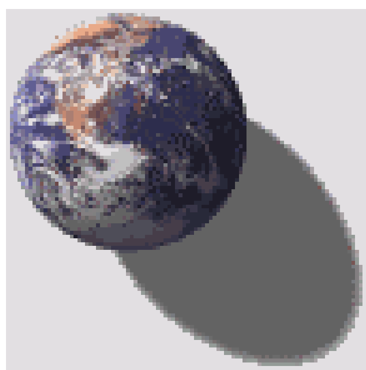
Applications of Gender and Development: An Econometric Analysis of Women's Autonomy and Fertility Behavior



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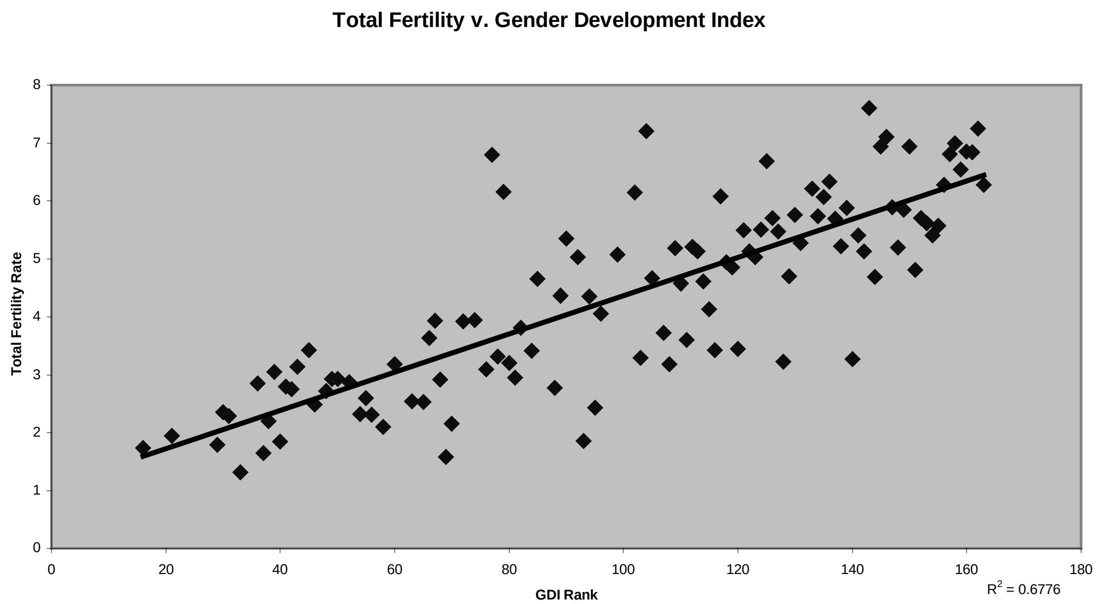
1. Introduction

Do women have children in order to gain social and economic security? Do they have children to appease their husbands or partners? Women are often expected to provide caring labor, manage the household, bear children and raise children. Many women want to perform these tasks, but some may also feel compelled by financial necessity or the expectations of others. If so, then the social status of women may determine their fertility behavior.

Fertility behavior is important because it affects poverty, population growth and the spread of disease. Economic theory suggests that poverty may be propagated through the generations by high fertility (Iyigun 2000). The United Nations Population Fund projects that, depending on the fertility behavior of people currently coming into their childbearing years, global population will either stabilize at 9 billion by 2050, or climb to 11 billion by the same year and continue rising (UNFPA 1998). UNAIDS estimates that over 5 million people contracted HIV/AIDS in the year 2000 (UNAIDS 2000). Policy-makers must understand how and why individuals make choices about fertility and sex in order to efficiently respond to the spread of AIDS, population trends, and poverty.

This paper seeks to clarify the relationship between women's autonomy and fertility by first reviewing economic theories of the household and previous empirical work. Second, a conceptual model is constructed, which is then used to generate an actual model. Third, probit regressions are used on World Bank data from South Africa and Peru. Finally, the regression results are discussed with reference to policy and research implications.

Figure 1



A cursory glance at the relationship between fertility behavior and women's position suggests that women's empowerment is correlated with lower fertility rates. In the graph above, the Gender Development Index (where a rank closer to one indicates a stronger position for women), a measure of women's status calculated by the United Nations Development Project, is plotted against the total fertility rate for a group of middle- and low-income countries.[1]

2.1 Literature Review: Theory

Economists since Adam Smith have often assumed that household behavior can be modeled as the maximization of a single set of preferences because family members all behave altruistically towards one another (Folbre 1996). If all members of a household are altruistic, then conflicts between family members are unimportant and the household may be treated as a unitary decision-maker. Today, neo-classical economists

[1] Data are taken from the UNDP's Human Development Report 1999, and the sample includes all medium- and low-developed countries for which the HDR has the necessary observations.

writing on the family tend to make this assumption. This eliminates the need for a theory of intrahousehold conflict and power and leads to a *unitary* model of the household (Phipps and Burton 1995). Becker (1981), the most prominent neo-classical theorist of family economics, does relax the assumption of altruism in his Rotten Kid Theorem, but only for children. By maintaining strict altruism for parents, Becker appears to relax the assumption of altruism, but nevertheless avoids issues of bargaining and power (Folbre 1996).

