Economic Crises and Mortality: Short and Medium-term Changes in Latin America

Jorge Bravo

CELADE
Casilla 91
Santiago, Chile

Introduction

An intriguing fact about the relationship between the economic
crisis of the nineteen-eighties in Latin America and health
indicators, is the apparent lack of strong effects. The past decade
has been one of the worst experienced by the region as a whole
during this century; it has been dominated by economic recession
and stagnation, large external debts and onerous debt servicing,
international trade imbalances, reduced investment, unemployment,
falling real wages, and large negative fluctuations in aggregate
economic activity (ECLAC, 1990; IDB, 1989). Some countries had also
experienced sharp recessions in the mid-seventies, echoing the
international oil crisis in that decade.

Aggregate health indicators, however, have in general continued to
show improvements. Infant mortality, the classic global health
indicator, seems only marginally affected in a majority of
countries by even the most pronounced economic fluctuations. Chile
appears to be a particularily clear case in this regard, but data
for Costa Rica and Uruguay for the last two decades suggest a
similar situation, and the same may be said of other Latin American
countries. Even in El Salvador, a country suffering from both an
economic crisis and a civil war starting in 1980, infant mortality
-though comparatively high in the regional context- has continued
to decline rather smoothly during the nineteen-eighties (CELADE,
1990a). Honduras and Nicaragua show similar trends.

In other countries like Brazil and Panama, and to a lesser extent
Guatemala, temporary upswings in infant mortality around the mid-
seventies or the mid-eighties can be observed. Sub-national case
studies in some regions and cities of Brazil (Wood, 1977; Becker
and Lechtig, 1986; Macedo, 1987) show increases in infant mortality
concurrently -or soon after- economic recessions. At a more local
level, in a rural region of Costa Rica, Mata (1985) detects marked
increases in mortality following economic crises. These cases,
however telling as they may be, do not appear to reflect the
dominant pattern throughout the region.

The lack of generalized strong effects is particularily striking
because numerous cross-sectional studies of the socio-economic
determinants infant and child mortality show large differentials
associated with these variables (see CELADE, 1990b, and references
therein). This would lead one to expect the direction of the effect
to be similar for temporal changes.

Many possible explanations for this weak response appear to be
plausible: Taucher (1989) has noted for the case of Chile, that
during times of economic difficulties both marriages and births are
postponed, a behavioural response that can buffer to some extent
the effects on infant mortality, by the concentration of reduced
resources among fewer than normal children. This may apply to other
countires too. The trend toward greater fertility control, by

reducing the proportion of high mortality risk births (births of high parity, mothered by older women) may be superimposed and added to the shorter-term response.[1] Mata (1985, 1988) emphasizes that control of infection and 'maternal technologies', which encompass a variety of behaviour related to nutrition, hygiene, and personal health care that may not be too adversely affected by temporary economic setbacks, are the crucial elements behind recent improvements in health and survival in Costa Rica, and possibly in other countries too. Strictly speaking, what the studies on infant mortality risk factors show, is that the maternal educational level (income is generally absent from these studies) is one of the key explanatory factors, something consistent with Mata's suggestion.

Jolly and Cornia (1984) noted at the beginning the eighties that since the effects tend to be lagged, they may not have been expressed as yet. This is still a plausible, but less appealing explanation as time advances. Finally, and without exhausting all possible explanations, although economic recession in the region has in general been accompanied by declines in public health spending (Musgrove, 1988), some observers believe that either efficiency in the use of the reduced funds has increased, or that little of it was initially allocated to effective prevention, so that the overall declines have not had a significant impact on child survival (World Bank, 1990, 45).

Instead of trying to delucidate the true causes of the apparent lack of effects, this paper examines the basic assumption (or fact) of low-response itself. It seems evident, from the studies cited above, that the phenomenon is not completely generalized, and that there are regions and localities where noticeable 'crisis' effects have been detected. The analysis in this paper suggests that this basic assumption needs to be qualified further, even at the national level, in relation to the time frame, and the type of mortality indicator employed. Distinguishing the short from the medium and long terms, and among different causes of death appear to be useful in this regard.

Time frames

Figure 1 shows the evolution of infant mortality and per capita GDP in Costa Rica, Chile, Guatemala and Uruguay during 1950-1990. These countries are among the few in the region for which there are relatively reliable annual mortality series for the last forty years. All countries show a downward trend in infant mortality

---

[1] Hojman (1989), labelling Chile as a paradoxical case, argue that simultaneity effects (unemployment reduces the birth rate, which in turn reduces infant mortality) and focalized health-related policies can account for the paradoxical result. Similar ideas had been proposed before by Raczynski and Oyarzo (1981), and Castañeda (1985), except for the simultaneous effect.

until the end of the nineteen-eighties. Before 1970 the four countries displayed some fluctuations in this indicator, but with the exception of Guatemela, the short-term oscillations have dampened significantly afterwards. As anticipated in the introduction, and contrary to a priori expectations, the sharp economic fluctuations of the nineteen-seventies and nineteen-eighties have not been followed by significant changes in infant mortality: one could at most note decelerations in the downward trends in Costa Rica and Chile.

The expectation that, other things being the same, infant mortality should respond inversely to GDP, cannot really be falsified (at least not with the present data), because -as stated above- 'other things' have not remained the same during the last couple of decades. A few, but relevant indicators have continued to show improvements in spite of the crisis, like literacy and other educational statisitcs (UNESCO, 1989), the extension of access to piped water, and caloric intake (UNDP, 1990, table 4). Abstracting from these medium-term trends (and other, less measurable ones, like those in 'maternal technologies') and concentrating in the short-term deviations of mortality and GDP about their trends, would seem desirable to isolate the hypothesized effect. An additional reason for distinguishing the short from the medium to long terms is that the latter frequently fail to capture 'crisis' effects, the most severe of which should be manifest whithin a few years after economic downturns. Failing to make this distinction in Chile and Uruguay, where the general level of unemployment increased from the mid-sixties to the mid-eighties, could mislead to the spurious conclusion that higher unemployment produces lower infant mortality.

