Are Children from Smaller Families Healthier? Examining the Causal Effects of Family Size on Child Welfare.

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[Draft: Comments Welcome!]

Abstract

The method of Instrument Variables is used to estimate the causal effect of family size on child health status (measured by height and the weight to height ratio) and immunization. The method overcomes problems caused by the fact that child welfare and family sizes are possibly endogenous. Utilizing data from the two rounds of the National Family Health Survey conducted in India, the instruments I use are the sex of the first child born in the family and the occurrence of twin births in the family. The results demonstrate that on average family size has no affect on the measures of health examined here for surviving children. However, the analysis does suggest that children in well-off families benefit more from smaller families and that this is particularly true for girls.

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"Small Family, Happy Family"

- Slogan for Family Planning Campaign in India

In the belief that a large family has detrimental consequences for its members, efforts to reduce family sizes constitute an important component of family planning programs that dominate health policy around the developing world. The overwhelming emphasis placed on these programs often has debilitating effects on other health interventions (see Dreze and Sen 1996 and the literature cited there). Smaller families – translating to reduced population pressure on scarce and strained resources might indeed have many social, economic and environmental benefits. Family planning programs in addition might have other benefits that are distinct from their effects on family size and are possibly valuable on their own right. Ignoring these other potential benefits, this paper tries to answer a narrow but focused question: are children from smaller families healthier?

The question being examined is not a new one. Indeed, it lies at the heart of a large body of literature across a wide variety of academic disciplines – Sociology (e.g. Desai 1995), Economics (e.g. Rosenzwieg and Wolpin 1979) and Anthropology (e.g. Scrimshaw and Scrimshaw 1978) – amongst others. This large body of literature is plausible evidence of both -- the importance of answering this question as well as the difficulties in trying to answer it. As will be elaborated later, isolating the effects of family size from the effects of other factors with which it is correlated is an empirically challenging task. The problem comes not only from the inability of social scientists to observe (or measure) factors that influence both family size and child health but also the plausible simultaneous nature of the decision made by parents on the 'quantity' of children as well as the 'quality' of children .

In this paper, using data from India, I attempt to overcome this problem by using the method of Instrument Variables. The instruments used here are the sex of the first born child and the occurrence of twinning. Assuming both to be random events – outside the influence of parents and other decision makers, the instruments are used to isolate the exogenous variation in family size in order to estimate the causal effects of family size on child health. In addition to isolating the causal effects of family size on child health, I also explore the contextual factors that might affect the relationship between family size and child health by comparing and contrasting the experiences of children in rich and poor families as well as between families living in villages with and without a health care center.

Increased family size is thought to have a direct effect on child welfare primarily through its reduction in per-capita resources -- monetary and non-monetary. However, in the contexts of developing countries where children often make productive contributions to family resources, this assumption of reduction in per-capita resources is not an obvious one. Indeed there is a large and contentious literature on whether larger families are poorer and vice-a-versa. Characterizing this debate, Anand and Murdoch (1998) ask an obvious but relevant question: "To the extent that households do control fertility, can they really be impoverishing themselves intentionally (by having more children)? Or, to the contrary, might high fertility rates in fact help to reduce poverty? The central reason is that children can help poor families earn extra income and adapt to imperfections in labor and credit markets. Higher fertility may be a way out of poverty, rather than a force which holds poor families down."

Keeping aside that debate for the moment, the extent to which family size can affect a child's health outcomes depends largely on the marginal effect that family resources have on a child's health. As Desai (1995) writes, "Sibling competition will only become relevant if a moderate addition to parental resources (due to smaller families) directed toward the child is sufficient to bring about a substantial improvement in child outcomes."

If for instance, girls experience discrimination in big and small families, then changes in family size and the consequent reduction in family resources might have little impact on girls compared to its impact for boys. Similarly, in comparing children from 'poor' and 'rich' families we might find a smaller impact in 'poor' families because other factors that affect health, independent of family size, like low levels of health and sanitation facilities in the neighborhoods they live in make the effects of family size moot. Thus the social and physical environment surrounding children is likely to be an important determinant of the direction and magnitude of the effects of family size.

Consistent with previous literature, I find mixed evidence of the consequences of family size. On average, family size is not found to have a direct causal impact on the measures of health examined for either boys or girls. However, I do find that the benefits from smaller families are larger for children in more well-off families and this is particularly true for girls. One possible explanation for this counter-intuitive finding is that the marginal impact on family resources due to an additional child is too small, relative to other determinants of child health to translate into a significant impact on the health of children in poor families.

In the next section, I briefly examine reasons why family size might be related to child welfare, particularly child health. In the third section, I elaborate on the challenges in estimating the causal relationship between family size and child and problems with using a normal linear regression framework. Section 4 reviews some of the past empirical work done on the topic with an emphasis on how the issue of endoegeneity has been tackled in previous literature. The literature on the consequences of family size in developing countries is extensive and rather than trying to survey the literature, I focus on studies that either emphasize the effects of family size on child health or are quite unique in the empirical strategy used. In Section 5, I describe the method of instrument variables and elaborate on the instruments used here. Possible limitations in the methodology and steps taken to address them are also discussed in this section. Section 6 describes the data being used for the survey, the measures of child health and other control variables used in the analysis. I also provide evidence of the predictive power of instruments used here. The results from the analysis are presented in Section 7. I also examine the differences in the effects of family size between 'rich' and 'poor' families in this section, as well as between families living in villages with a health care center and those living in ones without it. In section 8, I explore the sensitivity of results to possible bias introduced by use of the sex of the first child as an instrument. Tests of over-identifying restrictions as well as sensitivity tests conducted here are not suggestive of any bias in using this instrument along with the twins instrument. I conclude in Section 9 with a discussion of some of the implications of this analysis.

II. The Relationship between Family Size and Child Outcomes

The primary direct source of the negative relationship between family size and child outcomes is attributed to a reduction (or 'dilution' as it has come to be referred in the literature) in both material and non-material resources as they get divided amongst more children in a family. Thus, keeping constant the amount of food a family can buy or grow, an increase in the number of mouths to be fed decreases the amount for each mouth (assuming parents desire to feed each mouth equally). Similarly, time constraints can reduce the time parents can spend on taking care of the health needs of any single child. In addition, another pathway through which family size could affect child welfare is by adversely affecting the mother's health –'maternal depletion' as it has come to be called in the literature. Assuming that these are significant determinants of child welfare, it is hypothesized that a decrease in per-capita resources lowers the welfare of children in the family.

Closely related to the 'dilution' explanation, a child's health might also be adversely affected because of increased congestion due to an increase in family size resulting thereby in an increased risk of falling prey to infectious or contagious diseases that are amongst the leading causes of child mortality in developing countries.

However, a larger number of siblings need not necessarily be associated with worse outcomes in contexts where children often take on responsibilities both inside and outside households at a fairly young age. Bhargava (2003) for instance finds that the presence of older siblings increase a child's survival chances and attributes this to the care that the older sibling can provide. Similarly, for families dependent on common property resources, their "share (of open access natural resources) is roughly proportional to the number of 'transformers' of common resources into private property it employs." For such families, children might be the "primary vehicle of resource capture, with the result that a large number of children is seen as asset rather than a liability." (Panayotou 1994 p. 152)

Thus, parents with many children might indeed be ones that *want* many children because of the economic contributions that they make starting at fairly young ages. These parents in turn might also be more willing to make more investments in their health. If the size of the family is driven by the potential value of the economic contributions that children make, then family size could even be associated with a positive effect on child welfare.

Referring to the ambiguous nature of the relationship between family size and child outcomes, Lloyd (1994 p. 183) writes, "This conventional wisdom (of large families being associated with worse outcomes for children) although intuitively appealing, is based on a particular view of the parent-child family as a bounded economic unit in which children consume parental resources but do not contribute to them. It further assumes that parents of similar means allocate the same proportion of the family budget to their children collectively regardless of their number – a somewhat surprising assumption, given the widely accepted image of parents as unselfish caretakers of their children who are willing to adjust their own resources to meet their children's needs."

The sign of the relationship between family size and child welfare is therefore not obvious *a priori*, but given the over-whelming priority accorded to reducing family size it is important to not only find the correct sign but also the magnitude of the effect of family size on child welfare.

Do the 'Poor' Benefit More from Reductions in Family Size? Does 'Context' Matter?

Keeping total family resources constant, the reduction in per-capita resources for children in richer families is larger in absolute terms than is the reduction for poorer families. If poorer families are spending little on investments in child health to begin with, then dilution of resources due to an additional child might have little impact on health outcomes. Thus, we might observe limited effects of family size in poorer families than those in richer families.

But if we assume, as is done frequently, that there are diminishing returns to monetary and non-monetary family resources for both rich and poor families, we might expect reductions in family size and the consequent increase in per-capita resources to have an equal or even greater impact on the health of children in poorer families than in richer one. However, this reasoning ignores the importance of other contextual factors that affect child health directly regardless of family size and that might differ significantly for rich and poor families.

