Desired Fertility and the Impact of Population Policies

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FROM 1950 TO 1990, population in the developing world grew at historically unprecedented rates, more than doubling to reach 4.1 billion. By 2025, population in the developing world is projected to exceed 7 billion (World Bank, 1993a). Even those skeptical about the destructive power of the population bomb should be convinced that the political, economic, and environmental landscape of the next century will be greatly affected by the speed of the demographic transition in developing countries.[1] Policies that can accelerate (or delay) this transition have been the focus of countless debates since 1798, when Malthus warned that the "power of population" would someday overwhelm the planet.

Since mortality rates have fallen and are continuing to fall rapidly almost worldwide, differences in fertility are the dominant determinant of the evolution of population in the developing world. Since there are large variations in fertility rates across countries (e.g., total fertility rates of 6.5 births per woman in Kenya and 6.3 in Syria versus 3.0 in Indonesia and 2.8 in Argentina), and large changes in fertility over time, it is reasonable to expect social scientists to be able to reach a consensus on the primary determinants of fertility.

Yet two contending views on why fertility varies appear commonly in discussions of public policies concerning fertility. The first, the "family planning gap" view, is that high fertility is in large part a consequence of inadequate contraception due to the inaccessibility or high cost of contraceptive services. This places heavy emphasis on the mechanistic role of contraception as a "direct" or "proximate" determinant of fertility. A recent article by Robey, Rutstein, and Morris (1993) expresses this common view in such statements as: "Of the direct influences, the most powerful is family planning," and "differences in contraceptive prevalence explain about 90 percent of the variation in fertility rates," and "fertility levels have dropped most sharply where family planning has increased most dramatically" (p. 62). They downplay the adage, "development is the best contraceptive," contending instead that "although development and social change create conditions that encourage smaller family size, contraceptives are the best contraceptive" (p. 65). According to this view, the provision or subsidization of contraceptive services offers the possibility of substantial reductions in fertility rates, independent of broader development trends.

The second, the "desired children" view, is that high fertility primarily reflects desired births and that couples are roughly able to achieve their fertility targets. This view is held by most economists who have studied fertility behavior. As Becker (1991) argues, "the major changes [in fertility] have been caused primarily by other [than birth control methods–related] changes in the demand for children" (p. 141), and "improvements in birth control methods are mainly an induced response to other decreases in the demand for children rather than an important cause of the decreased demand" (p. 143). In this view men's and women's fertility choices, which are conditioned and constrained by the social, educational, cultural, and economic conditions they face, are the primary determinants of actual fertility. Furthermore, policies that improve objective conditions for women—raising their income, increasing their education, encouraging empowerment—are probably the most important voluntary and sustainable way to achieve the reductions in fertility necessary to slow population growth.

The analysis in this article demonstrates that the "desired children" view of fertility is valid. Analyses purporting to demonstrate the dominant importance of the provision of family planning services are typically based on analytical errors. Using data and statistical techniques that allow us to isolate women's fertility desires independent of contraceptive costs or access, we show that to a striking extent the answer to why actual fertility differs across countries is that desired fertility differs. In countries where fertility is high, women want more children. "Excess" or "unwanted" fertility plays a minor role in explaining fertility differences. Moreover, the level of contraceptive use, measures of contraceptive availability (such as "unmet need"), and family planning effort have little impact on fertility after controlling for fertility desires.

We develop these conclusions in six sections. The first section makes a prima facie case for the "desired children" view by showing that nearly all (roughly 90 percent) of the differences between countries in actual fertility are accounted for solely by differences in desired fertility. The second section addresses the two most cogent objections to the analytic use of reported desired fertility: the ex-post rationalization of births and the influence of contraceptive cost or availability on reported desires. These two objections are surmounted, empirically and econometrically. Third, we present data on contraceptive prevalence which show that although contraceptive use is an obvious proximate (or direct) determinant of fertility and hence an important correlate of fertility, contraceptive prevalence has no effect on excess fertility (or the fraction of births that are unwanted) and little independent effect on fertility, after controlling for fertility desires. Moreover, measures of a country's family planning effort also have only a small effect on fertility after controlling for fertility desires.

The fourth section shows that in spite of the mechanistic link between contraception and fertility, the interpretation which attributes a very small influence of contraceptive access on fertility levels is intuitively correct and consistent with a choice-based approach. The decision to have another child is simply too important and too costly for contraceptive costs to play a major role. In economic terms, fertility is inelastic with respect to contraceptive costs because contraceptive costs are so small in comparison to the costs of children. The fifth section assesses historical and contemporary household survey evidence which supports a finding that contraceptive access has little effect on fertility levels.

The sixth section addresses several strands of evidence often cited in support of the importance of family planning effort and contraceptive access: the large reported "unmet need" for contraception, the rapid recent changes in fertility in the developing world, and the results of the deservedly famous family planning experiment in Matlab, Bangladesh. Each of these strands is able to show some statistically significant, independent influence on fertility. However, we also show that none of this evidence refutes our two key contentions: that fertility is quite unresponsive to changes in contraceptive access and that differences in family planning effort explain very little (at most 5 percent) of the large cross-country differences in fertility.

Our analysis indicates that the challenge of reducing fertility is the challenge of reducing people's fertility desires, not reducing "unwanted" fertility. The key question is to what extent fertility desires are determined by economic influences and to what extent by social and cultural forces. More operationally, how and when can government policy instruments effectively influence these underlying fertility determinants? The roles and scope for policies for increased female schooling, improved maternal and child health, and larger economic opportunities and higher social status for women are critical questions not addressed in this article.

Actual fertility and fertility desires

The best evidence available on total fertility rates (TFR)[2] and on the desire for children across countries is women's responses to questions about their fertility behavior and their fertility preferences in household surveys. Such surveys have been conducted to date in a large number of countries by the World Fertility Survey (WFS) and the Demographic and Health Surveys (DHS) programs. Using these, researchers have derived three indicators of fertility preferences. The first draws on women's responses to a question about their ideal number of children to compute the "average ideal number of children" (AINC). A second measure of fertility preferences, the "desired total fertility rate" (DTFR), recalculates the total fertility rate in each country from age-specific birth rates after subtracting from the number of actual births those prior births that exceed each woman's reported desired family size (Lightbourne, 1987a; Westoff, 1991). A third approach (Bongaarts, 1990) calculates the "wanted total fertility rate" (WTFR) by using answers to questions about women's future desire for children to classify births (or current pregnancies) as wanted or unwanted.[3]

Our Data Appendix presents the following information for the years available from the WFS and DHS surveys and the Lightbourne (1987a), Westoff (1991), and Bongaarts (1990) articles: actual TFR, the average ideal number of children (AINC), the desired total fertility rate (DTFR), and the wanted total fertility rate (WTFR). Also reported (to be discussed later) are the fraction of births that are wanted, from the Bongaarts (1990) calculations, and the fraction of women with four living children who want no more children, taken directly from the published WFS and DHS surveys. These data show the enormous differences across countries in fertility. In our sample, the range of TFR is over 6 births per woman, from a high of 8.5 in Yemen (in 1979) to a low of 2.2 in Thailand (in 1987). The standard deviation of TFR in this data set is 1.5. In assessing the impact of various measures on fertility, keeping in mind this large range—and the large decreases in fertility (of 3 to 4 births per woman) that the demographic transition entails—will be helpful.

Even at first glance it is apparent that high-fertility countries generally have high desired fertility. Figure 1 shows the tight relationship between actual fertility and each of the three measures of fertility desires. For example, Cameroon's actual TFR in 1978 was 6.4, whereas its AINC was 8.0, DTFR was 6.1, and WTFR was 6.0. In contrast, Sri Lanka's TFR in 1987 was 2.7 while AINC was 3.1, DTFR was 2.2, and WTFR was 2.2. The differences across countries in desired fertility are very much larger than the differences for a given country between actual and desired fertility.

Table 1 reports the results of regressing actual fertility on fertility desires. There are two striking findings. The fraction of cross-country fertility variation explained (the R-squared) by fertility desires is .92 for DTFR, .89 for WTFR, and .65 for AINC.[4] These R^2s are extremely high for cross-country regressions and imply that 90 percent of the differences in actual fertility levels across countries are associated with differences in desired fertility.[5] High fertility is explained almost completely by a high desire for children.

Second, the slopes of the regression lines closely approximate unity. This implies that actual fertility increases almost one-for-one with desired fertility. The fourth row of Table 1 shows tests that the coefficient is 1. In general, the hypothesis that the best predictor of a country's actual fertility rate is desired fertility (plus a constant) is not rejected. Imposing the constraint that desired fertility affects actual fertility exactly one-for-one only modestly lowers the regression's explanatory power.[6]

A second way to say that fertility rates reflect almost entirely desired fertility is by examining "excess fertility," defined here as the difference between actual

TABLE 1 Regressions, by two estimation methods (OLS and IV), of the total fertility rate on three measures of fertility desires in less developed countries

	Explanatory variable					
	Average ideal number of children (AINC)		Desired fertility rate (DTFR)		Wanted fertility rate (WTFR)	
Estimation method[a]:	OLS	IV	OLS	IV	OLS	IV
Constant	1.44	1.04	1.16	1.23	1.42	1.54
(Standard error)	(.36)	(.394)	(.17)	(.190)	(.25)	(.277)
Slope	.79	.88	.93	.91	.95	.91
(Standard error)	(.074)	(.082)	(.036)	(.042)	(.063)	(.067)
t test for H_0: $\beta = 0$	10.7	10.6	25.5	21.0	15.1	12.6
t test for H_0: $\beta = 1$	2.72	1.37	1.92	2.06	.85	1.24
R^2	.65	.64	.92	.92	.89	.85
IV first stage R^2	—	.84	—	.77	—	.84
Number of observations	64	64	57	57	42	42

[a]OLS: Ordinary least squares; IV: Instrumental variables (see discussion in text).
NOTE: Instruments used in all three IV regressions were the fraction of women with 2, 4, and 6 living children not wanting more children.
SOURCE: See Data Appendix for source of data.

and desired fertility. Excess fertility is not systematically related to the level of fertility (that is, it is not higher for countries with higher fertility), nor is it an important determinant of total fertility. If actual fertility were importantly determined both by fertility desires and by excess fertility, countries with high fertility would not necessarily have high desired fertility. This would imply that the explanatory power of desired fertility for actual fertility alone would be low and that the slope of the regression of actual fertility on desired fertility would be less than 1. In the limiting case in which fertility desires were constant across countries and differences in excess fertility were the only factor determining actual fertility, the slope and the R^2 in the regressions in Table 1 would be zero. This is emphatically rejected by the data.

Women mean what they say

In order to claim that a one-to-one and close relationship across countries between desired fertility and actual fertility implies that actual fertility is explained almost completely by the desire for children, the question of how

FIGURE 1 Relationship between actual fertility and three measures of fertility desires in less developed countries

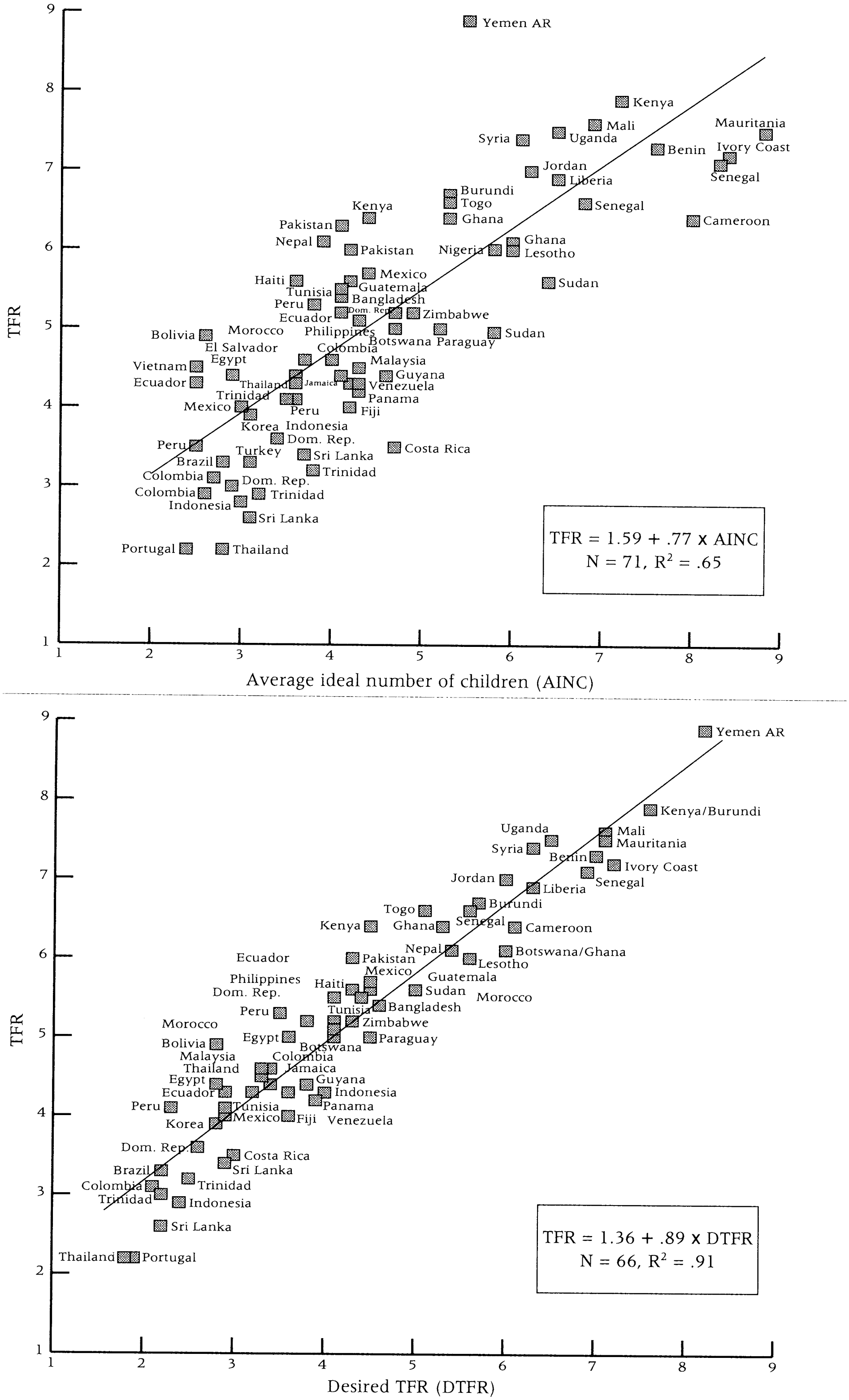
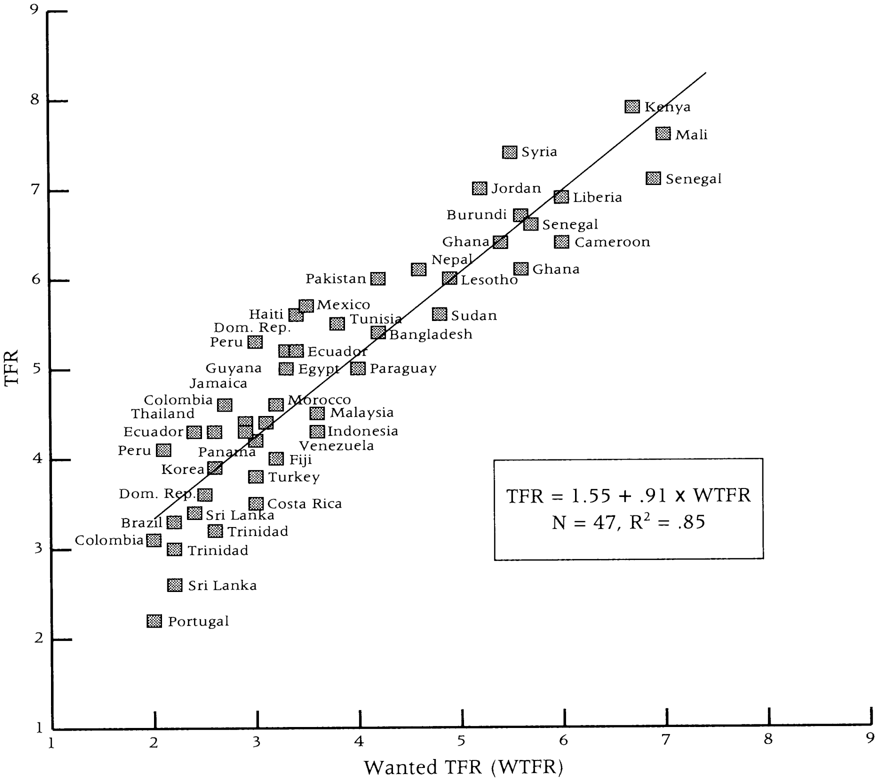


FIGURE 1 (continued)



Source: See Data Appendix

accurately these indicators identify and measure fertility desires must be addressed.[7] Taking women's reported reproductive desires at face value is often characterized as naive and two major objections are raised: ex-post rationalization and dependence on contraceptive costs.[8] First, a woman's responses to questions about desired fertility are believed to be heavily influenced by the woman's actual fertility. That is, women do not like to admit that they have children they did not want; hence retrospective questions about fertility desires will be influenced by ex-post rationalization. Second, women's reported fertility desires not only reflect desires for children, but are also affected by the supply of contraception. That is, knowledge, availability, or cost of contraception itself affects reported desires. Under this reasoning, desired fertility could not be used to assess the effect of contraception.