Directly controlling for the effects of some of these variables is difficult if not impossible in the context of comparative longitudinal analyses, since the required annual time-series data spanning four or more decades are unavailable in most countries in the region[2]. Some cross-sectional studies have included such controls (e.g., Castañeda, 1985, Palloni and Wyrick, 1981), and have found in general expected (though not always strong) associations; but as noted above, cross-sectional results do not automatically extrapolate into temporal relations.

The short-term analyses carried out here draw some basic ideas from the more sophisticated methods now routinely used in historical studies, which, contrary to be present case, normally include long time-series of several dependent and independent variables (e.g.,

---

[2] Hojman's (1989) analysis of Chilean data is one of the few longitudinal studies where some statistical controls have been included, with a sample restricted to 14 to 21 yearly observations. Fifty or more observations would be required to implement more rigorous statistical procedures, as in Galloway (1989).

Lee, 1981; Galloway, 1985, 1989; Reher, 1989). The short lenght of the present series (26 to 40 annual observations), and the use of only one independent variable[3] has lead us to several simplifications, to use a slightly different detrending procedure, and to present only bi-variate correlations and elasticities.

Following now conventional procedures, the short-term deviations of a given variable x_t (where t is a time index) are obtained by dividing each observation by the underlying medium term trend $T(x_t)$. The usual estimate for T is an 11-year moving average, centered around t. Although that estimate has the advantage of a non-restrictive functional form for T, it has the disadvantage of substracting 10 observations from the sample, aside from those required by lagging. We have opted for estimating T as a cubic function of time, a procedure that yields reasonable estimates that in general match closely those of the moving average (over the range in which they coincide), and does not force us to delete a significant portion of our already small samples.

Figure 2 shows the estimated short-run fluctuations in infant mortality and per capita GDP for the same previous four countries. The inverse movement in the two variables is evident in Costa Rica and Guatemala during the entire 40-year period, but is noticeable in Chile and Uruguay beginning in the nineteen-seventies. The zero-order correlation coefficients shown in table 1 roughly confirm this visual impression: in Costa Rica the negative correlation has remained high over time, whereas in the three other countries it has gone from a weak negative (or even positive) association to a stronger negative one in the last fifteen years, a period of time that covers the last two major economic recessions.

In summary, very different conclusions are obtained by looking at the relationship between the absolute levels of economic and mortality indices, or at their short-term fluctuations; the second more clearly revealing the expected inverse movement during the economic crises experimented during the last 10 to 15 years.

Mortality by cause.

Morbidity and mortality by some causes may be more sensitive than others to economic fluctuations (e.g., Galloway, 1985; Bravo, 1990). Although there are many studies that deal with changes in the causes of death in the region (e.g., Taucher, 1978; Palloni and

---

[3] For some countries and restricted time periods, more independent variables can be used (e.g., Bravo, 1990), but since this is not in general possible, the option was made of using only per capita GDP in order to obtain results comparable across all countries.

Wyrick, 1981; Rosero, 1984; Díaz, 1987; Yazaki, 1990), very few have attempted to quantify the effects of changes over time in economic circumstances on deaths from specific diseases[4].

To examine this topic, we concentrate our attention in Costa Rica, Chile and Guatemala. Regarding overall development and mortality levels, Costa Rica and Chile (with life expectancy at birth of 75 and 72 around 1990) are more similar than either one with Guatemala (with life expectancy of 63), although the first has achieved favourable development indices with somewhat lower per capita income and lower industrialization levels than the second.

Two general problems with cause of death statistics are under-registration of deaths and defective classification. An investigation by Chackiel (1987) suggests that, although not exempt of some problems, the data for these three countries are relatively reliable according to these two criteria, those of Costa Rica and Chile considered to be better than those of Guatemala. Aside from the purposive selection of countries, another action undertaken that may help to ameliorate possible problems with the data has been to choose some well-known diseases that have been, presumably, well-diagnosed and classified since at least 1960 (the starting year of the series), and discard those that present obvious discontiuities in the years where transitions to new revisions of the international classification of causes of death take place (Vallin, 1988, 56, 57; WHO, 1978). Also, the short-term analysis described above, is not much affected by under-registration problems, even if completeness had changed gradually over time[5].

The initial set of causes is listed in table 2, as well as the corresponding codes for the seventh, eight and ninth international classification revisions. Series that were eliminated from the analysis because of evident discontiunuities in the years of transition to a new revision of codes were those of early infancy, measles and gastritis of Chile and Costa Rica, and also that of pnemonia of Guatemala. The series of malaria were eliminated since there are no deaths due to this cause in Chile, there are very few registered cases in Costa Rica, and the series of Guatemala displays inconsistencies during the period under study. For more details about the selection and trends in specific causes, see Bravo and Vargas (1990).

---

[4] Palloni and Wyrick (1981) estimate cross-sectional effects, which, we have argued, are not directly relevant to temporal relations.

[5] For example, if completeness had an increasing trend over time, it would be absorbed in the estimation of $T(x_t)$, and would not greatly affect the analysis, which is based on the proportional deviations about the trend. Other errors, which cannot be characterized by a simple time trend, may remain.

