory proponents ignore women as a specific category in development because they believe women's status will automatically rise as part of the modernization process. However, more and more studies show that certain groups may reap a disproportionate share of the benefits of development while other groups may become victims of development. This happens when the products they were selling or the services they were performing are replaced by new alternatives (Abraham and Abraham, 1988). A large number of women in developing countries are losing grounds because they have been relegated to jobs in the backward sectors of the economy. Some studies conclude that the global division of labor actually circumscribes work opportunities for women in the Third World. The type of employment available to them often marginalizes women in low-paying, tertiary and informal economy (Fernandez-Kelly and Sassen, 1993; Marshall et al., 1988; Osirim, 1992; Ward and Pyle, 1995). Evidence from even the Asian NICs shows that sustained economic growth and industrialization in that region over the past few decades has not resulted in a significant reduction of gender wage differentials. To the contrary, in some cases the gap has widened (Seguino, 1997).

Gender inequality theorists attempt to explain differences in privilege and power in society that are linked to gender. Gender inequality is different, but in addition to other dimensions of inequality such as those based on social class and ethnicity. Gender inequality theory can be used to argue that societies in which women have higher status will generally be societies in which infant mortality is lower. Women with high social status in the family and society usually are better educated and have more autonomy in deciding on the number of children to have (as well as the related

question about whether to use contraception) and in seeking medical treatment for themselves and their children.

Many case studies suggest that a mother's education is one of the most important predictors of infant mortality (Caldwell, 1979; Martin et al., 1983). However, few quantitative cross-national studies (except for Boehmer and Williamson, 1996) have systematically tested the effects of women's relative educational status and reproductive autonomy on infant mortality. This lack of attention is unfortunate because, as we shall show, many aspects of women's status affect infant mortality. And no prior cross-national studies have examined the indirect effects of economic dependency on infant mortality as mediated by various dimensions of women's status.

## METHODOLOGY

### *Countries Included*

Because dependency theorists believe economic dependence needs a number of years to show an effect on LDCs, we consider a period from the mid 1960s to the early 1990s in this study. We exclude countries classified as industrial market economies by the World Bank as well as countries with populations below 1 million in 1991 (World Bank, 1993). Also excluded are former and current socialist countries due to the absence of data for several key predictors such as GDP per capita (1970), economic growth rate (1965–1990), and foreign investment (1967). We were able to obtain data on infant mortality for both 1965 and 1991 and to get data on GDP per capita in 1970 (a key control variable) for 82 LDCs.<sup>3</sup> However, due to the constraints of data availability, for most models the sample size ranges between 55 to 70 countries. To maximize the use of the available data, we allow our sample size to vary from one model to another depending on data availability. Caution should be taken when interpreting differences between models. When constructing models, we follow the common practice of keeping the ratio of cases to predictors above 10.

### *Research Design: Panel Regression*

Because we are interested in infant mortality decline in LDCs, we selected a panel regression design. In panel-regression analysis, the dependent variable at a recent point in time is regressed on itself and the independent variables at an earlier point in time. This method estimates the effects of the independent variables on *change* in the dependent variable between two time points, which is widely regarded as a powerful tool for making causal inferences with non-experimental data (Allison, 1990). Many prior quantitative cross-national studies have applied this method (Bornschiefer and Chase-Dunn, 1985; Bradshaw and Huang, 1991; Wimberly and Bello, 1992). Panel regression is especially appropriate for the present study because we are interested in the effects of the independent variables (dependency) on infant mortality over time. A panel design helps rule out reciprocal effects and reduces the threat of spuriousness due to an apparent effect that can be accounted for by another variable causally prior to both the dependent and independent variable of concern. In addition, given the usually high correlation between the dependent variable at the two points in time, this method yields very conservative estimates of the effect of the independent variables (Hannan, 1979). This makes it appropriate to discuss effects that are significant at the  $p < 0.10$  level as well as the more conventional  $p < 0.05$  and  $p < 0.01$  levels.<sup>4</sup> Finally, it also avoids some of the problems associated with other measures of change, such as a simple difference score as dependent variable measurement (Bohrnstedt, 1969).

Our dependent variable is infant mortality in 1991 and the lagged dependent variable is infant mortality in 1965. Data for most independent variables were obtained for the 1960s or early 1970s, with exception of contraceptive prevalence, for which there is no need for a long time lag to affect infant mortality. This design is also called cross-lagged effects model as shown in the mathematical notations:

$$Y_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \epsilon_t$$

The dependent variable  $Y_t$  is hypothesized to be determined by the constant  $\beta_0$ , lagged value of the independent variable  $X_{t-1}$ , the lagged dependent variable  $Y_{t-1}$ , and an error term.