In this section we show that these objections do not undermine the results we have just presented. The availability of measures of fertility desires based on both retrospective and prospective questions about fertility allows us to combine the data to solve both problems. Since questions about future fertility desires are unaffected by ex-post rationalization, they can be used to solve the ex-post rationalization problem. Conversely, since retrospective questions about wantedness of previous births are not affected by the contraceptive costs of preventing future births, the responses are independent of contraceptive costs.

Ex-post rationalization

The average ideal number of children (AINC)[9] is a simple and intuitive concept, but it has a number of serious drawbacks as a proxy for desired reproductive behavior and is the worst indicator of fertility desires.[10] Some factors lead a woman's response to this question to underestimate desired fertility while others lead to an overestimate. If a woman chooses births to achieve a desired family size, then child mortality will cause AINC to underestimate desired fertility. Also, as one cannot choose the gender of children born, strong gender preference (whether for boys, girls, or a particular mix of each) would cause reported ideal family size to be smaller than the number of desired births.[11] A final survey problem is that in countries where the desired number of births is large, non-numerical responses occur more frequently, again leaving AINC as an underestimate of desired births.[12] Due to these limitations AINC is mainly used as a comparison with the better measures: DTFR and WTFR.

A second measure of fertility preferences, the desired total fertility rate (DTFR), calculates a desired total fertility rate from desired family sizes by subtracting from the number of actual births those births that exceed each woman's reported desired family size (Westoff, 1991). A variant on this measure (Lightbourne, 1987a) also deletes births if they were reported as unwanted.[13] Since there is a high degree of congruence between reports of desired family size and the declaration that a birth was unwanted if it exceeds this size, these two measures are very highly correlated (the coefficient is .98 for the 39 countries for which both measures are available). DTFR is therefore essentially retrospective as it is based on answers about wantedness and excludes those past births in excess of desired family size (even if not declared unwanted). This is an improvement on AINC, but may still underestimate true desired fertility if gender preferences are strong.

Many demographers suggest that offsetting these tendencies for AINC or DTFR to underestimate desired fertility is that women's responses to questions about fertility preferences are subject to psychological ex-post rationalization, that is, women will tend to deny that their desired family size is smaller than their actual family size. It is difficult to decide how serious this issue is.[14] The fact often used as evidence of ex-post rationalization, that larger ideal family sizes are strongly associated with larger numbers of currently living children, is perfectly consistent with women achieving exactly their desired family size. Fortunately, we have two solutions to the influence of ex-post rationalization on the present results: one empirical, finding measures of desired fertility free of rationalization of prior births, and one econometric, using statistical techniques that overcome the bias induced by this measurement error.

The measure of wanted fertility (WTFR) set forth by Bongaarts (1990) avoids the potential ex-post rationalization in AINC and DTFR of reproductive preferences by producing a measure of desired fertility and fraction of births unwanted based only on questions about future desires, not questions about past behavior. Bongaarts uses the answer to the question of whether a woman currently wants another child at some future time to classify the woman's previous births (or current pregnancy) as wanted or unwanted. If a woman currently wants another child, then the previous birth is classified as wanted. This "want more" fertility rate needs to be corrected to derive a "wanted" fertility rate to account for the possibility that a woman may currently want no more children because the most recent birth or pregnancy achieved the desired family size and for the possibility that some women may never achieve their desired family size. Bongaarts uses the household survey results from the WFS and DHS to make these adjustments and to calculate the "wanted" total fertility rate (WTFR) and the fraction of births unwanted.[15] This measure should be free of ex-post rationalization as it is based on whether women want more children given the most recent birth, not whether the most recent birth was wanted.

The use of two different measures, one of which explicitly attempts to correct for ex-post rationalization, should avoid potentially spurious results due to rationalization of unwanted births. Since the results in Table 1 are nearly identical for DTFR and WTFR,[16] it cannot be the case that simple ex-post rationalization substantially affects the present findings, as these two measures should then give different results.

Beyond the use of different empirical measures there also lies an econometric solution. Even if these indicators are observed with error, a straightforward econometric solution to this problem is the use of instrumental variables.[17] An adequate instrument for the purpose is a variable that is correlated with the "true" desired fertility but free of ex-post rationalization. In this case we have an excellent instrument because in addition to asking women about their ideal family size and about the wantedness of previous children, the household surveys also ask women if they want more children and these responses are tabulated by the number of living children.[18] The final column of the Data Appendix reports the fraction of women with 4 living children who want no more children. This varies greatly, from only 3.0 percent of women in Cameroon and 3.2 percent in Ivory Coast to 87.7 percent in Thailand and 89.3 percent in Colombia. Since these answers refer only to future desires for children, they cannot be contaminated with ex-post rationalization.

Note that the instrument does not use the fraction of women at various family sizes (which would be affected by the frequency of unwanted births), only women at a given family size who want no more children. The fraction who want no more children at various family sizes is correlated with desired fertility since the responses summarize the same distribution of desired family size.[19] Westoff (1990) has shown that the overall fraction of women wanting no more children in a country has high predictive power for future fertility rates.

The instrumental variables (IV) results strongly confirm the ordinary least squares (OLS) results that actual and desired fertility move one-for-one. In all cases, the point estimate on desired fertility is approximately 0.9, and is neither robustly nor strongly different from 1.[20] The explanatory power is still very high with the IV estimates.

If ex-post rationalization were empirically a major factor, then the estimated IV coefficient should be smaller than the OLS estimate.[21] In fact, the IV coefficient estimate is either greater (AINC) or roughly equal (DTFR and WTFR).[22] The fact that the coefficient estimate is substantially larger for AINC accords well with our claim that AINC is the worst indicator of current desired fertility and suggests substantial random measurement error, hence explaining the low R^2 in OLS. Since the IV results are nearly identical using instrumental variables for all three measures, the econometrics suggest that ex-post rationalization is not an important objection to using these country aggregate measures of fertility desires.

Dependence of fertility desires on contraceptive access

Using these measures of fertility desires to distinguish between desires for children and contraceptive supply as fertility determinants requires a critical assumption, namely, that these responses indicate what the demand for children would be at zero price of contraception.[23] Hence, the second objection to the use of fertility desires is that reported desires might be determined by contraceptive access or costs. If this were the case the use of desired fertility, especially to distinguish alternative explanations of fertility, would be problematic.[24] However, it is unlikely that the results are affected by the influence of contraceptive access (or cost) on women's responses, for four reasons. First, the survey questions themselves are generally structured to avoid this dependence. Second, experimental evidence on changing contraceptive costs suggests that expressed desires are independent of contraceptive access or cost. Third, the use of retrospective data purged of measurement error avoids this contraceptive cost problem, as past fertility decisions are unaffected by future contraceptive costs. Fourth, the cost of contraception is too small relative to the importance of the decision about having or not having a child to play a major role. Given the importance of this question, we discuss the evidence for these four arguments below.

First, the issue of survey questions. There are two ways in which contraceptive access could influence reported desires: either women ignorant of contraception cannot answer such questions appropriately at all, or the stated number of desired children is in part determined by the price of contraception women face.

Do women, even in developing countries, know enough to answer questions about fertility desires? One might argue that numerical answers are invalid because women are inumerate or do not perceive fertility to be within the sphere of their conscious control. However, WTFR is based only on a question about wanting another child, which requires neither numeracy nor a speculative response about a desired lifetime total. It is difficult to argue that uneducated women, even in the absence of knowing how to avoid childbirth, would fail to understand such a question. People can answer how tall they would like to be, even though they have no control over their height.

By the time the survey data we are using here were collected, contraceptive knowledge in the countries concerned was generally so widespread and available that cross-country differences in these respects are unlikely to be a major factor affecting reported fertility desires, even in high-fertility countries. WFS and DHS data tend to confirm this claim. For example, in Kenya in 1989, TFR was 6.4 yet 91 percent of respondents knew of a modern contraceptive method; in Jordan in 1990, TFR was 5.6 yet 99 percent knew a modern method; in Ghana in 1988, TFR was 6.4 yet 76 percent knew of a modern method. Moreover, even where contraceptive knowledge is not widespread, arguably the causation runs from a low desire to regulate fertility to low knowledge of contraception, not vice versa. Particularly striking in this regard is the fact that in many high-fertility countries more women know of modern than know of traditional methods. Among married women in Ghana, 64 percent know of the pill, but only 33 percent know of withdrawal. In Kenya, 91 percent know of the pill but only 51 percent of withdrawal. Even in Nigeria, where knowledge of any method is only 44 percent, 41 percent know of a modern method while only 24 percent know of a traditional method. The fraction of women actually using the pill in these three countries is 1.9, 5.2, and 1.2 percent respectively, even with this widespread knowledge. Both this low use in spite of extensive awareness of modern methods and the fact that knowledge of modern methods is much higher than knowledge of easy-to-discover, but not advertised, do-it-yourself methods[25] suggest that modern contraceptive knowledge has actually run far ahead of desires to limit fertility.

The survey questions clearly elicit answers concerning the demand for children at zero contraceptive cost. The question in the DHS about the desired number of children (posed to women with children) was, "If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" The phrase "if you could choose exactly" seems aimed to prevent answers being influenced by the cost or difficulty of actually effecting the choice. Also, questions about whether a prior birth was wanted are independent of costs of contraception.

Only questions about future fertility desires are potentially affected by contraceptive costs.

Second, the issue of experimental evidence. The strongest evidence that reported fertility desires are independent of contraceptive costs is from the Family Planning and Health Services Project (FPHSP) in the Matlab region of Bangladesh. The experiment saturated a treatment area with contraceptive knowledge and availability, with trained female family planning workers visiting every household every two weeks with messages and supplies, while a comparison area was (as best as possible) left alone. From 1975 to 1990, the self-reported "ideal family size" fell from 4.4 to 3.1 in the treatment area, and by exactly the same amount, from 4.5 to 3.2, in the comparison area (Koenig et al., 1992), even though contraceptive knowledge and use increased dramatically as contraceptive costs fell in the treatment area.

The third reason why reported fertility desires are likely to be independent of contraceptive costs is that the three measures of wanted fertility largely agree (the correlations across countries are each above 0.9)[26] and the results, presented above, are broadly the same with each. Therefore, those arguing that these measures of desired fertility are seriously affected by systematic incorporation of contraceptive costs into expressed fertility desires must also argue that this is equally true of each measure (and of reported unwanted births). But the latter argument, given the different reference timing and structures of the question, is highly implausible. Moreover, the results we presented in the previous section, showing that the DTFR was not compromised by ex-post rationalization, allow us to use the retrospective data on DTFR as an instrumental variable to purge prospective fertility of contraceptive costs. Doing so *raises* the WTFR coefficient to .96—virtually indistinguishable from 1.0[27]—leaving the basic results unchanged.

Fourth, it is unlikely that desired fertility is importantly affected by contraceptive costs, simply because such costs are small relative to other factors entering the childbearing decision. We will return to this point later in this article.

Excess fertility, total fertility, and contraceptive prevalence

Since actual fertility can be explained almost completely by fertility desires, which are independent of contraceptive availability or cost, these results place a tight upper bound on the importance for fertility of factors that affect the difference between desired and actual fertility without changing desired fertility. Even if all of the cross-country variation in fertility not explained by desires were attributable to contraceptive access (which would be extraordinary indeed, leaving no room to gender preference, measurement error, etc.), it would account for at most 10 percent of cross-country fertility differences.

What then is the role of availability of cheap, effective contraception in determining fertility? Is it not obvious that contraception is an important factor in fertility? After all, the probability of pregnancy can be defined as the frequency of coitus times the chance of conception per coital act. Therefore, a reduction in fertility must be due to either a reduction in coital frequency or a decrease in the probability of conceiving per coital act, and certainly one important determinant of the latter probability is the effectiveness of contraception.

But there is a clear and important distinction between contraception as a proximate determinant of fertility and contraceptive access as an independent, causal determinant of fertility. Indeed, data presented below confirm (as many others have found) that contraceptive prevalence (the fraction of women of reproductive age using contraception) is strongly negatively correlated with fertility. However, this empirical fact could be the result of any one of three mechanisms: increased contraceptive availability affects desired fertility; increased contraceptive availability leads to lower fertility because the gap between desired and actual fertility is lower; or changes in fertility desires lead to changes in contraceptive prevalence as people use more contraception to achieve their fertility targets. In all three cases, contraception is a proximate fertility determinant. But access to contraception in the first two cases would also be an independent, causal determinant. As the previous section ruled out the first possibility, in this section we will examine the second, that contraceptive access lowers fertility by lowering the gap between desired and actual fertility.

Since actual fertility increases roughly one-for-one with desired fertility, the difference between actual and desired fertility is a relatively good measure of "excess fertility." By combining the three derived measures of excess fertility (TFR − AINC, TFR − DTFR, TFR − WTFR) with the fraction of births that are unwanted, we have four semi-independent indicators of excess fertility.[28]

Actual use of contraception depends on both the demand and the supply, so contraceptive prevalence is not, by itself, an indicator of contraceptive access. However, if it were the case that cheaper or more widely available contraception led to substantially less excess fertility, then one would expect that the absolute amount by which fertility targets were missed would decrease with contraceptive prevalence. This is clearly not the case. Table 2 regresses each of the four measures of excess fertility on both total and modern contraceptive prevalence reported in the WFS and DHS surveys. There is no statistically or practically significant negative effect of contraceptive prevalence on the magnitude of excess fertility.

