Economic Status Proxies in Studies of Fertility in Developing Countries: Does the Measure Matter?

Kenneth A. Bollen, Jennifer L. Glanville, and Guy Stecklov

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Carolina Population Center
University of North Carolina
at Chapel Hill
123 W. Franklin Street
Suite 304
Chapel Hill, NC 27516
Phone: 919-966-7482
Fax: 919-966-2391
measure@unc.edu
www.cpc.unc.edu/measure

Collaborating Partners:

Macro International Inc.
11785 Beltsville Drive
Suite 300
Calverton, MD 20705-3119
Phone: 301-572-0200
Fax: 301-572-0999
measure@macroint.com

John Snow Research and Training Institute
1616 N. Ft. Myer Drive
11th Floor
Arlington, VA 22209
Phone: 703-528-7474
Fax: 703-528-7480
measure_project@jsi.com

Tulane University
1440 Canal Street
Suite 2200
New Orleans, LA 70112
Phone: 504-584-3655
Fax: 504-584-3653
measure2@tulane.edu

Funding Agency:

Center for Population, Health and Nutrition
U.S. Agency for International Development
Washington, DC 20523-3600
Phone: 202-712-4959

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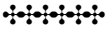

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ECONOMIC STATUS PROXIES IN STUDIES OF FERTILITY IN DEVELOPING COUNTRIES: DOES THE MEASURE MATTER?[*]

Kenneth A. Bollen
Department of Sociology
University of North Carolina at Chapel Hill

Jennifer L. Glanville
Department of Sociology
University of North Carolina at Chapel Hill

Guy Stecklov
Department of Sociology
Hebrew University

[*] All authors contributed equally. This study was funded by a grant from the MEASURE *Evaluation* Project (USAID Grant Number HRN-A-00-97-0018-00) We thank Mark Montgomery for his participation in this project. Direct correspondence to Kenneth Bollen, CB #3210, Dept. of Sociology, University of North Carolina, Chapel Hill, NC 27599-3210. E-mail: bollen@email.unc.edu.

ECONOMIC STATUS PROXIES IN STUDIES OF FERTILITY IN DEVELOPING COUNTRIES: DOES THE MEASURE MATTER?

ABSTRACT

Practically every empirical study of fertility in developing countries includes economic variables as either a primary focus variable or as an important control variable. Yet economic status variables are included in various ways, and researchers have little guidance as to the implications of alternative approaches. This paper investigates the consequences of using different economic status proxies on the estimated impact of economic status and other determinants of fertility. Using micro survey data from Ghana and Peru and techniques for comparing non-nested models, we find that the proxies for income that best predict fertility are a principal components score of various consumer durable goods and an index that is constructed by summing ownership of those durable goods. The choice of the proxy used influences the predicted effects of some of the control variables, but overall the substantive conclusions are quite consistent. We also compare the results from using a restricted set of proxies such as those typically available in the Demographic and Health Surveys to the results obtained when we have a lengthier set of proxies. Though our focus is on childbearing, our results suggest implications beyond this specific dependent variable, providing researchers with an awareness of the sensitivity of microanalyses to the treatment of economic status. Our results also suggest practical recommendations for survey data collection.

INTRODUCTION

It is the exceptional fertility study that ignores the impact of economic status. Even if interest lies in other determinants of women's childbearing, empirical analyses are sure to include some measures of the economic or socioeconomic status of the woman or the household. Yet this near universal agreement on the importance of economic status variables is not accompanied by identical implementations. Instead we find diverse definitions of economic status as well as a wide variety of measures or proxy measures of economic status, and as a consequence, diverse empirical results. This is particularly problematic when we wish to analyze the effect of economic status on fertility. Moreover, the choice of definitions and measures of economic status could matter even when their impact is not the primary focus because, for example, assessments of a new fertility policy might not be accurately evaluated if the status measures are faulty. In other words, effects attributed to the policy might be due to inadequate measurement of economic status.

The primary purpose of this paper is to investigate the consequences of different ways of measuring economic status on the estimated impact of economic status and other determinants of fertility in developing countries. We focus on the dominant practice of using proxy variables to measure economic status. Our goal is to provide evidence that addresses several practical questions for empirical researchers:

- Does the effect of economic status on fertility substantially differ depending on the measure of economic status?
- Do the effects of the other explanatory variables substantially differ depending on the measure of economic status?
- Does the added expense involved in collecting detailed expenditure data appear warranted or do the different proxies for economic status lead to similar conclusions?
- Do the answers to these questions heavily depend on the developing country examined?

Using micro survey data from Ghana and Peru, we compare how the estimated impact of economic status varies depending on the measures used. In addition, we compare the effects of these measures on the estimated effects of the other explanatory variables. Though our focus is on childbearing, our results suggest implications beyond this specific dependent variable. They provide researchers with evidence of the sensitivity of microanalyses to the treatment of economic status and permanent income. Our results also provide some practical advice to consider before planning household surveys in developing countries.

The next section reviews various measures of economic status that are common in the literature and highlights recent studies that have evaluated these measures. We follow this with a section on the data and measures that we use in our analyses. Next, we present the results comparing a series of proxies for economic status, including occupational status, household expenditures, and a series of measures based on ownership of consumer durable goods. Finally, we summarize our primary findings in the conclusion and discuss some important next steps.

MEASURING ECONOMIC STATUS

Among the best known conceptualizations of economic status is Friedman's *permanent income* hypothesis, one of the most influential economic ideas of the 20th Century. Essentially, Friedman argued that income is composed of two components: permanent and transitory. "The permanent component is to be interpreted as reflecting the effect of those factors that the unit regards as determining its capital value or wealth: the nonhuman wealth it owns; the personal attributes of the earners in the unit, such as their training, ability, personality; the attributes of the economic activity of the earners, such as the occupation followed, the location of the economic activity, and so on." (Friedman 1957: 21). In contrast to permanent income, the notion of *economic status* has less specific ties to a particular theory or theorist. In its most general sense it calls attention to the potential effects of economic resources on behavior and

decision making. For example, how does higher economic status affect childbearing? Like permanent income, economic status tends to have a less transitory component than other temporary aspects of income or resource gain. In our discussion, we use economic status and permanent income interchangeably while recognizing that the concept of permanent income, though controversial, is further developed.

While there is widespread agreement on the importance of economic status as a long-term economic influence, this agreement quickly vanishes when we move from the conceptualization of economic status and permanent income to their actual measurement in empirical work. This is partly because economic status and permanent income are theoretical concepts that are not directly measurable. Therefore, a wide range of proxy measures have been proposed that differ according to the types of goods they count and how those goods are counted; whether they focus on existing stocks or assets or on the resource flows over of a chosen time period; or whether they attempt to capture economic status indirectly through occupation, education or other related measures.

One of the most common approaches is to use data on income or expenditure flows over a specific time period, such a month or year. Friedman's emphasis on the distinction between permanent and transitory income has led many researchers to reject proxy measures of permanent income and economic status such as current annual earnings since income may vary greatly from year to year. One alternative is to average income over several years to get a better measure as done by Behrman and Deolalikar (1990), but longitudinal data on income are rarely available.

A more common proxy for long-run economic status is to measure household expenditures or consumption rather than income. Friedman (1957) suggested that consumption behavior reflects permanent income because it is primarily driven by permanent income. Households tend to smooth their consumption from year to year under the assumption that they can borrow or save to maintain a steady

standard of living. Therefore, since expenditures are generally considered to be less variable than income and more reflective of longer-term economic status, annual household expenditures may provide better permanent income proxies (Deaton 1992). Another advantage of expenditure measures over measures of current income is that collecting these data is more straightforward and reliable. Income data are often unreliable and difficult to collect in developing countries (Hentschel and Lanjouw 1996).