### *Measurement*

For the dependent variable, we transformed infant mortality to infant survival probability defined as the probability that an infant survives from birth to age one year; that is, 1 minus infant mortality per one thousand live births. As the trend was for infant survival probability to increase between 1965 and 1991, our panel regression model in effect assesses the impact of the various predictors on decline in infant mortality (or increase in infant survival rate). For some variables we have used logarithmic or square root transformations to correct skewed distributions. (See the Appendix for a listing of: a short name, a full name, the data source, and any transformation applied for each variable used.)

We focus on three indicators in our assessment of modernization theory: (1) GDP (real GDP per capita in 1970), (2) Economic growth (average annual economic growth rate between 1965 and 1990), and (3) Secondary school enrollment in 1965, and in 1991 for some models. Real GDP per capita is an estimate of gross domestic product per capita, adjusted for purchasing power parity so that it is more immediately comparable internationally than GDP per capita.

To evaluate the utility of dependency theory, we consider three dimensions of economic dependency: (1) commodity concentration of exports in 1973, an indicator of trade dependency; (2) foreign investment (MNC penetration in 1967), an indicator of investment dependency; and (3) debt increase (the increase in the ratio of debt service to exports between 1970 to 1990), an indicator of debt dependency. The importance of concentration in trade has long been recognized: the more a country's trade (exports and imports) is concentrated in a small number of goods, the more likely its economy will be subject to fluctuation and disturbances (in price, quantity, or both) (Michaely, 1984). We use stocks of foreign investment in 1967 as our measure of investment dependency. A number of prior studies use the same indicator and the same source (Bornschier and Chase-Dunn, 1985; Boswell and Dixon, 1990; London and Williams, 1990; Wimberly and Bello, 1992). We do not include recent flow of foreign investment as a control variable as have some studies, because the time lag between the measurement of MNC penetration (1967) and the dependent variable (1991) is long enough to ignore it. For debt dependence, we use

debt increase from 1970 to 1990, because LDCs have experienced significant increases in debt during this period of time (World Bank, 1992).

We use state strength and state strength increase as indicators linked to the developmental state perspective. Following other studies, we use revenue extraction (the percentage of total government revenue over GNP) as our measure of state strength. Revenues (tax and nontax) are indicators of the state's capacity to extract resources for various societal goals including infrastructure, health, education, and other programs. We measure state strength increase as the percentage increase in total current central government revenue, as a proportion of GNP, between, 1965 and, 1990. Many LDCs achieved their independence during the 1960s and the role of state has expanded substantially for many LDCs since then (Evans, 1985).

Drawing on Boehmer and Williamson (1996) we focus our assessment of women's status on three key indicators in our assessment of gender stratification theory: (1) female/male ratio of secondary school enrollment, (2) female secondary school enrollment, and (3) contraceptive prevalence.

The first indicator is a measure of women's relative educational status. The relative status of women, the status women hold in comparison to men, is at the core of gender inequality theory (Mason, 1986). When testing the indirect effect of dependency indicators on infant mortality through women's relative educational status, the variable is measured differently; the ratio for 1989 is used as the dependent variable and the ratio for 1965 as a lagged dependent variable. The second indicator of women's status – female secondary school enrollment rate is an absolute measure of women's educational level. When testing the indirect effect of dependency on infant mortality through women's absolute educational status, we use 1991 data for the dependent variable and 1965 data for the lagged dependent variable.

Contraceptive prevalence measures the percentage of married women of childbearing age currently using contraception. UNICEF (1990) estimated that there are presently 300 million couples in the Third World who do not want any more children, but who do not have any effective means of family planning. If women who do

not want to become pregnant were empowered to do so, the rate of population growth in LDCs would fall by approximately 30% and there would be a steep drop of both maternal and infant mortality. In many patriarchal societies men do not allow women to practice family planning. In this sense, we use the prevalence of contraception as a measure of women's status. Overall, our three measures of women's status, capture two aspects of women's general status: education and reproductive autonomy.

