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3 Child Mortality and Fertility: Issues in the Demographic Transition of a Migrant Population

Yoram Ben-Porath

3.1 Introduction

The relationship between child mortality and fertility is central in explaining the transition of European populations from high to low levels of fertility. The recent decline in child mortality in several less developed countries has caused a renewed interest in this relationship, and several cross-sectional studies have tried to sharpen some of the issues concerning it.

Several cross-sectional studies have found statistically significant relationships between fertility and child mortality. Some interpret this evidence as indicating a fairly strong and rapid response that would not predict a long lag between turning points in aggregate fertility series after the onset of declining mortality (Schultz 1975). Others tend to view the evidence as showing modest to small response (Preston 1975*a*). As to the aggregate experience over time, there is no dispute concerning the long and variable (across individual countries) lag in the decline in fertility relative to the decline in mortality in Europe. As far as the less developed countries of today are concerned, while Taylor, Newman, and Kelly (1976) (and United Nations 1974) indicate a shorter lag than historically observed, Kuznets (1974), examining the aggregate

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time series of LDCs, emphasizes the sluggishness in the response of fertility to the decline in child mortality.[1]

In this paper I consider the experience of the foreign-born population of Israel from this perspective. Immigration to Israel constituted a sharp change in conditions that is a dramatically speeded-up version of economic and social development for those immigrating from the less developed countries of Asia and Africa. There is no way to assess how much the responses to a shock like this can tell about processes of more continuous change—potentially this can either sharpen what is otherwise confounded with other things or bring out "anomalies" that would make it so unique as to be uninteresting.

In section 3.2 I briefly review some of the main issues in the child-mortality/fertility relationship, then in section 3.3 I present cross-sectional regression models based on the analysis of the experience of individual foreign-born women in Israel. In section 3.4, using mostly the same data, I infer what happened over time abroad and following immigration, then try to fit this together with the cross-sectional findings.

3.2 Some General Issues

Here let me summarize some of the main issues with respect to the mechanism relating fertility to child mortality (see also Schultz 1975; Preston 1975*a*).

3.2.1 Replacement versus Hoarding

The reaction of fertility to child mortality can take two forms: replacement, a sequential response to a death, and what is described as hedging or hoarding—the response to *expected* mortality. If mortality of offspring were only infant mortality, and if there were no fecundity constraints on the number of successful pregnancies, replacement would be the superior mode of response.

The need for hoarding arises when there is a danger of not attaining the desired number of surviving children of the right age and at the right time. Offspring who die as adults may not be replaced by the same mother because she is too old (or has died); or, even if they can be replaced, they would not be available as earners contributing to family income at the necessary time. Situations like this involve uncertainty concerning the number and age distribution of surviving children along the parental life cycle. Hoarding is a natural strategy to cope with the problem, particularly if one has a view of the demand for children as being of the "at least (so many children/sons)" type. It should, however, be stressed that hoarding implies not only a higher expected cost of surviving children, but also higher risk that disposable income will be "too low" for parental or per capita consumption if the number of

surviving children is ex post facto "too large." (Such a risk may be more tolerable with higher income, and this may itself lead to a direct relationship between births and income, for a given level of expected child mortality.)

The distinction between replacement and hoarding is important for at least two reasons: (*a*) quantitatively, the effect on fertility of hoarding in order to achieve a given target is greater than that of replacement (O'Hara 1972*b*); (*b*) replacement is a quick response, and it is natural to expect replacement to generate a close, short-lagged, association between fertility and child mortality. Hoarding, based as it is on expectations, may respond sluggishly to child mortality, depending on the speed at which expected mortality is revised as actual mortality changes.

Classical demographic transition, reflecting a lag of several decades before the decline in aggregate child mortality is followed by a decline in aggregate fertility, would be consistent with the importance of hoarding, but the long lag in aggregate series could also result from a combination of replacement and some countervailing force.

The issue is whether hoarding can be quantitatively distinguished from replacement and, if not, what can be said about the likely dominant mechanism behind the coefficients estimated in cross-sectional studies. These obvious things have to be noted: (1) To the extent that expected mortality is shared by the observation analyzed, obviously it is not reflected in fertility differences and is thus silent. (2) To the extent that expected mortality is strongly correlated with experienced mortality (and any attempt to estimate expected mortality will have to rely heavily on experienced mortality), it cannot be distinguished from replacement. (3) Similarly, to the extent that variables other than experienced mortality affect expected mortality, if they also affect fertility directly, the effect of expected mortality would be confounded with these direct effects. (4) Hoarding may have its larger effect on age at marriage.

In a cross section of countries or regions or social classes, the sample observations are likely to differ in expected mortality, so that hoarding has a chance to contribute to the explanation of differential fertility. This contribution will, however, be empirically expressed through experienced mortality and other variables (schooling, income, etc.) in the fertility equation. The effect of hoarding is based on the reciprocal of surviving probability and should be larger than that of replacement; so in this type of data we should expect larger coefficients if hoarding is indeed important.

In a cross section of households in one country, all shared expectations are, of course, silenced. If people tend to infer from excessive experienced mortality that their future children are less likely to survive, then the estimated effect of experienced mortality includes some hoarding. Obviously, some of the differences in experienced mortality are

systematic, depending on permanent health and environmental characteristics of parents and households. Such factors may operate for more than one generation and reinforce the correlation between expected and experienced mortality. The variables that enter the fertility equations for other reasons will carry some of these effects. In general the correlation between experienced and expected mortality is likely to diminish as the data are more disaggregated. It is also reasonable to expect that in studies where experienced mortality and, say, schooling are included—and particularly where the data are organized sequentially—the coefficient of experienced mortality expresses mostly a replacement mechanism. If hoarding is important, then in a cross section of countries the coefficients of mortality should be larger (in absolute terms) than those of the household studies; and in household studies the coefficient of experienced mortality should be greatly affected by introduction of those other variables. (For a recent attempt to identify hoarding by direct questions on expected mortality see Heer and Wu 1975.)

3.2.2 Rigid and Revised Targets

The simple way of looking at child mortality and fertility is to take a given objective in terms of desired number of children (or sons) and ask how many births are required to attain at least this number of surviving children (with a given level of certainty). The level of experienced or expected child mortality may also affect the target, and the relationship between fertility and child mortality is the net outcome of the effect of mortality on the desired number (or rather profile) of surviving children and the effect of mortality on the number of births necessary to reach the target.

The *experience* of child mortality by itself is analogous to a loss of real income. This loss is likely to increase with the age of the child at death. Targets would be revised according to the relevant income elasticities. The less income-elastic the demand for children (and the lower the income loss associated with the death), the more complete should replacement be. Less than full replacement may occur near the attainment of the (revised) desired number of surviving children, or, more likely, the revision may be distributed over the life cycle, letting the whole time profile of surviving children absorb the downward revision. Some evidence for that is provided in Rutstein (1974) and Ben-Porath (1976*b*).

Expected mortality affects the price of children and generates both an income and a substitution effect against surviving children. If children were to die only after the full parental expenditure on them has been made, then we could say that the elasticity of the number of births with respect to the survival rate (η_{ns}) equals $-(1 + \eta_{n\pi})$, where $\eta_{n\pi}$ is the demand elasticity for children. This would mean that if the demand for

children has an elasticity larger than unity, the response of fertility to increased survival would be direct because the increased demand for survivors increases births by more than the decline in the number of births necessary for one survivor. If we remind ourselves, however, that most of child mortality is infant mortality and only a fraction γ of expenditures on children who would survive is spent on children who do not survive, then this equation becomes $\eta_{ns} = -(1 + \eta_{n\pi}\gamma)$, which implies that the elasticity of demand will have to be larger (in absolute terms) than $1/\gamma$ in order for fertility to respond favorably to increased survival (declining mortality). For reasonable values of γ, the demand for children is not likely to be elastic enough for this condition to be fulfilled. (Incidentally, this would mean that it is incorrect to infer from an inverse relationship between fertility and mortality that the demand for children is inelastic.)

All this rests on the premise that the demand for surviving children in fact will rise when child mortality declines, which is rather inescapable if expenditures on children are treated as an exogenous price.

However, this is not clear if, as argued by O'Hara (1972*a*) and others, there is a substitution from numbers of children to quality as mortality declines; or, as argued by Kuznets (1973, 1974), there is a shift from human lottery to human capital. Under certain conditions it is then possible, but not necessary, that the demand for *surviving* children will decline as mortality declines.[2] It may be reasonable to suggest that the revisions of desired number of surviving children that are related to changing expenditure patterns lag behind this more "technical" response.

The pure effects of the uncertainty associated with high child mortality are difficult to tackle. An attempt to guarantee a given number of survivors is associated, as already indicated, with greater risks concerning the consumption levels of the parents and the children, so that it may reduce the demand for children unless demand is indeed asymmetrically biased toward "at least" a given number of children. Note, however, that where high mortality prevails other risks are greater, so nothing firm can be said here.

3.2.3 Partial versus Global Effects

The discussion of the effects of infant or child mortality on fertility in most microdata (including this study) does not deal explicitly with some associated developments that may lead to quantitative discrepancies—perhaps even to the extent of a change in direction—between the temporal relationships and the partial cross-sectional estimates.

Although the trends of declining mortality do not occur uniformly along the age profile of mortality, the rapid declines in mortality that have occurred in LDCs in the last few decades have not been confined

to children (Stolnitz 1974). The increase in parental life expectancy, unlike the increase in the survival of children, is on the whole likely to be pronatal. First, supply considerations: fewer mothers die when they are still in the childbearing period; fewer marriages are dissolved by the husband's death, and thus the loss of time between marriages and early cessation of pregnancies owing to widowhood are reduced (Ryder 1975). Parental health that improves with declining mortality may increase fecundity (see United Nations 1974; Stolnitz 1974; Sheps and Ridley 1965). Second, demand considerations: the discussion of old-age support is couched in terms of how many births are required to guarantee at least one son for the father when he is, say, 65. Whatever the merits of this, its implications for demand surely depend on the probability that the father will survive to age 65. As mortality declines, the probability that children will survive to a *given* parental age rises more than the probability that they will outlive their parents. As mortality declines, some parents may be afraid that they will survive their children. The issue is not just that of having one surviving supporter, but also that of spreading the heavier burden of support implied by the longer period among more children. This is a partial effect and is likely to be less important in the long run than the simultaneous decline in the desired number of surviving children and the rise in investment in human capital. But the timing of the responses may differ, and we cannot rule out the possibility that at some initial phase the positive effects on demand would stand out.

Beyond this, we have the obvious problem of the correlation between the decline in mortality and other aspects of economic and social change. Other variables may either strengthen or eliminate the effect of declining mortality on fertility, and the relationship between mortality and other variables relevant for fertility varies over time and place and may be different in cross-sectional data and time-series data.

3.2.4 Reverse Causality

The death of children is not necessarily given to the families but rather can be a result of behavior. Parents have discretion as to the amount of care they devote to protecting children from common causes of death, in particular gastrointestinal illnesses. The endogenous element in the decline in child mortality in Europe may have been substantial (Shorter 1975). In our data there is a strong relationship between child mortality and parental schooling. (We have examples of increased child mortality when women have left the house for work and delegated infant care to the older children.) In some cases infant mortality is just another way of regulating family size, where the control of the number of pregnancies is complicated. Thus, families who find themselves with more children than they want would let excess infants die off. Except

for some cursory remarks, I shall not deal with this possibility here (see Kelley, this volume, chap. 7).

3.2.5 Behavior versus Physiology

In the economic-demographic literature there is a distinction between demand and supply factors in the explanation of fertility (see, e.g., Easterlin 1975). Sometimes biological or physiological factors are the dominant determinant of fertility—natural fertility being the effective constraint on the number of births. The postpartum sterility accompanying lactation reduces the number of possible pregnancies. Infant mortality and the interruption of breast-feeding raise the possible number of pregnancies and perhaps the number of live births (Knodel 1968; Jain et al. 1970). When fewer children are desired than would result from uncontrolled fertility, the explanation of fertility response to child mortality must be sought within a demand framework. In the gray area between supply and demand there are social customs that may act as constraints on individual behavior but that in the long run are themselves shaped by the needs of individuals. Breast-feeding customs may belong here, and thus the effect of mortality on fertility via lactation may in part depend on demand considerations. In general we can assume that in populations of low fertility demand considerations are dominant. It is hard to distinguish between supply and demand factors in populations that have high fertility.

