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DIANE J. MACUNOVICH

As emphasized by John Caldwell (1997), demographers still do not possess a “unifying theory” of the global fertility transition. They tend to “treat the earlier transitions, unassisted by national family planning programs, as qualitatively different” from those occurring in the last half-century. They have not even been able to develop a unified theory covering fertility transitions in currently developing countries (Caldwell and Caldwell 1997). Notestein’s (1945) framework, commonly known as the “demographic transition,” does not explain the wide variation in timing of the fertility transition, relative to the mortality transition, and in rates of decline.1 The maxim “economic development is the best contraceptive,” favored by economists, has come increasingly under attack.

In this article I point out an empirical regularity in the global data that appears to have gone unnoticed, but that synthesizes two hypotheses first advanced by Richard Easterlin (1966, 1978a). The first is that relative cohort size affects male relative wages, which in turn affect fertility: what I refer to as his theory of relative cohort size. The second is the “supply–demand” framework for explaining fertility in developing countries that combines the economic concept of demand for children with the sociological concept of supply.

As I demonstrated in a recent review and evaluation (Macunovich 1998a), while the theory of relative cohort size has been the focus of more than 75 studies using developed-country data, it has never been applied in a developing-country context. Conversely, the supply–demand framework has been adopted widely as a descriptive tool in studying the fertility transitions of the past half-century, but is not generally associated with fertility patterns in the developed countries. And while the relative cohort size theory provides a quantitative mechanism for explaining the fluctuations in demand for children that lead to fertility booms and busts, the supply–de-
mand framework, like the theory of the demographic transition, does not explain why the demand for surviving births declines when it does. Many factors have been identified as correlated with the decline, including reductions in infant mortality, the increasing net cost of children with economic development, the gradual replacement of children as a source of old-age support, and the increased acceptance of individual control over fertility; but these seem to be necessary rather than sufficient conditions for fertility reduction. None of them has a good track record in identifying the initiation of fertility decline.

The data that I present here suggest that the relative cohort size mechanism applies not just in developed countries but also within the supply-demand framework, providing the heretofore missing explanation. The present analysis is simple in light of the breadth and depth of the literature on the fertility transition. But in some ways that simplicity is its best feature, for in its lack of specificity it consolidates a framework that appears to describe the genesis of fertility transitions around the globe, as well as fluctuations in fertility after the demographic transition has been completed.

**Easterlin’s relative cohort size theory**

Easterlin (1987b) defined his hypothesis in *The New Palgrave* as follows: “The Easterlin, or ‘cohort size’, hypothesis posits that, other things constant, the economic and social fortunes of a cohort (those born in a given year) tend to vary inversely with its relative size, approximated by the crude birth rate in the period surrounding the cohort’s birth. The linkage between higher birth rates and adverse economic and social effects arises from what might be termed ‘crowding mechanisms’ operating within three major social institutions—the family, school and labour market.” He went on to describe the labor market mechanism involved: imperfect substitutability between younger and older workers, leading to a deterioration in the wages of the young relative to those of the older generation. Since “a comparison between younger and older adults...translates largely into a comparison of children with their parents,” and “if parents’ living levels play an important role in setting their children’s material aspirations,...then an increase in the shortfall of children’s wage rates relative to parents, will cause the children to feel relatively deprived and under greater pressure to keep up.”

Easterlin hypothesized that this deterioration in a cohort’s prospects relative to those of its parents may induce demographic adjustments by members of the younger generation, including delayed marriage, reduced fertility, and increased female labor force participation as they seek to maintain their relative economic status. In this formulation it is relative, rather than absolute, income that is a factor in decisionmaking, and relative cohort size is seen as the primary determinant of secular shifts in relative income.
Easterlin (1978a) introduced relative income concepts into his discussion of the fertility transition as follows:

Because of the substantial upward trend in living levels during economic development, each generation typically comes from a more prosperous background than that of the preceding generation. Because of this, the views of each successive generation as to the material requisites of the “good life” tend to be progressively higher. Goods which to one generation may have been luxuries become necessities to the next—the automobile is a case in point. This “inter-generation taste effect,” as it might be called, tends to raise the minimum living level which parents feel is necessary before they can “afford” to have children. There is a floor to the curvilinear indifference map at the minimum required living level. Below this floor the indifference lines become horizontal, signifying that welfare depends only on the parents’ goods and having children adds nothing to satisfaction. With the progress of economic growth this “subsistence” floor shifts upward and the marginal rate of substitution decreases at any given point above the floor, indicating that children are becoming less attractive relative to goods. In effect, a third (“subsistence level”) constraint is added to the analysis...along with the budget line and production constraints. (p. 115)

But the potential connection between relative cohort size and relative income—and hence fertility—has been applied only in the post-transition context (Macunovich 1998a). It has not been used to explain the fertility transition itself.

The supply–demand framework

Although economists have long discussed the demand for children, Easterlin (1978a) is generally credited with the formal juxtaposition of the economic concept of demand with the sociological concept of supply in a framework that incorporated both the demand for children and the demand for, and costs of, fertility regulation. Perhaps his most well-known formulation of this framework is presented in his work with Eileen Crimmins (1985), where it was used to explain secular shifts in fertility during the demographic transition.