The possible mechanisms linking econonomic changes to mortality from these (and other) causes are numerous (Palloni and Wyrick, 1981; Mosley and Chen, 1984; Cornia, 1987; Galloway, 1989; Bravo, 1990), ranging from reduced accessability to food, clean water, greater probability of contagion due to undernutrition, non-hygienic living conditions, crowding, depression and stress. For non-contagious diseases (e.g., cerebro-vascular diseases), the economic effects, if any, should have consequences on the precipitation of death rather than on morbidity. On the supply side, health services often reduce their capacity to satisfy the increasing demand in times of crises, due to budgetary constraints. Again, the present focus is not on determining underlying causes, but rather on the documentation of the mortality responses.

A. Pre and post-crisis trends.

The great majority of these causes display a declining mortality trend over 1960-1986 (Bravo and Vargas, 1990, appendix tables), something consistent with the downward trend in the crude death rate and increased life expectancy at birth. There are some, however, that show an upward trend during the last few years, including hepatitis, cerebro-vascular and ischaemic heart disease, acute respiratory infection, cirrhosis, and suicide in Costa Rica; hepatitis and pneumania in Chile; and typhoid fever, malnutrition, ischaemic heart disease, early infancy, peptic ulcer, and suicide in Guatemala.

One could be led to think that these recent upturns are somehow associated with the economic crisis of the eighties, but there are several reasons to be cautious in this respect: as argued above, the absolute level of mortality reflects both the inertia of past trends -which may or may not be closely related to the present economic situation-, and shorter-term effects. In some cases the observed upturns may be due to reasons altogether different from the downturn in per capita GDP, like the increase in air pollution in Santiago and Guatemala City leading to greater morbidity and a larger than expected number of deaths due to respiratory infections; or population ageing leading to a higher mortality rate of cerebro-vascular disease in Costa Rica. However, if one is willing to follow this hypothesis through, it seems reasonable to add that some of the declining mortality trends could have been decelerated by the crisis (e.g., as in Goldani and Pullum, 1989, in relation to Brazil).

A very crude way of studying these hypotheses, keeping in mind the above limitations, has been to estimate the time trend[6] of each cause (for each country) up to 1979, project forward, and compare

_____

[6] A logistic function of the form $w_t = k/(1+ae^{bt})$, with parameters k, a, and b specific to each series, was chosen because of its relative flexibility and properties of smoothness and positiveness.

the result with the observed rates during 1980-86, the 'crisis' period. The results are presented in table 3 and may be summarized as follows:

The infectious diseases whose transmission is related to the digestive tract (enteritis and diarrhea, typhoid fever and hepatitis) are the most consistent in reaching values 10 per cent or more above the expected values. The group of respiratory infections also tends to be above their expected values, though less consistently than the previous set. With the exception of Costa Rica, cerebro-vascular and heart disease mortality evolve in a manner consistent with their past trends, while the remaining ones do not show consistent patterns. A clear predominance of causes with mortality above expectations can be observed in Costa Rica and Guatemala, a situation less marked in the case of Chile. Of the thirteen causes available for the three countries, enteritis and typhoid fever are the only ones that show higher than expected mortality in all countries.

In summary, during the eighties the declines in the majority of causes of death have slowed down in relation to past trends, and some even show increases in their mortality rates. However, it seems problematic, in the light of the foregoing discussion, to attribute these decelerations entirely or principally to the economic crisis. We proceed in the next section to the short-term analyses, which yield more refined measures of association.

B. Short-term relations.

Figure 3 contains the calculated elasticities[7] (which measure the percent change in mortality associated with a 1 per cent increase in per capita GDP) for twelve causes in the three countries, and for lags 0 to 3 years.

Substantial variation exists in the response of mortality by causes and among countries. Three causes stand out by their consistently negative association with changes in GDP: malnutrition, influenza, and peptic ulcer. Also, clear negative associations are observed for cerebro-vascular disease, entiritis, and ischaemic heart disease in Costa Rica, typhoid fever and tuberculosis in Chile, and cirrhosis and acute repiratory infection in Guatemala. There are no causes with consistently positive elasticities, though tuberculosis in Costa Rica and Guatemala, and ischaemic heart disease in Chile and Guatemala approach this situation.

The positive short-term associations are not easy to explain. The

---

[7] In the present (bi-variate) context, the elasticity η_{yx} can be estimated directly as the regression coefficient of the detrended y on the detrended x, or obtained from the correlation coefficient r_{yx} and standard deviations s as $\eta_{yx} = r_{yx}(s_y/s_x)$.

positive response of hepatitis, typhoid fever, and respiratory tuberculosis in Guatemala may be partly influenced by rural to urban migration, associated with increases in GDP: suceptible populations, through their incorporation into the urban environment, may increase the risk to exposure and contagion, and possibly also to poor living conditions that could aggravate morbid states. The positive response of ischaemic heart disease seems to offer even greater resistance to explanation. Relatively poor data for specific causes cannot be completely ruled out either.

Whatever the case may be, it is evident that an overall low mortality response to changing economic circumstances, even in the context of short-term analyses, hides important variability, with positive and negative responses partly cancelling each other. Elasticities of morbidity with respect to GDP (Bravo, 1990; Bravo and Vargas, 1990, table 5) also show subtstantial variation, with negative elasticities for typhoid fever, hepatitis and tuberculosis, but unsystematic responses of influenza and malaria morbidity. As in the case of mortality, the data for Guatemala shows more frequently positive associations.

Summary and Conclusion

The recent economic crises in Latin America, and specially the more generalized, deeper and longer-lasting one of the nineteen-eighties has had negative impacts on the global economy and individual well-being. Although demographic variables have not been immune to these changes, their effects are only starting to be documented and quantified. There are some indications that nuptiality and natality have responded quickly and sentitively to economic recessions (e.g., Taucher, 1989; Goldani and Pullum, 1989), but the effects on mortality indicators have apparently been less generalized and less strong.