But the issue is broader than that. The incidence of child mortality is likely to be correlated with nutrition and health of the mother, which in turn may affect fecundability. Age at menarche is associated with levels of nutrition, and certain diseases affect fecundity within marriage and pregnancy wastage. There is no reason to assume that there is some stable relationship between all these supply effects. It could well be that measures that result in a decline in child death rates directly affect fecundability in some situations more than others. As we will see later, this is an issue of some importance in the present context.

3.3 Micro Cross-sectional Data of the 1961 Census

The 1961 census of population in Israel included a 20% sample of households for which a detailed questionnaire on economic and demographic matters was completed. The unique feature of this population is that most of the adult women were foreign-born and that there is a large population of women who were married before immigration and had had some children abroad. Sample size is large enough to allow separate analyses by woman's country of birth, thus providing the opportunity to do a quasi-international study with a homogeneous body of data. The important pieces of information for our purposes are the

number of births that took place in Israel (BIS), the number of births abroad (BAB) (before immigration), and the number of children born abroad who died before they were five years old (DAB). We know the woman's age when she immigrated and her age at the time of the census; there is no information on the age and sex of the children.

The population considered covers a broad spectrum of countries of origin. Immigration from Asia and Africa was mostly from the Arab countries of the Middle East and North Africa and from Turkey and Iran, with mean levels of completed fertility abroad of approximately six or seven children, of which approximately one out of three or four died by the age of 5. The immigrants classified here as European and American are mostly from Eastern and Central Europe, with completed fertility abroad of two or three children, of which one in seven or eight died by the age of 5. Large, though somewhat narrower, differences are also present in fertility in Israel after immigration.

We can get an initial impression of the mortality-fertility relationship by examining a cross-tabulation of births in Israel by age at immigration and the number of births and deaths that occurred abroad, distinguishing between immigrants from countries in Asia and Africa and those from countries in Europe and America (table 3.1). The number 0.933 in column 2 and row 2–1 means that women who were 25–29 of age when they immigrated and who had had two births abroad (BAB), had 0.933 more children in Israel (ΔBIS) if two of their children died abroad rather than one (2–1). What emerges from the table is the following: (*a*) women with a given number of births abroad (BAB) had more children in Israel if they had lost one or more of the children born abroad; (*b*) the response of fertility to child mortality is in some cases greater than unity, particularly among young women and at low birth orders; (*c*) the particular response to the death of one child tended to be lower for women who were past the mid-thirties when they immigrated; (*d*) given the woman's age at immigration, the response to a death is lower, the greater the number of births she had had before immigration; (*e*) the response to the second or third death of a child is often negative; (*f*) the response of women born in Asia or Africa (AA) is greater than that of women born in Europe or America (EA).

I am concerned mainly not with examining the determinants of desired fertility but rather with the effect of child mortality on fertility. Still, it is impossible to ignore the fact that joint determinants of both may create an inflated impression of the effect of one on the other (even if we go on ignoring the possible causality from fertility to mortality).

The equations estimated include schooling categories of the mother (dummy variables), place of birth of the mother (continent or country), and age variables (age at immigration and age at the time of the census).

The age variables are not attached to the occurrence of a vital event; absence of such information is a drawback of this body of data.

Deaths abroad (DAB) and births abroad (BAB) are introduced into two functional forms: a free-form discrete interaction model (model I; with separate dummy variable for each DAB BAB combination) and a restricted continuous interaction form (model II).[3]

There is no control for child mortality in Israel. The level has been very low, but it is quite clear that it is correlated with child mortality abroad, so that its absence can generate an upward bias in the coefficient of DAB.

In table 3.2, results of model I are presented for women who were 30–34 at immigration and above 40 in 1961, classified in two categories

Table 3.1 **Difference in Births in Israel (△BIS) between Women (aged 40+ in 1961) with Different Numbers of Deaths Abroad (△DAB), by Woman's Continent of Birth, Age at Immigration, and Births Abroad (BAB)**

Age at Immigration and △DAB	Births Abroad (BAB)						
	1	2	3	4	5	6	7
	Women Born in Asia-Africa						
20–24							
1–0		0.236					
2–1							
3⁺–2							
25–29							
1–0	1.031	1.829	1.316	0.222	0.590		
2–1		0.933	−0.116	0.401	−0.223		
3⁺–2				0.635	0.656		
30–34							
1–0	1.740	1.526	0.881	1.289	0.293	0.533	0.321
2–1		1.576	1.039	0.143	0.328	0.242	−0.170
3⁺–2			0.869	−1.106	0.769	−0.053	−0.377
35–39							
1–0	0.127	−0.698	0.662	0.573	0.539	0.234	0.084
2–1				0.701	0.254	0.333	0.033
3⁺–2				−0.167	0.725	0.228	−0.333
40–44							
1–0		1.967	0.079	0.354	0.174	−0.049	0.131
2–1					−0.085	0.656	−0.097
3⁺–2					1.985	−0.304	−0.025
45–49							
1–0			0.320	0.550	−0.261	0.939	0.021
2–1							−0.030
3⁺–2							

Table 3.1 (continued)

Age at Immigration and △DAB	Births Abroad (BAB)						
	1	2	3	4	5	6	7
	Women Born in Europe-America						
20–24							
1–0	1.490						
2–1							
3⁺–2							
25–29							
1–0	0.885	0.932	0.755				
2–1		0.852	−0.158				
3⁺–2							
30–34							
1–0	0.884	0.752	0.035	−0.653			
2–1			−0.804				
3⁺–2							
35–39							
1–0	0.602	0.438	0.182	−0.550			
2–1		0.457	0.117	0.145			
3⁺–2							
40–44							
1–0	0.167	0.094	−0.060	0.138	0.024		
2–1			0.143	−0.190	−0.087		
3⁺–2					0.105		
45–49							
1–0	0.092	−0.006	0.024	−0.044	0.083		
2–1		0.200	0.567	0.205			
3⁺–2							

Source: Based on unpublished CBS data from the 1961 Census of Population.
Note: Foreign-born women, married abroad, married once, and with at least one birth abroad.

by place of birth. There is some reduction in the estimated "effect" of mortality on fertility compared with the tabulations, but essentially the same picture remains true (in spite of the fact that women's education is correlated with fertility and child mortality).

The aggregation of all countries of origin by continent may be too crude given the heterogeneity of the individual countries. Looking now at all women who immigrated when they were ages 15–49 and running separate regressions for each country, pooled with dummy variables for each country and pooled without dummy variables, we see that the country differences turn out to be statistically significant.[4] Most of the country differences are captured by the dummy variables, though the contri-

Table 3.2 **Difference in Births in Israel (△BIS) between Women (aged 30–34 at Immigration and 40+ in 1961) with Different Numbers of Deaths Abroad (△DAB), by Continent of Birth and Births Abroad: Regression Results of an Interaction Model**

△DAB	Births Abroad (BAB)							
	1	2	3	4	5	6	7	8
				Women Born in Asia-Africa				
1–0	1.427	1.201	0.743	1.025	0.084	0.534	0.508	0.038
2–1		1.470	0.793	0.353	0.365		−0.067	0.094
3+–2			1.006	−1.069	0.541		−0.682	−0.258
Mean DAB = 1.1		Mean BAB = 4.7		$R^2 = 0.327$			Observations 866	
				Women Born in Europe-America				
1–0	0.877	0.700	0.036	−0.623	0.100			
2–1		0.266	0.761	0.404	−0.504			
3+–2			0.770	0.685	−0.238			
Mean DAB = 0.2		Mean BAB = 1.7		$R^2 = 0.158$			Observations 1,474	

Note: Foreign-born women, married abroad, married once, and with at least one birth abroad.

Other variables in the regression: woman's age at immigration, age in 1961, and years of schooling (six categories, dummy variables); and dummy variables for country of birth (seven countries in Asia-Africa, six in Europe-America).

The figures are differences in the coefficients of dummy variables. Where no figure appears, it is because at least one of the coefficients did not pass a critical (low) level of significance.

bution of separate coefficients by country is statistically significant. (This is based upon model II.)

Examining both the regression coefficients and the derivatives of BIS with respect to DAB, we find the following (table 3.3): (1) The responses to DAB and BAB are significant and in the expected direction in both continent groups (AA and EA). (2) There is a negative interaction between BAB and DAB that implies that the response of births in Israel to child mortality abroad is smaller, the greater the number of births abroad. (3) For any given BAB and DAB combination, the response to child deaths abroad is greater among AA women than among EA women, but, if we calculate the response close to the mean level of fertility (BAB = 4 for AA and BAB = 2 for EA), the response of EA women is slightly higher (because of the significant interaction between BAB and DAB). (4) The country dummy variables in the pooled regression indicate that women from Libya and Algeria and Tunisia have significantly higher fertility in Israel and women from Egypt significantly lower than would be indicated by their experience abroad, education, and age (there is some variation in EA as well). (5) The response to child deaths around mean fertility is in the range 0.3–0.5 in the individual AA countries and goes up to 0.6 in EA. All these magnitudes are somewhat higher in the regressions confined to women aged 30–34 at immigration and aged 40+ in 1961, ranging from 0.35 to 0.71 for AA and going up to 0.8 for EA (now shown). Model I, which (as in table 3.2) does not constrain the functional form of the interaction (see table 3.A.1) was run separately for each country and shows that the response to one death in the low birth orders is in some countries above one. (6) The magnitude of the coefficient of experienced mortality in the regressions for the continents is not larger than in regressions for individual countries.

What do these findings suggest? The similarity between magnitude in the pooled and country regressions may be interpreted to mean one of two things: (1) Hoarding is not that important; this is based on the conjecture that expected mortality should be more closely associated with experienced mortality across countries than across individuals in the same country. (2) Given that the dependent variable is fertility in Israel, in a regime of much lower and uniform child mortality, past experience has been discarded as a predictor of future survival.

That even the low fertility immigrants from Europe show a high response indicates that demand-based mechanisms are very important. It may still be true that supply mechanisms are important in the Asian and African populations, and this may explain the somewhat higher coefficient (per parity) in AA. The variation in coefficients among individual countries is not consistent with the U-shaped relationships observed by Preston (1975*b*) as one moves from what he describes as

Table 3.3 **Effect on Births in Israel (BIS) of Births Abroad (BAB) and Deaths Abroad (DAB): Regression Model II (Women Aged 15–49 at Immigration)**

Woman's Country and Continent of Birth	Regression Coefficients of[a]					Derivative of BIS with respect to DAB at $D_{AB} = 1$ and		R^2	Number of Observations
	DAB	DAB^2	DAB ×BAB	BAB	BAB^2	BAB = 2	DAB = 4		
Asia-Africa	0.921 2·0	0.004 0·7	−0.116 15·5	−0.329 35·9	0.013 4·1	0.697	0.465	0.485	74,426
Algeria and Tunisia	0.833 6·4	0.014 1·0	−0.116 4·9	−0.273 2·8	0.018 1·7	0.513	0.397	0.527	697
Egypt and Sudan	1.106 6·2	0.012 0·5	−0.155 4·4	−0.145 1·5	0.013 1·1	0.820	0.510	0.364	602
Iran	0.982 6·7	−0.011 0·5	−0.110 14·0	−0.547 5·0	0.025 2·1	0.740	0.520	0.459	619
Iraq	1.053 12·0	0.005 0·5	−0.130 8·7	−0.390 7·3	0.019 3·3	0.803	0.543	0.486	2,068
Libya	0.894 5·7	0.012 0·5	−0.117 3·9	−0.354 2·8	0.014 1·0	0.684	0.450	0.561	543
Morocco and Tangier	0.606 8·0	—[b]	−0.073 7·4	−0.067 1·3	−0.010 1·9	0.557	0.314	0.471	1,989
Yemen and Aden	0.777 6·8	−0.008 0·5	−0.080 3·1	−0.557 5·1	0.013 1·0	0.601	0.441	0.465	908

Table 3.3 (continued)

Woman's Country and Continent of Birth	Regression Coefficients of[a]					Derivative of BIS with respect to DAB at $D_{AB} = 1$ and		R^2	Number of Observations
	DAB	DAB^2	DAB ×BAB	BAB	BAB^2	BAB = 2	DAB = 4		
Europe-America	0.674 22•8	0.061 5•9	−0.154 13•9	−0.372 16•9	0.051 13•3	0.488	0.184	0.316	9,117
Bulgaria	0.848 9•5	0.067 2•6	−0.191 5•2	−0.618 10•3	0.086 7•5	0.600	0.218	0.438	830
Germany and Austria	0.372 1•6	−0.107 0•6	−0.036 0•4	−0.275 2•5	0.038 2•3	0.086	−0.034	0.182	344
Hungary	0.494 2•9	0.271 2•9	−0.243 3•9	−0.159 1•5	0.036 2•1	0.550	0.064	0.364	372
Poland	0.696 14•6	0.064 3•1	−0.156 8•5	−0.453 12•9	0.058 9•8	0.512	0.300	0.295	3,564
Romania	0.559 8•4	0.027 0•8	−0.134 5•7	−0.235 5•6	0.040 5•2	0.345	0.077	0.293	2,536
Russia	0.859 11•0	0.055 2•4	−0.176 6•4	−0.412 6•9	0.052 4•8	0.617	0.265	0.400	1,471

Note: Foreign-born women, married abroad, married once, and with at least one birth abroad.