Their stylized framework divided the demographic transition into roughly five phases. The initial pretransition phase is characterized by an excess demand for surviving births because of high mortality rates and involuntary infecundity. Declining infant mortality and, possibly, rising fecundability resulting from improved health and nutrition during the mortality transition transform this excess demand into a potential excess supply in the second phase; in the third phase the salience of this excess supply is magnified by a decline in the demand for children. The potential for an
excess supply of children motivates fertility-control behavior. Thus despite a continued fall in demand, any realized excess supply is gradually eliminated in a fourth phase, with the length of that phase determined by the costs of fertility regulation, psychic as well as economic. The stylized transition ends with a rough equilibrium between demand and achieved supply, despite a potentially very large excess supply.

Within this supply–demand framework the reduced mortality among children and young adults that in time increases relative cohort size would add to the potential excess supply of surviving births in the second phase of this framework, and thus generate additional motivation for fertility control. But since this is only a conceptual framework, it provides no explanation for the declining demand for children that occurs in the third and fourth phases. In addition to changing norms and attitudes toward children (which still need to be explained), researchers have suggested changes in the costs and benefits of children, and changing relative prices, as factors in this decline. But the relationship between changing relative cohort size and changing relative income has not been examined in this context.

Tests of the relative cohort size hypothesis

Tests of the relative cohort size (RCS) hypothesis fall into two categories: the effects of RCS on male relative income; and the effects of changes in RCS and/or male relative income on fertility. The first of these categories was addressed in terms of the relative wages of US baby boomers in the period prior to 1980 by, among others, Freeman (1979), Welch (1979), and Berger (1984), all of whom demonstrated strong effects of the type suggested by Easterlin. Korenman and Neumark (1997) extended those analyses to demonstrate similar effects in a sample of 15 industrialized countries in the period 1970–94; and I (Macunovich 1999) demonstrated that the effects of RCS were still highly significant in the United States in the 1980s and 1990s. I demonstrated, in addition, that the effects are not “symmetrical”; that is, cohorts on the “leading edge” of a boom benefit from positive aggregate demand effects that counteract the adverse effects of large cohort size, while cohorts on the “trailing edge” fail to benefit significantly as cohort size begins to decline, because of economic slowdowns brought on by that decline. The turnaround in the growth rate of new young households as RCS declines confounds producer expectations, resulting in a general production cutback whose longer-term economic impact depends on the stability of financial institutions. Thus an increase in RCS typically produces a reduction in male relative income that is not ameliorated even once relative cohort size begins to decline.

The second category of tests, carrying the effects of RCS through to fertility, has been reviewed in detail elsewhere (Macunovich 1998a). As mentioned above, the number of such tests exceeds 75; and “with an equal
number of micro- and macro-level analyses using North American data (twenty-two), the ‘track record’ of the hypothesis is the same in both venues, with fifteen providing significant support in each case. The literature suggests unequivocal support for the relativity of the income concept in fertility, but is less clear regarding the source(s) of differences in material aspirations, and suggests that the observed relationship between fertility and cohort size has varied across countries and time periods due to the effects of additional factors not included in most models” (p. 53). In particular, the relationship between relative income and fertility appears to be more robust than that between relative cohort size and fertility, probably because of the aforementioned asymmetric effects of RCS on relative income. In addition, Pampel (1993) demonstrates that differences in “institutional structures of collective social protection and changes in rates of female labor force participation” (p. 496) must be taken into account in analyses using cross-country data. These institutional differences tend to influence the relationship between RCS and relative income, thus weakening the observed relationship between RCS and fertility. As a result, tests of the theory using relative cohort size and the total fertility rate in countries other than the United States, Canada, Australia, and New Zealand have provided more ambiguous results.

Relative cohort size effects in developing and developed countries

It is quite possible that the motivations underlying any effect of relative cohort size on fertility in developing countries result not from an imbalance between younger and older cohorts in a formal labor market, but rather from an imbalance at the level of the family or village. Increasing RCS would require that intergenerational transfers—of agricultural holdings, for example—be divided among ever-larger numbers of offspring, resulting in a secular decline in young people’s “relative income.” Even in cases where a formal labor market has been established, institutional and cultural differences among countries undoubtedly temper the relationship between relative cohort size and relative income. Strong labor unions, for example, which maintain high wages for current members at the expense of new labor market entrants (probably as a protective measure during periods of large relative cohort size) would tend to counteract positive effects of subsequent smaller relative cohort size.

Similarly, developed countries with policies encouraging wage cuts rather than layoffs during periods of excess labor supply might dilute relative cohort size effects, if wage cuts occur at all levels of work experience. Studies have found, for example, that while the United States tends to have “sticky wages” that promote high unemployment during such periods, many European countries trade that unemployment for lower wages. An economy like Japan’s must also experience more diluted effects of relative cohort size.
on relative income. There, rigid pay scales are often tipped strongly in favor of older, more experienced workers in order to entice employees into long-term commitment. Young workers in this situation would rarely experience the benefits of smaller cohort size.