In this paper, reasons for distinguishing short from medium and long term effects and among different causes of death, as useful ones in assessing 'crisis' effects, have been considered. The results of the analyses for Costa Rica, Chile, Guatemala and Uruguay show that short-term measures more clearly reveal the expected inverse association of infant mortality with changes in economic activity. The different causes of death show substantial variation in their responses to economic fluctuations, a fact that helps to explain the low level of aggregate mortality response. Three causes that show consistently negative associations with changes in per capita GDP are malnutrition, influenza, and peptic ulcer, aside from specific ones in particular countries. Although the short-term variability of the studied causes is generally lower in Costa Rica and Chile than in Guatemala, the negative associations with changes in per capita GDP are found to be more systematic in the former. All these general conclusions must be qualified by the limitations inherent in bi-variate analyses.

In spite of some general limitations in the data, much more could be done to gain a better understanding of the economic effects on health indicators. For example, to examine more carefully causal pathways underlying the observed effects, the interrelations among the fluctuations of the different causes of death or other health indicators (e.g., malnutrition or morbidity); and to determine which economic variables have stronger effects[8]. The conclusions about these questions would be strengthened by multivariate analyses. Other diseases may be worth exploring, that could be more sensitive to economic changes than those studied so far.

---

[8] Previous work for Chile (Bravo, 1990) suggests that the unemployment rate is more closely related to fluctuations in mortality, morbidity, and undernutrition than either per capita GDP or real wages, and that the effects tend to be greater at the metropolitan than at the national level.
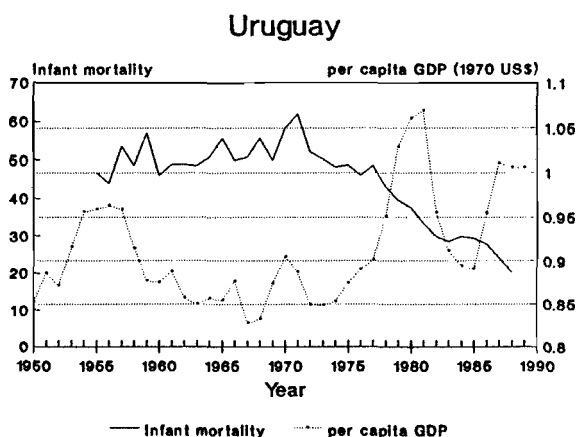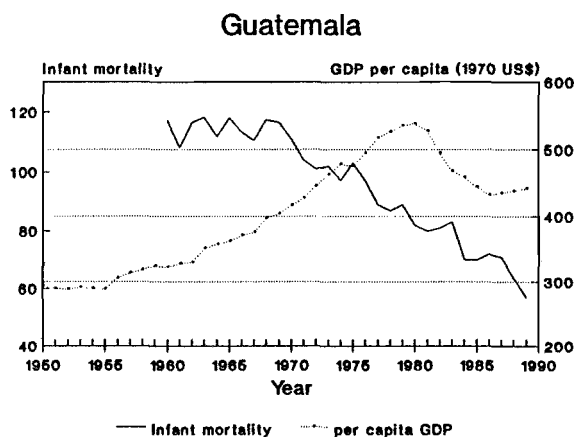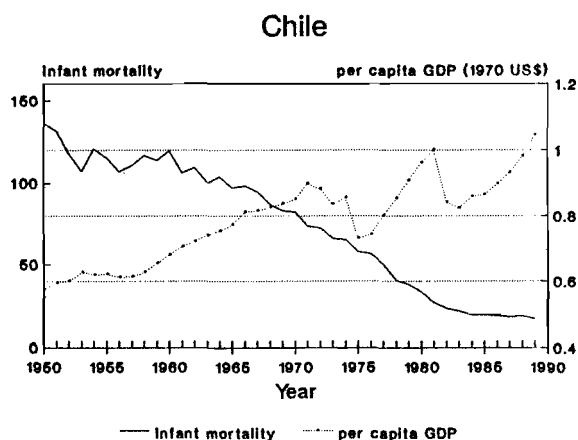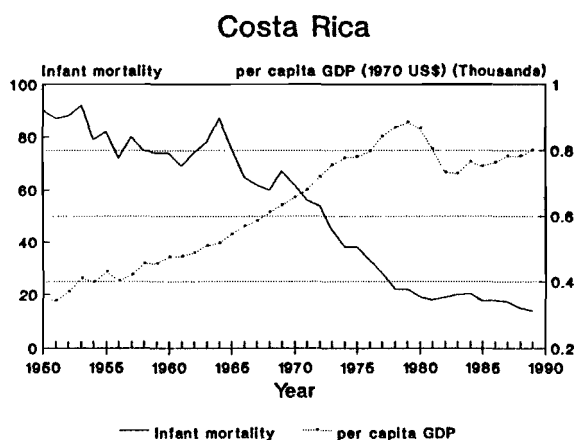
References

Becker, R. and Lechtig, A. (1986) 'Increasing poverty and infant mortality in the North East of Brazil'. Brasilia, Centro de Documentacao, Ministerio de Saúde.

Bravo, J. (1990) Fluctuaciones en los indicadores de salud y la economía chilena, 1960-1986 _Estudios de Economía_ Vol 17, No. 1, June 1990. Facultad de Ciencias Económicas y Administrativas, Universidad de Chile, Santiago, Chile.

Bravo, J. and Vargas, N. (1990) 'Tendencias y Fluctuaciones de la Morbilidad y la Mortalidad por ciertas causas, y la Actividad Económica: Costa Rica, Chile y Guatemala, 1960-1986'. Unpublished manuscript, CELADE, 1991.

Castañeda, T. (1985) Determinantes del descenso de la mortalidad infantil en Chile: 1975-1983 _Cuadernos de Economía_ Universidad Católica de Chile, Agosto, 1985, Santiago, Chile.