Although consumption is generally regarded as a more reliable indicator of long-run economic status than income, there are some disadvantages to this measure. First, many surveys do not collect information on expenditures because of the time and cost involved. For example, the Demographic and Health Surveys (DHS), which are the richest source of data on childbearing in developing countries, do not collect expenditure data.[1] Second, in the context of poor, developing nations, there is reason to question the assumption that households are able to smooth consumption behavior over time by borrowing and saving. For instance, research on households in Cote d'Ivoire suggests that income and consumption tend to track each other quite closely over time (Deaton, 1992). Third, studies have shown that measures of consumption can also be error prone (Bouis 1994; Scott and Amenuvegbe 1990).

Reliance on consumption and expenditure data for measuring economic status is easing as researchers explore the usefulness of alternative measures. This is particularly true for analyses of developing countries where income and expenditure data are often not available or are of poor quality. One common concern in very poor settings such as sub-Saharan Africa is that many households are the primary consumers of much of their own production and market values for both income or consumption may be difficult to accurately estimate. When income and expenditures data are not used, measures of households' ownership of consumer durable goods and housing quality are frequently employed to capture household economic status. In fact, a recent review of the use of socioeconomic variables in studies of child health and fertility found that such measures are the most commonly used indicators of

[1] The World Bank's Living Standards Measurement Study surveys collect extensive expenditure data. However, the demographic and health data collected in the LSMS surveys are far more limited than in the DHS.

economic status in studies of fertility and child health (self-identifying reference). One reason is that information on these household characteristics is easier to collect than both income and expenditure data. In particular, the DHS and the earlier round of World Fertility Surveys (WFS) have collected these basic data in over 50 countries, making this information widely available.

There are several possible ways of incorporating asset and housing quality measures in analyses of demographic outcomes. One approach is to include a series of separate indicator variables for durable goods and housing quality measures. Montgomery, Gragnolati, Burke, and Parades (2000) argue that this approach is best when one assumes that these variables are proxies for consumption because it renders the best statistical test of whether consumption's effect on the dependent variable is statistically different from zero. As they note, one disadvantage of this approach is that it does not enable one to disentangle the direct effect of a variable, such as availability of piped water, from its indirect effect through household economic status. Many studies follow this basic approach in that they include a few of these variables entered separately. For example, in her analysis of contraceptive use in Bangladesh, Degraff (1991) includes boat and land ownership, access to clean drinking water, and type of wall structure as controls for household economic status. Several other recent demographic studies also employ this approach (e.g., Adair, Popkin, and Guilkey 1993; Devin and Erickson 1996; Sandiford, Cassel, Montenegro, and Sanchez 1995)

Other strategies involve constructing an index of these variables, but there are several possible ways to construct such an index. One possibility is to create an indicator variable for whether a household owns any one of a set of items. Muhuri (1996), for example, uses an indicator for whether the household owns at least one of five durable goods or receives remittances as an indicator of household socioeconomic status in his examination of child mortality. More often researchers construct an index of equally weighted items. For example, Jensen (1996) uses an index that includes both durables owned and housing quality variables in his analysis of fertility in Indonesia. Guilkey and Jayne (1997) use a sum of

the number of consumer durables owned in addition to indicator variables for land ownership, good drinking water, and good sanitation facilities in their study of contraceptive use in Zimbabwe. Indeed, this is a common way of incorporating asset measures in demographic studies as can be seen in other examples as well (Bollen, Guilkey and Mroz 1995; Desai 1992; Gorbach et al 1998; Razzaque et al 1990).

Still other researchers have created an index that does not weight each item equally. For example, Dargent-Molina, James, Strpoatz, and Savitz (1994) use a measure that sums the values of all the goods owned by the household. However, information about the value of items is not widely available in surveys. Filmer and Pritchett (2001; 1999) have proposed an alternative way of weighting these variables that does not rely on knowledge of their values. Instead, Filmer and Pritchett use principal components analysis to estimate the appropriate weights to apply to each of the factors. The weights that are estimated using principal components analysis represent the linear combination of each of the variables that explains the greatest proportion of total variation between all the included variables. This provides a convenient way of capturing common information from a long list of consumer durable goods, housing quality, and land ownership. However, the resulting weights are simply the culmination of an empirical process with little or no theoretical foundation.

There are other potential proxies for economic status as well. Friedman (1957), for example, highlights the importance of occupation in the permanent income hypothesis and Houthakker (1957) and Mayer (1963) test the use of occupation as a proxy. Sociologists have also suggested that occupation is a good proxy for long-run economic status (Hauser and Warren 1997). Other studies have attempted to proxy for permanent income with adult height. Steckel (1995) uses height in a historical study where income was unavailable. Thomas, Strauss, and Henriques (1990) use height to capture unobserved family background characteristics in Brazil. Education is also closely related to economic status and a recent review found maternal education to be the most commonly included socioeconomic variable (self-identifying cite). The role education plays often differs in that it is cited both for its effect through

learning and knowledge as well as for proxying economic status (Desai and Alva 1998; Sandiford et al 1995). Many authors apparently use education as a proxy for economic status because it is readily available. Yet, other data are frequently available in surveys such as the DHS that might offer more direct proxies of economic status, and such data would also enable researchers to include education as a separate variable and to measure its direct effects on demographic outcomes.

In sum, our literature review reveals no consensus on the best way to include economic status in empirical models. The use of proxy variables is the clear dominant approach, but empirical strategies range from selecting a single variable to proxy economic status to constructing one or more proxies based on a composite of different factors with potentially equal or variable weightings. The proxies themselves are sometimes included as simple dummy variables while at other times they enter as aggregations of multiple assets with estimated or reported values attached to each asset.

Two recent studies have examined the performance of various proxies for economic status. Montgomery et al (2000) begin with the assumption that consumer durable goods and housing quality variables should be taken as proxies for the preferred measure of household consumption per adult. They find that while these variables are generally very weak proxies for consumption, they are still suitable for assessing whether expenditures has a statistically non-zero effect on fertility, child mortality, and children's education. Filmer and Prichett (2001) compare a proxy based on the principal components score of several consumer durable goods and housing quality to a proxy based on household expenditures. They find that the principal components score is more consistent over time and is a better predictor of school enrollments in India than household expenditures. In addition, by using instrumental variable and reverse regression techniques, they find evidence that this composite may be a less error-laden representation of long-run economic status than expenditures.

We extend this research in two primary ways. First, we focus on how the choice of proxy for economic status influences the predicted effects of the other explanatory variables in the model. We did

not find any studies that did this, with the exception of Montgomery et al's comparison of the predicted effect of maternal education in models that use expenditures versus models that use consumer durable goods. Second, we examine the performance of several proxies for economic status, rather than focusing on a more restricted set. Unlike Montgomery et al (2000), we do not assume that consumption is the gold standard. Instead we compare its performance to other possible proxies. In evaluating the performance of proxies constructed from indexes of ownership of consumer durable goods, we look at several ways of weighting the individual items. Filmer and Pritchett (2001; 1999) assume that the items in the index should be weighted differently, rather than equally, as is done in the common practice of summing the number of items owned. We assess this idea by comparing the performance of these two ways of constructing an index. Also, we examine whether alternative weightings based on the monetary value of the goods are more appropriate. And finally, we explore whether collecting information about household ownership of a longer list of consumer durable goods than is typically available in the DHS provides a better proxy for economic status.

