Within-family resource pressures and child health in Indonesia, Korea and the Philippines[*]

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The societies of central interest in this volume are characterized by recent histories of declining family size and improvements in the overall well-being of members of their populations. In every country, life expectancies are longer, earnings are higher, educational attainment has increased--by virtually any measure of human welfare, the average member of these societies is significantly better off than his or her parents. Certainly, over time, health and educational infrastructures have expanded dramatically. This makes it easier for parents to provide education and health care to their children, all else constant. Nonetheless, the rapid increase in human capital observed in the "Asian miracle" economies has in part come about because, through some combination of willingness and ability to do so, parents are committing significantly more resources to each of their children.

Over time, the patterns of fertility decline and enhanced quality of life are clear. Far from clear is whether these trends represent contemporaneous responses to common underlying change, or a causal relationship of some sort. The causality question is of great interest in a study of these societies, as the quality of their labor forces is often put forth as one explanation of why the Asian miracle economies have done so well economically. Do the declines in fertility that have occurred in these societies merely reflect concurrent choices made by individuals in a changing society, or were the changes themselves enabled or facilitated by underlying demographic change? It is naive to expect that either competing explanation stands alone. Fertility decline made investments in human resources more affordable. An underlying process of "modernization" brought with it preferences for both smaller family sizes and children of higher quality. For countries less far along the path taken by the Asian miracle economies, the key question is how best to facilitate the process of change, and in this context, an important question is the role played by fertility decline. If fertility declines help to initiate economic development, encouraging such declines becomes an important development policy lever. A significant operational problem arises in attempting to separate initiating declines in fertility from fertility declines which merely accompany the broader processes of change.

Our aim in this paper is to examine, at the family level, the allocation of resources to children for evidence of responses to fertility or family size. Specifically, we investigate the impact of wanted and unwanted fertility on child health. Our premise is that family resources are finite, and therefore that allocative choices must be made. These choices, or their consequences, may be observable in survey data on child health. To examine this contention, we will inspect five outcome measures and two measures of resource availability and parental willingness to commit resources to a given child. The outcomes are diarrheal and respiratory disease incidence in children, curative care provision to children for either illness, and preventive care (in the form of vaccinations) provided to children. Assuming that family resources are spread more thinly with increases in numbers of children, we examine the impact of numbers of siblings on outcome variables for reference children. If fertility is imperfectly controlled, unwanted births are likely to occur, and family resources are stretched more thinly than is desired by the parents. Therefore, many choices requiring resource commitments by parents, including our measures of child health, will be affected by the occurrence of unwanted births. We view the occurrence of an unwanted birth as a largely exogenous shock occurring outside of the parents' decisionmaking calculus. However, because the proportion of unwanted births is low (16% or less in the countries we study), we view sibsize as largely reflective of deliberate choice by parents.

We examine data from three Asian countries: Indonesia, the Philippines, and Korea, and focus on the observable impact of resource constraints on nutritional levels and basic sanitation, in terms of their impact on diarrhea and respiratory disease morbidity in children, or on the provision of very simple care, in terms of curative health care for these conditions, or vaccinations. These are not, in general, the sorts of impacts one would expect to see in a relatively wealthy country. We expect that as incomes increase, the relative costs of basic nutrition and child health care decline, quality of care rises, and institutions, such as health insurance, evolve to spread the burden of child health care beyond the family. The

allocative mechanisms with which we are concerned are ones which we expect to see operating with some degree of force in a relatively poor country, such as Indonesia or the Philippines. As development progresses, we expect to see less and less evidence of such difficult allocative choices being made.

Our focus in Korea is not one of disease incidence. We have some information about vaccination, and examine, to the extent possible, variations in vaccination status with respect to wantedness status. Vaccinations are very inexpensive in Korea, so we are looking here mainly for the mother's willingness to commit her time to take a child to be vaccinated. We use two comparable data sets from Indonesia, spaced three years apart, and we make some effort to compare results from the two surveys. We include analysis of the Philippines data to ensure that the findings for Indonesia are reflective of the level of modernization in these two (roughly comparable) countries, rather than a specific description of conditions in Indonesia.

I. Recent History of Health and Fertility in Indonesia, the Philippines, and Korea

Throughout Asia, the past several decades have been periods of declining fertility and decreasing mortality. More subtle increases in population well-being than mortality declines have occurred concurrently, in the form of morbidity declines, increases in educational attainment, and so forth. Starting values and rates of change have not been uniform, however. Figures 1 and 2 show this for several countries since 1965. Figure 1 plots the relationship between the total fertility rate and life expectancy at birth. For each country, the highest total fertility rate comes at the beginning of the period, and life expectancies increase as total fertility rates decline.[1] Starting fertility levels in Thailand and the Philippines were relatively high, and starting life expectancy in Indonesia relatively low. The slopes of the curves are roughly comparable, indicating a similar correspondence between total fertility rate declines and life expectancy increase in each country. This lends some credence to the notion that

[1]The curves are smoothed by plotting the predicted values for the total fertility rate following a regression on life expectancy and life expectancy squared.

historical patterns in currently more-developed Asian miracle economies and current situations in other countries in the region are comparable. On the other hand, the longer the curve, the greater the change that has occurred. The relatively short curve for the Philippines shows that somewhat less change, overall, has occurred there in the past thirty years than in Indonesia, Thailand, or Korea. Especially notable is the relatively small increase in life expectancy at birth in the Philippines, although apparently the pace of fertility decline is slowing there, as well.

(Figure 1 here)

Figure 2 shows an even more clear picture of convergence in the correspondence between total fertility rates and infant mortality rates. The recent experience of Thailand, for example, blends almost exactly into the mid-period Korean experience. The Philippines started with relatively low infant mortality, and Indonesia with relatively high infant mortality, but both appear to be converging on the same general relationship displayed by Korea and Thailand. Again, the pace of change is slowest in the Philippines.

(Figure 2 here)

II. Methods

A. Child health and education as indicators of well-being

Educational attainment and child health are two broad categories of indicators which have been used in the past to assess the human capital improvements accompanying development (Kelley 1996, Cassen 1994). A literate (and numerate) population is important in moving from traditional, largely agrarian economies to modern, manufacturing-centered production. Returns to education in the form of increased earnings provide clear quantification of the value of attaining such education. On the other hand, well over a decade passes before a newborn child completes his or her education. This makes it difficult to address directly the impacts of fertility upon family-level resource allocation, and through this

mechanism, subsequently upon educational attainment[2]. The relationship between education and fertility is treated in more detail elsewhere in the volume.

Child health has less direct ties to subsequent productivity. Evidence from the Asian miracle economies, most notably Japan, shows the impact of childhood nutrition on adult physical stature. When severe, malnourishment in childhood can cause diminished intellectual function in adulthood, and also may harm the performance of children in school. However, the ties are less clear between child health and subsequent (adult) productivity than between education and productivity. It is not clear that small physical stature is relevant in determining manufacturing-based productivity, for example. Rather, child health is interesting as an indication of parents' willingness and ability to commit resources to children, at a point in time near birth. If the underlying family-level allocative mechanism is one based on scarcity, then the family resources being doled out, whether for child nutrition, health care of children, or their education, are reflective of the same process. Empirically, examining relationships between fertility or sibsize and child health is an appealing way to get at underlying resource allocation decisions, because observable consequences of these decisions may begin to appear almost immediately after a child is born.

Said another way, the increase in mean adult heights observed in postwar Japan shows that resource scarcity plays an important role in human capital outcomes[3]. Families, on average, are providing their children with more protein and calories because they are able to afford to do so. This is true in such a large proportion of families that the overall impact in the entire population has been significant. Incomes per family member have increased both because family incomes have increased, with increases in productivity, and because the average family size has fallen. Historically, these phenomena are deeply intertwined, and inferring a causal role for fertility decline is difficult. Certainly,

[2]One exception to this is a study for Finland by Nhyrman *et al*. (1995), which uses data from a baseline survey and two revisits, the latter of which came 24 years after the initial survey.