The rigidity of a country's boundaries with respect to immigration, and its policies toward "guest workers"—relevant, for example, in the case of Germany, Austria, and Oman—would also impinge on the relationship between relative cohort size and wages. Where workers can cross international boundaries freely, tests for any relationship would be most appropriate at a regional rather than a national level. Conversely, very large countries such as China or the former Soviet Union may contain many subnational "markets" in which any relative cohort size effects would emerge most clearly, especially if the movements of their citizens are restricted by government.

And at the other end of the causal network, cultural and institutional differences impinge on the relationship between relative income and such factors as marriage and childbearing. These cultural effects may show up only as differences in the overall levels of marriage and fertility, however, rather than in the response to changing economic circumstances.

Proposing a synthesis of the relative cohort size and supply–demand models

My initial focus using the two models is on a pretransition society experiencing both high fertility and high mortality, where it is possible for the demand for children to exceed the biological supply. In addition, as noted by Bourgeois-Pichat (1967b):

Fertility in preindustrialized societies...is determined by a network of sociological and biological factors.... Freedom of choice by couples is almost absent. The couples have the number of children that biology and society decide to give them.

One of the main features of the so-called demographic revolution has been precisely to change not only the level of fertility but also change its nature. Having a child has been becoming more and more the result of free decision of the couple. And this change in the nature of fertility may be more important than the change in its magnitude. (p. 163)

That is, in pretransition society either conscious fertility control is absent or control is exercised only through cultural constraints within the community, not at the level of the individual couple.

Initially, a decline in infant mortality is observed: the first stage of the mortality transition. This may accompany economic development or occur prior to that change, as a result of international public health interventions. Because
“High levels of child mortality still found in low income countries are primarily due to gastroenteritis and diarrheal disease” (Schultz 1981: 116), typically mortality rates fall first among infants, who are most susceptible to these diseases. Within the context of the supply–demand model, this reduction results in an increase in the biological supply of surviving infants, but will not necessarily be translated into a significant increase in the supply of young adults until mortality rates decline among young children and teenagers as well.

The reduction in infant mortality, followed by child and teen rates, will result 15 to 20 years later in an increase in relative cohort size—the size of cohorts just entering the labor market (and family formation) relative to the number of prime-age adults—and a decline in relative wages. The mechanism might be similar to that documented in the United States and other industrialized countries. An excess supply of young relative to prime-age adults depresses the relative wages of the young workers to the extent that they are poor substitutes for older, more experienced ones. Alternatively, in less sophisticated economies the relative decline in earning potential for younger workers may take the form of reduced size of landholdings passed on from parents to a larger number of surviving offspring. However it occurs, this need only be a relative decline. That is, concurrent economic development might raise absolute wages at all age levels; but if the wages of younger workers progress more slowly than those of older workers, as they will for large cohorts, younger workers will still tend to experience relative deprivation.

The effects of this labor market crowding may be exacerbated by crowding in the family, given increasing child survival rates, and in schools to the extent that they are available. The earning potential of young men will be reduced relative to their material aspirations as shaped in their parental households. They will feel less able to support themselves at a standard commensurate with that experienced in their parents’ homes. The resultant decline in relative income would lead young couples to seek to delay or forgo marriage and/or reduce fertility in an attempt to maintain a higher level of per capita disposable income.

In this way, a society with little or no individual control of fertility will begin to experience a strong motivation for such control. Large cohorts are known for their disruptive effects on social norms (as, for example, in the United States in the 1960s and 1970s, and in Iran today). In this case, a large cohort’s need for fertility control may mark a turning point in a society’s attitudes toward contraception and toward the individual’s—as opposed to society’s—right to control fertility. Easterlin (1978a) suggested this when he wrote:

It is possible that the emergence of a pressure for fertility limitation is one of the first forms in which modernization comes to impinge directly on the mass of the population. The appearance of a problem that had not previously ex-
isted—that of limiting family size—and thereby of a need for decision making of an entirely new sort, creates a pressure for attitudinal changes in a fundamental and immensely personal area of human experience. From this viewpoint the “population problem” may have positive consequences, by contributing to modernized attitudes that may more generally favor economic and social development. (pp. 122–123)

Easterlin cited Bourgeois-Pichat (1967a, b), Wrigley (1969), and Srinivasan et al. (1972) in describing the shift from “social sanctions” to “family sanctions” in determining fertility—the development of deliberate individual control that is fundamental to modernization. Cognitive dissonance would lead to the widespread acceptance of the concept of fertility regulation, and the passing of that milestone could have a cumulative “snowball” or “cascade” effect, as declining average family size reinforces a society’s acceptance of smaller numbers of children. This would explain the often-observed co-movement of fertility rates among older and younger women, and it is a mechanism suggested by Kenneth Wachter (1991) in explaining cyclic fertility movements in the United States.