Rich and poor families are likely to differ substantially in the physical and social environment around them. The physical environment – the health and sanitation facilities in the neighborhood for instance – could have an independent and large effect on the health of children regardless of family size. For a child living in an unhygienic environment, the lack of competition from an additional sibling is unlikely to significantly reduce his or her vulnerability to infectious diseases for example. Similarly social networks could serve as a resource providing information about health and child care, with more well off families possibly having access to more informed networks. How these 'environmental' factors affect the relationship between family size and child size is going to depend largely on whether family resources act as a substitute or a complement to these factors. The arguments by both Desai (1995) and Lloyd (1995) suggest that family resources are likely to be more important in contexts that are conducive to better health. For instance Lloyd (1995) suggests the possibility that, " In an environment without schools or health clinics, parents have few ways to impact materially on their children's health of schooling, whether their resources are spread among few or many." [1]

Conceptually one can imagine these contextual factors as parameters that both shift the relationship between family resources and health as well as affect how sensitive the health of a child is to family resources. For example, moving to a neighborhood with proper sewage facilities might lead to a substantial increase in health but also increase the marginal value of each dollar spent on other investments in health, say medicines.

Consider the health of a child to be a function of per-capita family resources (Y) and Z is a parameter capturing the different contextual factors that affect child health regardless of family size. For illustrative purposes one can assume that Z just takes two values: Z_P for Y < Y* and Z_R for Y > Y* where Y* is the median level of wealth. Thus, families with Y< Y* are defined as being 'poor' and those with Y > Y* are defined as being 'rich'. Further $Z_P < Z_R$ in an ordinal sense meaning that the contextual factors affecting the health of children in rich families are 'better' than those in poor families (better health and sanitation facilities, access to better information etc.).

The health of children from poor and rich families can therefore be written as

$H_P = H(Y; Z_P)$ for Y < Y*

$H_R = H(Y, Z_R)$ for Y > Y*

respectively.

And the marginal effects of a decrease in per-capita family resources for the poor and the rich to be

$$\frac{\partial H_P}{\partial Y} = \frac{\partial H(Y;Z_P)}{\partial Y} \text{ for } Y < Y^*$$

$$\frac{\partial H_R}{\partial Y} = \frac{\partial H(Y;Z_R)}{\partial Y} \text{ for } Y > Y^*$$

The assertion that environment with poor health and sanitation facilities for instance mitigate the effects of family resources on child health implies that

$$\frac{\partial H(Y;Z_P)}{\partial Y} \langle \frac{\partial H(Y;Z_R)}{\partial Y}$$

[1] This argument does assume that the neighborhood or environment that people live in is exogenous to resource constraints due to family size, which although debatable is not an unviable one.

Figure 1 plots this conceptualized relationship between child health and per-capita family resources. If the 'rich' and 'poor' both live in the same neighborhoods or have similar environmental contexts, then the curve labeled Z_R captures the relationship between health and family resources for both rich and poor. Now a fall in per-capita resources for children in 'rich' families leads to a smaller impact on children's health than does a smaller fall for 'poor' families because of the assumption that each additional dollar spent on health-care has a smaller marginal effect than the previous one. However, if the environments where the 'rich' and 'poor' live differ substantially then the relationship between health and per-capita family resources for 'poor' families is given by the lower curve labeled, Z_P. Now, the same reduction in per-capita resources might have a smaller affect on the health of children from 'poor' families than it does on the health of children from 'rich' families because the environments that 'poor' families live in, reduces the marginal impact of each dollar, even at low levels of expenditure.

The figure thus suggests that the benefits of smaller families might be experienced more for children from richer families than those from poorer families if they differ substantially along other factors that are complements to family resources. Thus, family resources and the impact on it due to changes in family size can only be as important as the broader context in which the family is situated allows them to be.

Examining the effects of family size on 'rich' and 'poor' also serves as a useful means to explore the importance of contextual effects of family size on child health. The conceptual framework described above can be used to explain the importance of different contextual factors including the different social contexts surrounding girls and boys. The study by Desai (1995) described later in more detail, explores this in comparing the effects of family size across different nations in Africa. Another level at which to do this might be at the regional level in countries as diverse as India. However, comparing the effects at such aggregate levels also runs the risk of loosing the important variations within each country or region which are perhaps better captured by comparisons between 'rich' and 'poor' controlling for other factors common to a region.

Comparing the effects of family size for the 'rich' and 'poor' separately for cities and villages is another dimension to explore the importance of contextual factors.[2] The differences

[2] However, the empirical strategy used here will not allow for this examination since the urban sample is not sufficiently large.

between the effects of family size are likely to be more acute in cities than in villages since the later are more homogeneous with respect to the context. In contrast, families are much more likely to be segregated by wealth in cities and the level of health and sanitation facilities is likely to vary a lot more between the neighborhood where the 'rich' and 'poor' live. Literature on segregation by wealth in cities in developing countries is sparse. Estimates suggest that 38 percent of the population of developing country cities live in slums. (Herr and Karl 2002 and citied in Montgomery and Hewett 2004). Some recent work by Montgomery and Hewett (2004) suggests that the poor might not be as spatially concentrated as commonly perceived .But household economic status is most strongly correlated (.60) with the mean economic status of the 'cluster' in their sample of South and Central Asian countries suggesting greater spatial concentration in these countries. Preliminary results reported in Montgomery and Hewett (2004) also suggest that neighborhood effects as measured by 'cluster mean values of living standards scores' have a significant effect only in a few of the examined countries.[3] However they do caution that their measure of neighborhood effects might be "too many steps away removed from the epidemiological mechanisms that produce within-neighborhood contagion."

III. Estimating the relationship between Family Size and Child Welfare:

Since both family size and child welfare are outcomes of decisions made by the same individuals, establishing a causal relationship between the two involves more than simply regressing measures of child welfare on the size of the family. The first problem is that of simultaneity. The choice made by parents about the number of children ('quantity') to have is thought to depend on the choice of the 'quality' of children they desire and vice-a-versa (Becker and Lewis 1973). Thus, parents choices of 'quantity' and 'quality' of children are thought to be outcome of decisions made by parents simultaneously. If this is true then isolating the effect of the 'quantity' of children on the 'quality' of children (which is inherently assumed to be negative in this framework) is empirically challenging.

The second problem is that of unobserved heterogeneity in the population (David 1998). Families that have large families might also differ across other factors that affect child health, some of which might be unobserved to the econometrician. In other words, there could be other

[3] They do not report the results by countries but by regions. In only 2 of 11 countries was their variable capturing neighborhood effects statistically significant.

variables that affect both the size of the family as well as child welfare. If these other variables are unobserved, estimates of the effect of family size would be biased. Amongst others, some of these variables might be the bargaining position of the mother in the family, risk aversion (considering both expenditures on health/education as well as having children as investments with a certain risk attached to them), the contribution that children can make by working both within and outside households and lack of access to/ information about fertility control.

A third but related problem arises from the fact that while there indeed might be a direct negative relationship between family size and child welfare, parents might differ in their perception of it. Thus, parents who are more informed of a quantity-quality tradeoff or other costs of having more children like withdrawal of the mother from the labor market might have fewer children than those less informed of it. The 'self-selection process' (Knodel, Havanon and Sittitrai 1990) could result in an biased estimate of the relationship since the family size variable could be picking up the effect of the (perhaps) unobserved variables leading to the self-selection.

The discussion above emphasizes the fact that the underlying causes determining both family size and child welfare need to be understood before reaching conclusions about the causal nature of the relationship. Desai (1995) for instance provocatively suggests the possibility that, "Children of parents who choose to have smaller families, because they value high-quality offspring, will benefit from small family size, but this is not necessarily true for children whose parents have smaller families as a result of exogenous factors, such as high mortality or government policies." While one possible solution would to be to examine the effect of family size in the presence of such 'exogenous' factors, one can argue about the extent to which factors like high mortality or even government policies are truly exogenous.

IV. Review of Literature

King (1987) conducts an exhaustive review of the literature examining the relationship between family size and family welfare and highlights that " it has not always been clear in past studies that family welfare (as measured by child's health and education, and so on) is the result of decisions by parents and not simply a consequence of family size."(p. 397) Although studies that have followed it express an awareness of the issue and acknowledge the problem, they take few steps to solve it.

In examining the effects of family size on the education of children, Knodel, Havanon and Sittitrai (1990) find that parents with large and small families do not differ in their preferences with regard to the desired level of education of their children. In addition, they observe that their finding of small families having more educated children does not depend on whether or not the parents stopped having more children because of a deliberate choice or because of inability to have more children. Assuming the later is exogenous, they conclude that this mitigates problems of interpretation of a causal relationship between family size and child's education.

In one of the few studies to examine the effects of family size on health of the child, Desai uses 'stunting'[4] as a dependent variable and examines individual level data from a cross-section of countries. Desai (1995) highlights the point that the suggested negative relationship between family size and child welfare is predicated on the assumption that parental resources and not 'external social institutions' are the key determinants of child welfare. Desai emphasizes the role that extended kinship groups and governments can play in determining child welfare and the fact that the effect of family size only depends on its marginal impact compared to other factors that also affect child welfare. As an example, she mentions, "in communities without a school, having one or two fewer siblings may have little impact on the probability of a child attending school…Similarly, children who succumb to a variety of chronic diseases are less likely to eat well, and a low nutrient intake raises their vulnerability to disease." Desai finds that the magnitude of the negative effect of family size on child welfare increases with the level of the "basic infrastructure for the maintenance of good health and economic development."