Intriguingly, independent data on the percentage of pregnancies or births self-reported as unwanted show that the *fraction* of fertility that is unwanted is higher in many developed, low-fertility countries (for example, Finland 10 percent, United States 10, Hungary 14, France 16) than in many poor, high-fertility countries (for example, Sudan 3.8 percent, Ghana 4.2, Uganda 4.6,

TABLE 2 Relationship between contraceptive prevalence and measures of excess fertility

Measures of excess fertility (dependent variable)	Total contraceptive prevalence		Modern contraceptive prevalence		
	Coefficient (*t*)	R^2	Coefficient (*t*)	R^2	N
TFR–AINC	−.005 (.94)	.013	−.0078 (1.24)	.022	71
TFR–DTFR	.003 (1.02)	.016	.0017 (.50)	.004	65
TFR–WTFR	−.0005 (.13)	.000	.0004 (.08)	.000	47
Fraction of births unwanted	.002 (2.85)	.153	.0025 (3.05)	.172	47

NOTE: AINC = Average ideal number of children; DTFR = Desired TFR; WTFR = Wanted TFR.
SOURCE: For data on contraceptive prevalence see WFS and DHS surveys. For other data, see Data Appendix.

Pakistan 13) (United Nations, 1987). In our sample the fraction of fertility that is excess or unwanted is not strongly positively correlated with the level of fertility. The highest fractions of wanted births by the Bongaarts measure are in high-fertility countries like Senegal (TFR of 6.5, 91 percent wanted) and Cameroon (TFR of 6.4, 94 percent wanted), and the fraction of unwanted births actually *increases* with contraceptive prevalence. The data, moreover, suggest that the percentage of fertility which is excess actually *increases* with contraceptive use.[29]

Figure 2 illustrates the correlations between contraceptive prevalence and TFR, desired fertility (DTFR), and excess fertility (TFR − DTFR). Contraceptive prevalence is strongly negatively related to actual fertility (the R^2 is .72 in this sample). But contraceptive prevalence is also strongly negatively related to desired fertility, even though, as shown, DTFR is independent of contraceptive access, suggesting higher use is driven by lower desired fertility. Moreover, contraceptive prevalence has no relation at all with excess fertility. The data are inconsistent, with higher contraceptive prevalence leading to lower absolute (or lower percentage of) excess fertility.

If, instead of explaining excess fertility, we regress the TFR on fertility desires and add contraceptive prevalence, we can ask what additional explanatory power contraceptive prevalence imparts over and above desired fertility.[30] Table 3 shows that the magnitude of the impact of contraceptive prevalence, although statistically significant, is very small. An exogenous 10 percentage point increase in modern contraceptive prevalence, holding desires (DTFR) fixed, would reduce actual fertility (measured by TFR) only by .17.

In a 1977 survey, Haiti's desired fertility was 4.3, while modern contraceptive prevalence was only 4.7 percent; whereas Zimbabwe's desired fertility was also 4.3 (in 1989), but modern contraceptive prevalence was 36.2 percent. If somehow Haiti's modern contraceptive prevalence could be raised to Zimbabwe's level, holding desires constant, by how much would fertility fall? The regression estimates suggest that this very large (eightfold) expansion in contraceptive prevalence would reduce fertility by only about 0.5, half a birth per woman's lifetime, or just 10 percent. This small effect (derived from the regression estimates) is plausible, as fertility in Haiti was actually only about 0.4 of a birth higher than Zimbabwe's fertility (TFR of 5.6 versus 5.2), despite the large difference in modern contraceptive use.

This small estimated impact is in sharp contrast to common statements in the literature like "a 15 [percentage point] increase in contraceptive prevalence decreases fertility by nearly one child per woman" (Family Health International, 1990: 4). Actually, the numbers behind the various statements fit, but cause and effect are exactly reversed. The simple bivariate relationship between TFR and modern contraceptive prevalence does indeed suggest that increasing contraceptive prevalence by 15 percentage points would reduce TFR by about one birth per woman (that is, $15 \times .071 = 1.07$).[31] However, using the estimates of the relationship between DTFR and modern contraceptive prevalence in reverse, we find that a one birth per woman decline in DTFR would cause about a 15 percentage point increase in modern contraceptive prevalence (i.e., $(1/0.073) = 13.7$).[32] But a 15 percentage point increase in modern contraceptive prevalence, holding desired fertility constant (as would be caused by a shift in contraceptive access), leads only to a decline in TFR of .26 births (that is, $.017 \times 15 = .26$). Failing to account for the cause of the shift in contraceptive prevalence in bivariate relationships leads to an overestimate of the independent effect of contraceptive access by a multiple of at least four. Nothing useful at all can be inferred solely from a strong cross-sectional relationship between contraceptive use and fertility about the effect of expanding contraceptive access on fertility.

Although contraceptive prevalence is an important *proximate* (or direct) determinant of fertility rates, after controlling for variations in desired fertility, contraceptive prevalence has an empirically small effect and explains only 1 to 2 percent of cross-country fertility variation. When modern contraceptive prevalence is added to the regression expressing the relationship between actual fertility and desired or wanted fertility, the (unadjusted) R^2 increases by only .015 with DTFR and by .011 with WTFR. (The corresponding increases in R^2 with total contraceptive prevalence are .011 and .022, respectively.) Variations in contraceptive prevalence explain at most 2 percent of the variation of actual fertility, after controlling for fertility desires. Contraception is not important as a *causal* or *independent* determinant of fertility. Contraceptive use is higher where fertility is lower primarily because desired fertility is lower, which leads to both

FIGURE 2 Relationship between contraceptive prevalence (CPV) and actual, desired, and excess fertility in less developed countries

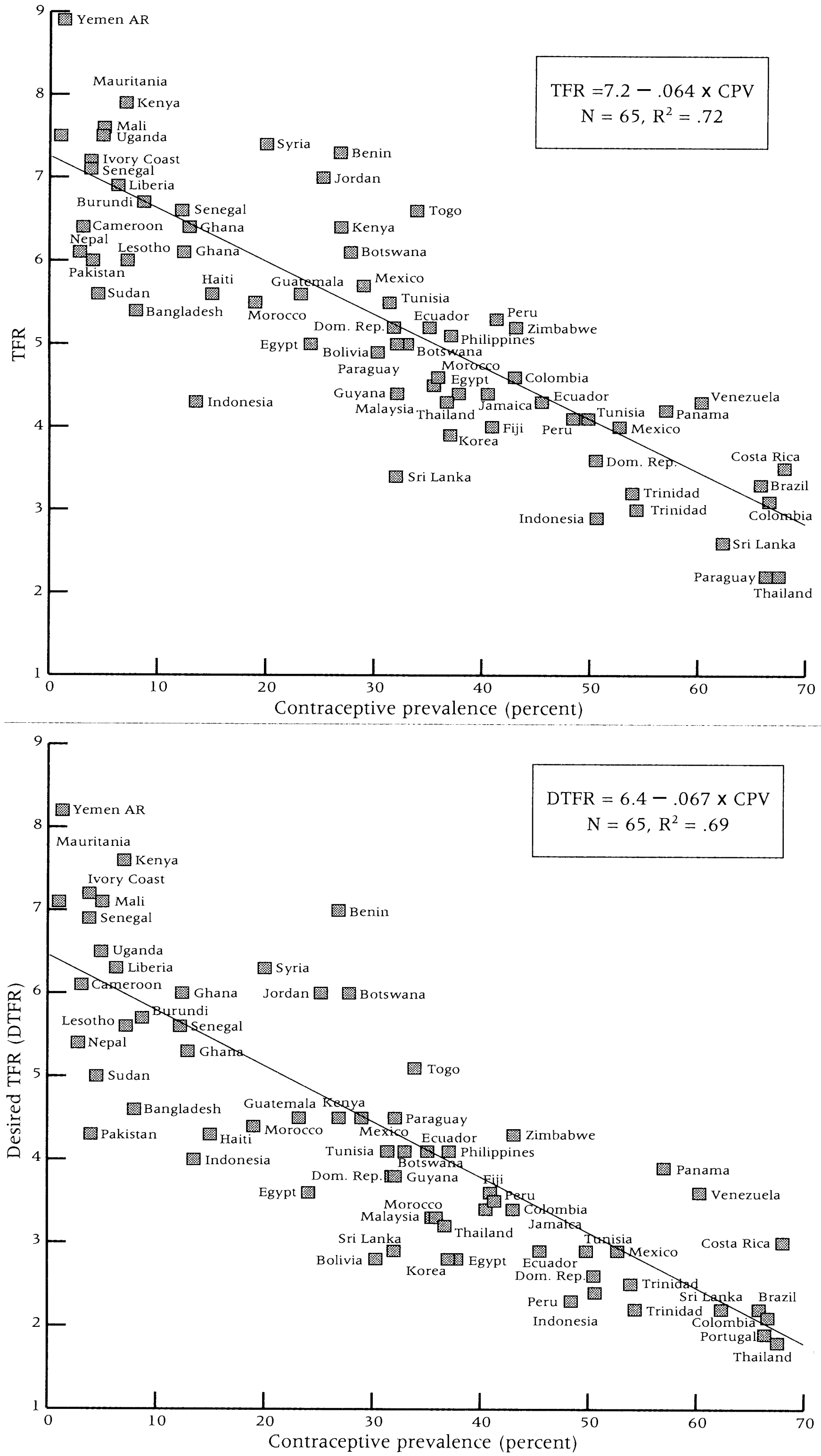
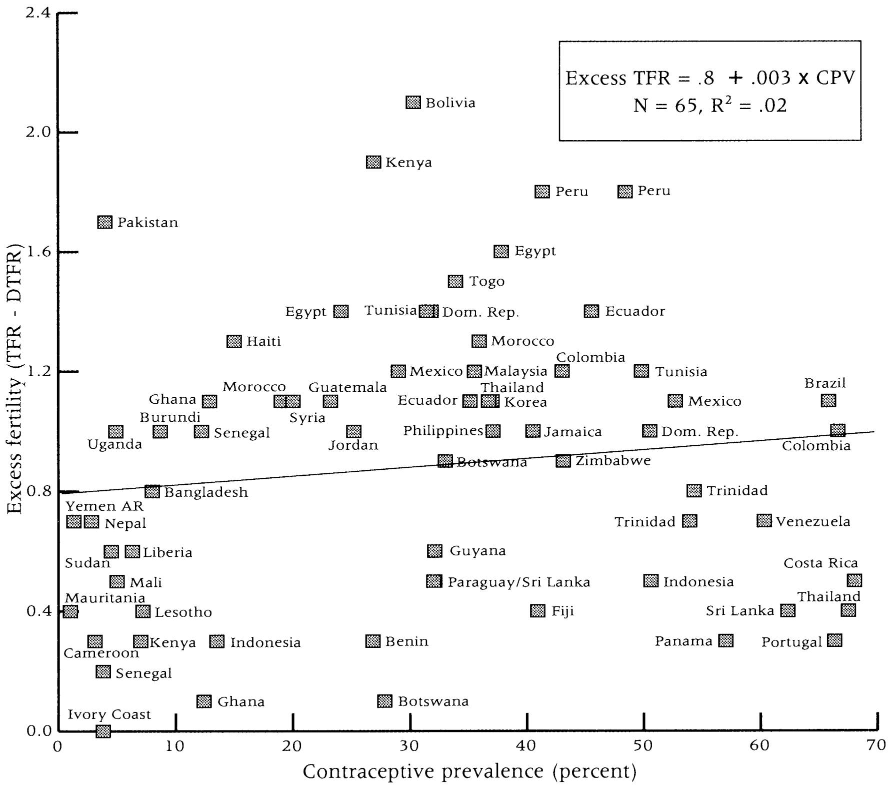


FIGURE 2 (continued)



Source: Same as Table 2

TABLE 3 Regressions of actual fertility rate on measures of desired fertility, modern contraceptive prevalence, and family planning effort

Dependent variable: TFR	With and without modern contraceptive prevalence				With and without family planning effort			
Explanatory variables	DTFR		WTFR		DTFR		WTFR	
Desired or wanted fertility	.894 (25.3)	.742 (13.5)	.912 (16.07)	.772 (0.55)	.877 (25.8)	.802 (16.99)	.887 (16.11)	.753 (11.7)
Modern contraceptive prevalence		−.017 (3.41)		−.014 (1.94)				
Family planning effort						−.007 (2.21)		−.012 (3.31)
R^2 (unadjusted)	.910	.925	.852	.863	.914	.920	.855	.885
N	65	65	47	47	65	65	46	46

NOTE: All regressions are OLS. Columns refer to separate regression equations. Entries in first three lines are coefficients with *t*-statistics in parentheses. Modern contraceptive prevalence is from WFS and DHS surveys; for family planning effort data, see text. See Data Appendix for other data.

lower fertility and higher contraceptive demand, and hence higher contraceptive use.

Prevalence does not measure access. Some authors have gone beyond focusing on prevalence alone and argued for the important role of contraceptive access and a large influence of family planning programs on fertility, using quantitative subjective indicators of the strength of countries' family planning effort (FPE) developed by Lapham and Mauldin (1984). FPE scores are derived by rating numerically the strength of each country's family planning program along 30 dimensions, including several dimensions of contraceptive access. These FPE indicators have been used in empirical work to assess the impact of family planning programs on fertility. Robey and colleagues (1993: 65) cite this research as proving that—"independently of the effect of social and economic changes—family-planning programs played a significant role in reducing fertility. . . ." Many believe Lapham and Mauldin's analysis shows that "the independent effect of program effort is somewhat greater than that of socioeconomic development" (*International Family Planning Perspectives*, 1984: inside front cover).

However, studies relating fertility to family planning activity and development (Lapham and Mauldin, 1984; Bongaarts, Mauldin, and Phillips, 1990; Mauldin and Ross, 1991; Bongaarts, 1993) suffer from three major flaws in empirical implementation. They limit the indicator of development to a single index, which is responsible for two of the flaws. First, this aggregation of various economic or social indicators into a single index imposes on the empirical results that each element of the development index has exactly the same effect on fertility.[33] Imposing this unwarranted constraint on the data increases the portion of fertility not explained by "development" and hence the fraction that is potentially explained by FPE. Second, the use of a development index excludes all other social indicators not in the index, for example the separate specification of female schooling. This will also inflate the amount of fertility explained by FPE. Third, these studies generally ignore the potential endogeneity, that is that FPE responds to changed fertility desires. With the combination of these three analytic flaws it would be possible to find with empirical data an arbitrarily large effect attributable to FPE, even controlling for a development index, even if the true fertility impact of an exogenous increase in FPE were zero.[34]

These flaws are not hypothetical, as the regression results obtained are completely different if desired fertility or its socioeconomic determinants are controlled for properly. If FPE is added to fertility regressions that control for desired fertility (as we have done above by adding contraceptive prevalence), the estimated impact of FPE on TFR is statistically significant but quite small.[35] As is shown in Table 3, the coefficient on FPE is $-.007$ (*t*-statistic 2.21) using DTFR and $-.012$ (*t*-statistic 3.31) using WTFR. This implies that a move from zero FPE to the mean level of country effort, holding desired fertility fixed, would reduce fertility by only between .22 and .37 births per woman (e.g., $.007 \times 31.4 = .22$).[36] Even the absolute extreme case of moving a country from no family planning program at all (zero FPE) to the largest FPE in the sample (80 percent of the attainable maximum) would reduce fertility by only between .56 (using DTFR) and 1 birth (using WTFR), a small fraction of the differences in actual fertility. As with contraceptive prevalence, the incremental explanatory power of FPE in both regressions is very low, .006 (DTFR) and .03 (WTFR), hence FPE explains at most 3 percent of the variance in fertility.

Although desired fertility is independent of contraceptive access (and, based on the Matlab evidence, of family planning effort), the assertion of the independence of reported fertility desires with respect to overall family planning effort, which includes information dissemination and encouragement of small families, is more problematic. However, two recent studies (Schultz, 1993; Subbarao and Raney, 1993) show that once the effects of the various socioeconomic variables are not artificially constrained and endogeneity is accounted for, the empirical estimates of the family planning effort effect are small (even possibly zero).[37] This is consistent with the view that fertility desires are largely determined by socioeconomic forces other than family planning and that fertility desires determine fertility.