In this way an increase in relative cohort size could initiate the fertility transition. But 15 to 20 years later, any fertility reduction will result in declining RCS: will this not tend to raise fertility rates again? The evidence from industrialized countries suggests that it will not. As mentioned earlier, relative cohort size effects on relative income are not symmetrical, because of differential aggregate demand effects on the leading and lagging edges of a baby boom. Thus one should not expect them to be symmetrical in terms of fertility. Without some external stimulus, male relative income will not begin to increase again when RCS begins to subside, but only after a considerable lag. Any potentially positive effect of decreasing relative cohort size on young men’s wages will be counteracted for a time by the depressing effect of the economic slowdown induced by a turnaround in cohort size. This may have been the case in the industrialized countries in the 1930s and 1980s, and may also have been the recent experience of the “Asian Tigers.” In addition, any potentially positive effects of declining cohort size will be counteracted by the negative “cascade” effect of changing cultural norms on fertility rates, as set out above.

A look at the data

The United Nations (1999a, b) provides estimates of vital statistics and population age structure for 184 countries covering the period 1950 through 1995. These data are not ideal, since their preparation of necessity involved considerable interpolation, especially at greater levels of disaggregation. Far outweighing the disadvantages of the UN data is the fact that they provide a
unique source in terms of uniformity of geographical and chronological coverage. The population data were obtained in two stages: first from United Nations (1999a) for quinquennial observations and a limited number of age groupings (under 5 years, 5–14, 15–24, and 60+); and later from United Nations (1999b) in annual observations for five-year age groups by sex, although these are largely estimates and interpolations of the first set of data.

The vital statistics in the UN data, which are available only quinquennially, include aggregate rather than age-specific fertility measures, the best of which is the total fertility rate (TFR); and although they include a measure of infant mortality, no other age-specific mortality measures are available. There is no information on income.

Ideally an examination of relative cohort size effects on fertility would have access to measures of male relative income, given the asymmetry of RCS effects and the potential for intervening institutional influences on wage structure; additionally, selected variables might be used to control for changing economic costs and benefits of children and for availability of contraceptives. In the absence of such income data, the analysis should be based on specific age groupings (those aged 15–24 relative to those aged 45–54, for example) in order to capture the effects of imperfect substitutability across groups by level of labor force experience. The inclusion of younger and older members of the 25–59 age group in the denominator of RCS will dilute measured effects if—as occurs in many developed economies—those age groups are fairly good substitutes for workers aged 15–24. However, the appropriate measure of RCS may vary across countries depending on the sophistication of their labor markets. For this reason—and because the UN’s five-year age groups rely on a great deal of estimation—most of the analyses presented here make use of a general measure of RCS: males aged 15–24 relative to males aged 25–59. Alternative estimates using a more specific RCS measure (males aged 15–24 relative to males aged 45–54) are presented for comparative purposes.

The fertility measure analyzed here is the TFR, as a function of the infant mortality rate (as, for example, in Schultz 1981) and as a function of RCS (approximated using the ratio of 15–24-year-olds first to those aged 25–59 and then to those aged 45–54). Although the TFR is an aggregate measure composed of fertility rates at all ages, it tends to be highly correlated with the pattern of fertility among women aged 20–29, since fecundability is highest in this age group; there is also a considerable precedent for using the TFR in tests of Easterlin’s hypothesis. As a check on the validity of results based on the TFR, the statistical analyses presented in the next section include estimates based on a small subsample of countries and years for which age-specific fertility rates are available. These will demonstrate that the relative cohort size hypothesis appears to be supported both at the aggregate (TFR) and age-specific levels.
The UN data suggest that relative cohort size, probably acting through effects on male relative income, has played a crucial role in bringing about the fertility transition in developing countries between 1950 and 1995. Countries appear not to begin reducing their fertility, despite a reduction in infant mortality, until that reduction and the accompanying fall in mortality rates among children and young adults permit the proportion of the population aged 15–24 to rise relative to those aged 25–59. This is seen in more than 100 countries that have begun the fertility transition since 1950. Several that have not, such as Gambia, Guinea-Bissau, and the Congo (formerly Zaire), have not yet experienced an increase in the ratio of 15–24-year-olds to those aged 25–59, despite marked and prolonged reductions in infant mortality in many cases.

The pronounced relationship between relative cohort size and the total fertility rate is evident both in the aggregate and in country-specific data, even using data reported at five-year intervals. Figure 1 presents graphs for selected developing countries in which a characteristic relationship begins to emerge. Total fertility rates are constant or even increasing until relative cohort size begins to increase: at that point, the TFR begins to decline. Although the overall rate of TFR decline might be affected by the trend in infant mortality, its point of initiation seems in all cases to depend on the trend in relative cohort size.

This relationship has been demonstrated around the globe, in countries both small and large, regardless of religious or political orientation. Figure 2 shows that it emerges even at the regional level, in all developing parts of the world. The characteristic shape evident in these graphs is not a statistical artifact: the relative cohort size variable used here is calculated relative only to prime-age adults, not to the total population; thus RCS is not increasing as a result of the decline in the proportion of children in the population. A measure of infant mortality rates is also presented in Figures 1 and 2, and, although it is not immediately obvious because of the scaling, the levels vary widely from country to country, both at the point of initiation of fertility decline and throughout its full extent. For the nine countries shown in Figure 1, Table 1 gives infant mortality rates in 1950–55, 1990–95, and at the start of the fertility transition. Table 1 indicates that the transition in Hong Kong did not begin until infant mortality was down to 33 deaths per thousand live births, while in Egypt it began at the very high level of 175. And although Brazil and Iran exhibit similar infant mortality rates in 1990–95 (47 and 43, respectively), the TFR in Iran (5.3) is more than twice that in Brazil (2.4).