[a]Other variables in the regression are woman's age at immigration and in 1961, and years of schooling (six categories, dummy variables). The regressions for the continent totals include dummy variables for the individual countries.

[b]Variable excluded because the associated *F*-statistic was too low.

supply-dominated to imperfect demand control to efficient planning societies.

Why does the estimated response decline from full (or more) replacement as the number of births abroad rises? Women with births abroad consist of those who had fewer children than they would have liked (at that phase of their life cycle), those who had exactly the number of children they wanted, and those who had more children than they would have liked. The first group would want to replace deceased children fully and will do so unless there are constraints operating from the supply side (fecundity, health, etc.); if child death by itself relaxes a supply constraint (the lactation effect), those below desired fertility would respond fully. Those who are close to the optimum may revise the desired number of children downward (see section 3.1), and this may result in less than full replacement. Those who have more children than they want would not replace deceased children. When the data are controlled for some exogenous determinants of fertility and the women are grouped by the *actual* number of children, the proportion of those with excess fertility increases with the number of births. The random element in fertility should lower the estimated response. If those at low birth orders are not constrained in replacing deceased children, the major reason for lack of response is excess fertility, and thus the coefficient should decline with the number of children. Also, a greater number of births may already include a preimmigration response; in fact, the quicker the response, the less likely it is to be reflected in births in Israel.

This is also related to the age pattern of response. We observe that women who immigrated in their forties, particularly from EA, have a lower coefficient of BIS on DAB. This seems to contradict the hypothesis that women approaching the end of their childbearing period would be more responsive to child death. A reason for this could be that early child deaths have been replaced abroad. In another body of data where the birth order of the deceased children was known and the subsequent stopping probabilities and births intervals could be observed (for EA), I found a stronger response of older than of younger women (Ben-Porath 1976*b*).

Just in passing we can ask how these results fit the reverse causality —the view that more children die when there are more births. Given that births in Israel are subsequent to deaths abroad, they would be correlated according to this view only if people who expect to have higher future fertility (while in Israel) are particularly negligent with their earlier children (while abroad). This is, to say the least, unlikely.

There is another finding worth stressing: in the free-form interaction model (model I), cases with more than two deaths are often associated with *lower* births in Israel than cases with less (or no) child mortality. (This was also found in the Taiwanese data by Heer and Wu 1975.)

Let me suggest two possible explanations: a demand-based view suggests that those who experience child mortality beyond the common experience of their environment may "learn" from their experience and give up trying. There may, however, be a supply consideration. Generally, in discussing micro data there is a tendency to emphasize physiological and environmental factors that induce a *direct* relationship between child mortality and fertility. The termination of postpartum sterility is an explicitly causal factor. In addition, there may be a correlation across households between the ability to keep children alive and the ability to control family size. There may, however, be health and physiological factors that reduce both infant and prenatal mortality. The history of pregnancies terminated without the birth of a live child is not well documented and has been only sparsely researched, but there is evidence that (apart from stillbirths) a large proportion of pregnancies do not come to term, and it seems quite reasonable that there are physiological and environmental causes common to both prenatal and postnatal mortality.[5] This is in fact a major line that will be followed later—unfortunately, only speculatively.

3.4 Fertility and Mortality over Time

In this section I will try to infer the temporal aggregate movements in fertility and child mortality from more or less the same data. These developments fall into two phases: (*a*) changes that occurred in the country of birth; and (*b*) changes associated with immigration to Israel. I concentrate on the Asia-Africa immigrants, since the Second World War and its atrocities complicate a temporal analysis of the Europe-America immigrants.

3.4.1 Temporal Changes in Fertility and Mortality in the Countries of Birth

The main source used to trace the movements over time abroad is again the 1961 census of population of Israel.[6] Tabulations of fertility abroad and child mortality abroad by woman's age at immigration, period of immigration, or age at the time of the census (1961) can provide a basis for some inferences concerning temporal movements before immigration. The drawbacks of such a procedure are obvious; first, births in general and particularly births of children who did not survive are likely to be underreported, particularly by older women. This can reduce or even eliminate a downward trend in both fertility and child mortality; second, even if the data can give a reasonable picture of the immigrant population, it may not be a proper representation of the Jewish communities in the country of origin. In comparing immigrants of different periods it seems that individual choice and selection

were less important in the period 1948–61 than in either prior or subsequent waves of immigration. In relative terms, emigration in this period involved whole communities, complete families, and greater predominance of Israel as a destination. But even here selectivity bias cannot be ruled out.

Let us now examine the evidence by period of immigration and age at immigration. By observing women of a given age at immigration we control the life-cycle phase; differences in period of immigration translate into year of birth. There is at least one other selectivity problem—we are dealing with women who were married abroad when they immigrated, married once, and were still married at the time of the census. Given the variance in the age of marriage and the close relationship between fertility and duration of marriage, women who were young and already married at the time of immigration have more children than would be representative of the cohort as a whole.

The data for immigrants from Asia and Africa taken as a group (tables 3.4 and 3.A.2–5) indicate that there has been a downward trend in child mortality abroad, and that this decline probably started sometime in the early 1940s. This is based on the following observations: holding age at immigration constant, the more recent immigrants report lower child mortality abroad than earlier immigrants. The differential is the greatest and extends over the longest period of some twenty years for women aged less than 25 when they immigrated: while those immigrating in the early 1940s report a loss of about one out of three or four children, those who immigrated in the late 1950s report a loss of one

Table 3.4 **Percentages of Children Who Died before Age 5 and Average Births Abroad, by Mother's Age at Immigration and Period of Immigration: Women Born in Asia and Africa**

Period of Immigration	Percentage of Children Who Died		Average Number of Births	
	20–24[a]	40–44	20–24	40–44
1956–61	12.5	22.3	1.7	6.1
1951–55	16.1	23.5	1.8	6.1
1946–50	24.8	27.1	1.5	5.6
1941–45	34.2	18.8	1.6	
1936–40	27.8	54.1	(2.3)	
1931–35	32.4	(25.0)	1.6	
1926–30	(24.5)[b]		(2.3)	
–1925	(40.0)		(1.5)	
Mean	20.2	24.8	1.7	5.9

Source: Tables 3.A.2–5.
[a]Mother's age at immigration.
[b]Parentheses indicate small numbers of observations.

child in eight. Among women who were older at immigration, the differentials between birth cohorts (or immigration cohorts) are smaller, reflecting the fact that more of their children were born when mortality was higher (there is always the possibility that the older women underreported child mortality and births).[7]

This description rests on an aggregation of immigrants from AA countries that differ from each other. Because of the small number of observations, we can get only a tentative picture of individual countries. The reported child death rate in Yemen and Aden is over 40%, and there seems to be no downward trend in it. The other Asian countries report rates half or somewhat less than half of this figure, and there seems to be a (somewhat blurred) moderate trend of decline. In North Africa, Egypt—with a Jewish community partly of European origin—has the lowest child mortality. Mortality in the other North African countries (Morocco and Tangier, Algeria and Tunisia, Libya) is higher than in the countries of the Middle East; the decline in the death rate in North Africa (with the possible exception of Libya but including Egypt) is steeper than in the Middle East. What is said here about *trends* in individual countries is partly based on the difference between countries in the cross-sectional variation of the child death rates by age at immigration, holding constant the *period* of immigration (1948–54, see table 3.A.6). Although in a single cross section age differentials confound life cycle with temporal variations, the differences between countries probably reflect differences in the time trends (the typical curve relating infant mortality to age of mother is J-shaped with a trough at the early twenties; see, e.g., Legg et al. 1969).

Let us turn now to the evidence on fertility. Looking first at the number of children born abroad (tables 3.4 and 3.A.2–5) by period of immigration and age at immigration, one can see a slight decline from the early to the late 1950s. The immigrants of the period before the 1950s often report lower fertility abroad than do those of recent periods. This could reflect a real increase in fertility abroad, but it could also be due to changes in the selection of immigrants from the original population and to a downward bias in reporting early fertility. A recent retrospective study of marriage cohorts also found that AA women who married before the late 1940s had lower fertility, with duration of marriage held constant, than those who married later (Central Bureau of Statistics 1976). In any case, there is little evidence in the by-continent aggregation of any tendency for fertility to decline to match the decline in mortality.

In individual countries, Iraq is the only one for which three five-year means show a consistent downward trend in fertility; in Libya and Algeria and Tunisia there is a tendency to decline over two five-year means.

Table 3.5 relates fertility and mortality levels across countries: Turkey, Syria and Lebanon, and Egypt are relatively low both in fertility and in mortality. The fertility ranking between the middle and the top mortality levels is ambiguous. Yemen, with at least twice the mortality of any other country, has a fertility level below that of Morocco and Algeria and Libya.

Note that intercountry differences in fertility are closely associated with women's age at marriage, as indicated by the percentage of women married abroad who married under 17 (table 3.5). The simple correlations across countries are 0.64 between number of children born and percentage deceased; 0.81 between number of children and age at marriage; and 0.59 between percentage deceased and age at marriage. I draw attention to this relationship because if there is a relationship between desired fertility and child mortality, to the extent that it operates via age at marriage, it *must* be a relationship between desired fertility and *expected*—as distinct from *experienced*—child mortality.

3.4.2 Changes in Fertility after Immigration: Aggregate Figures

Immigration was associated with a dramatic change in environment and conditions. The extent of the changes varied depending on where the immigrants came from and when they came. As already indicated, there were differences among the immigrants from Asia and Africa, and correspondingly this would mean that the impact of immigration could differ (the economic and social gap between the Jews coming from Alexandria or Baghdad and those coming from Yemen was no less

Table 3.5 **Fertility, Child Mortality, and Early Marriage: Selected Countries in Asia-Africa (Women Aged 40–44 at Immigration)**

Woman's Country of Birth	Number of Children Born Abroad	Children Who Died before Age 5 (%)	Women Married before Age 17 (%)
Algeria and Tunisia	6.2	32.0	27.4
Egypt and Sudan	4.1	17.3	18.9
Iran	5.9	21.4	48.5
Iraq	6.3	19.5	35.7
Libya	6.9	33.2	37.0
Morocco and Tangier	7.3	24.4	53.5
Syria and Lebanon	4.9	13.7	31.3
Turkey	3.8	13.5	14.1
Yemen and Aden	6.5	47.8	54.9

Source: Central Bureau of Statistics 1961, p. 54, table 20 (births abroad); p. 61, table 25 (child deaths); p. 10, table 5 (married young).
Note: Foreign-born women married abroad, married once, and with at least one birth abroad.

than the gap many of the immigrants faced by immigrating). Note also that the largest wave of immigration that occurred in 1948–51 (known as the period of mass immigration) was very large relative to the original population (population almost doubled in this short period) and constituted a large pressure on resources, so that immigration was not an immediate jump to the mean per capita income of a semideveloped country. For many of the immigrants, the initial period of residence in Israel was associated with poor housing conditions in camps of temporary huts and with significant unemployment. Others were settled on the land and got their income from public employment projects. It is impossible to judge their realized real income and, more important, their initial expectations concerning their future material well-being. Subsequent years have seen rising incomes, improved housing, increased labor force participation of women, and other corollaries of participation in a rapid development process. The issues that matter here are the differential timing in realization of the change in income, the change in price of children (and their schooling and health), and the timing of changes in the supply of births.

Total fertility for women born in Asia and Africa declined (except for a slight rise at the period of mass immigration when new immigrants with high fertility were added en masse to the small community of longer residence and low fertility) (see tables 3.A.7–8). Child mortality declined (see tables 3.10 and 3.A.10). It would be desirable to follow the changing behavior associated with immigration of women at different phases of their own and the family life cycle—unmarried, married abroad, married with children born abroad, and at various ages at immigration—but we do not have the means to follow in the necessary detail the process of adjusting to this sudden change.

