INCOME POOLING AND DEMAND AGGREGATION IN LOW-INCOME HOUSEHOLDS IN NAVI MUMBAI, INDIA: EVIDENCE FROM WILLINGNESS TO PAY, RISKY CHOICES AND ANTHROPOMETRICS.

by

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ABSTRACT

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Income pooling and demand aggregation in low-income households in Navi Mumbai, India: Evidence from willingness to pay, risky choices and anthropometrics. (Under the direction of Dale Whittington)

Maternal employment brings with it additional income that may result in benefits to the household such as better nutrition and health for family members, and more autonomy for the mother. However, it could also mean less time that a mother has for housework, childcare and leisure. The benefits and costs of maternal employment depend upon how the mother and other household members utilize their time, money and other resources. Thus, a study of the economic benefits of maternal employment should take issues of intrahousehold resource allocation into account.

Traditional analyses based on the common preference model neglect the differences in household member preferences and do not account for issues of intrahousehold resource allocation. Emerging empirical evidence and theoretical advances recognize the differences in household member preferences and recommend that we study the bargaining that takes place among households members. While the literature largely has relied on revealed preference data, an integrated approach that combines revealed and stated preference information can help us understand the complexity of intrahousehold resource allocation to the fullest.

In this dissertation, I examine issues of intrahousehold resource allocation in the slums of Navi Mumbai, India, through a novel multidimensional approach. The dissertation consists of three modules, each of which examines issues of intrahousehold resource allocation in its own way. In the first module, I examine the differences in husband and wife preferences and evaluate the utility of a short private discussion between husbands and wives in aggregating preferences. In this study, husbands and wives were interviewed separately first and jointly thereafter in a stated preference framework to obtain their household willingness to pay for a malaria vaccine. This protocol is the first of its kind in a developing or an industrialized nation.

The second component examines the differences in anthropometric measurements (z-score for height-for-age and stunting) of children of different genders. These differences may be the result of differences in the investment in children's health over a period of time. The third component examines intrahousehold resource allocation through differences in income pooling behavior when individuals are faced with a risky choice. Both husbands and wives were offered a lottery choice with real monetary payoffs, designed so that the preferred choice by an income pooler was different from that of a non-income pooler. This is the first study of its type in a developing nation. This research also represents the first time that stated preference data, revealed preference data and choice experiment data were analyzed simultaneously.

Husbands' and wives' stated demand for vaccines differed significantly at lower prices, where respondents had the freedom of budget space. The short private discussion enabled a majority of husbands and wives to reduce differences in their stated demand, with many couples choosing to purchase a vaccine either for all members of the

household or for no one. Respondents tended to be especially accommodative of their spouse's wishes at lower prices. Wives who had some source of income were less likely to change their opinion in a joint interview indicating that they probably had higher autonomy in decision-making. However, analyses of z-score for height of children revealed that daughters of these women were shorter than those of women who did not work. Furthermore, the eldest daughter was likely to be shorter than her other female siblings, but the eldest son was not shorter than his male siblings. Overall, the analysis demonstrates how intrahousehold allocation asserts itself in multiple ways—maternal employment improved the autonomy of women but did not counterbalance the detrimental effects of the mother's absence from her home on the well being of her daughters, particularly the eldest daughter, who was likely helping her mother with housework and childcare responsibilities from a young age. In the choice experiment (lottery data), I found that a specific rule of intrahousehold resource allocation did not apply universally to all households.

Overall, the research rejects the common preference model of intrahousehold resource allocation in slums of India. The stated demand as estimated by a traditional survey that interviewed both husbands and wives randomly from a household is likely to underestimate demand at lower prices and hence the associated welfare benefits.

Dedicated to my parents,

Sunita and Shrikant.

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LIST OF ABBREVIATIONS

API	:	Annual Parasite Index (Number of confirmed positive cases of malaria per 1,000 of population).
CDC	:	Centers for Disease Control and Prevention.
CDF	:	Cumulative Density Function.
IPE	:	Income Pooling Equivalent lotteries.
ITN	:	Insecticide Treated Net.
NMMC	:	Navi Mumbai Municipal Corporation.
UHP	:	Urban Health Post.
WTP	:	Willingness to Pay.

CHAPTER 1

INTRODUCTION

Man and Woman are equal in status…I should treat daughters and sons

on a footing of perfect equality.