To examine the endogeneity issue, Desai tries to (unsuccessfully) instrument family size by variables like "duration of marriage, proportion of women in the local community with an unplanned birth, and change in infant mortality during the previous 10 years. Hausman's test, however showed that far from improving the model's fit, these instruments introduced noise." Instead, she compares the effect of family size for those families that have reached or exceeded their desired (as measured by a question asking women about their fertility preference) family size and those that have not. Using this strategy, she argues that if parental motivation (tastes or preference) is important in explaining the relationship between family size, then the negative effects of family size should be greater amongst the families that have exceeded the desired family size. However, she finds limited support for the importance of parental motivation.

[4] "Child's height measured in terms of standard deviations from the mean of children of the same gender and age in the international reference population" (Desai 1995)

Rosenzweig and Wolpin (1980) use the unanticipated birth of twins to examine the "*exogenous* impact of a fertility change on the demand for schooling and other household goods" using household data from India. From a theoretical perspective, they view the birth of twins as an exogenous subsidy to the price of bearing an additional child (or increasing the 'quantity' of children) and are interested in evaluating how this exogenous price decrease affects investment in child quality. If, as economic models in this field usually assume, the 'quantity' and 'quality' of children are indeed substitutes, then a decrease in the price of 'quantity' of children should increase the 'quality' of children. Their results "confirm the hypothesis that exogenous increases in fertility decrease child quality and suggest that a decrease in family size brought about, say, by exogenous improvements in birth control technology, would increase schooling levels of Indian children."

While the study is rigorous in its accounting for the endogeneity problem, the empirical results are based on a survey of 2.939 households out of which only 44 contained women who had multiple birth. Moreover, it is not clear that the birth of twins is simply an exogenous increase in family size. Besides being a rare phenomena (less than 1 percent of birth), twinning is also a unique phenomena in which not only is an additional (unanticipated) child born but he/she is born right then. This probably makes twinning a different kind of shock than that due to an additional child born at a much later date. Thus, the extent to which experiences as a result of twinning alone can be generalized to reaching conclusions about a result of a typical increase in family size is debatable.

Horton (1986) explicitly looks at the determinants of the quantity and quality of children using household data from the Philippines. She uses the total number of ever born children and nutritional status of children (as measured by the z-score of height for age as measures of child quantity and quality respectively). As independent variables, she uses a number of proxy variables for inputs in the production of child quantity and quality. These include educational and occupational status of the mother and the father as measures of the parental wages; ownership of physical assets as measure of wealth status; community indicators like distance to nearest family planning center, water supply and sanitation as measures of input costs. In addition, urban location was used as a measure of relative price between child quantity and quality. The argument being that the shadow price of quality is lower in urban centers due to easier accessibility to health care and "there is less opportunity for children to work and earn wages, and mothers are less able to combine child care and market work activities (in urban centers)"(p. 165). A measure of the height of parents is also included to control for genetic factors and a mortality variable is included to account for its affects on both fertility and child height.

The strategy used by Horton (1986) is to estimate reduced form equations of child quantity and quality and then interpret the coefficients on the independent variables as representing the effect of the independent variable on the substitution between child quantity and quality. Looking first at the household average z-scores for children below 15 years, she finds that "some of the predictions of the quality-quantity model are borne out, in that parental education, maternal occupation, and the infant and child mortality rate cause the expected substitution between child quality and quantity." Next she looks at individual z-scores of children and finds birth order of the child to be an important determinant. In particular, she finds a child's nutritional status is negatively related to the number of older siblings and concludes from this that "households do not seem to invest in quality of children according to the efficiency of such investments. Instead, their rather limited ability to even out resource availability over time leads to (possibly undesired) inequalities amongst their children"(Horton 1986).

Summing up the literature, Ahlburg (1994, p.185) writes, "At the level of the household, it appears that additional children reduce the education and health of other children in the family but estimates of the size of these effects vary considerably: sometimes they are positive, sometimes insignificant, and more often than not negative and fairly small."

V. Methodology

In order to overcome problems discussed earlier with measuring the causal relationship between family size and child welfare, I use an instrument for family size. The strength of the methodology lies in the fact that an instrument, if valid, affects family size only and does not have any independent affect on measures child welfare being examined, once other observables determinants have been controlled for. Thus, changes in family size due to changes in the instrument can be thought of as exogenous changes and therefore free from the endogeneity problems described earlier.

Consider child-welfare to be a function of family size, a set of other observed exogenous variables *(X)* and an unobserved variable *(U)* that is correlated with family size, described by the equation below.

$$ChildWelf_i = \alpha + \beta_1 FamSize_i + \beta_2 X_i + \beta_3 U_i + \varepsilon_i$$

Now since *U* is unobserved, the OLS regression estimates for the effect of family size of Child Welfare will be biased. In order to overcome this problem, I use an instrument variable *(Z)* that although correlated with *FamSize* is uncorrelated with U i.e.

$$Cov(FamSize, Z) \neq 0$$

and

$$Cov(U, Z) = 0$$

The methodology can best be understood as a two stage process. Since *FamSize* and *Z* are correlated, in the first stage I predict family size as a function of Z in the first stage. In the second stage I use these predicted values instead of the actual values to estimate the effect of family size on child health.

First Stage:

$$FamSize = \gamma + \delta_1 Inst + \delta_2 Control + \eta_{ij}$$

$$Fam\hat{S}ize = \hat{\gamma} + \hat{\delta}_1 Inst + \hat{\delta}_2 Control$$

Second Stage:

$$Health_{ij} = \alpha + \beta_1 Fam\hat{S}ize_j + \beta_2 Control + \varepsilon_{ij}$$

Thus, in essence the instrument separate the variance in family size into two components. The first component that is solely due to the variance in Z, and second a residual component. Since Z and U are assumed to be independent, the component that is due to variance in *Z* is independent of the variance in *U* allowing us to obtain an unbiased estimate of the effect of family size on child welfare.

The instrument variables used here are:

i) Son1st: whether or not the first child that born in a family is a boy, Son1st (=1 if first born child is a boy, =0 if first born child is a girl)

ii) Twin1 : Birth of Twins in first pregnancy

iii) Twin2: Birth of Twins in second pregnancy.

The Son1st instrument is in line with that suggested by Angrist and Evans (1998).[5] The rationale for it being a good instrument for family size in India lies in the strong preference for sons in India and its effect on fertility via differential stopping behavior (Clark 2000). For instance, it has been estimated that elimination of gender preferences would result in a 8 percent decline in fertility in India (Mutharayappa, Choe, Arnold and Roy 1997). Secondly, since the sex of a child is random so will the sex of the first child ever-born in the absence of sex-selective abortion.

The second set of instruments (or different variants of it) have been used in many different contexts (Rosenzweig and Wolpin 1980) and as shall be discussed later there is potentially less concern about the validity of this instrument – a factor that will be useful to test the validity of the Son1st instrument.

The models are estimated using the IVREG2 routines in Stata and all the standard errors are corrected for clustering at the household level.

VI. Data and Descriptive Statistics

The data comes from the National Family Health Survey of ever-married women conducted in almost all states in India in 1992-93 and repeated on an independent cross-section in 1998-99. The surveys collected nationally representative data from ever-married women aged 15 to 49. With the exception of country –specific modules and modifications in some of the questions asked, the survey is in line with the Demographic and Health Surveys – II and III respectively.

One important shortcoming of the data is that the anthropometric measures of child health are collected only for children born in the last 4 years (1992-93 round) and 3 years (1998-99). For most families, this restricts the analysis to the last born child in the family. Thus, I am unable to distinguish between the effects of birth order and sibship size in the analysis here. This limitation must be kept in mind when interpreting the results.

Measures of child-welfare:

Child Weight to Height ratio: The child weight to height ratio is used as a measure of 'body wasting'(Onis 2000). The variable has been used as a measure of current health status dependent

[5] Angrist and Evans(1998) use a sex-mix instrument i.e. whether or not the first two children are of the same sex to estimate the effect of fertility on labor supply of women in the United States. Conley(2003) uses the same instrument to estimate the effect of family size on child health in the United States.

on short-term illnesses and nutritional status and thus is more sensitive to current or recent illness.

Child Height: The effects of family size on the long term nutritional status of a child are examined by estimating the effect of family size on a child's height. In line with prior literature, I use the standard deviation of the child's height from the median height of the reference population of the same sex and age (z-scores of height).

While both 'wasting' and 'stunting' might also reflect a wide variety of other factors like the genetic potential, anthropometric research suggests they capture distinct biological processes reflecting nutrition and vulnerability to diseases. Given that the effects of family size are more likely to be through marginal decreases in food or nutrition or marginal increases in neglect, we might expect family size to have a larger effect of the height. However, since analysis is restricted to young children we might not be able to observe the complete effects of family size on child. In line with previous work by Desai (1995), the sample is restricted to children six months and older for models estimating the effects of family size on these anthropometric measures.