DATA

We choose two countries for our analysis: Ghana and Peru. The main advantage of these two countries is the availability of relatively recent LSMS surveys including the essential fertility module. In addition, we were interested in choosing countries in different contexts rather than two countries in the same region and general socio-economic level. Examining our research questions in two different contexts enables us to test whether differences between the economic status proxies and their association with fertility are location-specific or whether some more general, though tentative, results might be inferred.

Our data analysis is based on the second Ghana Living Standards Survey (GLSS) collected by the Ghana Statistical Service in conjunction with the World Bank and the 1985 Peru Living Standards Survey

(PLSS) collected by the Statistical Institute of Peru in conjunction with the World Bank. Both data sets are part of the World Bank's Living Standards Measurement Study, which collects extensive socioeconomic data on households and individuals, as well as limited but important demographic and health data. In addition to general information about the household collected from the household head, both surveys collected very detailed information on the agricultural and non-agricultural economic activities of the household from a best-informed household member. The surveys also contain extensive questions on all household expenditures and assets and durable goods belonging to the household. Both surveys used a stratified random sample. The GLSS collected data on 3,192 households and the PLSS collected data on 5,107 households. (See World Bank [1993a; 1993b] for a detailed description of the data and sampling procedures used in the two surveys.)

In both surveys one woman between the ages of fifteen and fifty was randomly selected from each household for the fertility module. The GLSS collected fertility data on a total of 2,270 women and the PLSS collected fertility data on a total of 4,119 women. We restrict our sample to women who live in households where there is a senior male present and those who have ever cohabited with a man. This results in a loss of 710 and 137 cases respectively for Ghana, and 607 and 830 cases respectively for Peru. Consequently, our results are only generalizeable to these populations of Ghanaian and Peruvian women. Nevertheless, these restrictions also enable us to avoid a number of potential endogeneity concerns. The Ghana survey had 1,376 women who met our sample definition and who had complete data. The Peruvian sample had 2,548 such women.[2]

Variable definitions

[2] For Ghana, of the 3,192 households in the sample, 847 had no women between the ages of fifteen and fifty. Seventy-five additional women were missing from the fertility module. An additional 47 cases were missing on individual variables. For Peru of the 5,107 households in the sample, 907 had no women between the ages of fifteen and fifty. Eighty-three women were missing from the fertility module and 132 had missing values on individual variables.

We use children ever born as the dependent variable. A case could be made that children ever born is problematic since explanatory variables that affect a woman's fertility may vary over time and the use of children ever born may be a less accurate reflection of their current association with fertility. However, one of our goals is to construct empirical analyses that are similar to those most common in the literature, and consequently using less typical fertility measures would cast doubt on the generalizability of our findings to studies of fertility.

To assess the usefulness of the various possible ways of measuring economic resources, we adopt a basic model of fertility that includes religion, ethnicity, region, urban/rural, and age. This reduced-form model provides a set of exogenous controls that researchers often include in studies of fertility, making our model comparable to common practice. These variables, along with the education variables are described in Table 1.

Table 1. Description of Control Variables

	GLSS	PLSS
Foreign	Equals 1 if head of hhld. was born out of the country	Equals 1 if head of hhld. was born out of the country
Religion	Catholic, other Christian, Moslem, other religion, and traditional religion (reference)	
Ethnicity	Ewe, Gaadang, Akan, other ethnicity (reference)	Equals 1 if interview was conducted in an indigenous language
Place of residence	Ecological zones: coast, greater Accra, forest, and savannah (reference)	Ecological zones: northern coast, southern coast, Lima (reference), northern mountain, central mountain, southern mountain, jungle
	Urban, semi-urban, and rural (reference)	Urban and rural (reference)
Women's age	15-19 (reference), 20-24, 25-29, 30-34, 35-39, and 40-50	15-19 (reference), 20-24, 25-29, 30-34, 35-39, and 40-50
Female education	None (reference), primary, and middle or greater[a]	None (reference), primary, secondary or greater
Male head's education	None (reference), primary, middle, secondary or greater	None (reference), primary, secondary or greater

The variables in Table 1 form the basis of our reduced-form model. In addition, we introduce a series of measures of economic status, which we describe below.

We measure the **occupational status** of the head of the household with two variables. First, we use Treiman's (1977) international occupational prestige measure, which is a continuous variable with a theoretical range between -2 and 92. Second, we were concerned that the occupational prestige score would not capture the distinctive aspects of being a farmer in this context, so a dummy variable is

[a] We do not use a category for secondary or higher schooling for females in Ghana because less than 3% of the sample had this much education.

included for farmers to reveal any effects that would not be captured by the occupational prestige variable.

The **log of household expenditures** is a common proxy for household income or permanent income. The LSMS adjusts consumption to include the value of rent contributed by owner-occupied housing and flows of services available through consumer durables owned by utilizing the information on their values in conjunction with assumptions about their rates of depletion. We also adjust this measure for regional variations in price and inflation during the time of data collection.[3] We follow the common practice of dividing consumption by the number of adults in the household since dividing by the total number of persons within the household would create a feedback between children ever born and the denominator of expenditures. In Ghana the units are expressed in cedis, and in Peru they are expressed in intis. In 1988 the exchange rate was 188 cedis for one U.S. dollar, and in 1985 the exchange rate was 10.98 intis for one U.S. dollar. We do a log transformation of the expenditure variable because it is highly skewed with a long right tail.

The LSMS survey data provide a number of possible measures of **consumer durable goods**. Respondents in the GLSS were asked if their households owned a series of 17 consumer durable goods, such as a cassette player or a stove. Respondents in the PLSS were asked if they owned 15 types of consumer durable goods.[4] A variety of different combinations of the assets can be constructed from the data.[5] Our analyses evaluate four distinct approaches. The main difference between the approaches is whether the weights are assumed to be equal or not and if not, how the weights are constructed.

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[3] For the GLSS we obtained the regional and monthly inflation adjustments from the basic information document provided by the World Bank (1993a). For the PLSS we obtained the regional price deflators from Glewwe (1987) and the monthly adjustments from Webb and Baca de Valdez (1991).

[4] For the GLSS the full list is: sewing machine, stove, refrigerator or freezer, air conditioner, fan, radio, cassette player, phonograph, stereo equipment, video equipment, washing machine, black and white television, color television, bicycle, motorbike, car, and camera. For the PLSS the full list is: radio; refrigerator; sewing machine; car; bicycle; floor polisher; telephone; black and white television; color television; washing machine; knitting machine; motorcycle; record player or other sound equipment, blender, mixer or fan; and gas stove.

[5] We might also measure economic resources using separate indicator variables (dummies) for each of the asset variables. While there are merits to that approach (see Mongtomery et al. [2000]), it is less useful here because the ownership of most individual assets poorly reflect overall household status and are not helpful in categorizing households.

1. Simple sum method. One common method to proxy for economic resources is a simple sum of the number of goods owned. A potential problem with this approach is that it equally weights relatively inexpensive items, such as radios, and relatively valuable items, such as cars.
2. Current value sum method. The surveys also provided information that can be used to estimate the values of the goods. For any good owned by the household, respondents were asked how much they paid for it and how much they believe they could sell it for at the time of the survey. Therefore, another measure is the sum of the respondents' estimates of the current values of the goods owned by the households.
3. Median value sum method. We expect that the answers to the reported value of goods may be highly variable, particularly in settings where no market exists for the goods. Therefore, we include another approach to estimating the value based on calculating the median value for each asset over all households owning the good, and then summing the median value of goods owned by each household.
4. Principal components sum method. A final measure we use is the principal components score for the goods owned, which is based on the approach of Filmer and Pritchett (2001; 1999). This approach allows each good to have a different weight, but the weight is based on the results of the principal component analysis rather than any information on the reported value of each of the assets. The first component captured about 24 and 32 percent of the variation in the data for Ghana and Peru respectively.[6]

[6] The weights in Ghana are as follows: sewing machine .183, gas stove .280, refrigerator or freezer .370, air conditioner .067, fan .317, radio .089, radio/cassette player .241, phonograph .159, stereo equipment .316, video equipment .322, washing machine .089, black and white television .307, color television .286, bicycle .008, motorbike .044, car .283, camera .292. The weights in Peru are as follows: radio .062, refrigerator .352, sewing machine .216, car .264, bicycle .176, floor polisher .315, telephone .279, black and white television .210, color television .323, washing machine .318, knitting machine .109, motorcycle .065, record player or sound equipment .261, blender mixer or fan .339, gas stove .315.