[3] See Steckel (1995) for a survey of the literature on the relationship between childhood nutrition and adult physical stature.

in present-day Japan, the overwhelming majority of parents would be able to provide adequate nutrition to numbers of children much greater than the numbers they currently bear. However, during the post-Meiji fertility decline in Japan, incomes were much lower than their present level. Plausibly, the tradeoffs between numbers of children and the nutrition (and subsequent health conditions) these children enjoyed was more stark than currently is the case. In this sense, the historical tradeoff between number of children and their health status was much like the present-day tradeoff between number of children and education, or number of children and bequests, in Asian miracle societies.

B. Inferring resources devoted to child health

One major problem in the area of inferring resources devoted to child health is empirical. Child health, and indeed the broader concept of child well-being, has many dimensions, and in this sense is difficult to measure. The tie between resources devoted to child health and actual health outcomes is a noisy one. Genetic endowments and chance play an important role in morbidity, for example. Very well-nourished, well-fed and clean children still get diarrheal and respiratory infections, and conversely, poorly nourished children are not always ill. The presumption underlying our analysis of child morbidity is that the relative frequency of illness decreases with increases in resources committed to children. Other indirect measures of child welfare are available, but are equally imperfect. For example, weight-for-height measurements are taken as part of some surveys (although not in any of the surveys we use for this paper). Just as with health outcomes, the tie between inputs, in the form of nutrition and so forth, and anthropometric outcomes depends on a range of unobserved factors, including genetic, metabolic, and others.[4]

An additional confounding factor is theoretical in nature, and leads to statistical problems of identification. Parents are making choices regarding a host of factors simultaneously. In the broadest of

[4] Not all DHS surveys (and none of those we employ) include anthropometric data, so an additional reason to focus on health outcomes is pragmatic.

terms, they are making decisions regarding numbers of children, resource commitment per child, and non-child expenditures. Some parents may choose relatively more children, with relatively less committed per child, than other parents. As Montgomery and Lloyd (1996a) point out, the simple finding of an inverse relationship between fertility and child-well being therefore does not, of itself, constitute justification for policy. It is completely consistent with standard economic models of family formation (*e.g.*, Becker and Lewis 1973) that parents with a taste for lower quality per child choose to have more children, because the price per child is lower compared to children of higher quality. In terms of evidence of a causal impact of fertility on child well being, what is needed is evidence that changes in number of children affects quality per child independent of the underlying variation in tastes, income, or prices generating the initial distribution in number of children. Such independent effects, by the nature of the quality-quantity interaction in children, are inherently difficult to tease out, rendering statistical identification of structural quantity and quality equations difficult.

Little work has been done on estimating the quantity-quality tradeoff using child health as a measure of quality. However, some work on the impact of fertility on educational attainment has focused on the quantity-quality tradeoff, branching in two directions toward analyzing the within-household impacts of large family sizes . One path focuses on the average well-being within families, examining, for example, differences in average educational attainment of children as a function of numbers of siblings. One of the strongest impacts of sibsize on average educational attainment by family members is found in the work of Knodel, Havanon and Sittitrai (1990) for Thailand. Other studies based on essentially similar conceptions of within-family allocation include those by Bauer *et al.* (1992) for the Philippines, Behrman and Wolfe (1987) for Nicaragua, and Rosenzweig and Wolpin (1980) for India. All of these authors find that children from large families receive less education than do children from small families. The effects are often small, and again, causality is difficult to infer. It may be that

increasing competition amongst siblings for finite family resources decreases average access to education. This is the "resource dilution" model associated with Judith Blake (1981). As we have already touched upon, it also is plausible that parents with a preference for larger families are those who see less need to educate their children, and rather than reflecting a pure causal relationship, the correlation between family size and children's educational attainment is based in part on both variables' response to parental tastes and resource constraints (Montgomery and Lloyd 1996a, Becker and Lewis 1973).

The unsuitability of empirical models which do not account for the endogeneity of fertility in parents' decisions lies at the heart of reviewers' criticisms of much of the work in the field (*e.g.*, King 1987, Kelley 1996). Models which pay careful attention to the issue of statistical identification tend to find small effects of family size on household resource allocation. For example, in an attempt to examine the impact of the purely exogenous component of fertility, Rosenzweig and Wolpin (1980) use a sample of twin births, and find a small impact of exogenous fertility on subsequent educational attainment[5]. Behrman and Wolfe (1987) use a sample of adult sisters toward similar statistical ends. Work to date has generated little firm support for the notion that negative within-family consequences of family size on the welfare of family members are important, at least when measuring welfare by educational attainment.

In considering parents' decisionmaking process, we have thus far spent little time on discussing how their decisions translate into actual fertility. Conception carries with it a substantial element of randomness, and therefore so does contraception imperfectly employed[6]. Desired births may not happen, undesired births may occur, or births may come earlier or later than desired. The occurrence of an

[5]Given the extremely small numbers of multiple births in the survey these authors employ, the finding of non-significance should be interpreted with caution.

[6]Trussell *et al.* (1987) provide estimates of annual failure rates, largely for the US, that are typically an order of magintude greater than their theoretical minima.

unwanted birth represents the exogenous impact of fertility. Unless one makes the heroic assumption that parents anticipate (perfectly) not only the likelihood, but the actual occurrence, of contraceptive failure, the unplanned nature of an unwanted birth implies that the event is independent of the parents' decisionmaking calculus. Therefore, a "pure" causal impact of unwanted births on measures of child quality may be estimable. The impact may be felt by the child in question, or it may be distributed over a larger group of children. For instance, in Thailand, Frenzen and Hogan (1982, cited in Montgomery and Lloyd 1996b), found that children wanted by both parents have a significantly higher probability of surviving their first year than do children wanted by only one or neither parent.

In considering within-family resource allocation, a more fully-developed strand in the literature examines differential allocations of family resources on the basis of an indirect measure of wantedness: the child's sex. This strand, in a sense, is a logical extension of the work by Rosenzweig and Wolpin, in that the birth of a girl is outside of parents' pre-conception decision making calculus. Work by Chen *et al.* (1981), Simmons *et al.* (1982) and Dasgupta (1987) has shown that South Asian girls receive less food than their male siblings, and are less likely to survive their childhood. The Simmons *et al.* work is noteworthy in demonstrating the strengthening effect of sibling competition for resources on the impact of an unwanted daughter's birth. Rosenzweig and Schultz (1982) tie this to unfavorable labor market outcomes for some Indian girls. Consistently in the literature for South Asia, one sees an impact of the sex of a birth on resource allocation, as measured by food, education, or other costly resources devoted to the child.

Montgomery and Lloyd (1996b) cite a Finnish study by Myhrman *et al.* (1995), in which mothers interviewed in their sixth or seventh month of pregnancy were asked whether the pregnancy was wanted, mistimed, or unwanted. The timing of the questions guarantees that the responses are not influenced by the characteristics of the child, as the final followup survey was done more than two decades after the

baseline survey. Myhrman *et al.* found that differentials in educational attainment by wantedness appeared for daughters at any sibsize, and for sons with two or more siblings. This shows a strong element of parental choice, coupled to a resource constraint which appears to bind as sibsize increases, albeit with differing strength for sons and daughters. That resource constraints (measured by sibsize, all else constant) bind less tightly for sons than for daughters shows that parents are able to compensate, to some degree, for increasing sibsize. On the other hand, that sibsize matters, even for sons, implies that resource constraints are increasingly important as sibsize grows.

Wantedness of births plays a key role in our subsequent analysis. Mothers in Demographic and Health Surveys are asked specifically about wantedness at the time of conception for each live birth in a period of 3 to 5 years preceding the survey. Because they are asked retrospectively, responses to these questions are often thought to be subject to *post-hoc* rationalization. The direction of such rationalization is not clear, however. Knodel and Prachuabmoh (1973), for example, believe their Thai data on unwantedness understates the degree of unwantedness, as mothers are reluctant to say that a given child was in fact unwanted. Rosenzweig and Wolpin (1993), on the other hand, claim that their United States data show the opposite. On the basis of an undesirable outcome, such as an unhealthy baby, Rosenzweig and Wolpin claim that some women (perhaps nearly one-fourth) who, prior to conceiving, said that they wanted a birth changed their post-partum response to "unwanted". It seems prudent to take both arguments into account by allowing wantedness (potentially) to be endogenous, that is, dependent upon characteristics of mother, of siblings, and of the reference child, and we do so in our empirical work.