In addition to the measures of health I use two other measures of child care. While child health is an output measure and can be influenced by factors other than family size, e.g. genetic factors, child care measures can be considered as input measures that directly capture the role of resources. While the vaccines themselves are available for free, there are both pecuniary (e.g. transportation costs) and non-pecuniary costs (e.g. time) in obtaining them. In order to examine the effects of family size on immunization I estimate models for the receipt of two vaccines given at different ages.

i) Received BCG vaccine at birth: Given to children at birth (or less than 15 days after it) to protect against tuberculosis. The sample is restricted to children older than 1 month for models predicting the receipt of BCG vaccines.
ii) Received Measles vaccine. Usually given to children 9 months after birth and hence models are restricted to children older than 9 months for these samples.

However, since the results are qualitatively similar for both I only report and discuss the results for the receipt of measles vaccine here.

Control Variables:

The summary statistics for the variables used to control other possible factors that can confound the relationship between family size and child welfare are provided in Table 1 for families of different sizes. Amongst others, these include the age of the child and its square and cube, birth interval with preceding child, mothers age at the birth of the child, parental education, household wealth (as measured by an asset index constructed using the method of principal components using the method outlined in Filmer and Prittchet (1999), number of adults in the household, dummies for the geographical region : North: Delhi, Haryana, Himachal Pradesh ,Jammu , Punjab and Rajasthan ; Central: Madhya Pradesh, Uttar Pradesh ; East: Bihar, West Bengal, Orissa ; North- East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura; West: Goa ,Gujarat, Maharashtra ; South: Andhra Pradesh, Karnataka, Kerela, Tamil Nadu. In addition I add linear time trend for each year. Thus, omitted factors that are common to children in each regions or changes in region specific factors are controlled for in the analysis. In models restricted to the rural sample, I also control for the distance of the village to the nearest all weather road.

The differences in child heath and immunization across families of different sizes are also shown in Table 1. Consistent with conventional wisdom, Table 1 suggests that children from smaller families are healthier and more likely to be immunized. On average, a child from a family with 5 children is likely to weigh .2 kilogram less than a child of the same height from a family of 2 children. Similarly a child from a family of 5 is at least 20 percent less likely to have received a measles or a BCG vaccine. Table 1 also illustrates the differences in parental education and other socio-economic characteristics of different sized families. 42 percent of fathers and 76 percent of mothers of families with 5 children have no education. In contrast, the figures are 22 percent and 42 percent respectively for families with two children. Similarly 28 percent of 5 children families are in the poorest quintile in comparison to 16 percent of 2 children. Overall, the table suggests significant differences amongst various observed characteristics of differently sized families.

Table 2 repeats the same exercise with families classified by the desired number of children expressed by the respondent. To the extent that realized 'quality' is a reflection of 'desired' quality and 'desired' quantity is independent of 'realized' quantity, then the table does suggest a tradeoff between 'quality' and 'quantity' as assumed by many economic models. Children of respondents desiring larger families are less likely to be immunized and appear to be less healthy.

In a pattern similar to Table 2, families with lower socio-economic characteristics (less educated, less wealthy) are more likely to have a preference for greater number of children. However amongst rural households, the desired number of children increases with the acres of irrigated land owned by the family (except for families desiring 6 or more children). This suggests that some families do view the number of children as a complement to the existing assets they own and might be inclined to both have more children as well as invest in healthier children.

Validity of the Instrument:

In Table 4, I report the results from the 'first stage' regression of the number of children ever born to a mother on the instruments as well as other control variables. The results confirm that the sex of the first child and occurrence of twin births is a strong predictor of family size. On average, families in which the first born child is a boy, are likely to be smaller by .09 children than one with a girl as the child. Having a twin birth in the first pregnancy increases family size by 1.29 children and having a twin birth in the second pregnancy increases family size by 1.32 children. The F-statistic for the null hypothesis that the coefficients are jointly equal to zero, which is also an indicator of the power of the instrument is equal to 92.44. Table 4 also reports the first stage regressions for the models that are estimated separately by sex. Given that problems with bias in the IV estimates increase with weak instrument, the 'power' of the instrument in predicting the measure of family size is reassuring (Bound et al 1995).

As mentioned earlier, the second assumption for consistency for IV estimates is that the instruments should not be correlated with the error term. This assumption cannot be tested directly. Instead over-identification tests, which asses the sensitivity of the estimates from using different instruments are used to evaluate the bias associated with using any of the instruments. Assuming that at least one of the instruments is valid, these tests provide an indirect way to test the validity of the assumption that the instrument is independent of the error term in the second stage of the estimating procedure. The results from these tests are reported alongside the main results here and are available from the author for other estimates. In general, these tests and those discussed later in section 8 do not suggest any bias created by the use of the Son1st instrument.

Lastly, although we cannot check whether or not the instruments are correlated with the error term (which by definition is unobserved) we can see if they are correlated with the observed variables. Table 3 tabulates the observed characteristics of the family by the sex of the first child -- the instrument of more concern because of possible sex selective abortions. As the table suggests there are no significant differences between families that had a boy as their first child and those that had a girl.

VII. Results

Main Results

The results from models predicting the child anthropometric measures and receipt of a measles vaccines are presented in Table 5. The first column of numbers in the table shows the estimated effect of the total number of children ever born to the mother on the particular dependent variable using ordinary least squares. The second column shows the estimated effects from using both the Son 1st as well as twin instrument. Column 3 reports the p-value for the null hypothesis that the estimates from using the different instruments are statistically different from each other (a test of over-identifying restrictions for the validity of the instruments).

The OLS models are unanimous in predicting a negative relationship between the number of ever born children and the child's health. Although statistically significant, the magnitudes of the effects are rather small. For instance, an additional sibling is found to be related to a loss in weight of 44 grams, keeping height constant.

In contrast, the IV results using both the Son1st and Twin instruments suggest that family size have no effect on both the weight to height ratio as well as the z-scores for height with both estimates being slightly positive and statistically insignificant. The estimated effect of sibship size on the weight to height ratio is 0.06 (standard error: 0.065) and that on height is 0.04 (standard error: 0.07).

Similarly, OLS estimates suggest small but statistically significant, 3.5 percent reductions in the probability of receiving a Malaria vaccine. In contrast the IV estimates suggest that the estimated effects of family size on the probability of receiving a Measles vaccine is extremely small, -0.003 (standard error 0.027) and statistically insignificant.

Effects of Family Size on Boys and Girls

A large body of evidence documents the unequal distribution of resources between boys and girls within families in India and many other parts of the world (see Sen 1988 and the literature cited there). It is possible that this bias exacerbates with the strain on resources due to additional family members. For instance, Ahlburg (1995 p.135) writes that "Although it is difficult to prove, it is likely that inequality within a household is greater in larger household…Larger households place an additional burden on women and, probably, on female children."

Table 6 reports models estimated separately for boys and girls. These models are more flexible and allow the effect of family size and the other control variables to differ for boys and girls. The results suggest that family size has a small positive but statistically insignificant effect on the weight to height ratio for both girls (0.023, standard error 0.11) and boys (0.09, standard error 0.11) with the estimated effect being slightly larger for boys than for girls. Similarly, family size has no effect on the height for both boys (-0.027, standard error 0.13) and girls (0.04, standard error 0.13)

With regard to immunization against measles, the effect of an additional sibling is positive but statistically insignificant for boys (0.03, standard error 0.04). The probability of being immunized from measles decreases for girls (-0.05, standard error 0.03) with an additional sibling but the estimated effect is statistically insignificant.

Overall, large families do not seem to particularly disadvantage girls in comparison to boys. Given the conventional wisdom about discrimination against girl, this might be surprising at first. However, it is not obvious *a priori* whether the dilution of family resources would translate into a bigger impact for girls than for boys. The extra resources that a girl in small family might have in comparison to a girl in a larger family might not be enough to confer any nutritional or health advantage to her if other disadvantages that affect girls regardless of family size outweigh the marginal impact of these resources.

Effects of Family Size on 'Rich' and 'Poor' Families

The explanation that some children are too disadvantaged by factors that are independent of family size to be affected by dilution of family resources might not only be relevant for comparing the experiencing for boys and girls but also the experiences of children in rich and poor families. If factors affecting child health independent of family size leave some children too disadvantaged to begin with, then the addition of a member might have little or no affect on their nutritional and health outcomes.

In order to explore this possibility further, I examine the effects of family size on ‘rich’ and ‘poor’ families separately. The families are divided into these categories if they fall above or below the median asset index and models are estimated separately for each of these sub-samples. The models are estimated separately for boys and girls in order to keep their specifications flexible. Results reported in Table 7, using instrument variables suggest that it is in fact children in richer families who might benefit more from a decrease in family size. The results suggest that the negative effect of larger families is felt most by girls in rich families. This is particularly true for current as well as long term nutritional status as well. An additional sibling reduces the weight to height ratio for girls in well off families by .67 (standard error, .24) kilograms/meter. The estimated reduction in height of girls as measured by standard deviations from the reference median is .55 (standard error .29). In addition, family size is found to have a larger negative effect on boys in ‘rich’ families than it does have on boys in ‘poor’ families. It is important to emphasize that the results do not imply that child from a large but ‘poor’ family is healthier than a child from a rich family of the same size. Instead, they suggest that a child from a poor family is not necessarily healthier in a small family compared to a bigger family and suggest amongst other things, the importance of contextual factors in determining the relationship between family size and child health.