Let us first consider women married before immigration (and in most cases with some children born abroad). We know the number of children by the woman's age in 1961 and also the number of children born abroad, so that we know how many were born in Israel and can calculate a rough measure of children born per year of residence in Israel. The birthrate abroad can be inferred from the difference in the number of children born to women of different ages who immigrated in a given period. If fertility abroad has tended to decline, these differences would give an *upward*-biased estimate of the birthrate abroad; and if fertility abroad has risen, these rates would give an underestimate. The rates will likewise be underestimated to the extent that older women underreport births.

Table 3.6 yields the following observations:

1. The total number of children born to women married abroad and aged j years in 1961 (the date of the census) is generally higher than

Table 3.6 **Births per Year, in Israel up to 1961, and Abroad, by Period of Immigration, Selected Countries (per 1,000 Women)**

Country of Birth and Period of Immigration	Age (i) in 1961 and (ii) at Immigration					Length of Period over Which Calculated
	25–29	30–34	35–39	40–44	45–49	
Asia-Africa						
1948–54						
i. Rate in Israel	349	340	283	217	113	10.6
ii. Rate abroad	210	240	230	170	90	10.0
1955+						
i. Rate in Israel	415	415	268	146	98	4.1
ii. Rate abroad	320	220	220	140		5.0
Algeria and Tunisia						
1948–54						
i. Rate in Israel	385	424	405	267	118	10.1
ii. Rate abroad	210	290	330	190	*180*	10.0
Egypt and Sudan						
1948–54						
i. Rate in Israel	280	220	180	90	40	10.0
ii. Rate abroad		140	*230*	170	200	10.0
1955+						
i. Rate in Israel	231	231	128	51	103	3.9
ii. Rate abroad	80	140	*220*	20		5.0
Iran						
1948–54						
i. Rate in Israel	395	346	296	148	128	10.2
ii. Rate abroad	230	310	260	120	*140*	10.0
Iraq						
1948–54						
i. Rate in Israel	343	295	246	197	98	10.2
ii. Rate abroad	200	130	240	*230*	120	10.0
Libya						
1948–54						
i. Rate in Israel	415	433	361	289	135	11.1
ii. Rate abroad	260	320	280	220	*150*	10.0
Morocco and Tangier						
1948–54						
i. Rate in Israel	346	365	336	207	89	10.1
ii. Rate abroad	260	340	320	170	10	10.0
1955+						
i. Rate in Israel	434	434	320	114	46	4.4
ii. Rate abroad	400	300	260	*140*		5.0
Turkey						
1948–54						
i. Rate in Israel	195	195	119	102	85	11.8
ii. Rate abroad	80	170	*160*	140	120	10.0

Table 3.6 (continued)

Country of Birth and Period of Immigration	Age (i) in 1961 and (ii) at Immigration					Length of Period over Which Calculated
	25–29	30–34	35–39	40–44	45–49	
Yemen and Aden						
1948–54						
i. Rate in Israel	362	379	336	250	172	11.6
ii. Rate abroad	240	250	230	220	120	10.0
Europe-America						
1948–54						
i. Rate in Israel	174	141	108	75	41	12.1
ii. Rate abroad	50	70	60	50	30	10.0
1955+						
i. Rate in Israel	227	131	65	65	33	3.0
ii. Rate abroad	140	80	20	40	—	10.0
Poland						
1948–54						
i. Rate in Israel	(161)	136	110	85	51	11.8
ii. Rate abroad	50	70	70	60	40	10.0
1955+						
i. Rate in Israel	169	141	56	56	56	3.5
ii. Rate abroad		100	20	40	0	5.0
Romania						
1948–54						
i. Rate in Israel	183	147	119	73	27	10.9
ii. Rate abroad	50	70	60	50	*40*	10.0
1955+						
i. Rate in Israel	199	199	132	66	66	1.5
ii. Rate abroad	120	60	20	—	0	5.0
Russia						
1948–54						
i. Rate in Israel		156	110	92	46	10.9
ii. Rate abroad		60	40	50	10	10.0
1955+						
i. Rate in Israel	221	147	110	74	74	2.7
ii. Rate abroad	120	80	0	20	—	5.0

Source: Appendix table 3.A.9 and Central Bureau of Statistics (1975, p. 4, table 1).

Note: i. Births per year of residence in Israel up to 1961, by mother's age in 1961, calculated by taking the difference between the total number of children and the number born abroad and dividing by average years of residence.

ii. Birthrates abroad calculated as one-tenth the difference between the number of children born abroad to women whose age at immigration differed by ten years.

Foreign-born women married abroad, married once, and with at least one birth abroad.

that born to women aged j years at immigration [compare lines i and ii in table 3.A.9].

2. Correspondingly, births per year of residence in Israel of foreign-born women married abroad is higher than births per year abroad, even for women coming from countries of very high fertility.

3. The increase in fertility (in Israel compared with abroad) is general (over countries) and substantial for women who were relatively young at the time of immigration.

4. There is a somewhat blurred picture as to the crossover age—the age at immigration at which women reduce rather than raise fertility after immigration. In table 3.6 the italic figures indicate the crossover ages. The younger crossover ages are found in the countries with the lowest child mortality (of those listed), Egypt and Turkey. The highest crossover age (and it is not clear that there is a crossover at all) is for Yemen and Aden and Libya, the countries with the highest rates of child mortality abroad.

5. There is some evidence (in a calculation similar to that of table 3.6, based on somewhat different tabulations) that immigrants from a given country who came after 1955 had more births per year by 1961 than those who came in 1948–54 (in table 3.6 this is so for Morocco and Tangier but not for Egypt and Sudan).

It can be argued that the phenomenon we point to, namely the increased fertility after immigration, reflects the fact that immigration is associated with postponed fertility, so that preimmigration fertility is depressed and postimmigration fertility exaggerated. The procedure used for estimating fertility rates abroad by taking *differences* in number of

Table 3.7 **Annual Percentage of Change in Total Fertility in Israel, Selected Periods of Immigration**

Period of Immigration	End Points for Calculated Change	Women Born in Asia-Africa		Women Born in Europe-America	
		Specified Period	All	Specified Period	All
–1947	1951–61	—4.1	—2.7	—2.2	—2.4
1948–54	1951–61	—3.4	—2.7	—1.8	—2.4
	1961–64	—3.6	—1.4	6.9	4.1
–1954	1964–71	—0.0	—1.6	6.3	1.6
1955–60	1968–71	—4.2	—1.6	7.2	3.6
1961–64	1969–74	—5.3	—2.5	—1.4	0.1

Source: Tables 3.A.7–8. Annual rates are calculated for end points of the designated period. In the case of the immigrants classified to subperiods, 1961 is the average for 1960, 1961, 1962.

children born abroad between women of different age at immigration is likely to avoid half of this problem. Fertility rates in Israel, however, could in principle reflect such possible postponement effects. We would get these results artificially if women were systematically classifying births abroad as if they occurred in Israel, but I do not see any reason to assume so. Dr. Van der Walle has raised the possibility that women who were older at immigration could have had lower marriage duration than the selected group of those who were already married when they immigrated at a younger age. This would indeed bias downward the estimated birthrates abroad. Given, however, that marriage abroad occurred at a very young age, this could apply only to the very young. Also, looking at the immigrants from all of Asia and Africa we can control for duration of marriage: In table 3.8 we first compare the total number of births abroad by duration of marriage for women married abroad, by age at immigration (lines 3), with the number of births (in Israel and abroad), by age in 1961 (lines 2). The latter figure is consistently and significantly higher and indicates that per year of marriage, fertility in Israel of AA women married abroad was significantly higher than it was abroad.[8]

Admitting the possible biases, and noting the unusual pattern of the implied birthrates by age, I still tend to regard the phenomenon described as a real one.

It is interesting to consider the women who married in Israel. The control for duration of marriage is admittedly imperfect (the five-year interval may be too crude); subject to this qualification, we see that in the first decade of marriage, the fertility of women who married in Israel (lines 1) in table 3.8 is *higher* than the fertility abroad of women of the same age (lines 3) and lower than fertility (including fertility in Israel) of those married abroad (lines 2).

We do not have an unbiased way of inferring the change in the marriage age after immigration. There is, however, enough indication to believe that the picture of rising age at marriage (table 3.A.11), though exaggerated, does point in the right direction. If this is so, we can summarize the picture in the following way: (*a*) foreign-born women who came to Israel unmarried curtailed early marriage and raised the average age at marriage; (*b*) within marriage, fertility is somewhat higher in the first few years than it was abroad for women who married abroad, and limitation of family size then sets in; (*c*) women who married abroad and immigrated to Israel relatively young increased the number of births immediately after immigration and then reduced fertility gradually; (*d*) women close to the end of the childbearing period tended to reduce fertility after immigration, though the evidence for this is somewhat ambiguous. The rates of decline of fertility of a given immigration co-

Table 3.8 **Average Number of Births, by Woman's Age, Place of Marriage, and Duration of Marriage (Women Born in Asia-Africa)**

Age	Total	Duration of Marriage (Years)				
		0–4	5–9	10–14	15–19	20–24
20–24						
1. Age in 1961: married in Israel	1.0	1.2	2.7			
2. Age in 1961: married abroad	2.9	1.8	3.2			
3. Age at immigration: married abroad	1.7	0.9	2.5			
25–29						
1. Age in 1961: married in Israel	2.5	1.4	2.9	3.7		
2. Age in 1961: married abroad	4.2	1.9	3.4	4.6		
3. Age at immigration: married abroad	3.0	1.0	2.7	4.2		
30–34						
1. Age in 1961: married in Israel	2.5	1.5	2.7	3.5		
2. Age in 1961: married abroad	5.2	1.8	3.3	4.7	6.2	
3. Age at immigration: married abroad	4.3	1.3	2.6	3.1	5.8	
35–39						
1. Age in 1961: married in Israel	2.2	1.0	2.6	2.8		
2. Age in 1961: married abroad	5.7		3.1	4.1	5.7	7.3
3. Age at immigration: married abroad	5.3	0.9	2.6	4.0	5.6	6.7

Source: Central Bureau of Statistics (1975, p. 38, table 14 [lines 1, 2], p. 57, table 22 [lines 3]).
Note: Women married once. Empty cells indicate no cases or too few cases. Lines 1, BIS, lines 2, BLS+BAB, lines 3, BAB.

hort will be above or below the rate of decline for the total depending on how recent was immigration compared with the recency of arrival of other immigrants (see table 3.7).

I have refrained so far from discussing the experience of the immigrants from Europe-America (mostly Europe). Fertility before immigration was much lower than in the countries of Asia-Africa. Child mortality was also lower, but by no means negligible. Those who immigrated in 1948–54 were mostly survivors of the holocaust. Their marital histories were disturbed and interrupted; child mortality was also a result of war and atrocities. Calculations analogous to those shown above indicate that EA women also experienced a rise in fertility after immigration. But fertility does not decline sharply. In the case of EA women there is more reason to believe that preimmigration fertility was abnormally low. There has been some decline in period fertility rates of European-born women in Israel and then some increase. On the whole, higher levels of fertility were sustained than those experienced abroad.

3.5 Can Things Be Fitted Together?

The cross-section microdata indicated a strong direct relationship between child mortality abroad and fertility in Israel. They also indicated that response in terms of fertility in Israel is weaker among those who immigrated with many children and those who immigrated relatively old and is often negative among those who lost many children. The significant direct relationship between child mortality and fertility leads us to expect a downward trend in fertility abroad, for those periods and countries where child mortality declined, and a decline in fertility after immigration as a consequence of the sharply reduced child mortality.

When the same data were aggregated in order to unravel the relationships, we observed a small and unstable decline in fertility accompanying decline in child deaths abroad. Subject to qualifications stemming from possible biases in the data, there is some possibility that fertility had even increased in the past. More interesting and clear is the finding that, after immigration, young foreign-born women who married abroad first increased fertility, then gradually reduced it; this was not always true if they immigrated in their late thirties or forties. Those who immigrated unmarried postponed marriage in Israel, started their married life with a high level of fertility, then reduced it after only a few years of marriage.