C. The Model

We model three measures of child well-being as functions of child, family and community characteristics: odds of illness with either diarrhea, or fever or cough; use of curative care for these

conditions; and use of preventive care (in the form of vaccinations). Pragmatic concerns dictate this strategy, as diarrhea and respiratory infections are the two illnesses most readily observed in survey data. However, they are also of policy interest, as these two disease categories account for roughly one-third of infant and child mortality in the developing world. We construct a model based upon the concept of a child-specific index of "child value", or parents' willingness to commit resources to a particular child. This index is posited to be a function of exogenous individual, household and community variables. Household resource commitments are measured directly by usage of health care, with associated monetary, time and other costs; and indirectly by the incidence of morbidity.

Define Z to be the index value for a given child, where, for X a vector of family and child-specific values, such as age, educational attainment and wealth holding, w a scalar index of wantedness, and s a scalar count of sibsize,

$$(1)\quad Z = f(X,w,s)$$

and define A to be a vector of variables measuring family access to health care, and R to be a vector measuring risks of illness. Then the following conditions characterize the incidence of illness, curative care, and preventive care for living children:

$$(2)\quad \textit{Illness observed: } I = 1 \text{ if } Z_1^* \geq Z \mid X, w, s, R$$
$$(3)\quad \textit{Treatment observed: } T = 1 \text{ if } Z_2^* \leq Z \mid X, w, s, A, I = 1$$
$$(4)\quad \textit{Preventive care observed: } V = 1 \text{ if } Z_3^* \leq Z \mid X, w, s, A$$

where Z^* denote unobserved threshold variables. Illness occurs if the index of child value, conditioned on child and family specific covariates and risks of illness, falls below an unobserved threshold value, and curative treatment occurs if child value, conditioned on access, covariates and illness, exceeds a minimum (unobserved) threshold. Preventive care is much like curative care, though not conditioned on illness. The presumption is that all else constant, wantedness is associated with decreased odds of illness and increased odds of curative and preventive treatment, while sibsize is assumed to work in the opposite

direction. Family-level covariates associated with increased wealth , income, or socioeconomic status are expected to exert a similar effect to wantedness, and increases in accessibility and risk are presumed to increase the odds of treatment and illness, respectively.[7]

Wantedness responses, because they are given after the birth has occurred, may be subject to the sort of *post-hoc* rationalizations we have discussed previously, and we therefore model wantedness as a function of family characteristics and sibsize. Finally, sibsize is a reflection of past values of child value indices. These values are likely to be highly correlated with current values. Therefore, to complete the model, we have:

$$(5)\quad w = g(X_w, s)$$
$$(6)\quad s = h(Z_{-T})$$

where X_w is a vector of variables measuring family-specific considerations including characteristics of the child, such as sex, birth weight, and non-singleton status. Sibsize is a function of Z_{-T}, notational shorthand for the set of past values of the satisfaction index Z.

An important part of the Rosenzweig and Wolpin (1993) study is their claim that wantedness is subject to post-birth adjustment, conditional on child characteristics (including, but not limited to, child morbidity). Because DHS surveys only have information about child morbidity in the immediate pre-survey period, it is not possible to subject the morbidity aspect of the Rosenzweig and Wolpin finding to full scrutiny. It *is* possible to examine whether recent or current illness has such an impact, however. To do so, one would specify wantedness as an endogenous structural determinant of equations 2-4. Our measure of health, limited as it is to the immediate pre-survey period, is a somewhat noisy measure of child endowments. A failure to reject the hypothesis of nonendogeneity lends support to the notion that

[7] The model is one of resource allocation to living children. Clearly, prior mortality is relevant in selecting the sample of children for whom the allocation decisions are being made, and non-random prior mortality has the potential to bias empirical results based on this model. However, in our initial empirical work, we found no evidence of mortality selectivity. In related work, Pitt (1997) found only very small impacts of a failure to include the self-selectivity of fertility in models of child mortality. Therefore, we treat survival to selection in our sample as exogenously determined.

our outcome measures are not determinants of wantedness, but such a test is less powerful than one might like in testing the contention that child endowments (broadly defined) do not affect wantedness. Similarly, it is feasible to allow for endogeneity of sibsize[8], and to test statistically for such a possibility. Comparable caveats apply, as the test specifically regards the impact of illness in the immediate pre-survey period (or treatment for this illness) upon sibsize, and not the impact of some more general measure of child endowments upon sibsize.

It also seems clear that a birth (a) generates an increase in sibsize and (b) must be classified as either wanted or unwanted. Therefore, wanted births carry with them only a (relatively pure) sibsize effect, while unwanted births are accompanied by the differential impact of an unwanted birth into the family, as well as whatever effect the accompanying increase in sibsize might have upon child well-being. Sibsize, except for the occasional contamination by unwanted births, is a reflection of parents' desires. Unwanted births, on the other hand, are reflective of exogenous shocks to the family-formation process, and therefore are expected to generated more prominent impacts on subsequent resource allocations.

The within-family mechanism through which unwantedness operates could be one in which per capita resource decreases are spread more or less evenly over household members, or, as seems more likely given models of within-household allocation (Simmons *et al.* 1982, Rosenzweig and Schultz 1982), unequally according to preferences or past investments. Children who are older or otherwise relatively favored are less likely to feel the consequences of the birth of an unwanted younger sibling, therefore concentrating the observable response on younger children, particularly the unwanted birth itself. If the resource pressures accompanying an unwanted birth are spread evenly over all children and one were to examine the consequences only on the child of his or her unwantedness, the effect will be to

[8]One reason that this might be desirable is because past fertility contributes to current sibsize, and the past and current determinants of fertility, especially in survey data, may be difficult to separate.

understate the apparent effect of unwantedness, since the impact on only one child is included in the analysis. As long as the response of parents to an unwanted birth is not to concentrate resources on unwanted births, the impact of unwanted status on the most recent birth can be taken as a lower bound to the total intrahousehold allocative response to unwantedness.[9]

A case also may be made that those parents who have unwanted children are those who, for a variety of reasons, are bad planners, and therefore that the apparent impact of unwanted fertility is in fact another reflection of their lack of competence. For example, Jensen (1991) finds the impact on fertility, conditional on contraceptive usage, of unobservable characteristics of the mother such as fecundity, tastes, and motivation to avoid pregnancy to be sizable in Peru and the Dominican Republic. While it is undoubtedly true that we have failed to capture all of the sources of variation in sibsize and unwantedness in our model, we find this issue to be somewhat of a red herring. Attributing the occurrence of unwanted births to such a mechanism does not change the policy implications of the reduction of unwantedness, though it may have implications regarding the specific form such a policy may take. Reducing the cost of access would most likely induce good planners to use more family planning, for example, but would be expected to have a smaller effect on those unmotivated to limit fertility.

III. Data and country settings

The Philippines data come from the 1993 Philippines National Demographic Survey (Philippines National Statistics Office and Macro International 1994). This is a nationally representative survey in the Demographic and Health Surveys series, in which 15,029 women were interviewed. Of these women, 8,961 were married at the time of the survey. There were 8,803 births to respondents in the five years preceding the survey, and the estimated total fertility rate for women aged 15 to 44 is 4.05.

[9] It would be desirable to incorporate some sort of family-level effects in this model. However, data constraints make such effects impossible to estimate using DHS-style data sets, as there are very few multiple-birth households reporting the data we require.

The Indonesian data come from the last two Demographic and Health Surveys, administered in 1991 and 1994 (Indonesia Central Bureau of Statistics, State Ministry of Population and Ministry of Health and Macro International, 1992 and 1995). The 1991 survey uses interviews with 22,909 ever-married women, of whom 21,109 were married at the time of the survey, and reports births of 14,393 children in the five years preceding the interview date. The 1995 survey interviewed 28,168 ever-married women, of whom 26,220 were married at the time of the survey. There were 16,831 births reported in the five years preceding the survey. Estimated total fertility rates for 15-44 year-olds in 1991 and 1994 were 2.99 and 2.83.

