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Relative Cohort Size: Source of a Unifying Theory of Global Fertility Transition

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Abstract

Using United Nations estimates of age structure and vital rates for nearly 200 nations at five year intervals from 1950 through 1995, this paper demonstrates how changes in relative cohort size appear to have affected patterns of fertility across nations since 1950—not just in developed countries, but perhaps even more importantly in countries as they pass through the demographic transition. The increase in relative cohort size (defined as the proportion of the population aged 15 to 24 relative to that aged 25 to 59) which occurs as a result of declining mortality rates among children and young adults during the demographic transition, appears to act as the mechanism of transmission which determines when the fertility portion of the transition begins. As hypothesized by Richard Easterlin, the increasing proportion of young adults would generate a downward pressure on young men's relative wages, which in turn causes young adults to accept a trade-off between family size and material well-being, setting in motion a "cascade" or "snowball" effect in which total fertility rates tumble as social norms regarding acceptable family sizes begin to change. Thus relative cohort size can be thought of as the mechanism which prevents excessive rates of population change— reducing fertility when previous high rates, in combination with low mortality rates, have caused relative cohort size to increase, and increasing fertility when previous low rates have caused relative cohort size to decline.

Introduction

As emphasized by John Caldwell (1997), we still do not possess a "unifying theory" of the global fertility transition. We tend to "treat the earlier transitions, unassisted by national family planning programs, as qualitatively different" from those occurring in the last half-century. We have not even been able to develop a unified theory covering fertility transitions in currently developing countries (Caldwell and Caldwell 1997). Notestein's (1953) framework that we all know as the "demographic transition" has been castigated for its inability to generate explanations for the wide variation in timing of the fertility transition, relative to the mortality transition, and in rates of decline. The old maxim "economic development is the best contraceptive", favored by economists, has come increasingly under attack.

I will not attempt a full review of the literature on this topic, which I'm sure is familiar to most readers. The purpose of this article is simply to point out an empirical regularity in the global data that appears to have gone unnoticed, but which synthesizes two hypotheses first put forward by Richard Easterlin (1966,1969,1978). The first is his hypothesis that relative cohort size affects male relative wages, which in turn affect fertility: what I'll refer to as his relative cohort size (RCS) theory. The second is the "supply-demand" (SS-DD) framework for explaining fertility in developing nations.

The RCS theory has been the focus of at least 44 studies using developed-nation data (Macunovich 1998)—but has never been applied in a developing-country context. Conversely, the SS-DD 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 MDCs. And while the RCS theory provides a quantitative mechanism for explaining the fluctuations in demand for children which lead to fertility booms and busts, the SS-DD framework, like the theory of the demographic transition, is limited in that it does not explain *why* the demand for surviving births declines when it does.

The data which will be presented here—largely graphically—suggests that the RCS mechanism applies not just in MDCs but also within the SS-DD framework, providing that missing explanation. In many ways my analysis here is embarrassing in its lack of detail, given the breadth and depth of the literature on the fertility transition. But in other ways the simplicity of this approach is its best feature, for in its lack of specificity it consolidates a framework which appears to describe the genesis of fertility transitions all around the globe, as well as fluctuations in fertility after the demographic transition has been completed.

Easterlin's Relative Cohort Size Theory

> "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. . ."

This is Richard Easterlin's definition of the Easterlin hypothesis as presented in *The New Palgrave* (1987). He goes 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 of the type just given translates 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 children to feel relatively deprived and under greater pressure to keep up."

He hypothesized that this deterioration in a cohort's prospects relative to that of its parents may induce demographic adjustments on the part 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 which is a factor in decision-making—and relative cohort size is seen as the primary determinant of secular shifts in relative income.

Easterlin (1978) did bring relative income concepts into his discussion of the fertility transition when he wrote:

> "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' children. . .[T]here 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 become 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 1996,1998a,1998d). It has not been used to explain the fertility transition.

The SS-DD Framework

Economists have long discussed the demand for children, but Richard Easterlin (1969,1978) is generally credited with the formal juxtaposition of the economic concept of demand with the sociological concept of *supply* in a framework which incorporated not only the demand for children, but also 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 pre-transition phase is characterized by an excess demand for surviving births due to high mortality rates and involuntary infecundity. Declining infant mortality and, possibly, rising fecundability because of improved health and nutrition during the mortality transition transform this excess demand into a potential excess supply in the second phase, which in the third phase is exacerbated by a decline in the demand for children. This potential for an excess supply 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 a function of the cost of fertility regulation—psychic as well as economic. The model ends with a rough equilibrium between demand and achieved supply, despite a potentially very large excess supply.

Within this SS-DD framework the reduced mortality among children and young adults which in time produces an increase in 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 (assuming that parents wish to have their children survive *to adulthood*, rather than just through infancy). But since this is only a conceptual framework it doesn't provide any 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.

Relative Cohort Size Effects—in the Third World?

The mechanism is hypothesized to be similar to that observed in the United States and other industrialized nations. An excess supply of young relative to prime-age males depresses the relative wages of the young men, thereby reducing their earning potential relative to their material aspirations as shaped in their parental households. And 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. This decline in relative income would lead young couples to delay or forego marriage and/or reduce fertility in an attempt to maintain a higher level of per capita disposable income. The surprise here is not that we should observe the relative income effect operating on fertility in newly developing economies, since that relationship appears to be significant in MDCs (Macunovich 1996,1998d), but rather that such a strong market mechanism should be observable in LDCs—one which differentiates workers by age and level of experience in order to translate changes in relative cohort size into changes in relative income.

Undoubtedly institutional and cultural differences among countries must temper the relationship between relative cohort size and relative income across nations and regions. Strong 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, countries with strong policies encouraging wage cuts rather than layoffs during periods of excess labor supply might dilute relative cohort size effects, if wage cuts occur across all experience groups. Studies have found 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.

Japan, too, must experience more diluted effects of relative cohort size on relative income, because of widespread adherence to rigid pay scales which are tipped strongly in favor of older more experienced workers, in order to entice employees into long-term commitment. Here again, young workers would rarely experience the benefits of smaller cohort size. This policy appears to have resulted in Japan's current low fertility rates despite very small—and declining—relative cohort size.

The rigidity of a nation's boundaries with respect to immigration, and its policies toward "guest workers" as for example in Germany, Austria and Oman, would also impinge on the relative cohort size/wage relationship. Tests for any relationship would be most appropriate at a regional rather than a national level, when workers can cross international boundaries fairly freely. And conversely, it is possible that very large countries such as China or the former USSR might contain many sub-national "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 it goes without saying that cultural and institutional differences must impinge on the relationship between relative income and factors such 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.

The Evidence

The United Nations (1998) provides estimates for nearly 200 nations at five year intervals from 1950 through 1995, of vital statistics and population age structure (the proportion of the total population aged under 5, 5 to 14, 15 to 24 and 60+). These data suggest that relative cohort size (approximated using the ratio of 15 to 24 year olds to those aged 25 to 59[1])—probably acting through effects on male relative income—has played a crucial role in bringing about the fertility transition in developing countries during that period.

Countries appear not to begin reducing their fertility, despite reductions in infant mortality, until mortality rates fall among children and young adults, permitting the proportion of those aged 15 to 24 to rise relative to those aged 25 and over. This is seen in country after country which has begun the fertility transition since 1950—more than 100 in all. Several which have not, such as Ethiopia, Nigeria and Mozambique, have not yet experienced any increase in the ratio of 15 to 24 year olds to those aged 25 and over, despite marked and prolonged reductions in infant mortality in many cases.

It is even common to observe a *decline* in relative cohort size in most countries immediately before it begins to increase, suggesting that mortality rates among older adults tend to fall more quickly during the transition, than mortality rates among children and young adults.

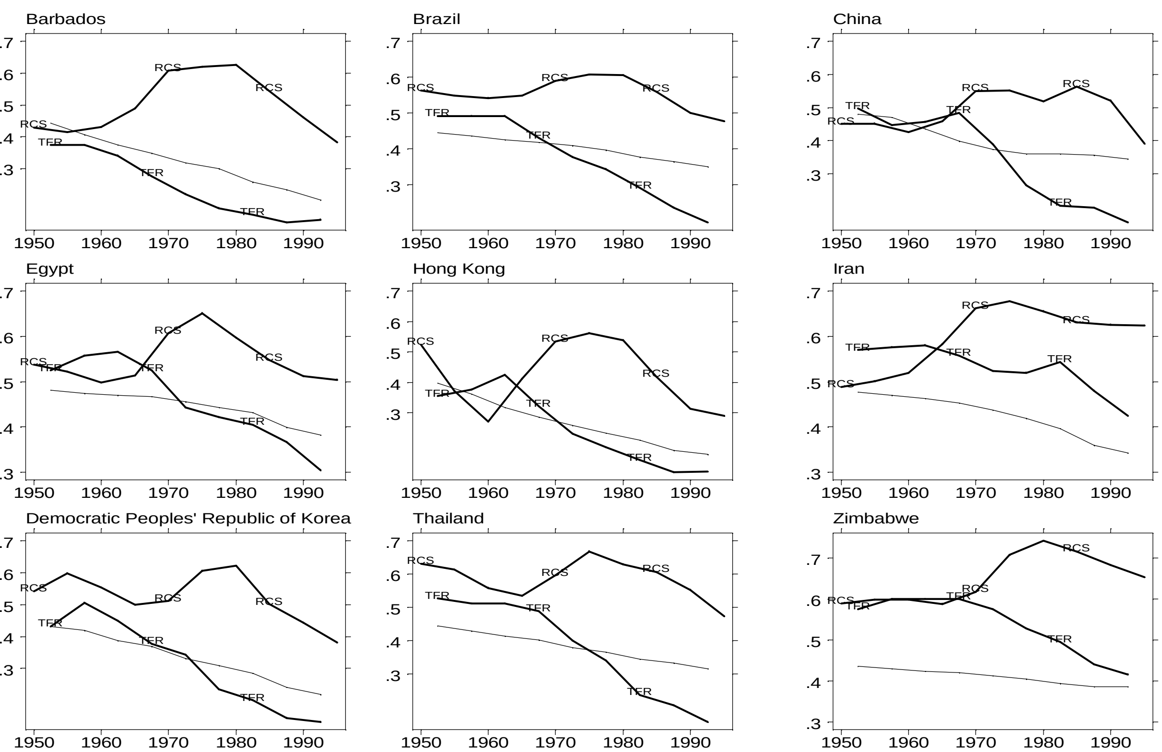


Figure 1: The relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (the unmarked solid line) in various individual countries, 1950-1995.
Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.