## RESULTS

Least squares estimates for our preliminary models are displayed in Table II. Due to the inclusion of the lagged dependent variable, these models in effect test the direct effects of the various predictors on change in infant survival probability. First, we test the direct effects of the three dependency variables: (1) commodity concentration, (2) foreign investment, and (3) foreign debt increase. Then we want to evaluate the effects of some key internal variables from other theoretical perspectives. Among the control variables, the lagged dependent variable, infant survival probability 1965, has the expected strong, but theoretically uninteresting, effect in all seven equations. GDP always has the predicted positive effect, though in three of these equations the coefficients are not significant.

Equation (hereafter Eq) 2.1 shows that once the substantial variance due to the lagged dependent variable and GDP have been partialled out, only the trade dependency indicator – commodity concentration, has the significant negative effect on infant survival that would be hypothesized based on dependency theory. In additional analysis not presented in Table II, we examined the effects of these three forms of economic dependency one at a time, using the same two controls. Neither foreign investment, nor foreign debt increase had significant effects.

From Eq 2.2 through Eq 2.7, we dropped foreign investment and debt increase and add one possible internal determinant of infant mortality for each equation to further test the effect of commodity concentration and the effect of these internal variables. For the internal variables, our goal was to use measures of the same time point around 1965 so as to keep consistent with other variables with

TABLE II  
Standardized OLS Estimates of the Effects of Economic Dependency and Selected Internal Variables on Infant Survival Probability (1991)

Independent variables	Eq 2.1	Eq 2.2	Eq 2.3	Eq 2.4	Eq 2.5	Eq 2.6	Eq 2.7
Infant Survival Probability 1965	0.64***	0.66***	0.57***	0.56***	0.61***	0.51***	0.43***
GDP 1970	0.31***	0.24***	0.32***	0.12	0.20**	0.09	0.11
Commodity Concentration 1973	-0.14**	-0.10	-0.02	-0.06	-0.06	-0.04	0.03
Foreign Investment 1967	-0.05						
Foreign Debt Increase 1970–1990	0.03						
State Strength Increase 1965–1990		0.12*					
Economic Growth 1965–1990			0.22***				
Secondary School Enrollment 1965				0.27***			
F/M Secondary School Enrollment 1965					0.16**		
Female Secondary School Enrollment 1965						0.36***	
Contraceptive Prevalence 1985							0.46***
Adj. R <sup>2</sup>	0.79	0.81	0.83	0.80	0.79	0.81	0.84
N	59	57	69	75	73	75	68

\*\*\*p < 0.01.

\*\*p < 0.05.

\*p < 0.10.



exception of two variables measuring change – economic growth rate between 1965 and 1990 and state strength increase between 1965 to 1990. However, for contraceptive prevalence, there is no data available around that time, so we had to use 1985 data. In none of the six equations does commodity concentration have a significant effect although in most of them its sign does remain negative. It is reasonable to conclude based on this evidence that the three indicators linked to dependency theory have little if any direct effects on infant mortality. The evidence that these indicators have neither positive nor negative effects on infant mortality once a few other controls are introduced fails to support either modernization/free trade theory or dependency theory. Our finding that the various dependency indicators do not have significant direct effects on infant mortality once a few other controls are introduced is consistent with some prior studies (Bradshaw et al., 1993; Firebauch and Beck, 1994), but it contradicts others (Lena and London, 1993; Wimberly, 1990).

It is also of note that all the internal determinants added in Eq 2.2 through 2.7 have significant positive effects on infant survival: Two indicators linked to modernization/free trade theory, economic growth and secondary school enrollment, have significant effects. One indicator linked to the developmental state perspective, state strength increase, has a significant positive effect (although its beta value is smaller than that of other internal predictors). All three indicators of women's status have significant positive effects: female secondary school enrollment (an absolute measure of women's educational status), female/male secondary school enrollment (a relative measure of women's educational status), and contraceptive prevalence.

The results in Table II offer support for the gender inequality perspective and the developmental state perspective as well as some support for the modernization/free trade perspective. It is of note that two women's status indicators, female secondary school enrollment (Eq 2.6), and contraceptive prevalence (Eq 2.7), have larger betas than does GDP, suggesting that women's educational status and reproductive autonomy have at least as much, if not more, impact than a nation's national product on infant survival. Our evidence that women's education and reproductive autonomy are strong predictors

of infant mortality is consistent with some prior case study evidence suggesting that social factors such as these have a greater impact on mortality than does income level (Caldwell, 1993).