Other aspects of the diversity among the nine countries in Figure 1 are notable. Population size (in 1995) ranged from 260,000 in Barbados to 1.2 billion in China. Hong Kong is a city-state and Barbados an island. Iran is a predominately Muslim country, while Brazil has a large proportion of
FIGURE 1  Relationship between the total fertility rate (TFR), relative cohort size (RCS), and infant mortality (IM) in selected developing countries, 1950–95

Barbados  Brazil  China

Egypt  Hong Kong  Iran

South Korea  Thailand  Zimbabwe

NOTES: RCS is the ratio of males aged 15–24 to males aged 25–59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000 live births) has been scaled by dividing its logarithmic value by 11.
FIGURE 2  Relationship between the total fertility rate (TFR), relative cohort size (RCS), and infant mortality (IM) in developing regions of the world, 1950–95
NOTES: RCS is the ratio of males aged 15–24 to males aged 25–59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000 live births) has been scaled by dividing its logarithmic value by 11.

Roman Catholics. And China is not a free-market economy. The widespread imposition of a one-child policy in China has been credited by many for the country’s remarkable fertility decline. However, several studies (e.g., Lavely and Freedman 1990) have indicated that the decline began—at least in urban areas—prior to that policy, and the data presented here suggest that the underlying motivation for China’s urban fertility decline was the increase in relative cohort size.

Similar graphs have been prepared for the more than 130 countries that had not experienced a fertility transition prior to 1950. Most have by now begun the transition and conform to the pattern discussed above, but there are differences among countries that undoubtedly result from cultural and/or institutional peculiarities not captured in these data. A few countries have experienced little if any fertility decline, as illustrated in Figure 3, but even among these, many like Gambia appear to be on the threshold.

In most cases the patterns of change in the two measures of relative cohort size—the ratios of 15–24-year-olds to 25–59-year-olds and to 45–54-year-olds—were found to be very similar, so that only the first measure is presented here. But for several countries this is not the case. As demonstrated in Figure 4, there is fairly close correspondence between changes in the TFR and the refined RCS measure (15–24 relative to 45–54), which is not so readily apparent between the TFR and the general measure of RCS.

In addition, several countries—such as Fiji and Nigeria—appeared not to conform to the general pattern based on earlier published data such as United Nations (1998), but fit the pattern quite well in the 1998 revisions (United Nations 1999b) available on diskette. Thus it seems possible that apparently “nonconforming” countries may eventually prove to conform,
FIGURE 3  Relationship between the total fertility rate (TFR), relative cohort size (RCS), and infant mortality (IM) in three countries that, by 1995, had shown little sign of beginning the fertility transition

NOTES: RCS is the ratio of males aged 15–24 to males aged 25–59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000 live births) has been scaled by dividing its logarithmic value by 11.

given future updating and refinement of the data; or that such nonconforming patterns are simply instances in which relative cohort size is too crudely measured, or is not directly reflected in relative income for cultural, institutional, or economic reasons. It is unfortunate that data are not available to measure relative income directly in all of these countries, since the hypothesized relationship is, after all, between relative income and the TFR, rather than directly between RCS and the TFR.

Experience during the fertility transitions of developed countries

Keyfitz and Flieger (1968) provide historical data for three industrialized countries around the time of their fertility transitions: England and Wales, France, and Sweden. Although they do not provide the TFR, they provide information on sex and age composition, together with the crude birth rate (CBR: births per 1000 population). These data are presented in Figure 5. Although not as conclusive as the patterns exhibited in most developing countries, these graphs demonstrate a similar tendency for the fertility transition to begin when relative cohort size starts to increase. Only decennial
FIGURE 4  Examples of the 14 countries that display substantive differences between the patterns of the general measure (ratio of males 15–24 to males 25–59) and refined measure (ratio of males 15–24 to males 45–54) of relative cohort size (RCS)

Refined measure of RCS

Country where refined measure did not rise despite increase in general measure

United Arab Emirates

One of 4 countries where refined measure rose despite no increase in general measure

Azerbaijan

One of 3 countries where refined measure increased earlier than general measure
NOTES: In each case the refined measure of RCS, presented on the left, corresponds more closely to the pattern of the TFR than does the general measure. The 14 countries that display substantive differences are: Afghanistan (where the refined measure did not rise despite an increase in the general measure); United Arab Emirates, Saudi Arabia, Kuwait, and Qatar (where the refined measure rose despite no increase in the general measure); Azerbaijan, Albania, and Armenia (where the refined measure increased earlier than the general measure); and North Korea, Cape Verde, Syria, Central African Republic, Madagascar, and Uganda (where the refined measure increased later than the general measure). The refined measure of RCS is the ratio of males aged 15–24 to males aged 45–54. The general measure of RCS is the ratio of males aged 15–24 to males aged 25–59. TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000 live births) has been scaled by dividing its logarithmic value by 11.
FIGURE 5  Relationship between relative cohort size (RCS) and the crude birth rate (CBR) during the fertility transition in England and Wales, France, and Sweden.