Using data across countries and over time and controlling for female and male education separately as well as for other factors,[38] Schultz (1993) reports four findings. First, the largest estimates of the FPE impact are obtained in a reduced-form equation, with child mortality excluded as potentially endogenous. Even here the statistically significant estimate is empirically quite small, −.019 (only slightly larger than our highest estimate). Moving from no family planning program at all (FPE equal to zero) to the average level of FPE would decrease fertility by only about .65 births.[39] Second, the fraction of fertility variation explained by differences in FPE was less than 5 percent.[40] Third, after controlling for the potential endogeneity of FPE (that is, that FPE scores are caused by, rather than cause, changing fertility desires), the estimate of FPE impact is (implausibly) positive but statistically insignificant. Fourth, when fixed-effects estimates are used that exploit only the changes within countries over time, Schultz finds no empirically significant effect for FPE at all, although this may be due to an inadequate dynamic specification.

Supply and demand for contraception, child costs, and fertility

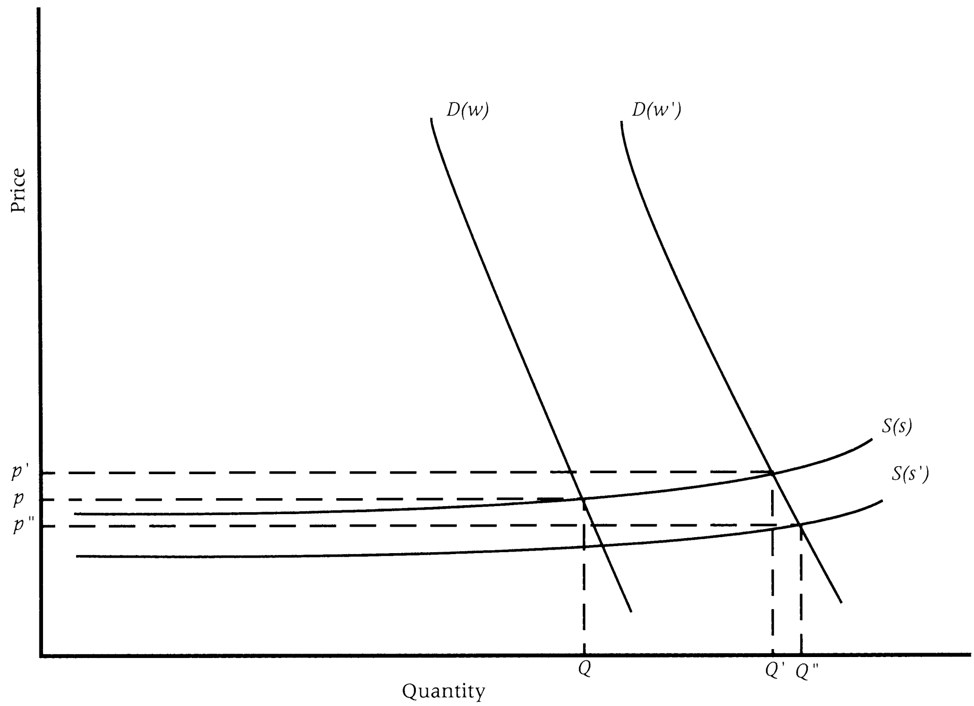
In no small measure, the apparent paradox about the importance of the "supply" of contraception for fertility stems from linguistic confusion about the term "supply." Since in the demographic literature (e.g. Bongaarts, 1978) contraception is an important proximate determinant of fertility (in a mechanical sense, the probability of a birth in any given period is the product of coital frequency, natural fecundity, and contraceptive efficacy), this is at times taken as evidence that expanding the "supply" of contraception is an important condition for reducing fertility. However, this confuses an expansion of the "supply" of contraception—the entire schedule of the amount of contraception that would be available at various prices—with an expansion in the "quantity supplied" of contraception—the amount supplied at a given price. The finding that contraceptive use (quantity supplied) increases as fertility declines does not imply that contraceptive supply (usually referred to as "access" or "availability") is an important causal determinant of fertility declines.

A large increase in contraceptive prevalence may be the result of a movement along a given supply curve of contraception as demand for contraception shifts due to changed demand for children caused by factors independent of contraception (for example, increased women's education or lower child mortality). In this case, a high correlation of contraceptive prevalence (the quantity of contraception supplied) with fertility is the result of shifts in the derived demand for contraceptives, not shifts of the supply curve itself. The impact of an exogenous fall in the price of contraceptive services (where the price includes the total direct costs to the user, including travel, inconvenience, service quality, method suitability, etc.) caused by a shift of the entire supply relation is determined by the elasticity of the demand for contraception. If the demand for contraception is inelastic with respect to the cost of contraception (as we argue below is the case intuitively and empirically), then a shift of the supply relation would have little effect on the use of contraception (and a fortiori on fertility).

This implies that all cross-country or household calculations showing strong statistical relationships between contraceptive use and lower fertility that do not adequately control for shifting demand are simply not to the point in assessing the implications of a shift in the supply of contraceptives. Any correlation, no matter how perfect, between contraceptive use and fertility may simply represent movements of quantity supplied in response to changing demand.

Figure 3 illustrates this point with a hypothetical demand–supply diagram. Suppose that the demand for contraception is entirely derived from the demand for limiting childbearing and that depends only (for simplicity) on women's wages (w). Also suppose that the supply of contraception is private but receives a per unit subsidy from the government of s. If women's wages rise from w to w' then the demand for contraception shifts and total contraceptive prevalence (quantity supplied, which equals quantity demanded) increases from Q to Q' in a movement *along* the given supply curve. If, on the other hand (and, in this illustration, in addition to the rise in women's wages), the government increases the per unit subsidy on contraception, that would shift the supply relation from s

FIGURE 3 Illustration of the effect of shifts in the supply and demand for contraception



Note: See discussion in text.

to s'. In this diagram, lower contraceptive costs induced by the subsidy prompt only a small increase in quantity demanded (from Q' to Q'') because demand is assumed to be inelastic.

Is the available evidence consistent with the view pictured in Figure 3—an elastic supply of contraception and an inelastic demand for contraception and, more especially, an underlying inelastic demand for children with respect to contraceptive costs? Demand for children must be inelastic with respect to total contraceptive costs (which, again, subsume price, information, access, and availability) both because demand for children is likely to be price-inelastic and because contraceptive costs are a very small fraction of total child costs. The marginal cost of avoiding the birth of a child is generally trivial compared to the marginal cost of having a child. Table 4 presents various estimates of the monetary cost of avoiding a single birth through the use of various forms of contraception in developing countries. These costs depend on the cost per couple

TABLE 4 Estimates of the cost of avoiding a birth in less developed countries

	Study	Country or region	Method	Per couple-year of protection	Per averted birth
(A)	Molyneaux and Diman (1991)	Indonesia	Pill	$14.0	$49
			IUD	$11.2 (insertion)	
(B)	World Bank (1992)	SSA	Pill	$27.0	$94.5
		ME&NA	Pill	$43.0	$150
		LAC	Pill	$48.0	$168
		Asia	Pill	$14.0	$49
(C)	Cochrane and Sai (1993)	Sri Lanka	Per user	$9.2	$31
		Pakistan	Per user	$22.0	$71
		Jordan	Per user	$31.0	$88
		Nepal	Per user	$80.0	$330
(D)	Schwartz et al. (1989)	Philippines	Pill	$8.3	$29
		Thailand	Pill	$8.5	$30
		Jamaica	Pill	$8.3	$29
(E)	Cochrane et al. (1990)	Morocco	Sterilization	$8.9	—
		Indonesia	Sterilization	$2.9	—
(F)	Schearer (1983)	20 countries (median)	Pill	$33.5	—
		14 countries (median)	Sterilization	$12.25	—

NOTES: (A) Reports commercial prices (which are several multiples of the public sector price), (B) reports summaries from surveys of commercial prices, (C) reports public family planning expenditures per user, (D) reports mean prices paid by users, (E) reports cost to the user, (F) reports unsubsidized commercial prices (sterilization assumes 15 years of use). All costs have been translated to 1992 US dollar prices. Abbreviations for regions: SSA = Sub-Saharan Africa; ME&NA = Middle East and North Africa; LAC = Latin America and the Caribbean.

per year and the number of years of use needed to avert a birth. The full costs are somewhat difficult to ascertain, as in estimating costs we want to use neither public cost per user (which may overstate the marginal cost) nor prices paid by users (which often include a substantial subsidy element). The range of estimates is large, but a fair guess of the cost range for the pill (a relatively expensive temporary method typically chosen to space rather than limit births, and hence a high-side estimate) would be US$30–$100 per birth avoided. For ending reproduction, sterilization is a much cheaper option as it avoids all future births. Its cost per year of protection is low, ranging from $2.9 to $12.25. A very high-side estimate of the typical total direct contraceptive cost per birth avoided for a woman would be $50.[41]

A child is well known to be vastly more costly because a birth generally obligates the parents to incur an ongoing stream of large expenses. While measuring the total cost of a child with precision is impossible, we can fix some orders of magnitude. Table 5 presents various estimates of just the direct monetary expenditures for maintaining a child, expressed as a fraction of adult consumption or household income. These are derived from "equivalence scales" and represent roughly the additional income a household would need in order to maintain its consumption of non-child goods after adding an extra child. A child costs between 30 and 40 percent of per-adult consumption.

In addition to these direct monetary expenditures occasioned by an additional child, there are the substantial opportunity costs incurred due to the time allocated to child care, which may be as high as the direct costs (Lindert, 1980; Joshi, 1990). For example, evidence from the rural United States in the early twentieth century suggests that women spent 10 hours per week caring for young children. Women aged 15–39 years in a Javanese village spend 8.9 hours weekly on child care plus another 17.2 on household food preparation and 10 on other household maintenance (amounts that are also likely to be higher with a larger family). Women aged 15–39 in a Nepalese village spend an estimated 8.9, 15.4, and 6.7 hours on the same three activities. There are some economies of scale to caring for children in both monetary and time costs, and older children do help with household tasks, factors that make higher-order births less costly. But these economies of scale are probably played out quite rapidly and the time costs of caring for higher-order children are still substantial. These are only the

TABLE 5 Direct cost of a child as a fraction of adult consumption or household income, selected countries

			Fraction (in percent) of				
				Household income			
Study	Country	Year of study	Adult consumption	General	1st child	2nd child	3rd child
Deaton and Muellbauer (1986)	Sri Lanka	1969–70	30–40				
	Indonesia	1978	30–40				
Henderson (1950)	Great Britain (low income)	1938			41	29	
Espenshade and Calhoun (1986)	USA (low income)	1972			40	18	17
Glewwe (1987a and 1987b)	Ivory Coast	1985	33				
	Peru	1985–86	33				
Chongvatana, Manaspaibul, and Hoopanich (1982)	Thailand (Bangkok)	1978		19.2			

direct time costs and as such are likely to understate the impact of children on women's time-use allocation; also, they do not account for changes in women's lessened productivity in other activities, due to pregnancy or lactation.

Suppose that, on the basis of these estimates, the direct monetary costs of a child are 20 percent of household income and that all other indirect costs (including costs not typically measured, such as maternal mortality risks) are half that amount. Total annual costs of an additional child would be 30 percent of annual household money income.[42] To calculate the lifetime cost of an additional child, these annual costs need to be summed. Tables 6 and 7 show the discounted value of direct and total costs for various levels of annual household income (and various discount rates). Even for the poorest economies with average household income of $1,500,[43] the total cost of a child (discounted at the annual rate of 5 percent) exceeds $5,000. This is two orders of magnitude (100 times) larger than the cost of avoiding one additional child. This ratio is even higher for higher levels of household income.[44]

Measuring either the cost of avoiding a birth or the costs of a child is very difficult, both conceptually and empirically, and both of these estimates are subject to a wide margin of error. Nevertheless, it is hard to gainsay differences of two orders of magnitude or larger. The contraceptive cost of avoiding a child is very small relative to the cost of having and rearing a child.

Obviously there is a counterbalancing large flow of benefits to parents generated by an additional child, as evidenced by the simple fact that people express strong desires for children. The decision to have another child is based on comparing total (gross) costs of childbearing to the total (gross) benefits to find the net cost (or benefit) of an additional child. Even if the net cost of a child is very low, and does not rise with family size so that larger family sizes are desirable, this does not imply that the gross costs are small, only that the gross benefits are large. For instance, if children work for income or help with household chores (child feeding, carrying water, or gathering firewood), this raises the benefits relative to costs and hence lowers the net, but not the gross, cost.

One of the benefits of childbearing is avoiding contraceptive costs. If gross benefits are large relative to contraceptive costs, then even very large percentage

TABLE 6 Estimated lifetime costs of a child at various levels of household income

Average household income	Direct costs	Total child costs
$1,500	$3,450	$5,250
$3,000	$6,900	$10,500
$6,000	$13,800	$21,060

NOTE: See discussion in the text.

TABLE 7 Estimated lifetime costs of a child as a multiple of annual household income for various assumptions about cost and the annual discount rate

	Annual cost of a child as fraction of annual household income		
Discount rate (percent)	**15 percent**	**20 percent**	**30 percent**
3	2.1	2.8	4.1
5	1.75	2.3	3.5
10	1.2	1.6	2.5

NOTE: See discussion in the text.

differences in contraceptive costs would lead to small changes in the gross benefits of a child. This would lead one to expect that the demand for children would be very inelastic, or unresponsive, with respect to contraceptive costs, simply because the latter are a small fraction of total costs. An analogy would be to think of households' decisions to purchase a major consumer durable, such as an automobile. There is a large flow of gross costs (purchase price, gas, repairs, motor oil, etc.) balanced against a large flow of the benefits from the services the automobile provides. People purchase cars as long as the net benefit per dollar is greater than that from other goods, which implies that the net benefit at the optimal consumption level is very much smaller than either the gross cost or gross benefit. One could ask, how many additional cars would people buy if motor oil were free?[45] Not many. Of course, this is not to say that people make decisions about children the way they do about cars, but the principle—that small components of cost have small effects—is the same.

Some would argue that the cost of contraception is irrelevant for many couples since they cannot afford it. However, being so poor as to not afford contraception would also imply, a fortiori, that another unwanted child is not affordable either. Moreover, if costs per couple-year of protection are $15.5, then even for a household of four at an international poverty line of $1 per person per day (see World Bank, 1990) contraception would cost 1 percent of household income. While this expenditure is a burden, it is not an impossible one, as 1 to 3 percent is roughly the fraction of income that low-income households in poor countries devote to expenditures on tobacco.

This intuition about responsiveness of childbearing to contraceptive costs derived from comparing relative cost shares, hence the proposition that the demand for children will be inelastic, accords well with the few empirical estimates of the price elasticity of the demand for contraceptives. A review of such estimates cited in a recent report finds that estimated elasticities for individual modes of contraception are quite low. Schwartz et al. (1989) show a price elasticity of demand for the pill of −.003 in the Philippines, −.08 in Jamaica, and −.09 in Thailand. These elasticities of particular methods overestimate the elasticity of total contraceptive use to price changes as they include the effect of substitution between contraceptive methods (for example, switching from the pill to IUD). A study in Indonesia (Molyneaux and Diman, 1991) finds that the net price elasticity of all contraceptive use with respect to the price of the pill is only −.02, only a fifth their estimated pill use elasticity of −.11. This implies that a 100 percent increase in pill prices would only reduce modern contraceptive use by 2 percent. The Indonesia study estimated that a doubling of all contraceptive method prices would lower use by just 3 percentage points, from the prevalence level of 43 percent to 40 percent.