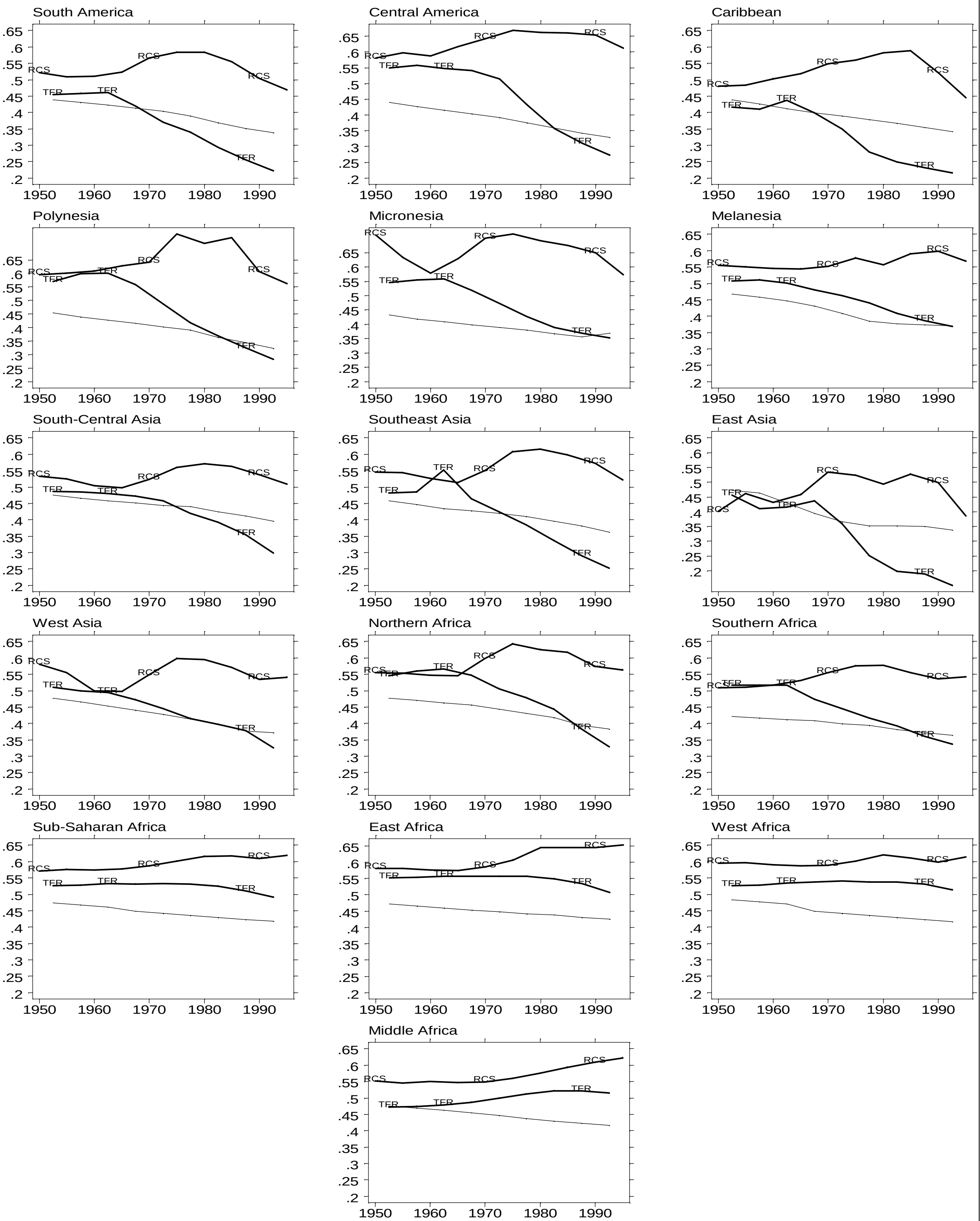


Figure 2: The relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (the unmarked solid line) in developing regions of the world, 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15to 24 to population aged 25to 59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*

The very 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 a selection of Third World nations around the globe, where we can see what will emerge as a characteristic relationship. We see Total Fertility Rates which are constant or even increasing until relative cohort size begins to increase: at that point, the Total Fertility Rate begins to decline. Although the overall rate of decline might be affected by the trend in infant mortality, its point of initiation seems in all cases to be set by the trend in relative cohort size.

This relationship has been demonstrated around the globe, in country after country 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. It is important to note that 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 aged 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.

(Scaled) infant mortality rates are also presented in Figures 1 and 2, and although 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. Thus, for example, the transition in Hong Kong did not begin until infant mortality was down to 33, while in Egypt it began at the very high level of 175. And although Brazil and Iran exhibit very similar infant mortality rates in 1990-95 (47 and 43, respectively), the TFR in Iran (5.3) is more than twice that in Brazil (2.44).

Country	**Infant Mortality Rates**		
	1950-55	*1990-95*	*at the start of the fertility transition*
Barbados	132	9	87
Brazil	135	47	109
China	195	44	81
Egypt	200	67	175
Hong Kong	79	6	33
Iran	190	43	78
North Korea	115	24	58
Thailand	132	32	84
Zimbabwe	120	70	101

Table 1: Infant mortality rates (deaths per 1000 live births) in countries presented in Figure 4.

One might also note other aspects of the diversity among the nine countries in Figure 1. Population size (in 1995) ranged from only 260,000 in Barbados, to 1.2 billion in China. Hong Kong is only a city-state and Barbados only an island, as compared with the large geographic areas of the other seven countries. Iran is a predominately Muslim nation, while Brazil has large proportions of Roman Catholics. And China and North Korea are not free-market economies—yet they still exhibit this characteristic pattern. China's draconian "one child" policy has been credited by many for China's dramatic fertility decline. However, several recent studies such as 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 such an urban fertility decline was the increase in relative cohort size.

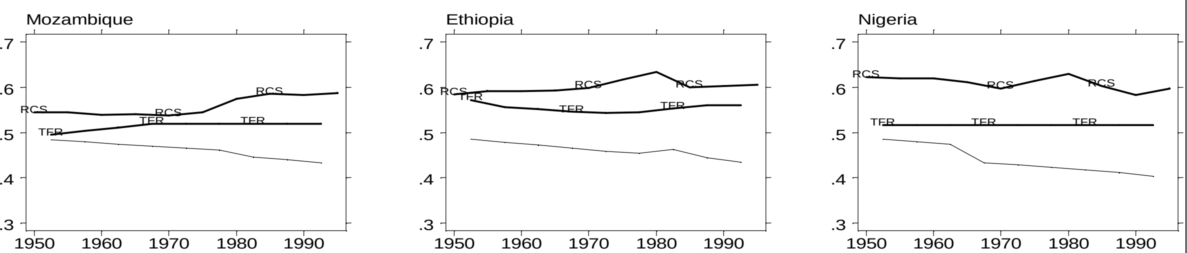


Figure 3: Three countries which, by 1995, had shown no signs of beginning the fertility transition.

The Appendix contains graphs for all of the 136 countries which had not experienced a fertility transition prior to 1950, presented alphabetically by region in Figures A1 to A8. Nearly all have by now begun the transition, and conform with the pattern discussed above. A few have not yet experienced any fertility decline, as in Figure 3, but many such as Mozambique in Figure 3 appear to be on the threshold.

In addition, Keyfitz and Flieger (1968) provide historical data for three of the currently industrialized nations around the time of their own fertility transitions: Sweden, France, and England and Wales. Although they do not provide the TFR, unfortunately, they do provide information on age composition, together with the crude birth rate (CBR: births per 1000 population). These data are presented in Figure 4. Although not as conclusive, perhaps, as the patterns exhibited in most of the currently developing countries, these graphs do demonstrate a similar tendency for the fertility transition to begin just at the point where relative cohort size starts to increase. Only decennial

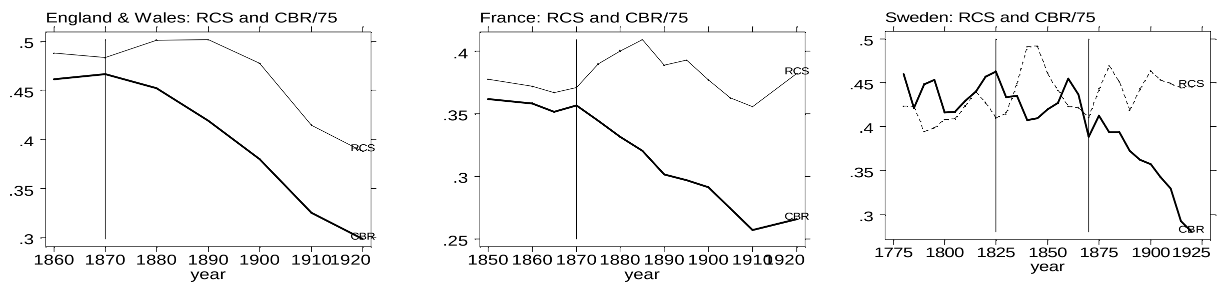


Figure 4: Relative cohort size and the crude birth rate during the fertility transition in England and Wales, France and Sweden. *(Crude birth rate is births per 1000 population, but is scaled by dividing by 75. Relative cohort size is the population aged 15 to 24 relative to the population aged 25 to 59. Source: Keyfitz and Flieger, 1968).*

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

Figure 5 suggests that improved survival rates among children and young adults was the primary reason RCS 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. We have a much longer history available for Sweden, where we see an explanation for the "on again, off again" changes in Swedish 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 again until after 1870, coincident with an increase in RCS and the beginning of Sweden's fertility transition.

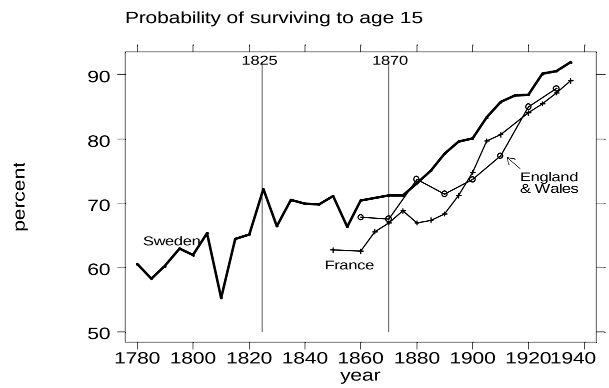


Figure 5: Probability of surviving to age 15 in England and Wales, France and Sweden. *(Source: Keyfitz and Fkieger, 1968).*

Despite the consistent association between fertility and RCS during both historic and recent fertility transitions, however, there are exceptions to the rule. Two groups of countries exhibit either a marked increase in RCS with no accompanying decrease in the TFR (18 countries, presented in Figure A9), or a marked decline in the TFR with no increase in RCS (Fiji, Kuwait, Mauritius, Qatar,

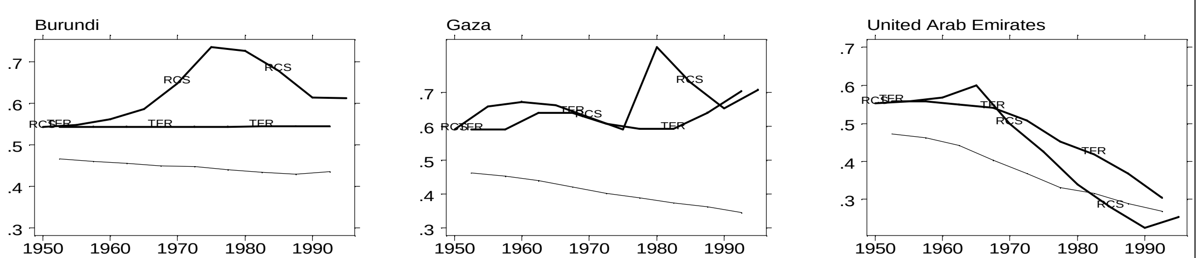


Figure 6: Three "non-conforming" countries. The full set is presented in Appendix Tables A9 and A10..