At this point it may be relevant to bring in the experience of Israel's Arab population. This group experienced very high and declining levels of infant and child mortality in the period of the British Mandate. The Arabs who lived in Israel also experienced rapidly declining mortality after 1948 (see table 3.9). The fertility of the Arab population has, however, increased from the British to the Israeli period and during the Israeli period. Moslems, who constitute approximately two-thirds of the Israeli Arabs, increased fertility steadily for several decades, from about 6 in the late 1920s, 7 in the mid-1930s and 1940s (Central Bureau for Medical Statistics 1945), to reach a peak of close to 10 in the mid-1960s; it is only in the last decade that they have reduced fertility. Among Christian Arabs the decline in fertility began earlier.

Even when one is dealing with a single group of people, so that there is no change in personal characteristics, immigration entails a dramatic change in environment, personal conditions, and expectations. But the response to the different aspects of the change may vary. If one looks only at the time series of total fertility in Israel of AA women, the trend is downward, as would be expected on the basis of several reasons, including lower child mortality. The surprise is in the initial increase in fertility immediately after immigration, and the questions are what could cause this burst and why is it so pronounced among the younger women.

Table 3.9 **Infant and Child Mortality of Non-Jews: Selected Years, 1924–42 (Palestine) and 1953–71 (Israel)**

	Infant Mortality		Child Mortality Age 0–4	
	Moslems	Christians	Moslems	Christians
1924–26	167.1	151.9		
1931–33	162.9	133.7	350.6	209.4
1940–42	139.7	100.1	302.6	150.9
1953	65.4	42.8		
1961	48.5	45.8		
1971	32.2	33.7		

Source: Schmelz (1974, p. 56, table A; p. 71, table 1).

Here I start speculating about health rather than behavior. Immigration meant a shift to a different public health system. This was very quickly reflected in low child mortality rates, but it presumably also affected the health of women in and out of pregnancy. The improvement in health services and nutrition could have some effect on fecundability, at least among the most undernourished immigrants (Yemen and Aden). There also seems to be room for an increase in the number of births out of a given number of pregnancies through a reduction in pregnancy wastage of various sorts (see Bierman et al. 1965). Some nutritional and behavioral habits that reduce prenatal wastage are transferable and are not predetermined by the mother's "permanent" characteristics. One hypothesis is that immigration was followed by a decline in both child mortality and prenatal wastage, so that initially the same number of pregnancies resulted in more live births. To the extent that women were previously constrained by the supply of births, one can see why the initial increase in supply would be welcome before desired family size is revised downward. But even if this was not the case, the downward adjustment in fertility that is supposed to reflect replacement would have required an even larger reduction in pregnancies to compensate for the increase in successful pregnancies, or for a means of inducing abortion, and one could see why this would not be instantaneous. Induced abortion has probably been the most important means of controlling family size in Israel, and it is also prevalent among AA women. (This may be the closest substitute for natural abortion, and it has the advantage over the then most popular preventative method that it does not depend on the husband.) There is, however, strong evidence on the nature of the pre- and postbirth mortality correlations that would support this particular emphasis.

Can this hypothesis account for the fact that the increase in fertility after immigration was marked in the young age groups and may not

have occurred among older women of childbearing age? Two things might be at work here: Older women may have found it easier to reduce the frequency of pregnancy. On the other hand, for older women who arrived with a large stock of children who survive, the new realities of low child mortality would have much more immediate consequences in terms of family size. Younger women could borrow from the future by allowing themselves higher fertility as long as they were below their desired completed family size. Potentially, older women had more room for increase in successful pregnancies; the question is whether they would be responsive to the changed health regime.

What we are examining is the possibility that the health measures that affected mortality were associated with health developments that increased fertility; this possibility is consistent with the before-and-after immigration experience, with the experience of the Arab population, and perhaps with the experience of immigrants over time abroad. Although we do not have a direct test of this hypothesis, let us examine some child mortality data to see whether they can provide some support for it.

The decline in child mortality over time has the following features (table 3.10)[9]: (1) neonatal, postneonatal, and perinatal mortality all declined; (2) infant mortality declined relatively more than perinatal mortality; (3) within infant mortality the steepest decline in the period as a whole is in mortality after the first month of life (which declined to between one-quarter and one-fifth of its initial level). In the early 1950s, however—that is, immediately after mass immigration—the decline in perinatal mortality was as large as that in postneonatal mortality. This would be sympathetic (to use a weak term) to the speculation offered here. Comparing child mortality by mother's continent of birth in 1952 and 1960–63, we again observe that (4) the decline in postneonatal mortality is the most marked in both continent groups (table 3.A.10). Also, the only important differences *between* continents are in postneonatal mortality; (5) the decline in deaths from infectious diseases, pneumonia, and gastroenteritis is the main cause of the decline in infant mortality. The data by continent of birth do not reflect the early relative decline in perinatal mortality, which had already occurred by 1952, and the comparison between the continents does not provide support for this speculation.

Is there a demand-behavior explanation for the short-term rise in fertility and the subsequent decline? A reasonable speculation would be that a pronatal income effect precedes the adjustment in the elements of the economic changes in the life of parents and their aspirations for their children that generate antinatal substitution effects. As indicated, we do not have a well-defined picture of *actual* real income of immigrants immediately after immigration. If a direct income effect is to be

Table 3.10 **Infant Mortality, Perinatal Mortality, and Late Fetal Deaths: 1948–70 (per 1,000 Live Births)**

Year	Total (2)+(3)+(4) (1)	Infant Mortality			Late Fetal Deaths (5)	Perinatal Mortality (4)+(5) (6)
		1–11 Months (2)	7–27 Days (3)	0–6 Days (4)		
1948	36.3	—	—	—	14.9	—
1949	50.3	28.0	7.6	14.7	18.6	33.3
1950	45.6	22.9	7.9	14.8	17.3	32.1
1951	39.4	21.8	6.0	11.6	15.0	26.6
1952	38.7	22.8	5.4	10.5	15.7	26.2
1953	35.9	18.0	5.3	12.6	15.3	27.9
1954	34.4	17.9	4.8	11.7	14.1	25.8
1955	32.3	16.3	4.6	11.4	13.6	25.0
1960	27.2	10.7	3.3	13.2	13.0	26.2
1965	22.7	7.4	2.4	12.9	14.2	27.1
1970	18.9	5.4	1.9	11.6	10.3	21.9

Source: Central Bureau of Statistics (1974, p. 112, table 1).

invoked, it must rely on the revision of permanent income on the hopes that immigrants had for the new phase in their lives. Such an income effect would indeed be more powerful for younger than older women and would thus be consistent with the age patterns observed.

With respect to the Moslem population, we have a longer period of rising fertility and of rising incomes, and there is some indirect support to the lag in the emergence of fertility-reducing variables (see Ben-Porath 1972).

What implications does the temporal phenomenon have for the cross-sectional findings? In discussing the cross-sectional results I partly ignored the fact that we are relating fertility in Israel, occurring under conditions of much lower child mortality, to prior differences in child mortality and fertility abroad. There has been a downward *convergence* of child mortality in Israel. Thus, higher child mortality abroad is associated with steeper declines in child mortality: higher fertility in Israel, given the number of births abroad, means greater increase in fertility (in Israel compared with abroad). It is thus possible that what we have estimated is a mixture of the positive replacement effect of child deaths on fertility, with the positive effect on fertility of factors associated with the *decline* in child mortality. This could explain the presence of coefficients greater than unity in the Asia-Africa countries. The smaller response in the cross-sectional study observed for older women would again be consistent with the temporal finding that older women did not increase fertility after immigration. I should mention that a study based on another body of data in which behavior following each birth was

analyzed according to whether or not the child survived resulted in somewhat smaller responses than those observed here (Ben-Porath 1976*b*).

3.6 Summary

This paper poses some of the issues relating to the relationship between child mortality and fertility, then examines the fertility-mortality relationship of mostly foreign-born women in Israel, women who immigrated from various countries in Asia, Africa, and Europe and continued childbearing in Israel. The marriage between questions of general interest and the experience of a very particular population, coupled with methodological problems, means not only that these findings do not settle the questions one started with, but that the road to generalizations may be obscured. There is, however, a potential gain from the diversity in background of immigrants, the nonmarginal nature of the changes associated with immigration, and the unusual configuration and timing of various corollaries of economic and social development, coupled with a uniform set of data.

Among the general issues I listed, in section 3.5 a major one is the distinction between response to the experience of child mortality (replacement) versus the response to expected mortality (hoarding). This distinction is important with respect to both the magnitude and the promptness of the responses. Some of the other issues are the distinction between behavioral and physiological mechanisms, the degree to which child mortality affects the desired number of surviving children, and the effect of other variables correlated with the decline in fertility affecting either the demand or the supply of births and children.

The cross-sectional phase of the study consists of regressions of fertility in Israel as a function of fertility and mortality abroad, and education and age variables. The regressions were run by separate countries of origin and pooled for Asia and Africa and Europe. Fairly sizable coefficients of child mortality on fertility were estimated. The presence of such effects among the immigrants from Europe suggests the importance of the behavioral mechanism. The strong effect among the high-fertility immigrants from Asia-Africa may be partly reflections of a supply mechanism.

That the coefficients in intercountry regressions were not higher than in the intracountry regressions is considered evidence against the hoarding hypothesis (based on the supposition that the intercountry differences in expected mortality are more strongly correlated with experienced mortality than the intracountry differences). The weakness in replacement among older women in this particular study (unlike another body of data describing Israeli women) is here taken to result from fairly quick replacement response abroad.

Viewing the same data for inferences concerning what happened over time, I concluded that (1) in the countries of origin there had been a decline in child mortality without appreciable decline in fertility; (2) immigration was followed quickly by drastically declining mortality, but fertility initially *rose* above its preimmigration levels; (3) beyond the initial stage, fertility of Israeli women married abroad declined, and there have been also postponed marriages of unmarried immigrants and decline in their fertility after the first years of marriage. The increase in fertility after immigration, as well as the rising fertility over time of Moslems (in the face of declining child mortality) suggests that the discrepancy between the cross-sectional and time-series relationships between fertility and mortality (i.e., the sluggish aggregate response compared with large cross-sectional coefficients) may arise from the operation of other variables in the two contexts rather than from the slow revisions of expectations concerning child mortality, as part of a hoarding mechanism.

In speculating about the nature of the phenomena that delay the effect of replacement, I mention the possibility that income effects (associated with immigration in the case of the Jews) may precede in time the adjustment in life-style and aspirations that generates the fertility-depressing substitution effects. Alternatively, it is being argued that correlated with the same factors that reduced fertility over time there were health developments that increased the supply of births, possibly by reducing various forms of pregnancy wastage.

To sustain the latter hypothesis we must argue that temporally, either in the before-and-after immigration comparison or in some phases of the temporal decline in child mortality, the factors that determine child mortality and those that determine prenatal death or involuntary sterility are correlated with one another more closely in the time series than in the cross section.

It is not clear how implications can be carried over from a case of a sudden change associated with immigration from a less developed to a semideveloped country to a process of gradual development. The experience of the Arab population in Israel is not inconsistent with the explanation presented here, so it may well be that in a more moderate way similar counteracting forces operate in a more usual less developed country setting.