The conservative estimation procedure (using a lagged dependent variable) in Table II shows that the dependency indicators do not have substantial direct effects on infant mortality. But it leaves open the possibility that these dependency predictors have important indirect effects. Do they have strong effects on some other intervening internal variables, which in turn have strong direct effects on infant mortality? The relevant data are presented in Table III. We check for possible indirect effects on infant mortality for each of the three economic dependency variables via their effects on each of six potential intervening variables. In Table II each of these variables had a significant direct effect on infant survival probability. The intervening variables are: economic growth, state strength increase, secondary school enrollment, and the three women's status variables: female/male secondary school enrollment, female secondary school enrollment, and contraceptive prevalence. In Table III, these intervening variables become dependent variables. In several of these models we have made date of measurement changes in the variables used in Table II, changes making them more appropriate for use as intervening variables. As shown in Table III, for Eqs 3.2, 3.3, 3.4, and 3.5, we use data circa 1990 as dependent variables and use the corresponding 1965 data as lagged dependent variables. In effect, we made the intervening variable a change measure so as to get a conservative estimate of the strength of any indirect effect.

Eq 3.1 examines the effect of trade dependency (commodity concentration), foreign investment, and foreign debt increase on economic growth controlling for GDP. Commodity concentration and foreign debt increase have significant negative effect on economic growth. Our results for foreign investment dependency are also in the predicted direction, but they are not significant; however, in a model not presented here in which the other two dependency predictors are excluded, we do find that the effect of foreign investment is significant. The results for Eq 3.1 are central to a comparison of dependency theory with modernization theory. Modernization/free trade theorists contend that integration into the global economy, including trade, foreign investment, and

TABLE III

Standardized OLS Estimates of the Effect of Economic Dependency Variables on Selected Intervening Variables with Lagged Dependent Variables Where Appropriate

Independent variables	Dependent variables					
	Eq 3.1 Economic Growth	Eq 3.2 State Strength 1990	Eq 3.3 Sec. Sch. Enroll. 1991	Eq 3.4 F/M Sec. Sch. Enroll. 1989	Eq 3.5 F. Sec. Sch. Enroll. 1991	Eq 3.6 Contraceptive Prevalence 1985
GDP 1970	0.22	0.09	0.14	0.40***	0.38***	0.85***
Commodity Concentration	-0.33***	-0.16	-0.003	-0.03	0.09	-0.16
Foreign Investment	-0.26	0.12	-0.09	-0.20	-0.25**	-0.35**
Foreign Debt Increase	-0.26**	-0.01	-0.12**	0.08	-0.08	-0.04
State Strength 1965		0.34**				
Secondary School Enrollment 1965			0.80***			
F/M Secondary School Enroll 1965				0.66***		
Female Secondary School Enroll 1965					0.70***	
Adj. R <sup>2</sup>	0.34	0.08	0.85	0.77	0.81	0.56
N	57 <sup>a</sup>	51 <sup>b</sup>	51 <sup>c</sup>	44	55	57

\*\*\*  $p < 0.01$ .

\*\*  $p < 0.05$ .

\*  $p < 0.10$ .

<sup>a</sup>For this equation, Nicaragua is removed because it is an influential outlier.

<sup>b</sup>For this equation, Peru is removed because it is an influential outlier.

<sup>c</sup>For this equation, Algeria is removed because it is an influential outlier.

loan should enhance economic growth, whereas dependency theorists contend that the integration has negative effect on economic growth. The results for Eq 3.1 are much more consistent with dependency theory than with modernization/free trade theory.

In Eq 3.2 we test the effect of commodity concentration, foreign investment, and foreign debt increase on state strength 1990 when GDP is controlled and state strength 1965 is included as a lagged dependent variable. Dependency theorists assert that economic dependency erodes state capacity to intervene in local economic growth and social programs. Our analysis contradicts this argument showing that none of the three dependency indicators has a significant effect on state strength.

In Eq 3.3 we examine the effects of our three indicators of economic dependency on secondary school enrollment. We find no effect for commodity concentration, but a significant negative effect for foreign debt increase. We also find a negative, but not significant effect for foreign investment. In additional analysis not presented here, we examined the effects of the three forms of economic dependency one at a time, with the same two controls. Both foreign debt increase and foreign investment had significant negative effects on secondary school enrollment, a result that is consistent with some previous studies associated with dependency theory (Reimers, 1990; Stokes and Anderson, 1990).