Saudi Arabia and the United Arab Emirates, in Figure A10). Figure 6 presents a sample of these non-conforming nations for illustration.

Do these 24 countries invalidate the hypothesis—or are they simply instances in which relative cohort size is too crudely measured, or is not directly reflected in relative income, for some cultural or institutional (or economic) reasons ? It is even possible, in the case of Fiji, Kuwait, Qatar and the Arab Emirates, that relative income might be *hyper*-sensitive to changes in relative cohort size: in each of these cases RCS *did* rise, but only very briefly and minimally. 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.

Statistical Tests

For those who are uncomfortable with a simple visual analysis of the relationship between RCS and fertility, we can use regression analysis to determine whether the apparent relationship is statistically significant. The model we wish to test is very simplistic, containing only RCS and infant mortality as explanatory variables. In order to control for the many other factors which are thought to play a role in fertility determination, we can include a lag of TFR itself, which contains information about these other factors. That is, the value of the TFR in time *t-1* is used as another variable in explaining the TFR in time *t*. This is a very stringent test, and we will see that infant mortality often loses its significance under these circumstances—but the estimated effect of RCS remains quite strong.

Another hurdle has been created in the tests conducted here, by examining only *changes* in TFR, RCS and infant mortality. This has the effect of removing any possible relationship flowing *from* past values of fertility and infant mortality *to* RCS. That is, generally we would expect to see lower levels of RCS when the level of fertility is low, or when the level of infant mortality is high, and by looking only at changes we remove this potential correlation among levels. These changes, or first differences, in the value of each variable are calculated by subtracting the value of each variable in time *t-1* from its value in time *t*.

Table 2 provides an abbreviated version of the results of this type of regression analysis, with a more complete set of results in Appendix Table A1. The results in Table 2 are the estimated effects of relative cohort size and infant mortality on the Total Fertility Rate when we include *all* of the 189 countries in the United Nations data—the 40 members of the "early transition" group like the United States. together with Third World countries. Even though the lagged TFR exerts a very strong effect, RCS maintains a very significant estimated coefficient which is more than *twice* the absolute magnitude of the estimated (standardized) coefficient on infant mortality (-0.189 and 0.090, respectively).

Relative Cohort Size	**-1.355** -0.189 (-8.0)
infant mortality	**0.276** *0.090* *(3.1)*
lagged TFR	**0.371** *0.374* *(7.0)*
No. of obs	**1316**
adj R-sq	**0.3385**

The dependent variable is the first difference of the Total Fertility Rate (TFR).
All independent variables are expressed as first differences.
t-statistics are italicized in parentheses , and standardized coefficient estimates are in italics.

Table 2: Estimation of the effect of relative cohort size and infant mortality on the Total Fertility Rate in 189 countries between 1950 and 1995, using OLS regression.

Appendix Table A2 presents similar results for various subsets of the United Nations data: four groups of countries based on their fertility levels in 1950-55—from high (greater than 6.5 births per woman) to low (3.5 births per woman or less)—and nine groups of countries by geographical region. It can be seen in Table A2 that, in all cases except two "outlier" countries—Niger and Cape Verde in Western Africa—RCS exhibits the expected significant negative effect on TFR. Infant mortality, on the other hand, retains its positive statistical significance in only 4 of the 13 regressions presented in Table A2.

It is interesting to note the very strong effects which are estimated for the Western developed nations as a group (in Tables A1 and A2): a large and very significant negative effect of relative cohort size, as hypothesized by Easterlin. Probably the most significant aspect of relative cohort size with respect to fertility, however, is its apparently unique identification of the *turning point* when the fertility transition is initiated, which is so evident throughout Figures A1-A8.

Asymmetric Effects of Relative Cohort Size on Fertility

But many readers will have noted that the Total Fertility Rate in all countries continues to decline, once it has started the transition, often despite a subsequent *decrease* in relative cohort size. Aren't the effects of RCS on fertility supposed to be symmetrical, with an increase causing the TFR to decline and a decrease causing it to rise? That has been the expectation among academics who have tested for cohort size effects on fertility in the MDCs (Macunovich 1998a). Why don't we observe fertility *increasing again* in countries during the fertility transition, once relative cohort size begins to abate?

However, as demonstrated by Macunovich (1998b,1999a,1999b), 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 we should not expect them to be symmetrical in terms of fertility.[2] Even if decreasing relative cohort size exerts a positive effect on fertility, that positive force is counteracted to some extent by the depressing effect of the economic slowdown induced by a turnaround in cohort size.

Perhaps more importantly however, it seems likely that the relative deprivation felt by large young cohorts in currently developing countries, and their consequent desire to reduce fertility in order to improve economic status, might mark a turning point in a society's attitudes with regard to contraception, and with regard to the individual's—as opposed to society's—right to control fertility. Easterlin (1978) 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 existed—that of limiting family size—and thereby the 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. (p.123)"

He cited Bourgeois-Pichat (1967), Wrigley (1969) and Srinivasan (1972) in describing the shift from "social sanctions" to "family sanctions" in determining fertility—the development of deliberate individual control which is a fundamental aspect of 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. That strong negative "cascade" effect would also counteract any positive effect on fertility, of declining relative cohort size.

We can test for this type of asymmetry econometrically using the 1998 United Nations population and fertility data, with an approach similar to the one adopted for relative income in Macunovich (1998b,1999a,1999b): we can look at the effect of the *rate of change* in relative cohort size, as well as the effect of relative cohort size itself. The hypothesis is that a positive rate of change will tend to slow the decline in fertility when cohort size is rising, while a negative rate of change will tend to dampen fertility increases when cohort size is declining.

Our measure of the rate of change in RCS is very crude, however, since we have only quinquennial observations between 1950 and 1995, and we hypothesize 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. Five-yearly observations give us only a very weak identification of that point of transition.

RCS	**-1.355**	**-2.038**
	-0.189	*-0.285*
	(-8.0)	*(- 8.3)*
RCS change		**1.100**
		0.176
		(4.5)
infant mortality	**0.276**	**0.291**
	0.090	*0.095*
	(3.1)	*(3.3)*
lagged TFR	**0.371**	**0.311**
	0.374	*0.314*
	(7.0)	*(6.6)*
No. of obs	**1316**	**1316**
adj R-sq	**0.3385**	**0.3464**

The dependent variable is the first difference of the Total Fertility Rate (TFR).
All independent variables are expressed as first differences.
t-statistics are italicized in parentheses, and standardized coefficient estimates are in italics.

Table 3: Estimation of asymmetric effects of relative cohort size and infant mortality on the Total Fertility Rate in 189 countries between 1950 and 1995, using OLS regression.

Despite the weakness in our measure of change in cohort size, however, there are fairly strong and significant effects of a change variable, with the expected positive sign, as demonstrated in Table 3. Table 3 repeats the results which were presented in Table 2, and adds in the second column a set of results in which the basic model is supplemented with an RCS change variable. The second column in Table 3 is, once again, an abbreviated version of regression results which are presented in full in the Appendix—this time in Table A3.[3]

In this extended model, the positive effect 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 fertility in subsequent years. This cascade effect together with the asymmetry of the relative cohort size effect accounts for the continuing decline of the TFR even once RCS has begun to decline in these developing nations.

Conclusions

The attempt here has been to demonstrate that changes in relative cohort size are important in determining the pattern of fertility—not just in developed countries, but perhaps even more importantly in countries as they pass through the demographic transition. The increase in relative cohort size which occurs as a result of declining mortality rates during the demographic transition, acts as the mechanism of transmission which determines *when* the fertility portion of the transition begins. The increasing proportion of young adults would generate a downward pressure on young men's relative wages, which in turn would cause young adults to accept a trade-off between family size and material well-being. This acceptance of a trade-off could mark a turning-point in a society's acceptance of contraception, setting in motion a "cascade" or "snowball" effect in which total fertility rates tumble as social norms regarding acceptable family sizes begin to change.

This seems to be an aspect of the demographic transition which has been overlooked in the past, because of a focus on *absolute* rather than relative income, which 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 reductions in *infant* mortality, until mortality rates fall among *children and young adults*, permitting the proportion of those aged 15 to 24 to rise relative to those aged 25 and over. According to Richard Easterlin's (1980) 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 which has begun the fertility transition since 1950—more than one hundred in all—and evidence suggests that this was the case in earlier transitions as well.

These results are consistent with the hypotheses put forward by Watkins (1990), who suggested that "market integration" was one reason for a notable 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 cohort size. Similarly, Coale and Watkins (1986) found that fertility patterns in various cities in Europe generally resembled those in the cities' own hinterlands (i.e., market areas) more than they did those in other cities.

Thus, relative cohort size can be thought of as the mechanism which prevents excessive rates of population change—reducing fertility when previous high rates, in combination with low mortality rates, have caused relative cohort size to increase, and increasing fertility when previous low rates have caused relative cohort size to decline. It 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 the transmission of relative cohort size effects, to male relative income.

Endnotes

1. This is unfortunately a fairly crude measure of relative cohort size, since the younger and older members of the 25 to 59 age group are fairly good substitutes for those aged 15 to 24, but it is the only measure permitted by the available data.

2. Two effects are important here. First, as demonstrated in Macunovich (1998c), increases in relative cohort size produce strong 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, these 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. And, as demonstrated in Macunovich (1998b, 1999a,1999b) 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 effects leads to asymmetry in the effects of relative cohort size on relative wages.

3. Similar effects have been obtained, in results available from the author, using more aggregated data; that is, when the 1950-1995 data for countries are aggregated up to the United Nations' 20 world regions.