Appendix

Table 3.A.1 **The Difference in Births in Israel (△BIS) between Women (aged 15–49 at Immigration) with Different Numbers of Deaths Abroad (△DAB), by Country of Birth and Births Abroad: Regression Results of an Interaction Model**

Age at Immigration and △DAB	Births Abroad (BAB)						R^2
	1	2	3	4	5	6+	
			Women Born in Asia-Africa				
Algeria and Tunisia							0.545
1–0	2.054	0.703	0.563	0.669			
2–1		0.513	0.953	0.362	0.300		
3+–2			−1.577	−1.519	−0.642	0.660	
Egypt and Sudan							0.394
1–0	2.572	1.484	−0.118	0.528			
2–1		1.816	0.413	1.322	0.532		
3+–2			1.330	−2.263	−0.073	−0.587	
Iran							0.450
1–0	2.391	1.535	0.105	1.062			
2–1		−0.115	1.188	0.741	0.793		
3+–2			−2.254	0.540	−0.237	−0.522	
Iraq							0.423
1–0	0.882	0.115	0.108	0.451			
2–1		0.697	0.916	0.112	0.339		
3+–2			−2.178	−1.692	−0.511		
Libya							0.394
1–0	1.303	1.066	0.833	1.092			
2–1		0.143	0.741	−0.363	−1.036		
3+–2			0.781	0.128	0.726	−1.086	
Morocco and Tangier							0.438
1–0	0.926	0.761	0.392	0.197			
2–1		−0.042	0.757	0.770	0.878		
3+–2			−0.830	0.114	−0.060	−1.177	
Yemen and Aden							0.456
1–0	0.115	1.066	1.402	1.194			
2–1		1.089	−0.390	0.098	1.144		
3+–2			−0.668	−0.647	−0.608	−0.157	

Table 3.A.1 (continued)

Age at Immigration and △DAB	Births Abroad (BAB) 1	2	3	4	5	6+	R^2
			Women Born in Europe-America				
Bulgaria							0.466
1–0	1.112	0.441	1.056	0.567			
2–1		1.003	0.287	−0.092	0.102		
3+–2			−1.065	−0.468	0	0.734	
Germany and Austria							0.193
1–0	0.455	−0.007	0.020	0.297			
2–1		−0.128	−0.593	0.044	−0.489		
3+–2			0.581	−0.416	0.144	0.212	
Hungary							0.377
1–0	0.965	2.085	−0.092	−0.421			
2–1		−2.096	0.131	0.518	0.334		
3+–2			3.673	2.231	−0.543	2.815	
Poland							0.310
1–0	0.870	0.575	0.058	0.042			
2–1		0.155	0.475	0.402	−0.199		
3+–2			0.998	−0.096	−0.091	0.347	
Romania							0.297
1–0	0.598	0.336	0.153	−0.151			
2–1		0.739	−0.214	−0.053	0.057		
3+–2			0.629	−0.068	−0.252	0.072	
Russia							0.398
1–0	0.732	0.546	0.397	0.466			
2–1		0.687	0.308	0.214	0.985		
3+–2			−1.512	−0.231	−0.885	−1.012	

Note: Foreign-born women, married abroad, married once, and with at least one birth abroad. Other variables in the regression are woman's age at immigration, age in 1961, and years of schooling (six categories, dummy variables). The figures are differences in the coefficients of dummy variables. Where no figure appears it is because at least one of the coefficients did not pass a critical (low) level of significance.

Table 3.A.2 **Percentage of Children Who Died before Age 5, by Mother's Age at Immigration and Period of Immigration (Women Born in Asia-Africa)**

Age at Immigration	Period of Immigration								
	Total	1956–61	1951–55	1946–50	1941–45	1936–40	1931–35	1926–30	–1929
Number of Women	81,155	16,365	27,880	31,200	2,110	845	1,685	500	570
Total	23.5	19.2	21.0	28.0	30.0	30.1	28.3	33.3	39.0
0–19	22.9	13.5	15.4	28.0	32.6		21.3		35.0
20–24	20.2	12.5	16.1	24.8	34.2	27.8	32.4	(24.5)	(40.0)
25–29	22.9	19.5	19.4	30.4	30.6	19.5	25.5	(33.3)	(44.2)
30–34	21.2	15.8	19.3	25.8	28.3	(28.6)	26.1	(29.2)	(13.0)
35–39	22.2	18.0	18.6	27.8	39.6	25.6	28.4		
40–44	24.8	22.3	23.5	27.1	18.8	54.1	(25.0)		
45–49	25.6	20.0	25.7	29.1	14.9	(50.0)		58.8	
50+	29.4	24.8	26.3	30.3	36.6		(38.0)		

Source: Central Bureau of Statistics (1966, p. 56, table 21; p. 63, table 26).
Note: Foreign-born women, married abroad, married once, and with at least one birth abroad. Empty cells indicate too few cases or no cases. Parentheses indicate small number of cases.

Table 3.A.3 **Average Births Abroad, by Mother's Age at Immigration and Period of Immigration (Women Born in Asia-Africa)**

Age at Immigration	Period of Immigration								
	Total	1956–61	1951–55	1946–50	1941–45	1936–40	1931–35	1926–30	–1929
Number of Women	81,155	16,365	27,880	31,200	2,110	845	1,685	500	570
Total	3.6	4.1	4.0	3.6	2.6	2.7	2.3	2.1	1.7
0–19	0.7	0.6	0.8	0.7	0.6	0.6	0.9	0.5	(1.5)
20–24	1.7	1.7	1.8	1.5	1.6	(2.3)	1.6	(2.3)	(1.5)
25–29	3.0	3.2	3.1	2.8	2.3	(3.1)	2.0		
30–34	4.2	4.4	4.4	4.0	3.1		3.4		
35–39	5.3	5.5	5.5	5.0	(4.8)				
40–44	5.9	6.1	6.1	5.6					
45–49	6.1	6.0	6.6	5.7					
50+	6.0	5.5	6.4	6.2					

Source: Central Bureau of Statistics (1966, p. 56, table 21; p. 63, table 26).
Note: Foreign-born women, married abroad, married once, and with at least one birth abroad. Empty cells indicate too few cases or no cases. Parentheses indicate small number of cases.

Table 3.A.4 **Percentage of Children who Died before Age 5, by Mother's Age at Immigration and Period of Immigration (Women Born in Europe-America)**

Age at Immigration	Period of Immigration								
	Total	1956–61	1951–55	1946–50	1941–45	1936–40	1931–35	1926–30	–1929
Number of Women	120,285	21,340	10,670	60,815	2,745	8,360	12,555	1,325	2,475
Total	11.2	9.6	11.9	11.6	12.3	8.1	11.6	10.6	19.2
0–19	7.6			7.1			(22.2)		
20–24	8.4	(4.3)	(6.7)	7.1	(23.8)	22.0	12.7		15.1
25–29	9.1	4.7	13.1	8.5	(11.1)	9.4	10.8		18.4
30–34	9.7	3.8	9.6	12.1	15.2	6.0	8.8	11.1	25.0
35–39	11.2	4.9	13.2	14.7	16.7	8.5	12.2		14.0
40–44	11.7	11.0	12.3	12.4	12.6	7.0	13.0		(16.7)
45–49	13.1	15.7	13.4	12.0		7.0	16.3		(50.0)
50+	12.9	15.5	11.7	12.8	(6.5)	8.6	7.1		

Source: Central Bureau of Statistics (1966, p. 56, table 21; p. 63, table 26).
Note: Foreign-born women, married abroad, married once, and with at least one birth abroad. Empty cells indicate too few cases or no cases. Parentheses indicate small number of cases.

Table 3.A.5 **Average Births Abroad, by Mother's Age at Immigration and Period of Immigration (Women Born in Europe-America)**

Age at Immigration	Period of Immigration								
	Total	1956–61	1951–55	1946–50	1941–45	1936–40	1931–35	1926–30	–1929
Number of Women	120,285	21,340	10,690	60,815	2,745	8,360	12,555	1,325	2,475
Total	1.3	1.6	1.6	1.3	1.0	0.9	1.0	0.7	1.0
0–19	0.4	(0.2)	0.3	0.4	(0.1)	0.2	0.3		0.3
20–24	0.4	0.4	0.4	0.5	0.2	0.1	0.2	0.3	0.9
25–29	0.8	1.2	0.9	0.9	0.4	0.4	0.6	0.7	1.0
30–34	1.3	1.6	1.3	1.3	1.1	0.9	1.4	1.5	2.2
35–39	1.7	1.7	1.5	1.6	1.6	1.7	2.3		2.4
40–44	1.9	1.9	1.8	1.8	1.9	2.1	2.1		
45–49	1.9	1.6	1.6	2.0	(1.8)	2.5	3.9		
50+	2.5	2.0	2.4	2.8	(2.1)	2.9	(4.3)		

Source: Central Bureau of Statistics (1966, p. 56, table 21; p. 63, table 26).
Note: Foreign-born women, married abroad, married once, and with at least one birth abroad. Empty cells indicate too few cases or no cases. Parentheses indicate small number of cases.

Table 3.A.6 **Average Births Abroad and Percentage of Children Who Died before Age 5, by Mother's Age at Immigration, Period of Immigration, and Country of Birth**

	Period of Immigration							
	Average Number of Children				Percentage Who Died before Age 5			
Age at Immigration	All Periods	1946–50	1951–55	1956–61	All Periods	1946–50	1951–55	1956–61
Algeria, Tunisia	3.8				28			
0–14	0.7				18			
15–19	0.4	0.3	0.5		12	14	21	
20–24	1.1	1.0	1.1	1.3	22	32	15	15
25–29	2.5	2.6	2.6	2.4	21	32	14	18
30–34	4.0	3.9	4.2	3.7	21	22	26	13
35–39	5.9	5.5	5.3	5.0	27	36	23	22
40–44	6.1	6.2	6.0	6.3	32	35	32	30
45–49	6.6		7.1	6.0	33		38	26
50+	6.3		7.4	5.6	35		41	25
Egypt and Sudan	2.8				16			
0–14	1.5	1.7			9	12		
15–19	0.5	0.6		0.3	6	16		0
20–24	1.2	1.1	1.2	1.6	9	9	12	5
25–29	2.0	2.1	1.3	2.0	13	14	5	4
30–34	2.7	2.7	3.0	2.6	13	17	14	9
35–39	3.9	4.5	3.4	3.7	19	27	9	15
40–44	4.1	4.3	4.0	4.0	17	27	23	9
45–49	4.5	6.1		3.3	22	37		9
50+	4.2		4.2	4.0	21		10	20

Table 3.A.6 (continued)

Age at Immigration	Period of Immigration							
	Average Number of Children				Percentage Who Died before Age 5			
	All Periods	1946–50	1951–55	1956–61	All Periods	1946–50	1951–55	1956–61
Iran	3.6				22			
0–14	1.2	1.8			26	44		
15–19	0.7	0.6	0.6	0.7	23	24	28	7
20–24	1.7	2.0	1.5	1.5	16	23	9	4
25–29	3.2	3.2	3.0	3.5	20	20	18	25
30–34	4.8	5.1	4.5	4.7	22	27	18	17
35–39	5.7	5.0	6.2	5.8	22	26	21	18
40–44	5.9	5.6	5.5	7.1	21	17	19	30
45–49	7.1	6.6	7.3	7.1	25	22	27	24
50+	7.4	9.0	6.9	6.6	29	27	28	32
Iraq	3.9				18			
0–14	0.9	2.2	0.6		23	18	43	
15–19	0.7	0.7	0.9		17	15	13	
20–24	1.7	1.9	1.6	1.1	15	14	15	9
25–29	2.8	2.9	2.8		15	16	15	
30–34	3.9	4.4	3.9	1.7	15	13	14	36
35–39	5.1	6.1	4.9	3.7	15	19	13	
40–44	6.3	6.5	6.2		19	19	19	34
45–49	6.4	6.7	6.2		20	14	19	
50+	6.7	6.7	6.6		22	21	23	

Table 3.A.6 (continued)

Age at Immigration	Period of Immigration							
	Average Number of Children				Percentage Who Died before Age 5			
	All Periods	1946–50	1951–55	1956–61	All Periods	1946–50	1951–55	1956–61
Libya	4.0				30			
0–14	1.9				28			
15–19	0.5	0.5			24	30		
20–24	1.6	1.7	1.2		21	22	15	
25–29	3.1	3.2	2.9		26	28	21	
30–34	4.7	4.8	4.7		31	30	31	
35–39	6.0	6.3	5.3		31	35	23	
40–44	6.9	6.8	7.2		33	35	31	
45–49	7.7	7.2	8.1		29	24	36	
50+	6.4	6.9	5.8		36	40	31	
Morocco, Tangier	4.3				21			
0–14	2.5	2.4	3.0		16	14	20	
15–19	0.7	0.6	0.9	0.6	16	22	13	19
20–24	2.1	1.9	2.5	2.0	17	25	18	14
25–29	4.0	3.2	4.3	3.9	20	29	20	17
30–34	5.6	5.4	5.5	5.8	19	19	19	18
35–39	7.0	6.6	7.2	7.0	21	14	21	20
40–44	7.3	6.3	7.0	7.6	24	30	26	22
45–49	7.2	6.9	7.2	7.2	24	35	30	19
50+	6.4	7.9	5.8	6.6	30	41	29	30

Table 3.A.6 (continued)

Age at Immigration	Period of Immigration							
	Average Number of Children				Percentage Who Died before Age 5			
	All Periods	1946–50	1951–55	1956–61	All Periods	1946–50	1951–55	1956–61
Syria, Lebanon	3.2				14			
0–14								
15–19	0.4				11			
20–24	1.5				8			
25–29	2.2	2.4			13	8		
30–34	3.4	3.5			11	14		
35–39	4.8	5.1			17	9		
40–44	4.9	5.8	3.2		14	14	14	
45–49	5.9			5.4	14			5
50+	5.3		5.4	4.6	18		19	8
Turkey	2.4				18			
0–14	0.9	1.0			0	0		
15–19	0.4	0.4		0.2	33	40		0
20–24	0.9		1.5	0.9	18		36	8
25–29	1.3	1.2	1.7		17	9	17	
30–34	2.4	2.5		2.1	21	25		3
35–39	2.8	2.9		2.7	16	17		5
40–44	3.8	3.9		3.3	13	14		12
45–49	4.0	3.9	5.4	3.7	17	18	24	10
50+	3.8	3.6	3.0	4.6	22	19	27	22

Source: Unpublished Central Bureau of Statistics data from the 1961 Census of Population.