Even these small estimated responses of contraceptive use to price changes will overstate the elasticity of fertility to contraceptive prices if some of this effect is a shift from modern to nonmodern method use. Among the alternatives to modern contraceptives are less effective forms of contraception (for example, rhythm, withdrawal) and more effective (but psychologically more costly) forms of avoiding births (for example, delayed marriage, long postpartum abstinence) so that even the small price elasticity of modern contraceptive use must substantially overstate the responsiveness of fertility to contraceptive costs.

Schultz (1993) also includes the price of oral contraceptives in a regression that links fertility with various determinants[46] in a sample of LDCs and finds its effect to be small and barely statistically significant. The implied elasticity of fertility with respect to (pill) contraception costs is .05 (higher prices raise fertility). With these estimates, reducing the price of oral contraceptives from the mean of $38 per year to zero would decrease fertility by less than 5 percent, or about .26 births.

This small relative component of contraceptive costs in the total costs and benefits of a child is of course relevant to our discussion above, examining the question to what extent survey responses about desired fertility are determined by contraceptive costs. The fact that contraceptive costs are not the major element in the childbearing decision reinforces the arguments we presented earlier, suggesting that individuals can answer and have correctly answered survey questions about how many children they would have if contraception were perfect and free.

The question of the supply of contraception is altogether more difficult to address empirically, as in many countries the market has been dominated by government supply or government regulation. However, since the costs and benefits of contraception are primarily private[47] and there are no significant economies of scale in provision, it is not clear why the private market would not adequately meet the effective demand for contraception, as it does with so many other goods.[48] While there are information gaps and people must learn of the benefits of contraception in order to have demand, this is certainly not unique to contraception and is a problem solved with the introduction of any new product or service. Especially since most contraceptives are internationally tradeable (except, of course, for components or procedures that require clinical services), it is difficult to see why, in the absence of governmental barriers and active opposition, the supply of contraception would not be elastic.

Historical and household evidence on contraceptive access

Almost by definition, the historical evidence demonstrates that access to modern contraceptive methods was not a necessary condition for lowering fertility. Many societies were able to achieve rates of fertility substantially below those currently observed in developing countries well before the advent of modern means of birth control. While crude birth rates are not directly comparable because of differences in demographic structure, it is striking that crude birth rates around 1800 in European countries (about 31 births per thousand population) were roughly equal to those in lower-middle-income countries today (30 births per thousand) and a quarter *lower* than those of the low-income countries (38 births per thousand) (Table 8). The lack of any modern means of contraception did not prevent eighteenth-century European peasants from achieving levels of fertility lower than those observed today in many developing countries, with noncontraceptive practices (e.g., high age at marriage) playing a key role. The very uneven progress of the fertility revolution both within and across countries in Europe suggests that shifts in contraceptive technology or availability were not a major factor in the fertility revolution.[49]

A great deal of household-level evidence is also consistent with the view that fertility variations are not due to differences in fecundity and that cost of

TABLE 8 Crude birth rates (births per thousand population) in Europe, circa 1800, and in selected less developed countries and regions in 1990

Europe, circa 1800		Less developed country or region, 1990	
Germany[a]	39.5	Nigeria	43
France	32.9	Bolivia	36
England and Wales[b]	30.3	Algeria	36
Denmark	29.9	India	30
Sweden	28.7	China	22
Norway	27.2	Weighted average for low-income countries (excluding China and India)	38
Average	30.6	Weighted average for lower-middle-income countries	30

[a]Rate is for 1817. [b]Rate is for 1838.
SOURCE: Mitchell, 1978 and World Bank, 1992.

contraception and proximity to contraceptive outlets are not important determinants of fertility, after controlling for fertility desires.[50] Rosenzweig and Schultz (1987) use birth histories of Malaysian women to disentangle the relative influence of estimated couple fecundity on completed family size. If fertility control were impossible (or very expensive) then each couple's fecundity should explain a large fraction of couples' actual fertility differences. Yet these authors estimate that couples' fecundity, although a statistically significant determinant, explains only 2 percent of the total variability of fertility. This is an even smaller fraction than they found earlier (Rosenzweig and Schultz, 1985) in examining data from the United States, where, they estimate, 10 percent of fertility is explained by fecundity.

Gertler and Molyneaux (1992) use Indonesian household survey data on fertility combined with district and subdistrict-level data on economic conditions, schooling, and family planning program effort to explain the large (25 percent) decline in fertility from 1982 to 1987. They find that, as a proximate determinant, increased contraceptive use explains 75 percent of the fertility decline. However, after accounting for changes in demand for contraception, they estimate that exogenous variation in family planning inputs accounts for only 4 to 8 percent of fertility decline, and point estimates of the magnitude of the impact of such inputs are small and not significantly different from zero.[51] Similarly, Pitt, Rosenzweig, and Gibbons (1993), using Indonesian data over time at the subdistrict level, find, after controlling for program placement, no statistically significant effect of family planning clinic placement on fertility. These studies provide confirmation with household data that very strong associations between changes in contraceptive prevalence and fertility change are perfectly consistent with a very small, or even zero, effect of supply shifts of contraception on fertility.

In a series of papers, Cochrane and Guilkey (1991, 1992a, and 1992b) estimate the effect of contraceptive access or family planning effort after accounting for fertility demand in Zimbabwe, Colombia, and Tunisia. In Zimbabwe, they find that although receipt of a family planning message has some effect on women wanting to space their children, neither receipt of a message nor the presence of a community-based distributor has any significant effect on the fraction of women wanting no more children. They also find that of seven indicators of family planning access only one (presence of a community-based distributor) had even a modest effect on the use of modern contraception, given fertility intentions.[52] In Colombia, none of the family planning access variables[53] was significant in reduced-form regressions for contraceptive use. In structural equations explaining contraceptive use, either in total or for individual methods (pill, IUD, traditional), none of the access variables was significant at the 5 percent level. However, the effect of fertility intentions was large and strongly significant. For Tunisia, they find moderately more positive results for the impact of access on use, as methods available and having received a message are both significant determinants of contraceptive use, although these are still much less important than fertility intentions.[54]

There is also some household evidence of an experimental nature. The Contraceptive Distribution Project in 1975 divided the Matlab region of Bangladesh[55] randomly into villages in the treatment area, in which households received contraceptives (pills or condoms) delivered to the door free of charge, and a comparison area with only the regular government program. The findings from this attempt to bring about a large reduction in contraceptive costs in the treatment area were that, in the second project year, the total fertility rate was 1.8 percent *higher* in the treatment area, in spite of the expanded access (Stinson et al., 1982).

In sum, certain household evidence, survey and experimental, is consistent with our findings from the cross-national data that although contraception and its expansion is an important proximate determinant of fertility, this is almost exclusively due to shifts in the demand for children, which shift the demand for contraception. Very little of household variation in fertility, either in cross-section or over time, is attributable to variations in the supply of contraception.

Evidence to the contrary

The evidence we have presented so far shows that high fertility, where it occurs, is largely desired and is not primarily a consequence of the difficulty or expense of controlling fertility. How does this evidence square with the evidence often cited to support a large role for contraceptive access and family planning programs? We will examine three strands of this evidence: the existence of a large "unmet need" for contraception, the ongoing fertility change in developing countries, and the evidence from the extensively studied experiment in Matlab, Bangladesh.

"Unmet need"

There is a large (and widely cited) body of evidence that a substantial "unmet need"[56] for contraception exists. This might suggest that fertility rates are affected by a lack of available contraception. However, the finding that contraceptive access is unimportant as a determinant of total fertility is consistent with these findings of "unmet need" for contraception. The figures for "unmet need" assume that every woman who reports herself as not wanting a child immediately and not currently using contraception is in "need" of modern contraception. Besides its conceptual drawbacks (see below) this construct vastly overstates the potential effect of improved contraceptive provision.

The level of "unmet need" and other measures of contraceptive access are not empirically important determinants of fertility. Calculations of the fertility declines from reducing "unmet need" are generally based on idealized assumptions about the effect of improved contraceptive access on fertility, for instance that all women would then meet their fertility spacing and limiting targets exactly.[57] In order to calculate the actual effects of changes in "unmet need," Table 9 reports estimated values of the regression coefficient and the incremental R^2 when using three measures of contraceptive availability—"unmet need," "percentage of demand satisfied," and "proportion of exposed women who do not want more children but are not using contraception"—in the regression explaining total fertility after controlling for desired fertility (DTFR).[58] Only between 4 percent and 6.5 percent of the fertility variation is accounted for by variations in "unmet need" or variants of that measure.[59] Calculations we present below suggest that "unmet need" could be reduced by improved contraceptive access by only about one-third. By these estimates, even reducing "unmet need" by one-third (about one standard deviation) by eliminating directly access-related "unmet need" would reduce fertility by less than half a birth.

The cross-country estimates shown in Table 9 in combination with reference to the figures on "unmet need" shown in Table 10 can illustrate the impact of a very large reduction in "unmet need." For example, in Ghana, if "unmet need" were reduced by a third, from 35 percent to 23 percent, or 12 percentage points (which is actually more than the total estimated access-related nonuse of 7 percent), this would reduce fertility only from 6.4 to 5.7. This result is intuitively quite plausible as Ghana's DTFR is 5.4 and 90 percent of births are wanted.[60] The evidence of substantial "unmet need" for contraception is thus compatible with a practically quite small (although statistically quite significant) effect of contraceptive access on fertility.

TABLE 9 Estimates of parameter values describing the relationship between total fertility and various measures of contraceptive availability and use, controlling for total fertility and desired fertility (DTFR)

Measures of contraceptive availability and use	Coefficient	Incremental R^2	*t*-statistic	N
"Unmet need"	.056	.056	6.8	25
Percentage of total contraceptive demand satisfied	−.036	.039	4.4	25
Percentage of currently married fecund women not wanting more children and not using contraception	.141	.064	8.91	25

SOURCE: Data for DTFR: see Data Appendix: for other data see Table 10.

The combination of very high *t*-statistics with a low fraction of the total variation explained highlights an important point in interpreting the statistical results shown in Table 9. The fact that the point estimate of the effect on fertility is a small absolute number with a high *t*-statistic implies very precise estimates, which means that not only can we rule out zero effect but we can also rule out anything much larger than the empirically small estimated effect. For instance, while the point estimate of the effect of decreasing "unmet need" by a third of the average (8 percentage points) is a reduction in TFR of .46, even if we add two standard deviations to the point estimate the simulated fertility effect of the same reduction in "unmet need" is only slightly higher, .58 births.[61]

The evidence of large "unmet need" for family planning (Westoff and Ochoa, 1991) is often cited in discussions of the potential effect of increased provision of family planning services on population growth (United Nations, 1991; World Bank, 1993b). But given the evidence above, how large is the potential?

First, it must be recognized that the assumptions according to which "unmet need" properly includes women who want family planning services, and that "unmet need" could be zero under some access conditions, are both untenable. Although general linguistic usage would rank "needs" higher in the hierarchy of wants than "demands" or "desires," in calculating "unmet need" all women not wanting a child immediately who report not using contraception (even for reasons other than cost or availability—for example, infrequent sexual activity, dislike of side effects of contraceptives, or religious objections) are classified as "needing" contraception. In sub-Saharan Africa, only 37 percent of those with "unmet need" intend to use contraception, even though 85 percent know of a modern method. Therefore, women who have no demonstrated demand or expressed desire for family planning are reported as "needing" it. "Unmet need" does not reflect just women who want contraceptives (a supply need) but also those women who require motivation to want what they are presumed to need. This usage is consistent only with either a very broad, or very paternalistic, definition of "need."

This is important as the fraction of women not using family planning because of access, the supply portion of "unmet need," is quite small. In many of the surveys, typically only one-quarter to one-third of women who are not using contraception and who report that they "would not be happy if they were to become pregnant in the next few weeks" also report lack of contraceptive supply or access (taken broadly to include knowledge, availability, or cost) as the major reason for not using family planning.[62] Since access is often not the issue, even costless availability of contraception would not drive down "unmet need" very far, a point confirmed by the existence of substantial "unmet need" even in countries with excellent contraceptive access (Table 10).

A second reason why "unmet need" empirically does not have the large potential fertility consequences some might expect is that a substantial portion of

TABLE 10 Estimates of "unmet need," demand satisfied, and access-related nonuse, based on DHS surveys, selected less developed countries, 1985–91

Country	Year of survey	"Unmet need"	Percentage of "demand" satisfied	Percentage of spacing demand satisfied	Currently fecund married women who want no more children and are not using contraception	Percentage of women not using contraception owing to lack of access	
						Definition 1	Definition 2
Sub-Saharan Africa							
Botswana	1988	26.9	53.6	46.4	6.5	3.6	
Burundi	1987	25.1	25.8	24.7	5.1		
Ghana	1988	35.2	26.8	23.4	7.0	7.0	
Kenya	1989	38.0	41.5	27.7	11.5	14.1	
Liberia	1986	32.8	16.4	15.4	4.6	2.5	
Mali	1987	22.9	17.0	18.9	4.3		
Nigeria	1990	—	—	—	—		6.3
Sudan	1990	—	—	—	—	2.6	
Togo	1988	40.1	23.2	22.0	8.5		
Uganda	1989	27.2	15.2	9.5	5.2	11.4	
Zimbabwe	1989	21.7	66.5	73.1	8.1	3.8	
Asia							
Indonesia	1987	16.0	73.8	62.5	5.0		11.1
Pakistan	1991	—	—	—	—		7.5
Sri Lanka	1987	12.3	81.3	60.9	4.1	1.8	
Thailand	1987	11.1	85.0	72.9	4.3	0.3	

North Africa							
Egypt	1988	25.2	58.4	35.8	9.8		
Morocco	1987	22.1	59.1	48.1	6.5		
Tunisia	1988	19.7	70.0	54.2	5.8		
Latin America and the Caribbean							
Bolivia	1989	35.7	43.4	37.1	15.2	11.4	
Brazil	1986	12.8	81.6	74.0	5.7		
Colombia	1986	13.5	80.1	69.7	6.2		
Dominican Republic	1986	19.4	69.9	46.2	6.3	0.6	
Ecuador	1987	24.2	62.5	48.7	10.5		0.2
El Salvador	1985	26.0	64.1	36.3	8.1		
Guatemala	1987	29.4	43.3	23.1	9.0		
Mexico	1987	24.1	66.7	52.1	9.3		
Peru	1991	—	—	—	—		0.9
Peru	1986	27.7	58.8	51.6	13.1	6.0	
Trinidad & Tobago	1987	16.1	74.2	66.1	6.7		

NOTE ON ACCESS: The fraction of women not using contraception due to access has two definitions, depending on the question in the DHS. Definition 1 results from first asking women: "If you became pregnant in the next few weeks, would you feel happy, unhappy, or would it not matter very much?" then, of those who do not respond "happy," asking: "What is the main reason that you are not using a method to avoid pregnancy?" In the list of 13 possible responses is: "lack of knowledge," "access/availability," and "costs too much." The fraction not using owing to lack of access is of all currently married women the fraction unhappy if pregnant and not using due to one of these three reasons. Definition 2 is the result of asking women who are not using and do not intend to use: "What is the main reason you do not intend to use a method?" In addition to the three access reasons, "Wants children" is a possible (and generally most frequent) answer.