…Mahatma Gandhi (excerpt from Women and Social Injustice)

1. Motivation

Indian women have come a long way from the days of 'purdah'[1]. Women like Kalpana Chawla, the astronaut who sacrificed her life in the 2003 Columbia shuttle; Indra Nooyi, the CEO and President of PepsiCo; and Sania Mirza, the first Indian woman to win an ATP Tennis tournament, embody the rising spirits of independent Indian women. Despite these achievements, India remains a patriarchic society. The 2003-04 Economic Survey of India reports that Indian women suffer from lower literacy rates, lesser labor participation and lower earnings when compared to their male counterparts.

Despite these constraints, the participation of women in the workforce has increased steadily from about 32% in 1992-93 (IIPS, 1995) to 39% in 1998-99 (IIPS and ORC-Macro, 2000). More and more women have to do a balancing act between employment and household work. Additional income in the hands of the mother can improve the decision-making power of women within the household and can increase

[1] Purdah is the custom of preventing men from seeing women. This custom was practiced widely in India in olden times. These are still some instances of women practicing the purdah.

the quality of nutrition and health of the family. At the same time, it can reduce the time available for other activities such as housework, childcare and leisure. Understanding intrahousehold resource allocation—how households manage their money, food and time resources—is crucial to assess whether households benefit from maternal employment.

The most widely used model of intrahousehold resource allocation is the common preference model. This model examines the preferences of a single individual within the household and extrapolates it to other members of the household. This is possible because of extremely restrictive assumptions that either all household members have homothetic preferences or that the person whose preferences are examined is a dictator responsible for all decisions made by the household, much akin to the husband in a stereotypical patriarchic society. However, there seems to be an emerging consensus that the common preference model is passé and that intrahousehold behavior is more complex with some "bargaining" taking place among household members. Tests on intrahousehold resource allocation have emerged and since the '90s "resource pooling has emerged as the crucial empirical issue" (Pollak, 2003).

Economic analyses that involve these complex models of bargaining require additional resources, including better quality secondary data. Rosenzweig and Schultz (1982) contend that to replace the common preference framework with a "less parsimonious model of intra-family resource allocation, the increase in complexity should be explicitly demonstrated to have empirically distinguishable predictions". In

other words, is it really worth it to examine complex issues of intrahousehold resource allocation, especially in a patriarchic setup such as India?

There are several reasons why intrahousehold resource allocation should be studied. While power asymmetries do exist in Indian households, there is emerging evidence that more and more women are playing an increasing role in household decision-making and that their preferences cannot be taken for granted. Despite this, most studies that measure household demand rely on aggregated data or interview only a single person within the household. Secondly, preferences of women who are more vulnerable are likely to be neglected in a common preference approach as their opinions count the least. Yet such women bear a disproportionately large burden of social costs in the case of diseases such as HIV/AIDS. Assessing the bargaining power of women within the household can help us identify changes in factors that could improve the status of such vulnerable women within the household. The primary motivation to for research is to conduct a parsimonious analysis that incorporates issues of intra-family resource allocation.

Observing intrahousehold resource allocation could be difficult as every action taken by a household member (such as a stay-at-home mother joining the workforce) could have multiple impacts. Measuring all of these using a single technique may not be possible. Measurement of intrahousehold resource allocation is still restricted to the domain of revealed preference methods. Although these methods can help us measure certain aspects of intrahousehold resource allocation such as income pooling, they are not enough to measure differences in preferences of household members and the preference aggregation method adopted by these

members to arrive at decisions. Stated preference studies and choice experiments offer promise in this regard. The secondary motivation for this research is to measure simultaneously different possible impacts of intrahousehold resource allocation through different techniques and to compare multiple models and measures of intrahousehold resource allocation.

2. Brief description of the study

The study was conducted on 422 married couples with at least one child between the ages of 1 and 18 and who live in slums in Navi Mumbai, India. In this study, I examine intrahousehold resource allocation in three different ways:

The first component is a stated preference survey that measures the demand to reduce the risk of getting malaria by assessing their willingness to pay (WTP) for a (hypothetical) preventive vaccine. The main objectives of this component are to examine the differences between household member preferences, how members aggregate their preferences, and the role of income pooling within the household. Essentially, it examines if women have bargaining power within the household and the factors that affect their bargaining power. To achieve these objectives, the husband and wife were invited to a central office and interviewed, separately first and jointly thereafter, about their household WTP for a malaria vaccine. The second component is a revealed preference analysis that measures health outcomes (z-score for height and stunting) that are the result of allocation of intrahousehold resources over a period of time. The main objective of this component is to examine if there are

different health outcomes among children of different gender and whether there are other factors that accentuate these differences including the birth order of the child.