Effect of ‘Context’: Presence of Village Health Centers

While the results from estimating the models by gender and wealth suggest that the effects of family size on child health are likely to depend on important contextual factors, they do so only indirectly. For instance, using the comparison between ‘rich’ and ‘poor’ households to make conclusions about contextual effects rests on the assumption that the ‘rich’ and ‘poor’ differ significantly along the environment and context that surrounds them – not an unviable assumption. But to asses this hypothesis more directly, I compare the effects of family size for families living in a village with a health facility (a primary health care center or sub-center). These results are reported in Table 8.

The reduced sample sizes do reduce the power of the instruments and caution needs to be exercised in taking the numbers too literally. However, the results do suggest that the adverse effects of family size are felt more by children living in villages with a health care center. The results in fact suggest that children of families not living in villages with a health care center might in fact benefit from the presence of additional siblings, one possible explanation for these results (and the earlier ones comparing rich and poor families) might be the role that additional siblings might take on as care-givers or even economic providers, especially in less developed rural settings. However, the results are also not in-consistent with the notion that children might benefit from reduced sibling competition only when other factors influencing their health are also favorable. In more unfavorable contexts, sibling competition might be irrelevant compared to the other forces that impinge on a child's health. Admittedly, this is a rather imperfect measure of context since the presence of a health care center is determined largely by the population of the village. Moreover, the presence of a health care does not necessarily imply access to a functioning health care center.

However, an important note of caution needs to be drawn in interpreting these results. As mentioned earlier, the estimation technique makes no correction for the selection bias induced by the fact that in the sample we only observe children who were alive at the time of the interview. Thus, if children from poor families face higher mortality risks as a result of family size then the estimated effects of family size are likely to be more downward biased for this group. In the next section I examine how differential rates of child mortality might affect the estimates of the effects of family size. I plan to examine the effects of family size on child mortality by wealth and gender in future work and emphasize that the current findings can only be interpreted as the effects of family size on surviving children.

VIII. Sensitivity of Results

Given that that the average number of children is families is 3, the sex composition of the first two or even three children might be a more powerful instrument i.e. it explains more of the variance in family size. However there are two reasons why it might be better to use the sex of the first child only. First sex-selective abortions are probably less frequent in the first pregnancy and thus the sex of the first born child is a more random variable than is the sex of the second born child. Second, the sex of the first child is likely to be less correlated with the actual sex-composition of siblings than is the sex-composition of the first two children. This is important given the concern that the sex composition of children would independently affect child welfare and thus belong in the original estimating equation (Das Gupta 1987, Muhri and Preston 1991). For instance, Muhri and Preston(1991) expect that "larger number of children of a particular sex in a family will be associated with higher mortality rates among children of that sex." (p.417).

Using data from Matlab in Bangladesh , Muhri and Preston (1991) conclude that they find “abundant support for the inference that girls’ mortality is higher in families which already had daughters” and that “sex composition effects are much less evident among boys”. While it is not obvious whether their results (and those of many other studies that examine the same question (e.g. Das Gupta 1987) are capturing the effects of the same sibling or that due to larger family size as their models do not include a measure for family size or the total number of children in the family.[6] Since girls that have older sisters are likely to be from larger families than are girls with older brothers (“children of higher birth order are more likely to have older sisters”) their findings are not inconsistent with the hypothesis that increased family size adversely affects girls but not boys.

In contrast, Pande (2003) does include a measure of household size while estimating the effect of sex of siblings on child nutrition and immunization and in fact finds that “on the whole, however sex composition does not appear to be a strong determinant of severe stunting (her measure of child health) for all children combined.” Instead, she argues, her results lead to the conclusion that the effect of sex composition varies by gender of the child. She also finds that the sex-composition of siblings does not affect the likelihood of receiving a full set of vaccines for girls but does so for boys. In addition, she finds that the sex-composition of siblings affects the likelihood of severe stunting for boys but does not do so for girls. While her findings suggest the need to guard against potential biases in using the sex composition instrument, they also suggest that the evidence on the effects of sex-composition is at best mixed.

To test the sensitivity of my results to any bias created because of the correlation between the Son1st instrument and the error term in the second stage equation, I estimate the models controlling explicitly for the presence of 2 sisters or 2 brothers (creating a dummy for each) for each index child. These results are reported in Appendix Table.1. Most evidence including that from Pande (2003) suggest that it is children with either 2 or more sisters (with no brothers) or 2 or more brothers (with no sisters) who are advantaged or disadvantaged depending on their gender. The presence of 1 sister or 1 brother alone or both brothers and sisters seems to have no significant impact. The addition of these controls reduces the power of the Son1st instrument in predicting family size which might lead to a bias of its own and hence is not used for the main

[6] The models include the following measures for family composition: Presence of 1 brother, Presence of 2+ brothers, Presence of 1 sister, Presence of 2+ sisters.

analysis. However, the estimates from the models do not differ substantially from those without these controls and the results are qualitatively similar with the main results.

Secondly, as mentioned the use of additional instruments – the birth of twins in the first or second pregnancy allows me to conduct tests of over-identifying restrictions for the validity of the instruments used. The tests essential examines the sensitivity of the estimates to the choice of the instrument. As mentioned earlier, the instrument (or different variants of it) has been used in many different contexts, including in India, (Rosenzweig and Wolpin 1980) and there is potentially less concern about the validity of this instrument. Thus, assuming the twin instruments are valid the tests do not suggest that the results are biased by using the Son1st instrument.

Child Mortality

As mentioned earlier, if large families result in higher rates of mortality then the analysis which estimates the effect of family size on child health using only data from living children will underestimate the effects of family size on child health. To examine the sensitivity of my results I assign to children who have died the lowest values of the dependent variable in the sample amongst living children. Thus, children who would have been the sample if alive are assigned a value of -6 for the z-score for height and are assumed not to have received a measles vaccine. They are also assigned the lowest value of the weight to height ratio amongst children in the sample of the same age (had they been alive) and gender. The results from using this 'adjusted' data are presented in Appendix Table 2. With the exception of models when the weight-height ratio is used as the dependent variable, the estimated negative effects of family size are found to increase in general. However, the results are not qualitatively different from the main results and the differential patterns between the experience of children in 'rich' and 'poor' families is still evident. Admittedly, this method to test the sensitivity of the results is not without problems. It is not necessary that the heights of all children who died were 6 standard deviations below the reference median or that they did not receive a measles vaccine. However, by assigning them these values, the estimated negative effects of family size are now probably biased upwards and thus the estimates can be considered as an upper bound of the negative effects of family size.

IX. Discussion & Conclusions

The consequences of high fertility and over-population have long been a topic of much examination and discussion. Ignoring the larger social and environmental consequences of larger families, this paper takes a narrower look and focuses on the consequences of family size on child health in India. Using the method of instrumental variables to examine the consequences of exogenous changes in family size, the paper attempts to isolate the casual effects of family size. The instrument variables used for the purposes of identifying these causal effects are the sex of the first born child in the family and the occurrence of twin births in the first or second pregnancy. While the sex of the first born child is likely to be random, it is related to family size because of the preference for sons that leads to differential stopping behavior amongst women in India. Twin birth is also an exogenous shock to family size since it is an unanticipated increase in family size and by most accounts a random event.

One interesting side note from the study is that by and large the estimated effects from OLS do not differ substantially than those estimated by the instrumental variables strategy. Thus concerns about the possible endogeneity of child health with family size might not be as important in the context of developing countries like India. Indeed this is not inconsistent with the prior beliefs of many demographers. Summing up the proceedings of a seminar on "Fertility, Family Size and Structure", Lloyd (1993 p.6) writes :" A practical recognition seemed to emerge of the many situations in which the factors determining family size of the number of siblings can be seen as unrelated (or exogenous) to the particular decision about child welfare being modeled—either because contraceptive use is very low or because present conditions influencing decisions about child welfare are very different from previous conditions under which parents made fertility decisions."

Using data from the two rounds of the National Family Health Survey in India, the results from the analysis suggest that overall increased family size has no effect on the health of children – boys or girls as well as the probability of being immunized against measles. Given the conventional wisdom and indeed the raw correlations that suggest children from smaller families are healthier, this result that family size has no affect on the health of children might be rather surprising and counter-intuitive. Does this mean that family planning programs should be abandoned? No. But it does suggest that too much emphasis on simply family size might be misguided and inconsistent with the motivations and experiences of parents themselves. Admittedly, focusing on just family size as this paper has done is to take too narrow a view when other factors like birth spacing might better capture the effect of sibling competition on child health. And this might be one reason why family size per se is found not to affect child health directly. However, given the large attention and emphasis placed on family size in slogans like, "Small Family, Healthy Family" (the signature slogan of the Indian family planning program) it is important to understand the effects of this dimension alone.