Table 3.A.7 Total Fertility of Jewish Women in Israel by Continent of Birth

Year	Asia-Africa	Europe-America	Israel	Year	Asia-Africa	Europe-America	Israel
1950	5.6	3.2	3.9	1963	4.6	2.4	2.5
1951	6.3	3.2	3.6	1964	4.6	2.6	2.8
1952	6.2	3.0	3.3	1965	4.6	2.6	2.9
1953	5.6	2.8	3.2	1966	4.5	2.5	2.8
1954	5.7	2.7	2.9	1967	4.2	2.4	2.7
1955	5.7	2.6	2.8	1968	4.3	2.6	2.9
1956	5.6	2.6	2.8	1969	4.2	2.7	2.9
1957	5.4	2.6	2.8	1970	4.1	2.8	3.1
1958	4.9	2.5	2.7	1971	4.1	2.9	3.2
1959	5.2	2.3	2.7	1972	3.8	2.7	2.9
1960	5.1	2.4	2.8	1973	3.7	2.7	3.0
1961	4.8	2.3	2.7	1974	3.7	2.8	3.1
1962	4.6	2.3	2.5				

Source: Central Bureau of Statistics, *Statistical Abstract*, various years.

Table 3.A.8 Total Fertility by Continent of Birth and Period of Immigration

	Asia-Africa					Europe-America				
Year	–1947	–1954	1948–54	1955–60	1961–64	–1947		1948–54	1955–60	1961–64
1951	5.1		6.9			3.50		2.80		
1954	4.3		6.0			2.80		2.50		
1960–62	3.4		4.9			2.60		2.35		
1963			4.5			2.70		2.36		
1964		4.27	4.4				2.44	2.89		
1965		4.24					2.49			
1966		4.17					2.50			
1967		3.88					2.39			
1968		4.07		4.49			2.58		2.54	
1969		4.09		4.21	5.12		2.79		2.62	2.82
1970		4.11		4.00	4.72		3.20		2.81	2.90
1971		4.26		3.96	4.59		3.80		3.28	2.97
1972					4.24					2.70
1973					4.00					2.61
1974					3.92					2.63

Source: Central Bureau of Statistics, *Statistical Abstract*, various years.

Table 3.A.9 **Births (up to 1961), by Period of Immigration, Selected Countries**

	Age (i) at Immigration and (ii) in 1961					
	20–24	25–29	30–34	35–39	40–44	45–49
Asia-Africa						
1948–54						
i. Births abroad	1.6	2.9	4.0	5.2	5.7	6.1
ii. Total births	3.6	4.4	5.2	5.6	6.4	6.3
Abroad	0.8	0.7	1.6	2.6	4.1	5.1
In Israel	2.8	3.7	3.6	3.0	2.3	1.2
1955+						
i. Births abroad	1.8	3.4	4.5	5.6	6.3	6.1
ii. Total births	2.7	3.8	5.4	5.9	6.4	6.7
Abroad	0.8	2.1	3.7	4.8	5.8	6.3
In Israel	1.9	1.7	1.7	1.1	0.6	0.4
Algeria and Tunisia						
1948–54						
i. Births abroad	1.1	2.5	4.0	5.8	5.9	7.6
ii. Total births		4.4	5.3	6.4	6.9	6.8
Abroad		0.5	1.0	2.3	4.2	5.6
In Israel		3.9	4.3	4.1	2.7	1.2
Egypt and Sudan						
1948–54						
i. Births abroad	1.1	1.9	2.5	4.2	4.2	(6.2)
ii. Total births			4.0	4.1	4.3	4.8
Abroad		(0.9)	1.2	1.9	2.5	3.9
In Israel		2.8	2.2	1.8	0.9	0.4
1955+						
i. Births abroad	1.6	2.0	2.7	3.8	3.9	3.3
ii. Total births	(1.8)	2.8	3.1	3.5	4.2	4.2
Abroad	(0.6)	1.9	2.2	3.0	4.0	3.8
In Israel	(1.2)	0.9	0.9	0.5	0.2	0.4
Iran						
1948–54						
i. Births abroad	1.7	3.1	4.8	5.7	5.6	7.1
ii. Total births		4.5	5.3	6.1	7.2	7.3
Abroad		0.5	1.8	3.1	4.7	6.0
In Israel		4.0	3.5	3.0	1.5	1.3
Iraq						
1948–54						
i. Births abroad	1.7	2.8	4.0	5.2	6.3	6.4
ii. Total births	(3.1)	4.3	4.8	5.3	6.0	6.3
Abroad		0.8	1.8	2.8	4.0	5.3
In Israel		3.5	3.0	2.5	2.0	1.0

Table 3.A.9 (continued)

	Age (i) at Immigration and (ii) in 1961					
	20–24	25–29	30–34	35–39	40–44	45–49
Libya						
1948–54						
i. Births abroad	1.6	3.2	4.8	6.0	7.0	7.5
ii. Total births		4.9	6.2	6.9	9.8	7.8
Abroad		0.3	1.4	2.9	4.6	6.3
In Israel		4.6	4.8	4.0	3.2	1.5
Morocco and Tangier						
1948–54						
i. Births abroad	2.2	3.9	5.6	7.1	7.3	7.2
ii. Total births	(4.2)	4.6	6.0	9.0	8.0	9.7
Abroad		1.1	2.3	3.6	5.9	6.8
In Israel		3.5	3.7	3.4	2.1	0.9
1955+						
i. Births abroad	2.1	4.1	5.6	6.9	7.6	9.1
ii. Total births	3.0	4.3	6.2	7.3	7.4	9.9
Abroad	0.8	2.4	4.3	5.9	6.9	7.7
In Israel	1.2	1.9	1.9	1.4	0.5	0.2
Turkey						
1948–54						
i. Births abroad	0.8	1.2	2.5	2.8	3.9	4.0
ii. Total births		2.7	3.3	3.4	3.9	3.7
Abroad		0.4	1.0	2.0	2.7	2.7
In Israel		2.3	2.3	1.4	1.2	1.0
Yemen and Aden						
1948–54						
i. Births abroad	1.8	3.3	4.3	5.6	6.5	6.8
ii. Total births	(3.8)	4.7	5.9	6.8	7.3	7.4
Abroad	0.7	0.5	1.5	2.9	4.4	5.4
In Israel		4.2	4.4	3.9	2.9	2.0
Europe-America						
1948–54						
i. Births Abroad	0.6	1.0	1.3	1.6	1.8	1.9
ii. Total births		2.3	2.2	2.2	2.1	2.0
Abroad		0.2	0.5	0.9	1.2	1.5
In Israel		2.1	1.7	1.3	0.9	0.5
1955+						
i. Births abroad	0.5	1.2	1.6	1.7	1.9	1.7
ii. Total births	1.0	1.5	1.9	1.9	2.0	1.9
Abroad	0.3	0.8	1.4	1.7	1.8	1.8
In Israel	0.7	0.7	0.5	0.2	0.2	0.1

Table 3.A.9 (continued)

	Age (i) at Immigration and (ii) in 1961					
	20–24	25–29	30–34	35–39	40–44	45–49
Poland						
1948–54						
i. Births abroad	0.6	1.0	1.3	1.7	1.9	2.1
ii. Total births		(2.0)	2.1	2.2	2.2	2.1
Abroad		(0.1)	0.5	0.9	1.2	1.5
In Israel		(1.9)	1.6	1.3	1.0	0.6
1955+						
i. Births abroad	0.7	1.3	1.8	1.9	2.1	2.1
ii. Total births	(1.2)	1.6	2.1	2.1	2.1	2.3
Abroad	(0.3)	1.0	1.6	1.9	1.9	2.1
In Israel	(0.9)	0.6	0.5	0.2	0.2	0.2
Romania						
1948–54						
i. Births abroad	0.4	0.8	1.1	1.4	1.6	1.8
ii. Total births		2.1	2.0	2.1	1.8	1.7
Abroad		0.1	0.4	0.8	1.0	1.4
In Israel		2.0	1.6	1.3	0.8	0.3
1955+						
i. Births abroad	(0.4)	1.0	1.3	1.4	1.3	1.3
ii. Total births	(1.0)	1.1	1.5	1.5	1.6	1.3
Abroad	(0.5)	0.8	1.2	1.3	1.5	1.2
In Israel	(0.5)	0.3	0.3	0.2	0.1	0.1
Russia						
1948–54						
i. Births abroad	0.7	1.1	1.3	1.5	1.8	1.6
ii. Total births			2.4	2.3	2.2	2.0
Abroad			0.7	1.1	1.2	1.5
In Israel			1.7	1.2	1.0	0.5
1955+						
i. Births abroad	0.8	1.4	1.8	1.8	1.9	1.5
ii. Total births		(1.5)	2.1	2.1	2.1	1.9
Abroad		(0.9)	1.7	1.8	1.9	1.7
In Israel		(0.6)	0.4	0.3	0.2	0.2

Source: Central Bureau of Statistics (1966, tables 12, 19, and 20).

Table 3.A.10 Stillbirths and Infant Mortality Rates, by Mother's Continent of Birth: 1952 and 1960–63

	Asia-Africa		Europe-America and Israel	
	1952	1960–63	1952	1960–63
Stillbirths	15.9	14.7	15.2	12.0
Perinatal mortality	26.3	26.5	25.9	26.2
Infant mortality	47.9	27.0	28.3	23.7
Neonatal mortality	17.0	14.6	15.5	16.9
Postneonatal mortality	30.9	12.4	12.8	6.8
Postneonatal mortality, by cause of death				
Infectious diseases	3.4	0.9	1.7	0.4
Pneumonia, bronchitis	6.5	3.2	3.0	1.6
Gastroenteritis	10.7	2.8	2.6	1.4
Malformations and diseases of early infancy	3.8	2.4	3.1	1.8
External causes	0.7	0.3	0.4	0.1
Other	5.0	2.8	2.7	1.6

Source: Peritz and Adler (1974, p. 41, table A).

Table 3.A.11 Age at Marriage in Israel and Abroad (Women Born in Asia-Africa)

Country of Birth	Percentage of Women Married before Age 17		Mean Age at Marriage	
	Abroad	Israel	Abroad	Israel
Algeria and Tunisia	27.4	15.9	20.7	27.1
Egypt and Sudan	18.9	13.7	21.8	22.0
Iran	48.5	18.9	18.4	21.4
Iraq	35.7	13.2	19.8	21.8
Libya	37.0	14.5	19.3	20.6
Morocco and Tangier	53.5	24.4	17.4	20.1
Syria and Lebanon	31.5	18.4	20.4	21.2
Turkey	14.1	20.0	23.1	21.4
Yemen and Aden	54.9	26.5	17.0	20.2

Source: Central Bureau of Statistics (1966, p. 10, table 5).
Note: Foreign-born women, married, divorced, or widowed.

Notes

1. One should note, of course, that even with full replacement, halving of (e.g.) 200 per 1,000 child death rate would reduce a 45 per 1,000 birthrate to just 40 per 1,000, and half replacement to 43 per 1,000.

2. Take a simple model where

$$\max u[q(t, x)n, s] \quad s.t.\ \pi nx + s = y, \tag{1}$$

where t = indicator of survival
n = number of children
q = index of child quality
s = consumption of parents
y = full family income
x = inputs into children
π = the price of one unit of x.