For births in the five years preceding the sample, detailed information on immunization and health were collected. Mothers were asked if their children had experienced diarrhea, or cough or fever in the two weeks preceding the survey, as well as what treatment the children were given. Treatments can consist of commodities, advice, or some combination of both. As in many developing countries, there are active traditional sectors in both countries providing health care. We are unable to differentiate among various folk cures, in many instances. For example, "herbs" as a treatment for an illness is difficult to assess in terms of effectiveness. We have therefore focused on treatment supplied by the modern sector. The presumption is that effectiveness differentials are known to some reasonable approximation by mothers, and that modern methods cost at least as much as traditional methods and are less accessible. Therefore, use of modern-sector treatments reflects greater willingness on the part of parents to seek out effective care and commit resources.

The DHS question on wantedness comes in a section of the questionnaire extracting detailed information on recent births. The mother is asked whether she wanted the current birth at the time she became pregnant, whether she wanted the birth but would have preferred that it had come later, or whether she would have preferred that the birth had not occurred at all. In our regression analyses, we

classify a birth as "wanted" if it was wanted either at the time of conception or later. Roughly 84% of births occurring in the retrospective calendar interval are classified as wanted at the time of pregnancy or at some future date in the Philippines, and 95% and 93 % of births were classified in this way in the 1991 and 1994 Indonesia surveys. There were a minimum of 720 unwanted births (Indonesia, 1991), and a maximum of 1,485 (Philippines).

IV. Results

A. Philippines

Brief definitions, means and standard errors for variables used in subsequent analysis appear in Table 1. Many variables are familiar, but some bear further explanation. The first is our measure of permanent income or wealth. DHS surveys do not collect direct data on income or wealth. Instead, they use a collection of questions about asset ownership (vehicles and appliances), housing quality (roof and floor materials, and plumbing) and access to fresh water. We have combined the responses to many of these questions, using factor analysis, into two factors. This makes the subsequent regression results less cluttered, while allowing us to control for variations in a fairly large number of asset variables. Ownership of television or refrigerator, and housing attributes non-dirt floor and in-house electricity load on the first factor, while ownership of automobile or stove and numbers of rooms for sleeping load on the second. Taken together, these variables capture asset ownership, and as such are proxies for permanent income. There are three variables constructed as provincial-level means: the mean incidence of fever/cough and diarrhea, and the mean travel time to health facilities. These are constructed using responses for children of every eligible respondent in the province *except* the reference birth, and therefore are indicative of the community-level conditions faced by the reference birth. The sewer variable is another community-level variable in the analysis, while the variables for water and type of

toilet are household-specific. Since we are examining care given to living children, the sample is restricted to currently living children.[10]

(Table 1 about here)

Two sets of results will be discussed here. First are the impacts of areal, family and individual-level determinants, including wantedness and sibsize, on child morbidity. Second are the impacts of a similar set of determinants on curative and preventive child health care. The results are based upon model specifications which employ actual values of wantedness and sibsize rather than their instruments. We generated instruments for wantedness and sibsize using reduced-form equations[11]. We then used the residuals from these equations to construct Hausman tests for endogeneity of wantedness and sibsize in each of the morbidity and health care equations. In only one case, for sibsize in the diarrhea illness equation, were we able to reject the null hypothesis of exogeneity for either wantedness or sibsize[12]. In other words, we have virtually no evidence that illness in the last two weeks or health care provision to children affects either wantedness or sibsize. Therefore, the results we present do not employ instrumental variables for wantedness or sibsize.

An additional question of model specification is the manner in which sibsize might influence allocations to children. Kelley (1995) claims that failure to include potential nonlinearities in studies of the effect of sibsize on educational attainment of children is an error leading to overstatement of the

[10]If morbidity is a reflection of choice, then mortality might be a reflection of the same phenomenon. Therefore, in an analysis not reported here, we examined the possibility of selectivity bias induced by excluding dead children. Using a two-stage Heckman approach in models of morbidity, we were consistently and robustly far from being able to reject the null hypothesis of random mortality. In other words, had the children who died in fact survived, we would not predict the incidence of disease to be any greater among them than among the actual survivors.

[11]Reduced forms for these variables are estimated and used to generate instruments for subsequent Hausman tests. All predetermined variables from the structural equations for illness and treatment, as well as years since first marriage, whether parents expected financial support or to live with their children in retirement, birth weight categories, and whether the reference birth was one of a multiple birth, are used in estimating the reduced-form equations.

[12]However, in this case, structural coefficients of neither the raw variable nor the instrument were statistically significant at conventional levels (see Table 2) .

impact of sibsize on resources allocated per child. We find no evidence for such scale effects on the incidence of morbidity or allocation of health care. To test the proposition, we specified a variable which equaled one for large families and was equal to zero otherwise, where "large" was defined as sibsizes of five or more living children[13]. We used this "large family" dummy variable, interacted with the full set of covariates, to perform Wald tests on jointly restricting the coefficients across values of the large family dummy, and were unable to reject the null hypothesis that they did not differ. Individually, the signs and rough magnitudes of sibsize coefficients and their associated statistical significance levels were the same. Therefore, we present estimates which include the impact of sibsize (alone and untransformed) on illness and treatment[14].

Ideally, one would estimate the parameters of the illness/treatment sequence jointly. That is, if the underlying issue is one of the resource commitment of parents, the susceptibility of children to illness and their subsequent use of care, conditional on illness, are two manifestations of an unobserved resource allocation decision. Given the binary outcomes of the two measures, a bivariate probit model of sample selection is most efficient. However, the process is sufficiently noisy that the bivariate likelihood function would not converge[15]. We therefore have estimated the determinants of treatment in two ways. We have estimated a univariate probit for the odds of receiving treatment, ignoring that the child must first be sick before receiving treatment. As an alternative, we have estimated the treatment equation as a linear probability with a two-stage Heckman sample selectivity correction.[16] [17] When transformed to

[13]This value was picked because it is slightly larger than the current total fertility rate. The findings are robust to a variable defined on family sizes of two and seven children, which we chose to represent low and high extremes of fertility.

[14]It is often hypothesized that sibsize especially disadvantages girls. Work in the Philippines has shown that sons and daughters are treated differently, but that daughters are compensated for smaller land bequests with more education than their brothers receive (Quisumbing 1994), and in fact we find Filipino boys to be at a slight (but statistically insignificant) disadvantage. Our interaction of large sibsize with the child's sex shows no such effect for either morbidity or treatment.

[15] Pitt (1997) reports similar difficulties in a model of fertility and mortality.

derivatives evaluated at sample means, the simple probit gave virtually identical results to the Heckman estimates, and subsequent discussion of the estimates applies to either formulation. In either instance, we estimated a univariate probit transformation of the determinants of morbidity.

1. Child morbidity

Table 2 shows that for both diarrhea and cough and fever, there are four statistically and practically significant elements accounting for either sort of morbidity: family assets, wantedness, child age and areal disease prevalence. For diarrhea, wantedness decreases its probability of occurrence by roughly 22%.[18] The probability of contracting diarrhea initially increases with age, but begins to decrease after age 14 months. This pattern may be reflective of infants being fed increasing quantities of foods other than breast milk with the initiation of weaning. Asset availability, or roughly speaking, wealth, accounts for some variation in diarrhea incidence. A one standard-deviation increase in the first assets factor generates a decrease of roughly 10% in the probability of contracting diarrhea.

For fever or cough, the pattern is similar. If a child was wanted at birth, his or her probability of being sick with a fever or cough is about 15% less than for an unwanted child, expressed in terms of the sample mean probability of respiratory illness. As was the case with diarrhea, the probability of illness first rises, then falls with age. For fever or cough morbidity, the estimated age of maximum risk is 18 months, which seems close enough to the value for diarrhea to be consistent with the loss of mother's antibodies due to weaning. The presence of family assets in any form leads to lower probability of fever or cough appearing. A unit increase of both factors together would generate an estimated decline in the

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[16]The linear probability model is consistent, even with the Heckman λ as a covariate. It is inefficient, heteroskedastic (but in known fashion), and can yield predications outside of the unit interval. See, *e.g.*, van de Ven and van Pragg (1981).