In contrast to the unitary model, economists have created *collective* models that consider household bargaining and the reconciliation of differing preferences. Phipps and Burton (1995) suggest a variety of categories within the collective model. The most general distinction within the collective model is between *cooperative* and *non-cooperative* theories. In cooperative models, household decisions are the outcome of a Nash-bargaining process in which differing utility functions and relative power determine choices (see Manser and Brown 1980 and McElroy 1997). Chiappori (1997) claims a cooperative model in which the outcome of bargaining is Pareto-efficient, but not necessarily Pareto-optimal, is more general than other cooperative approaches. Lundberg and Pollack (1993) analyze a non-cooperative approach, in which individuals take the behavior of other household members as given and then maximize their utility. This categorization is described below in Figure 2.

Figure 2

Unitary Models	Becker (1973, 1981): HH Maximizes a Single Set of Preferences	
Collective Models	Cooperative Models	McElroy (1997), Manser and Brown (1980): HH performs Nash Bargaining and Finds Pareto-Optimal Decisions
		Chiappori (1997): HH outcome is Pareto-Efficient, but not unique
	Non-Cooperative Models	Lundberg and Pollack (1993): Individuals take spouse's behavior as given, and then maximize their own utility

The conclusion of all of the collective approaches is that differences in preferences between men and women are important. Previous literature indicates that men and women have different preferences about children. Surveys suggest men generally desire larger families than women (Robey and Drennan 1998), implying that when men make decisions fertility rates are higher. In some contexts, women depend upon male children for economic security later in life (Das Gupta 1995), which suggests that women may have "extra" children as a form of insurance. As such, women who with no economic income of their own, or with little decision-making power, may tend to have more children than women with economic income and a more equal status relative to their husbands. In short, women with greater *autonomy* may have fewer children.

For the purposes of this paper, autonomy is defined so as to capture the relative position of women in households: autonomy is the degree to which women make decisions, or participate equally in decisions, about themselves and their households. This paper also employs an inclusive definition of fertility behavior: fertility behavior includes decisions about the desired number of children, the timing of childbirths, actual number of pregnancies, and contraceptive use.

In most contexts, one expects that an increase in women's control over financial and economic resources, as well as an increased role in household and fertility decision-making, implies an increase in their autonomy, which is likely to lead to a decrease in fertility. Women, of course, desire children for reasons other than security and the fulfillment of expectations, but if their security concerns are ameliorated by increased autonomy, then one expects overall fertility to decrease.

2.2 Literature Review: Previous Empirical Work

Previous empirical work generally supports the theory's predictions. Sen (1993) uses female mean age at marriage as a proxy for autonomy in a country-level cross-section. Sen's dependent variable is total fertility rate, and she controls for GNP, urbanization, infant mortality rate, female enrolment in secondary school, and a "family planning effort" index. Sen's ordinary least squares (OLS) models find that female mean age at marriage is negatively correlated with total fertility rates. Abadian (1996) replicates Sen's study, modifying the sample and including female secondary school education and mean spousal age difference as proxies for autonomy, while controlling the same variables. Abadian's OLS models show a statistically significant, negative correlation between total fertility rates and both female secondary school enrolment rates and female mean age at marriage. Both Sen and Abadian take cross-sectional, aggregate data from the World Bank and the United Nations.

While aggregate data are convenient, they are also likely to vary in quality between countries. Additionally, theory suggests that local conditions will cause variables to have different effects in different places. To avoid these limitations, researchers have used micro-level data from household surveys administered by governments and development organizations.

Govindasamy and Malhotra (1996) use the Egypt Demographic and Health Survey from 1988 to study the connection between autonomy and fertility behavior. Their dependent variable is contraceptive use, and they control for education, employment, religion, region, urbanization, age, and marital duration. They use questions about expenditure decisions and women's freedom of movement as proxies for autonomy. Their multinomial logit and odds-ratio model results suggest that women's freedom of movement and preferences about who makes family planning decisions, along with education, urbanization, age, marital duration, and socioeconomic status are all significant determinants of contraceptive use in Egypt.

Handa (2000) uses data from the World Bank Living Standard Measurement Surveys and the Jamaica Survey of Living Conditions to study the relationship between education and fertility rates. Handa uses both number of births and recent fertility, defined as one or zero depending on whether or not a woman has been pregnant within a specified time period, as dependent variables. He controls for age, women's educational attainment (as a proxy for a woman's potential income), individual infant mortality rate, and household expenditures (as a proxy for income) in both OLS and probit models. Results suggest age, educational attainment, and infant mortality rate for individual women are all strong determinants of women's propensity to have children.

Another set of studies employs ethnographic interviewing and self-generated survey data. Schuler, Hashemi, and Riley (1997) use survey data from rural villages in

Bangladesh to study the hypothesis that women's participation in Grameen Bank and BRAC programs "reduce women's economic dependence on men" and therefore increase contraceptive use and decrease fertility rates. They use contraceptive use and survey questions about autonomy as dependent variables, and they control individual specific background characteristics in logistic regression models. Results suggest that women's contribution to household income, women's mobility, increased role in household decision-making and exposure to micro-credit lending programs all determine contraceptive use. Amin, Hill, and Yiping Li (1995) find a similar correlation between participation in income generating activities, such as Grameen Bank and BRAC programs, among rural women in Bangladesh, and an "elevated level of desire for no more children." These two approaches differ from Govindasamy and Malhotra (1996) and Handa (2000) because they gather their own survey information. As a result, they are able to use more direct, and locally appropriate, proxies for autonomy.

