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Economic Swings and Demographic Changes in the History of Latin America

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I. INTRODUCTION

Considerable effort has been invested in studying the effects of short-term economic fluctuations on demographic outcomes. Although the most influential work relates to conditions in pre-industrial North and Western Europe,[1] a growing number of authors have tried to assess the effects of short-term oscillations in economic well-being on mortality, fertility, and nuptiality in less developed countries.[2] Most of these studies are focused on the demographic responses to recent economic recessions and investigate the question of possible adverse consequences of the economic adjustment programmes initiated during the last decade. Some cross-sectional studies and, more rarely, detailed case studies offer persuasive arguments which suggest that such effects – particularly in the area of health – might be significant and relatively long-lasting. But the evidence is murky, contradictory, and somewhat inconclusive.

In this paper we study the effects of short-term economic fluctuations on natality, nuptiality, and infant and adult mortality in Latin America. We do not study the effects of economic crises *per se*, but, instead, assess the effects of short-term variations on indices of economic well-being. In order to increase the generalizability of our results, we have broadened the focus of inquiry by including 20 or so years before World War II, rather than the post-war period only. This increases the robustness of our results, and the expanded data base enables us to test the hypothesis that demographic responses at different moments in the history of these countries differed. We chose a set of 11 countries that represent, albeit imperfectly, a broad sample of demographic trajectories, styles of economic development, and, to a lesser extent, political evolution.

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[1] R. Lee, 'Short-term variation: vital rates, prices and weather', in E. A. Wrigley and R. S. Schofield (eds.), *The Population History of England, 1541–1871* (Cambridge, Mass.: Harvard University Press, 1981), P. Galloway, 'Basic patterns of annual variations in fertility, nuptiality, mortality, and prices in pre-industrial Europe', *Population Studies*, **42** (1988), pp. 275–302. D. Weir, 'Life under pressure: France and England, 1670–1870', *Journal of Economic History*, **44** (1984), pp. 27–47. T. Richards, 'Weather, nutrition and the economy: the analysis of short-run fluctuation in births, deaths, and marriages, France 1740–1909', in T. Bengtsson *et al.* (eds.), *Pre-Industrial Population Change* (Stockholm: Almquist and Wiksell, 1984).

[2] J. Bravo, 'Economic crisis and mortality: short and medium-term changes in Latin America'. Paper presented at the Conference on the Peopling of the Americas, Veracruz, Mexico (1992). J. Bravo, 'Demographic consequences of structural adjustment in Chile'. Paper presented at the Seminar on Demographic Consequences of Structural Adjustment in Latin America, Ouro Preto, Brazil (1992). K. Hill and A. Palloni, 'Demographic responses to economic shocks: the case of Latin America'. Paper presented at the Conference on the Peopling of the Americas, Veracruz, Mexico (1992). A. Palloni and K. Hill, 'The effects of structural adjustments on mortality by age and cause in Latin America'. Center for Demography and Ecology Working Paper 92-22, University of Wisconsin, Madison, Wis. (1992). D. Reher and J. A. Ortega, 'Short run economic fluctuations and demographic behaviour: some examples from twentieth century South America'. Paper presented at the Seminar on Demographic Consequences of Structural Adjustment in Latin America, Ouro Preto, Brazil (1992).

In the first section of the paper we summarize the mechanisms through which economic crises influence selected demographic outcomes. In the second section we discuss estimation techniques, the choice of countries, and the data sources. In this section we also review our results, compare our estimates with those from pre-industrial Europe and contrast them with the effects of economic fluctuations that apply within the narrower period between 1955 and 1990. In the third section we expand our analysis to include the study of mortality by age and cause of death, but doing so forces us to concentrate exclusively on the period 1955–90.

II. THE RELATIONS BETWEEN SHORT-TERM CHANGES IN ECONOMIC WELL-BEING AND DEMOGRAPHIC OUTCOMES

Although there are important gaps in the evidence and some unsolved difficulties of interpretation,[3] the idea that pre-industrial mortality, fertility, and nuptiality responded in significant ways to economic cycles is well established.[4] Increases in the price of food and other commodities, and contraction of economic opportunities exert downward pressures on marriages and births, but raise mortality, particularly that of young children and the elderly. These effects operate through time trajectories that involve lags and echoes that sometimes reinforce and sometimes weaken the initial responses. For the most part, the evidence about these mechanisms has come from Western and Northern Europe.

Demographic responses to crises induced by famines, epidemics, and wars have also been verified and studied in less developed countries,[5] but far less has been done to understand the short-term reactions to smaller economic fluctuations. Only a handful of authors have assessed the magnitude and direction of demographic responses in Latin America during the second half of this century,[6] and only one has made a serious effort to evaluate trends that started at the beginning of the century.[7] The post-independence period of most Latin American countries was punctuated by economic recessions and upturns of variable magnitudes and durations. They left clear imprints in the capital and labour markets (and, hence indirectly on population distribution), fiscal and monetary policies, and on investment decisions, and also modified the nature of class conflicts and the political alignments established to dissipate their effects.[8] Despite a fair amount of variability between countries in the nature and origins of economic fluctuations, some (including the recessions that began after 1975 and 1982, and the associated effects of structural adjustment programmes) are deemed to have been uniformly severe, and to have led to massive changes in the conditions of exposure, resistance, and recovery that affect health levels, and to subvert and erode, albeit transiently, established patterns of nuptiality and fertility.

[3] R. W. Fogel, 'Nutrition and the decline in mortality since 1700: some preliminary findings', in S. L. Engerman and R. E. Gallman (eds.), *Long-Term Factors in American Economic Growth* (Chicago: University of Chicago Press, 1986).

[4] For a summary, see R. Lee, 'The demographic response to economic crisis in historical and contemporary populations', *Population Bulletin of the United Nations*, No. 29 (1990).

[5] T. Dyson, 'On the demography of South Asian famines, Part I', *Population Studies*, **45** (1991), pp. 5–26. J. C. Caldwell and P. Caldwell, 'Famine in Africa'. Paper presented at the IUSSP Seminar on Mortality and Society in sub-Saharan Africa, Yaoundé, Cameroon (1987). B. Ashton, K. Hill, A. Piazza and R. Zeitz, 'Famine in China 1958–61', *Population and Development Review*, **10** (1984), pp. 613–645.

[6] Bravo, *loc. cit.* in fn. 2. Hill and Palloni, *loc. cit.* in fn. 2. Palloni and Hill, *loc. cit.* in fn. 2.

[7] Reher and Ortega, *loc. cit.* in fn. 2.

[8] C. Marichal, *A Century of Debt Crises in Latin America* (Princeton, NJ: Princeton University Press, 1989). J. A. Frieden, *Debt, Development, and Democracy: Modern Political Economy and Latin America, 1965–1985* (Princeton, NJ: Princeton University Press, 1991). A Maddison, *Two Crises, Latin America and Asia 1929–38 and 1973–83* (Paris: Development Centre of the Organization for Economic Co-operation and Development, 1985). R. Thorp, *Latin America in the 1930's* (New York: St Martin's Press, 1984).

What are the exact mechanisms that link changes in economic well-being with demographic outcomes? What are the conditions under which they operate? In what follows we summarize what is known about such relations.

(*a*) *The effects on nuptiality*

Postponement of marriage, particularly first marriage, is a very common response to economic crises and recessions, and is thought to be the only Malthusian mechanism with some relevance to population growth.[9] In pre-industrial Western Europe high grain prices were almost inevitably followed by a sharp fall in the number of marriages.[10] This is a behavioural effect which involves economic considerations, regarding the prospects for establishing a self-sufficient household. By and large, the nuptiality effect is immediate, but it may become protracted, depending on the severity and duration of the crisis. A 'boom' in marriages usually follows during the aftermath of a crisis, as postponed marriages are rapidly 'made-up'. When the economic effects of the crisis are long-lasting, a more permanent disequilibrium in the marriage markets sets in, and the making-up of postponed marriages ceases to be a feasible option. The consequence is an increase in the proportion of members of a cohort who never marry (or remarry).

A secondary mechanism through which a crisis may affect nuptiality is an increase in the mortality of adults: as the prevalence of widow(er)hood increases, there will be more opportunities to remarry. But whether or not trends in remarriage track closely the increase in the number of couples whose union was ended by widowhood will depend on the availability of occupational and economic niches and opportunities.

The typical pattern of nuptiality response is an immediate drop in the number of marriages, followed by a lagged increase above and beyond what is expected in normal times. Although the period spanned by these offsetting responses largely depends on the severity and duration of the crisis, the number of marriages will decrease during the first two years after the onset of the crisis, followed by an increase, as its impact recedes. Where anticipatory behaviour is widespread, the number of marriages may begin to dip during, or just before the beginning of the first symptoms of economic downturn. An analogous response pattern (with signs reversed) should be associated with economic upturns.

(*b*) *The effects on fertility*

Delays in marriages alone – whether or not followed by an increase in permanent celibacy – will reduce the number of births during the year following the onset of the crisis. In societies in which effective contraception is practised and where anticipatory behaviour and adjustments are the norm, the reduction in the number of births may occur even earlier than one or two years after the beginning of the economic downturn. In addition, postponement of higher-order births, temporary separation of couples caused by migration, and a reduction in coital frequency will all operate to reduce natality. These effects will become apparent within one or two years after the initial effects. If the crisis compromises the health and nutritional status of currently pregnant mothers, an immediate reduction in the number of births is expected, as numbers of stillbirths and spontaneous and voluntary abortions increase in the wake of deteriorating economic conditions, and as malnutrition-induced sub-fecundity, reduction in age at menopause, and increase in age at menarche reduce the number of new conceptions. As

[9] A. E. Wrigley and R. S. Schofield, *op. cit.* in fn. 1.
[10] Galloway, *loc. cit.* in fn.1.

with marriages, the number of births tends to rebound after the crisis has passed. This is due to a higher-than-normal number of new couples, to delayed births that are made up, and, finally, to the more favourable distribution of women by fecundity status.

But the fertility response may also move in the opposite direction, that is, the number of births could increase as a result of crisis. This can occur when mothers abandon traditional breastfeeding practices because they become involved in supplementary economic activities, or as a by-product of severe malnutrition – and if the crisis itself erodes norms that restrict sexual activity of the young and of widowed and separated spouses. This 'backward' response is unlikely to occur as the factors that trigger it are generally offset by compensating forces.

In summary, the effects on fertility are less clear-cut both in terms of direction and timing. For the most part, however, one would expect a drop in the number of births a year or so after the onset of the crisis, followed by a gradual recovery as a reflection of the boom in marriages and of births of second and higher order, that were postponed in the middle of the crisis.

(*c*) *The effects on health and mortality*

The relation between deteriorating economic conditions and mortality is mediated by changes in exposure and resistance to diseases, and by the capacity to recover from illnesses. A direct, non-mediated relation may be observable only in situations that lead to outright starvation, or to acute deficiencies in major nutrients and their sequelae. The mechanisms through which changes in economic conditions alter exposure, resistance, and recovery vary with age and sex.