CELADE (1990a) _La Mortalidad en la Niñez: Centroamérica, Panamá y Belize._ INCAP-UNICEF-CELADE Serie LC/DEM/CR/R.11 San José, Costa Rica.

CELADE (1990b) _Factores sociales de riesgo de muerte en la infancia._ LC/DEM.G.88, Santiago, Chile.

Cornia, J. (1987) Economic decline and human welfare in the first half of the nineteen-eighties. In Cornia, G., Jolly, R. and Stewart, F., eds. _Adjustment with a Human Face_, Vol. 1, chapter 1. Published for UNICEF by Siglo XXI editores, Spain.

Chackiel, J. (1987) La investigacin sobre causas de muerte en la América Latina. _Notas de Población_ Año XV, No. 44. CELADE, Santiago, Chile.

Díaz, E. (1987) _Causas de Muerte en Guatemala 1960-1979._ CELADE Serie OI, No. 1001, San José, Costa Rica.

ECLAC (1990) _Transformación productiva con equidad_ Economic Comission for Latin America and the Caribbean, United Nations, Santiago, Chile.

Galloway P. (1985) Annual variations in deaths by age, deaths by cause, prices, and weather in London 1670 to 1830. _Population Studies_ 39, 487-505.

Galloway, P. (1989) 'Secular Changes in the short-term preventive, positive, and temperature checks to population growth in Europe, 1460 to 1909'. Paper presented at the Simposium on 'The Reconstruction of past populations and their Dynamics', Institut National d'Etudes Dmographiques, Paris, June 6 to 7, 1989.

Goldani, A. and Pullum, T. (1989) 'Demographic change and stability in Brazil during a period of economic crisis'. Paper presented at the Meetings of the Population Association of America, Baltimore, Maryland, 1989.

Jolly, R. and Cornia, G. (1984) The impact of World Recession on Children Oxford, Pergamon Press.

IDB (1989) Economic and Social Progress in Latin America, 1989 Report. Inter-American Development Bank, Washington DC.

Lee, R. (1981) Short-term variation: vital rates, prices, and weather. In Wrigley, E. and Schofield, R. The Population History of England 1541-1871 Cambridge University Press.

Macedo, R. (1987) La infancia en Brasil y la crisis económica: situación del estado de Sao Paulo. In Cornia, G., Jolly, R. and Stewart, F., eds. Adjustment with a Human Face, Vol. 2, chapter 2. Published for UNICEF by Siglo XXI editores, Spain.

Mata, L. (1985) Estado nutricional del niño de Puriscal durante la crisis, 1979-1984. Revista Médica del Hospital Nacional de Niños de Costa Rica Vol. 20, No. 2, 121-140. San José, Costa Rica.

Mata, L. (1988) A public health approach to the "food-malnutrition-economic recession" complex. In Bell, D. and Reich, M., eds. Health, Nutrition, and Economic Crisis: Approaches to Policy in the Third World, chapter 11. Auburn Publishing Company, Massachussets.

Mosley, W. and Chen, L. (1984) An analytical framework for the study of child survival in developing countries. Child Survival: Strategies for Research, Supplement to Population and Development Review, Vol 10, 1984.

Musgrove, P. (1988) Crisis Económica y Salud: La experiencia de cinco países latinoamericanos en los años ochenta Pan American Health Organization, United Nations, Washington, D.C.

Raczynski, D. and Oyarzo, C. (1981) Porqué cae la tasa de mortalidad infantil en Chile? Colección Estudios CIEPLAN, Diciembre 1981, 45-84. Santiago, Chile.

Reher, D. (1989) 'Coyunturas Económicas y Fluctuaciones Demográficas en México durante el siglo XVIII'. IUSSP-ABEP-CELADE, Congreso sobre la Historia de la Población en América Latina, Ouro Preto, Brasil, 2 to 6 of July, 1989.

Rosero, L. (1984) Las Políticas socio-económicas y su efecto sobre en descenso de la mortalidad Costarricense. En Asociación Demográfica Costarricense, Mortalidad y Fecundidad en Costa Rica. San José, Costa Rica.

Taucher, E. (1978) Chile: Mortalidad desde 1955 a 1975. Tendencias y Causas. CELADE Serie A, NO. 162, Santiago, Chile.

Taucher, E. (1989) 'Behavioural factors in demographic responses to economic crises' Paper presented at Informal Session 1.13: Demographic response to the economic crisis of the XXIst IUSSP Conference in New Delhi, 20-27 September, 1989.

UNDP (1990) Human Development Report 1990, United Nations Development Program, Oxford University Press.

UNESCO (1989) Statistical Yearbook 1989 United Nations Educational, Scientific and Cultural Organization, Imprimerie Berger-Levrault, France.

Vallin, J. (1988) Seminario sobre Causas de Muerte. Aplicación al caso de Francia. CELADE Serie E No. 31, Santiago, Chile.

WHO (1978) Handbook of the International Classification of Diseases and Causes of Death. World Health Organization, United Nations.

World Bank (1990) Poverty alleviation, basic social services and social investment in Guatemala, El Salvador and Honduras. Paper presented to the International Seminar on "Social Development Funds", November 7 to 9, 1990. CEPAL, Santiago, Chile.

Wood, C. (1977) Infant mortality trends and capitalist development in Brazil: the case of Sâo Paulo and Belo Horizonte Latin American Persepctives, Vol 4., No. 4: 56-64.

Yazaki, L. (1990) Causas de Morte e Esperança de Vida ao Nacer no estado de Sâo Paulo e Regiôes 1975-1983. Coleçao Realidade Paulista, SEADE, Sâo Paulo, Brazil.