Similarly, Niraula and Morgan (1996) begin with ethnographic interviewing and focus-group discussions in their study of Nepal. From this interviewing, Niraula and Morgan develop a household questionnaire appropriate to their specific context, with which they generate their own data. Building on this data set, Morgan and Dharmalingam (1996) use logistic regressions and odds-ratio analysis to compare two villages with very different sociological views and practices surrounding women. They find that, among other things, spouse's difference in age at marriage and village context are important determinants of women's autonomy.

3. Conceptual Model

This theoretical and empirical work enables the construction of a conceptual model. Previous scholarly work suggests that fertility is a function of characteristics of the mother, household demand for children, the cost of childbearing, and the socioeconomic conditions of the household:

fertility behavior = ƒ(mother's fertility status, household demand for children, costs of childrearing)

In this model, a mother's fertility status includes her age, marital status, and her fertility history. A household's demand for children, or child services, is based on the desire for children of the potential father, mother, and other members of the household, as well as income and preferences. Here, women's status will be a major factor, shaping both a woman's desire for children and the relative weight that her desire holds in final decisions. The socioeconomic context of a household, including income, degree of urbanization, household structure, number of children already in the home, and the influence of religious forces, will also determine a household's demand for children. The cost of childrearing is intended to include the costs of health and maternal care, food and other goods for children, travel time to medical facilities, and the opportunity cost, most notably a mother's potential wage, of childrearing.

4. Ideal Data

Ideally, household panel data would exist that includes measures of household expenditures on each child health input, time-use, individual specific income, sociological and legal structures that determine women's position, anthropometric measures of children, and data on the availability and cost of health care services, clean water, and sanitation. Demographic information on surveyed individuals would include age, educational attainment, race, religion, household structure and cultural group. Ideal data would describe the source of unearned and earned income, so that the impact of government transfers to men and government transfers to women could be compared. Additionally, the ideal data set would provide space for comparison between different ethnic or cultural groups and between countries. Finally, ideal data would include a direct measure of male and female perceptions of relative status, or household power. This might include questions about decision-making roles within the household, freedom of movement, and preferences about who makes decisions. Given a representative sample of this information, one could trace the impact of men's and women's caring labor, income, education, and relative status on child health.

5.1 Available Data: Case Study

Unfortunately, this paper is limited to pre-existing cross-sectional household data and includes only a minor comparative dimension. The best available data are from South Africa 1993 and Peru 1994. They are taken from the World Bank's Living Standard Measurement Surveys (LSMS).[2] South Africa and Peru were chosen primarily through process of elimination. Language barriers and the exclusion of specific variables in many studies constrained choice. Furthermore, due to time constraints and the lack of accessible income data in the Peru study, this paper's empirical emphasis is on South Africa.

Despite these limitations, South Africa and Peru represent valuable samples. The South African survey was collected in 1993, one year before the new national constitution was drafted that permanently displaced Apartheid. Roughly 75% of the population, equivalent to 30 million people, is black African, and in 1993, 60% of black

South Africans lived below the nationally defined poverty line (Nicholas 1997). Other large cultural groups, including those identified as coloured, Indian, and white, are prevalent and have had very different recent histories, owing to the state-sponsored racial segmentation of the twentieth century.

The version of Protestant Christianity that prevails in South Africa has led to strict limitations on public discussions of sex, the availability of material on sex, sex education in public schools and contraceptives. These historical forces have contributed to a relatively low level of knowledge about sex, family planning and contraceptive methods (Nicholas 1997). The new constitution, drafted in 1994, and the increasing concern with HIV/AIDS has changed the political-economy of sex and contraceptive use, but the effects of these changes are unlikely to have affected this sample from 1993. As such, a follow-up study of South Africa in the next few years might reveal how national political changes affect household fertility behavior.

In both South Africa and Peru, traditional gendered expectations shape the relationship between men and women. In Latin America in general, traditional masculine identities, or *machismo*, cause many men to feel superior to women, justifying violence and perpetuating gender inequalities (UNFPA 2000). Additionally, women in Peru and some other Latin American countries have few economic opportunities, reinforcing their dependence on men (Monteon 1995).

5.2 Available Data: Variables Used

Given this historical background, the LSMS data gathered by the World Bank enables econometric analysis of fertility and autonomy. Fertility information is available in these data sets for all women between 15 and 49 years of age. For consistency, this

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[2] These data sets are available for download at www.worlbank.org/lsms/guide/select.html.

paper includes only those women who were identified by the surveys as either the head of the household or the spouse/partner of the head. This implicitly controls for the complexity of intrahousehold relationships between men and extended female family members. Because many of the variables in the model involve a ratio between men and women, women who identified as the head of the household but had no male spouse/partner in the home were also excluded. This may create a biased sample, as single women are often the most autonomous. Variations within the remaining sample, however, should still reveal the relationship between fertility and autonomy.

Data were organized for each individual in this sub-sample and their spouses/partners. For each woman, the number of times the woman has been pregnant was converted into a dummy variable, and all women who have been pregnant three or more (more than two) times were coded as 1. Women who were pregnant at the time of the survey, those who reported current use of any (modern or traditional) contraceptive, and women whose youngest child was younger than 5 years old were also coded as 1 in the appropriate data column. The age of the youngest child is available only for South Africa, and contraceptive information is available only for Peru.