[17]For each illness, we first estimate the structural equation for morbidity, and then use the estimated parameters in constructing the inverse Mills' ratio term for the treatment equation.

probability of fever or cough of roughly 8%. Two additional variables are statistically significant determinants of fever or cough incidence: water quality and mother's education. Children of more educated mothers are less likely to be sick than other children. The marginal impact of a mother's completion of secondary school, versus completion of primary school, is to decrease the incidence of fevers and coughs in her children by 7%. Also, the availability of good water (in the form of piped or well water) is associated with statistically significant increases in fever and cough morbidity of roughly 14%. We speculate that this may be an artifact of population density accompanying the water-supply infrastructure.

For both diarrhea and respiratory infections, the direction of the effect of areal prevalence seems intuitively clear. For neither fever nor respiratory infections do we find any impact of the child's sex. Males are slightly more likely to get diarrhea, while females are slightly more likely to get respiratory disease, but in neither case are the associated *z*-values greater than one. Akin *et al*. (1991) present similar findings for Cebu, where they show that girls are slightly less likely than boys to get either respiratory disease or diarrhea.[19]

(Table 2 about here)

2. Curative health care

The structural covariates accounting for treatment differentials contain substantial overlap with the morbidity set, including wantedness status, sibsize, measures of family resources, mother's education, and the child's age and sex. Added to the list of covariates are measures of access to health care facilities, and deleted are measures of environmental exposure to illness.

Roughly 40% of the children aged 0-4 in the sample had experienced a cough or fever in the two

[18] The mean prevalence of diarrhea is 10% (Table 1) and the partial derivative of wantedness in the diarrhea incidence equation is -.022 (Table 2), yielding a 22% reduction in diarrhea for wanted births, compared to the mean level of wantedness. This metric is used consistently in our discussions of regression results.
[19]The result comes from a simulation, so no confidence interval is presented.

weeks preceding the survey. Of these, 64% received some sort of modern-sector treatment (either a visit to a modern-sector provider, treatment with a modern cure, or both). The incidence of diarrhea in the same period was lower, at 10%, and of these children, 45% received modern-sector treatment. The simplest and best treatment for diarrhea is the administration of oral rehydration therapy (ORT). Paper packets of salts are widely available at low cost. It is surprising that modern-sector treatment is so low, given the ease with which diarrhea can be treated. In a detailed analysis of the Philippine ORT data, Costello and Lleno (1995) pointed out that treatment with an antibiotic regime seems much more common than it should be under accepted treatment protocols. We discuss possible consequences of this finding below.

(Table 3 about here)

The determinants of use of curative care are somewhat similar for both types of illness. Sibsize is statistically significant and of the expected sign. On the margin, each additional sibling decreases treatment probability by about 5% for diarrhea and 3.5% for fever. Comparing an only child to one in a family at the current total fertility rate, the impact of sibsize is to decrease treatment probability by about 15% for diarrhea and 11% for fever.[20] If, as we have argued, sibsize reflects the impact of resource constraints, it is unexpected that diarrhea treatment, which ideally is cheap and easy, is impacted more by sibsize than is respiratory illness treatment.[21] One possible explanation, as just discussed, is that actual treatments differ from suggested standard (ORT) protocol. Parents therefore wrongly perceive modern-sector diarrhea treatment to be expensive, with corresponding effects on utilization. A second possibility is that respiratory disease is more contagious than diarrhea. Therefore, the benefits which accrue to preventing illness in other family members by treating a sick child are larger for respiratory disease. As

[20]Mean sibsize is 2.2. The estimated total fertility rate is substantially larger, at 4.1. A prediction this far from the sample mean should be viewed as a rough illustration.

sibsize increases, so does this external benefit, which partially offsets the resource-diluting impact of sibsize.

The impact of wantedness on treatment is statistically insignificant at typical confidence levels. For fever/cough, wantedness implies a *decrease* (though also statistically insignificant at .05) in treatment probability of roughly 10%.[22]

Males do not enjoy a treatment advantage for either disease, while the probability of treatment for diarrhea first increases, then decreases with child's age, with a peak at age three. Older mothers are more likely to seek treatment for their children for either disease, although the effect is statistically significant only at .06 for diarrhea and at greater than .10 for fever or cough. Education of parents, especially the father, increases the probability of fever or cough treatment, and the first factor score for asset ownership has a marked positive effect on either sort of treatment. A one standard-deviation increase in this proxy for wealth accounts for a rough 15% increase in treatment probability for either sort of illness. Mothers who made prenatal visits themselves are more likely to take their own children in for treatment of fever or cough. However, a seemingly more direct measure of access, barangay mean travel time to a family planning facility,[23] is unimportant in accounting for treatment for either illness. It seems likely that travel time is a relatively pure measure of accessibility, while mother's own use of

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[21] The difference between the coefficients of sibsize in the diarrhea and fever equations is roughly the size of the standard error of the diarrhea coefficient, and so statistically negligible. However, ORT is *so* cheap and easy that even an effect of equal magnitude is unexpected.

[22]Failure of the bivariate probit likelihood to converge, and the combination of an extremely small Mills' ratio term together with a "wrong signed" (but insignificant) coefficient for wantedness in the Heckman regression for fever/cough are probably symptoms of a single underlying problem. It is very difficult to determine who will receive treatment, and therefore very difficult to estimate the parameters describing this choice. An important unobservable variable is severity of illness. If wanted children have less severe respiratory illnesses, or if the model does a poor job of controlling for the impact of wantedness through the morbidity equation, odd findings such as the negative coefficient for wantedness are possible.

[23]Travel time to health care provision points *per se* is not available in the DHS data. Travel time to family planning provision points is known, and roughly 85% of family planning provision points were hospitals, clinics, barangay health stations or other joint health and family planning facilities. Still, this variable is an imperfect proxy for travel time to health care facility.

prenatal care reveals an element of her preferences for health care, and as such serves partially as a control for heterogeneity in health-care preferences of mothers. The consistent findings for treatment of both respiratory and diarrheal disease are (1) that children from families with more resources ("Assets 1") are more likely to be treated, and (2) that competitors for these resources (siblings) decrease the probability of receiving treatment.

3. Preventive care

As the results presented in Table 4 show, there are several systematic influences on the number of vaccinations received. Table 4 presents ordinary least-squares, Tobit and Poisson regression estimates. The results are completely robust across these specifications, and so no distinction by estimation method will be made in discussing the results. By the nature of the vaccination protocol, child age plays a dominant role. Of more policy interest are other covariates. As was the case for curative care, wantedness is not important in accounting for numbers of vaccinations received. Sibsize works in the expected direction, but is statistically significant at 5 % only against a one-tailed alternative hypothesis and sufficiently small that a child with a sibsize of 10 would receive about only one-third of a vaccination fewer (a 5% reduction from the mean number of 6.1) than an only child.

(Table 4 here)

Education plays a statistically important role. The marginal impact of completion of secondary school by both mother and father, compared to their completion only of primary school, is to increase the predicted number of vaccinations received by the child by about two-thirds of a vaccination. Measures of health-care preferences and access play a role in accounting for vaccination, with women who used clinics for prenatal care likely to get .5 more vaccinations for their children. Travel time plays a statistically significant role, but a doubling of mean travel time (to 79 minutes) would account for only a tiny fraction of a vaccination.

B. Indonesia, 1991

As we did in our discussion of the results from the Philippines, we will first discuss the impacts of areal, family, and individual-level determinants, including wantedness and sibsize, on child morbidity. We then examine the impact of a similar set of determinants on curative and preventive care. In our discussion of the Philippines results, several modeling issues were examined. These points need not be revisited in detail in the Indonesian context; however, we address issues of model specification which rely on specific statistical tests. The questions in the two surveys are very similar, but there are a few differences between the Philippines and Indonesia surveys. Measures of access to modern plumbing are slightly different, for example, with access to a private flush toilet required in Indonesia, but access to any flush toilet required in the Philippines. There are similarly minor differences in the definitions of modern treatments for fever or cough, and in the specific assets tabulated (Indonesians are asked about radios, while Filipinos are asked about refrigerators), but the majority of survey questions of interest are identical in the two surveys.