Deteriorating standards of living can result in lower nutritional intake, and if sustained long enough, lower nutritional status. Deficiencies in nutritional status compromise immuno-competence by increasing susceptibility to infectious diseases, weakening the body's ability to ward off the effects of contacts with common pathogens, and disabling the mechanisms for recovery. Of particular importance are the relations between nutritional status and some ten infectious diseases, including cholera, bacterial diarrhoea, measles, respiratory tuberculosis, whooping cough, and some acute respiratory diseases. Young children (between the ages of one and ten years) and the elderly are the most susceptible section of the population to the effects mediated by nutritional status. Infants who are fully breastfed are better protected by the cleanliness of breast-milk, and the nutrients and immunities that are transferred from mother to child. However, in societies where the traditional norm of breastfeeding has been abandoned, or where the crisis itself affects traditional lactational practices, infants will also be severely affected, and among them those from poorer groups will face higher risks.

The effects of deteriorating nutritional status alone may be confounded, and are frequently exacerbated by conditions associated with sanitation, delivery of health services, personal hygiene, and poor housing. Individual and family reactions to the crisis could, and often do, aggravate levels of crowding, and multiply exposure to diseases, as several families share the same household, food, clothing, and shelter. Deterioration of the infrastructure (piped water, sewage, refuse disposal) as governments cut social expenditures, will compound the effects of increased exposure to infectious diseases. Finally, as health subsidies and services are reduced or eliminated, ante-natal care and basic preventive and curative services will be considerably more difficult to obtain in the public sector. Consequently, one would expect mortality responses to be enhanced when the downturn is sharp and sustained enough to cause damage to sanitation and public health, the continuity of public work programmes, food assistance and subsidies, and the integrity of social welfare and preventive and curative health services. The magnitude and duration of the morbidity and mortality effects will vary with the severity of the crisis, but also as a function of the resilience of programmes supported by government, and the size of the population covered by them. Where a large fraction of the population depends on these services, and where they are more vulnerable to reduction in government budgets, the effects on mortality should be correspondingly stronger. That the mortality response to the crisis may be mediated by centralized institutions is not a unique feature of less developed countries. Indeed, there is evidence that in some pre-industrial societies central governments were at least partly successful in cushioning the impact of shortages, and could smooth oscillations in inventories through anticipatory corrective interventions.[11]

The outcome of adjustments to individual behaviour and of the erosion of public programmes will be felt first by young children and the elderly, and should be most evident in the increased incidence of gastro-enteritis, respiratory tuberculosis, and acute respiratory ailments. Impoverished ante-natal care and weakened preventive services will take their toll among infants and very young children. Note that reductions in ante-natal care could also result in increased rates of pregnancy loss and stillbirths. Insofar as such increases are accompanied by a reduction in the average level of frailty of the newborn, the potential levels of neonatal mortality will be lower than normal.

Unlike those associated with nuptiality and natality, the timing and direction of the expected effects on morbidity and mortality are difficult to pin down with precision. First, effects that operate through nutrition should lag by at least one year, except when conditions are wretched. Shorter lags are expected for infant mortality, if the patterns of breastfeeding are disrupted. And finally, effects on neonatal and post-neonatal mortality should become apparent within a year or two of the onset of the crisis. Secondly, increases in respiratory ailments are unlikely to occur during the first year after the beginning of the crisis, and recrudescence of respiratory tuberculosis may take even longer, except where its prevalence is already high and/or where there are sharp increases in new cases. Adolescents, younger adults, and the elderly will be the groups most affected.

As in the case of nuptiality and natality, we expect to find echoes in the mortality response. An increase in mortality may be followed by an immediate decrease as the distribution of susceptibility in the population is sharply altered by excess mortality.[12] Echoes should be more apparent in the most vulnerable age groups (infants and children) and in societies that had experienced recent improvements in survivorship, since it is there that the variance of frailty composition is higher.[13] Another mechanism that leads to negative echo applies to infant mortality. As the crisis reduces natality, it will alter the composition of births by risk factors such as parity (lower proportions of first births), mothers' age (lower proportions of births to younger mothers) and birth interval (lower proportion born after very short intervals). This could exert non-trivial downward pressure on the levels of infant and early childhood mortality, and partly offset mortality increases. Thus, a year or so after a crisis we would expect to find higher-than-normal mortality alternating with lower-than-normal mortality in a wave-like pattern which is progressively damped as normal conditions are restored.

[11] R. W. Fogel, 'Second thoughts on the European escape from hunger: famines, price elasticities, entitlements, chronic malnutrition, and mortality rates', Working Paper No. 1, Working Paper Series on Historical Factors in Long Run Growth, National Bureau of Economic Research, Cambridge, Mass. (1989).
[12] Lee, *op. cit.* in fn. 4.
[13] Palloni and Hill, *op. cit.* in fn. 2.

(d) Contingencies that affect the responses in nuptiality, natality, morbidity, and mortality

The relations discussed above may apply in general, but involve important simplifications that obscure the fine details of observed responses. Variable lengths of crises and changing social conditions that characterize a society or social group are two important facts which affect the size of demographic responses. Not all economic downturns or upturns will have the same effect, even though they may be reflected in similar *observed* variability of economic indicators. Recessions that follow international crises and lead to draconian reorganization of patterns of consumption, massive loss of purchasing power, and significant cuts in government spending will hit the urban working class and lower white-collar groups more severely than those whose earnings depend on rural wage labour or on labour markets associated with primary export sectors. Instead, economic downturns that are more localized and associated with sagging demand for exports could have a less serious, immediate, and general impact. As has been shown elsewhere,[14] the recessions that began during the early 1980s in Latin America belong to the former class, whereas the recession in the 1930s and that which occurred around the time of World War II belong to the latter. A related though distinct factor that affects the size of the response is the duration of the downturn (upturn). Protracted crises are more likely to exhaust potential reserves and inventories or to outlast the shielding effect of public interventions. Longer exposure is also more likely to trigger effects that can be detected only when certain thresholds are exceeded (for example, the effects of malnutrition on mortality).

The presence (absence) of social institutions and the cultural norms that regulate the exchange and circulation of goods and persons will also intervene to modify demographic responses. First, the extent to which economic crises and recessions affect individual decisions to marry is dependent on the degree to which marriage is associated with household formation. In societies in which a newly married couple is expected to establish co-residence in the parental household, the economic constraints on union formation may be weaker than in societies – such as pre-industrial Northern and Western Europe – where couple formation and household creation were two aspects of the same phenomenon.[15] Thus, the prevailing system of cost–benefit allocation associated with marriage will have important influences on whether the nuptiality response is acute, or non-existent.

Secondly, as in the case of marriage, the existence of social institutions and cultural norms may depress or increase the size of the fertility response. In societies with easy access to contraception and where its use is an accepted routine, the reduction in the number of births could be larger than in societies in which the fertility response depends only on biological mechanisms related to nutrition and lactation, or behavioural mechanisms that are highly dependent on spouse separation or abstinence. Where the cost of childbearing is spread within extended households, the depressive effects of an economic downturn may well be smaller than when it is absorbed by couples.

Thirdly, morbidity and mortality will respond differently, depending on conditions of exposure, nutritional status, dietary habits, and past mortality changes. In societies with higher prevalence of respiratory tuberculosis or diarrhoea, for example, we would expect a larger rate of increase in associated conditions during periods of economic reversal. Similarly, where the norm of universal and long breastfeeding has been abandoned, the

[14] Marichal, *op. cit.* in fn. 8.

[15] J. Hajnal, 'Household formation patterns in historical perspective', *Population and Development Review*, **8** (1982), pp. 449–494.

upward pressure on infant (but particularly on post-neonatal) mortality will be stronger. Finally, one would expect a considerably smaller impact in countries in which there have been long-lasting changes in mortality through medical interventions, changes in parental behaviour, and the establishment of strong public health programmes, because in these societies the attitudes toward death and health care and the stock of knowledge and techniques that are available will not be undermined by transient economic setbacks.

Just as the presence (absence) of some social institutions may alter the nature of demographic responses, so can the relative position of a group in a social hierarchy reinforce or buffer the shocks triggered by a crisis. Some groups will be better insulated from its main effects, others will be able to adapt and accommodate though more or less efficient survival strategies, and, finally, others will resist erosion of standards of living by mobilizing political pressure and successful bargaining. Gauging the nature of these differentials is a difficult task since it requires data, broken down into social groups, which are generally not available. The issue is important, however, and should be kept in mind: the aggregate measures that we are frequently constrained to use conceal what can be formidable amounts of variability in the dynamics of social groups. This is as true today as it was in pre-industrial times.[16]

In what follows, we discuss the methods and data to test some of the many conjectures formulated above. Falsification of hypotheses is not an easy task with the data at hand and in some cases – group differential responses – it is outright impossible. Although the bulk of our analysis is devoted to 'aggregate' testing, we also use a deeper analysis of selected cases.

III. METHODS, DATA, AND RESULTS

(*a*) *Methods*

To obtain the effects of short-term variations in economic well-being on demographic outcomes we use distributed lag models similar to those formulated by Lee and Galloway[17] in their studies of England and Wales and other European countries. The most elementary model can be written as:

$$y_t = \alpha + \boldsymbol{\beta}\mathbf{X} + \delta\mathbf{Z} + \varepsilon_t, \tag{1}$$

where y_t is a detrended demographic outcome evaluated at year t, $\mathbf{X}$ is a vector of detrended lagged socio-economic indicators including $x_t, x_{t-1}, \ldots x_{t-n}$, $\mathbf{Z}$ is a vector of (possibly detrended) control variables that also include lagged values, α is a constant, and $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$ are vectors of coefficients. Finally, ε_t is an error term which follows a predefined autoregressive process. Several comments are in order. First, although we experimented with other formulations, the first-order autoregressive process provides the most parsimonious description of the data. In all cases we are to deal with autocorrelation with this very simple formulation, and for this reason (and to avoid cluttering) we do not report Durbin–Watson statistics in each of the models we estimate. Secondly, in vector $\mathbf{X}$ we include values for lags 0 to 4. Effects beyond lag 4 were found to be negligible. However, simple global tests of fit showed that, at least for some demographic outcomes and in some countries, a simpler lag structure fitted the data equally well.[18] In our discussion, however, we concentrate on models that include lags

[16] Fogel, *loc. cit.* in fn. 3.
[17] Lee, *op. cit.* in fn. 1. Galloway, *loc. cit.* in fn. 1.
[18] For further information on the nature of these tests and their application to some of these data see Palloni and Hill, *op. cit.* in fn. 2.

up to 4 to preserve comparability of our results with those obtained for Western Europe. In some circumstances, the estimated effects contained in vector $\boldsymbol{\beta}$ can be conveniently (though only approximately) interpreted as elasticities of demographic outcomes relative to the indicator(s) of well-being. Adding the values $\boldsymbol{\beta}_{t-j}$ contained in vector $\boldsymbol{\beta}$ yields an estimate of the *net* proportional change in the demographic outcomes that occurs in response to a unit proportional change of the indicator of economic well-being. As part of our search for multiple sources of falsification of hypotheses, we also calculate a statistic that enables us to determine whether the net effects of a variable are significantly different from zero.