A third component is a choice experiment to examine differences in pooling behavior within and among households. In this component, husband and wives were separately asked to play a series of risky choice experiments with real payoffs for both. The payoffs were decided by a toss of a coin and were designed so that income poolers and non-poolers would choose differently. The main objective of this experiment was to determine if husbands and wives displayed similar income pooling tendencies or whether the tendency to pool income varied by husband and wife.

The remainder of this chapter discusses the policy implications of my research and the rest of the dissertation is organized as follows: Chapter 2 reviews the literature on the various models of intrahousehold resource allocation and the different techniques that researchers have employed to examine intrahousehold resource allocation. It examines the costs and benefits of maternal employment, and the increased role that intrahousehold resource allocation plays in understanding these costs and benefits. It examines models of intrahousehold allocation and firmly establishes the role played by revealed techniques in analyzing intrahousehold resource allocation. It explores the yet unfulfilled promise held by stated preference techniques such as contingent valuation and choice experiments in assessing the differences in preferences of household members and the challenges in preference aggregation. It comments on the role played by social issues in intrahousehold bargaining and gender inequities. Toward the end, this chapter discusses the existing

gaps in the literature and describes the contributions that this research makes to the literature.

Chapter 3 presents the conceptual framework for the study. The heart of the conceptual framework is a universal demand model for health. This model is exploited in two ways— (1) to estimate the WTP for vaccines using a stated preference approach, and (2) to examine intrahousehold differences in health outcomes using anthropometric measurements. These two components form the basis for the stated and revealed preference modules of the study. In addition, the conceptual framework includes a series of conditions under which income poolers could respond differently to a risky choice (lottery) experiment from a non-income pooler. These conditions form the basis for the experiments involving risky choices. While, most studies of intrahousehold resource allocation attempt to study a single dimension of household resources, the conceptual framework presented herein allows us to examine various measures of intrahousehold resource allocation.

Chapter 4 describes the research design for the study. The research design consists of design and hypothesis testing for three different modules, each developed on the basis of the three different approaches discussed in the conceptual framework. These include:

1. Design of the stated preference module for separate and joint interviews of husbands and wives.
2. A section to collect anthropometric data on height (and weight) for all individuals within the household.

3. Design of choice experiment lottery with real payoffs offered to both husbands and wives separately. The payoffs were increased gradually in three installments.

Chapter 4 also provides me with an opportunity to describe my fieldwork, including the selection of study sites, sampling frame and fieldwork protocol. A research design involving vaccines, if not handled carefully, can lead to various ethical infractions. The protocols adopted to mitigate ethical risks to the satisfaction of the Internal Review Board (IRB) are also described in this chapter.

Chapters 5 to 8 present the empirical findings of the study. Chapter 5 focuses on findings of the raw data, where I present the demographics of the respondents, their living conditions, knowledge of malaria and knowledge of vaccines, among other things. This chapter demonstrates the tough conditions of people living in the slums. The poorest families often live in single rooms, built with building materials as temporary as plastic polythene, without electricity, private water supply or sanitation. Few adults were well educated or had high quality permanent jobs. Women had lower labor participation and on average, significantly lower wage rates then their male counterparts. Forty five percent of the sons and 39% of the daughters were stunted.

Chapter 6 presents the results of the stated preference component of this survey. Although, I found evidence for significant differences between husband and wife behavior when interviewed separately, the short private discussion did reduce the differences between husband and wife stated demand. Many respondents adopted an “all or nothing” approach and were willing to pay for a vaccine for either the entire household or for no one. Women were more likely than men to change their opinion

during the joint interview, with those women having no source of income the most likely to change their opinion. Overall, I did find some evidence in favor of bargaining. Other than examining issues of intrahousehold resource allocation, I also explored the use of the random effects probit model and the switching regression techniques to study household demand.

Chapter 7 presents the results of the revealed preference module of the research. I found that daughters of women who do not have any source of income or those who have only primary education or less are likely to be taller (compared to a well nourished population) than other children. Moreover, the eldest daughter of women who had some source of income was more likely to be shorter than others daughters. However, the eldest son was not likely to be shorter than other sons.

Chapter 8 focuses on the econometric results of the lottery choice experiment with real payoffs. I found differences in pooling behavior among households and also between husbands and wives.

Chapter 9 summarizes the conclusions of the entire study. Overall, I found that a specific rule of intrahousehold resource allocation does not apply universally to all households. Among other factors, education, household and individual income of both husbands and wives and age are more likely to influence income pooling and household bargaining. Overall, I was able to reject the common preference model of intrahousehold resource allocation.

3. Contributions

In the space of this dissertation, I make the following contributions to the literature:

The stated preference survey with separate and joint interviews of multiple household members and the (lottery) choice experiment survey do present themselves as novel approaches for examining bargaining in the developing world. Unlike analyses based on revealed preferences techniques, these approaches do not require quality secondary data. This study also represents the first attempt to assess household bargaining using different tools simultaneously.