The negligible effects of family size on health of children in India also highlights an important but perhaps under-appreciated fact: the impact of family resources is mitigated or exacerbated by the context and other factors influencing child health. Family resources that are impacted by the size of the family might be an important determinant of child health, but they are one amongst many other factors like the physical environment, health and sanitation facilities as well as other societal forces. For instance, the limited ability of family resources to explain child health in the context of other discrimination against girls might help explain why girls and boys are found to be similarly affected by larger families. The discrimination against all girls, regardless of family size, might be outweighing any positive benefits that come about as a result of smaller families.

I also find that family size has a larger negative effect on children of more well-off families than it does amongst the poorer families and this is particularly true for girls. Amongst the well off families, children in small families are much more advantaged than those in large families. However amongst 'poor' families, children in small families do not appear to be much more advantaged than children in large families. One possible explanation for this finding is that the 'marginal impact' of additional resources due to reduced family sizes in poorer families is not sufficient to lead to substantial improvements in the health of children from 'poor' families because of other disadvantages faced by poor families regardless of family size.

The finding that girls in rich families are particularly affected by family size however does suggests that when changes in family resources are able to exert influence on the health of children, girls do bear a disproportionate share of the burden of a reduction in per-capita resources.

The finding that children in better off families benefit from smaller families but those in poor families don't, also raises questions about the relative efficacy of programs and policies aimed at decreasing family size amongst the less well off visa vie other possible interventions. A number of these programs offer cash and other incentives to induce families to volunteer for procedures that prevent them from having additional children. Reports of women being forcefully sterilized by over zealous health officials required to meet targets are also not uncommon. The results from this study demonstrate a need for policy makers to re-evaluate the overwhelming emphasis on family planning programs at the cost of neglecting other interventions in health care.

A Table 1: IV Results from Models Controlling for the presence of 2 brothers or 2 Sisters

	All Children	All Girls	All Boys	Girls		Boys	
				'Poor'	'Rich'	'Poor'	'Rich'
Weight/Height	.056 (.083) [0.67]	.023 (.117) [0.20]	.069 (.116) [0.59]	.277 (.264) 1.05	-.77 (.28) [-2.79]	.19 (.17) [1.12]	-.241 .(272) [-0.88]
Height (Z-score)	.017 (.095) [0.18]	.085 (.144) [0.59]	-.086 .123 [-0.70]	-.015 (.256) [-0.06]	-.521 (.315) [-1.65]	-.04 (.18) [-0.23]	-.487 .327 -1.49
Received Measles Vaccine	-.016 (.028) [-0.56]	-.05 .035 [-1.41]	.01 (.041) [0.20]	-.062 (.05) -1.23	-.093 (.07) [-1.22]	.007 (.061) [0.11]	.037 (.096) [0.39]

	All Children	All Girls	All Boys	Girls		Boys	
				'Poor'	'Rich'	'Poor'	'Rich'
Weight/Height	.08 (.08) [1.04]	.05 (.12) [0.44]	.099 (.099) [1.00]	.19 (.24) [0.79]	-.54 (.24) [-2.23]	.16 (.15) [1.11]	-.13 (.22) [-0.58]
Height (Z-score)	.004 (.08) [0.05]	.019 (.12) 0.16	-.049 (.11) [-0.46]	-.08 (.21) [-0.40]	-.43 (.26) [-1.68]	.014 (.149) [0.09]	-.33 (.25) [-1.32]
Received Measles Vaccine	-.003 (.02) [-0.12]	-.048 (.03) [-1.72]	.03 (.03) [0.91]	-.098 (.04) [-2.44]	-.141 (.06) [-2.22]	.033 (.048) [0.68]	.06 (.08) [0.81]

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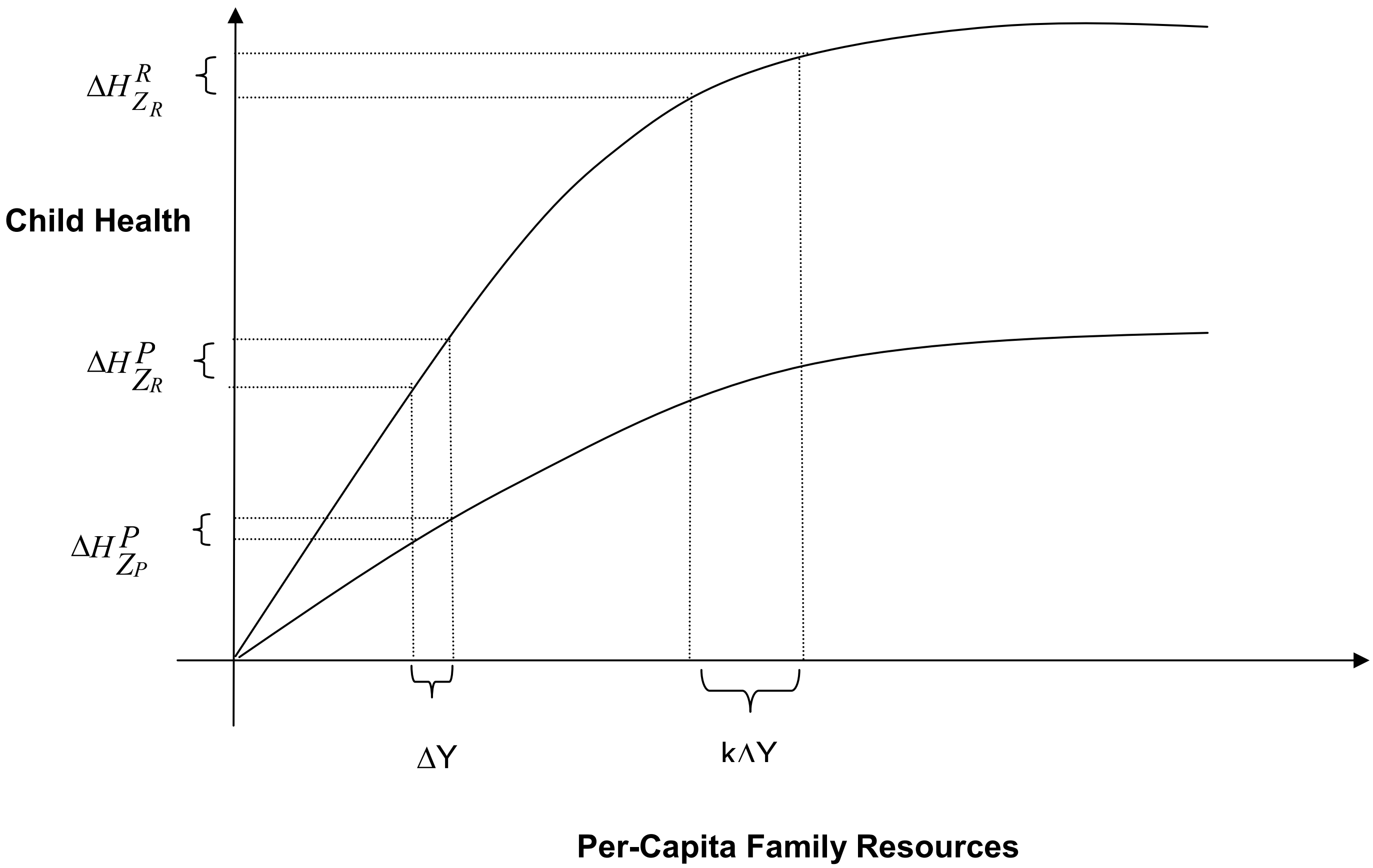
Figure 1. Affect of Contextual Factors on Relationship between Child Health and Per-Capita Family Resources



$$\Delta H^{R}_{Z_R} \geq \Delta H^{P}_{Z_R} \rangle \Delta H^{P}_{Z_P}$$

Table 1: Summary statistics by Family Size. Means (Standard Deviations)

Number of Children Ever-Born (Top-Code : 6)		**2**	**3**	**4**	**5**	6+
Child Anthropometric						
	Weight-Height Ratio	11.645 (1.999)	11.567 (1.994)	11.439 (2.05)	11.454 (2.037)	11.36 (2.062)
	Ht-Age Adjusted Z-Score	-1.740 (1.589)	-1.940 (1.599)	-2.039 (1.67)	-2.148 (1.68)	-2.290 (1.76)
Child Immunization						
	Received BCG vaccine	0.743 (0.437)	0.678 (0.467)	0.594 (0.49)	0.514 (0.50)	0.425 (0.49)
	Received Measles Vaccine	0.483 (0.50)	0.420 (0.494)	0.350 (0.48)	0.286 (0.45)	0.225 (0.42)
Child Characteristics						
	Age (months)	20.655 (11.88)	21.343 12.388)	21.244 (12.57)	21.559 (12.53)	21.769 (12.64)
	Male	0.518 (0.50)	0.512 (0.50)	0.515 (0.50)	0.523 (0.50)	0.523 (0.50)
	Birth Interval	29.106 (23.58)	35.614 (19.72)	36.606 (18.93)	37.549 (19.44)	36.774 (18.82)
Mother's age at Birth		22.771 (3.96)	24.522 (4.05)	26.542 (4.12)	28.599 (4.31)	32.542 (4.97)
Father's Education						
	No education	0.220 (0.41)	0.278 (0.45)	0.341 (0.47)	0.422 (0.49)	0.492 (0.500)
	Some primary	0.186	0.216	0.239	0.238	0.249