Control variables include the educational attainment of women, as a proxy for a woman's potential wage. The highest grade level attained is included in a scale from 1 to 17 for South Africa and 1 to 6 for Peru. This variable is used to control for the costs of childbearing. Another aspect of costs is degree of urbanization and distance to medical facilities. These data were not included because the survey documents do not provide sufficient information. Regressions also control for the mother's fertility status by including the woman's age as an independent variable. An individual infant mortality rate was also calculated and included for each woman.

The household demand for children includes both household expenditures and three measures of women's autonomy. For South Africa, household expenditure was measured as the average monthly expenditure on food and clothing. This measure of expenditure is likely to vary less than information on total expenditures or expenditures on durable goods. For Peru, an index of expenditures calculated by the survey practitioners is used. Measures of autonomy were calculated through comparisons of women and their spouses/partners. The age ratio was calculated as the husband's age divided by the wife's age. Educational difference was found by subtracting the wife's educational attainment from the husband's, so that a 0 indicates that both individuals have the same level of education; a positive number indicates that the woman has more education than men; and a negative number indicates that the man has more education. Finally, the income ratio was calculated as the husband's income subtracted by the wife's income, divided by the sum of their incomes. Thus, a 0 indicates that both individuals earn the same amount; a positive 1 means that only the wife earns income; and a –1 indicates that only the husband earns income. All measures of autonomy are hypothesized to compose part of the household demand for children by indicating women's relative weight in decision-making.

When all of these data columns are included, a large number of observations must be excluded because one or more data points are missing. Unfortunately, it is impossible to know what potential biases exist as a result of this unintended selection. Appendix B includes definitions for all variables used.

5.3 Available Data: Actual Model

Given the available data, an actual model that corresponds to the conceptual model can be constructed. Hypothesized signs are included below each coefficient.

Conceptual Model

$$\textit{fertility behavior} = f\ (\textit{ mother's fertility status, household demand for children, costs of childrearing })$$

Actual Model

$$\textit{Pregnant More than Twice} = \underset{(\,?\,)}{\beta_0} + \underset{(\,+\,)}{\beta_1}\ \textit{woman's age} + \underset{(\,-\,)}{\beta_2}\ \textit{woman's education} + \underset{(\,?\,)}{\beta_3}\ \textit{household expenditure} + \underset{(\,?\,)}{\beta_4}\ \textit{individual infant mortality rate} + \underset{(\,-\,)}{\beta_5}\ \textit{spousal age ratio} + \underset{(\,-\,)}{\beta_6}\ \textit{spousal education difference} + \underset{(\,-\,)}{\beta_7}\ \textit{spousal income ratio} + \varepsilon$$

The signs on the intercept, individual infant mortality rate, and household expenditure are all uncertain. Infant mortality rate is hypothesized to have both replacement and discouragement affects, acting in opposite directions (Handa 2000). Similarly, increased income may or may not increase fertility, depending on how parents choose between "quantity" and "quality" of children (Handa 2000). Since the dependent variable is how many children a woman has had in a lifetime, age is expected to have a positive sign. The three measures of autonomy and the woman's education, as a measure of opportunity cost of time to the woman, are expected to have negative impacts on pregnancy.

Variations on this model include contraceptive use and whether or not a woman is currently pregnant as the dependent variable and alterations of the specification through the use of race dummies. When the dependent variable changes, the age of the woman may become ambiguous because the relationship is likely to be quadratic rather than linear: up to a certain point, age will increase the likelihood of pregnancy but after that point it will have a negative impact.

6. Results

Initial results are presented in Table 1. This table includes OLS and Probit models with all three dependent variables. Additionally, a model that excludes the autonomy variables is included for comparison. It was necessary to use a model designed for a binomial dependent variable. Statistically, the difference between logit models and probit models is limited in most cases, and probit models were therefore chosen because they were more convenient given available software (Studenmund 1997). All reported coefficients are regression outputs converted into probability form.

These results are generally in accordance with theory. When number of pregnancies or age of youngest child is the dependent variable, the signs of all autonomy variables and women's education are negative. Age is strongly positive when number of pregnancies is used, and it is negative with the other two variables. This makes sense because women are more likely to have had a larger total number of children as they get older, but the relationship between age and the other two variables is likely to be quadratic rather than linear, allowing for a negative sign.

Statistically, the strongest autonomy variable is consistently the spousal difference in education. Because the regressions also control for women's education, this indicates that education and the spousal difference in education may affect fertility differently. Some studies have used women's education as a measure of autonomy, but these results suggest that they may have different, or perhaps complementary, effects on fertility behavior.