KEY TO REGIONAL GROUPINGS OF COUNTRIES:

FIRST WORLD:

North America:

- USA
- Canada

Oceania:

- Australia
- New Zealand

Western Europe:

- Austria
- Belgium
- France
- United Germany
- former West Germany
- Luxembourg
- Netherlands
- Switzerland

Northern Europe:

- Denmark
- Finland
- Iceland
- Ireland
- Norway
- Sweden
- UK

Southern Europe:

- Albania
- Greece
- Spain
- Portugal
- Malta
- Italy

SECOND WORLD:

- Belarus
- Bosnia Herzegovina
- Bulgaria
- Croatia
- Czechoslovakian Republic
- Estonia
- Georgia
- German Democratic Republic
- Hungary
- Latvia
- Lithuania
- Moldova
- Poland
- Romania
- Russian Federation
- Slovakia
- Slovenia
- Ukraine
- former Czechoslovakia
- former USSR
- former Yugoslavia
- former Yugoslav Rep.of Macedonia

South America:

- Argentina
- Bolivia
- Brazil
- Chile
- Colombia
- Ecuador
- Guyana
- Paraguay
- Peru
- Suriname
- Uruguay
- Venezuela

Central America & the Caribbean:

- Belize
- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama

Caribbean:

- Bahamas
- Barbados
- Cuba
- Dominican Republic
- Guadeloupe
- Haiti
- Jamaica
- Martinique
- Netherlands Antilles
- Puerto Rico
- Trinidad and Tobago

East, SE and South-Central Asia:

East Asia:

China
Dem.Peoples' Rep.of Korea
Hong Kong
Japan
Macau
Mongolia
Rep. Of Korea

SE Asia:

Brunei
Cambodia
East Timor
Indonesia
Lao
Malaysia
Myanmar
Philippines
Singapore
Thailand
Viet Nam

Pacific Islands:

Fiji
New Caledonia
Papua New Guinea
Solomon Islands
Vanuatu
Guam
French Polynesia
Samoa

South-Central Asia:

Afghanistan
Bangladesh
Bhutan
India
Iran
Kazakstan
Kyrgyzstan
Maldives
Nepal
Pakistan
Sri Lanka
Tajikistan
Turkmenistan
Uzbekistan

West Asia & North Africa:

West Asia:

Armenia
Azerbaijan
Bahrain
Cyprus
Gaza Strip
Iraq
Israel
Jordan
Kuwait
Lebanon
Oman
Qatar
Saudi Arabia
Syrian Arab Republic
Turkey
United Arab Emirates
Yemen

North Africa:

Algeria
Egypt
Libyan Arab Republic
Morocco
Sudan
Tunisia
Western Sahara

Middle, West & Southern Africa:

Middle Africa:

Angola
Cameroon
Central African Republic
Chad
Congo
Dem. Rep. Of the Congo
Equatorial Guinea
Gabon

Western Africa:

Benin
Burkina Faso
Cape Verde
Cote d'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Mauritania
Niger
Nigeria
Senegal
Sierra Leone

Togo

Southern Africa:

Botswana
Lesotho
Namibia
South Africa
Swaziland

<u>Eastern Africa</u>:

Burudi
Comoros
Djibouti
Eritrea
Ethiopia
Kenya
Madagascar
Malawi
Mauritius
Mozambique
Reunion
Rwanda
Somalia
Uganda
United rep. Of Tanzania
Zambia
Zimbabwe

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Model with All Interactions				Parsimonious Model			
	Relative Cohort Size	*Lagged TFR*	*Infant Mortality*	*Intercept*	*Relative Cohort Size*	*Lagged TFR*	*Infant Mortality*	*Intercept*
Basic model (First World)	**-1.884**	0.373	0.132	-0.071	**-1.355**	**0.371**	**0.276**	**-0.057**
	-0.263	*0.376*	*0.043*		***-0.189***	*0.374*	*0.090*	
	(-2.7)	*(3.9)*	*(0.6)*	*(-1.3)*	***(-8.0)***	*(7.0)*	*(3.1)*	*(-2.2)*
regional interactions:								
South America	-0.177	-0.265	0.254	0.006		**-0.170**		
	-0.006	*-0.089*	*0.029*	*0.004*		*-0.057*		
	(-0.2)	*(-1.7)*	*(0.5)*	*(0.1)*		*(-2.2)*		
Central America & Caribbean	0.828	-0.226	0.445	0.055		**-0.113**		
	0.041	*-0.104*	*0.082*	*0.044*		*-0.052*		
	(0.9)	*(-1.6)*	*(1.0)*	*(0.6)*		*(-1.8)*		
East, SE & South-Central Asia	1.083	-0.392	0.449	0.032		**-0.270**		
	0.089	*-0.267*	*0.108*	*0.034*		*-0.184*		
	(1.3)	*(-3.1)*	*(1.2)*	*(0.4)*		*(-5.3)*		
West Asia & North Africa	1.048	-0.030	0.240	0.134				
	0.068	*-0.012*	*0.048*	*0.118*				
	(1.1)	*(-0.2)*	*(0.6)*	*(1.4)*				
East Africa	0.566	0.068	0.051	0.176				**0.121**
	0.013	*0.015*	*0.004*	*0.129*				*0.089*
	(0.4)	*(0.4)*	*(0.1)*	*(1.8)*				*(3.5)*
Middle, West & Southern Africa	1.255	0.101	0.794	0.601			**0.565**	**0.532**
	0.029	*0.021*	*0.102*	*0.163*			*0.073*	*0.144*
	(0.9)	*(0.6)*	*(1.7)*	*(2.2)*			*(2.0)*	*(2.1)*
Niger & Cape Verde	4.407	-0.681	6.646	0.280	**4.033**	**-0.655**	**6.432**	**0.240**
	0.128	*-0.091*	*0.178*	*0.263*	*0.117*	*-0.088*	*0.172*	*0.225*
	(3.3)	*(-2.4)*	*(2.3)*	*(3.1)*	*(4.0)*	*(-2.6)*	*(2.3)*	*(6.2)*
Second World	0.969	-0.494	-0.009	-0.034		**-0.424**		
	0.042	*-0.135*	*-0.002*	*-0.029*		*-0.116*		
	(1.2)	*(-3.8)*	*(0.0)*	*(-0.5)*		*(-4.5)*		
fertility-level interactions:								
3.51 - 5.5	-0.815	0.107	-0.038	-0.167				**-0.163**
	-0.063	*0.061*	*-0.009*	*-0.161*				*-0.157*
	(-1.0)	*(0.8)*	*(-0.1)*	*(-2.1)*				*(-5.6)*
5.51 - 6.5	-0.573	0.343	-0.947	-0.248		**0.261**	**-0.696**	**-0.213**
	-0.038	*0.207*	*-0.217*	*-0.291*		*0.158*	*-0.159*	*-0.250*
	(-0.6)	*(2.5)*	*(-2.5)*	*(-2.9)*		*(4.4)*	*(-3.8)*	*(-5.7)*
>6.5	0.155	0.407	-0.071	-0.152		**0.384**		**-0.097**
	0.013	*0.264*	*-0.017*	*-0.192*		*0.249*		*-0.123*
	(0.2)	*(2.9)*	*(-0.2)*	*(-1.8)*		*(6.5)*		*(-3.5)*
Number of obs				1316				1316
F-Statistic				15.55				34.65
Adjusted R-square				0.3422				0.3385

[*] excluding Niger and Cape Verde
Dependent variable is the year-to-year change in the Total Fertility Rate (TFR).
Relative Cohort Size is the ratio of population aged 15-24 to those aged 25-59.
All variables expressed as first differences.
t-statistics in italics and parentheses, standardized coefficients in italics below estimated coefficients.

Appendix Table A1: Estimated effects of a change in Relative Cohort Size (RCS) on the Total Fertility Rate (TFR) in 189 countries between 1950-1995, using an aggregate time-series cross-section model with full interaction terms for eight regions and three 1950-55 fertility levels.

	(1) Relative Cohort Size	(2) Lagged TFR	(3) Infant Mortality	(4) Intercept	(5) No.of obs (Adj.R-sq)
By Region:					
South America	**-2.041 *(-2.9)***	0.526 *(5.5)*	-0.043 *(-0.1)*	-0.221 *(-3.5)*	84
	-0.286	0.570	-0.012		(0.2668)
Central America & Caribbean	**-1.531 *(-3.0)***	0.408 *(5.4)*	0.262 *(1.0)*	-0.213 *(-3.6)*	133
	-0.233	*0.448*	*0.079*		(0.2335)
East, SE & South-Central Asia	**-1.352 *(-3.1)***	0.258 *(4.5)*	0.077 *(0.4)*	-0.259 *(-5.6)*	280
	-0.185	*0.264*	*0.021*		(0.0799)
West Asia & North Africa	**-0.947 *(-2.7)***	0.728 *(11.3)*	0.379 *(2.1)*	-0.070 *(-1.7)*	168
	-0.162	*0.669*	*0.126*		(0.4335)
East Africa	**-1.298 *(-1.6)***	0.772 *(9.4)*	-0.256 *(-0.9)*	-0.072 *(-2.2)*	112
	-0.121	*0.696*	*-0.064*		(0.4352)
Middle, West & Southern Africa*	**-1.136 *(-2.1)***	0.796 *(13.5)*	0.070 *(0.5)*	-0.026 *(-1.5)*	196
	-0.106	0.727	0.028		(0.5245)
Niger & Cape Verde	**2.679 *(2.4)***	0.099 *(0.4)*	6.708 *(2.2)*	0.378 *(1.3)*	14
	0.555	*0.095*	*0.479*		(0.5779)
Second World	**-0.978 *(-2.6)***	0.033 *(0.5)*	0.183 *(1.3)*	-0.113 *(-3.6)*	156
	-0.208	*0.039*	*0.107*		(0.0407)
First World	**-2.044 *(-4.5)***	0.473 *(7.9)*	-0.024 *(-0.1)*	-0.125 *(-3.3)*	173
	-0.294	*0.518*	*-0.010*		(0.2963)
By fertility level in 1950-55:					
<= 3.5	**-0.965 *(-2.7)***	0.187 *(3.2)*	0.137 *(1.2)*	-0.085 *(-3.4)*	280
	-0.158	*0.191*	*0.073*		(0.0641)

Appendix Table A2: Estimates for 1950-1995 of the effects of a change in Relative Cohort Size (RCS) on the Total Fertility Rate (TFR) in 189 countries grouped by region and by fertility level in 1950-55.