The stated preference component is the first experiment of its type in either an industrialized or a developing nation in which husbands and wives were interviewed separately first and jointly thereafter within a contingent valuation framework for their household WTP for a vaccine. Chapter 6 assesses how a short private discussion can help reduce the differences in husband and wife stated demand. With measures of the husband's and wife's separate and joint household demand, I was able to conduct a variety of tests, compare aggregated demand to heuristic estimates, and estimate sharing weights for husband and wife welfare functions. I also examined the socio-economic characteristics of women most likely to change their opinion in the joint discussion.

The second module on analyses of anthropometric data reveals how additional effort in collecting simple anthropometric data can reveal rich information about intrahousehold resource allocation. This is the first instance when additional

information on anthropometrics has been collected and analyzed along with a stated experiment.

The (lottery) choice experiment is also the first experiment of its type in developing countries. While such a choice experiment has been conducted in an industrialized nation before, my study design was inherently simpler and modified for use in developing countries, where literacy rates are much lower. This study assesses differences in income pooling behavior between husbands and wives.

On the technical front, I experimented with different ways to compute household demand. I introduced the random effects probit framework, which shows potential but did not work as expected, mainly because a majority of respondents adopted an "all or nothing" approach. But it has potential for other applications. I also presented the concept of switching regression in the computation of WTP, which shows that respondent behavior is different at higher and lower prices, a finding consistent throughout the analyses.

4. Policy implications

This research demonstrates the role played by intrahousehold resource allocation in the accurate estimation of economic benefits of economic interventions. It provides insights into the household decision-making process, something that can help us with additional information to formulate policy.

Accurate estimation of economic surplus: A major component of this research focuses on the household demand for the malaria vaccine for people living in slums in Navi Mumbai. The foremost benefit of this particular study is that it

provides us with refined estimates of consumers' surplus and WTP for a malaria vaccine. The term, "WTP," encompasses both, a person's ability and her desire to pay. The constraint on "ability" may be economic or political, as in having sufficient or insufficient power within the household to fulfill the desire. Power asymmetries in households may restrict the ability of certain individuals to participate in decision-making, thus hindering their ability to mitigate risk and increasing their vulnerability to the disease. Bergstorm (2003) raises the question that "If parents are willing to pay different amounts to save their child from a single day of cold symptoms when asked in a stated preference setup, should the value of child's health be the sum of two parents' WTP, the maximum or the minimum of their two answers?" An assessment of how members aggregate their preference is necessary to answer this question.

This study provides an opportunity to observe husband and wife preferences separately and jointly. The resulting estimates are likely to be more accurate, resulting in a more informed decision-making by policy makers. In Chapter 6, I have demonstrated the differences between the WTP estimated by studies that would and would not take into account the impact of preference aggregation. These differences can affect the accuracy of economic analyses of a vaccine intervention program.

Demand forecasting: The study provides us with a demand estimate for a malaria vaccine for a slum in Navi Mumbai. This estimate can be used in demand forecasting exercises, which can help the government, pharmaceutical companies, public health planners and donor organizations assess the size of the market for a vaccine, and help us design strategies to introduce the vaccine once such vaccine is invented (Whittington et al., 2004).

Patterns of household demand: The study underlies the importance of identifying patterns of intrahousehold allocation in household demand, in addition to estimating WTP. One such pattern that respondents could adopt is an "all or nothing" approach. Households with same aggregate household WTP but different patterns of intrahousehold resource allocations may react differently to the market prices resulting in different market demand for the good.

Consider two households, A and B, with four household members and a similar aggregate household WTP of $8, and cost of vaccine sold to be $1. Let us suppose that household A adopts an "all-or-nothing" approach whereas household B is willing to pay for only one household member. The demand curves for the two households are shown in the figure 1.1 and the estimates of economic benefits for two different prices ($1.5 and $6.5) are shown in table 1.1 with the dark curve indicating the demand curve for household A and gray curve indicating the demand curve for household B.