Figure 1. Infant Mortality and per capita GDP (selected Latin American countries)

Costa Rica

Infant mortality   **per capita GDP (1970 US$) (Thousands)**

—— Infant mortality   ⋯ per capita GDP

Chile

Infant mortality   **per capita GDP (1970 US$)**

—— Infant mortality   ⋯ per capita GDP

Guatemala

Infant mortality   **GDP per capita (1970 US$)**

—— Infant mortality   ⋯ per capita GDP

Uruguay

Infant mortality   **per capita GDP (1970 US$)**

—— Infant mortality   ⋯ per capita GDP

Source: GDP: ECLAC (1978, 1990); IMR: National vital statistics.

Figure 2. Short-term fluctuations in Infant Mortality and per capita GDP (selected Latin American countries)

Costa Rica

x(t)/T[x(t)]

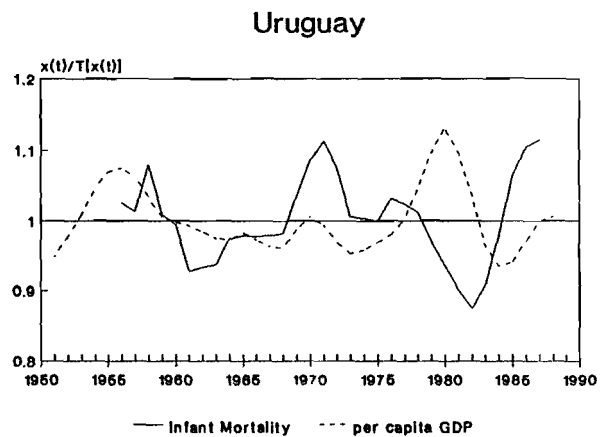—— Infant Mortality   --- per capita GDP

Chile

x(t)/T[x(t)]

—— Infant Mortality   --- per capita GDP

Guatemala

x(t)/T[x(t)]

—— Infant Mortality   --- per capita GDP

Uruguay

x(t)/T[x(t)]

—— Infant Mortality   --- per capita GDP
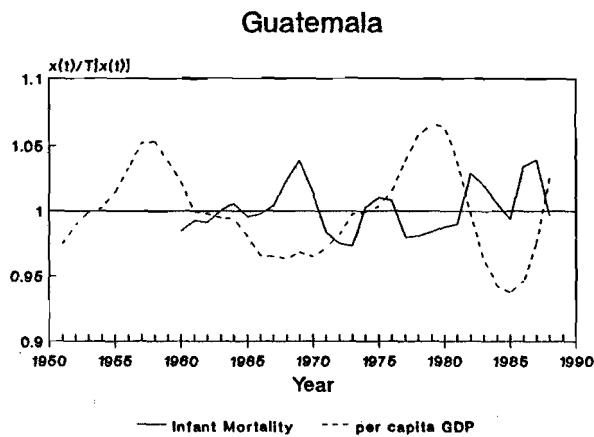
Figure 3. (continued)

Source: Bravo and Vargas, 1990, table 4.

Figure 3. GDP-mortality elasticity by cause, 1960-1986.