Because they are highly skewed and have outliers, all of these measures are logged.[7]

We also construct a set of measures that correspond to these four approaches based on only the consumer durable goods that are available in the DHS. These include radio, television, refrigerator, bicycle, motorcycle, and car. Our analyses assess whether the extra information on these goods that is available in the LSMS adds anything or if the subset of DHS goods performs equally well.

Finally, in some models we add indicators of **housing quality** that are common in other analyses to the consumer durable goods proxies**.** These include the presence of a flushing toilet, piped water, electricity, non-dirt floor, and more than one room in the dwelling.[8] It was impossible to include the housing quality variables in the current and median value indexes. Therefore, we include them in separate models with the simple sum and principal components measures to assess whether their inclusion makes a difference.

Descriptive statistics for all variables in the analyses appear in Table 2.

[7] For each we added '1' before logging except for the principal components score where we added a constant value so that no values were 0 or negative before transformation.

[8] To maintain consistency with the scaling for the other items we code the number of rooms in the dwelling as an indicator variable for more than one room in the GLSS. About forty percent of the sample had only one room. In the PLSS we code this variable as 2 or less rooms and more than 2 rooms. About 50 percent of the sample had 2 or fewer rooms.

Table 2. Descriptive Statistics

	Ghana			Peru	
Variable	Mean	St. D.		Mean	St. D.
Dependent Variable			*Dependent Variable*		
Children ever born[a]	3.677	2.765	Children ever born[a]	4.184	2.890
Economic Resources			*Economic Resources*		
Occupational prestige	39.626	8.021	Occupational prestige	38.343	10.459
Farmer	0.579	0.494	Farmer	0.394	0.489
Expenditures per adult	11.407	0.566	Expenditures per adult	6.372	0.772
Sum of asset indicators	0.711	0.617	Sum of asset indicators	1.251	0.718
Sum of current values	6.518	4.785	Sum of current values	6.670	3.446
Sum of median values	6.567	4.775	Sum of median values	6.915	3.092
Principal components	0.453	0.600	Principal components	0.858	0.646
DHS--sum of asset indicators	0.410	0.453	DHS--sum of asset indicators	0.889	0.514
DHS--sum of current values	4.592	4.814	DHS--sum of current values	5.942	3.520
DHS--sum of median values	4.413	4.765	DHS--sum of median values	6.198	3.216
DHS-principal components	0.320	0.504	DHS-principal components	0.759	0.556
Housing quality	1.757	1.053	Housing quality	2.371	1.491
Education			*Education*		
Female none (reference)	0.485	0.500	Female none (reference)	0.212	0.408
Female primary	0.184	0.388	Female primary	0.428	0.495
Female middle or greater	0.331	0.471	Female secondary	0.272	0.445
			Female greater than secondary	0.089	0.284

Male none (reference)	0.355	0.479	Male none (reference)	0.080	0.272
Male primary	0.122	0.328	Male primary	0.489	0.500
Male middle	0.417	0.493	Male secondary	0.286	0.452
Male secondary or greater	0.106	0.308	Male greater than secondary	0.144	0.352
Place of residence			*Place of residence*		
Urban	0.281	0.450	Urban	0.553	0.497
Semi-urban	0.167	0.373			
Rural (reference)	0.552	0.498	Rural (reference)	0.447	0.497
Coast	0.211	0.408	Northern coast	0.225	0.418
Grtacra	0.108	0.310	Southern coast	0.086	0.280
Forest	0.445	0.497	Northern mountain	0.099	0.299
Savannah (reference)	0.236	0.425	Central mountain	0.126	0.332
			Southern mountain	0.122	0.327
			Jungle	0.045	0.207
			Lima (reference)	0.297	0.457
Age			*Age*		
15 to 19 (reference)	0.094	0.292	15 to 19 (reference)	0.043	0.202
20 to 24	0.214	0.411	20 to 24	0.117	0.322
25 to 29	0.220	0.415	25 to 29	0.207	0.405
30 to 34	0.193	0.394	30 to 34	0.212	0.409
35 to 39	0.129	0.335	35 to 39	0.181	0.385
40 to 50	0.150	0.358	40 to 50	0.240	0.427
Religion					
Catholic	0.171	0.376			
Other Christian	0.393	0.489			
Moslem	0.134	0.341			
Other religion	0.055	0.227			

Traditional (reference)	0.246	0.431			
Ethnicity			*Ethnicity*		
Ewe	0.156	0.363	Indigenous language	0.061	0.240
	0.069	0.254			
Gaadang					
Akan	0.432	0.496			
Other (reference)	0.342	0.475			
Foreign	0.046	0.209	Foreign	0.004	0.063
N=1376			N=2548		

[a] For all women fertility is higher in Ghana than it is in Peru, but in our sample we find a higher mean on children ever born in Peru because there were proportionately fewer women in Ghana who had never married or cohabited.

ANALYSIS

We use an ordinary least squares model to predict children ever born, and we correct the standard errors for the clustering in the sampling design. Although a Poisson model could be used because children ever born is a count variable, ordinary least squares is more frequently used in demographic studies of fertility. Additionally, the distribution of this variable does not deviate excessively from a normal distribution, which is typical in a high fertility context. We checked to see if the results would differ if we used Poisson regression instead of OLS and did not find any substantive differences.

We begin with a model that includes only religion, ethnicity, place of residence, and age which forms a baseline so that we can evaluate how the estimated parameters for these variables change as a result of both adding the economic resource proxies and how they are measured. Next, we add the educational status variables. We then introduce each of the proxies for economic status one at a time to assess the performance of the various economic resource proxy variables for economic status. For example, we consider how the measure of expenditures performs relative to other measures based on ownership of consumer durable goods.

We employ several ways of determining whether these different strategies of measuring economic resources matter. For the control variables, we: (1) note which variables shift from statistically significant to insignificant and vice versa and (2) note shifts in the estimates of the size of the effects by noting any parameter estimates that shift more than 15% in magnitude, for those variables that are statistically significant. For the economic status variables, we: (1) examine statistical significance, (2) compare their magnitude of effects in several ways, and (3) evaluate their relative fits based on the

Bayesian Information Criterion (BIC) (Schwarz 1978). To rule out differences in samples as an explanation for possible differences, we use the same sample in each model.

Ghana

Table 3 reports the results for Ghana. To conserve space we only report results for the models with DHS proxies in a later table that compares all the proxies in both countries. Model 1 includes only the exogenous variables. Residence in the coastal and forest regions has a marginally significant and positive effect on fertility. Urban residence leads to an expected reduction of about .6 children. Age has a strongly positive and significant effect. Of the religion indicators, only 'other religion' has a significant effect and it is expected to increase the number of children born in comparison to traditional religion. Of the ethnicity indicators, only Ewe is a marginally significant negative predictor of fertility in comparison to the reference category 'other ethnicity.'

Model 2 adds the female and male head education variables. Compared to women with no schooling, women with middle schooling or higher have lower expected fertility. Male education does not have a significant effect. Adding the education variables to the model does little to change the estimated effects of the exogenous variables except for urban residence, which decreases by over 20 percent.