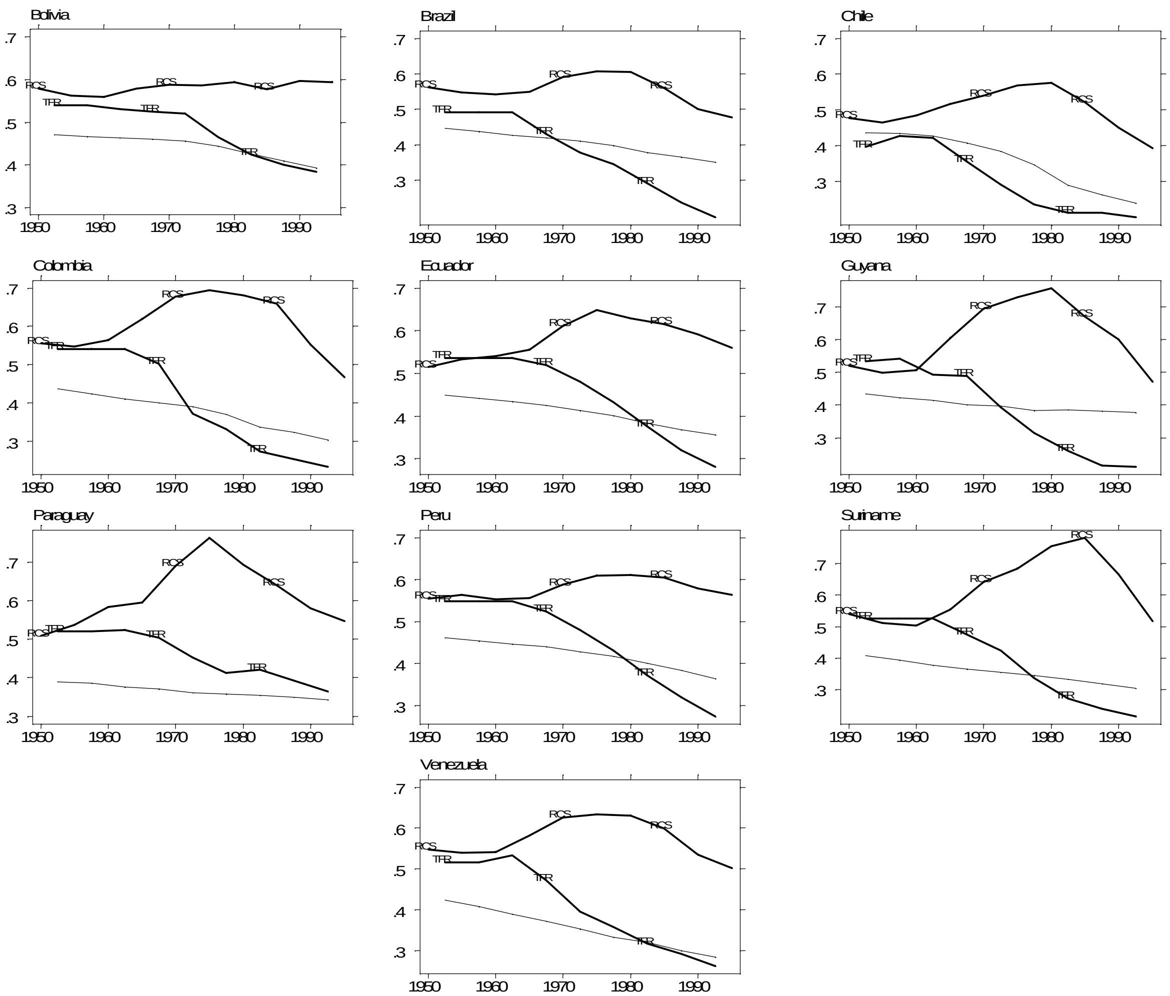
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Full Model with All Interactions					Parsimonious Model				
	Relative Cohort Size	*Change in RCS*	*Lagged TFR*	*Infant Mortality*	*Inter-cept*	*Relative Cohort Size*	*Change in RCS*	*Lagged TFR*	*Infant Mortality*	*Inter-cept*
Basic model	**-2.805**	**1.806**	0.350	0.162	-0.064	**-2.038**	**1.100**	**0.311**	**0.291**	**-0.057**
(First World)	**-0.392**	**0.289**	0.353	0.053	.	**-0.285**	**0.176**	0.314	0.095	.
	(-3.4)	**(2.3)**	(3.7)	(0.7)	(-1.2)	**(-8.3)**	**(4.5)**	(6.6)	(3.3)	(-2.2)
regional interactions:										
South America	0.168	0.277	-0.272	0.194	-0.010			**-0.147**		
	0.005	0.007	-0.091	0.022	-0.007			-0.049		
	(0.1)	(0.2)	(-1.7)	(0.4)	(-0.1)			(-2.0)		
Central	2.024	-2.041	-0.130	0.271	0.044		**-1.096**			
America &	*0.101*	*-0.106*	*-0.060*	*0.050*	*0.035*		*-0.057*			
Caribbean	*(1.8)*	*(-1.9)*	*(-0.9)*	*(0.6)*	*(0.5)*		*(-2.3)*			
East, SE &	1.617	-0.976	-0.342	0.408	0.030			**-0.247**		
South-Central	*0.133*	*-0.092*	*-0.233*	*0.098*	*0.032*			*-0.169*		
Asia	(1.5)	(-1.0)	(-2.6)	(1.0)	(0.3)			(-5.5)		
West Asia &	2.207	-1.837	0.039	0.129	0.123	**0.840**	**-0.843**			
North Africa	0.143	-0.152	0.016	0.026	0.108	0.054	-0.070			
	(2.0)	(-1.8)	(0.3)	(0.3)	(1.3)	(1.7)	(-2.0)			
East Africa	0.728	0.059	0.118	0.002	0.177					**0.120**
	0.017	0.001	0.026	0.000	0.130					0.088
	(0.4)	(0.0)	(0.7)	(0.0)	(1.8)					(3.5)
Middle, West	1.870	-1.049	0.165	0.721	0.562				**0.598**	**0.247**
& Southern	*0.043*	*-0.025*	*0.035*	*0.093*	*0.152*				*0.077*	*0.232*
Africa	(1.1)	(-0.7)	(0.9)	(1.5)	(2.1)				(2.2)	(6.4)
Niger &	3.786	0.814	-0.452	5.576	0.279	**3.966**		**-0.550**	**6.008**	**0.516**
Cape Verde	0.110	0.023	-0.061	0.150	0.262	0.115		-0.074	0.161	0.140
	(2.3)	(0.6)	(-1.6)	(2.0)	(3.1)	(3.9)		(-2.2)	(2.1)	(2.0)
Second World	2.412	-2.377	-0.422	-0.144	-0.047	**1.090**	**-1.355**	**-0.375**		
	0.104	*-0.135*	*-0.116*	*-0.029*	*-0.040*	*0.047*	*-0.077*	*-0.103*		
	(2.4)	*(-2.7)*	*(-3.2)*	*(-0.5)*	*(-0.7)*	*(1.6)*	*(-2.5)*	*(-4.1)*		
fertility-level interactions:										
3.51 - 5.5	-1.197	0.445	0.021	0.126	-0.161					**-0.166**
	-0.093	0.039	0.012	0.030	-0.156					-0.161
	(-1.2)	(0.5)	(0.2)	(0.4)	(-2.1)					(-5.7)
5.51 - 6.5	-0.468	-0.413	0.304	-0.915	-0.253			**0.266**	**-0.715**	**-0.215**
	-0.031	*-0.029*	*0.184*	*-0.209*	*-0.297*			*0.161*	*-0.164*	*-0.252*
	(-0.4)	*(-0.4)*	*(2.2)*	*(-2.3)*	*(-3.0)*			*(4.5)*	*(-3.9)*	*(-5.8)*
>6.5	-0.086	-0.008	0.363	-0.002	-0.150			**0.407**		**-0.094**
	-0.007	*-0.001*	*0.236*	*-0.001*	*-0.189*			*0.264*		*-0.118*
	(-0.1)	*(0.0)*	*(2.5)*	*(0.0)*	*(-1.7)*			*(6.9)*		*(-3.4)*
Number of obs					1316					1316
F-Statistic					13.06					28.87
Adjusted R-square					0.3512					0.3464

[*]excluding Niger and Cape Verde
Dependent variable is the year-to-year change in the Total Fertility Rate (TFR).
Relative Cohort Size is the ratio of population aged 15-24 to those aged 25-59.

All variables expressed as first differences.

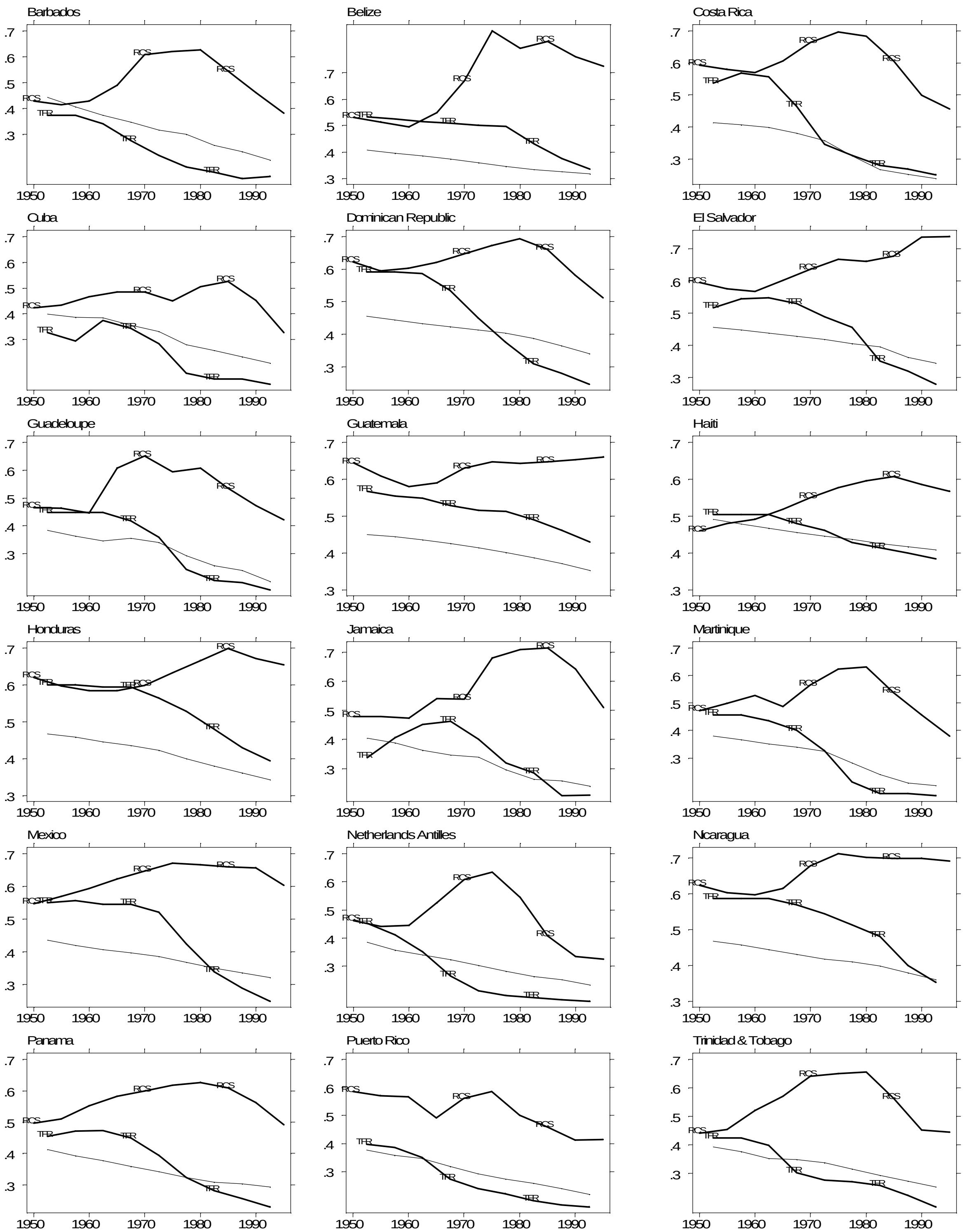
t-statistics in italics and parentheses, standardized coefficients in italics below estimated coefficients.

Appendix Table A3: Estimated effects, allowing for asymmetry, of a change in Relative Cohort Size (RCS) on the Total Fertility Rate (TFR) in 189 countries between 1950-1995, using an aggregate time-series cross-section model with full interaction terms for eight regions and three 1950-55 fertility levels.