NOTES: RCS is the ratio of males aged 15–24 to males aged 25–59; CBR (in births per 1000 population) has been scaled by dividing by 75.
SOURCE: Keyfitz and Flieger (1968).

observations are available for England and Wales, so it is possible that some of the increase there is missed, but a decided increase in RCS occurred in France. Sweden experienced a sharp jump in RCS after 1825 that seemed to initiate a decline in fertility; but this was followed by an equally sharp drop in RCS, with some recovery in fertility, so that the real fertility transition only occurred after 1870 when RCS increased once again.

Figure 6 suggests that improved survival rates among children and young adults were the primary reason relative cohort size began to increase when it did in each of these three countries. The percent surviving to age 15 began to increase in 1870 in England and Wales—at the same point that RCS began to increase—whereas both RCS and the survival probability began to increase slightly earlier in France, in about 1865. A much longer history is available for Sweden, where there appears to be an explanation for the “on again, off again” changes in RCS and fertility between 1825 and 1870. The survival probabilities of children and young adults in Sweden increased markedly prior to 1825, producing an increase in RCS up to about 1840, but then faltered and did not resume their improvement until after 1870, coincident with an increase in RCS and the beginning of Sweden’s fertility transition.
Statistical tests

A simple visual inspection of the relationship between relative cohort size and fertility is an inadequate test of the hypothesized relationship between them, however. Regression analysis can be used to determine whether the apparent relationship is statistically significant. The model to be tested here is simplistic, containing only RCS and infant mortality as explanatory variables. To control for the many other factors that are thought to play a role in fertility determination, a lag of TFR itself is included, which contains information about these other factors (and will control to some extent for changing norms and attitudes). That is, in this quinquennial data the value of the TFR in time $t-5$ is used as another explanatory variable in estimating the equation for the TFR in time $t$.

Relative cohort size is represented in the model using two variables: one to control for the level of RCS as suggested by Easterlin, and the other to control for its rate of change, in order to allow for asymmetry in the effects of RCS on fertility; this approach is similar to the one adopted for relative income in Macunovich (1998b, 1999, 2000). The hypothesis is that a positive rate of change in RCS will slow the decline in fertility when cohort size is rising, while a negative rate of change will dampen fertility increases when cohort size is declining. It is assumed that any economic slowdown results not so much from declining relative cohort size as from the transition to decline and its effect on expectations and business investment. Thus in theory it is important to be able to identify that point of transition; but this is difficult because while annual population estimates are provided in the UN data,
only quinquennial observations of TFR and infant mortality are available. The RCS rate-of-change variable is thus calculated as the value in year $t$ minus the value in year $t-5$, since it would be inappropriate to associate quinquennial changes in the TFR with anything other than quinquennial changes in RCS.

A complication is introduced by the fact that levels of RCS will be lower in societies where the level of fertility has been low, or where the level of infant mortality has been high, creating a potential for spurious correlation among levels because of a relationship flowing from past values of fertility and infant mortality to RCS. The focus in this analysis is on any contemporaneous effects of changes in RCS on changes in the TFR; thus it is appropriate here to examine only changes in TFR, RCS, and infant mortality. These changes, or first differences, in the value of each variable are calculated by subtracting the value of each variable in time $t-5$ from its value in time $t$. Although a change in the TFR or infant mortality in time $t$ will affect changes in RCS 15 to 20 years later, there can be no possibility of an immediate effect once the correlation in levels has been removed. In the case of infant mortality, fertility is expected to respond to the cumulative effect of changes in mortality, rather than to changes in only the most recent period. Thus the variable used to control for the effects of infant mortality in year $t$ is the sum of the changes observed between 1950 and year $t$.\textsuperscript{6}

Table 2 provides estimated effects of relative cohort size—both level and rate of change—and infant mortality on the total fertility rate when all 184 countries in the UN data are included. Even though the lagged TFR exerts a very strong effect, RCS and its rate of change exhibit highly significant estimated coefficients. Although the impact of infant mortality is significant, the standardized coefficients presented in italics indicate that the absolute effect of RCS is substantially greater (−0.21 for RCS but only 0.17 for cumulative changes in infant mortality). Even with these additional controls, the estimated coefficient on RCS remains highly significant, with the hypothesized negative sign. And despite the potential weakness of the measure of RCS change used in the analysis, that variable is estimated to have a fairly strong and significant effect, with the expected positive sign.