Table One: Autonomy v. Three Measures of Fertility

	Probit	OLS	Probit	OLS	Probit	OLS	Probit	OLS
Dependent=	Preg>2	Preg>2	Preg>2	Preg>2	Preg Now	Preg Now	Child < 5	Child < 5
C	**-0.3350**	**0.0860**	**-0.4778**	**0.0728**	**-0.1096**	**0.0887**	**1.0570**	**1.4473**
	-(11.33)	(2.42)	-(9.21)	(1.68)	-(5.90)	(4.38)	(19.79)	(32.98)
Age	**0.0154**	**0.0190**	**0.0218**	**0.0190**	**-0.0008**	**-0.0009**	**-0.0279**	**-0.0249**
	-(19.62)	(21.07)	(16.81)	(18.05)	-(1.76)	-(1.77)	-(21.05)	-(23.37)
	35.9997		*35.9253*		*35.9348*		*35.9289*	
Education	**-0.0201**	**-0.0249**	**-0.0331**	**-0.0292**	**-0.0020**	**-0.0021**	**-0.0167**	**-0.0144**
	-(12.00)	-(12.42)	-(10.67)	-(11.14)	-(1.67)	-(1.70)	-(5.64)	-(5.45)
	5.7862		*5.8294*		*5.8280*		*5.8335*	
Expenditure	**-5.92E-05**	**-7.37E-06**	**-5.30E-06**	**-3.36E-07**	**5.36E-07**	**5.23E-08**	**-1.64E-05**	**-1.83E-06**
	-(4.79)	-(4.81)	-(0.25)	-(0.18)	(0.06)	(0.06)	-(0.75)	-(0.95)
	5765.2820		*5746.4430*		*5746.1540*		*5753.6820*	
Infant Mort	**0.0210**	**0.0266**	**0.0059**	**0.0077**	**0.0044**	**0.0047**	**-0.0033**	**-0.0031**
	(1.22)	(1.31)	(0.23)	(0.35)	(0.47)	(0.45)	-(0.12)	-(0.14)
	0.1341		*0.1351*		*0.1351*		*0.1346*	
Age Ratio			**-0.0277**	**-0.0112**	**0.0003**	**0.0004**	**-0.0043**	**-0.0037**
			-(1.73)	-(1.48)	(0.10)	(0.10)	-(0.52)	-(0.48)
			0.8122		*0.8120*		*0.8120*	
Edu Difference			**-0.0179**	**-0.0160**	**-0.0017**	**-0.0018**	**-0.0126**	**-0.0106**
			-(5.82)	-(6.10)	-(1.47)	-(1.48)	-(4.26)	-(3.99)
			0.4097		*0.4078*		*0.4085*	
Income Ratio			**-0.0439**	**-0.0367**	**0.0002**	**0.0000**	**-0.0392**	**-0.0379**
			-(2.60)	-(2.56)	(0.03)	(0.00)	-(2.43)	-(2.61)
			-0.3846		*-0.3843*		*-0.3843*	
N	3901	3901	2919	2919	2913	2913	2913	2913
Log-Likelihood	-2276.259		-1704.457		-536.6358		-1719.88	
Dep=1	2294		1705		133		1349	
Dep=0	1607		1214		2780		1564	
Adj-R-squared		0.174408		0.174491		0.000181		0.178019
F-stat		206.9708		89.11284		1.075258		91.09456

Coefficients are in bold, t-stats in parenthesis and means of variables in italics

All monetary figures are in South African rand. Age, education, and infant mortality rate refer to individual women. Expenditure is a calculation of food and clothing expenditures per month. Age ratio, income ratio, and education difference refer to the women relative to her husband/partner. Preg>2 indicates that a woman has been pregnant more than twice. Preg Now indicates a woman was pregnant when surveyed. Child < 5 indicates that a woman's youngest child is less than five years old.

The signs of the coefficients on autonomy are as expected, but the magnitude of the coefficients suggests that the autonomy's determination of fertility may be limited. If women have one additional year of schooling relative to their husband or partner, the probability that they have more than two children decreases by about two percent. Thus, if a woman has five years of schooling more than her husband, then the probability that she will have more than two children decreases by ten percent. This is a significant change, but the impact of a full unit change in the income ratio causes only a four percent change in a woman's likelihood of having more than two pregnancies.

The autonomy variables are not significant when the dependent variable is current pregnancy. Probit models may be poor estimators when the balance between zeros and ones is very unequal, which is the case for current pregnancy (Studenmund 1997). Additionally, the F-stat on the OLS model for current pregnancy is very low, indicating that is not a good predictor of current pregnancy. While current pregnancy may be an interesting measure of fertility, its utility within this framework is limited.

The third dependent variable, the age of the youngest child, is problematic as a measure of fertility because it excludes abortions, stillbirths, miscarriages, and infant mortalities. Results are similar to results when number of pregnancies is the dependent variable. While both number of pregnancies and age of youngest child may be good indicators of fertility, the limitations of the age of child described above and the desire for simplicity dictated the choice of one model for use in other regressions. Thus, number of pregnancies is the preferred dependent variable, and it is used for additional regressions.

To see how the three autonomy measures might be related to each other, one regression is run that excludes each measure of autonomy in Table 2. Because all three autonomy variables are proxies for the same concept, they may be multicollinear. The most significant change in the coefficients occurs when women's educational attainment is omitted. This appears to bias the coefficients in general, and education difference in particular. If education is omitted, education difference loses statistical significance.

This may indicate that women's education and spousal education difference have a complementary effect on fertility behavior. A woman with a high educational attainment and a high difference statistic is thus less likely to have more than two pregnancies than a woman with only one of these statistics. If one does not control for educational attainment, the difference between men's and women's education becomes ineffective.