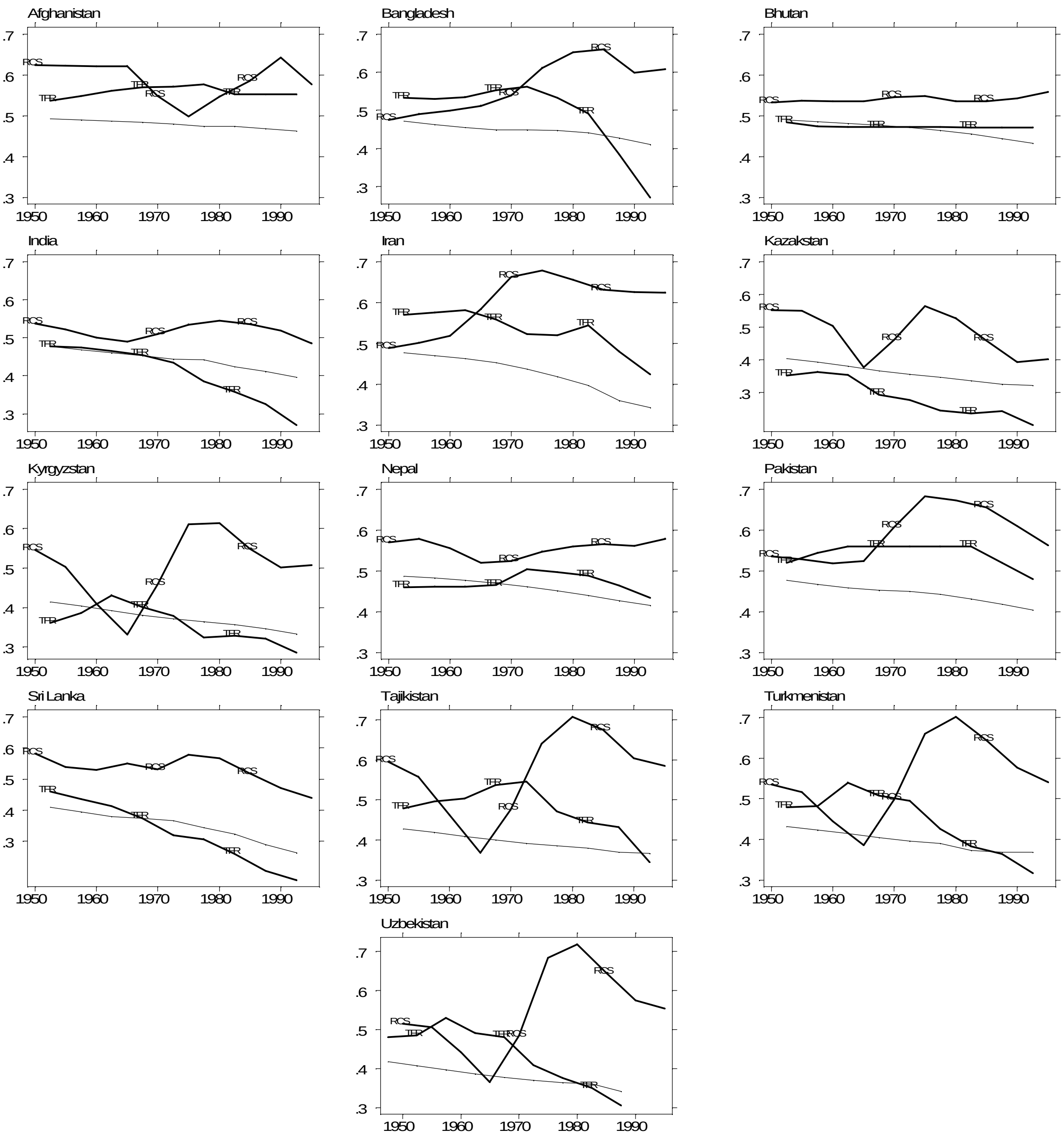
Appendix Figure A1: South American countries in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality, 1950-1995.

Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.

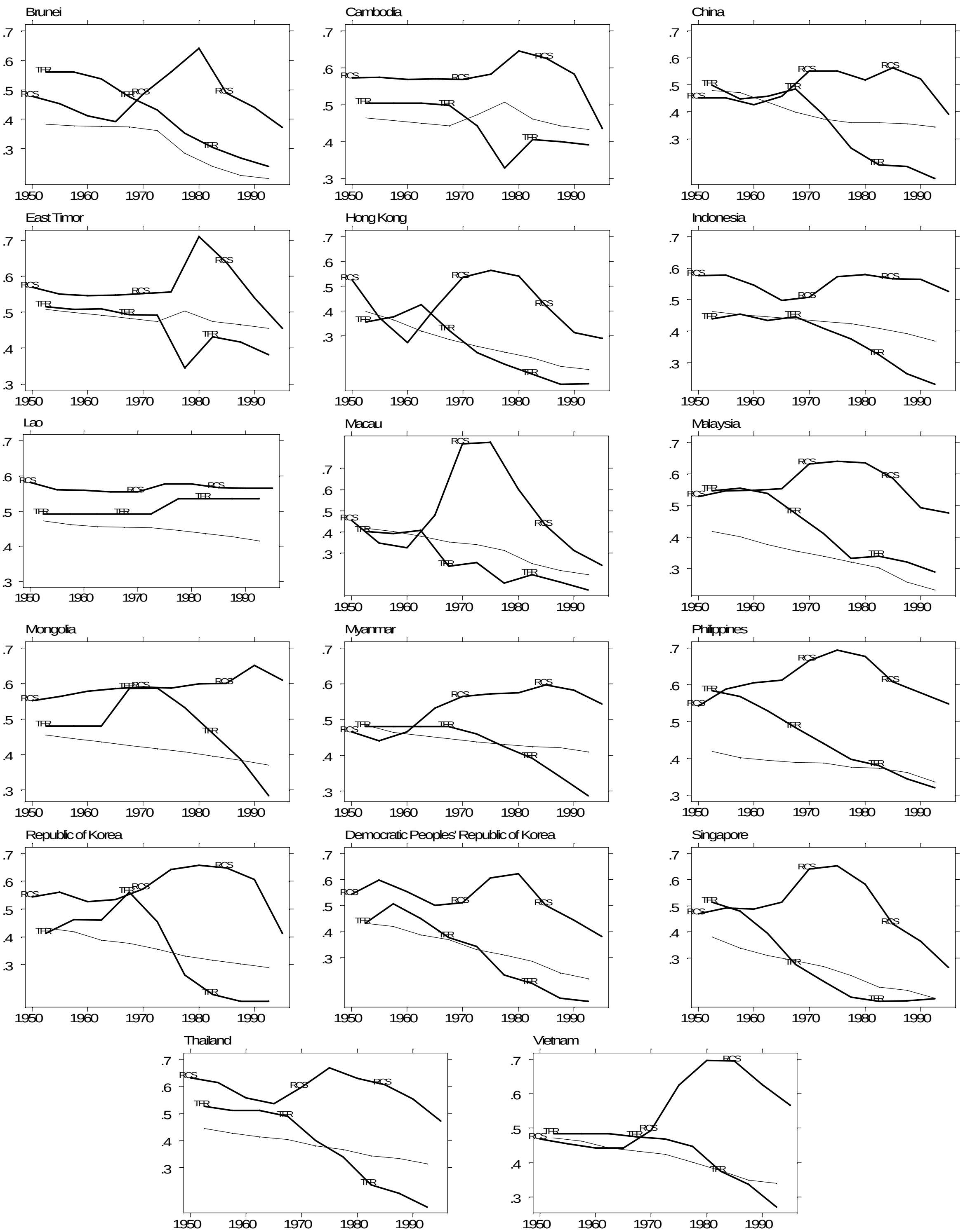


Appendix Figure A2 : Central American and Caribbean countries in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality, 1950-1995.

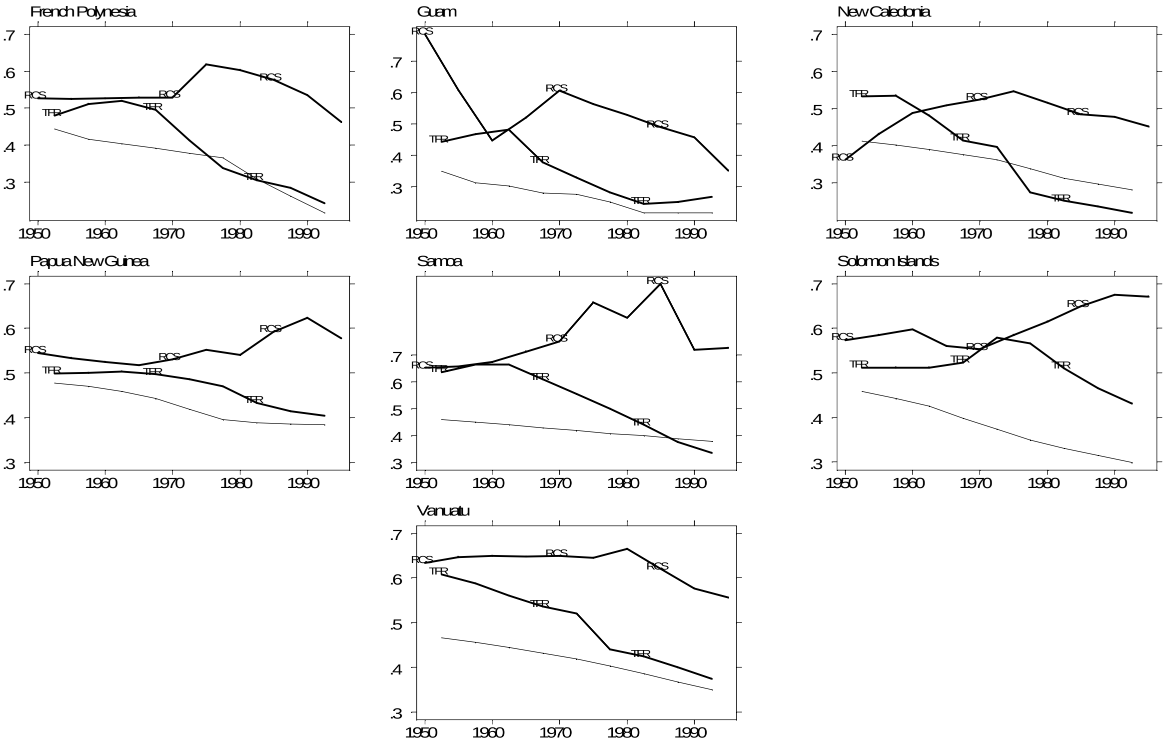
Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11



Appendix Figure A3: South_Central Asian countries in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (the solid unmarked line), 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*