To improve its efficiency, we introduce several modifications to Model (1). These also enable us to test some fairly straightforward hypotheses about conditions that modify demographic responses.

(a.1.) *Detrending*

To obtain detrended values for our series we applied local least squares, a technique that provides a robust fit to the data without imposing a global functional form, and without costly losses of degrees of freedom (as with the more conventional 11-year moving average). The local least-squares fit reproduces successive portions of the data using a variable bandwidth or fraction of all data points employed to fit a single point.[19] A bandwidth that is too short assigns too much weight to observations that are too close the point being fitted and hence can attribute unduly high influence to deviations from long-run trends that occur in neighbouring points. Conversely, a bandwidth close to unity reproduces the general contour of the time trends better without imposing a single, closed functional form to it. We experimented with variable bandwidths in the range 0.20–0.90 and observed that the results were robust to changes. In all cases we have used bandwidths in the neighbourhood of 0.80–0.90. Once a local least-squares fit has been obtained we calculate the ratio of the observed to the predicted values in the series. These become the values for the variable y_t and for the elements of the vector $\mathbf{X}$. Alternative forms of detrending are, of course, possible. Differencing the series, or calculating ratios of observed to predicted values by using moving averages, are just two possibilities. However, we opted for local least squares since this method simultaneously enables us to preserve the interpretation of the coefficients as elasticities, and optimizes the use of information without imposing strong assumptions about the underlying trend.

An important caveat is necessary here.[20] During the period studied (1920–90) there were only three major economic downswings followed by corresponding rebounds. Therefore, we expect that our estimated effects will be highly dependent on the short-term responses to *relatively* minor crises, and are thus likely to be biased toward zero. The relatively short period of observation means that random variation could be influential in inflating the variances of the estimates.

(a.2.) *Main variables and controls*

To evaluate levels of nuptiality we use the yearly reported number of legally sanctioned marriages. In some countries of Latin America where consensual unions are fairly prevalent, the reported number of legally married couples at any one time amounts to

[19] W. S. Cleveland, 'Robust locally weighted regression and smoothing scatterplots', *Journal of the American Statistical Association*, **74** (1979), pp. 829–836. The term 'bandwidth' refers to the fraction of the data used in fitting one observation and should not be confused with the term as it is applied in spectral decomposition analysis.

[20] See also Hill and Palloni, *loc. cit.* in fn. 2; Palloni and Hill, *loc. cit.* in fn. 2.

between 40 and 60 per cent of the total number of couples in a union, while the residual corresponds to consensual unions.[21] To the extent that decision-making rules about union formation are different in countries with different prevalence of consensual unions, our estimated responses will be biased. As we show below, however, there is no obvious relation between the estimated responses of nuptiality and the type of nuptiality regime.

Since the number of marriages can be affected by recent surges in adult mortality – principally through re-marriage – we experiment with a control for lagged detrended adult mortality. However, as the results are virtually the same as those for models without a control, we conclude that the impact of mortality on the frequency of marriages is trivial, and to simplify presentation of results we discuss only estimates from a model which does not control for lagged adult mortality.

To model natality we use the reported yearly numbers of births. To obtain estimates of the response of *marital fertility* we introduce a control for lagged number of detrended marriages: since economic downswings have important potential effects on both marriages and deaths, the estimated response of births while controlling for marriages is an approximation to the response of fertility *within* marriage. As in the case of marriages, we also estimated models which control for adult mortality, and concluded that its effects are wholly inconsequential.

In the analysis of mortality we use the infant mortality rate and the number of non-infant deaths. We also examine results obtained with a more detailed breakdown of deaths by age and cause, but we are able to do this only for the period after World War II. Infant mortality rates are used instead of the number of infant deaths to circumvent the problem generated by the fact that the absolute number of infant deaths in one year changes in response to changes in the number of births that occurred during the preceding year.

To the extent that completeness of reporting of vital events changes only gradually, the observed detrended series will represent a good approximation to reality. However, as recessions themselves may have non-negligible consequences on the smooth functioning of vital registration systems, it is likely that we will obtain lower-than-average completeness precisely during periods of economic hardship. Although the observed numbers of marriages, births, and non-infant deaths are more likely to be distorted than the observed infant mortality rate (since this indicator is affected by errors in both numerator and denominator), all our estimated elasticities may be biased. The size of these biases is expected to be less important in some countries with well established vital registration systems (Chile, Argentina, Uruguay, and Costa Rica) and in all countries during the most recent period (after 1955).

As an indicator of well-being we chose the average Gross Domestic Product (GDP) expressed in constant U.S. dollars of 1970. In pre-industrial societies annual fluctuations in grain prices were regarded as the most important determinant of real wages, and used as indicators of standards of living. The choice has not gone uncriticized, as even drastic fluctuations in food availability may not have been entirely reflected in their market price.[22] In contemporary Third World countries with fairly diversified economies, real wages and the prices of one or a combination of commodities are unlikely to be good indicators of standards of living. Diversified production and consumption render futile

[21] A. Palloni and S. DeVos, 'Changes in Families and Households in Latin America since 1950'. Paper presented at the meetings of the American Sociological Association (1992).

[22] Fogel, *loc. cit.* in fn. 11.

the attempt to single out a combination of staples whose price could be taken as a reliable indicator of budgetary pressure experienced by households. Real wages represent the experience of variable (and frequently reduced) segments of the labour force and, more often than not, fluctuations in real wages are heavily influenced by the strength and fortunes of working-class political organizations, but track poorly even sharp oscillations of economic performance. Although the choice of average GDP is by no means ideal, we believe it has some important advantages over other equally plausible choices, at least during the period following World War II.[23] In this paper, however, we simply had no choice: average GDP is the only indicator available to us from national accounts that reaches as far back as 1920.

In addition to controlling for the lagged number of adult deaths (in the equations for births and marriages) and for the lagged number of marriages (in the equation for births), we also model the effects of historical period. Period is measured as a dummy variable with a value of 1 for years 1955, and 0 otherwise. With this simple indicator we are trying to separate the years before and after the onset of what turned out to be a sustained period of economic growth following World War II that rested on far-reaching import substitution programmes.

(a.3.) *Remarks on the model*

The model that we estimate has two weaknesses. First, as most others of its kind, it is based on the simplifying assumption that the demographic structure which reflects the past trajectory of marriages, births, and deaths does not affect the economy, and that the latter only experiences truly exogenous changes. Although this may not be entirely accurate as a representation of long-term trends, what is more relevant is that the bulk of the deviations from secular trends is attributable to exogenous forces, and this is likely to be a realistic assumption.

Secondly, we assume throughout that demographic responses are inherently symmetric in the following sense: the absolute value of the proportional change in demographic outcomes that is attributable to economic oscillations is identical, irrespective of whether the latter is positive or negative, above or below the expected trend. There are a number of ways of breaking away from this simple assumption but they all involve making the basic model more complex and therefore have not been pursued.

(*b*) *Data, data sources, and data quality*

For the analysis of nuptiality, natality, and infant and non-infant deaths we use the following countries and periods: Argentina (1910–89); Chile (1908–89); Colombia (1925–88); Costa Rica (1925–89); Guatemala (1930–89); Mexico (1921–89); Panama (1945–89); El Salvador (1925–89); Uruguay (1935–89) and Venezuela (1936–89). In addition, information for Cuba (1950–89) is included in some analyses of the post-World War II period. For the more detailed analysis of mortality by cause we were unable to use data for Argentina, Cuba, Colombia, and El Salvador, but added Trinidad and Tobago and Ecuador instead. The set of countries was chosen to represent the entire spectrum of demographic regimes in Latin America. The mortality and fertility transitions in Argentina and Uruguay began during the last two decades of the nineteenth century, whereas in Chile, Costa Rica, and Cuba they began later during the

[23] Palloni and Hill, *loc. cit.* in fn. 2.

second or third decade of the twentieth century, and are close to demographic regimes in Europe and North America. In the remaining five countries, but particularly in Guatemala and El Salvador, the mortality transition began rather late, and indications of an onset of fertility decline are weak. Colombia, Mexico, and Venezuela are in an intermediate situation, closer to the more modern Latin American countries, but do not fully share a modern demographic regime.

In addition to variability in demographic regimes we are interested in maximizing the variability in response to economic crises. On one hand Argentina, Chile, Costa Rica, and Cuba are the four countries most affected by the crisis of 1929, whereas Colombia, for example, experienced milder effects.[24] Similarly, the depth of the crisis of 1980 differed substantially in different countries. Frieden[25] has argued that in Argentina and Chile, the two countries where class conflict was rife in the wake of the crisis, the state intervened in a more decisive way with redistributive policies which favoured asset-holders and economic domestic sectors at the expense of well-established social programmes. By contrast, conditions in Mexico and, to a lesser extent in Venezuela, did not dictate such draconian interventions, and milder forms of structural adjustments were made. In these circumstances we expect stronger responses in the first two countries.

To construct annual series of births, marriages, and deaths (total and by age and cause) we used unadjusted vital statistics. As mentioned before, our analysis is based on *detrended values*, and is robust to errors of coverage as long as these represent a constant fraction of observed events during the interval of observation. The only potentially serious problems are episodic deficiencies caused by the crises themselves. Sudden drops in registration coverage will lead to overestimation of early responses for births and marriages, but to underestimation of the mortality response. We have performed limited checks to detect these defects and, as we discuss later, we have discovered some anomalies in a few countries.

The information on GDP for the post-war period is based entirely on national accounts as reported, collected, and adjusted by the Inter-American Development Bank. The estimates for the pre-World War II period were obtained by combining figures from the national accounts for each country, deflationary factors and multipliers to convert into constant dollars.[26]

(*c*) *Analysis of results*

Figure 1 shows plots of detrended average GDP, detrended numbers of births, marriages and infant mortality rates for Argentina and Chile, the countries with the longest and perhaps highest-quality time series. The imprints of the crisis of 1929, of the recessions that followed the outbreak of World War II, and of the last (and longest) recession that began after 1980 (the 'debt crisis') stand out. In addition to these three major recessions, there are other relatively minor ones (figures not shown). In the case of Chile, for example, a crisis of some significance occurred around the years 1973–78, right after the military coup that terminated Allende's government.

Results obtained with the most parsimonious models are shown in Table 1, which shows the estimated coefficients, the adjusted values of R^2, and the net effects (the sum of the coefficients for the five lags). To avoid cluttering the table we have not given

[24] Maddison, *op. cit.* in fn. 8.
[25] Frieden, *op. cit.* in fn. 8.
[26] A brief document that describes the sources and procedures used to obtain these figures is available from the authors on request.