Table 2: Relations of Three Autonomy Variables

Dependent=	Probit Preg>2	Probit Preg>2	Probit Preg>2	Probit Preg>2	Probit Preg>2
C	**-0.4778**	**-0.4859**	**-0.5202**	**-0.6830**	**-0.4356**
	-(9.21)	-(9.65)	-(10.31)	-(14.43)	-(9.42)
Age	**0.0218**	**0.0213**	**0.0222**	**0.0240**	**0.0212**
	(16.81)	(16.74)	(17.46)	(19.27)	(18.06)
	35.9253	*35.9253*	*35.9253*	*35.9253*	*36.0320*
Education	**-0.0331**	**-0.0331**	**-0.0242**		**-0.0349**
	-(10.67)	-(10.86)	-(9.03)		-(12.36)
	5.8294	*5.8294*	*5.8294*		*6.0640*
Expenditure	**-5.30E-06**	**-5.62E-07**	**-5.07E-06**	**-1.30E-05**	**-2.71E-06**
	-(0.25)	-(0.26)	-(2.56)	-(7.05)	-(1.42)
	5746.443	*5746.443*	*5746.443*	*5746.443*	*6165.962*
Infant Mort	**0.0059**	**0.0055**	**0.0116**	**0.0224**	**0.0112**
	(0.23)	(0.21)	(0.45)	(0.87)	(0.45)
	0.1351	*0.1351*	*0.1351*	*0.1351*	*0.1312*
Age Ratio	**-0.0277**		**-0.0333**	**-0.0401**	**-0.0304**
	-(1.73)		-(2.07)	-(2.44)	-(1.91)
	0.8122		*0.8122*	*0.8122*	*0.8175*
Edu Difference	**-0.0179**	**-0.0181**		**-0.0023**	**-0.0171**
	-(5.82)	-(5.97)		-(0.87)	-(6.25)
	0.4097	*0.4097*		*0.4097*	*0.4742*
Income Ratio	**-0.0439**	**-0.0431**	**-0.0367**	**-0.0436**	
	-(2.60)	-(2.59)	-(2.23)	-(2.65)	
	-0.3846	*-0.3846*	*-0.3846*	*-0.3846*	
N	2919				
Log-Likelihood	-1704.457	-1706.39	-1721.533	-1762.28	-1976.131
Dep=1	1705	1705	1705	1705	1893
Dep=0	1214	1214	1214	1214	1481

Coefficients are in bold, t-stats in parenthesis and means of variables in italics

All monetary figures are in South African rand. Age, education, and infant mortality rate refer to individual women. Expenditure is a calculation of food and clothing expenditures per month. Age ratio, income ratio, and education difference refer to the women relative to her husband/partner.

Racism in South Africa has historically divided communities. Thus, looking at autonomy and fertility in each racial group acts as a comparison. To see if prevailing cultural norms modify the relationship between the three measures of autonomy and the number of pregnancies, regressions were run that dummy the intercept and autonomy coefficients by race.[3] In general, regressions produce expected signs on the dummied coefficients. While the dummying process does cause some change in coefficients, these changes are small. Thus, internal comparisons suggest that autonomy and fertility are related similarly within different racial categories delineated by the survey designers.

Table 3: Autonomy and Fertility in Peru v. South Africa

Country	South Africa	Peru	South Africa	Peru	Peru
Dependent=	Preg>2	Preg>2	Preg Now	Preg Now	Contra
C	**-0.4778**	**-0.1582**	**-0.1096**	**-0.0361**	**0.2124**
	-(9.21)	-(2.37)	-(5.90)	-(0.66)	(2.41)
Age	**0.0218**	**0.0181**	**-0.0008**	**-0.0055**	**-0.0070**
	(16.81)	(13.93)	-(1.76)	-(4.96)	-(4.52)
	35.9253	*34.6831*	*35.9348*	*34.6831*	*34.6831*
Education	**-0.0331**	**-0.0784**	**-0.0020**	**-0.0116**	**0.0207**
	-(10.67)	-(8.84)	-(1.67)	-(1.38)	(1.77)
	5.8294	*2.8354*	*5.8280*	*2.8354*	*2.8354*
Expenditure	**-5.30E-06**	**-2.13E-07**	**-5.36E-07**	**5.21E-06**	**3.57E-06**
	-(0.25)	-(1.66)	(0.06)	(0.43)	(2.07)
	5746.4430	*9107.1100*	*5746.1540*	*9107.1100*	*9107.1100*
Infant Mort	**0.0059**	**0.2465**	**0.0044**	**0.0771**	**-0.1175**
	(0.23)	(4.24)	(0.47)	(3.19)	-(2.28)
	0.1351	*0.0434*	*0.1351*	*0.0434*	*0.0434*
Age Ratio	**-0.0277**	**-0.0059**	**0.0003**	**0.0035**	**0.0891**
	-(1.73)	-(0.84)	(0.10)	(0.06)	(0.99)
	0.8122	*0.8884*	*0.8120*	*0.8884*	*0.8884*
Edu Difference	**-0.0179**	**-0.0298**	**-0.0017**	**-0.0002**	**0.0037**
	-(5.82)	-(3.58)	-(1.47)	-(0.03)	(0.34)
	0.4097	*0.3755*	*0.4078*	*0.3755*	*0.3755*
Income Ratio	**-0.0439**		**0.0002**		
	-(2.60)		(0.03)		
	-0.3846		*-0.3843*		
N	2919	1707	2913	1707	2913
Log-Likelihood	-1704.457	-850.1023	-536.6358	-327.5168	-1095.115
Dep=1	1705	1212	133	90	1096
Dep=0	1214	495	2780	1617	611

Coefficients are in bold, t-stats in parenthesis and means of variables in italics
All monetary figures are in national currency. Age, education, and infant mortality rate refer to individual women. Expenditure is a calculation of food and clothing expenditures per month. Age ratio, income ratio, and education difference refer to the women relative to her husband/partner. Contra is contraceptive use.