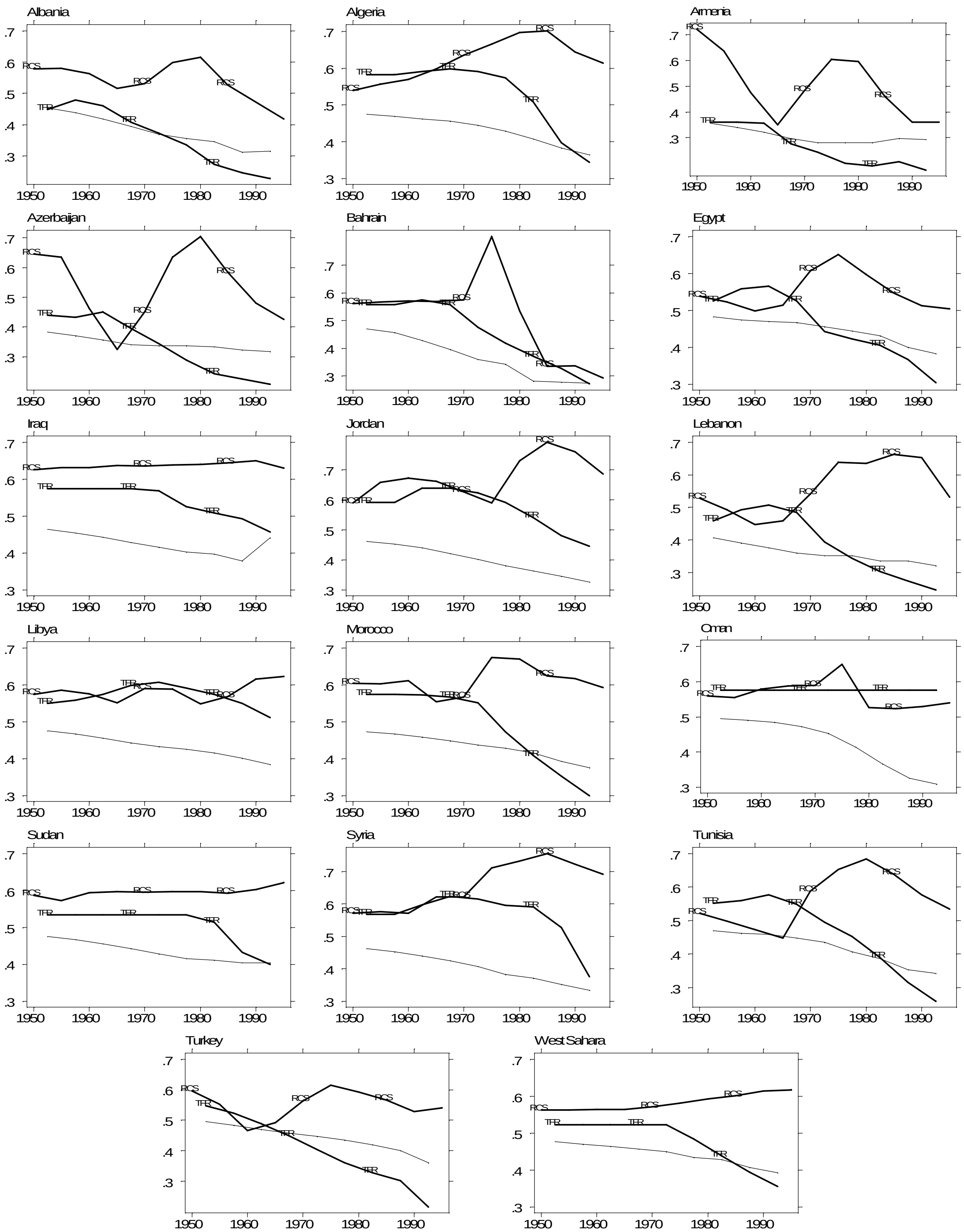


Appendix Figure A4: East and South-East Asian countries in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (the solid unmarked line), 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*

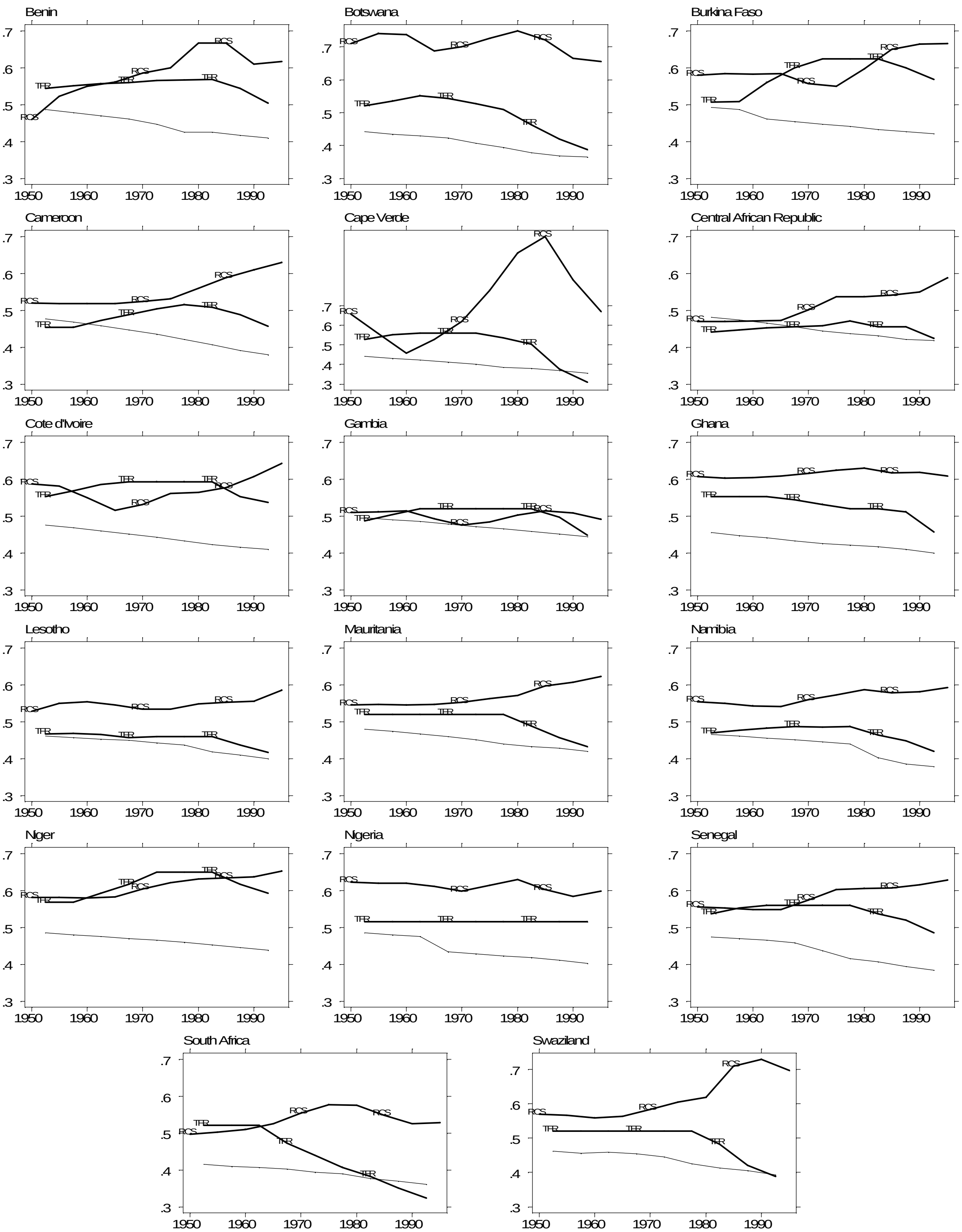


Appendix Figure A5: Pacific Islands in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (the solid unmarked line), 1950-1995.

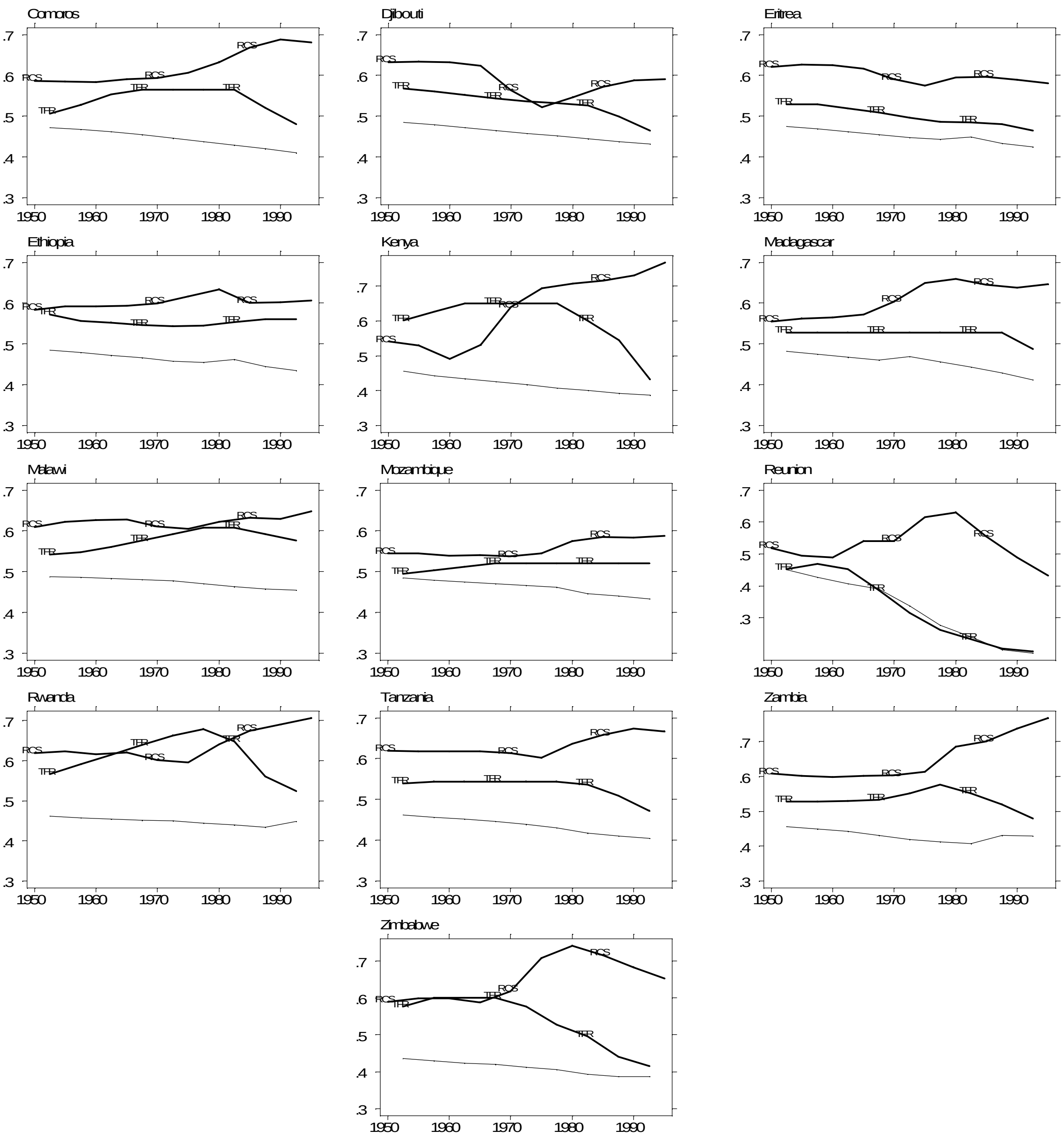
Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.