Figure 1.1: Economic benefits for two different households

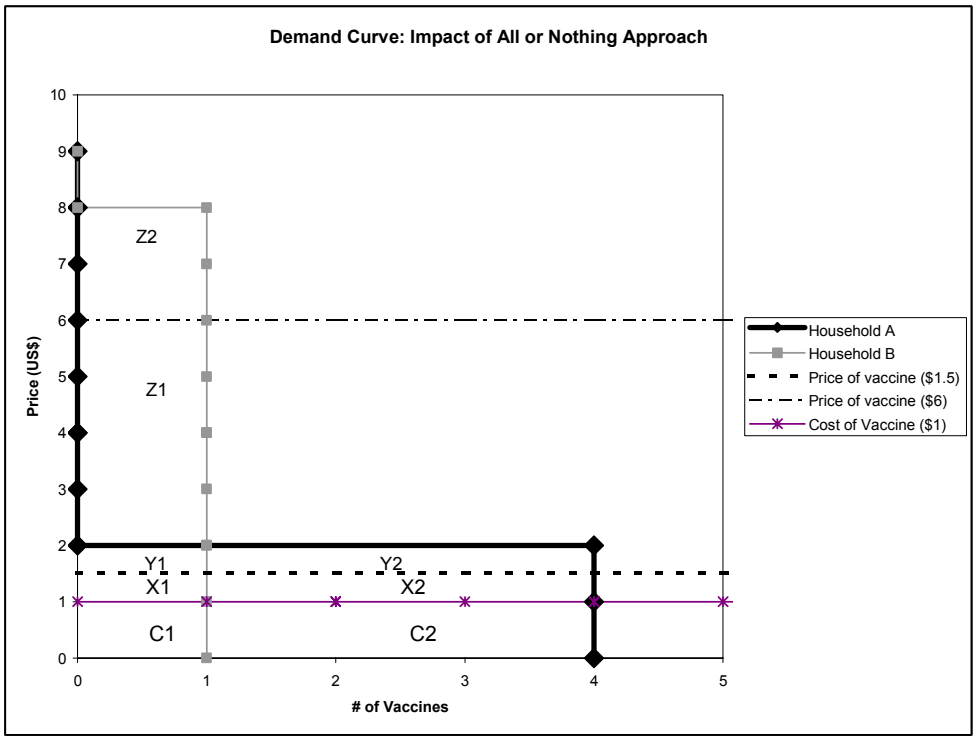


Table 1.1: Intrahousehold resource allocation and economic surplus

Surplus	**Scenario 1 (price of vaccine = $1.50)**	**Scenario 2 (price of vaccine = $6)**
Cost of vaccine	C1 + C2	C1+C2
Household A		
# Vaccines purchased	4	0
Producers' surplus	X1 + X2 = 0.50*4 = 2	0
Consumers' surplus	Y1 + Y2 =0.50*4=2	0
Total surplus	**4**	**0**
Household B		
# Vaccines purchased	1	1
Producers' surplus	X1 = 0.50	X1+Y1+Z1=0.50+0.50+4=5.0
Consumers' surplus	Y1+Z1+Z2=0.5+4+2=6.5	Z2=2
Total surplus	**7.0**	**7.0**

Table 1.1 shows that as the price is increased from $1.5 to $6, household B will still pay for one vaccine and the total surplus (producers' and consumer's surplus) for household B is maintained at $7. However household B adopts an all-or-nothing approach, and in doing so, it will not pay for even a single vaccine at a higher price even though it will pay for four vaccines at the lower price. Although both households have identical aggregate household WTP, the all-or-nothing approach imposes additional constraints on the prices that vaccine manufacturers could charge in the market. If a majority of respondents adopt an all-or-nothing approach, it is necessary to qualify the household WTP estimates to arrive at an appropriate demand forecast.

Multiple dimensions of intrahousehold resource allocation: This research demonstrates that intrahousehold resource allocation does have multiple impacts. In the stated preference module and choice experiment, I found that women who do not have any source of income are likely to have less bargaining power. However, in the revealed preference module, I found that the same group of women has significantly taller daughters. Further, the eldest daughter of women who work is likely to be shorter than other daughters, but the eldest son is not likely to be shorter than other sons. It is likely that women in slums who work have their own set of problems and may be compromising on nurture of their children. Our data show that women's value of time as valued by their hourly wage rate is significantly lower than that for men. Are women working in the informal sector appropriately compensated for their time? Are daughters of working women more likely to contribute to household work than those of women who stay at home? These questions are difficult to answer with my

research. However, the research demonstrates that each action that a household member takes, such as a mother joining the workforce, could have both welfare costs and benefits and that it is essential to analyze different sources of data to study the overall impact of such action

CHAPTER 2

LITERATURE REVIEW

1. Costs and benefits of maternal employment

In the modern world, mothers' responsibilities often include earning income in addition to the traditional responsibilities of doing household work and providing childcare. Maternal employment has its benefits and costs for the household. On one hand, maternal employment brings along with it an increase in household income with possible improvements in quality of dietary intake of household members and health status. On the other hand, maternal employment results in reduced time for cooking, household work and providing childcare.