Table 3. Proxy Results for Ghana, N=1376a

	Model 1 Exogenous only			Model 2 Plus Education			Model 3 Plus Occupation		
	Coef.		S.E.	Coef.		S.E.	Coef.		S.E.
Economic status proxies									
Occupational prestige							-0.014	*	0.007
Farmer							0.135		0.124
Expenditures									
Simple sum									
Current value sum									
Median value sum									
Principal components									
DHS-simple sum									
DHS-current value									
DHS-median value									
DHS-principal comp.									
Education									
Female primary				-0.120		0.137	-0.115		0.137
Female middle or more				-0.626	**	0.118	-0.597	**	0.119
Male primary				0.100		0.170	0.102		0.170
Male middle				0.120		0.142	0.149		0.144
Male secondary or more				-0.244		0.196	-0.050		0.210
Place of residence									
Urban	-0.583	**	0.136	-0.446	**	0.136	-0.406	**	0.154
Semi-urban	0.045		0.156	0.076		0.151	0.095		0.151
Coast	0.340	†	0.200	0.321	†	0.185	0.328	†	0.187
Grtacra	0.088		0.261	0.164		0.246	0.169		0.245
Forest	0.283	†	0.151	0.291	*	0.145	0.287	*	0.143
Age									
20 to 24	1.162	**	0.097	1.145	**	0.098	1.145	**	0.098
25 to 29	2.430	**	0.112	2.435	**	0.116	2.431	**	0.116
30 to 34	3.905	**	0.136	3.873	**	0.140	3.878	**	0.140
35 to 39	5.135	**	0.218	5.115	**	0.217	5.122	**	0.217
40 to 50	6.646	**	0.203	6.521	**	0.203	6.517	**	0.202
Religion									
Catholic	-0.035		0.147	0.018		0.151	0.028		0.149
Other Christian	-0.190		0.155	-0.050		0.161	-0.048		0.162
Moslem	0.187		0.179	0.144		0.181	0.154		0.181
Other religion	0.374	*	0.185	0.407	*	0.184	0.404	*	0.185
Ethnicity									
Ewe	-0.342	†	0.184	-0.313	†	0.186	-0.340	†	0.188
Gaadang	-0.418		0.279	-0.354		0.276	-0.360		0.276
Akan	-0.119		0.159	-0.007		0.158	-0.013		0.158
Foreign	0.270		0.262	0.291		0.267	0.293		0.266
constant	0.586	**	0.120	0.639	**	0.126	1.041	**	0.297
R2	0.588			0.599			0.600		

**p<.01, *p<.05, +p<.10

[a] Highlighting indicates > 15% change between minimum and maximum & 1or both estimates p<.05.

Table 3, continued

Model 4 Plus Expenditures			Model 5 Plus Simple Sum			Model 6 Plus Current Value			Model 7 Plus Median Value			Model 8 Plus Principal Components		
Coef.		S.E.	Coef.		S.E.	Coef.		S.E.	Coef.		S.E.	Coef.		S.E.
0.070		0.089												
			-0.357	**	0.091									
						-0.030	*	0.012						
									-0.031	**	0.012			
												-0.473	**	0.094
-0.120		0.136	-0.110		0.138	-0.110		0.137	-0.112		0.137	-0.101		0.138
-0.630	**	0.118	-0.570	**	0.115	-0.597	**	0.116	-0.600	**	0.116	-0.541	**	0.117
0.091		0.171	0.104		0.170	0.096		0.170	0.098		0.170	0.106		0.169
0.109		0.145	0.167		0.146	0.144		0.145	0.144		0.144	0.172		0.145
-0.263		0.201	-0.077		0.200	-0.171		0.199	-0.169		0.199	-0.015		0.200
-0.457	**	0.137	-0.324	*	0.142	-0.384	**	0.142	-0.382	**	0.142	-0.250	†	0.142
0.077		0.151	0.117		0.153	0.099		0.154	0.100		0.154	0.111		0.150
0.310	†	0.185	0.290		0.184	0.298		0.186	0.296		0.186	0.360	*	0.180
0.135		0.250	0.221		0.237	0.168		0.240	0.170		0.241	0.356		0.238
0.281	†	0.145	0.239		0.150	0.257	†	0.150	0.254	†	0.151	0.283	†	0.147
1.133	**	0.096	1.163	**	0.095	1.158	**	0.096	1.159	**	0.096	1.157	**	0.096
2.416	**	0.117	2.478	**	0.116	2.466	**	0.117	2.468	**	0.117	2.478	**	0.118
3.847	**	0.141	3.917	**	0.140	3.897	**	0.140	3.899	**	0.140	3.906	**	0.140
5.101	**	0.218	5.166	**	0.214	5.135	**	0.216	5.139	**	0.216	5.164	**	0.214
6.511	**	0.203	6.567	**	0.199	6.546	**	0.200	6.547	**	0.200	6.566	**	0.200
0.015		0.150	0.035		0.153	0.029		0.153	0.028		0.153	0.028		0.151
-0.052		0.161	-0.029		0.163	-0.041		0.162	-0.040		0.162	-0.025		0.163
0.138		0.181	0.212		0.184	0.185		0.183	0.188		0.183	0.210		0.185
0.420	*	0.186	0.352	†	0.185	0.362	†	0.187	0.362	†	0.187	0.372	*	0.184
-0.306		0.186	-0.299		0.182	-0.298		0.184	-0.298		0.184	-0.312	†	0.181
-0.354		0.274	-0.334		0.273	-0.320		0.275	-0.318		0.274	-0.354		0.270
-0.008		0.157	0.009		0.157	0.010		0.158	0.011		0.158	0.022		0.156
0.292		0.267	0.245		0.266	0.268		0.267	0.268		0.267	0.246		0.265
-0.125		0.984	0.756	**	0.143	0.763	**	0.154	0.775	**	0.155	0.628	**	0.126
0.599			0.603			0.601			0.601			0.605		

Models 3 through 8 compare what happens when we add different proxy variables for economic status. Occupational prestige is a significant negative predictor of fertility so that higher prestige occupations are associated with fewer children ever born, net of the education and control variables that are in the model. Interestingly, the farmer indicator does not have a significant effect. The log of expenditures per adult does not have a statistically significant effect on fertility, and the coefficient is positive, counter to our expectation. However, a Hausman test of endogeneity revealed that consumption is endogenous to fertility. Using two stage least squares and housing quality as an instrumental variable for expenditures, we find that the coefficient for expenditures is 1.82 (s.e.=1.43).[9] Although this does not reach statistical significance because of the large standard error, a common problem with instrumented variable estimates, the sign is consistent with all of the other proxies for economic status. All of the consumer durable goods measures are significant at conventionally accepted levels. [10] We reserve a comparison between these proxies for a later section that includes a discussion of the proxies for the PLSS as well.

Using Model 2 as a baseline we can see that the inclusion of economic status influences the estimated coefficients for some of the other explanatory variables in the model. Surprisingly, female education, often viewed as indicative of economic resources, does not change appreciably with the addition of the proxies for economic status. This

[9] We do not use the durable goods index as an instrument for expenditures because the LSMS expenditures estimates includes the rental value of goods owned.

[10] Often measures like the simple sum are not logged. Here, it is more important to log the variables because there are so many durable goods and the resulting index is quite skewed. We also estimated a series of models with these variables not logged. Using these models instead would not alter the substantive conclusions that we reach, except in Ghana the current value sum, both for the full set of goods and the DHS subset, is not statistically significant. We also examined outlier diagnostics to see if the estimates were influenced by extreme cases. In brief, we found that removing cases identified as outliers by the DFBETAS procedure increased the estimated impact of the economic resource variables. A fuller description of the outlier analyses appears in the Appendix.

result suggests that much of the effect of education is through its direct effect on fertility rather than its economic status proxy effect.