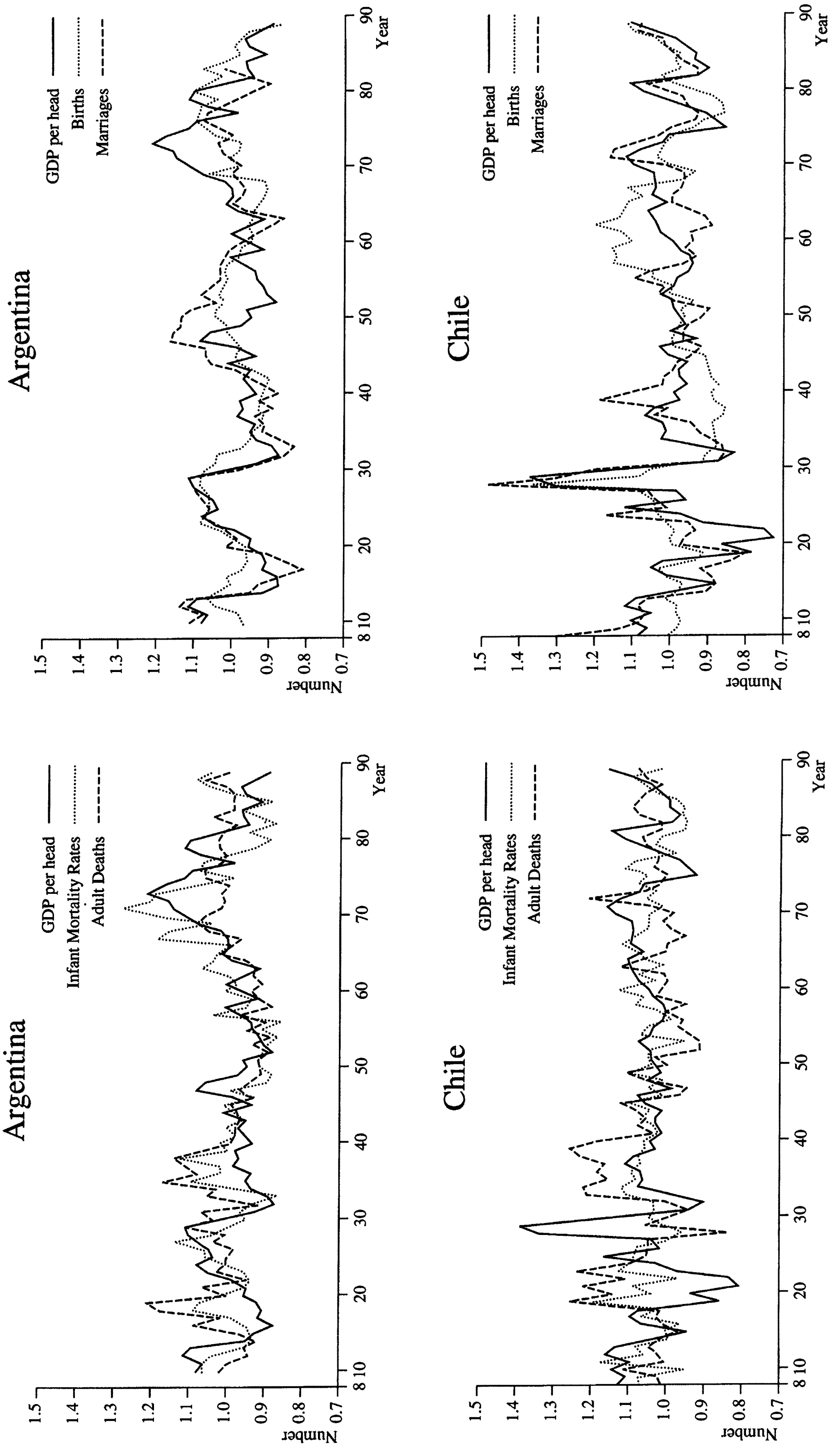

Figure 1. Plots of detrended average GDP, detrended numbers of births, marriages, and infant mortality rates for Argentina and Chile.

standard errors, but identify estimates that are significantly different from zero at various levels of significance but only when they are at least twice the size of their standard errors. The estimated coefficients are also represented in graphic form as box-plots in Figure 2.

(c.1.) *The response of marriages*

The estimated response of number of marriages at lag 0 is positive as expected in Argentina, Chile, Cuba, Costa Rica, El Salvador, Uruguay, and Venezuela. However, the associated coefficients differ significantly from zero only in Chile, Uruguay, and Venezuela. By and large, the pattern of responses by lag is as expected, and only Guatemala shows a truly anomalous, odd response pattern with negative (though statistically insignificant) coefficients for all lags. The net effects (sum of all coefficients) are positive in all cases, except Guatemala and Mexico, where the net response is close to zero.

Does the marriage response depend on the nature of the nuptiality and/or household formation regimes? Two arguments could be advanced. The first is that consensual unions are less vulnerable to the whims of the economy, as they involve considerably fewer longer-term commitments. In that case, we should find a substantially reduced response in countries with higher prevalence of consensual unions. But this cannot be verified directly since vital statistics only record the number of legal, not that of total unions. However, we would still expect a relation between prevalence of consensual unions and size of the marriage response if consensual unions are more common among the most vulnerable sub-groups of the population. If so, the sensitivity of legal marriages to economic cycles should be correspondingly lower.

The second argument rests on the nature of the relation between the nuptiality regime and that of household formation. In societies in which entry into marriage implies the creation of a new household, decisions about marriage anticipation or postponement should be correspondingly more sensitive to appraisal of economic horizons than in societies where couple formation is subordinate to pre-existing households. A simple test of this relation is to compare the size of responses in countries with varying prevalence of extended households. The test is far from ideal since, among other things, it relies on aggregate indices when the argument is about individual or couple decision-making.

Tables 2*a* and *b* display indices of prevalence of extended households, prevalence of consensual unions, and a set of rank-order correlation coefficients between these indices and the size of the net marriage response (sum of all lagged coefficients) and the sum of the response at lag 0 and lag 1 only. The rank-order correlation coefficients indicate that although the associations are in the right direction, their size is too low to place any confidence on inferences drawn from them.

(c.2.) *The response of marital fertility*

There is considerably greater heterogeneity in the patterns of responses of births. Our previous discussion leads us to expect positive effects at lags 0 or 1, whereas lags of higher order may show negative responses as postponed births are made up. Of the 22 estimated effects, only ten are in the expected direction. In five of the 11 countries the coefficients for lags 0 and 1 are positive but in only one of them (Cuba, lag 1) does it differ significantly from zero. In as many as six countries (Chile, El Salvador, Mexico, Panama, Uruguay, and Venezuela), the coefficients corresponding to lag 1 have the wrong sign. Positive responses at lag 0 are present in seven of the 11 countries, and these would be expected only if the possibility of anticipatory behaviour, expressed as reduced

Table 1. *Estimated effects (elasticities) on lag on births (B), marriages (M), non-infant deaths (NID), and infant mortality rate (IMR)*

Lag	B	M	NID	IMR		B	M	NID	IMR
Argentina ($n = 80$)					Chile ($n = 82$)				
0	0.13	0.42	0.15	0.25		0.12	0.60***	−0.16	−0.11*
1	0.03	−0.01	−0.04	−0.01		−0.09	0.03	−0.04	0.09
2	0.10**	0.10	−0.09	−0.04		−0.04	−0.02	−0.04	−0.16***
3	0.01	0.10	−0.01	−0.03		0.18**	0.06	−0.14	0.17***
4	0.03	−0.08	−0.01	−0.03		−0.13	0.02	−0.01	−0.11***
R^2 adj	0.18	0.13	−0.02	0.22		0.08	0.44	0.03	0.10
Net	0.30	0.53	0.00	0.14		0.04	0.67	−0.39	−0.12
Colombia ($n = 66$)					Cuba ($n = 40$)				
0	−0.67	−0.20	−0.63*	0.51		0.27	0.51	0.10	0.25
1	0.18	0.13	−0.02	−0.80		0.45**	−0.55	−0.04	−0.01
2	0.43**	−0.07	−0.04	0.17		0.01	−0.02	−0.10	−0.04
3	0.16	0.04	0.00	−0.09		0.10	−0.09	−0.01	−0.03
4	−0.33*	0.10	−0.11	0.00		0.05	0.26	0.02	−0.03
R^2 adj	0.58	−0.02	0.07	−0.02		0.17	−0.11	−0.05	0.22
Net	−0.23	0.18	−0.80	−0.21		0.88	0.11	−0.03	0.29
Costa Rica ($n = 65$)					El Salvador ($n = 65$)				
0	−0.04	0.24	0.06	0.18		0.16	0.07	0.03	0.02
1	0.05	0.14	−0.34**	−0.42***		−0.07	0.22	−0.15	0.00
2	−0.07	0.09	−0.09	0.01		0.11	0.05	−0.16	−0.08
3	−0.06	−0.03	−0.05	−0.07		0.05	−0.00	−0.05	0.12
4	0.04	−0.04	0.00	0.03		0.04	−0.00	−0.04	0.02
R^2 adj	0.02	0.24	0.14	0.17		0.19	−0.06	0.08	−0.02
Net	−0.08	0.40	−0.42	−0.28		0.29	0.32	−0.36	0.08

numbers of conceptions or increased numbers of voluntary and spontaneous abortions, is accepted (see p. 107). The pattern of response in these countries is as anticipated and rebounds in the number of births occur at lags of order 2 or higher. In the cases of Mexico, Colombia, and Uruguay, a somewhat perverse pattern of response prevails in which the echo outplays the initial effect, so that the *net* effect is negative.

Since the results shown in Table 1 belong to a model with a control for lagged marriages, it is of some importance to compare them with results obtained from a model without controls. With two exceptions, Argentina and Chile, comparison of the estimates in Table 1 with those obtained from a model *without* control for lagged marriages yields virtually identical results. In Argentina and Chile, however, the introduction of a control for lagged marriages reduces the absolute magnitude of the estimated response of births at lag 0 to the point where the estimated coefficients cease to be statistically significant. In all likelihood the relative invariance of the original birth elasticities to control for marriages is due to the rather muted marriage response that we documented above.[27]

[27] The statistical significance of the positive birth response at lag 0 for Argentina and Chile in a model without control for lagged marriages is puzzling. This pattern is to be expected when there is widespread anticipatory behaviour through which couples avoid pregnancy, sometime before the first signs of a recession are observable (with a symmetric response in the case of an economic boom), a somewhat unlikely occurrence. The fact that the response is attenuated after controlling for lagged marriages suggests that this may be the result of pre-marital conceptions that, in normal times, would lead to a marital union. Alternatively, it could be argued that the pattern is obtained as a result of oscillations in the quality of birth registration triggered by economic fluctuations. But, although not far-fetched, this is an unlikely explanation for these are countries in which vital statistics are most solid and depend on well-established bureaucratic practices. The argument of anticipatory behaviour and possible increases in (voluntary and spontaneous) abortions is more plausible, but we have no way of proving it. And even if we did, how can one account for the fact that such anticipatory behaviour only occurs in two of the eleven countries surveyed here?