Much of the literature examines the impact of maternal employment on the time that a mother has available for her traditional duties. In his study in Laguna, Philippines, Popkin (1980) found that maternal employment did result in reduced time that mother provided for her children. He found that this slack was picked up by elder siblings but not by fathers. In India, the caretaker sibling can be a daughter as young as five to six years old who can barely take care of herself (Chatterjee, 1992 cf Daniels, 2000).

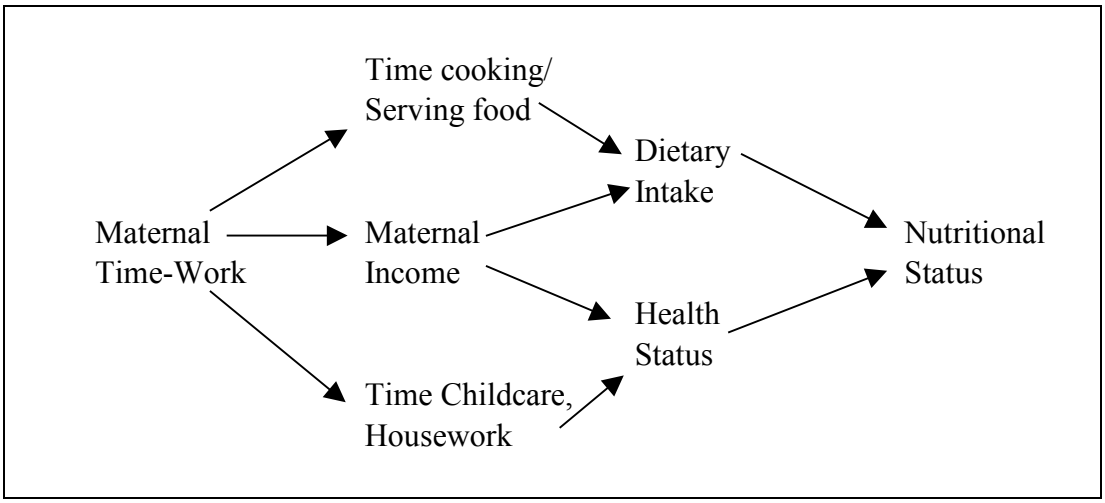
It is not necessary that an employed mother always spend less time on childcare than an unemployed mother, especially in a rural setting. Desai and Jain (1994) found only a small decline in the time that mothers in rural Karnataka, India,

spent with their children, and a moderate increase in alternate childcare time. This is because mothers in rural areas, although not employed were often busy conducting "expenditure saving activities" such as cooking and cleaning, fetching water, hauling large loads of firewood, carrying meals to family members, etc. Thus, these women were not the sole caretakers of their children as children still spent substantial time of about 3 to 4 hours daily under supervision of other adults or children when mothers were busy. Desai and Jain (1994), however, did find that maternal employment did cause a considerable reduction in leisure time and sleep of mothers actively employed.

The quality of life of women working in the informal sector is further compromised because of the quality of their jobs. In her study in slums of Delhi, Fernandes (1990) cf Daniels (2000) found that low status jobs that women take may "perpetuate their bondage".

Tucker and Sanjur (1988) developed a model of the tradeoff between income from maternal work and time available for household work and childcare, and how it may affect nutritional status. The framework is presented in figure 2.1.

Figure 2.1: Tradeoffs of maternal employment



As can be seen in the framework, a variety of factors such as household composition/ structure, availability of substitute caregivers, distance to work, nature of work, household income/income of other members, food production, housing, sanitation, child's age, child's gender, etc., can have a potential confounding effect of maternal work on nutritional status.

For example, maternal work is often associated with a shift from traditional preparations to less time intensive preparations, which are expensive. In such cases, the nutritional quality of diet could suffer unless food expenditures increase significantly (Senauer 1990). Household infrastructure such as piped water and modern cooking equipment can reduce the time needed for household activities (Popkin, 1980).

The magnitude and direction of impact of maternal employment on dietary intake and anthropometric measurements of children are inconsistent. In Laguna, Philippines, Popkin (1980) found no significant effect of maternal work on kilocalorie

or protein intake when controlled for mother's education, presence of electricity, etc. However, he found a significantly negative relationship between maternal employment and weight for age for preschool children. Popkin and Solon (1976) found a significantly positive impact of maternal employment on nutrition at lower income levels and significantly negative impact at middle income levels. Evidence of a positive and significant impact of maternal employment on weight-for-age of children was found by Tripp (mothers employed in trading in Ghana), and Kumar (working mothers in Kerala, India). In a review of relationship between income through maternal employment and nutritional status of children, Leslie and Paolisso (1989) found evidence of both positive and negative relationships in the literature.