Finally, parallel models for South Africa and Peru are included in Table 3. Peruvian data did not include information on income ratios. Thus, South African

[3] A full table of results is reported in Appendix A.

regressions are run which exclude this variable for comparison. Additionally, contraceptive use is included as a third dependent variable for Peru, instead of age of youngest child. The signs on all variables for the comparative regressions are the same for each country. The only significant coefficient in the Peru models for autonomy, however, is on the education difference when more than two pregnancies is the dependent variable. All other signs are as hypothesized, but many are not statistically significant. The regression with contraceptive use as a dependent variable has a positive, insignificant sign for both measures of autonomy. Interestingly, the contraceptive regression yields a significant negative sign on age, suggesting that younger people are more likely to use contraceptives. Additionally, the expenditure index, which has an insignificant t-stat in the other regression, is significantly positive. This suggests that contraceptive use is partly a function of class.

7. Conclusion

The results of this study support the theory that an increase in women's autonomy is related to a decrease in fertility rates. These results are largely in accordance with previous findings and theory. When probit regressions are run with whether or not a woman has a child younger than five or whether or not she has been pregnant more than twice as the dependent variable, the sign on the autonomy proxies is consistently negative. When current pregnancy is the dependent variable, the income and age ratios have positive, insignificant signs.

The coefficients on the autonomy variables are, however, fairly small. This indicates the possibility that, while autonomy is relevant, it is not a primary determinant of fertility. Additionally, the inclusion of multiple measures of autonomy in regressions suggests that these measures may represent different impacts. When one measure of autonomy is excluded, the other two are affected only slightly. This implies that they may each have a unique relationship with fertility. This suggests the need for a more complicated model that expresses the relationship between autonomy and fertility choices.

The danger of an important omitted variable is relatively high. While the case-study method employed here is very useful, the theory and the previous literature that generated the variables used in the regression are not particular to South Africa. It is possible that either the control variables or the autonomy variables were inappropriate for this particular data set. Additionally, most previous research found that the level of urbanization was a significant determinant of fertility measures. The omission of this variable, a result of data availability, may have biased the coefficients.

Further research is necessary to assess the generalizability of these findings. The relatively ambiguous results from the Peru sample indicates that the measures used in this study may be context-sensitive. While the signs on the coefficients were largely the same for both samples, the Peruvian data had very few significant coefficients on autonomy variables. As such, it is possible that either women's status relative to men in Peru does not lead to an increase in women's decision making power about fertility issues, or that women's earned income or relative age are poor measures of their status.

The historical conditions in South Africa may have generated results that are not replicable in other places. Increased attention to local conditions would improve the validity of autonomy and control variables. Furthermore, in order for policy-makers to take advantage of this information, further research needs to establish how the relationship between autonomy and fertility behavior varies in different regions of the world, including developed nations as well as developing areas. Additionally, this study sampled only husband-wife dyads. It is possible that educational attainment and income earnings of members of a household other than the head of the household or the head's spouse may not contribute to autonomy and reduce fertility in the same way.

Circumscribed by these limitations, this paper's findings do hold suggestions for policy-makers. National governments and donor organizations seeking to maximize the effectiveness of family planning and fertility reduction initiatives should be aware of the interaction between women's autonomy and fertility. These results imply that integrated approaches to fertility reduction, which might include funding for women's education or increases in female wage earning, may enhance the effect of standard approaches that focus on contraceptive dissemination and sex education. Additionally, development practitioners should note that programs aimed at women's empowerment are likely to have the indirect benefit of reducing fertility. This should be factored into the cost-benefit analysis of women's empowerment programs. For example, women's participation in micro-credit lending programs or religious and community groups may decrease fertility rates through an increase in women's status and independence. This suggests that an integrated approach to development that considers women's education and status as well as fertility behavior during project design and evaluation may lead to a more efficient allocation of scarce development resources.

Appendix A: Additional Tables

Summary Statistics

South Africa

	Mean	Standard Deviation		number
Age	36.05970149	8.262605996	Total	3953
Education	5.770437864	4.072407528	African	2570
Expenditure	5759.287759	5342.629298	Coloured	414
Infant mort	0.134756337	0.34988816	Indian	182
			White	787
			Preg>2	1428
			Preg Now	190
			Child<5	2318

Peru

	Mean	Standard Deviation		number
Age	41.50903935	13.76277705	Total	2012
Education	2.779866332	1.233836501	Preg>2	1440
Expenditure	9171.062265	9263.513654	Preg Now	113
Infant mort	0.047667863	0.227096375	Contra	1246