Malnutrition

Cerebro-Vascular Disease

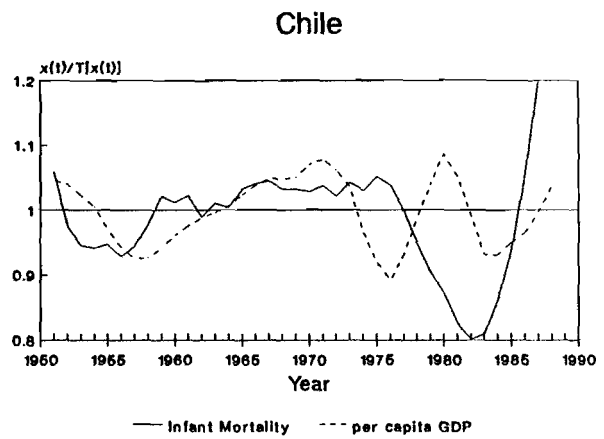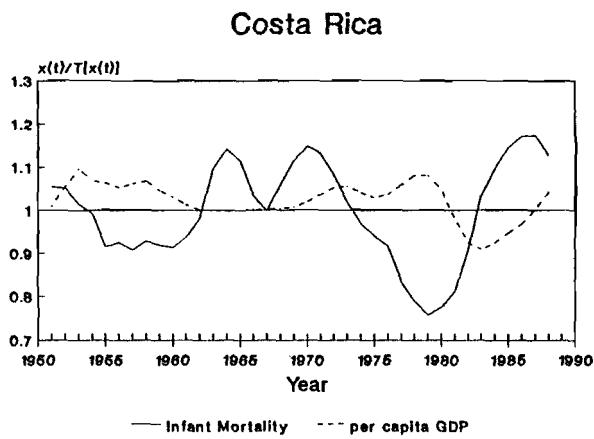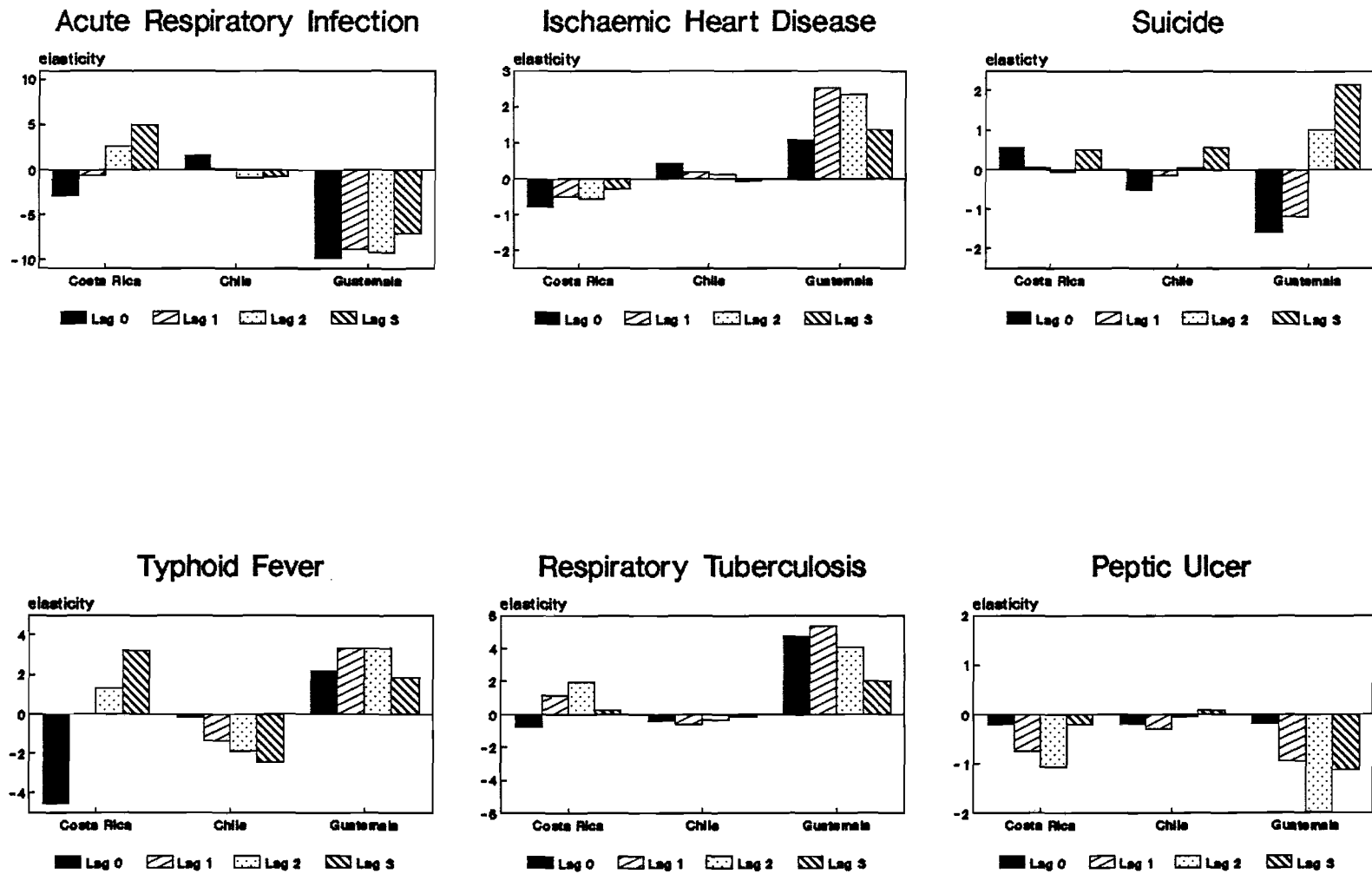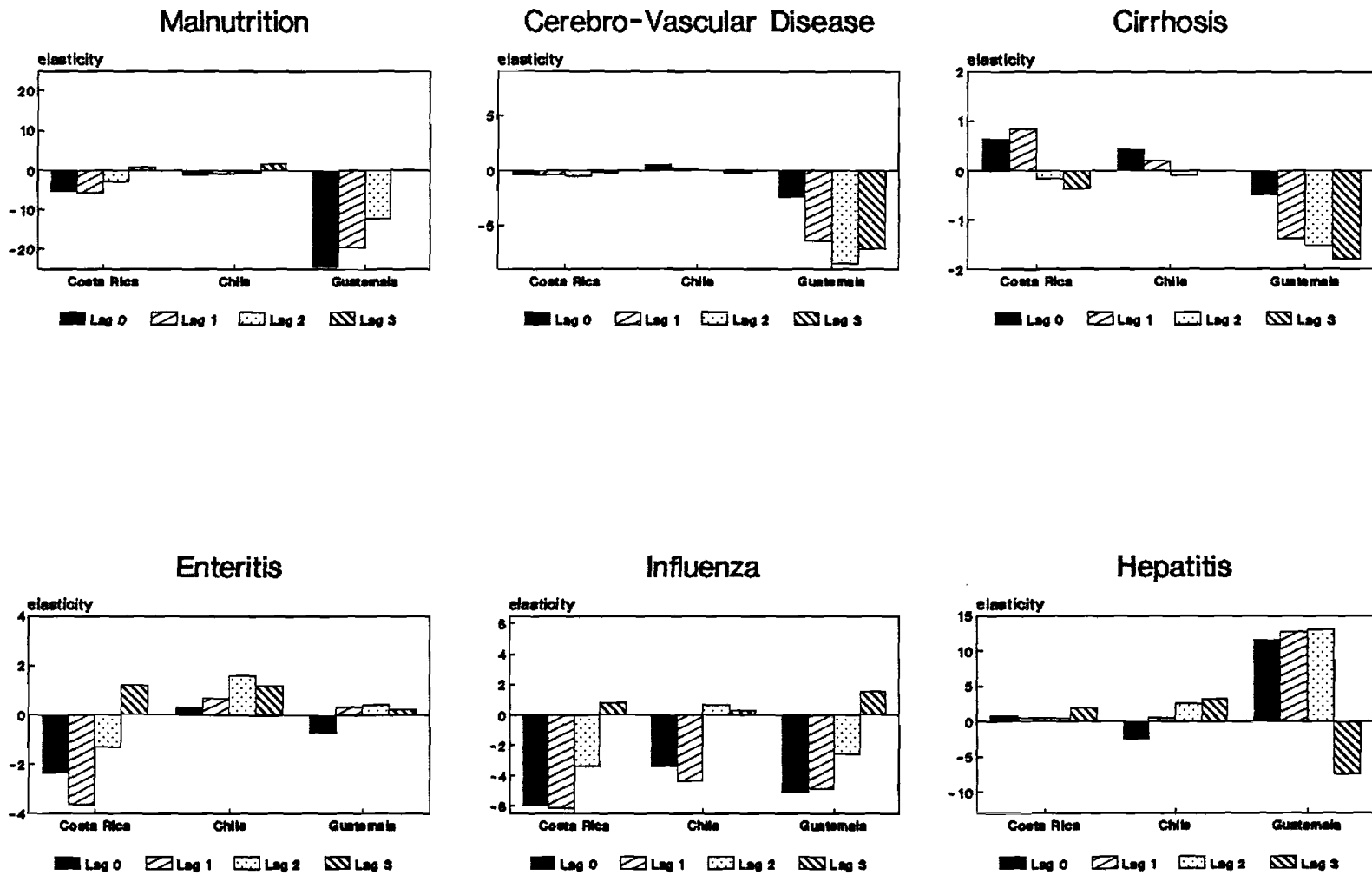### Cirrhosis