In all of these models, the positive impact of the lagged TFR supports the idea of a “cascade” effect on social norms regarding fertility during the transition, with the declining fertility rate in past years exerting a strong influence on subsequent fertility. This cascade effect together with the asymmetry of the relative cohort size effect accounts for the continuing decline of the TFR in developing countries, even once RCS has begun to decline. Additional analyses not presented here demonstrate that similar results are obtained when the model is estimated separately for subsets of the UN data: four groups of countries based on their fertility levels in 1950–55, and eight groups of countries by geographic region.\textsuperscript{7} In all cases RCS exhibits the ex-
TABLE 2  Regression coefficients, with and without allowing for asymmetry, of the effects of changes in relative cohort size and infant mortality on changes in the total fertility rate in 184 countries between 1950 and 1995, using ordinary least squares regression with no controls for individual country differences

<table>
<thead>
<tr>
<th></th>
<th>Without allowance for asymmetry</th>
<th>With a control for asymmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative cohort size</td>
<td>-0.987</td>
<td>-1.307</td>
</tr>
<tr>
<td></td>
<td>-0.155</td>
<td>-0.205</td>
</tr>
<tr>
<td></td>
<td>(6.3)</td>
<td>(6.7)</td>
</tr>
<tr>
<td>Change in RCS</td>
<td>0.449</td>
<td>0.083</td>
</tr>
<tr>
<td></td>
<td>(2.7)</td>
<td></td>
</tr>
<tr>
<td>Infant mortality</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>0.168</td>
<td>0.173</td>
</tr>
<tr>
<td></td>
<td>(6.7)</td>
<td>(6.9)</td>
</tr>
<tr>
<td>Lagged TFR</td>
<td>0.458</td>
<td>0.448</td>
</tr>
<tr>
<td></td>
<td>0.450</td>
<td>0.440</td>
</tr>
<tr>
<td></td>
<td>(18.0)</td>
<td>(17.5)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,288</td>
<td>1,288</td>
</tr>
<tr>
<td>Adjusted R-square</td>
<td>0.259</td>
<td>0.263</td>
</tr>
</tbody>
</table>

NOTES: The dependent variable is the first difference of the total fertility rate (TFR). Relative cohort size (RCS) is the ratio of males aged 15–24 to males aged 25–59. All independent variables are expressed as first differences, and infant mortality is the cumulative change from 1950 to year. t-statistics are italicized in parentheses, and standardized coefficient estimates are in italics.


Expected negative effect on TFR, and this effect is always statistically significant when the RCS change variable is included in the model. The estimated relative cohort size effects are particularly strong and significant for the industrialized countries as a group, with a large and significant negative effect of RCS, as hypothesized by Easterlin, and a significant positive effect of the RCS change variable, consistent with findings in models of male relative income (Macunovich 1999).

Finally, as a check on the relevance of the TFR in the analysis of relative cohort size effects, Table 3 presents results obtained from estimating the model using only younger women’s fertility rates. The data used here cover only a small subset of the 1,288 observations in the full data set, based on availability. Only quinquennial observations were used in the analysis of age-specific rates, to ensure comparability with the original TFR-based results (and because infant mortality was available only quinquennially). Table 3 demonstrates that the hypothesis is supported when analysis is limited to the age-specific fertility rates of a small sample of younger women.
### TABLE 3 Estimation, allowing for asymmetry, of the effects of changes in relative cohort size and infant mortality on changes in younger women's age-specific fertility rates in selected developing and developed countries

<table>
<thead>
<tr>
<th>Relative cohort size</th>
<th>Developing countries</th>
<th>Full sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in RCS</td>
<td>-115.036</td>
<td>-165.737</td>
</tr>
<tr>
<td></td>
<td>-0.467</td>
<td>-0.332</td>
</tr>
<tr>
<td></td>
<td>(2.1)</td>
<td>(2.6)</td>
</tr>
<tr>
<td>Lagged fertility (age specific)</td>
<td>103.965</td>
<td>146.198</td>
</tr>
<tr>
<td></td>
<td>0.479</td>
<td>0.333</td>
</tr>
<tr>
<td></td>
<td>(2.2)</td>
<td>(2.6)</td>
</tr>
<tr>
<td>Infant mortality (cumulative decrease)</td>
<td>0.161</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>0.193</td>
<td>0.130</td>
</tr>
<tr>
<td></td>
<td>(0.9)</td>
<td>(1.1)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.550</td>
<td>-1.829</td>
</tr>
<tr>
<td></td>
<td>(0.2)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>27</td>
<td>81</td>
</tr>
<tr>
<td>P-statistic</td>
<td>1.91</td>
<td>4.22</td>
</tr>
<tr>
<td>prob&gt;F</td>
<td>0.1446</td>
<td>0.0039</td>
</tr>
<tr>
<td>Adjusted R-square</td>
<td>0.1227</td>
<td>0.1387</td>
</tr>
</tbody>
</table>

NOTES: The dependent variable is the first difference of age-specific fertility rates. Relative cohort size (RCS) is the ratio of males aged 15–24 to males aged 25–59. t-statistics are italicized in parentheses, and standardized coefficient estimates are in italics.


Larger relative cohort size is estimated to reduce fertility (the coefficient on RCS is significant and negative), but this reduction is asymmetric: weaker when cohort size is declining than when it is on the increase (the coefficient on RCS change is significantly positive). This result holds for the developing countries alone, as well as for the sample as a whole.