Table 4: Autonomy and Fertility, dummied by Race

Dependent=	Preg>2	Preg>2	Preg>2	Preg>2	Preg>2
C	**-0.4778**		**-0.2032**	**-0.4652**	**-0.4750**
	-9.2097		*-10.6066*	*-9.1470*	*-1.2679*
Age	**0.0218**	**0.0222**	**0.0082**	**0.0212**	**0.0209**
	(16.81)	(17.10)	(17.25)	(16.73)	(0.06)
	35.9253	*35.9253*	*35.9253*	*35.9253*	*35.9253*
Education	**-0.0331**	**-0.0222**	**-0.0085**	**-0.0325**	**-0.0303**
	-(10.67)	-(6.71)	-(7.16)	-(10.69)	-(0.08)
	5.8294	*5.8294*	*5.8294*	*5.8294*	*5.8294*
Expenditure	**-5.30E-06**	**1.02E-05**	**3.27E-05**	**2.15E-06**	**7.98E-06**
	-(0.25)	(4.11)	(3.69)	(0.10)	(0.00)
	5746.4430	*5746.4430*	*5746.4430*	*5746.4430*	*5746.4430*
Infant Mort	**0.0059**	**0.0121**	**0.0035**	**0.0059**	**0.0073**
	(0.23)	(0.46)	(0.37)	(0.23)	(0.02)
	0.1351	*0.1351*	*0.1351*	*0.1351*	*0.1351*
Age Ratio	**-0.0277**	**-0.0241**		**-0.0281**	**-0.0265**
	-(1.73)	-(1.56)		-(1.78)	-(0.07)
	0.8122	*0.8122*		*0.4097*	*0.8122*
Edu Difference	**-0.0179**	**-0.0100**	**-0.0041**		**-0.0164**
	-(5.82)	-(3.13)	-(3.61)		-(0.04)
	0.4097	*0.4097*	*0.4097*		*0.4097*
Income Ratio	**-0.0439**	**-0.0516**	**-0.0186**	**-0.0415**	
	-(2.60)	-(3.06)	-(3.04)	-(0.38)	
	-0.3846	*-0.3846*	*-0.3846*	*-0.3846*	
African		**-0.5544**			
		-(10.52)			
		0.6444			
Coloured		**-0.6163**			
		-(9.81)			
		0.1076			
Indian		**-0.6718**			
		-(9.33)			
		0.0517			
White		**-0.8832**			
		-(12.85)			

		0.1963			
Age African			**-0.0069**		
			-(0.05)		
			0.4803		
Age Coloured			**-0.0271**		
			-(0.19)		
			0.1022		
Age Indian			**-0.0524**		
			-(0.37)		
			0.0469		
Age White			**-0.1212**		
			-(0.86)		
			0.1828		
Edu African				**-0.0135**	
				-(3.50)	
				-0.0199	
Edu Coloured				**-0.0088**	
				-(0.93)	
				0.0757	
Edu Indian				**-0.0284**	
				-(2.10)	
				0.0487	
Edu White				**-0.0250**	
				-(5.23)	
				0.2018	
Inc African					**-0.0528**
					-(0.14)
					-0.2437
Inc Coloured					**-0.0931**
					-(0.25)
					-0.0350
Inc Indian					**-0.1069**
					-(0.29)
					-0.0204
Inc White					**0.0452**
					(0.12)
					-0.0856
N	2919	2919	2919	2919	2919
Log-Likelihood	-1704.457	-1659.199	-1663.495	-1701.667	-1699.074
Dep=1	1705	1705	1705	1705	1705
Dep=0	1214	1214	1214	1214	1214

Coefficients are in bold, t-stats in paranthesis and means of variables in italics
All monetary figures are in South African rand. Age, education, and infant mortality rate refer to individual women. Expenditure is a calculation of food and clothing expenditures per month. Age ratio, income ratio, and education difference refer to the women relative to her husband/partner.

Appendix B: Variable Dictionary

Age: Age is the age of a woman in the sample, in years.

Age Ratio: Age ratio is the age of a woman divided by the age of her husband or partner.

Child < 5: Child < 5 is a dependent variable, where a woman was coded as 1 if she reported the age of the youngest living child as less than 5. Women with no children or with a youngest child aged over 5 were coded as zero. Note that women who have been pregnant within the last five years may not be included if they did not carry to term or if the child died. This is included only for South Africa.

Contra: Contra is a dependent variable, where a woman was coded as 1 if she reported current use of any contraceptive method. This includes modern contraceptives and traditional contraceptive methods (like withdrawal and the rhythm method).

Education: Education is the code number that corresponds to the level of educational attainment included in the surveys. For South Africa, this ranges from one to seventeen, with a higher number indicating more education. Peru is also an ascending range, from one to six.

Edu Difference: Edu Difference is the educational attainment of a woman minus the educational attainment of her husband or partner.

Exp Index: Exp Index is the expenditure index. For South Africa, this was calculated as the sum of a year’s worth of expenditures on food and clothing. The Peru data set included an expenditure index, which was used. This index includes a large number of variables.

Income Ratio: Income Ratio is a the man’s income minus the woman’s income over the sum of their incomes.

Infant Mort: Infant Mort is the infant mortality rate calculated for each individual woman. For South Africa, this was calculated as the sum of the number of stillbirths, children who died before the age of one and children who died between five and one years of age, all divided by the total number of pregnancies. The Peru data set included a statistic for children that died before the age of five.

Preg>2: Preg>2 is a dependent variable, where a woman was coded as 1 if she reported having been pregnant, regardless of whether or not they carried to term, more than twice. Women who had had zero, one, or two pregnancies, were coded as 0.

Preg Now: Preg Now is a dependent variable, where a woman was coded as 1 if she reported currently being pregnant.

(All data were taken from the Living Standard Measure Surveys from the World Bank, available at www.worldbank.org/lsms/guide/select.html.)

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