Although some of the estimated effects change with the addition of economic status to the model, what we are more interested in here is whether the estimated effects change when different proxies are used. Therefore, we examine the smallest and largest estimated effects for each control variable across Models 3 through 8. In Table 3 we have highlighted the smallest and largest coefficients for the variables that are statistically significant and for which the difference between the two is greater than fifteen percent. Place of residence is most affected by which proxy is used. Residence in the coastal ecological zone has its lowest value in the simple sum model and its largest coefficient in the principal components model. Residence in the forest ecological zone has its smallest coefficient in the simple sum model and largest in the occupation model. The coefficient for urban residence, the most dramatically altered coefficient, is smallest in the principal components model and largest in the expenditures model. 'Other religion' is largest in the expenditures model and smallest in the simple sum model. Female middle or greater schooling is largest in the expenditures model and smallest in the principal components model. Even though the predicted impacts of these five explanatory variables change somewhat in magnitude across the models, it is important to note that most of these differences are not greater than two times the standard errors of the coefficients. Overall, the results in Table 3 show a mixed picture where some coefficients for the other explanatory variables are affected by the choice of proxy variable and others are not.

Peru

The results for Peru appear in Table 4. In Model 1, containing only exogenous variables, urban residence has a large negative (-1.459) predicted impact on children ever born. In comparison to their counterparts in Lima, women living in all regions, except for southern coast, have higher expected fertility. As expected, age has a strong effect. Women residing in households headed by someone born outside of Peru have lower expected fertility. In Model 2 we see that all levels of female schooling have a large negative effect on fertility, while male primary schooling is a marginally significant positive predictor and the other male schooling variables are insignificant. The addition of the education variables reduces the magnitude of the coefficients for urban residence, several of the region indicators, and foreign head.

In Models 3 through 8 we add economic resource proxies one at a time. As in Ghana, the coefficient estimate for occupational prestige in Peru is a significant negative predictor though farmer is not. Furthermore, the magnitudes of these coefficient estimates are nearly identical (-0.014 and –0.013). Expenditures per adult is not a statistically significant predictor. However, expenditures is negative and statistically significant (-1.80, s.e.=.60) when we estimate its coefficient with two stage least squares using housing quality as an instrumental variable. All of the proxies based on consumer durable goods are significant negative predictors.

Table 4. Proxy Results for Peru, N=2548[a]

	Model 1 Exogenous only		Model 2 Plus Education		Model 3 Plus Occupation	
	B	SE	B	SE	B	SE
Economic status proxies						
Occupational prestige					-0.013 **	0.004
Farmer					0.172	0.146
Expenditures						
Simple sum						
Current value sum						
Median value sum						
Principal components						
DHS-simple sum						
DHS-current value						
DHS-median value						
DHS-principal comp.						
Education						
Female primary			-0.875 **	0.157	-0.851 **	0.159
Female secondary			-1.898 **	0.171	-1.839 **	0.175
Female more than 2nd.			-2.788 **	0.191	-2.693 **	0.192
Male primary			0.330 +	0.194	0.342 +	0.196
Male secondary			0.084	0.214	0.151	0.218
Male more than 2nd.			-0.128	0.225	0.105	0.236
Place of residence						
Urban	-1.459 **	0.148	-0.646 **	0.130	-0.594 **	0.147
Northern coast	0.651 **	0.176	0.335 *	0.141	0.350 *	0.138
Southern coast	0.383	0.272	0.373 *	0.184	0.373 *	0.182
Northern mountain	0.571 *	0.222	0.256	0.196	0.275	0.193
Central mountain	0.871 **	0.184	0.681 **	0.154	0.692 **	0.153
Southern mountain	0.763 **	0.208	0.519 **	0.190	0.534 **	0.189
Jungle	1.135 **	0.203	0.830 **	0.187	0.873 **	0.185
Age						
20 to 24	1.137 **	0.144	1.276 **	0.145	1.280 **	0.144
25 to 29	2.414 **	0.143	2.562 **	0.145	2.585 **	0.143
30 to 34	3.505 **	0.164	3.567 **	0.157	3.615 **	0.157
35 to 39	4.301 **	0.185	4.238 **	0.177	4.282 **	0.177
40 to 50	5.496 **	0.190	5.163 **	0.184	5.218 **	0.183
Ethnicity						
Indigenous language	-0.036	0.262	-0.410	0.288	-0.393	0.289
Foreign	-1.690 **	0.521	-1.022 **	0.310	-1.003 **	0.302
constant	1.036 **	0.207	1.780 **	0.251	2.041 **	0.329
R^2	0.398		0.465		0.467	

**p<.01, *p<.05, +p<.10

[a] Highlighting indicates >15% change between minimum and maximum & 1 or both estimates p<.05.

Table 4, continued

Model 4 Plus Expenditures		Model 5 Plus Simple Sum		Model 6 Plus Current Value		Model 7 Plus Median Value		Model 8 Plus Principal Components	
B	SE	B	SE	B	SE	B	SE		
-0.078	0.076								
		-0.411 **	0.080						
				-0.030 *	0.015				
						-0.060 **	0.018		
								-0.579 **	0.094
-0.867 **	0.157	-0.778 **	0.158	-0.848 **	0.159	-0.817 **	0.160	-0.763 **	0.157
-1.875 **	0.171	-1.694 **	0.176	-1.838 **	0.177	-1.784 **	0.177	-1.628 **	0.176
-2.751 **	0.192	-2.504 **	0.203	-2.709 **	0.198	-2.650 **	0.200	-2.383 **	0.206
0.349 +	0.197	0.400 *	0.194	0.358 +	0.194	0.385 *	0.193	0.380 +	0.194
0.122	0.219	0.192	0.213	0.129	0.213	0.157	0.213	0.187	0.213
-0.064	0.237	0.065	0.224	-0.060	0.224	-0.019	0.224	0.109	0.225
-0.635 **	0.130	-0.547 **	0.130	-0.620 **	0.131	-0.594 **	0.130	-0.518 **	0.129
0.324 *	0.142	0.251 +	0.142	0.330 *	0.141	0.295 *	0.141	0.207	0.141
0.372 *	0.184	0.376 *	0.183	0.389 *	0.183	0.381 *	0.184	0.352 +	0.181
0.247	0.196	0.124	0.198	0.253	0.196	0.189	0.197	0.060	0.198
0.682 **	0.154	0.603 **	0.156	0.677 **	0.156	0.648 **	0.156	0.530 **	0.155
0.517 **	0.190	0.466 *	0.189	0.534 **	0.190	0.504 **	0.190	0.386 *	0.189
0.815 **	0.182	0.690 **	0.174	0.810 **	0.178	0.745 **	0.173	0.646 **	0.179
1.284 **	0.145	1.300 **	0.144	1.294 **	0.145	1.299 **	0.144	1.296 **	0.142
2.585 **	0.145	2.637 **	0.145	2.591 **	0.145	2.611 **	0.145	2.650 **	0.144
3.597 **	0.159	3.696 **	0.157	3.606 **	0.157	3.638 **	0.157	3.723 **	0.156
4.263 **	0.178	4.407 **	0.177	4.286 **	0.178	4.328 **	0.176	4.447 **	0.177
5.180 **	0.183	5.358 **	0.186	5.214 **	0.187	5.263 **	0.185	5.410 **	0.188
-0.432	0.289	-0.451	0.290	-0.424	0.288	-0.440	0.289	-0.438	0.287
-0.973 **	0.304	-0.999 **	0.378	-1.030 **	0.318	-1.010 **	0.338	-0.941 *	0.394
2.216 **	0.480	1.958 **	0.253	1.852 **	0.253	1.974 **	0.260	1.904 **	0.246
0.466		0.471		0.466		0.468		0.474	