Table 1 (*cont.*)

Lag	B	M	NID	IMR	B	M	NID	IMR
Guatemala (n = 60)					Mexico (n = 69)			
0	0.19	−0.13	0.10	0.21	−0.04	−0.08	−0.12	0.28
1	0.01	−0.10	−0.10	−0.14	−0.10	0.05	−0.04	−0.03
2	−0.01	−0.09	−0.06	0.05	−0.03	−0.06	−0.02	0.01
3	−0.03	−0.04	0.02	0.10	−0.04	0.03	0.06	0.04
4	−0.05	−0.08	0.01	−0.05	0.16	0.05	0.04	−0.11
R^2 adj	0.33	0.11	−0.05	0.03	0.20	−0.06	0.01	−0.01
Net	0.21	−0.44	−0.03	0.17	0.05	−0.01	−0.08	0.31
Panama (n = 45)					Uruguay (n = 55)			
0	0.10	−0.11	−0.02	0.56*	0.01	0.50***	0.02	−0.61**
1	−0.09	0.46	−0.03	−0.13	−0.17	−0.21***	−0.15	−0.09
2	−0.03	0.04	0.04	0.12	−0.02	−0.07	0.06	0.05
3	−0.13**	0.01	−0.17**	−0.12	−0.18	−0.02	0.01	0.01
4	−0.12**	0.12	−0.07	0.08	0.01	−0.05	−0.08	−0.19
R^2 adj	0.20	0.12	0.08	0.11	−0.13	0.05	0.09	0.10
Net	−0.27	0.52	−0.21	−0.61	−0.35	0.15	−0.14	−0.33
Venezuela (n = 54)								
0	−0.07	0.31*	−0.13	0.28				
1	−0.02	0.31***	−0.01	0.01				
2	0.09	0.09	−0.03	0.05				
3	0.09	0.14***	0.03	−0.02				
4	0.03	0.05	−0.14***	−0.05				
R^2 adj	0.21	0.33	0.01	−0.04				
Net	0.12	0.09	−0.28	0.27				

The model for births (B) includes controls for lagged marriages at lags t, $t-1$, ... $t-4$.
* *Signifies* $2.00 < |t| < 2.20$, ** Signifies $2.20 \leqslant |t| < 2.50$, *** Signifies $|t| \geqslant 2.50$.

As in the case of marriages, high prevalence of extended family arrangements is likely to spread the costs of childbearing among several members of a family. If so, we expect the birth response to decrease as the prevalence of extended or complex households increases. Again, the figures Table 2*a* and the rank-order correlation coefficients relating to births do, indeed, support at least the direction of the association.

(c.3.) *Infant and non-infant mortality*

For the most part, the effects on non-infant mortality have the expected sign and follow the expected wave-like pattern, but the estimated responses at earlier lags (0, 1, and 2) are statistically significant only in Costa Rica and Uruguay. In general the effects are minor and the net responses are always negative (or zero in the case of Argentina). The effects on infant mortality are stronger and statistically significant in Chile, Costa Rica, Panama, and Uruguay. We will defer discussion of these findings to the last section of this paper.

(c.4.) *Variability of responses over time*

Do the effects of fluctuations in standards of living vary over time? The sensitivity of demographic outcomes to economic fluctuations could change as a result of two very different processes. First, the nature of the mechanisms that link demographic responses to economic changes may change. If not central, this is at least an important issue in theories of the mortality and fertility transition. As a more modern demographic regime is established, mortality levels and patterns should become more dissociated from short-

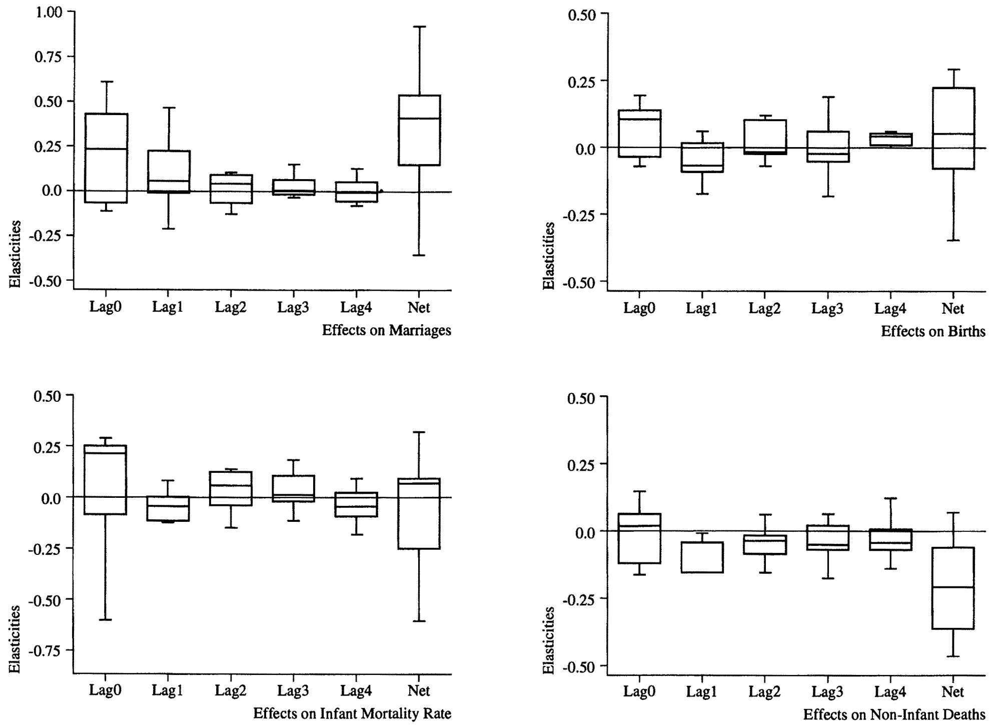

Figure 2. Box plots of proportionate effects of GDP on marriages, births, non-infant deaths (NI deaths) and infant morbidity rates (IMR).

run fluctuations in standards of living. At the very least, this had been one of the discernible characteristics of the passage from high to low mortality regimes in more developed countries.[28] The evolution of the linkage between measures of economic output and births and marriages is less straightforward since, even in modern demographic regimes, the numbers of births, though not always those of marriages, do fluctuate as prosperity gives way to recession. However, in societies with fairly high levels of marital fertility such as those in Latin America before 1940, we are likely to find only modest responses in marital fertility. During more recent periods, propelled by the advent and diffusion of voluntary fertility control, marital fertility may tend to respond more closely to cycles of economic contraction and expansion than during the past. There is little theoretical or empirical work which can be used to predict the evolution of the linkage between marriages and aggregate economic performance. We could expect, however, that in societies in which there has been a transition from high to low prevalence of extended household arrangements, the marriage response should become sharper (see discussion above). Regrettably, we have little empirical evidence to discern changes of this type with any accuracy.

The second process that may yield time-varying effects is the changing intensity and duration of crises. Economic downturns (or upturns) before, say, 1955 may have been more (less) intense and longer (shorter) than those that have occurred more recently. If so, one would expect that the responses of births, marriages, and mortality would be much stronger (weaker) before 1955 than after.

[28] M. W. Flinn, 'The stabilization of mortality in pre-industrial Western Europe', *Journal of European Economic History*, 3 (1974), pp. 285–318. A. Mercer, *Disease, Mortality and Population in Transition* (New York: Leicester University Press, 1990).

Table 2*a*. *Relation between nuptiality regime and household complexity and the marriage and birth response*

Country	Proportion of complex households (*c*. 1980) (CH)	Proportion of consensual unions (*c*. 1980) (CU)	Responses: Marriage: Net Nm	Marriage: Sum lags 0 and 1 Sm	Births: Net Nb	Births: Sum lags 0 and 1 Sb
Argentina	0.24	0.12	0.53	0.41	0.30	0.16
Chile	0.23	0.05	0.67	0.63	0.04	0.03
Colombia	0.30	0.29	0.18	0.11	−0.23	−0.49
Costa Rica	0.22	0.18	0.40	0.38	−0.08	0.01
Cuba	—	0.35	0.11	−0.04	0.88	0.72
El Salvador	—	0.58	0.32	0.29	0.29	0.09
Guatemala	—	0.45	−0.44	−0.23	0.21	0.20
Mexico	0.24	0.14	−0.01	−0.03	0.05	−0.14
Panama	0.31	0.47	0.52	0.35	−0.27	0.01
Uruguay	0.18	0.08	0.15	0.39	−0.35	−0.16
Venezuela	—	0.33	0.90	0.62	0.12	−0.09

Sources: Estimates of CH and CU from Palloni and DeVos (1992).

Table 2*b*. *Summary of rank-order correlations*

Association between	Rank correlation coefficient (Kendall's τ)
CH and Nm	0.17
CH and Sm	−0.32
CH and Nb	0.10
CH and Sb	0.05
CU and Nm	−0.09
CU and Sm	−0.54*
CU and Nb	−0.33
CU and Sb	−0.20

* Significant at $p < 0.05$.
Sources: Estimates of CH and CU from Palloni and DeVos (1992); Nm, Nb, Sm and Sb from Table 2*a*.

We first test for the existence of response changes by using a model designed to identify shifts in the structure of responses for all four demographic outcomes. The model relies on two simplifying assumptions. First we argue that the demographic and economic changes that occurred after the period 1945–60 have altered the regime of demographic responses in the sense that the articulation of demographic outcomes and economic indicators is either reinforced or weakened. In the absence of a better gauge we chose 1955 as the year of the turnaround.[29] Secondly and more importantly, we assume that the increase (decrease) in the response of one period relative to the other is *constant across lags*, that is, that it remains the same regardless of whether the effect is an initial effect or simply an echo. To implement this model we assume that the responses before 1955 were equal to the responses after 1955, plus a constant. Equation (1) then becomes:

$$Y_t = \alpha + \boldsymbol{\beta}\mathbf{X} + \delta A \times W + \varepsilon_t, \qquad (2)$$

[29] As suggested before, the period 1950–60 turns out to be one of economic turnaround with massive implementation of economic policies targeted to import substitution, and with important advances in social programmes.

where α, $\boldsymbol{\beta}$ and $\mathbf{X}$ are as before, δ is the difference between the level of response before and after 1955, W is a dummy variable equal to 1 if t is less than 1955, and A is the sum of the five lagged terms of GDP.[30] When the coefficient for the interaction term (the estimate of δ) is positive, the responses of outcomes with positive signs in the first few lags (births and marriages) will be larger before 1955, but the corresponding echoes will be lower. The opposite applies to the mortality outcomes. Expectations about what we should observe in the data depend on which mechanism that links demographic responses to economic indicators actually applies.