Enteritis

Influenza

Hepatitis

Source: Bravo and Vargas, 1990, table 4.

Table 1. Correlations between per capita GDP and Infant Mortality

Correlation coefficient

country/period	Lag (in years)				N
Costa Rica	0	1	2	3	
1950-1974	-0.53[a]	-0.76[a]	-0.86[a]	-0.84[a]	25
1950-1990	-0.44[a]	-0.69[a]	-0.78[a]	-0.75[a]	41
1975-1990	-0.55[a]	-0.84[a]	-0.92[a]	-0.84[a]	16
Chile	0	1	2	3	
1950-1974	0.72[a]	0.59[a]	0.38[b]	0.16	25
1950-1990	0.10	-0.05	-0.12	-0.10	41
1975-1990	-0.27	-0.51[a]	-0.50[a]	-0.31	16
Guatemala	0	1	2	3	
1950-1974	-0.49[b]	-0.25	-0.07	0.03	15
1950-1990	-0.44[a]	-0.33[a]	-0.17	-0.02	31
1975-1990	-0.63[a]	-0.52[a]	-0.34	-0.17	16
Uruguay	0	1	2	3	
1950-1974	0.31	0.20	-0.20	-0.50[a]	20
1950-1990	-0.33[a]	-0.59[a]	-0.70[a]	-0.58[a]	36
1975-1990	-0.50[a]	-0.88[a]	-0.94[a]	-0.64[a]	16

The significance levels are: a 5%, b 10%.

All variables have been detrended, as explained in the text, by dividing each variable x_t by a trend term $T(x_t)$, estimated as a cubic function of time of the form $T(x_t) = \pi_0 + \pi_1 t + \pi_2 t^2 + \pi_3 t^3$, where the πs are specific to each series.

Table 2. Initial list of causes of death in Costa Rica, Chile, and Guatemala.

Denomination of cause in seventh internacional revision	Code according to revision		
	VII	VIII	IX
Nutritional defficiencies	A64	A65	260-269,579
Cerebro-vascular disease	A70	A85	430-438
Cirrhosis	A105	A102	571
Enteritis & other diarrheic diseases	A104,A132	A5	008, 009
Typhoid fever	A12,A13	A2,A3	002, 003
Gastritis	A101	A98	535
Influenza	A88	A90	487
Hepatitis	A34	A28	070
Acute respiratory infection	A87,A92	A89	460-466
Ischaemic & other heart diseases	A81,A82	A83,A84	410-416,420-429
Pneumonia	A89-A91	A91,A92	480-483,485,486
Early infancy deaths	A130-A135	A131-A135	760-779
Measles	A32	A25	055
Suicide	AE148	AE147	E950-E959
Whooping cough	A22	A16	033
Respiratory tuberculosis	A1	A6	010-012
Peptic ulcer	A99,A100	A98,A99	531-533

Table 3. Observed mortality during the crisis period (1980-86) and expected from a logistic trend.

cause	Costa Rica obs	exp	percent difference (obs/exp)	Chile obs	exp	percent diffrence (obs/exp)	Guatemala obs	exp	percent difference (obs/exp)
Enteritis	6.43	2.57	+	5.22	3.82	+	174.76	99.93	+
Typhoid fever	0.02	0.00	+	0.51	0.42	+	4.62	2.30	+
Hepatitis	0.68	0.40	+	0.41	0.05	+	0.44	0.69	-
Whooping cough	0.31	0.20	+	0.13	0.15	-	15.51	7.08	+
Tuberculosis	2.67	1.90	+	7.01	6.99	0	16.28	8.59	+
Acute respiratory infection	0.68	0.11	+	1.55	1.17	+	4.57	15.66	-
Influenza	0.65	0.78	-	1.86	2.54	-	20.72	18.42	+
Pneumonia	14.91	6.38	+	36.63	27.20	+			
Cerebro vascular	27.70	17.79	+	58.94	60.41	0	9.37	11.86	-
Ischaemic & other heart diseases	70.70	65.38	0	87.04	89.24	0	41.73	37.31	+
Malnutrition	2.16	0.52	+	24.54	25.50	0	36.38	35.55	0
Cirrhosis	6.43	5.79	+	30.72	32.56	0	8.23	12.32	-
Peptic ulcer	1.82	0.97	+	2.41	2.90	-	2.25	1.51	+
Suicide	4.79	5.45	-	5.50	5.46	0	2.65	0.68	+

Number of cases	+ :	11		5		8
	0 :	1		6		1
	- :	2		3		4

Notes:
+ = percent difference > 10%
0 = percent difference < |10%|
- = percent difference < -10%

The logistic projected trend has the general form $y_t = k/(1+ae^{bt})$ and is estimated with a non-linear least-squares program on the basis of 1960-1979 observations.