As in the Philippines, we employ a linear specification for sibsize in the equations for morbidity and treatment. We employ the same two-stage Heckman model for selection into treatment, conditional on illness. We test for the potential endogeneity of wantedness and sibsize on both morbidity and treatment equations, again based on residuals from reduced-form equations on wantedness and sibsize. Table 5 presents descriptive statistics.

(Table 5 here)

1. Child morbidity

Table 6 shows that wantedness at birth plays the same role in reducing morbidity in Indonesia as in the Philippines. The impact of wantedness is to decrease the chance of contracting diarrhea by 50%

compared to the overall prevalence level of diarrhea, a very large and statistically significant effect, and one which is somewhat greater than the comparable impact in the Philippines. Diarrhea incidence peaks at age 1 year, somewhat younger than in the Philippines. In contrast to the Philippines, asset availability, as measured by the constructed factors, shows no impact on diarrhea incidence. On the other hand, mother's education, access to flush toilets and the mean areal prevalence all are statistically significant in Indonesia, and all operate in expected fashion, with children of more educated mothers, with access to flush toilets, and living in areas where diarrhea prevalence is lower all experiencing less diarrheal disease, all else constant. Unexpectedly, increasing numbers of siblings are associated with a small, but statistically significant *decrease* in the probabiliity that a child will contract diarrhea. The estimated decline in diarrheal morbidity odds is approximately 4% per sibling.

(Table 6 here)

The pattern for respiratory infections is much the same. According to the single-stage estimates, wanted births are 24% less likely to contract respiratory infections than are unwanted births. Asset ownership is statistically significant but of little importance, with a one-standard deviation increase in wealth yielding an increase of 5% in ARI morbidity. As was the case with diarrheal disease, the odds of illness peak at a very young age, and respiratory illness is more likely in areas where its prevalence is high. Access to a private flush toilet decreases the odds of contracting a respiratory illness. It is doubtful that this represents as direct a link in disease reduction as in the case of diarrheal disease, so perhaps this variable is acting some sort of proxy for housing quality. Boys are more (barely) statistically more likely to contract respiratory illnesses, although only by 5%. As was the case for diarrhea, children with many living siblings are *less* likely to contract respiratory disease than are those from smaller families. Once again, the magnitude is small, with each additional sibling accounting for a drop of 3% in the probability of illness. The apparent beneficial impact of siblings is swamped, if that child is unwanted.

The impact of sibsize on disease incidence, while very small, is statistically significant, and of the opposite sign predicted by a model of household resource allocation. This stands in contrast to the results for the Philippines, which showed no significant impact of sibsize on disease incidence. One possible explanation draws on the well-known claim of John Bongaarts (1987) that family planning programs, when successful, increase mean infant and child mortality rates. This occurs because as fertility falls, the proportion of births which are first births increases, and for physiological reasons, first births are at higher risk of mortality. In fact, the Indonesian sample contains markedly more first births than does the Philippines sample. The median sibsize in the 1993 Philippines sample was 2, and the mean sibsize was 2.25. In the 1991 Indonesia sample, median sibsize was 1, and mean sibsize was 1.58. Of the Indonesian children in the 1991 sample, 33% were first births, and 59% had either no siblings or one sibling. In contrast, just under 25% of children in the Philippines sample were first births, and only 46% had either no siblings or one sibling. If Bongaarts' notion of first birth frailty carries force, then the data are consistent with a morbidity pattern dominated by the differentials between first and subsequent births in Indonesia, but where (in either country) sibsize is not an especially useful measure of the impact of family resource allocation upon subsequent morbidity.[24] [25]

The negative impact of unwantedness on child health is robust to an instrumental variable specification of unwantedness and sibsize, although the estimated magnitude of the impact of unwantedness is much greater for the instrumental variables estimates. ARI incidence falls by 95%, compared to mean prevalence, for wanted births, and a prediction of no diarrheal disease at all for wanted births is within the 95% confidence interval.

[24] To test this contention, we re-estimated the model using only those cases where sibsize was greater than 2. The coefficient of sibsize becomes statistically insignificant, with an asymptotic *t*-ratio less than one in absolute value. The coefficient and statistical significance of wantedness was unchanged.

[25] A second possibility is that ownership of assets is a bad measure of family income, and that number of children is a normal good. In this case, (unobserved) high incomes are associated with larger numbers of children, and the

2. Curative health care

Of ill children, 76% of those with diarrhea and 81% of those with ARI received modern sector treatment. Both are significantly higher than the corresponding figures of 45% for diarrhea and 64% for ARI in the Philippines. There is some evidence in Indonesia of the preference for (typically incorrect) antibiotic-based treatment regimens for diarrhea which Costello and Lleno found in the Philippines, with only about 20% of children ill with diarrhea receiving oral rehydration salts. It therefore seems unlikely that the higher treatment rates in Indonesia are attributable to adherence to ORS protocol. Another explanation of the higher treatment levels in Indonesia is that there is a difference, compared to the Philippines, in access to health care facilities. One measure of accessibility is average travel time to a treatment facility. By this measure, treatment was only slightly less accessible in the Philippines, where mean travel time was 40 minutes, than in Indonesia, where travel time averaged 32 minutes. On the other hand, the standard deviation of travel time was over an hour in the Philippines, compared to only 7 minutes for Indonesia, which may say that access differentials within the Philippines are relatively pronounced.

For a child with ARI, Table 7 shows that family wealth, education of the husband and of the wife, and the mother's use of prenatal care all increased the probability that he or she will be treated. The probability of ARI treatment peaked at about age 4.5 years. Neither wantedness nor sibsize played a role in accounting for ARI treatment in the instrumental variables Heckman specification[26], with the largest premium for residence on Java or Bali, but the only statistically significant residence variable was

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children of higher income families are better-nourished, generating a spurious positive relationship between sibsize and the odds of illness. More widespread fertility control, as in Indonesia, would accentuate this problem.

[26] These results are based on the instrumental variables specification, which in turn is the result of rejecting a Hausman test of exogeneity of wantedness and sibsize to ARI treatment. While a case may be made for the causal impact of disease *incidence* on wantedness, it seems unlikely that there is true simultaneity in the wantedness-*treatment* relationship. The Hausman test is based on a symptom of misspecified endogeneity which is shared by other specification errors, and the instrumental-variables cure works on a wide range of such problems (including errors in variables, a likely candidate for wantedness). The results we describe are robust to a non-instrumental

urban domicile. By far the largest impact among the group of statistically significant covariates is that of mother's use of prenatal care, which increased ARI treatment probability by 13%. Both asset ownership factors had positive, statistically significant coefficients, with a simultaneous one standard-deviation change accounting for an increase of 8% in treatment probability. None of the other covariates could account for a deviation of more than 1% from mean treatment probability.

For children with diarrhea, the list of determinants of treatment is somewhat different. Increases in one of the family assets factors still was associated with increases in treatment probability, and probability of treatment peaked at age 4 years. However, wanted births were 17% more likely to receive treatment than were unwanted births, and increases in travel times were associated with decreases in treatment probability, with an addition to travel time of 30 minutes (half a standard deviation) estimated to decrease treatment probabilities by 20%. Wantedness was statistically significant, accounting for an increase of 16% in treatment probability.

(Table 7 here)

Wantedness and access played a much more important role for diarrhea treatment than for ARI treatment. This is somewhat of a puzzle, since diarrhea treatment is, at least in theory, somewhat cheaper and easier. Possibly, parents take ARI more seriously than diarrhea (so that costs play a less important role in assessing treatment choices), but the clear differentials in mean treatment levels for these conditions which might support such a contention in the Philippines are not in evidence in Indonesia. On the other hand, whatever is driving these results appears to be acting in similar fashion in both countries. In the Philippines, wantedness was statistically significant at .065 [27] with a coefficient of comparable magnitude to that estimated for Indonesia, but, as in Indonesia, was unimportant in explaining variation in ARI treatment.