In Eqs 3.4 to 3.6 we examine the effect of our three dependency indicators on three women's status variables, each of which had a significant effect on infant mortality in Table II. According to dependency theory, one would expect women's status to be lower as a result of economic dependency of the LDCs on core countries.

Eqs 3.4 and 3.5 test the effects of the dependency variables on women's relative and absolute educational status respectively. None of the three dependency variables have significant effects on the ratio of female to male secondary school enrollment, a key gender inequality theory indicator. In additional analysis not presented here, when the lagged dependent variable is excluded, foreign investment does have a significant and detrimental effect on female/male ratio of secondary school enrollment. Eq. 3.5 shows foreign investment has a negative impact on women's absolute educational status. In Eq 3.6 we consider the impact of economic dependency on contra-

ceptive prevalence. All three dependency variables have negative effects, but only the effect of foreign investment is significant.

Results from Eqs 3.5 and 3.6 are consistent with previous research on women and economic dependency (Clark, 1991; Marshall et al., 1988; Ward and Pyle, 1995) and support the dependency theory argument that high levels of economic dependency, especially MNC investment, impede women's access to education and means of birth control.

While we have already given some attention to our state strength indicator, we have not given this variable the attention it deserves given the importance of the developmental state perspective to the present analysis. The relevant data are presented in Table IV. The first purpose of Table IV is to check the utility of the developmental state perspective; the second purpose is to reexamine the effects of other internal determinants of infant mortality; and finally we intend to develop final model(s) including all key predictors of infant mortality in LDCs.

The models we will consider (Eqs 4.1 to 4.6) are in some ways similar to those in Table II except that each of the models in Table IV includes state strength increase instead of the dependency predictors which we now know have little if any direct effect on infant mortality.

In Eq 4.1 we see that state strength increase has a significant positive impact on infant survival when controlling for level of development (GDP per capita). But what happens when other controls are introduced? In Eqs 4.2 to 4.6 we add one additional predictor at a time. All of these predictors had significant positive effects on infant survival in the models presented in Table II. State strength increase has a significant positive effect in each model except for Eq 4.2, the model that adds the economic growth indicator, and even here the effect of the state strength increase variable is positive.

Based on the criterion mentioned earlier, our final models should include no more than five predictors. We try to include key predictors from the three theoretical perspectives in two final models with the lagged dependent variable – infant mortality in 1965 in the model: GDP, economic growth; state strength increase; and two strong predictors linked to gender inequality theory –

TABLE IV  
Standardized OLS Estimates of the Direct Effects of State Strength Change on Infant Survival Probability (1991) and Final Models

Independent variables	Eq 4.1	Eq 4.2	Eq 4.3	Eq 4.4	Eq 4.5	Eq 4.6	Eq 4.7	Eq 4.8
Infant Survival Probability 1965	0.66***	0.52***	0.51***	0.57***	0.46***	0.48***	0.37***	0.46***
GDP 1970	0.26**	0.35***	0.15*	0.22**	0.10	0.14**	0.19**	0.20***
State Strength Increase 1965–1990	0.14**	0.07	0.13**	0.14**	0.16***	0.13***	0.11**	0.12**
Economic Growth 1965–1990		0.23***					0.17***	0.09
Secondary School Enrollment 1965			0.31***					
F/M Secondary School Enrollment 1965				0.17*				
Female Secondary School Enrollment 1965					0.41***		0.35***	
Contraceptive Prevalence 1985						0.39***		0.33***
Adj. R <sup>2</sup>	0.81	0.84	0.84	0.82	0.86	0.89	0.87	0.89
N	60	57	60	58	60	55 <sup>a</sup>	57	52 <sup>a</sup>

\*\*\*p < 0.01.

\*\*p < 0.05.

\*p < 0.10.

<sup>a</sup>For this equation, Iran is removed because it is an influential outlier.

female secondary school enrollment (in Eq 4.7) and contraceptive prevalence (in Eq 4.8). In both final models the betas for women's status are far greater than for the indicators of economic development or state strength increase. Once again, the gender inequality perspective is unequivocally supported. State strength increase is significant even with the presence of economic growth, confirming the previous finding that strong state helps to reduce infant mortality in LDCs. In Eq 4.8 economic growth rate does not reach statistical significance due to the presence of the other important predictors in the model.