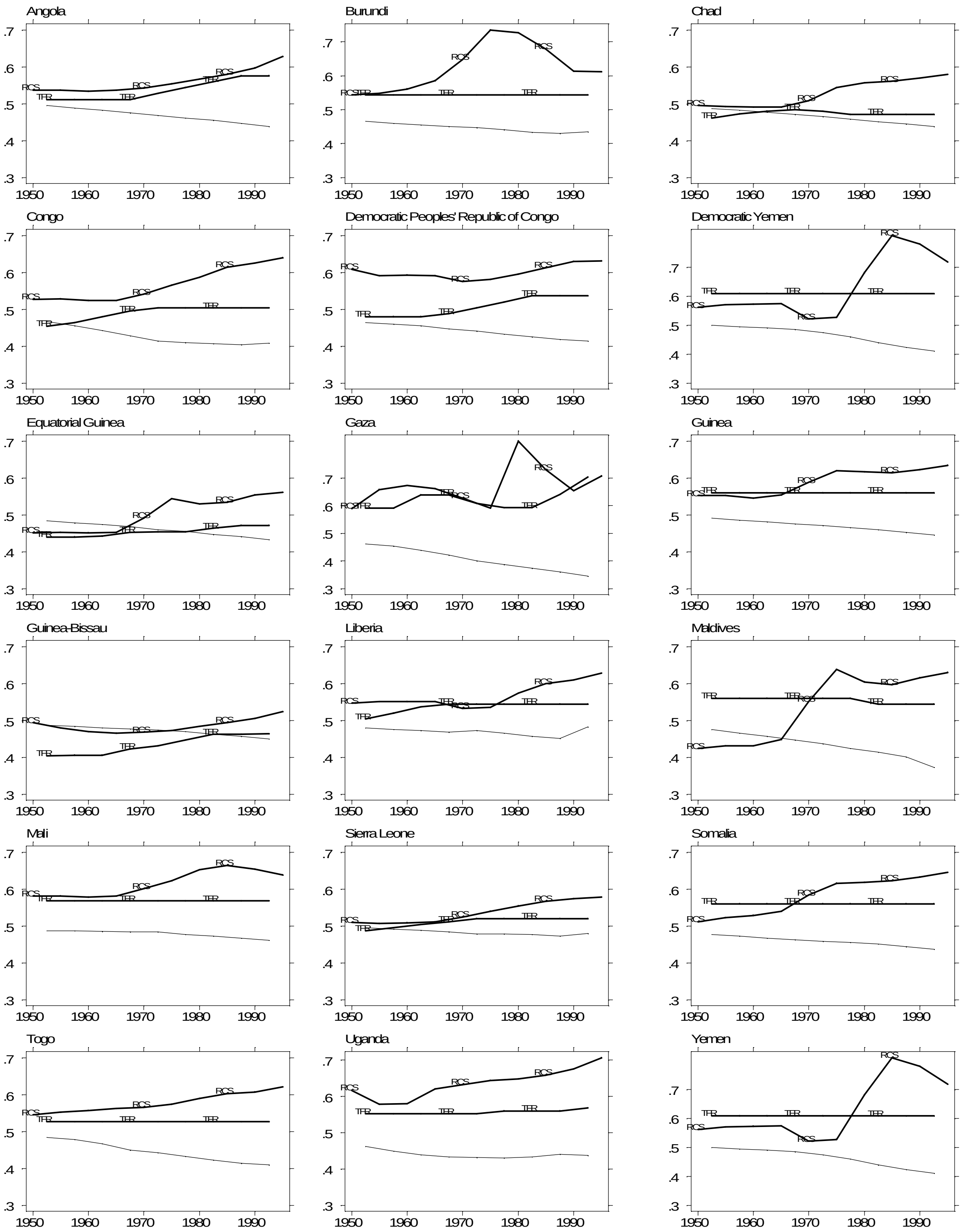
Appendix Figure A6: West Asian and North African countries (and Albania) in transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality, 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*



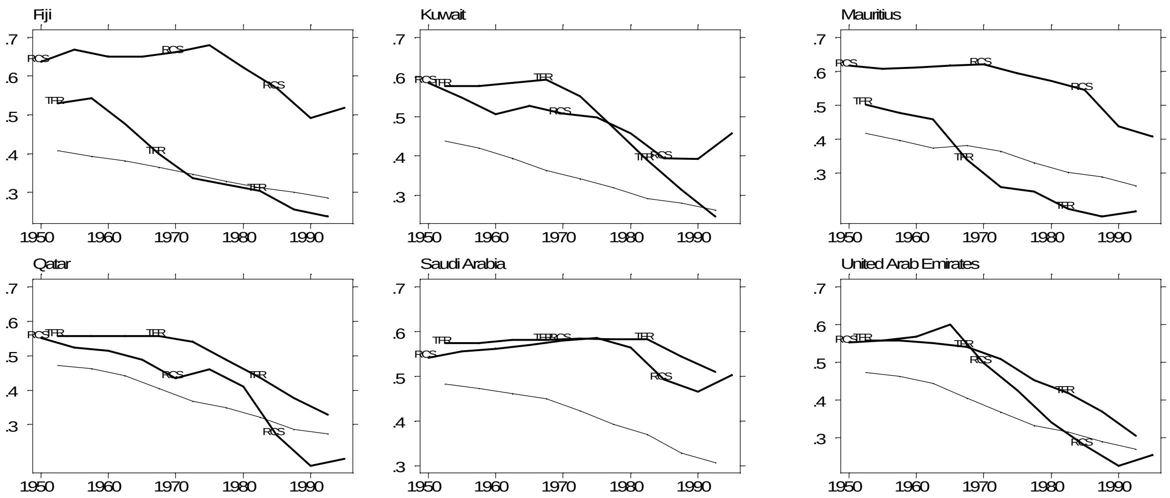
Appendix Figure A7: Western , Middle, and Southern African countries in—or approaching— transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (solid unmarked line), 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*



Appendix Figure A8: East African countries in—or approaching—transition: the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality (solid unmarked line), 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*



Appendix Figure A9: Countries which do not fit the standard pattern of the relationship between the Total Fertility Rate (TFR), relative cohort size (RCS), and infant mortality in developing regions of the world, 1950-1995. *Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.*



Appendix Figure A10: Countries which began the fertility transition with a declining RCS , 1950-1995.
Source: United Nations (1998). RCS = ratio of population aged 15-24 to population aged 25-59; TFR has been scaled by dividing by 12.5; infant mortality (in deaths per 1000) has been scaled by logging and dividing by 11.

Bibliography

Caldwell, J.C. 1997. "The Global Fertility Transition: The Need for a Unifying Theory," *Population and Development Review,* 23(4): 803-812.

Caldwell, J.C. and P. Caldwell. 1997. "What Do We Now Know About Fertility Transition?" In G.W. Jones, R.M. Douglas, J.C. Caldwell, and R.M. D'Souza (eds), *The Continuing Demographic Transition*. Oxford: Clarendon Press, pp. 15-25.

Coale, A.J. and S.C. Watkins. 1986. *The Decline of Fertility in Europe*. Princeton, NJ: Princeton University Press.

Easterlin, R.A. 1966. "Economic-Demographic Interactions and Long Swings in Economic Growth," *American Economic Review*, 56(5): 1063-1104.

Easterlin, R.A. 1969. "Towards a Socioeconomic Theory of Fertility: A Survey of Recent Research on Economic Factors in American Fertility." In S.J. Bereman, L. Corsa, and R. Freedman (eds), *Fertility and Family Planning: A World View*. Ann Arbor, MI: University of Michigan Press, pp. 127-156.

Easterlin, Richard A. 1978. "The Economics and Sociology of Fertility: A Synthesis." In Charles Tilly (ed), *Historical Studies of Changing Fertility*. Princeton University Press, Princeton, NJ.

Easterlin, R.A. 1980. *Birth and Fortune: The Impact of Numbers on Personal Welfare*. New York: Basic Books.

Easterlin, R.A. 1987. "Easterlin Hypothesis." In J. Eatwell, M. Milgate, P. Newman (eds), *The New Palgrave: A Dictionary of Economics 2*. New York: Stockton Press, pp. 1-4.

Easterlin, R.A. 1996. *Growth Triumphant: The Twenty-First Century in Historical Perspective*. Ann Arbor, MI: University of Michigan Press.

Easterlin, R.A. and E. Crimmins. 1985. *The Fertility Revolution: A Supply-Demand Analysis*. Chicago, IL: University of Chicago Press.

Keyfitz, N. and W. Flieger. 1968. *World Population: An Analysis of Vital Data*. Chicago, IL: University of Chicago Press.

Lavely, W. and R. Freedman. 1990. "The Origins of the Chinese Fertility Decline," *Demography*, 27(3): 357-367.

Macunovich, D.J. 1996. "Relative Income and Price of Time: Exploring Their Effects on U.S. Fertility and Female Labor Force Participation." In *Fertility in the United States: New*

Patterns, New Theories, Population and Development Review, supplement to Volume 22: 223-257.

Macunovich, D.J. 1998a. "Fertility and the Easterlin Hypothesis: An Assessment of the Literature," *Journal of Population Economics*, 11: 1-59

Macunovich, D.J. 1998b. "Relative Cohort Size and Inequality in the U.S.," *American Economic Review (Papers and Proceedings)*, 88(2): 259-264.

Macunovich, D.J. 1998c. "The Baby Boom As It Ages: How Has It Affected Patterns of Consumption and Saving in the U.S.?" CPR Working Paper No. 7, Center for Policy Research, The Maxwell School. Syracuse, NY: Syracuse University.

Macunovich, D.J. 1998d. "Race and Relative Income/Price of Time Effects on U.S. Fertility," *Journal of Socio-Economics*, 27(3): 365-400.

Macunovich, D.J. 1999a. "The Fortunes of One's Birth: Relative Cohort Size and the Youth Labor Market in the U.S.," *Journal of Population Economics*, forthcoming spring.

Macunovich, D.J. 1999b. "Why the Baby Bust Cohorts Haven't Boomed Yet: A Re-Examination of Cohort Effects on Wage Inequality in the U.S." In Ray Marshall (ed.), *Restoring Broadly Shared Prosperity*. M.E.Sharpe (forthcoming).

Rostow, W.W. 1998. *The Great Population Spike and After: Reflections on the 21st Century*. Oxford: Oxford University Press.

United Nations. 1998. *World Population Prospects, the 1998 Revision*, Population Studies No.145. New York: United Nations.

United Nations. 1998. "Age Specific Fertility," a document made available by the Population Information Network Gopher of the U.N. at gopher://gopher.undp.org:70/00/ungophers/popin/wdtrends.

Watkins, S.C. 1990. "From Local to National Communities: The Transformation of Demographic Regimes in Western Europe, 1870-1960," *Population and Development Review*, 16(2): 241-272.

Wrigley, E.A. 1969. *Population and History*. New York: McGraw-Hill.

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