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variables specification, except that Java-Bali residence is associated with a statistically significant increase in treatment odds of 5%.

[27] Versus a two-tailed alternative hypothesis.

The bottom line is that, at least for treatment of diarrheal disease, a set of results consistent with the predictions of a within-family model of resource allocation again emerge. In the Philippines, sibsize, family assets, and mother's use of prenatal care played prominent roles in accounting for differentials in use of curative care for diarrhea or ARI. In Indonesia, family assets also play a role. In the case of diarrheal disease, unwantedness and the time cost of care, and for ARI, mother's use of prenatal care, account for substantial differences in use of curative care. The evidence shows that unwanted births are less likely to receive treatment for diarrhea in Indonesia. There is no support for the notion that sibsize matters in accounting for variations in curative care.

3. Preventive care

In the DHS surveys for both the Philippines and Indonesia, mothers were asked about vaccinations in the following sequential fashion. First, they were asked to show vaccination cards. Each child's vaccinations are recorded on the cards, and, if the mother is able to show the card, the information is simply transcribed from it. If she cannot show the card, she is asked which vaccinations her child has received. In the Philippines, most mothers have the cards for their children, and much of the vaccination information comes from the vaccination cards. In Indonesia, on the other hand, most mothers do not have the cards, and those who do are far more likely to have them for young children than for four- or five-year olds.. When vaccinations are calculated as the reported number from the card, if the mother has it, or as the recalled number on probing, if she does not, numbers of vaccinations (which could be as large as eight in Indonesia) peak at age 12 months, at just under four vaccinations, and then decline. However, numbers of vaccinations are consistently around seven for children with cards, and below two for children without cards. Therefore, the apparently declining numbers of vaccinations as children age represent an increasing number of lost cards. Our results for Indonesia rely only upon those children who had vaccination cards, which constitute about 21% of all children with some vaccination information.

Even these responses probably should be viewed with some suspicion, as they show very high mean numbers of vaccinations at young ages, even though some vaccinations are not normally given until later in life. Figure 3 illustrates the age pattern of vaccination data in the 1991 Indonesia DHS.

(Figure 3 here)

As was the case in the Philippines, Table 8 shows that the impacts of most covariates on numbers of vaccinations are small. In the Poisson specification, no covariates are significant. This is sensible, given that the count of vaccinations rarely varies from the mean of seven. For the Tobit and OLS regressions, only child age, mother's use of prenatal care, and sibsize have statistically significant effects on the number of vaccinations. However, all these effects are small. The impact of child age is initially positive, but aging eventually decreases the number of vaccinations. Since vaccinations cumulate, and there has been no programmatic change that could account for higher vaccination rates at younger ages, this seems to be a questionable result. The impacts of both prior usage of antenatal care and sibsize are statistically significant, but small, together accounting for at most one-tenth of a vaccination, at a sibsize of three. The bottom line, unfortunately, is that we can say very little about systematic impacts of covariates on preventive health care.

(Table 8 here)

C. Indonesia, 1994

Although the sample is somewhat larger, the structure of the 1994 Indonesia DHS was, for our purposes, virtually identical to the 1991 Indonesia DHS. Therefore, our discussion of the results largely will mirror the preceding remarks. In the 1994 data, we reject the contentions that sibsize and wantedness are exogenous to incidence of respiratory illness. This may indicate that the presence of respiratory illness at the time of the survey influences wantedness and sibsize[28].

[28] Our previous caveats to use of the Hausman test apply, so that more correctly, we reject the contention that sibsize and wantedness do not display the statistical symptoms of mistakenly specified exogeneity. Other possible problems include measurement error in wantedness or sibsize and omitted explanatory variables.

Table 9 gives descriptive statistics for this sample. One clear difference which emerges in these data is the declining proportions of ill children who received treatment, compared to 1991. The proportion of ill children receiving treatment fell by roughly half for both diseases by 1994. This period coincides with a move toward fee-for-service for primary health care in Indonesia, and the decline in treatment odds we observe may be tied to increasing treatment prices in Indonesia. Table 10 presents summaries of the odds of illness and treatment from our three DHS samples.

(Tables 9 and 10 here)

1. Disease incidence

Table 11 shows that diarrheal disease incidence was unaffected by wantedness or sibsize in the 1994 Indonesian data, even though wantedness played a significant role in the 1991 data. In fact, the only meaningful determinants of diarrheal disease incidence were child age, mother's education, the availability of toilets in the home, mean areal prevalence of diarrhea, and the sex of the child. The probability of contracting diarrhea declines throughout the age range. Mother's education also is statistically significant, with each year of education accounting for a decline in roughly 3% in the probability that her child contracts diarrhea. Modern toilets are associated with a 25% reduction in the probability of contracting diarrhea. Male children are 13% more likely to get diarrhea.

One conjecture which would account for the fact that unwantedness is less a factor in 1994 than in 1991 in accounting for diarrheal disease incidence is that the rapid pace of change, both economic and demographic, in Indonesia, has led to greater family resources, on average, and fewer competitors for these resources. Per capita income growth averaged near double-digit levels for much of the period preceding the 1994 survey, and fertility was at low levels (the estimated total fertility rate was 2.83 in 1994), which together would decrease competition for resources within families, on average, when compared to the 1991 data. While incomes are reasonably evenly distributed in Indonesia, the pace of

change is most rapid on the core islands of Java and Bali. Therefore, a cross-section of Indonesia which excludes observations from Java and Bali might give an approximation of the core islands' situation in the recent past. In regressions not presented here, which excluded observations from Java and Bali, we found that the impact of unwantedness is now large, of the expected sign, and statistically significant, at least in the instrumental-variables specification.

(Table 11 here)

On the other hand, the evidence for respiratory infection provides another unambiguous example of the impact of resource allocation within families. The mean prevalence of infection in the sample is 35%. Table 11 shows that, for either instrumental variables or single-stage probit estimates, an individual child's probability of contracting ARI deviated from this mean according to his or her wantedness status, age, number of siblings and access to toilet facilities, and with the areal prevalence of ARI. In addition, the instrumental variables result shows that boys were very slightly more likely to contract ARI. Wanted births were 18% less likely to contract ARI, and those with toilet facilities in their homes 6% less likely. Each additional sibling *reduced* predicted ARI incidence by 2.5%, which, like the results from the prior survey, runs counter to our expectations, but which, also like the results from the prior survey, is a fairly small effect.[29].

2. Curative care

Of children with ARI, 45% received some form of modern-sector treatment in the 1994 Indonesia DHS sample. Statistically significant causes of increases from this mean, according to Table 12, were the first family-assets factor, mother's age, husband's (but not wife's) educational attainment, child's age and sex, mother's use of prenatal care, accessibility of clinics, residence, and sibsize. As is typical for Indonesia, ARI treatment probability declined from the age of one year onward. Males, who earlier were

[29] Economic growth and the trend toward small families continued in Indonesia in the years between 1991 and 1994. Both the Bongaarts first-birth frailty and the incomplete income-measurement arguments are therefore likely to be more important in 1994 than 1991 in accounting for the seemingly beneficial impact of sibsize on morbidity

shown to be more likely to contract ARI, were also more likely, controlling for illness, to receive treatment. They enjoyed a treatment differential of 8%. Mothers who themselves used prenatal care were 25% more likely to take their children in for ARI treatment. Those who said that clinic access was "easy" were 14% more likely to take their children in for treatment, with an additional contribution made by short travel times[30]. Finally, each additional sibling decreased ARI treatment probability by 5%. As in Indonesia in 1991, the impact of unwantedness on ARI treatment was statistically insignificant. In contrast to the earlier data, the impact of sibsize was statistically significant in 1994. To put the magnitude of the effect in perspective, our estimates show that three siblings roughly cancel out the impact of "easy" clinic access. This finding has significant policy implications, as it implies that clinic usage may be demand-constrained for families with relatively large numbers of children.