		(0.39)	(0.41)	(0.43)	(0.43)	(0.43)
	Some secondary	0.413 (0.49)	0.388 (0.49)	0.342 (0.47)	0.280 (0.45)	0.222 0.42)
	> Secondary	0.181 (0.39)	0.118 (0.32)	0.078 (0.27)	0.059 (0.24)	0.037 (0.19)
Mother's Education						
	No education	0.419 (0.49)	0.550 (0.49)	0.660 (0.47)	0.755 (0.43)	0.83 (0.37)
	Some primary	0.161 (0.37)	0.182 (0.39)	0.176 (0.38)	0.147 (0.35)	0.118 (0.322)
	Some secondary	0.322 (0.467)	0.230 (0.42)	0.151 (0.36)	0.092 (0.29)	0.052 (0.22)
	> Secondary	0.098 (0.298)	0.038 (0.19)	0.012 (0.11)	0.006 (0.08)	0.001 (0.024)
Hindu		0.764 (0.43)	0.750 (0.43)	0.744 (0.44)	0.715 (0.45)	0.673 (0.47)
SC/ST		0.257 (0.44)	0.293 (0.46)	0.32 (0.47)	0.361 (0.48)	0.353 0.48)
Household Wealth						
	Rooms	3.17 (2.27)	2.9 (2.14)	2.72 (1.99)	2.617 (1.95)	2.645 (1.93)
	Asset_Quintile1	0.162 (0.368)	0.204 (0.40)	0.250 (0.43)	0.279 (0.45)	0.308 (0.46)
	Asset_Quintile2	0.169 (0.375)	0.195 (0.40)	0.22 (0.41)	0.240 (0.43)	0.272 (0.44)
	Asset_Quintile3	0.193 (0.39)	0.212 (0.41)	0.216 (0.41)	0.223 (0.42)	0.208 (0.41)
	Asset_Quintile4	0.215 (0.41)	0.198 (0.4)	0.184 (0.39)	0.162 (0.37)	0.140 (0.35)
	Asset_Quintile5	0.261 (0.44)	0.192 (0.39)	0.130 (0.34)	0.096 (0.29)	0.072 (0.26)
Irrigated Land (Acres)		1.905 (19.29)	1.919 (18.04)	1.477 (11.06)	1.66 (10.45)	1.715 (17.81)
	One Adult in	0.048	0.048	0.047	0.049	0.038

	HH	(0.21)	(0.214)	(0.213)	(0.22)	(0.19)
	Two Adults (Opposite Sex)	0.458 (0.498)	0.507 (0.50)	0.561 (0.496)	0.590 (0.49)	0.553 (0.50)
	Two Adults (Same Sex)	0.010 (0.10)	0.006 (0.08)	0.006 (0.08)	0.008 (0.09)	0.007 (0.08)
	Three + Related Adults	0.469 (0.499)	0.428 (0.49)	0.378 (0.49)	0.345 (0.48)	0.395 (0.49)
	Unrelated Adults	0.015 (0.12)	0.012 (0.11)	0.008 (0.09)	0.009 (0.09)	0.008 (0.09)
	Listen to Radio	0.455 (0.498)	0.386 (0.49)	0.326 (0.47)	0.272 (0.45)	0.22 (0.41)
	Listen to TV	0.470 (0.499)	0.374 (0.48)	0.283 (0.45)	0.219 (0.41)	0.161 (0.37)
	Rural	0.681 (0.47)	0.732 (0.44)	0.763 (0.43)	0.80 (0.40)	0.829 (0.38)
Region						
	North	0.257 (0.44)	0.263 (0.44)	0.256 (0.44)	0.237 (0.43)	0.21 (0.41)
	Central	0.157 (0.36)	0.190 (0.39)	0.22 (0.41)	0.263 (0.44)	0.319 (0.47)
	East	0.158 (0.36)	0.167 (0.37)	0.19 (0.39)	0.190 (0.39)	0.187 (0.39)
	North-East	0.121 (0.33)	0.123 (0.33)	0.141 (0.35)	0.156 (0.36)	0.161 (0.37)
	West	0.138 (0.34)	0.141 (0.35)	0.113 (0.32)	0.089 (0.28)	0.064 (0.24)
	South	0.168 (0.37)	0.116 (0.32)	0.082 (0.28)	0.064 (0.246)	0.054 (0.23)
Year						
	1992-93	0.470 (0.49)	0.495 (0.50)	0.52 (0.50)	0.527 (0.499)	0.543 (0.498)
	1998-99	0.530 (0.499)	0.51 (0.50)	0.48 (0.50)	0.473 (0.499)	0.457 (0.498)
N		9020	8,295	5,250	3,291	4,840

Table 2: Summary statistics by Desired Family Size . Means (Standard Deviations)

Ideal Number of Children (Top-Code : 6)		**2**	**3**	**4**	**5**	6+
Child Anthropometric						
	Weight-Height Ratio	11.64 (1.99)	11.469 (2.012)	11.378 (2.059)	11.480 2.085)	11.665 (2.116)
	Ht-Age Sex Adjusted Z-Score	-1.76 (1.59)	-2.05 (1.615)	-2.15 (1.732)	-2.128 1.799)	-2.193 (1.837)
Child Immunization						
	Received BCG vaccine	.75 (.43)	0.624 (0.484)	0.496 (0.500)	0.415 (0.493)	0.392 (0.488)
	Received Measles Vaccine	.49 (.50)	0.380 (0.485)	0.265 (0.441)	0.217 0.412)	0.200 (0.40)
Child Characteristics						
	Age (months)	21.029 (12.11)	21.313 (12.399)	21.148 (12.44)	21.187 (12.64)	21.443 (12.47)
	Male	0.531 (0.499)	0.523 (0.50)	0.483 (0.50)	0.516 (0.50)	0.485 (0.50)
	Birth Interval	33.316 (22.45)	33.455 20.93)	34.703 19.78)	35.70 (18.99)	35.042 (17.84)
Mother's age at Birth		25.165 (4.99)	25.145 (5.04)	26.53 5.61)	28.008 (5.91)	29.86 (6.12)
Father's Education						
	No education	0.235 (0.424)	0.317 (0.47)	0.42 (0.49)	0.456 (0.50)	0.499 (0.50)

	Some primary	0.196 (0.40)	0.229 (0.42)	0.229 (0.42)	0.245 (0.43)	0.245 (0.43)
	Some secondary	0.396 (0.49)	0.361 (0.48)	0.296 0.46)	0.254 (0.44)	0.226 (0.418)
	> Secondary	0.172 (0.38)	0.093 (0.29)	0.058 0.23)	0.045 (0.21)	0.031 (0.174)
Mother's Education						
	No education	0.438 0.49)	0.640 0.48)	0.752 0.43)	0.751 0.43)	0.747 (0.435)
	Some primary	0.172 (0.38)	0.166 0.37)	0.132 0.34)	0.140 0.35)	0.162 (0.37)
	Some secondary	0.301 (0.46)	0.175 0.38)	0.107 0.31)	0.104 0.31)	0.083 (0.28)
	> Secondary	0.089 (0.29)	0.019 0.14)	0.009 0.097)	0.005 0.07)	0.008 (0.09)
Hindu		0.775 (0.42)	0.784 0.41)	0.691 0.46)	0.576 0.49)	0.40(0.49)
SC/ST		0.230 (0.42)	0.301 0.46)	0.372 0.483)	0.009 0.1)	0.54 (0.499)
Household Wealth						
	Rooms	3.02 (2.19)	2.85 (2.14)	2.77 (2.04)	2.65 1.72)	
	Asset_Quintile1	0.174 (0.38)	0.223 (0.42)	0.290 0.45)	0.312 0.46)	0.252 (0.43)
	Asset_Quintile2	0.160 (0.37)	0.218 (0.41)	0.256 0.44)	0.282 0.45)	0.29 0.454
	Asset_Quintile3	0.189 (0.39)	0.222 (0.42)	0.216 (0.41)	0.192 0.39)	0.242 0.429
	Asset_Quintile4	0.219 (0.41)	0.189 (0.39)	0.147 (0.36)	0.142 0.35)	0.131 0.337
	Asset_Quintile5	0.258 (0.44)	0.148 (0.36)	0.091 (0.29)	0.072 0.26)	0.085 0.279
Irrigated Land		1.707 (12.83)	1.760 (13.76)	1.885 (22.92)	2.45 35.30)	1.660 (11.214)
	Listen to Radio	0.443	0.344	0.275	0.253	0.218