The estimated impact of several of the control variables varies depending on which proxy is used. As in Ghana, the coefficients for place of residence are most influenced by the choice of proxy. Urban residence has its largest estimated influence in the expenditures model and its lowest predicted influence in the principal components model. The coefficients for residence in the northern coast, central mountain, southern mountain, and jungle regions are highest in the occupation model and lowest in the principal components model. The predicted effects of female secondary and female greater than secondary education range by slightly over fifteen percent, with their largest coefficients being in the expenditures models and smallest coefficients being in the principal components models. Finally, male primary education is smallest in the occupation model and largest in the simple sum model. Despite these differences, it is important to note that they are not substantively that large and are not greater than double the standard errors of the coefficients. Overall, we find that the choice of proxy variables shifts the coefficient estimates for some of the variables, but it does not have a dramatic effect in the sense that a researcher's general conclusions about the impact of the other explanatory variables on fertility would be similar regardless of the proxy.

Comparing Proxies for Economic Status

We now compare the estimated effects on fertility of the different proxies for economic status. We begin with the results from Ghana and then contrast these results with those from Peru. Table 5 presents the standardized and unstandardized coefficients for all of the proxies. The comparison of the proxy variable coefficients is complicated by the fact that we are comparing effects across equations and the variables have different units of measurement. However, the comparison is still possible. First, since all variables except the

occupational prestige/farmer variables are logged, we have semi-log models. As such we can interpret the unstandardized coefficients divided by 100 as an estimate of the expected difference in children ever born for a one percent change in the unlogged proxy variable. Examining the "unstandardized b" column in Table 5, we see that for the Ghanaian sample the "strongest" returns for a one percent change in the proxies are the full set and the abbreviated DHS subset principal component variables, followed by the full set simple sum and the DHS simple sum.[11] For instance, a one percent change in the simple sum leads to an expected 0.0036 reduction in the number of children ever born. Put this way this effects seems very small. However, moving from one good to two goods represents a one hundred percent change, and the mean value of the simple sum in Ghana is less than one. Consequently, it is not realistic to talk about changes in terms of one percent, yet one cannot use large percent changes when referring to partial elasticities. Therefore, we employ additional methods to compare the proxies.

The standardized regression coefficients form another basis of comparison that relies on an estimate of the number of standard deviation units difference to expect in the dependent variable for a one standard deviation shift in the explanatory variable. The fourth column of coefficients provides these values for Ghana. Interestingly, the pattern of effects is similar to the pattern for the metric coefficients. As with the metric coefficients the simple sum and principal components proxies have a larger estimated effect.

In addition to evaluating the magnitude of the proxies' effects, we also examine the relative fits of each of the models using the Bayesian Information Criterion (BIC) (Scharz 1978). Raftery (1995) describes a way of assessing the relative fits of non-nested models.

[11] For ease of presentation we do not shown the results for the models with simple sum and principal components measures that include housing quality. In general, these coefficients are similar to their counterparts that do not include housing quality, but some are slightly larger.

Table 5. Comparing Proxies for Permanent Income

	Unstandardized Coefficient	S.E.	Standardized Coefficient
Ghana			
Occupational prestige	-0.014 *	0.007	-0.039
Farmer	0.135	0.124	0.024
Expenditures per adult	0.070	0.089	0.014
Expenditures instrumented	-1.817	1.426	-0.372
Sum of asset indicators	-0.357 **	0.091	-0.080
Sum of current values	-0.030 *	0.012	-0.052
Sum of median values	-0.031 **	0.012	-0.054
Principal components	-0.473 **	0.094	-0.103
DHS-Sum of asset indicators	-0.292 *	0.112	-0.048
DHS-Sum of current values	-0.027 *	0.011	-0.047
DHS-Sum of median values	-0.024 *	0.010	-0.040
DHS-Principal components	-0.413 **	0.109	-0.075
Peru			
Occupational prestige	-0.013 **	0.004	-0.047
Farmer	0.172	0.146	0.029
Expenditures per adult	-0.078	0.076	-0.021
Expenditures instrumented	-1.796 **	0.602	-0.480
Sum of asset indicators	-0.411 **	0.080	-0.102
Sum of current values	-0.030 *	0.015	-0.035
Sum of median values	-0.060 **	0.018	-0.061
Principal components	-0.579 **	0.094	-0.129
DHS-Sum of asset indicators	-0.476 **	0.102	-0.085
DHS-Sum of current values	-0.031 *	0.014	-0.036
DHS-Sum of median values	-0.061 **	0.017	-0.065
DHS-Principal components	-0.544 **	0.105	-0.105

**p<.01, *p<.05

The model with the smallest (most negative) BIC is the best fitting model and other models can be compared to it. He suggests that differences in the BICs of two models between 2 and 6 indicate "positive" evidence of a difference in fit, differences between 6 and 10 indicate "strong" evidence, and differences greater than 10 indicate "very strong" evidence (p. 139). Table 6 displays the BIC values for each of the proxy models. It also reports the difference between each proxy's BIC and the lowest BIC and the rank ordering

Table 6. Bayesian Information Criterion (BIC) Comparisons of Non-Nested Model Fit

	Ghana			Peru		
	BIC	Difference from lowest	Rank	BIC	Difference from lowest	Rank
Occpuational prestige	-1079.799	23.834	10	-1431.696	38.151	10
Expenditures per adult	-1082.905	20.728	9	-1432.376	37.471	9
Sum of asset indicators	-1098.075	5.558	2	-1459.222	10.625	2
Sum of current values	-1090.124	13.509	5	-1435.239	34.608	8
Sum of median values	-1090.814	12.819	4	-1443.368	26.479	6
Principal components	-1103.633		1	-1469.847		1
DHS-Sum of asset indicators	-1088.746	14.887	6	-1452.484	17.363	4
DHS-Sum of current values	-1088.402	15.231	7	-1435.716	34.131	7
DHS-Sum of median values	-1087.370	16.263	8	-1443.847	26.000	5
DHS-Principal components	-1095.997	7.636	3	-1457.295	12.552	3

of the proxies from smallest to largest BIC. The pattern we observe is strikingly similar to that of the ordering of the magnitudes of the coefficients. The full-set principal components proxy has the lowest BIC value, followed by full-set simple sum, and then the DHS principal components. This criterion suggests that the full-set principal components score is a better proxy than all the others we tested because there is "positive" evidence that it is better than the full-set simple sum and "strong" or "very strong" evidence that it is better than all of the other proxies. We also observe that for the simple sum and the principal components, the full-set measures have a better fit than their DHS counterparts. Finally, in comparision to the principal components and the simple sum proxies, the measures based on values of goods perform a good deal worse, and occupational prestige and expenditures have still a worse fit.[12]

The results from the PLSS (Peru) are remarkably similar to those of the GLSS (Ghana). After expenditures instrumented, the principal components scores and simple sum

[12] Our BIC calculation for expenditures is for the original, uninstrumented expenditure variable. Using the instrumented version would lead to a lower R^2 and hence a larger BIC value for the expenditure equation than we get here with the original expenditure variable.

proxies have the largest effects on fertility whether we compare the metric, standardized, or same scale columns of Table 5. Also, the principal components proxy has the lowest BIC value and therefore the best fit. In fact, the rank ordering of the BIC values for each proxy from smallest to largest is roughly the same in Peru as in Ghana. Where there are differences in the ordering, the differences in the BICs are generally very small. As in Ghana, we observe that for the principal components and simple sum proxies, the full-set proxies have a better fit than their DHS counterparts. In contrast to Ghana, in the Peru results the median value sum has a larger effect than the current value sum. In addition, the BIC values for the median sum proxies show a better fit than those of the current value proxies.