"unmet need" consists of women who are currently pregnant or amenorrheic whose pregnancy or most recent birth was either mistimed or unwanted. These temporarily infecund women account for between one-third and one-half of all "unmet need" in sub-Saharan African countries. "Unmet need" also includes a substantial fraction of women with demand for spacing, that is, who want more children but not immediately.[63] While including these two groups is relevant, Table 10 reports the total "unmet need" alongside the most relevant group for determining total completed fertility levels, the fraction of currently married fecund women wanting no more children who are not using contraception. The fraction of all "unmet need" that consists of this group is typically less than a third of all "unmet need," with a median fraction of only 6.5 percent. For instance, in Uganda 27 percent of women are said to have "unmet need," but only 5 percent of married fecund women want no more children and are not using contraception. While both the question of the fertility impact of spacing and the question of the appropriate treatment of pregnant and amenorrheic women are difficult, it is nonetheless apposite to note that large "unmet need" figures are consistent with very small numbers of fecund women wishing to limit childbearing but not using contraception.

Fertility change

Some argue that the magnitude and rapidity of the fertility transition in developing countries compared to the historical transition in the now-developed countries provides strong evidence for the importance of family planning programs in reducing fertility. For example, Robey and colleagues (1993: 64) claim that, "The differences between fertility declines in developing countries today and those seen in Europe may best be explained by differences in the approaches to family planning."

But if access to contraception or improved family planning programs were driving fertility declines, they should be accompanied by a reduction in excess fertility. This is not the case. The impressive declines in fertility observed in the contemporary world are due almost entirely to equally impressive declines in desired fertility, not to reductions in excess fertility. Only 17 of the countries in the Data Appendix have complete survey data at two points in time.[64] In that subsample the actual fertility decline observed was 1.08 births. Desired fertility (DTFR) fell by a *larger* amount, 1.32 births.[65] Excess fertility, the difference between TFR and DTFR, decreased in only six of the countries while rising in 11. Even in those six countries where a closer match between actual and desired fertility contributed to lower fertility, it was generally by a small amount. Only in Thailand did the reduction in excess fertility account for more than a quarter of the fertility decline. Even in Mexico, where fertility fell by 1.7 births between 1976 and 1987, desired fertility fell by 1.6, while excess fertility reductions accounted for only .1 births. Since DTFR is not affected by contraceptive access, the increased excess fertility observed in 11 of these countries with declining fertility suggests that decreases in desired fertility lead, and cause subsequent increases in contraceptive use and reductions in actual fertility, rather than vice versa.

Moreover, most of the intuitive appeal of an argument based on the speed of the current demographic transition is lost once it is recognized that differences in respect of family planning programs—active today, absent in the past—are just one small aspect of differences between today's fertility transitions and Europe's historical fertility transitions. In many developing countries that experienced rapid fertility decline, everything happened faster than for the now-developed countries: mortality fell faster, incomes rose faster, education expanded more rapidly. Compare for instance Thailand with Great Britain. According to WFS and DHS data, Thailand's TFR fell from 4.3 in 1975 to 2.2 in 1987, a 50 percent fall (to near replacement levels) in just 12 years. By comparison the fertility transition in England and Wales was much slower, as TFR fell from 4.6 to 1.9 only over the course of 50 years. But note that infant mortality rates in Thailand fell 60 percent in 25 years, from roughly 100 in the early 1960s to around 40 by 1985 (United Nations, 1992). In contrast, from a level of 160 in 1800, British infant mortality took 120 years to fall 60 percent (and did not reach 40 until after 1945).[66] Thailand's real per capita income has tripled in the 30 years since 1960, whereas it took British per capita income almost 90 years to triple (between 1855 and 1939).[67] Similarly, the expansion of education has occurred very rapidly in Thailand, the proportion of adult women with no schooling dropping from 60 percent to 20 percent in only 25 years (Barro and Lee, 1993a).

Similarly rapid improvements in mortality, income, and education also accompanied other rapid fertility transitions in the contemporary developing world (e.g., in Indonesia, Korea, and Taiwan). Therefore on mere speed alone it is impossible to attribute any effect to modern contraceptives and their availability. Studies of the underlying causes of rapid fertility transition in these cases reveal that attributing all (or in some cases, even a substantial fraction) of the fertility decline or its speed to family planning programs per se vastly overstates the program effect (Schultz, 1987, 1992; Hernandez, 1984).

The Matlab experiment

Perhaps the most famous controlled study examining the effects of family planning activities on contraceptive use and fertility is the Family Planning and Health Services Project (FPHSP) carried out in a research station of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) in the Matlab region of Bangladesh. This project, succeeding the Contraceptive Distribution Project, provided half of the villages in the region (the treatment area) with very intensive family planning services, including visits every two weeks to each currently married, fecund woman by a full-time project employee (generally a married, contracepting, well-educated, female village resident from an influential family). This family planning worker presented information, discussed family planning needs, and offered a variety of contraceptive methods (the pill, condoms, IUDs, injectables). The other half of the Matlab region received no additional family planning services beyond the usual government services.

The project began in October 1977 and achieved almost immediately a large increase in the contraceptive prevalence rate and a decrease in the fertility rate. Within 18 months contraceptive prevalence in the treatment area rose from 7 percent to 33 percent (Phillips et al., 1988), and 1990 estimates placed contraceptive prevalence in the treatment area at 57 percent versus 27 percent in the comparison area (Koenig et al., 1992). Fertility rates also fell in the treatment area relative to the comparison area. By 1980 total fertility in the treatment area had fallen 24 percent compared to the comparison area (to 5.1 versus 6.7), a gap of 1.6 births that has been roughly maintained since.[68]

This project proves that family planning activity can have a role in the determination of fertility. But does this experiment refute either of our main contentions: namely, that the responsiveness of fertility to incremental changes in family planning program activity is small, and that very little of cross-country differences or changes in fertility are (or are likely to be) explained by differences in contraceptive access or family planning programs? No. The fertility changes were large not because fertility was particularly responsive to program intervention but because the effort was massive and expensive. This program expense makes it unlikely that this degree of effort will be replicated at a national scale in Bangladesh, or in any low-income country.

The FPHSP experiment took "contracepting" costs from about as high as they could possibly be and drove them to about as low as they possibly can be. The price of contracepting has at least six components: the money cost of the contraceptive service, the search costs of acquiring information about contraception and where to purchase it, the time and travel costs to obtain contraception, the "variety constraint" cost,[69] the side effects of contraceptive use, and the psychic costs of using contraception in the face of perceived social or familial disapproval. Prior to the experiment many of these costs were very high. The Matlab region is predominantly Muslim and most women observe "purdah," involving substantial restriction on their movements outside the home, making both the costs of acquiring information and the costs of obtaining contraceptives dramatically higher than in most other cultures. Moreover, in 1984, some 42 percent of women in the treatment area perceived disapproval from their husbands or others (Degraff, 1991).

The program reduced all of these costs to as low a level as possible. Contraceptives were provided free, eliminating money costs. Contraception was delivered to the home (except when requiring a clinic), avoiding travel and time costs. A broad variety of methods was offered and used.[70] The recruitment of educated village women to provide continuous (fortnightly) contact and support was a deliberate attempt to overcome both the costs of obtaining contraception in a traditional society and social and familial disapproval[71] and to reduce the disutility of side effects. Even for goods provided "free," the user usually bears all but the money costs. The FPHSP made contracepting much cheaper than free.

Given the radical reduction in contracepting costs due to the truly extraordinary sustained effort (a 35-year-old woman would by now have received over 300 visits from a family planning worker), a fertility decline of 1.5 births (or about 25 percent) in Matlab seems perfectly consistent with all the other evidence. The close link between desired and actual fertility, lack of a contraceptive prevalence effect on excess fertility, small independent impact of family planning effort, low contraceptive price elasticities, limited effect of "unmet need" measures all suggest that fertility is substantially inelastic with respect to costs of contraceptive access or family planning effort. We are not arguing that fertility is invariant with respect to the cost of contraception, just that it is sufficiently inelastic to make cost variations an unlikely source for explaining or causing major demographic changes.

Fertility reduction in the Matlab experiment came at a sufficiently high cost to make it not replicable at a national scale, let alone everywhere in the developing world. Table 11 presents estimates of the cost of the program. The total costs include many costs not directly related to the project (such as data collection, international technical assistance, and non–service-related overheads). While it can be argued that these costs should be discounted, the role of international technical assistance was likely crucial in the success of the project and probably would be critical to replicability. Even taking the "core service" costs, they amount to over $8 per woman, which in Bangladesh is roughly 5 percent of per capita GDP.

To consider another comparison, these core service costs alone are 35 times the average public expenditure levels on family planning per married woman of

TABLE 11 Costs of Matlab (FPHSP) experiment and Bangladesh government expenditures on family planning in 1985 (in 1993 US$)

	Cost	Cost per woman aged 15–49	Cost per woman aged 15–49 (percent of GDP per capita)
Total cost	$386,000	$17.27	10.0
"Core service" cost	$189,000	$8.44	4.9
Public expenditures in Bangladesh on family planning	$45,400,000	$3.38	1.8

NOTES: Based on Simmons, Balk, and Faiz, 1991 and Nag, 1992. Number of women aged 15–49 in treatment area was 22,370. Per capita GDP in 1985 was $150. All 1985 dollar figures were transformed to current (1993) dollars by the US consumer price index.

reproductive age (MWRA) for four components of family planning programs (contraception, staff training, IEC, and compensation payments) in Asian countries (Sanderson and Tan, 1993).[72] Bangladesh has by far the highest family planning expenditures in Asia for these four components,[73] at .41 percent of GDP, and total expenditures on family planning per MWRA are 1.8 percent of GDP, about one-third the Matlab "core service" program cost. Worldwide total expenditures on family planning (public and private) per woman of childbearing age are about 0.6 percent of GDP per capita (World Bank, 1993b).[74] If the Matlab level of spending (as a fraction of GDP)[75] were to be achieved in the developing world at large, family planning program expenditures would need to rise to over $40 billion, an eight-to-tenfold increase over current levels.

How much did contraceptive costs faced by program clients in the Matlab project decline? The costs of the program are a useful proxy. While the "core service" cost reflects the cost of delivering the additional services, even though the additional costs of the total project were not spent directly on the project, they may better reflect the design and implementation of this experiment, which may be seen in lower contracepting costs to users even for a given expenditure. If the total contracepting cost to women in the Matlab treatment area is between 2.5 and 5 times lower than the cost to women in the comparison area (taking administrative costs as a crude proxy for contracepting cost changes) and fertility is 25 percent lower, a simple calculation suggests an elasticity of fertility with respect to contracepting costs of between –.17 and –.063.[76] This number is certainly consistent with other results, as seen when expressed in elasticity form. From Table 3 the elasticity (at the means) of fertility with respect to family planning effort is between $-.04$ [i.e., $(-.007) \times (31/5)$] and $-.074$, while the elasticity with respect to contraceptive prevalence is between $-.074$ and $-.061$. These are not of course directly comparable, as we do not know the elasticity of family planning effort and contraceptive prevalence themselves with respect to expenditures. The fertility elasticity with respect to the price of the pill of $-.05$ and the overall price elasticities of contraceptive use of around $-.1$ are also broadly consistent with the crude estimate from Matlab. A calculation assuming a constant elasticity of fertility with respect to contraceptive costs of $-.1$ suggests that an exogenous doubling of family planning expenditures in low-income countries excluding China would reduce fertility by about .5 births per woman.[77]

Put another way, the cost per birth averted by the Matlab program was $180 in 1987, equivalent to about 120 percent of Bangladesh's GDP per capita.[78] At this cost as a fraction of GDP per birth averted, a doubling of family planning program expenditures would reduce the rate of natural increase by one tenth of one percentage point (a decline in the CBR from 30 to 29).[79] These are crude calculations; most fertility reduction would occur in the poorer areas of the countries rather than equiproportionately by population, so the average dollar cost would be lower. Nevertheless, even under the most optimistic assumptions about the likely course of family planning expenditures, exogenous variations in these expenditures (as opposed to increases in response to increased demand) are unlikely to play a major role in reducing fertility levels, if the Matlab costs are any guide.[80]

Conclusion

The conclusion that follows from the evidence and analysis we presented is that because fertility is principally determined by the desires for children, contraceptive access (or cost) or family planning effort more generally is not a dominant, or typically even a major, factor in determining fertility differences.[81] We add five final comments. These comments do not follow directly from the evidence presented here but are more speculative as to broader implications and suggestive of future research.

First, some might argue that we are attacking a straw man, since no one really believes that the cost and availability of contraceptives is all-important for fertility. As for what is popularly believed, we can do no better than quote Paul Kennedy's recent book (1993: 338) in which he summarizes his view of the conventional wisdom on family planning programs:

> [A] detailed proposal for dealing with the demographic explosion in developing countries would simply repeat what numerous studies by international agencies have pointed out: that the only practical way to ensure a decrease in fertility rates, and thus in population growth, is to introduce cheap and reliable forms of birth control. . . .

We could not have invented a clearer and more articulate statement of the view we argue is wrong.

Second, among experts in the field, a more subtle view has evolved. Decades of promoting contraception have convinced many that supply is not the only problem. Some would argue that what we are saying is already well known: that is, to achieve fertility reductions one must change desires *and* improve contraceptive access. But we suggest the evidence presented here shows that it is fertility desires and *not* contraceptive access that matter.[82] A low level of desired fertility appears to be both necessary and sufficient for low fertility. Desire to regulate fertility calls forth the requisite level of contraception, either from private (including household-produced) or government sources. In contrast, an improvement in contraceptive access (as distinguished from contraceptive use) is neither sufficient nor necessary for large fertility reductions. In economists' terms, the fact that the quantity of contraception supplied to users must increase does not imply that the supply curve must shift. Of course, if the government pursues policies that interfere with contraceptive access and thereby make the supply of contraception less responsive to increased demand, then this will attenuate the fertility reductions from changing desires for children.

Third, since we assert that the proposition that, in a causal sense, contraception is important for fertility is both widely held and demonstrably false, we owe the reader some explanation as to how this misreading of the evidence came to be prevalent. Contraception is an obviously important proximate determinant of fertility. Fertility rates and contraceptive use are strongly negatively associated across countries, across households, and over time. Hence, it is easy to conclude that variations in contraceptive access *cause* variations in fertility. The temptation to infer causation from association is strong, often overwhelming. In addition, there are conditions in which access could be a significant determinant: for example, if the supply of additional contraception were not flexible to meet additional demand or the government imposed conditions that would make access critical. Again, usually these conditions do not hold. Finally, if, as many believe, population growth is one of the most serious challenges facing humankind, it is tempting to hope that something relatively cheap and easy, like subsidizing contraceptive services, could solve the problem.

Fourth, even if contraceptive access has a small effect on fertility, this is certainly no reason for governments to limit the availability of contraception, and there may be valid reasons for a subsidy. Just because family planning is of marginal relevance for population change does not mean it does not have other beneficial impacts. Moreover, a reduction in the focus of family planning programs on population growth will allow greater attentiveness in the design of contraceptive supply to other considerations, such as child and maternal health, the timing of first births, and the prevention of sexually transmitted diseases. Undoubtedly, the expanded availability of modern contraception has greatly improved human welfare. As detailed in *World Development Report 1993*, there are important health benefits to contraception through better timing and spacing of births, independent of any reduction in overall fertility. Evidence suggests that, ceteris paribus, children born too early or too close together face an increased risk of mortality. Better and cheaper access to contraception, especially of temporary and reversible methods, may allow women to gain these health benefits for themselves and their children. In many countries, preventing early first births would not only improve maternal and child health at first birth but would also allow women to gain valuable educational and labor force experience before beginning childrearing. The experience in the United States shows that even if the number of total births is not a concern, the timing of the first birth can have important, lifelong socioeconomic implications for mothers.