First, it could well be that changes over time are dominated by a change in the articulation between responses and economic well-being. If, as we argued before, the 'modernization' of the demographic regimes facilitates a stronger link between marital births and standards of living, we would expect the coefficient of the interaction term to be negative for births – suggesting a stronger response during the most recent period. On the other hand, since transformations in public health and economic growth should have led to a weakening of the links between economic indicators and the mortality response, we expect the interaction effect to be negative – which implies that responses in the past were larger than current ones. The expectation for marriages is less clear-cut, since there is little reason to believe that nuptiality regimes would respond any differently today from the way they did 40 years ago, except in cases identified above, where there is an association with the regime of household formation.

This argument, however, may not hold if time-variance of responses is the result of the second mechanism described before, namely one that operates through sheer differences in the intensity (and/or duration) of crises. In this case expectations would be different but they should depend on the relative sizes and durations of crises. During periods of more intense and longer-lasting crises, marriages, births, and deaths should respond more sharply. This means that the interaction effects must be positive for births and marriages, but negative for mortality if crises before 1955 were, indeed, more intense and/or protracted.

The results obtained from this model (not shown) were largely inconclusive since in only a handful of cases (5 out of 40, excluding Cuba, for which no data were available before 1950) were the estimated effects of the interaction term statistically significant. In addition, these estimates followed no clearly interpretable pattern by countries or by demographic outcome, and thus did not furnish sufficient evidence to support the conjectures about structural shifts. One possible explanation for the lack of patterned responses over time is that structural shifts do occur, but do not translate into sudden changes that occur around the same turning point in all countries described above. Instead, they may occur gradually and/or with turning points that vary in different countries. If this were the case, the dummy variable defined for Model 3 (below) would be mis-specified for several countries. An alternative explanation is that the first mechanism described above did not operate and that, simultaneously, there was no great difference in the intensity and duration of crises experienced before and after 1955.[31]

[30] These arguments imply structural shifts of the response curve. Thus the appropriate model is one in which the effects are all simultaneously displaced. There are alternative (less restricted) ways of testing for the existence of structural shifts. See Palloni and Hill, *loc. cit.* in fn. 2.

[31] Is there any evidence that the intensity (duration) of the crises before and after 1955 differs systematically in all countries? if this were not the case, the second mechanism conjectured above could not operate. As a consequence, any structural shifts would be solely the outcome of different articulation between demographic outcomes and fluctuations in economic well-being. If so, mis-identification of the year of the turnaround would lead to inconclusive results.

Arguably Model (2) contains an important weakness since it assumes that the amount of change in the main effect is the same as in the echo. Indeed, Model (2) is constrained so that a constant shift, δ, applies across all lags. But this is unnecessarily restrictive since it is possible that the time-effects on the main response may be more significant than those on the echoes. Model (3) is a generalized version of Model (2) where the effects of time are free to vary across lags:

$$y_t = \alpha + \boldsymbol{\beta}\mathbf{X} + \boldsymbol{\mu}(\mathbf{X} \times A) + \varepsilon_t, \tag{3}$$

where y_t, $\mathbf{X}$, A, α, $\boldsymbol{\beta}$ and ε_t are as defined previously and $\boldsymbol{\mu}$ is a vector of coefficients δ_{t-j}, ($j = 0, 1, \ldots 4$), which represents the shift in each of the lag-specific responses. Unlike Model (2), in Model (3) all lag-specific responses are allowed to change freely. The results we obtain with this model (not shown) for the main effects and corresponding interaction terms for the first two lags for each of the outcomes reveal very little that is new relative to the simpler Model (2). Indeed, conventional statistical tests indicate that the loss of explanatory power incurred when we constrain the time effects to be constant across lags is statistically insignificant. Thus, Model (2) is a better representation of the data than Model (3), but reveals no evidence supporting the idea of structural shifts.

To assess the intensity of crises before and after 1955 we use the lowest ratio of observed to predicted GDP in each period. To measure the duration, we calculate the number of years elapsed between the year in which the minimum ratio is reached and the year when the ratios return to a normal trend (ratio of 1.0). This is a very rough instrument for a delicate task, and in all likelihood requires the careful weighting of historical records on a case-by-case basis. The results we obtain are suggestive, however, for in all cases they confirm the notion that the intensity of crises before 1955 was equal to or higher than that of post-1955 crises, even though their duration may have been shorter. With only three exceptions (for which our series only starts after 1976) the identifying crises corresponds to the Great Depression. The results of this exercise are as follow:

	Indices of intensity (duration in years)	
Country	Pre-1955	Post-1955
Argentina	0.87 (12)	0.89 (> 1)
Chile	0.87 (5)	0.85 (4)
Colombia	0.97 (2)	0.93 (5)
Costa Rica	0.84 (13)	0.092 (> 3)
Cuba	na.	n.a.
El Salvador	0.73 (10)	0.89 (> 7)
Guatemala	0.77 (8)	0.93 (> 6)
Mexico	0.77 (8)	0.96 (> 3)
Panama	0.90 (10)	0.84 (> 3)
Uruguay	0.84 (3)	0.91 (> 3)
Venezuela	0.80 (5)	0.87 (> 3)

With all the qualifications that apply, it is interesting to note that these figures coincide with Maddison's appraisal in 1985 which suggested that (*a*) Colombia experienced mild aftershocks from the Great Depression and the 'debt crisis'; (*b*) Argentina, Chile, and Mexico experienced worst-case scenarios during the Great Depression; (*c*) Mexico experienced only a 'mild' debt-crisis. In contrast, the figures for Venezuela are inconsistent with Frieden's evaluation in 1991 of Venezuela's debt crisis as less acute than that in Argentina and Chile.

It should be noted that the series for Panama, Uruguay, and Venezuela start after 1935, and hence do not include the effects of the Great Depression. Also, whenever the duration could not be calculated (the index does not return to a value of 1.00 before the series ends) we show the total number of years preceded by the '>' symbol to indicate that the duration will be at least as long as the number of years estimated from the data.

(c.5.) *Many countries, but only one process: a pooled sample*

The model estimated previously is not parsimonious enough, since it is based on the assumption of maximum inter-country heterogeneity of responses.[32] It could be argued that there is only trivial inter-country variability in responses, and that, as a consequence, the proper model is one that constrains all effects to be the same in all countries. An alternative argument is that countries are clustered into groups, for example, depending on levels of economic or institutional development, that exhibit different patterns of responses. Although we have the tools to test the first conjecture, testing the second one is far more complex since it requires us to have an *a prior* criterion for grouping the different countries. Although one could venture guesses, the proper way of proceeding would be to identify the criteria by an in-depth study of cases, a task that is far beyond the scope of this paper.

To assess the appropriateness of the constraints required to reduce one model for each country into one for all countries, we rely on *F*-tests that determine whether the addition

Table 3. *Results with a pooled sample of ten countries (excluding Cuba)*[a]

	Births		Marriages	
Lag	(1)	(2)	(3)	(4)
0	0.13 (0.03)	0.13 (0.03)**	0.34 (0.07)**	0.34 (0.07)**
1	−0.05 (0.02)	−0.05 (0.02)	−0.04 (0.03)	−0.04 (0.03)
2	0.01 (0.02)	0.01 (0.02)	−0.05 (0.03)	−0.05 (0.03)
3	0.01 (0.03)	0.02 (0.02)	−0.02 (0.03)	−0.02 (0.03)
4	0.01 (0.01)	0.01 (0.02)	−0.04 (0.03)	−0.04 (0.04)
Inter	—	−0.01 (0.002)**	—	−0.005 (0.004)
R^2 adj	0.10	0.18	0.06	0.06
Net	0.11	0.12	0.19	0.19
	Infant mortality rate		**Non-infant deaths**	
Lag	(5)	(6)	(7)	(8)
0	−0.10 (0.04)**	−0.10 (0.04)**	−0.02 (0.01)*	−0.03 (0.01)**
1	0.00 (0.02)	0.00 (0.02)	−0.01 (0.02)	−0.01 (0.02)
2	−0.01 (0.02)	−0.01 (0.02)	−0.01 (0.02)	−0.01 (0.02)
3	−0.01 (0.02)	−0.01 (0.02)	−0.06 (0.02)**	−0.06 (0.02)**
4	−0.00 (0.03)	−0.00 (0.02)	−0.03 (0.02)	−0.03 (0.02)
Inter	—	−0.003 (0.002)	—	−0.00 (0.002)
R^2 adj	0.03	0.04	0.00	0.00
Net	−0.12	−0.12	−0.01	−0.02

[a] The second model for each outcome corresponds to Model (2) in the text.
* Significant at $P < 0.025$; ** significant at $P < 0.01$.

of a constraint of one response being equal across countries significantly reduces the fit of the model. The first column which corresponds to each demographic outcome in Table 3 displays the estimates that are found after pooling together all countries except Cuba.[33] The second column corresponding to each outcome shows estimates associated

[32] This is, however, the kind of model that has been conventionally estimated in the study of demographic responses in Western Europe, Galloway, *loc. cit.* in fn. 1.
[33] We exclude Cuba, since its time series goes back only to 1950.

with Model 2 (with an interaction term to detect shifts over time) obtained from the pooled sample. A set of four *F*-tests indicates that, regardless of outcome, the unconstrained models (all countries with different responses) do not add significantly to the explanatory power of constrained models, in which all countries are assumed to have the same pattern of response.[34]

The patterns observed in the first column of each panel of Table 3 are more regular and in better agreement with the expectations stated at the outset of the paper. The initial response of marriages (first lag) is very strong, correctly signed, and statistically significant. The corresponding echo (a negative reaction) is protracted and dominates all other lags. The natality response at lag 0 is fairly strong and drifts toward zero at higher lags after becoming negative at lag 1.[35] The effects on infant and non-infant mortality are also statistically significant but their absolute size is about one-third that of the effects on marriages and births.

When applied to the pooled sample, the simple test for structural shifts in the relations between outcomes and the indicator of economic well-being (Model (2)) leads to more easily interpretable results than when applied on a country-by-country basis. The results shown in the second column of the panel associated with each outcome of Table 3 correspond to the estimated coefficients for Model (2). The last variable in this column ('inter') corresponds to the interaction term. As was pointed out before, if the estimated effect associated with this variable is positive, effects after 1955 are stronger for mortality and weaker for births and marriages. The estimates suggest that before 1955 the responses of births and marriages are lower, but those of mortality are higher. Here, as in the previous case, the sizes of the shifts (as gauged by the size of the estimated coefficient for the interaction term) are quite low, and only in the case of births do they differ significantly from zero. Estimation of the more complex model in the pooled sample (Model (3)) (results not shown) does not introduce important novelties, although it reinforces the impression that the time-variance of responses is minor, and that it particularly affects births and infant mortality rates.

[34] The basic inputs for the tests on each of the outcomes are presented below. The figures are the sums of squares accounted for by the unconstrained country-specific parameters and the overall sum of squared residuals in the unconstrained model. The unconstrained country-specific parameters are 50 (five interaction terms to retrieve the lagged effects for each of ten countries; the eleventh country operates as a baseline). There is a total of 680 observations, and hence the number of degrees of freedom associated with the residual sums of squares equals 624 (the number of observations minus 56 free parameters). Thus, in each case the *F*-test requires 50 degrees of freedom in the numerator and 624 degrees of freedom in the denominator.