#### DISCUSSIONS AND CONCLUSION

As a check on the robustness of our findings we looked for influential outliers (as measured by the Cook's D statistic) which if included in or excluded from our sample would change our results (Bollen and Jackman, 1985). For Eq 4.6 and Eq 4.8 we found that Iran was an influential outlier. When Iran is included in our sample, the coefficients fluctuate a little in Eq 4.6, but all predictors are still significant and the overall  $R^2$  for the equation drops from 0.89 to 0.87. Similarly, in Eq 4.8 when Iran is included, the results are basically the same as when it is excluded. The exclusion of these cases does not change any of our major conclusions, but for the models presented in Table IV we have decided to present the more robust version of our results that excludes these cases.

Our results suggest that internal factors account for much more of the cross-national variation in infant mortality rates than do external factors associated with dependency theory, but it also suggests that it is important to include the external factors. A study that considers only the internal determinants linked to modernization theory, gender stratification theory, and the developmental state perspective ignores important indirect effects due to external factors such as the growing importance of the transnational flow of capital. Although economic dependency does not have much by way of direct effects on infant mortality, its indirect effects are important. Debt increase has a detrimental effect on infant mortality due to its impact on secondary school enrollment and on economic growth. Foreign investment has a detrimental effect on infant mortality

through its impact on economic growth, female education, and contraceptive prevalence. Commodity concentration (trade dependency) has a detrimental effect on infant mortality through its impact on economic growth.

We find some support for each of the theoretical perspectives considered, but the evidence in support of gender inequality theory is of particular note. As is indicated in Tables II and IV, after we control for GDP per capita, state strength increase, economic growth, and the economic dependency variables, all three indicators of women's status have significant effects on infant mortality. Of the women's status indicators, contraceptive autonomy and female secondary school enrollment have the strongest effects. This suggests that women's reproductive autonomy and education level are particularly important predictors of infant mortality. The data presented in Table IV suggest that these two women's status variables have stronger effects on infant mortality than do the economic development indicators or the state strength indicator.

The data showing significant and often strong direct effects on infant survival probability for GDP per capita, economic growth rate, and secondary school enrollment all support modernization/free trade theory. But the evidence of adverse effects of the dependency predictors on many of these same variables and on women's reproductive autonomy is not consistent with this theory. These results call for a refinement of the theory that specifies the conditions under which foreign investment and other forms of dependency benefit Third World nations.

The evidence that state strength increase has a beneficial effect on infant mortality even after controlling for economic development level and other internal variables supports the developmental state perspective. Our results replicate the findings of some earlier studies (Bradshaw and Tshandu, 1990; Bradshaw and Huang, 1991) and contradict the argument made by free-market theorists that big government tends to slow economic growth and in the long-run reduce the health and general well-being of the population.

Our evidence that women's education and reproductive autonomy as well as overall education levels and state strength increase are all useful predictors of decline in infant mortality has important policy implications for LDCs.



Our results suggest that policies aimed at increasing education levels, particularly education for women, and at increasing the availability of contraception will generally contribute to a reduction in infant mortality rates. However, in practice, the implementation of such policies in many LDCs will not be easy. While relationship between women's education and infant mortality has been confirmed in many studies (Caldwell, 1993), finding the resources to provide that education is going to be difficult in many developing nations, particularly in rural areas.

Even if the resources could be found there would be resistance in many areas in spending the funds on educating women as opposed to any number of other needs in these communities. Most developing nations are patriarchal, particularly in rural areas. In such societies education for daughters is considered far less important than that for sons, and the dropout rate for girls is much higher than that for boys. To alter this situation a way must be found to change values at not only the level of the local community, but, in many cases, at the national level as well. Even more difficult will be changing values at the family level, particularly among men. This is a problem that can not be solved with the increase in GDP per capita alone.

Our study also suggests that contraceptive prevalence has an impact on infant mortality rates, implying the importance of women's reproductive rights. Although a recent United Nations (1995) document states forcefully that all couples and individuals have the rights to decide freely and responsibly the number, spacing and timing of their children and to have the information and means to do so, in many underdeveloped countries people do not have access to contraception at all, even when couples do not want any more children. Again, the problem is in part an economic issue of resources and in part an issue of cultural values. Until families can see the economic benefits of small families there will be a reluctance to make use of birth control even when the means are made available.