### Conclusions

The attempt here has been to demonstrate that changes in relative cohort size are influential in determining the pattern of fertility—not just historically in developed countries, but also in countries as they pass through the demographic transition. The increase in relative cohort size that occurs as a result of declining mortality rates during the demographic transition in part
determines when the fertility portion of the transition begins. The increasing proportion of young adults generates a downward pressure on young men’s relative wages; this in turn causes young adults to accept a tradeoff between family size and material wellbeing. This acceptance of a tradeoff could mark a turning point in a society’s regulation of fertility, setting in motion a “cascade” or “snowball” effect in which total fertility rates tumble as social norms regarding individual control of fertility and acceptable family sizes begin to change.

This aspect of the demographic transition has been overlooked because of a focus on absolute rather than relative income, a focus that is apparent in the following statement from Caldwell and Caldwell (1997: 20–21):

The search for materialist thresholds is frustrating. If we compare Britain in 1871 with a range of countries in Asia and Africa a century later when their fertility was beginning to fall or soon would fall, some surprising findings emerge.... In terms of real per capita income,...Britain was at the start of its fertility decline, ten times as wealthy as Bangladesh, and almost twice as rich as Thailand. The proportion of its workforce working outside agriculture was four times that in Bangladesh or Kenya and more than double Sri Lanka’s proportion. Its proportion of population living in conurbations with more than half a million inhabitants was eighteen times the proportion in Sri Lanka and even six times that in Thailand.

The evidence presented here suggests that one thing these countries had in common at the point of transition was increasing relative cohort size. Countries appear not to begin reducing their fertility, despite a reduction in infant mortality, until that reduction and the accompanying fall in mortality rates among children and young adults permit the proportion of those aged 15–24 to rise relative to those aged 25 and older. According to Easterlin’s (1980, 1987a) hypothesis this would create downward pressure on the relative wages of young adults, leading them to reduce fertility in order to achieve their desired level of material aspirations. This phenomenon is observed in country after country that has begun the fertility transition since 1950—more than 100 in all—and evidence suggests that this was the case in earlier transitions as well.

These results are consistent with the hypothesis advanced by Watkins (1990), who suggested that “market integration” was one reason for a pronounced reduction in demographic diversity in European provinces in the nineteenth century. Labor market integration would have generated common trends across provinces in terms of relative incomes. Similarly, Coale and Watkins (1986) found that fertility patterns in various cities of Europe generally resembled patterns in the cities’ own hinterlands (i.e., market areas) more than they did patterns in other cities.
Thus relative cohort size can be thought of as the mechanism that forestalls excessive rates of population change: reducing fertility when previously high rates, in combination with low mortality rates, have caused relative cohort size to increase, and increasing fertility when previously low rates have caused relative cohort size to decrease. The mechanism appears to have been operating not just in currently developed post-transition economies, but during both recent and historic fertility transitions, to the extent that social and economic institutions have permitted relative cohort size to have a bearing on the relative income of younger males.

Notes

The author gratefully acknowledges the support of the Maxwell Center for Policy Research at Syracuse University, financial assistance through an NIA Fellowship, and Richard Easterlin’s inspiration and support.

1 Simon Szreter (1993) writes that “[d]emographic transition theory is generally considered to have been given its classic formulation in two separate publications, by Frank W. Notestein and by Kingsley Davis, both composed in 1944 and published in 1945” (p. 661). In that year Davis (1945) edited an entire volume devoted to demographic transition theory. In addition, Szreter points out that Warren S. Thompson, “America’s then-leading demographer,” had already “publicly presented” the concept in 1929 but “[a]t that time it seems to have suffered a stillbirth” (ibid.).

2 Two factors are important here. First, as demonstrated in Macunovich (1998c), increases in relative cohort size produce sharp increases in the growth rate of personal consumption expenditures, which tend to strengthen economic growth and create expectations of further growth. When the growth of relative cohort size slows or reverses, the expectations are not realized and the resultant cutbacks in investment expenditures and production can cause dislocations in the economy. Thus there is a tendency for economic conditions to be strong when cohort size is on the increase, and weak when it stops increasing. Second, as demonstrated in Macunovich (1998b, 1999, 2000), the wages of young, inexperienced workers tend to be boosted disproportionately in good times and depressed disproportionately in a weak economy. The combination of these factors leads to asymmetry in the effects of relative cohort size on relative wages.


4 In order to display it along with TFR and RCS, infant mortality (in deaths per 1000 live births) has been scaled in all graphical presentations by logging it and dividing by 11.

5 These additional graphs for all the developing countries are available on request from the author, or online at http://www.columbia.edu/~dm555/pdr/appendix.pdf

6 The use of a cumulative measure was suggested by a referee. Results are also available from the author of tests conducted using only the most recent change in infant mortality. The variable is marginally more significant in its cumulative form.

7 These more-detailed results are available on request from the author, and also in Appendix Tables A2–A4 in the working paper online cited in note 5.
References


——. 1998c. "The baby boom as it ages: How has it affected patterns of consumption and saving in the U.S.?” Working Paper, Maxwell Center for Policy Research, Syracuse University, Syracuse, NY.