Both optimum quality of children, q^*, and optimum expenditure on them, x^*, can be solved as a function of survival (t). The solution of equation 1 is:

$$\eta_{nt} = -\eta_{q^*t} + \eta_{n\pi}-(\eta_{x^*t} - \eta_{q^*t}). \tag{2}$$

The first term represents a technical relationship—as children survive longer, parents have more child services ($\eta_{q^*t} > 0$) and need fewer children for a given volume of child services. The second term represents the effect of prices and expenditure. The term $\eta_{x^*t} - \eta_{q^*t}$ is equal to the elasticity with respect to survival of expenditure per unit of quality, $\eta_{(x^*/q^*)t}$. This term is likely to be positive and thus to contribute a downward slant to the fertility-survival relationships via the negative price elasticity (see also O'Hara 1972*a*). If expenditure were independent of survival, we would have the simple expression $\eta_{nt} = -(1 + \eta_{n\pi})\eta_{q^*t}$ which, like the analogous case of augmenting technical change, indicates that fertility will be directly associated with mortality if the demand for children is inelastic (see Ben-Porath and Welch 1975; Ben-Porath 1976*b*).

3. $\text{BIS} = \alpha_1\,\text{DAB} + \alpha_2\,(\text{DAB})^2 + \alpha_3\,\text{BAB} + \alpha_4\,(\text{BAB})^2 + \alpha_5\,(\text{BAB} \times \text{DAB}) + \beta\chi$

BIS the number of births that occurred in Israel.
BAB the number of births that occurred abroad.
DAB the number of deaths that occurred abroad.

$$\frac{\partial \text{BIS}}{\partial \text{DAB}} = \alpha_1 + 2\alpha_2\,\text{DAB} + \alpha_5\,\text{BAB}.$$

4.

	R^2	F	Degrees of Freedom
Women born in Asia-Africa			
Separate regressions for each country	0.515	6.4	68/7,339
Same slope, different intercept	0.486	32.6	6/7,407
Single regression	0.479		
Women born in Europe-America			
Separate regressions for each country	0.337	2.8	58/9,041
Same slope, different intercept	0.317	6.3	5/9,099
Single regression	0.315		

5. This possibility was suggested by Professors Davies and Halevi of the Department of Ecological Medicine, Hadassah Medical School, the Hebrew University.

6. See Schmelz (1971) for a valuable compendium on child mortality of Jews in the Diaspora and for a description and evaluation of the child mortality data in the 1961 census.

7. In retrospective data there are many problems associated both with the reported levels and with placing in time. In the Israeli census the distinction between children born abroad and children born in Israel is based on direct questions as to the number of children born in each place rather than an inference from matching birthrates of children and data of immigration. Age at immigration is determined by comparing year of birth and year of immigration.

8. The gross difference in fertility between women grouped by age in 1961 and grouped by age at immigration is larger than the difference when we also control for duration of marriage. Average marriage duration is longer for the grouping by age in 1961, compared with the age-at-immigration grouping. Because 1961 is approximately one decade after mass immigration, the women who married very young and immigrated soon after appear with long duration in 1961 and with short duration (and with younger age) when classified by age at immigration.

9. We use the following definitions: stillbirths, born dead after 28 weeks of gestation; neonatal mortality, deaths in the first month of life; and perinatal mortality, the sum of stillbirths and deaths in the first week of life. Rates are per 1,000 live births.

Comment

Etienne van de Walle

That parents strive to replace their dead children is plausible on a priori grounds. Nevertheless, the replacement child has been an evasive entity in empirical research. The data presented by Professor Ben-Porath are therefore both tantalizing and suspect. Tantalizing, because the relationship between mortality and subsequent fertility appears very strong—too good to be true. Suspect, because retrospective data collected in censuses are tricky to handle and abound in statistical traps. Add the problem of assigning causality when a relationship is detected. Is higher mortality (abroad) causing higher fertility (in Israel), or is some common factor operating on both variables? Ben-Porath does a beautiful job of untangling the evidence as much as possible. I shall perfunctorily list a few rather unconvincing alternative explanations of his findings before turning to some wider implications of his results.

Is it possible that some factors account for both higher fertility and higher mortality? The most likely set of such factors would be education and related socioeconomic statuses, and education has been controlled for in the regressions. One might unearth a factor unrelated to education;

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one ideal (but implausible) culprit would be the existence of sects that prohibit both contraception and medical assistance. If some women belonged to such sects, they would have had higher mortality before arriving in Israel and also higher fertility since their arrival. A more likely factor affecting both fertility and mortality is the time of entry in Israel; women entering more recently would be likely to have been subjected to lesser infant mortality and to lesser fertility than those belonging to earlier cohorts.

Professor Ben-Porath discards the possibility of reverse causality; that is, of high fertility resulting in high infant mortality, because births in Israel are necessarily subsequent to deaths abroad. But the same women could have had high fertility—and as a result, high mortality—both abroad and in Israel. It is also possible that women prone to losing their children (perhaps because they have unusually short birth intervals) benefited from better medical care in Israel and that their children, who would otherwise have died abroad, survived in their new country. Similarly, better prenatal care may have insured live births to women who would otherwise have miscarried.

Granted, the above mechanisms cannot be expected to account fully for the relationship found between infant mortality and subsequent fertility. The demographic transition framework implied in the paper's title seems to demand that a reduction in infant mortality provoked a reduction in fertility. If high mortality explains high fertility, must we also conclude that a decline in mortality—or in the author's phrase, the "dramatically speeded-up version of economic and social development" resulting from immigration to Israel—caused a drop in fertility? Were women whose children were surviving resorting to the deliberate control of their fertility after (and perhaps because of) their arrival in Israel whereas high-mortality women were curtailing contraception? Paradoxically, it is among women born in Asia and Africa, among whom fertility was least controlled, that the so-called replacement of dead children is most marked. But the shape of the fertility curve in table 3.6, with its very high childbearing in the forties, does not suggest family limitation.

The issues are further confused by some evidence of a rise in the fertility of migrants in Israel. The evidence is not very clear on this. Ben-Porath compares the experience of married women in Israel with that of women of unknown marital status abroad (in table 3.6). But it is not surprising that fertility may have been rising; after all, a very large proportion of the migration was occurring in the 1950s, when fertility was peaking almost everywhere—the baby boom phenomenon. Whether these findings have wider implications for other places and other times is doubtful. But this unique body of data was well worth exploring for the questions it poses rather than for the answers it provides.

Comment

Anne D. Williams

I wish to thank Professor Ben-Porath for an excellent paper. I am basically in agreement with his approach and findings, and I find it particularly intriguing to have access through the Israeli immigration experience to people with diverse origins and later common experience. The paper is a valuable contribution for the study of the response of fertility to infant mortality, yet tantalizing for the questions raised that cannot yet be answered.

To summarize briefly, Ben-Porath discusses the interaction of child mortality with fertility in considerable detail and sophistication and focuses in detail on the various mechanisms through which child mortality (assumed to be exogenous) can influence fertility. He then uses the 1961 Israeli census data to describe this response, first in terms of the cross section of household data, then with aggregate data showing some of the time trends. He finds substantial differences between the cross-sectional data and the time-trend evidence. The cross section shows a strong response of fertility to infant and child loss, particularly for young women at low parities who seem to have more than full replacement of child mortality. The results for individual countries of origin are very similar to the pooled results. The data which the author uses to measure time trends, however, present a completely different picture. Over time there has been continuing high fertility in the face of large declines in child mortality. He feels that this reflects rising levels of income over time, which not only reduce mortality but also stimulate fertility, for both biological and behavioral reasons.

I would like to comment in turn on each of these two basic findings.

Strong Cross-Sectional Response

Ben-Porath uses the sequential approach to fertility decisions that he and Finis Welch pioneered in the analysis of pregnancy histories (Ben-Porath and Welch 1972). Here he can observe each woman at only two points in the life cycle, first at immigration into Israel and later at the 1961 census. He thus has information on births up to the age of immigration, on how many of those births survived, and on the number of later births between immigration and 1961. The number of children born abroad who died is a good proxy for child mortality as of the time of immigration, because child mortality overwhelmingly takes place in the first year of life. He then explains fertility after immigration as a function of fertility and mortality experience before immigration, while

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holding constant the effects of other variables such as age, country of origin, and education.

He is not able, however, to obtain data on proportion surviving among children born in Israel after immigration. I believe this missing information serves to bias upward the estimated response of fertility to child mortality. Even though mortality should have fallen after immigration to Israel, one would expect high correlations between mortality before immigration and mortality after immigration, because of family-specific factors that could be either biological or behavioral. Information on later deaths would reduce the size of the coefficients but would not completely detract from his conclusion of a strong cross-sectional response.

The result of a strong cross-sectional response comes through clearly in both the cross-tabulations and the regressions. Let me note that although my own work (Williams 1976) has relied exclusively on regression analysis, I must confess to a growing suspicion that use of continuous variables to measure mortality and fertility may lead to spurious results. This is because of the high intercorrelations of fertility, mortality, current age, age at immigration, and birth order. I understand the attempt to conserve parameters in the regressions of table 3.3, but I prefer the use of dummy variables as in table 3.2.

Finally, it would also be interesting to know whether there has been any change in the response of fertility to mortality over different immigration cohorts.

Time-Trend Results

Ben-Porath uses data on fertility of women at different ages and different times of immigration to construct a picture of the time path of fertility of an individual woman. From tables 3.6 through 3.8 he concludes that the individual woman has relatively low fertility abroad. Immediately after immigration she has higher fertility (relative to her age group), which then tapers off over time. He feels this increase could be both biological and behavioral in origin. If I read the tables correctly there may be another, though not mutually exclusive, explanation.

Table 3.6 is difficult to interpret, partly because it does not hold marriage duration constant. Table 3.8, however, does indicate a rise in fertility after immigration. Looking at women married 10–14 years, for example, we can compare the fertility of those immigrating at different times. The table shows that women aged 30–34 in 1961 who were married abroad had 4.7 children, some of whom were born abroad, and some in Israel (line 2 of the third panel). The next line gives the number of children born by age 30–34 to women who immigrated to Israel at that age. For those married 10–14 years, number of children was 3.1, all of whom had been born abroad. The inference is that fertility after

immigration exceeds that before immigration, holding constant age and marriage duration.

However, it must be noted that women who were aged 30–34 at immigration are members of earlier cohorts than women age 30–34 in 1961. In fact, looking at the time patterns of immigration in tables 3.A.2–5, it seems quite possible that they were on average born ten years earlier than the women age 30–34 in 1961. Referring again to tables 3.A.2–5, it is clear that over the period described, immigrants of a given age have entered Israel with higher and higher fertility. For example, women who immigrated at age 30–34 in the early forties had 3.1 children, but those entering Israel at the same age in the late fifties had an average of 4.4 children.

Thus, although the phenomenon of rising fertility over time is clear, I am not convinced that there was a substantial rise in Israel after immigration. The women age 30–34 in 1961 are younger than those who immigrated at that age. Their higher fertility by age 30–34 may simply reflect higher fertility abroad before immigration. Over time there may have been a change in the composition of immigrants or change in the fertility abroad of a given population, owing to falling mortality and rising income. Thus the change in fertility behavior that Ben-Porath locates in Israel may in fact have taken place abroad. Then the Israeli experience would be one of continuously falling fertility, as migrants respond to the new environment.

It would be useful to compare women in 1961 of a given age and marriage duration with respect to their age at immigration and the extent of their fertility both before and after immigration.

Finally, in section 3.5 Ben-Porath discusses the nature of the increase in fertility owing to supply considerations. He emphasizes the importance of declines in fetal losses and child mortality for increasing the potential number of surviving children. In fact, there may also be a significant effect of improvements in nutrition and health on the ability to conceive (Frisch and McArthur 1974). Or there may be a decline in early fetal losses that is not apparent in the recorded data. French and Bierman (1962) and James (1970) estimate true spontaneous fetal loss rates of 250–500 per 1,000 conceptions in contrast with reported rates of 100–200. The effect on fertility of declines in malaria, in particular, may operate through this channel (Barlow 1967).

Conclusions

The answers to both my speculations appear, unfortunately, not to lie in the data source at hand. Ben-Porath has, however, described in another paper to which he refers here (Ben-Porath 1976), a 1971 fertility survey that asked about the timing of live births. His work with these

data showed lower cross-sectional responses of fertility to mortality and a different response pattern by age of the woman. He was able to stratify by country of origin, but it was not clear to me whether the date of immigration had also been recorded in the survey. If it has, we can observe the timing of fertility in the years before and after immigration rather than having to rely on just the total number of children born abroad and in Israel to determine the time trends.

I think that Ben-Porath's thoughts about observing the details of a modern demographic transition in the Israeli experience are well founded. The data he has used so far have provided some tantalizing insights. Future data analysis should prove even more rewarding.

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