Our results provide ample evidence that women's education and reproductive autonomy contribute to infant mortality decline. If the role of women in infant mortality decline is to be better understood, more variables measuring women's status and more reliable data for the variables we presently have are needed. Of the three gender

inequality indicators used in this study contraceptive prevalence has lowest reliability. As more reliable data become available, it would make sense to try to replicate our findings. As mentioned in the Appendix, this variable measures the proportion of married women between ages 15 to 49 using contraception. It excludes unmarried women, and it provides no information about the process by which individuals come to use contraceptives.

For a better understanding of the mechanisms by which the status of women and economic dependency impact infant mortality, additional multivariate studies are needed in which models are run that involve more than the five or so predictors we have been able to include at one time in our models. Although panel regression is a powerful method for this genre of research, to understand the effect of economic dependency more fully, we need more longitudinal data both for our dependent and for our independent variables. This would make it possible to pool cross-sectional data so as to increase the number of degrees of freedom making it possible to consider more control variables in one model. We need data for more countries and for more points in time making it possible to do more by way of regional comparisons. We could then replicate our findings across space and time.

#### APPENDIX\*

Commodity concentration; square root of commodity concentration of exports in 1973; Michaely 1984.

Contraceptive prevalence; the percent of women age 15 to 49 using contraception, circa 1985; UNICEF 1993.

Debt increase; the increase in the ratio of debt service to exports between 1970 to 1990; World Bank 1986; 1992.

Economic growth; average annual economic growth rate between 1965 and 1990; World Bank 1992.

Female secondary school enrollment 1965; logarithm of the number of female students in secondary school as a percentage of the number of females in the population who were of secondary school age (12 to 17) in 1965; World Bank 1992.

Female secondary school enrollment 1991; logarithm of the number of female students in secondary school as a percentage of the number of females in the population who were of secondary school age (12 to 17) in 1991; World Bank 1994a.

Female/male secondary school enrollment 1965; logarithm of the number of females in secondary school per 100 males in secondary school in 1965; World Bank 1992.

Female/male secondary school enrollment 1989; logarithm of the number of females in secondary school per 100 males in secondary school in 1989; World Bank 1992.

Foreign investment; Multinational Corporation (MNC) penetration 1967; Bornschieer and Chase-Dunn 1985.

GDP; logarithm of GDP per capita in 1970, the nation's real GDP per capita as the percentage of the base value – GDP per capita for U.S. in 1970 – \$4,790. Kravis, Heston & Summers 1978.

Infant survival probability 1965; the probability of an infant surviving from birth to age 1 year calculated as  $1 - (\text{Infant mortality rate} / 1,000)$ ; World Bank 1992.

Infant survival probability 1991; the probability of an infant surviving from birth to age 1 year calculated as  $1 - (\text{Infant mortality rate} / 1,000)$ ; UNICEF 1993.

Secondary school enrollment 1965; square root of the ratio of the number of students in secondary school to the number of people in the population who were of secondary school age (age 12 to 17) in 1965; World Bank 1992.

Secondary school enrollment 1991; square root of the ratio of the number of students in secondary school to the number of people in the population who were of secondary school age (age 12 to 17) in 1991; World Bank 1994a.

State strength 1965; square root of total current central government revenue, as a proportion of GNP in 1965; Bornschieer and Heintz 1979.

State strength 1990; square root of total current central government revenue, as a proportion of GNP in 1990; World Bank 1992; 1994b.

State strength increase; percentage increase in total current central government revenue, as a proportion of GNP, between 1965 and 1990; Bornschieer and Heintz 1979; World Bank 1992; 1994b.

\*(key: short name; full name; and source for each variable)

#### NOTES

<sup>1</sup> We have used 1970 as opposed to 1965 data for real GDP (adjusted for differences in the purchasing power of currency) per capita because 1970 is the first year for which this GDP measure is available for the countries considered in this study (Kravis et al., 1978).

<sup>2</sup> These correlations are to be interpreted as reflecting cross-sectional relationships. They do not reflect a theoretical interest in exploring a 1 or 5 year lagged effect. The discrepancy in the years selected is due to data availability considerations.

<sup>3</sup> The following are the 82 countries in our sample of LDCs: Afghanistan, Algeria, Argentina, Bangladesh, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Chile, Colombia, Congo, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guinea, Honduras, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Jamaica, Kenya, Korea (South), Kuwait, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Myanmar (Burma), Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Rwanda, Senegal, Sierra Leone, Singapore, Somalia, South Africa, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Zaire, Zambia.

<sup>4</sup> Messner (1989) suggests that given the relatively small sample size, it is appropriate to use and report results based on the 0.10 significance level with this genre of research.

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