		(0.497)	(0.48)	(0.45)	0.435	0.413	
	Listen to TV	0.484	0.310	0.186	0.122	0.121	0.327
		(0.50)	(0.46)	(0.40)	0.328		
Region							
	Rural	0.660	0.771	0.821	0.855	0.873	
		(0.47)	(0.42)	(0.38)	(0.35)	(0.33)	
	North	0.279	0.294	0.174	0.122	0.089	
		(0.45)	(0.46)	(0.38)	(0.33)	(0.285)	
	Central	0.158	0.227	0.274	0.288	0.237	
		(0.37)	(0.42)	(0.45)	(0.45)	(0.425)	
	East	0.142	0.174	0.234	0.200	0.171	
		(0.35)	(0.38)	(0.42)	(0.40)	(0.377)	
	North-East	0.087	0.105	0.193	0.293	0.427	
		(0.28)	(0.31)	(0.40)	(0.46)	(0.495)	
	West	0.150	0.124	0.073	0.051	0.035	
		(0.35)	(0.33)	(0.26)	(0.22)	(0.183)	
	South	0.184	0.075	0.051	0.046	0.041	
		(0.39)	(0.26)	(0.22)	(0.21)	(0.199)	
Year							
	1992-93	0.448	0.528	0.535	0.580	0.593	
		(0.497)	(0.499)	(0.499)	(0.49)	(0.491)	
	1998-99	0.552	0.472	0.465	0.420	0.407	
		(0.497)	(0.499)	(0.499)	(0.49)	(0.49)	

Table 3: Summary statistics by Sex of First Child. Means (Standard Deviations)

		Girl	Boy
Number of Children Ever-Born (Top-Code : 8)		3.65	3.521
		(1.70)	(1.699)
Child Anthrometric			
	Weight-Height Ratio	11.877	11.883
		(1.768)	(1.756)
	Ht-Age Adjusted Z-Score	-2.205	-2.226
		(1.584)	(1.55)
Child Immunization			
	Received BCG vaccine	0.658	0.648
		(0.474)	(0.477)
	Received Measles Vaccine	0.440	0.429
		(0.496)	(0.495)
Child Characteristics			
	Age		
	Hindu	0.744	0.733
		(0.436	(0.442)
	SC/ST	0.30	0.303
		(0.458	(0.460)
	Previous Birth Interval	36.062	36.373
		(19.469)	(19.786)
Father's Education			
	No education	0.315	0.313
		(0.465)	(0.464)
	Some primary	0.214	0.219
		(0.41)	(0.414)
	Some secondary	0.352	0.356
		(0.478)	(0.479)
	> Secondary	0.119	0.112
		(0.324)	(0.315)
Mother's Education			
	No education	0.58	0.588
		(0.494)	(0.492)
	Some primary	0.163	0.158
		(0.37)	(0.365)
	Some secondary	0.209	0.209
		(0.41)	(0.407)
	> Secondary	0.048	0.045
		(0.213)	(0.207)
Mother's age at Birth		26.327	25.94
		(5.267)	(5.242)
Household Wealth			
	Rooms	2.90	2.89
		(2.138)	(2.11)
	Asset_Quintile1	0.218	0.221

		(0.413)	(0.415)
	Asset_Quintile2	0.202	0.209
		(0.402)	(0.41)
	Asset_Quintile3	0.208	0.204
		(0.406)	(0.40)
	Asset_Quintile4	0.190	0.190
		(0.392)	(0.392)
	Asset_Quintile5	0.182	0.176
		(0.386)	(0.381)
	One Adult in HH	0.046	0.047
		(0.208)	(0.212)
	Two Adults (Opposite Sex)	0.516	0.511
		(0.50)	(0.50)
	Two Adults (Same Sex)	0.008	0.007
		(0.089)	(0.085)
	Three + Related Adults	0.419	0.424
		(0.493)	(0.494)
Media Exposure			
	Listen to Radio	0.368	0.36
		(0.482)	(0.480)
	Listen to TV	0.348	0.343
		(0.476)	(0.475)
Region			
	Rural	0.741	0.739
		(0.438)	(0.439)
	North	0.255	0.245
		(0.436)	(0.43)
	Central	0.205	0.214
		(0.404)	(0.41)
	East	0.173	0.170
		(0.378)	(0.37)
	North-East	0.134	0.139
		(0.341)	(0.346)
	West	0.119	0.114
		(0.324)	(0.317)
	South	0.114	0.118
		(0.318)	(0.322)
Year			
	1992-93	0.50	0.506
		(0.50)	(0.50)
	1998-99	0.50	0.494
		(0.50)	(0.50)
N		14,508	13,723

Table 4: Results from First Stage Regressions for all Reported Estimates

Dependent variable: Number of Children Ever- Born. Coefficient(Standard Error([t-stat]							
	Whole Sample	All Girls Sample	All Boys Sample	Girls		Boys	
				'Poor'	'Rich'	'Poor'	'Rich'
Son1st	-.076 (.01) [-5.38]	-.096 (.02) [-4.91]	-.059 (.019) [-3.08]	-.088 (.027) [-3.23]	-.11 (.028) [-4.12	-.057 (.027) [-2.08]	-.064 (.026) [-2.45]
Twin Birth (1st Pregnancy)	.85 (.11) [7.54]	.75 (.16) [4.79]	.93 (.15) [6.12]	.778 (.21) [3.72]	.648 (.23 [2.81	1.19 (.27) [4.39]	.833 (.16) [5.21]
Twin Birth (2nd Pregnancy)	1.36 (.09) [15.29]	1.47 (.12) [12.20]	1.26 (.12) [10.23]	1.56 (.16) [9.75]	1.33 (.18) [7.23]	1.29 (.152) [8.50]	1.24 (.195) [6.37]
Other Control Variables	√	√	√	√	√	√	√
N	29500	14204	15296	7755	6449	7929	7367
F-Statistic	F(3, 27203) = 93.28	F(3, 13632) = 57.45	F(3, 14736) = 43.67	F(3, 7401) = 35.02	F(3, 6230) = 22.82	F(3, 7631) = 27.64	F(39, 7104) = 141.34

Table 5: Effects of Family Size on Child Health (Whole Sample). Coefficient (Standard Error) [t-stat]

	OLS (Std. Error) [t-stat]	Son 1st IV + Twin (Std. Error) [t-stat]	Over- id Test Chi-sq(2) P-value	N
Weight/Height	-.04 (.008) [-4.99]	.06 (.08) [0.78]	0.87	29500
Height (Z-score)	-.07 (.008) [-9.07]	.037 (.09) [0.41]	0.29	28725
Received Measles Vaccine	-.036 (.002) [-14.74]	-.003 (.027) [-0.13]	0.12	26064

Table 6: Effects of Family Size on Child Health by Gender of Child. Coefficients (Std. Error)[t-stat]

Dependent Variable		OLS (Std. Error) [t-stat]	Sex Comp.+ Twin IV	Over-Id. Test P-value	N
Weight-Height ratio	Girls	-.05 (.01) [-4.23]	.023 (.11) [0.20]	0.58	14204
	Boys	-.03 (.01) [-2.86]	.09 (.11) [0.80]	0.57	15296
Height of Child (SD from Reference Median)	Girls	-.10 (.01) [-8.71]	.04 (.13) [0.33]	0.08	13822
	Boys	-.08 (.01) [-7.09]	-.027 (.12) [-0.23]	0.06	14903
Received Measles Vaccine	Girls	-.04 (.003) [-11.82]	-.05 (.03) [-1.61]	0.35	12597
	Boys	-.03 (.003) [-9.37]	.03 (.04) [0.89]	0.002	13467

Table 7: Effects of Family Size on Child Health by Wealth and Gender. Coefficients (Std. Error) [t-stat]

	Girls		Boys	
	Poor	Rich	Poor	Rich
Weight/Height	.26 (.23) [1.11]	-.67 (.24) [-2.75]	.19 (.17) [1.17]	-.13 (.24) [-0.57]
Ht-Age Sex Adjusted Z-Score	-.04 (.23) [-0.17]	-.55 (.29) [-1.87]	.008 (.17) [0.05]	-.27 (.27) [-1.00]
Received Measles Vaccine	-.08 (.05) [-1.63]	-.08 (.07) [-1.18]	.03 (.06) [0.51]	.096 (.09) [1.10]
N[7]	7755	6449	7929	7367

[7] Number of observations reported refers to models with Weight/Height as dependent variables

Table 8: Effects of Family Size on Child Health by Presence of Health Facility and Gender. Coefficients (Std. Error) [t-stat]

	Girls		Boys	
	No Health Facility	Health Facility	No Health Facility	Health Facility
Weight/Height	.09 (.21) 0.43	-.26 (.21) [-1.26]	.221 (.174) [1.27]	-.26 (.24) [-1.03]
Ht-Age Sex Adjusted Z-Score	.21 (.19) [1.10]	.01 (0.28) [0.07]	.059 (.156) 0.38	-.26 (.20) [-1.30]
Received Measles Vaccine	-.05 (.045) [-1.08]	-.10 (.06) [-1.53]	.079 (.049) [1.62]	-.013 (.083) [-0.16]
N[8]	6167	3963	6549	4272

[8] Number of observations reported refers to models with Weight/Height as dependent variables