A. Maternal education and child health

Although maternal employment is associated with costs and benefits, empirical evidence suggests that the impact of a mother's education is always positive. Education may work in several ways. Maternal education enhances knowledge about effective ways to prevent, recognize and treat childhood illnesses (Cleland and van Ginneken, 1988). Maternal education is positively correlated with knowledge of immunization (Streatfield et al, 1990). Education leads to better hygiene and sanitation practices, nutrition and greater willingness to seek medical care (Bennett, 1992). It also has been found to reduce under age five child mortality, infant deaths, maternal mortality and fertility (Summers, 1992). Educated mothers are generally thought to invest more in their children.

Quihui et al (2006) examined the impact of maternal education and employment levels on intestinal parasite infection in rural school children in 12 rural communities in two Mexican states. They found that children from lower-income families who had unemployed and less educated mothers, defecated in the open, and showed a higher risk of intestinal parasitism. Such a pattern is observed in most studies. Behrman and Wolfe (1987), however, assert that specific health knowledge may be more important than general formal education, although fewer illiterate women than educated women may have this "knowledge."

B. The role of intrahousehold resource allocation

Many studies that examine only the time-income tradeoff do not consider who controls the income, nor account for differences between working and non-working women such as marital status, education and poverty and the significance of alternative childcare arrangements (Lamontage et al, 1998). Recent studies such as those by Tucker and Sanjur (1988), Lamontage et al (1988) also focus on the efficient use of time and monetary resources. This is where intrahousehold resource allocation within the household comes to the fore.

Households assume importance as they can "shape gender roles" and form the basis for allocation of resources. The differences in boy's and girl's roles are more pronounced into adulthood and affect the allocation of resources within the household throughout their life (The World Bank, 2001). There may be various underlying social, economic and cultural reasons why resources are allocated in a particular manner within the household. The anxiety of Indian parents to know the gender of

their unborn child is a result of various implications that gender could have for the family. A son continues their family name and provides final religious rites (Mutharayappa et al., 1997). A daughter imposes a "burden" on her parents, as they have to finance her marriage and provide her with a dowry[2]. A son, on the other hand, earns the dowry during his marriage. Economics also matters. Rosenzweig and Schultz (1982) contend that differences in allocation among children of different gender are a response to the labor market, which itself discriminates against females. Sons are also more likely to provide farm labor, and support parents during old age (Bardhan 1998, Basu 1989, Dharmalingam 1996, Mamdani 1972, Miller 1981, cf Mutharayappa et al., 1997). Families try to control their sex composition by either differential stopping behavior (avoiding pregnancy after a son is born) or by female genocide in the form of feticide after detecting the sex of the child through ultrasound. The result of this discrimination is a skewed sex ratio of 927 females (894 for urban and 939 for rural India) per 1000 men, smaller families having significantly higher proportion of sons (Clark, 2000), higher female under age five mortality and lower nutrition for young girls as compared to boys (Chen et al., 1981).

In a typical male-dominated household, women have little bargaining power, and would play a small role in decision-making. Sons would be favored over daughters. Intrahousehold resource allocation helps us assess the power dynamics

[2] India has a tradition of "arranged marriage" where parents scout for potential matches of the same caste, and in some sects, particularly in North and South India, the groom's family is given (or promised) a "dowry" in marriage. Women who do not bring the promised dowry are oppressed by her in-laws. Burning of women for additional dowry results in about 600-750 dowry related deaths each year (Kumar and Kanth, 2004). Instances of suicide among poor illiterate newly wed women who want to escape torture to ensure that poor parents do not have to meet demands of greedy in-laws are also common (Kumar and Kanth, 2004). Although the number of annual deaths is very small as compared to the total population, the threat of death or torture does reduce the autonomy of women, and highlights the cultural issues that compromise the bargaining power of women in a household.

within a household, the autonomy that women have in their decision-making, whether they bargain with their husbands or whether husbands unilaterally make all household decisions, and how resources (time, money, nutrition and other) are allocated among household members, and what are the results of these allocations.

In the subsequent sections, I examine the different theories of intrahousehold resource allocation and try to answer some of the following questions regarding intrahousehold resource allocation: How do we observe mechanisms of intrahousehold resource allocation and whether household resources are utilized efficiently? How do we measure the differential impact that, for example, maternal employment could have on nutrition and health status of sons and daughters? How is bargaining power within the household measured? How do husbands and wives make decisions within the household, and how do we observe the decision-making process?