	Outcomes			
Deaths	Births	Marriages	Infant mortality rate	Non-infant
Added sums of squares	1.65	2.01	1.36	1.16
Residual sums of squares	3.22	12.93	4.70	4.40
F-value	0.36	0.16	0.29	0.26

Note that the critical *F*-value with $P = 0.05$ and the stated degree of freedom is 1.36 and with $P = 0.01$ is 1.55.

[35] As is the case in the country-by-country analysis, the results displayed in Table 3 for births include a control for lagged marriages. However, the model without this control produces results that are almost identical.

To summarize: these results suggest that the lag-specific pattern of response of marriages is as expected from theoretical considerations, that the response of births is strong but occurs unexpectedly at lag 0 rather than lag 1, and, finally, that the responses of mortality agree with expectations. The analysis further suggests that there are very weak indications of shifts over time of responses and that these appear to operate in the direction of strengthening the mortality response and weakening that of marital fertility.

(c.6.) *Are the net responses sizeable?*

Previous studies have emphasized an important operational aspect of the distributed lag models used throughout this paper. This is that the sum of the lag-specific effects is an estimate of the net effects of an initial economic change. For example, if the sum of the coefficients for births is 0.30, as in Argentina, one would expect that five years after an initial shock of, say, a drop of 10 per cent in average GDP, we shall observe an overall deficit of births (relative to normal periods) of about 3.9 per cent. Is this 'net' impact relevant? This is a rather complex problem that involves two separate aspects. The first has to do with whether or not such net effect is statistically significant. The second is whether or not it is of any demographic significance. We consider these two topics in turn.

The issue of statistical significance is not straightforward and needs to be stated precisely: we want to know whether the sum of a set of random variables – the estimated lag-specific effects – is close to zero.[36] To test for this, we estimate a model in which the sum of the coefficients is constrained to be zero, and perform an F-test to assess the statistical significance of the increase in explained variance accounted for by the elimination of the constraint. If the constraint entails a significant reduction of the explained variance, then the net effect of the lag-specific responses must be statistically different from zero. Table 4 contains the main results of the test and displays them in the

Table 4. *Critical probability values for testing the restriction that net responses are equal to zero*

	Outcome			
Sample	Births	Adult deaths	IMR	Marriages
Pooled	0.017**	0.080	0.773	0.026**
Argentina	0.034	0.891	0.542	0.214
Chile	0.813	0.078	0.152	0.001***
Colombia	0.483	0.036*	0.388	0.821
Costa Rica	0.316	0.014**	0.001***	0.052
Guatemala	0.060	0.882	0.499	0.303
El Salvador	0.037*	0.167	0.505	0.378
Mexico	0.798	0.715	0.542	0.961
Panama	0.107	0.439	0.123	0.207
Uruguay	0.219	0.083	0.028**	0.331
Venezuela	0.536	0.216	0.427	0.0002

Note: The values in the table correspond to the critical probability value for the observed value of the F-statistic with the appropriate degrees of freedom.
* Significant at $P < 0.10$; ** significant at $P < 0.05$; *** significant at $P < 0.001$.

[36] It is important to understand that this is *not* equivalent to testing for the statistical significance of the variance added by the five-lagged term: we are not interested in knowing whether constraining the coefficients to be zero is improved upon by an unconstrained model, but on whether or not the sum of the unconstrained effects is zero.

form of critical probability values. In the pooled sample, only the net effects of marriages and births are statistically significantly different from zero.[37] The net effects on non-infant deaths are significant only with fairly liberal criteria, and those for infant mortality not at all. The country-by-country results add very little to these patterns except to suggest that the net effects of infant mortality are negative and significantly different from zero in two countries, Costa Rica and Uruguay.[38]

The question of demographic importance is more difficult to evaluate. To simplify the problem we start with the assumption that only marriages and marital fertility show a net response different from zero. It can be shown that the proportionate deficit (excess) of births and marriages caused by economic oscillations during the interval (t_1, t_2) is given by:

$$\pi = \theta \times \delta_1 + \varphi \times \lambda \times \delta_2 \tag{4}$$

where θ and φ are the net effects on births and marriages respectively, λ is the fraction of all births due to a marriage that is lost (gained) by marriage postponement (anticipation) during the effective *arch* of a minimum duration crisis (in this study assumed to be five years from the onset, until the last echo is felt) and, finally, where δ_1 and δ_2 are the weighted averages of the deviations of average GDP from a secular trend, and the weights are the proportional distribution of counterfactual births during the period of the study.[39] The derivation of the expression neglects variances of random quantities, and overlooks age and time dependencies.

[37] We know from results for the pooled sample in Table 1 that the net effects on marriage and births are positive, whereas those on mortality are negative.

[38] It should be understood that the fact that the net effects are zero or close to zero does not mean that there is no demographic response to aggregate economic changes, but that the possibly important initial response is swamped by echoes that move the demographic outcomes in the opposite direction, so that the estimated net effect of the crisis (upturn) is small relative to its standard deviation.

[39] The derivation is fairly simple. The deficit (excess) of births (within marriage) and marriages due to a downturn (upturn) in GDP per head are given by:

$$\mathrm{B} = \theta \times \int_{t_1}^{t_2} (\delta(t)\,\mathrm{B}(t)\,dt)$$

for births and

$$\mathrm{M} = \varphi \times \int_{t_1}^{t_2} (\delta(t)\,\mathrm{M}(t)\,dt)$$

for marriages. Note that $\delta(t)$ is the proportionate increase (decrease) in GDP over the normal trend at time t. Although this is a genuine discrete quantity, we have assumed continuity to avoid clustering. $\mathrm{B}(t)$ and $\mathrm{M}(t)$ are the counterfactual births within marriage and marriage trajectories, e.g. those that would have occurred in the absence of any oscillations, and θ and φ are the net effects on births and marriages respectively, e.g. the sum of the effects across all five lags. The estimator of excess of births, however, only captures the immediate impact on births within marriages. To assess the overall impact we need to translate the decrease (increase) in marriages into deficit (excess) births. This, in turn, requires us to estimate the ultimate number of births per marriage, σ, and the fraction that is lost (gained) when marriages are postponed (anticipated), λ. Then the absolute deficit, (excess) of births is given by:

$$\mathrm{B}' = \mathrm{B} + \lambda \times \sigma \times \mathrm{M}.$$

We now multiply and divide B by the total number of counterfactual births during the period, b, and the second part of the expression by the total number of counterfactual marriages, m. This yields

$$\mathrm{B}' = \mathrm{b} \times \theta \times \delta_1 + \mathrm{m} \times \sigma \times \lambda \times \varphi \times \delta_2.$$

Since $\mathrm{m} \times \sigma$ must equal b, the proportionate deficit (excess) of births due to economic fluctuations is given by

$$(\mathrm{B}'/\mathrm{b}) = \theta \times \delta_1 + \varphi \times \lambda \times \delta_2.$$

To illustrate the implications of the expression derived before, we first chose the net effects on births and marriages, θ and φ respectively, from the pooled sample. We then calculated the values of δ_1 and δ_2 for each country in our sample and for two periods, before and after 1955. A period of crisis leads to lower values for these two parameters. But the relative magnitude of these parameters also depends on the timing of the crisis: when births (or marriages) are on an increasing (decreasing) trend, a crisis will have a larger effect if it occurs later (earlier) during the period. Of course, the opposite occurs when instead of a crisis there is an economic upturn. Finally, we need to assign alternative values to λ, the fraction of all births within marriage that are postponed due to the crisis. We assumed that in societies in which Total Fertility is within the range 5.00–6.00, λ could vary between 0.02 and 0.20 representing, respectively, a loss (gain) of 0.1 child and 1.0 child within the span of a minimum duration crisis. Consider a period of about 100 years during which each downturn (upturn) evolves from beginning to end over a maximum span of five years and, on average, represents average drops in GDP of about 15 per cent. This regime will produce a deficit of births close to five per cent in the worst-case scenario, and about 2.0 per cent in the most optimistic. By contrast, if the crises during the period are less severe (or the upturns less significant) so that average declines in GDP are about five per cent, the deficit in births will fluctuate between 0.7 and 1.6 per cent. Though not trivial, these are not dramatic figures since over, say, a century, they imply only correspondingly minor reductions in the rate of natural increase. But they are even less significant considering the fact that average losses of up to 15 per cent of GDP (relative to a century-long trend) are a fairly extreme assumption.

(*d*) *Comparison with other results*

How do our results look when compared with those obtained during the pre-industrial period and elsewhere in the developing world? In Table 5 (Panel 1) the lag-specific

Table 5. *Comparison of estimated effects by lag and net effects in different samples and contexts*

Demographic outcome	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Net
Panel 1. Pooled sample of 11 Latin American countries (1925–90)						
Births	0.16	0.01	0.00	0.01	−0.01	0.15
Marriages	0.34	−0.04	−0.05	−0.02	−0.04	0.19
Infant mortality rates	−0.10	0.00	−0.01	0.01	0.00	−0.10
Non-infant deaths	−0.02	−0.01	−0.01	0.06	−0.03	−0.01
Panel 2. Pooled results from less developed countries						
Births	0.01	0.19	−0.13	0.09	0.05	0.06
Marriages	—	—	—	—	—	—
Deaths (adult and infant deaths)	−0.60	0.25	0.20	0.10	0.01	−0.04
Panel 3. Medians of 14 European populations						
Births	0.05	0.11	−0.03	0.01	0.00	0.14
Marriages	0.13	0.04	−0.02	−0.02	−0.01	0.13
Non-infant deaths	−0.10	−0.19	−0.09	0.01	0.01	−0.36
Infant mortality	—	—	—	—	—	—

Sources: (*a*) Panel 1. From Table 1; (*b*) Panel 2. From R. Lee *loc. cit.* in fn. 4; (*c*) Panel 3. From P. Galloway *loc. cit.* in fn 1.

coefficients (elasticities) and the corresponding net elasticities from our pooled sample of eleven Latin American countries are shown. It contrasts them with the results from the combined analysis of two sub-periods for Japan, colonial Mexico, pre-industrial Taiwan, and Bombay[40] (Panel 2) and with the *median* estimates of the responses in 14 European countries before the demographic transition (Panel 3).[41] First, note that the *net* responses of births and marriages are remarkably similar in the pooled samples of Latin America and the median of pre-industrial Europe. The similarity of net response for marriages is particularly striking in view of the fact that Latin America is not known to be an area where constraints on the nuptiality regime were (or are) overly strict. Admittedly, however, the lag-specific patterns of responses are slightly different and, in particular, the estimated effects on both births and marriages at lag 0 are much larger in Latin America. A similar conclusion follows from the comparison of the results for Latin America and the available estimates from other less developed countries: the response of births at lag 0 in Latin America is unusually strong.