(Table 12 here)

As was the case in 1991, there were only a few significant determinants of diarrhea treatment differentials in Indonesia in 1994. These were mother's education, child's age and sex, and mother's use of prenatal care. A five-year advantage in education was associated with a 12% increase in the probability that the woman's child received modern-sector treatment for diarrhea. The decline in treatment probability began at about age 4 years, and males were roughly 14% more likely to be treated for diarrhea. Notable differences in 1994 compared to 1991 were two: unwantedness replies did not influence usage of curative care for diarrhea, and being male did. Male children also were more likely to receive ARI treatment in 1994, but enjoyed no apparent treatment advantage in 1991.

3. Preventive care

The vaccination data share the data collection method, and many of the problems, of the 1991 Indonesian data. In the 1994 sample, only 25% of women actually were able to show the interviewer

[30] The correlations between these measures were surprisingly low, with values less than 0.10 between mother's use of prenatal care and the access measures.

vaccination cards for their children. Subsequent probing apparently was more extensive, however, as the striking differences in numbers of vaccinations for children with and without cards are not apparent in the 1994 data. There was also substantial variation in the numbers of variations recorded on the cards themselves. This said, the numbers of vaccinations still are somewhat lower for children of women without cards.[31] The results are largely robust to usage of either the sample of children with cards, or the entire sample. To conform with our analysis of the 1991 Indonesia data, we use the card-carrying subset in our subsequent analysis.

(Table 13 here)

We find that vaccination probability varied in predictable ways. Most interesting for matters at hand, wanted children received about one-fourth of a vaccination more than unwanted children (although Table 13 shows that this result is not robust to a Poisson specification), and each additional sibling decreases the number of vaccinations by one-tenth. These are fairly small values, but still significant. Because of the discrete nature of vaccinations, they are best interpreted in the following way: one in four unwanted children got one fewer vaccination than average; and, choosing 4 siblings as an arbitrary family size, 40% of children in these large families got one fewer vaccination, on average, than only children. Other statistically important determinants of the number of vaccinations received, as seen in Table 13, were family assets, mother's educational attainment and prior utilization of prenatal care, child age, and residence. By far the dominant variable is child's age, with an estimated peak at age 3 years.[32]

D. South Korea, 1994

As we have stated earlier, we see the family resource-allocation decision as one which has

[31] This of course is the expected result if vaccination cards and numbers of vaccinations are two aspects of the same underlying decision to expend resources on child health. Our point is that it is hard to determine what is spurious and what is real in this relationship.

consequences for child nutrition only at relatively low levels of income. Korea in 1994 hardly qualifies as a poor country. Levels of disease are very low. However, there is some variation in incomes and the wantedness of births, and vaccination still requires a commitment of the caregiver's time. Also, there is evidence that family composition preferences are very strongly held. Korea displays one of the most pronounced son preferences in the world. In our data, 57% of births were male, yielding a sex ratio of births of 1.32. Even with such a high sex ratio at birth, if abortion is not costless, an excess fraction of females will be born, with observable vaccination differentials by sex a possible consequence.

The data we employ come from the 1994 National Survey of Fertility and Family Health (Korea Institute of Health and Social Affairs 1994). This survey was a retrospective fertility history, in which mothers also were asked brief questions about employment, child care arrangements, and child health. The list of dieseases are mostly those which are not prevalent in a society at Korea's level of development, such as tuberculosis, hepatitis and tetanus, or those with Korea's high prevalence of vaccination, such as diphtheria, whooping cough, or measles. The Korean sample is a much smaller sample than those collected in the DHS surveys we employed for the Philippines and Indonesia, and we have only 637 complete cases for our regression analyses. Put simply, we lacked the data to replicate our morbidity analysis in Korea.

On the other hand, there was some variation in several variables of interest. For example, only 91% of children who were old enough to have received the scheduled numbers of vaccinations had received them; the sex ratio at birth was very high; 11% of births were reported (retrospectively) to be unwanted at the time of conception; and 6% of births were the result of contraceptive failures. Apparently, even in Korea, vaccinations still are not costless, and Korean parents seem to have clear preferences on family size and composition which are not always being satisfied. The mechanisms for

[32] This peak mostly likely represents a combination of data problems and the effect of fitting a quadratic term to a relationship which approaches an upper limit asymptotically, rather than the notion that vaccinations actually decline after age 3.

the sort of allocative choices we observed in the Philippines and Indonesia are in place, in other words. We now turn our attention to the empirical question of whether resource constraints are severe enough, relative to the costs of vaccination, to generate observable differentials in vaccinations received by children.

(Table 14 here)

Table 14 reports descriptive statistics for the Korean sample, and Table 15 reports the results of ordinary least-squares and instrumental variable regressions of the number of vaccinations on a set of covariates. The results in the latter table generally are robust to either specification[33]. Mother's education was statistically significant in the OLS specification, but the coefficient was minuscule. Mother's age and the age difference between spouses were significant in both specifications, but again have only small impacts on numbers of vaccinations received. Mother's work outside the home decreased the number of vaccinations received, but only by .14 vaccinations, on average. Children ever born diminished the number of vaccinations by .16 vaccinations per child, according to the OLS specification, and by slightly over one vaccination per child in the instrumental variables specification (although the latter result is significant against a two-tailed alternative at only the 6% level). As Table 16 shows, though, almost all of the variation in number of vaccinations occurs at very large family sizes, for which there are few observations. When the regressions of Table 15 are repeated, omitting the four outliers in families with five or six children ever born, the coefficients for children ever born remain roughly constant (though the instrumental variables coefficient falls in absolute value, to -.75), but the significance levels rose to levels well above conventional cutoffs. Wantedness, sex of child, and birth order did not matter in either specification.

[33] In the instrumental variables specification, the excluded variables identifying the structural equation for vaccinations are mother's own use of health care and variables measuring attitudes toward abortion. Only children 18 months or older are included in the sample, because this is the age at which all vaccinations should have been completed.

(Tables 15 and 16 here)

Concluding our discussion of the Korean results, we found that the impact of family resource constraints on the decision to commit resources to children, measured in terms of a commitment with negligible monetary costs but unknown time costs, may be important. We lack even the crude measures of income that we had in the DHS data for the Philippines and Indonesia, so we were unable to examine the impacts of income or wealth directly. However, to the extent that family resource constraints are tested, all else constant, by increasing numbers of children, we found some support for the claim that parents respond to such tests in part by decreasing the resources available per child. Measures of the wantedness of individual children, such as answers to questions on wantedness, or child's sex or birth order, did not matter in explaining the numbers of vaccinations received.

V. Discussion

Our aim in this paper has been to demonstrate the impact of within-family resource pressures on allocations to children. We use one measure of such pressures, namely sibsize, which is potentially endogenous to the overall decisionmaking process of the family. Our second measure, unwantedness at conception, is more a reflection of exogenous shocks outside of the decisionmaking calculus of the parents. We focus on the impacts upon measures of child health because human capital improvements appear to account for a large share of the output increases which have occurred in the many societies. Such human capital increases come from a willingness to commit resources to children.

In Korea, the richest country we examine, we find very little evidence for the contention that family resources are taxed in any meaningful way by providing health care and basic nutrition to increasing numbers of children. This is a society in which, in addition to incomes being high, fertility control is very good, abortion is widely utilized, and health care is easily available. It is therefore consistent with the model of household resource allocation that we employ that we find little impact of

sibsize, and none of wantedness, on health allocations to children.

(Figures 4 -7 here)

In contrast, our other data come from much poorer settings, with a much less well-developed health and family planning infrastructure. In the Philippines, modern contraceptive prevalence is very low (25% in the survey data), and the healthcare infrastructure is not well-developed. While contraceptive prevalence is higher in Indonesia, incomes are lower there than in the Philippines, and reported travel time to health care facilities is roughly equal in both countries. Compared to the remaining five of the Asian miracle economies, incomes are low in both Indonesia and the Philippines, and low incomes imply harsher tradeoffs between numbers and quality of children, in that quality reductions translate into reductions in calories, protein, or other measures of nutrition. These are expected to generate observable implications for child morbidity, and indeed we find that unwantedness leads to increases in morbidity in most of the cases we examine. The morbidity implications are quite large, from a policy context. We find that sibsize plays a role, somewhat less clearly defined, in subsequent use of curative care, with children from larger families less likely to receive care. We summarize these findings in Figures 4 through 7.

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