We were also struck by the similarity of coefficient estimates across these two very different countries. We already noted the similarity of the coefficient estimates for occupational prestige. Given that the occupational prestige scale is comparable across countries and given that the unstandardized coefficients are partial elasticities, we decided to test whether the other proxies had equal values across Ghana and Peru. For only one of the proxies, the DHS median sum, was the difference between the coefficients across the two data sets greater than two times their respective standard errors.[13] In most other cases the difference was less than one standard error. We did not anticipate that the coefficients for the same proxy variable would be equivalent across these two very different countries.

Summary and Caveats

Overall, there are several consistent results across the two countries under study. First, the choice of economic status proxy influences the estimates of the effects of some of

[13] The standard error of the difference in these coefficients was estimated as the square root of the sum of the estimated variances for the coefficient estimates from each country. Since these samples were drawn independently there is no covariance between the same coefficient estimates from different countries.

the control variables, particularly place of residence, while other control variables, such as age, barely change across the models. However, for the most part these changes in coefficients are not large. Second, all proxy coefficients are negative and significant except for the expenditures coefficient in Ghana which is insignificant and positive, though the sign changes when expenditures is instrumented. In fact the instrumented expenditure variable has a large negative coefficient in both countries though fails to obtain statistical significance in Ghana. Third, of the asset-based economic resource indicators, the principal components score has the largest unstandardized, standardized, and same scale coefficients in addition to the lowest BIC value, which indicates the best fit. In contrast, the asset proxies based the on values of the goods they include have smaller predicted effects on fertility and a worse fit indicated by their BIC values. Fourth, the extra information included in the LSMS by adding additional assets leads to a small improvement in the models in both countries. These last two observations are important because they imply that while it may be useful to collect ownership information on a some slightly extended list of consumer durable goods, there is little apparent advantage to collecting information on values of those assets.

Our results require qualification in at least two ways. One is that despite the striking similarity of results across Peru and Ghana, this is no guarantee that the same results will hold for other developing countries or for alternative specifications. However, the similarities here are certainly impressive. Not only did we find a very similar pattern in the performance of the proxies across the data sets, but we also found strikingly similar coefficient estimates for the proxies. Furthermore, in both countries the estimated effects of the same sets of other explanatory variables are somewhat influenced by which proxy is employed.

A second important qualification concerns the neglect of the error of measurement in all the proxy variables we considered. Because we wanted to make our analyses relevant to many other empirical analyses of economic status and fertility, we did not take account of the measurement error in the proxy variables. Economic status or permanent income represents abstract variables that we cannot directly measure. Any of the proxies is likely to have far from perfect relation to the abstract economic status or permanent income variable. We have neglected the impact of measurement error on the results even though we know that measurement error has potentially serious effects on empirical analyses that ignore it. Indeed the change in the sign and magnitude of the consumption coefficient when instrumented suggests the potential importance of this issue. The evidence that we have cannot determine whether measurement error or some other factor causes the endogeneity. A valuable next step in this line of research would be to give more attention to the measurement properties of the proxies and to assess the impact on estimates of taking account of the measurement error in the proxy variables. Nonetheless, our results demonstrate that the choice of the proxy for economic status that is used can alter the results and that some proxies perform better than others.

CONCLUSIONS

The primary goals of this paper were quite practical. We wanted to learn whether the choice of proxy variables used to measure economic status in fertility studies makes a difference. More specifically, we asked whether the measure of economic status affects our conclusions about the economic status to fertility relation or the estimated fertility impact of other explanatory variables in the model. Based on our analysis of LSMS surveys from Ghana and Peru, we conclude that our assessment of economic status's impact can differ

depending on the proxy, but the estimated coefficients of the other explanatory variables exhibit greater robustness. Our results were surprisingly similar across our two very different countries, Peru and Ghana. Thus, if a researcher's focus is on the effect of economic status, the choice of proxy can make a difference. Alternatively, if attention lies on other variables, then the noneconomic status variables exhibit more robust estimated effects with different proxies.

We also wanted to assess whether collecting detailed data on household expenditures appears warranted, or if other proxies that are less costly to collect are suitable. We found that expenditures performed rather poorly, though its instrumented form performed better. Similary, we wanted to learn whether collecting information on the values of household goods produces a better proxy then merely collecting information on ownership. We found that proxies based on the values of household goods performed substantially worse than those based on ownership. This could be for several reasons. First, respondents may be unable to realistically estimate the value of their goods, and it may be particularly difficult to estimate the value of goods and services that are acquired through nonmarket channels. Consequently, these responses are likely to contain a large amount of error. Second, there can be a great deal of regional price variation and inflation as was the case for the countries in our study. Although adjustments for these variations can and should be made, this depends on obtaining rather extensive information on price deflators and making assumptions along the way. For example, in Peru monthly price information is only available for the 13 major cities. Thus, the researcher wishing to adjust the value of goods and expenditures must assume that the areas surrounding the cities for which the information on prices is available should be adjusted in the same way. Therefore, if the purpose is evaluating program effects on fertility and other outcomes such as child mortality, it hardly

seems worth the effort to collect detailed data on expenditures and the value of durable goods, especially since these measures do not even perform as well as other information that is collected more easily.

Based on our findings we have several recommendations for data collection and analysis. First, it appears that if the interest behind data collection is in fertility and most likely other demographic outcomes such as child health, then information on household ownership of consumer durables should be collected. Collecting information on a few items in addition to those in the DHS may increase the suitability of the proxy for economic status. The good news is that this type of information is relatively easy to collect in contrast to information about the values of these items and household expenditures. Furthermore, a large number of surveys with information on ownership of consumer durable goods are readily available for many different countries. Our results indicate a very common way of proxying for economic status, a sum of the number of goods owned by the household, performs relatively well in relation to several other proxies we examined. However, the principal components score performs even better in our analyses. Both of these approaches are easy to implement. Because the principal components score is a relatively new approach to measuring economic status (Filmer and Pritchett 2001), further research should assess its performance. In addition, as we mentioned above, further research that examines the impact of the measurement error that is likely to be inherent in these proxies is warranted.

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APPENDIX

Outlier Diagnostics

We used the DFITS procedure to identify cases that were influential on estimates for any of the parameters in the model, and the DFBETAS procedure to find cases that had a large impact on the estimates for the effects of the economic resource variables (Bollen and Jackman 1990). We first visually inspected the frequency distributions of the DFITS and DFBETAS and identified the cases with values on these diagnostics that stood out from the distribution. There were no striking differences in models with these 12 cases removed simultaneously.

Belsley, Kuh, and Welsch (1980) suggest cutoff values of 2sqrt(p/n) for DFITS and 2/sqrt(n) for DFBETAS so we also estimated models that excluded cases identified by these cutoffs. Not surprisingly since this resulted in removing many more cases than the other approach there were more differences between these results and models including all the cases. For each measure based on consumer durable goods, removing the DFBETA outliers associated with it resulted in asset coefficients that were about twice as large the coefficients in models with no outliers removed. Additionally, across these models the estimated effect of urban residence is diminished a great deal and loses statistical significance. In contrast to the effect on the asset-based coefficients of removing the DFBETA outliers, removing the DFITS outliers reduces their magnitudes somewhat, though they all continue to be statistically significant. In addition, the estimated effect of urban residence is slightly decreased in these models.