Our examination of actual and desired fertility in this article has not distinguished between ways in which unwanted births can be avoided. Modern contraception has also made it possible for people to meet their fertility goals without resorting to induced abortion. For instance, in parts of the former Soviet Union fertility is limited through widespread recourse to abortions, in part because of the greater availability of abortion services than of modern contraceptives.

Historical fertility transitions often involved reduced coital frequency (for example, late age of marriage, low rates of marriage, prolonged postpartum abstinence, etc.). In the developing countries the use of noncontraceptive fertility limitation has been less and this, arguably, is a major benefit of modern contraception. For instance, the birth rate in Sweden and Finland in 1875 was 30.5 and 37 respectively, partly because mean age at marriage for women was late, 27.1 and 25.6 years (Kumar, 1971), whereas contemporary Egypt and Peru have similar crude birth rates with a median age at marriage of 18.5 and 21.2, respectively. In Mexico, fertility has fallen from 6.3 births in 1973 to 3.8 in 1986 while age at marriage has barely risen. In the 1987 DHS survey in Mexico, women with a secondary education reported having sexual relations 40 percent more frequently than women with no schooling (6.1 versus 4.3 times per month), even though their fertility was less than half (2.5 versus 6.1). In Taiwan (China), coital frequency increased during the same period in which fertility fell dramatically from 4.8 to 2.8 (Sun, Lin, and Freedman, 1978); and similar increases were observed in the United States in the 1960s (Trussell and Westoff, 1980). Coital frequency is generally higher in households using contraception. Many recent surveys have asked whether women have been "sexually active" in the previous four weeks. In Peru, 53 percent of those using no contraceptive method had been sexually active as against 95 percent of those using the pill; the corresponding percentages were 47 and 91 in Colombia, and 59 and 86 in Nigeria. Of course the causation runs both ways in this instance.

The emergence of AIDS and the increased incidence of sexually transmitted diseases (STDs) generally introduce new complications into decisions about contraceptive mix. Some methods that are particularly cost-effective for fertility limitation (e.g., female or male sterilization) have no effect on disease transmission. Condoms, while generally thought not highly effective for fertility limitation, have important secondary health benefits in inhibiting STD transmission.

Fifth and finally, we have focused only on the importance of desired fertility in explaining fertility variations and on the relatively small independent role of contraceptive access (or family planning programs more generally). Our findings do not imply that, for a variety of economic and environmental reasons, a reduction in population growth rates may not be desirable, and even in some circumstances critical. However, since many couples in developing countries currently perceive they are better off with large families, the best (and perhaps the only palatable) way to reduce fertility is to change the economic and social conditions that make large families desirable.

Although this article has not focused on the determinants of desired fertility, expansion of female education appears to be a key to fertility reductions. Cross-national evidence that separates the two shows much stronger effects of female than male education in reducing fertility (Schultz, 1993; Subbarao and Raney, 1993; Barro and Lee, 1993b). Household-level evidence shows the importance of female education for reducing fertility through lower fertility desires. Summers (1992) shows, for example, that increasing female education through expanded access in Pakistan would be an important and cost-effective means of reducing fertility.

In sum, reducing fertility is best seen as a broad problem of improving economic and social conditions, especially for women: raising their levels of education, their economic position, their (and their children's) health, and their role and status in society. That is a task altogether more difficult, but with more promise, than manipulating contraceptive supply.

DATA APPENDIX (continued)

Country	Survey	Year	TFR	Average ideal number of children (AINC)	Desired TFR (DTFR)	Wanted TFR (WTFR)	Percentage of all births that are wanted	Percentage of women with 4 living children who want no more
Asia (excluding West Asia)								
Bangladesh	WFS	1976	5.4	4.1	4.6	4.2	79	76.7
Fiji	WFS	1974	4.1	4.2	3.6	3.2	80	66.7
Indonesia	WFS	1976	4.3	4.8	4.0	3.6	85	57.0
Indonesia	DHS	1987	3.3	3.2	2.4	—	—	79.2
Korea	WFS	1974	3.6	3.2	2.8	2.6	70	92.0
Malaysia	WFS	1974	4.2	4.4	3.3	3.6	85	51.9
Nepal	WFS	1976	6.8	3.0	5.4	4.6	77	58.0
Pakistan	WFS	1976	6.0	4.2	4.3	4.2	75	69.0
Pakistan	DHS	1991	6.3	4.1	—	—	—	51.6
Philippines	WFS	1978	5.0	4.4	4.1	—	—	68.0
Sri Lanka	WFS	1975	3.4	3.8	2.9	2.4	72	87.0
Sri Lanka	DHS	1987	2.7	3.1	2.2	2.2	84	92.6
Thailand	WFS	1975	4.3	3.7	3.2	2.6	64	81.3
Thailand	DHS	1987	2.2	2.8	1.8	—	—	87.7
Vietnam[a]		1988	4.5	2.5	—	—	—	80.6
West Asia, North Africa, and Europe								
Egypt	WFS	1980	5.0	—	3.6	3.3	70	75.3
Egypt	DHS	1988	4.4	2.9	2.8	—	—	82.1
Jordan	WFS	1976	7.3	6.3	6.0	5.2	77	38.3
Morocco	WFS	1980	5.5	—	4.4	—	—	44.7
Morocco	DHS	1987	4.6	3.7	3.3	3.2	76	58.8
Portugal	WFS	1980	2.4	2.3	1.9	2.0	95	96.2
Syria	WFS	1978	7.5	6.1	6.3	5.5	78	44.5
Tunisia	WFS	1978	5.5	4.1	4.1	3.8	74	—
Tunisia	DHS	1988	4.1	3.5	2.9	—	—	78.0
Turkey	WFS	1978	4.3	3.0	—	3.0	79	82.6
Yemen AR	WFS	1979	8.5	5.5	8.2	—	—	24.7

Data Appendix:
Actual fertility and various measures of fertility demand

Country	Survey	Year	TFR	Average ideal number of children (AINC)	Desired TFR (DTFR)	Wanted TFR (WTFR)	Percentage of all births that are wanted	Percentage of women with 4 living children who want no more
Sub-Saharan Africa								
Benin	WFS	1982	7.3	7.8	7.0	—	—	12.1
Botswana	WFS	1980	6.1	—	6.0	—	—	—
Botswana	DHS	1988	5.0	4.7	4.1	—	—	29.8
Burundi	WFS	1978	7.9	—	7.6	—	—	—
Burundi	DHS	1987	6.7	5.3	5.7	5.6	87	25.2
Cameroon	WFS	1978	6.4	8.0	6.1	6.0	94	3.0
Ghana	WFS	1980	6.2	6.0	6.0	5.6	91	15.0
Ghana	DHS	1988	6.4	5.3	5.3	5.4	90	25.1
Ivory Coast	WFS	1981	7.2	8.4	7.2	—	—	3.2
Kenya	WFS	1978	7.9	7.2	7.6	6.7	86	16.1
Kenya	DHS	1989	6.4	4.4	4.5	—	—	49.0
Lesotho	WFS	1977	6.0	6.0	5.6	4.9	84	26.6
Liberia	DHS	1986	6.5	6.0	6.3	6.0	90	23.0
Mali	DHS	1987	7.0	6.9	7.1	7.0	93	26.3
Mauritania	WFS	1974	7.5	8.8	7.1	—	—	26.3
Nigeria	DHS	1990	6.0	5.8	—	—	—	16.7
Senegal	WFS	1978	7.1	8.3	6.9	6.9	99	9.0
Senegal	DHS	1986	6.6	6.8	5.6	5.7	91	18.8
Sudan	WFS	1979	5.4	6.2	5.0	4.8	89	16.1
Sudan	DHS	1990	4.6	5.8	—	—	—	23.3
Togo	DHS	1988	6.6	5.3	5.1	—	—	26.6
Uganda	DHS	1989	7.5	6.5	6.5	—	—	17.9
Zimbabwe	DHS	1988	5.2	4.9	4.3	—	—	31.8

Latin America and the Caribbean								
Bolivia	DHS	1989	4.9	2.6	2.8	—	—	85.8
Brazil	DHS	1986	3.3	2.8	2.2	2.2	71	86.9
Colombia	WFS	1976	4.6	4.0	3.4	2.7	62	79.0
Colombia	DHS	1986	3.1	2.7	2.1	2.0	68	89.8
Colombia	DHS	1990	2.9	2.6	—	—	—	89.3
Costa Rica	WFS	1976	3.5	4.7	3.0	3.0	88	68.4
Dominican Republic	WFS	1975	5.2	4.7	3.8	3.3	68	69.6
Dominican Republic	DHS	1986	3.6	3.4	2.6	2.5	75	87.6
Dominican Republic	DHS	1991	3.3	3.1	—	—	—	95.9
Ecuador	WFS	1979	5.3	3.0	4.1	3.4	69	68.0
Ecuador	DHS	1987	4.3	2.5	2.9	2.4	60	80.7
El Salvador	DHS	1985	4.4	3.6	—	—	—	77.9
Guatemala	DHS	1987	5.6	4.2	4.5	—	—	62.1
Guyana	WFS	1975	4.4	4.6	3.8	3.1	74	60.0
Haiti	WFS	1977	5.6	3.6	4.3	3.4	65	68.0
Jamaica	WFS	1976	3.7	4.2	3.4	2.9	71	54.0
Mexico	WFS	1976	5.7	4.4	4.5	3.5	65	69.4
Mexico	DHS	1987	4.0	3.0	2.9	—	—	84.8
Panama	WFS	1976	4.2	4.3	3.9	3.0	75	81.7
Paraguay	WFS	1979	5.0	5.2	4.5	4.0	83	41.2
Peru	WFS	1978	5.3	3.8	3.5	3.0	61	74.2
Peru	DHS	1986	4.1	3.6	2.3	2.1	56	85.9
Peru	DHS	1991	3.5	2.5	—	—	—	89.1
Trinidad & Tobago	WFS	1977	2.5	3.8	2.5	2.6	87	74.8
Trinidad & Tobago	DHS	1987	3.0	2.9	2.2	2.2	75	86.5
Venezuela	WFS	1977	4.3	4.2	3.6	2.9	68	74.3

SOURCES: Various country Demographic and Health Survey or World Fertility Survey reports, Lightbourne (1987a), Westoff (1991), and Bongaarts (1990).
[a]Source for Vietnam: Demographic and Health Survey 1988, National Committee for Population and Family Planning, Hanoi, November 1990.

Notes

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1 The debate about the relationship between population and economic performance has a long history; Kelley (1988) and Birdsall (1988) provide useful reviews. The importance of population growth for political balance is argued forcefully by Paul Kennedy (1993). The links with the environment (updating many others) are discussed by then US Senator Al Gore (1992).

2 The total fertility rate is a synthetic construct indicating the number of children a woman would have during her reproductive years at current age-specific fertility rates.

3 The terminology for "desired" and "wanted" stems from Bongaarts, 1990 to distinguish DTFR based on desired family size and WTFR based on wanting an additional child. All three are referred to as measures of fertility desires, in spite of the potential confusion.

4 The results in Table 1 are slightly different from those in Figure 1 because several observations are dropped in Table 1 due to lack of observations on the instruments.

5 The low R^2 of AINC primarily represents measurement error, discussed below.

6 To .603, .900, and .844 for AINC, DTFR, and WTFR respectively. This is a heuristic equivalent to the t-tests reported in Table 1 of the null hypothesis that the coefficient equals 1.

7 In fact, one reason these reports of fertility desires have not been previously widely used in the literature is the belief they have a large amount of error. Lightbourne (1987b), for instance, points out the close correlation between actual fertility and fertility preferences: "most of the difference in current fertility is due to lower rates of wanted fertility."

8 A minor objection in this context (but major in others) is that women's fertility desires are unstable over time and hence dynamic stochastic modeling is required. The reason this problem is minor is that (except for AINC) we are explaining the current *flow* of fertility in terms of the current *flow* of fertility desires, not in terms of desired fertility *stocks*. Hence, timing and instability problems that are very serious in household models that seek to explain current household decisions (flow) by desired number of children (stocks) are not relevant in these aggregate data.

9 The question asked of women with children in the DHS on which this indicator is based was, "If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?"

10 One drawback of all three measures, but which will not be discussed here, is that generally only women are asked fertility questions. Other research, reviewing all then-available evidence (Mason and Taj, 1987), has found that husbands do not have systematically larger family size preferences than wives and that actual family size usually falls somewhere between husbands' and wives' preferences when they differ. For instance, in Kenya, AINC is 4.4 for all women (4.8 among married women) and 4.8 among husbands.

11 For instance, if women have an ideal family size of 3 but also want at least one boy, the average completed family size will be 3.25 and if they want one child of each gender the average completed family size will be 3.5. These differences are larger than the absolute differences between AINC and TFR in coun-

tries with low fertility, but this discrepancy due to gender preference will be relatively small at higher levels of ideal family size.

12 Yemen is a good example because actual fertility is 8.5, AINC is 5.5, but 30 percent of women responded that the number is "up to Allah." The statistics report the average of *numerical* responses.

13 Classification as unwanted is based on the following question women were asked in the DHS: "At the time you became pregnant with [name of last-born child] did you want to have that child then, did you want to wait until later, or did you want no more children at all?"

14 Women will, in fact, report desired family sizes less than actual. In Trinidad and Tobago, for example, 70 percent of women with 6 or more children reported a lower ideal number of children, as did 72 percent of women with 6 or more children in the Dominican Republic.

15 See Bongaarts (1990) for the details of the adjustment from "want more" to "wanted" fertility rate.

16 In fact the coefficient is slightly lower on DTFR than on WTFR. The differences for AINC for the ordinary least squares (OLS) method [though not for the instrumental variables (IV) method] are explained below.

17 An instrumental variables estimator can recover a consistent estimate of a linear regression parameter β, where $y = \beta x + \epsilon$, even for a variable (x) measured with error (for example, the observed x^* is $x^* = x + v$ where x is the true variable and v is an error) by projecting the observed variable x^* onto an instrument set (z) and using only that component of the observed variable x^* which lies in the space of z in the estimation of the parameters. This purges the effect of the error component of the observed variable on the estimation of the relationship.

18 Included in the "want no more" category are fecund women who want no more children and those who are sterilized, but not those who are infertile. Sterilized women are included on the grounds that sterilization is generally voluntary and is prima facie evidence of wanting no more. Some of the surveys asked sterilized women if they wanted more children. In the surveys, the number of sterilized women with ex-post regrets (that is, who now want more) was typically small.

19 Posit that the distribution of women by their true desired number of children is represented by a probability distribution function $f(n)$. The fraction of women who want no more children who now have N living children is the cumulative distribution $F(n)$ up to size N, that is, the fraction of women whose desired size is less than or equal to N. These partial cumulants provide information about the mean desired fertility since they summarize the same distribution.

20 Although for DTFR the H_0: $\beta = 1$ is rejected at modest significance levels, mainly because of the very high precision. The two standard error bounds around the point estimate run only from .831 to .997.

21 Suppose that the true model were that actual fertility responded to desired fertility, but only weakly, and the response to the question was the true desired fertility plus some fraction of the excess of actual over desired. The OLS estimate of β would overestimate the true coefficient. On the other hand, pure random measurement error would cause the OLS estimate to be biased toward zero. The IV estimate, on the other hand, would be consistent in the presence of either type of error.

22 A formal Hausman (1978) test, which depends on the normalized difference of the OLS and IV coefficients, fails to reject that OLS is a consistent estimator (at least for DTFR and WTFR) while rejecting that OLS with AINC is consistent. This latter finding likely reflects measurement error since the OLS estimate is lower than the IV estimate.