The comparison of responses of mortality shows that, by and large, the net effects in Latin America are more muted than in pre-industrial Europe, and that the most important effects, i.e. those at earlier lags, are some orders of magnitude below those observed in other less developed countries.[42]

IV. THE EFFECT OF ECONOMIC WELL-BEING ON THE PATTERN OF MORTALITY BY AGE AND CAUSE

A more finely tuned analysis of the mortality response by age and cause of death requires that we neglect years before 1955. The advantage of estimating age-cause specific responses is that this may show relations between changes in standards of living and health conditions that are concealed when aggregated data are used. In this section we summarize the framework and results obtained elsewhere,[43] but also provide new estimates from a pooled sample of countries.

(*a*) *The effects of swings in economic well-being on mortality by age and cause of death: a summary of previous results*

The most startling result revealed by the examination of data by age and cause of death is that there is, indeed, considerable heterogeneity in the mortality response which remains concealed if only total numbers of deaths, or deaths in coarse age groups are used. Even though the ultimate impact of economic recessions on mortality is somewhat weak,[44] the patterns of response illustrate the mechanisms that transmit the shock of

[40] See R. Lee, *loc. cit.* in fn. 4.

[41] Galloway, *loc. cit.* in fn. 1.

[42] This observation should be qualified by evidence presented in Table 3 according to which infant mortality responses after 1955 may have increased relatively to those before 1955 (tough the estimated increase appears to have been minor and statistically insignificant). As we show in Table 6, estimation with a larger set of Latin American countries for the period 1955–85 reveals that the effects at lag 0 are -0.48 rather than -0.10 (Table 6), which suggests a much stronger response. Bearing in mind that a conventional test of significance is not suitable (the assumption of independence of samples is not satisfied), it is worth noting that this difference in responses is fairly large, a result that could be expected if there are important differences in responses during the periods before and after 1955.

[43] Palloni and Hill, *loc. cit.* in fn. 2.

[44] A similar conclusion was reached by Fogel regarding the impact of crises in pre-industrial Europe (Fogel, *op. cit.* in fn. 11).

oscillations in aggregate indicators of economic well-being to individuals' health. The models that we have estimated in our previous work are the least parsimonious, since they assume different responses in different countries. Yet, despite the inefficiency of the estimates, we were able to identify some important features. By and large, the mortality responses follow a profile by age and cause that is consistent with expectations. Thus, infectious diseases and, in particular, respiratory tuberculosis and diarrhoea are the most responsive to economic downturns. Infants and young children, as well as youngsters up to age 15 and the elderly, are the most strongly affected. We also found some interesting patterns that need further investigation. First, the evidence suggests that the response of mortality during the first year of life is inversely related to the median level of breastfeeding. Thus, in countries with less than universal and low median lengths of lactation, the responses to bad economic times are sharper. This supports the idea that vulnerability of the very young is maximized in societies where the traditional lactation patterns crumble under the onslaught of modernization.

Secondly, we found only weak evidence to suggest that the mortality response was different during the most recent ('debt') crisis than it had been between 1955 and 1975. Thirdly, there is circumstantial but not yet convincing evidence to support the idea that the level of response of mortality to economic recessions depends on the level of socio-economic development already achieved in specific countries.

(*b*) *New estimates of elasticities by age groups and causes of death*

To increase the efficiency of our estimates we have pooled the countries in the sample in which information on causes of deaths was available between 1955 and 1990, and re-estimated the most significant models.[45] In Table 6 we show the estimated effects by lags, and the net effects of GDP for selected causes of death and age groups in the pooled sample.[46] The results confirm the conclusions consistent with the country-by-country analysis,[47] but provide additional information. First, the sub-populations that are most affected by downturns are infants and young children, and the elderly. There is also a surprisingly strong reaction in the mortality of older children (aged between 5 and 14).

Secondly, the causes of death that are most sensitive to economic recessions are, as was speculated in the first section of this paper, diarrhoea, respiratory tuberculosis, and acute respiratory infections. The overall response of infectious diseases attains its highest levels among infants and children, whereas the overall response of respiratory tuberculosis attains its maximum among those aged 5–14 and 15–64. The strong response of respiratory tuberculosis may at first be a surprise, though it should not be, given the many historical examples that suggest that it is highly sensitive to changes in nutritional status and to sudden shifts in the distribution of population. It should be remembered, however, that throughout Latin America the actual levels of mortality from respiratory tuberculosis are fairly low, and that deaths attributed to that cause amount to less than five per cent of all deaths.[48]

[45] Here, too, we applied a battery of *F*-tests to assess whether or not pooling of countries was, indeed, the most efficient strategy. The results are more ambiguous than previous ones. Although in the majority of cases we were able to accept the null-hypothesis (of no difference between fully unconstrained and constrained models), there are some age-groups and causes of deaths for which the null hypothesis of homogeneity is rejected although, admittedly, only after adopting somewhat liberal significance levels.

[46] To save space lag 4 is implicitly included as the difference between the net effect and the sum of the effects in the first three lags.

[47] Palloni and Hill, *loc. cit.* in fn. 2.

[48] Palloni and Hill, *loc. cit.* in fn. 2.

Table 6. *Effects by lag for selected causes of death: pooled results for nine countries 1955–90*

Age group/ Lag	All	Infectious diseases	Respiratory diseases	Violence	Ill-defined causes	Respiratory tuberculosis	Diarrhoea
All ($n = 242$)							
0	−0.05	−0.45*	0.08	0.33	−0.23	−0.38	−0.37
1	−0.12	−0.65*	−0.74**	0.15	−0.50	−0.87*	−0.81*
2	0.06	−0.00	0.08	0.40	0.49	0.39	0.02
3	0.02	−0.14	−0.08	0.12	−0.06	−0.16	−0.08
Adj R^2	0.00	0.08	0.03	0.05	0.04	0.04	0.05
Sum	−0.13	−1.18	−0.69	0.70	−0.16	−1.21	−1.29
0 ($n = 249$)							
0	−0.11	−0.59**	−0.05	−0.46	−0.56	—	−0.55**
1	−0.34*	−0.63**	−0.83*	0.64	0.60	—	−0.63**
2	0.04	−0.09	0.05	−0.48	0.09	—	−0.08
3	−0.09	−0.56	−0.51**	−1.13	−1.95*	—	−0.40
Adj R^2	0.02	0.08	0.04	0.00	0.04	—	0.05
Sum	−0.48	−2.08	−1.27	−0.87	−1.49	—	−1.81
1–4 ($n = 242$)							
0	0.06	0.17	0.26	0.69	0.29	—	−0.30
1	−0.37**	−0.60	−0.89*	−0.57	−0.46	—	−0.77*
2	0.10	−0.00	0.62**	−0.09	0.62	—	0.32
3	−0.30	−0.69	−0.44	0.15	−0.38	—	−0.58**
Adj R^2	0.00	0.00	−0.1	−0.02	−0.01	—	0.02*
Sum	−0.25	−0.62	−0.31	0.36	−0.32	—	−1.31
5–14 ($n = 242$)							
0	−0.06	−0.10	−0.21	0.60	−0.05	1.02	0.80
1	−0.26	−0.91*	−0.66	−0.49	−0.16	−2.64**	−1.69**
2	0.10	0.56	0.82	−0.06	−0.09	1.16	0.59
3	−0.17	−0.80**	−0.47	−0.20	−0.27	0.91	−0.87
Adj R^2	0.01	0.04	0.00	0.01	−0.02	0.02	0.01
Sum	−0.40	−1.04	−0.40	0.37	−0.77	−2.14	−0.95
15–64 ($n = 242$)							
0	0.04	−0.24	0.15	0.23	−0.13	−0.31	−0.31
1	−0.08	−0.41**	−0.50**	0.07	−0.34	−0.77**	−1.06*
2	0.12	0.13	−0.31	0.48	0.56	0.17	0.54
3	0.02	−0.14	0.26	0.14	−0.02	−0.11	−0.41
Adj R^2	0.05	0.03	0.02	0.04	0.00	0.02	0.02
Sum	0.04	−0.63	−0.49	0.61	0.24	−1.04	−1.21
65+ ($n = 242$)							
0	−0.06	−0.45*	0.06	0.52*	−0.17	−0.15	−0.74*
1	−0.15**	−0.03	−0.73*	−0.46	−0.33	−0.56**	−0.44
2	0.05	0.01	0.04	0.47	0.51	0.53	0.03
3	−0.02	0.20	−0.11	−0.08	0.07	−0.36	−0.07
Adj R^2	0.01	0.01	0.01	−0.01	0.02	0.01	0.04
Sum	−0.22	−0.33	−0.81	0.40	0.13	−0.89	−1.48

* Significant at $P < 0.05$; ** significant at $P < 0.01$.

Thirdly, the pattern of response by lags is remarkably consistent with expectations: with the exception of respiratory tuberculosis, deaths increase at lags 0 and 1, and decrease thereafter, perhaps because they are an echo of changes in composition by susceptibility to illnesses. Respiratory tuberculosis tends to respond at lags of higher order as it should if the mediating mechanism involves deterioration of nutritional status.

SUMMARY AND CONCLUSIONS

The analysis undertaken here for Latin American countries has extended the period of observation back to about 1920 and includes several demographic outcomes, nuptiality, natality, infant and non-infant mortality. The results are mixed. While in a handful of countries the estimated effects of economic swings in an aggregate indicator of economic well-being (average GDP) are statistically significant and follow the expected patterns, in most the responses are more muted and not statistically significant. Furthermore, while the analysis on the pooled sample is quite robust and confirms some expected relations, it also yields some anomalous findings related to the response of births at lag 0. These results also show that the link between short-run economic shocks and demographic outcomes are fairly similar to those found in pre-industrial Western Europe. Surprisingly, while the effects on births are almost identical in different samples, those associated with marriage are larger in Latin America than in pre-industrial Europe. On the other hand, even when they follow the expected pattern, the effects on adult and infant mortality are weaker than in either pre-industrial Europe or other less developed countries.

Finally, the analysis of the pooled sample enables us to identify some evidence which suggests that the marriage and birth responses to economic fluctuations might have declined after 1955 while those of infant mortality could have increased. The differences are not large, however, and their interpretation is ambiguous since it is difficult to discriminate between a mechanism that depends on changes in the degree of association between demographic outcomes and aggregate economic well-being, and another mechanism associated with changes in the size and duration of crises with their variable impact on the accuracy with which demographic outcomes are registered during economic recession.

The patterns of mortality responses by age and cause are intriguing but they are consistent with arguments that separate carefully the effects of crises caused by exposure, resistance, and recovery. Thus, we confirm the sensitivity of illnesses such as diarrhoea, acute respiratory infections, and respiratory tuberculosis and the vulnerability of infants, young children, and the elderly. Even though the patterns of response are surprisingly consistent with expectations, we find that the absolute impact of the mortality response on the ultimate levels of mortality is quite small.[49] Exactly the same conclusion applies to the absolute magnitude of the ultimate response through births and marriages.

[49] Palloni and Hill, *loc. cit.* in fn. 2.