23 In a demand and supply framework for children, one factor in the total demand for children is the price of contraception, which influences child demand. By having a measure of the quantity of children demanded at zero price of contraception (referred to here as desired fertility, not child demand), we can identify variation of this level as demand shifts (due to some other element of childbearing costs) and identify deviations of actual fertility from this level as the effect of supply factors. The general approach to supply and demand

for children is sometimes referred to as the "Easterlin synthesis" (Easterlin, 1975), although that label properly refers to a more specific set of hypotheses.

24 In economic jargon, the following discussion is about the "identification" problem. Since the quantity consumed of any commodity is determined by both supply and demand factors, it is generally impossible to determine from observation of outcomes alone whether supply or demand factors accounted for observed differences. In this case, however, since demand for children at zero price of contraception is a well-defined concept (unlike the demand for most economic goods at zero price) we can use reported desires, if they are independent of supply factors, to "identify" the demand.

25 After all, coitus interruptus has been known at least since the time of Onan.

26 The bivariate correlations are: AINC and DTFR .956, AINC and WTFR .923, DTFR and WTFR .974.

27 The overlapping sample for DTFR and WTFR is slightly different from that in Table 1; the OLS coefficient on WTFR is .91 in the smaller sample.

28 The fraction unwanted is not self-reported but calculated by Bongaarts (1990). It is not independent of WTFR but it largely agrees with ex-post reports of unwantedness.

29 If the regressions are run in percentage deviations for the other excess fertility measures (that is, if the dependent variable is (TFR − TFR*)/TFR, where TFR* is a measure of desired fertility) then the sign on contraceptive prevalence (except for AINC) is positive and statistically significant so that the percentage of excess fertility *increases* with contraceptive prevalence. This probably is just a consequence of the fact that it is harder to hit lower fertility targets because more years of effective protection are needed. If the absolute deviation is invariant with respect to contraceptive prevalence, the percentage deviation is inverse.

30 This is more than fair to contraceptive prevalence as the regressions in Table 2 require that the coefficient on desired fertility be 1. The incremental R^2 is still appropriate, given the identification assumption (discussed above) that contraceptive supply does not affect reported fertility desires.

31 Fifteen percentage points is quite a large increase, as the average modern contraceptive prevalence for developing countries (in this sample, which includes various dates) is only 23 percent, with a standard deviation of 17 percentage points.

32 These numbers are slightly different from those in Figure 2 because this calculation refers to modern contraceptive prevalence, while Figure 2 uses total contraceptive prevalence. The numbers for the former are larger.

33 For instance, suppose an index of development (DI) consists of three elements, say per capita income (Y), infant mortality (M), and literacy (L) with weights α_y, α_m, α_l, i.e., $DI = \alpha_y Y - \alpha_m M + \alpha_l L$. Entering this into an equation for fertility with a variable representing family planning effort, FPE gives: $TFR = \beta DI + \delta FPE + \epsilon$. This form *imposes* the almost certainly false condition that income gains, infant mortality falls, or literacy improvements have numerically exactly the same impact on fertility.

34 As a simple example, suppose that the true model was that fertility is determined by income (Y) positively and female education (FE) negatively and by a random term (ϵ): $TFR = \beta_1 Y + \beta_2 FE + \epsilon$. Suppose further that the "development index" gave equal weight to (suitably normalized) income and female education, $DI = \frac{1}{2}Y + \frac{1}{2}FE$. If family planning effort were related positively to female education (plus another error term), $FPE = \delta FE + \eta$, then a regression of TFR on the development index and FPE can produce large and significant negative effects for FPE (with the size determined by the error terms and cross-correlations of Y and FE), in spite of the fact that, by construction, FPE has no independent impact on TFR at all in this hypothetical example.

35 Since the FPE numbers are available only for 1972, 1982, and 1989 and the dates of the surveys are fixed, we tried various ways of matching FPE scores to the survey results shown in the Data Appendix (e.g., using the closest year, using the average FPE). We elected to use the closest FPE score preceding the survey date as that choice gave results most favorable to FPE. For instance, using the clos-

est FPE score gave smaller coefficients, −.003 and −.009 using DTFR and WTFR.

36 The FPE scores are expressed as a fraction of the maximum effort, so the scale is from 0 to 100. The mean level of effort in our sample is 31.4.

37 Earlier studies suggested a similar conclusion. For instance, Lapham and Mauldin (1985) find that FPE "explains" 90 percent of contraceptive prevalence as a bivariate regressor, but when socioeconomic effects are controlled for separately (although without separating male and female education) the incremental explanatory power of program effort is about 7 percent.

38 Also in Schultz's regression are GDP per adult, urbanization, fraction of male labor force in agriculture, religion controls (Catholic, Muslim, Protestant), and child mortality.

39 Subbarao and Raney (1993) also find in a cross-country regression explaining 1985 TFR (after controlling for the 1970 male and female secondary enrollment, and current GDP per capita, urbanization, and population per physician) that the effect of increasing FPE by one unit was −.021, strikingly similar to Schultz's reduced-form OLS result.

40 This low additional explanatory power is not surprising, given the high level of predictive ability of socioeconomic variables alone, especially once male and female education are distinguished. For instance, Barro and Lee (1993b), using GDP per capita, mortality variables, and their new data on male and female education stocks, explain (log) fertility with R^2 values of .90 across countries, and with R^2 of .63 even for changes from 1965 to 1985.

41 Even these numbers must be a substantial overestimate of the minimum monetary cost of achieving a given level of fertility. Any given target level of family size can be achieved with postpartum amenorrhea and abstinence combined with rhythm to space and sterilization to terminate. Moreover, all of these cost estimates of course ignore the difficult and delicate issue that there exists a backstop effective method to avoid conception with zero monetary cost: abstinence. The true cost of this method would require a calculation of the benefits forgone from coital abstinence. This is not zero and not infinite, but narrowing the range further is problematical.

42 It will be noted that the indirect costs are nonmonetary and hence 30 percent of *money* income does not imply 30 percent of total *potential* income, inclusive of male and female non-labor market time.

43 For instance, a country with per capita income of $300 and average household size of five has an average household income of $1,500. To illustrate, average household consumption expenditure in Ghana in 1987–88 was $1,680 when per capita GDP was around $400.

44 This of course raises the difficulty with properly defining "child costs" (see Birdsall, Cochrane, and van der Gaag, 1987). Presumably parents at higher levels of income could rear a child for the same money cost as could lower-income parents (although that might require feeding and clothing the child much less well than the adults). However, in contemplating an additional child parents can be expected to anticipate actual conventional expenditures for parents similarly placed, not the minimum feasible cost of raising a child to maturity.

45 The cost in the United States of an automobile per 10,000 miles driven in 1989 was estimated at $3,820 (US Bureau of the Census, 1991). Assuming three oil changes for every 10,000 miles and $15 per oil change (only $5 of which is for oil), this suggests that motor oil is about the same fraction of cost (1 percent) as is the cost of contraception in the gross cost of a child.

46 The regressors were: women's wages, men's wages, GDP per adult, urbanization, child mortality rates, dummy variables for calendar years, and three variables for the fraction of population with particular religious affiliation (Catholic, Protestant, Muslim).

47 While there are some arguments that children produce negative externalities, so that their social costs are greater than their private costs, this effect is likely to be small relative to the very large private costs discussed above.

48 As one observer pointed out, if Coke can be bought in remote villages in Africa, then so could contraceptives.

49 The historical, especially European, fertility record was early on used as an argument against the importance of contraception

in the demographic transition and is cited as an argument by Becker (1991). However, the fact that modern contraception was not necessary historically does not imply it will not be an independent factor if deliberately introduced.

50 This is not intended as a review of the relevant literature. This section simply shows that the reported cross-national results are not sharply at odds with the household-level evidence. The literature on the impact of family planning programs, more broadly taken than just contraception, is discussed in a subsequent article.

51 In their weighted fixed-effects estimates of fertility change, the four measures of subdistrict-level family planning effort (monthly family planning worker visits, village contraceptive distribution centers, number of health clinics, number of family planning fieldworkers) were individually and jointly not statistically significant.

52 The seven indicators of family planning access were five locational variables (the presence within 5 kilometers of a family planning clinic, a hospital, a mission, a health clinic, or a pharmacy) and two additional variables (the receipt of a family planning message and the presence of a community-based distributor).

53 The seven access variables were: number of methods available, receipt of a family planning message, and the presence within 5 kilometers of various sources of supply (doctor, two types of clinics, a hospital, or a pharmacy).

54 The estimates for the influence of access must be considered an upper bound, as having received a message is treated as exogenous even though certainly a woman with stronger desire to control fertility, even for a given level of expressed fertility intention, is more likely to seek out and recall having received a message.

55 This was prior to the more extensive FPHSP experiment, described above and discussed in more detail below, that began in October 1977.

56 "Unmet need" is left in quotation marks as, in the current discussion, it refers to a specific concept used in analyses of family planning programs.

57 This is an important distinction between the approach in this article and many calculations claiming to demonstrate the importance of access. We focus on the cross-country variation in fertility or excess fertility, comparing these in countries at various levels of access, family planning effort, or "unmet need." We do not assume that excess fertility can be eliminated entirely. Econometrically speaking, we examine the impact of shifts along a regression line (the slope) across countries, rather than shifting the line for all countries (changing the constant). We do not make hypothetical calculations as to what fertility would be if all mistimed or unwanted births were eliminated. Since that never happens in any country, it is simply irrelevant.

58 The "unmet need" is only available for some DHS countries so the sample sizes are much smaller than in related analyses we presented above.

59 The fraction of variation explained (R^2) is a function of the variation in the independent variable and the magnitude of the impact of variations. In this case, the small fraction of variation explained is not due to low variability of "unmet need," but simply because the estimated impact is small.

60 Since $.9 \times 6.4 = 5.7$, this implies that *all* unwanted births would be eliminated, which suggests either that even this relatively modest reduction in TFR is likely to be an overestimate of the impact or that such a reduction in "unmet need" is not feasible.

61 That is, $.056+2 \times (.00828) = .0726$ and $.0726 \times 8 = .58$.

62 See the note to Table 10 for the exact survey questions. It can be legitimately argued that this understates the importance of access. Access may not be named as the primary reason although it may be a factor. Also, better access could reduce or change other reasons for nonuse, like fear of side effects.

63 Increased use of contraception for spacing also may have some effect on fertility. However, if spacing left total fertility desires unchanged then, although immediate uptake of contraception would initially lower observed TFR (as women early in their reproductive careers began to space), over time this difference would be eroded as older women

began having the children that were spaced previously, albeit perhaps not completely due to the onset of infecundity before reaching the desired number of children. (The increased average age at maternity would also have a dampening effect on the rate of aggregate population growth.) The question of how to measure the fertility effects of avoided births due to spacing that may occur later is difficult, but it is clear that meeting limiters' demand is of greater relevance for reducing fertility.

64 Neither the timing nor the span between the two surveys is uniform across countries. The period covered is between 7 and 12 years.

65 These are the averages; the median falls in TFR and DTFR are exactly the same, at 1.2.

66 British infant mortality rates are for England and Wales and are taken from Mitchell (1978).

67 According to national income figures in Deane and Cole (1967). Needless to say, there is some uncertainty concerning estimates of long-term changes in income. Maddison (1991) reports that GDP per person less than doubled between 1870 and 1938.

68 The fact that relative to the comparison area contraceptive prevalence in the treatment area increased by much more than fertility fell is due to greatly increased contraceptive use in the treatment area for spacing, marked by three striking facts. First, in 1990 the use of permanent contraceptive methods (female or male sterilization), those preferred by limiters, was actually *higher* in the comparison area (9.9 percent) than in the treatment area (8.8 percent). Similarly, the use of contraception among women wanting no more children barely increased in the treatment area during 1977 to 1984, from 45.6 percent to 49 percent, while use by those wanting more children almost quadrupled over the same period, from 6.8 percent to 26.3 percent. Third, only 12.4 percent of the increased contraceptive use can be attributed to increased use among limiters, while 57 percent is due to increased use by spacers (Koenig et al., 1987, 1992).

69 This is the cost to the user of not getting exactly the variety she or he prefers. This cost is recognized in the economics literature on product differentiation. This may account for a significant fraction of the additional contraceptive use, as most of the additional use in the treatment area has been of injectables, while in the comparison area the use is predominantly the pill and sterilization (Caldwell and Caldwell, 1992).

70 Only 21 percent of women in 1990 used the pill. One lesson of the prior contraceptive supply saturation experiment in Matlab (Contraceptive Distribution Project) may be the unpopularity of the pill in this area, especially as compared to injectables. Also the Matlab data show a relatively high rate of switching from one method to another as consumers try a method and become dissatisfied, indicating a potentially large variety-preference problem.

71 This may be successful. Degraff (1991: 75) reports that while perceived disapproval from husband or others makes women less likely to use contraception both in the treatment area and in the comparison area, such discouragement is less strong in the former.

72 Sanderson and Tan (1993: Table 4.2) show comparable public family planning–related expenditures per MWRA for these components for ten Asian countries (excluding China). The average level is .14 percent of GDP per capita. Staff costs are excluded because of the difficulty of accounting for differences across countries in the allocation between family planning and other activities.

73 It is worth noting that external funding in 1989 accounted for 60 percent of Bangladesh's total public spending on family planning programs (Sanderson and Tan, 1993), also the highest in Asia.

74 The World Bank (1993b: Table 4) estimates family planning expenditures as between \$4 billion and \$5 billion (in 1988 dollars) in 1990. Our 0.6 percent figure takes \$5 billion (to be generous) combined with 1.04 billion women of reproductive age and the average developing country GDP per capita of \$840 (from World Bank, 1992).

75 The fraction of GDP is relevant because the major costs of the service are personnel, whose costs rise roughly one-for-one with GDP. A more sophisticated calculation could assume equal costs for internationally traded components, but would come up with much the same figures.

76 This is just the crude calculation of the ratio of the percentage fall in fertility (25 percent) to the higher costs (between 150 and 400 percent) without the program.

77 Taking the percentage increase times the elasticity times the actual fertility gives the figure (100) × (.1) × (5)/100 = 0.5. We take 5 as the typical TFR of low-income countries (the unweighted average is 5.9; the population-weighted average is 4.5; the median is actually over 6).

78 This points up an important distinction between costs to a couple of avoiding a birth that is unwanted and the costs of averting a birth through public action. Use of the former to estimate the latter is often done, but is completely erroneous conceptually and can be wrong empirically by orders of magnitude. The contraceptive cost of avoiding a birth cannot even be an approximation of the costs of averting additional births through family planning program expenditures.

79 Again, as a very crude calculation, a reduction of the CBR from 30 to 29 with a 1990 developing country population of 4.1 billion implies 4.1 million births averted. If program costs per birth averted are 120 percent of GDP, such a reduction (given $1010 as the average 1990 per capita GDP in developing countries) would call for increasing program expenditures by $5 billion.

80 Interestingly, Simmons, Balk, and Faiz (1991) argue that the Matlab program was *more* cost effective than the regular government program in cost per birth averted. This appears to be mainly because the government program is so ineffective in averting births. However, if this is the case, then the assumptions about cost per birth averted are optimistic and hence the costs of fertility reduction would be even higher at more typical levels of program effectiveness.

81 We do find in some instances a statistically significant influence of contraception, but the impact is always empirically small when judged by practical effect or explanatory power. Family planning optimists may point to the 3–5 percent of fertility differences that contraceptive supply does explain, as opposed to our sober emphasis on the 95–97 percent it does not.

82 Of course, it is always true that changing fertility desires *and* increased contraceptive access cause fertility reductions in the same trivial sense that gin *and* tonic make you drunk.

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