2. Intrahousehold resource allocation

A detailed discussion of the different models of various models of intrahousehold resource allocation is given in Appendix I. The most simplistic and restrictive model of intrahousehold resource allocation is the common preference model. Researchers that measure only aggregate consumption or aggregate income in the household, or those who interview only a single respondent for household demand, implicitly use this model.

This model assumes that either all household members have homothetic preferences or one of the household members (generally the head of the household) is a dictator responsible for all decision-making within the household. The common

preference models enables us to conduct economic analyses without taking into account the intricacies of intrahousehold resource allocation.

Modern theoretical advances and empirical findings in the field of household economics have questioned the findings of the common preferences model. The "Rotten Kid Theory" put forth by Gary Becker (1974, 1981) redefined the way economists examined household decision-making. He conceptualized an altruistic parent (or husband) who manipulated transfers for his rational but egotistic "rotten" kids (or wife), such that each member in the household behaved to maximize household income. Thus, household choice was essentially a collective choice. Although widely criticized by economists and feminists (Lindbeck and Weibull , 1988, Bergstorm, 1989, Bruce and Waldman, 1990), this model provided a real alternative to the common preference theory and a starting point to the study of household economics. McElroy and Horney (1981), and Manser and Brown (1980) defined the concept of bargaining in which husbands and wives were assumed to be independent utility maximizers indulged in a game of Nash Bargaining. These models assumed that individuals will stay in a marriage only if they have certain benefits to enjoy that outweigh the costs. Whether an individual stays in a relationship depends upon her/his reserve utility, defined as a "threat point," that she/he would get if she/he were single. If an individual does not derive benefits with respect to this reserve utility that she/he gets from the marriage, the marriage may dissolve and result in a divorce. Further modifications of the Nash Bargaining model investigate a more appropriate threat point than divorce (Bergstorm, 1996) as each argument in a marriage does not result in a divorce. Defining an appropriate threat point is often

problematic, and may require data that is difficult to get. Chippori (1988a), (1991) put forth a collective bargaining model that depends only on a pareto efficient outcome rather than Nash equilibrium to generate testable restrictions on labor supply functions and recover individual preferences and outcomes, thus reducing the need to define threat points and thus reduces data requirements. Non cooperating bargaining models (Chen and Wooley, 2001) focus on non-cooperative bargaining framework such as Cournot-Nash bargaining, where each person maximizes his or her welfare, given the expected actions of others and his or her own resource constraints.

While the common preference model is the most restrictive, the non-cooperative bargaining model is the least restrictive model. The key in differentiating between models lies in looking at what people do with their income—whether they pool it into a single "pot" or keep it for themselves. Since the 1990's "resource pooling has emerged as the crucial empirical issue" (Pollak, 2003). If individual labor income rather than total household income affects expenditure patterns, the common preference model can be rejected.

The collective model of bargaining is a generic model with Becker's unified model and the co-operative bargaining model as restricted cases of this model. Becker's unified model also involves pooling of household resources. However, merely testing whether individual labor income affects expenditure patterns is not enough. Among the early works on pooling that rejected Becker's unified model include those by Thomas (1990). Thomas (1990) showed that children have better mortality and morbidity if their mother controls a larger fraction of the family's resources. Thomas contended that labor income is endogenous as it reflects labor

supply decisions. Hence, he examined non-labor income, which he assumed to be exogenous. Thus, determining whether expenditure patterns are dependent upon non-labor income could provide us information to reject Becker's model of a unified household.

However, non-labor income could be the result of previous labor related decisions, and hence not really exogenous. In Thomas's case, one can also provide a counter-argument of unobserved heterogeneity, that "better mothers" control more resources in the household, and also raise children in a better manner (Pollak, 2003). Situations or shocks involving exogenous changes in income and expenditure are needed to test for income pooling.

Such a shock was provided in the late 1970's when Margaret Thatcher restructured the child-benefit program in UK from a tax deduction to a direct cash installment to mothers (at the post office). It indirectly transferred income from primary wage earners (typically the men) to their wives. Lundberg et al. (1997) studied this natural experiment, and found a significant increase in children's clothing expenditure relative to men's clothing expenditure and also a significant increase in women's clothing expenditure relative to men's clothing expenditure. Lundberg et al., (1997) provide perhaps the most compelling argument that husbands and wives do not pool their income, and hence the unified model of intrahousehold resource allocation is not appropriate. Thus, the unified model can be rejected if expenditure patterns are dependent on non-labor income, and there is no strong argument for any unobserved heterogeneity that affects outcomes.

Measuring non-labor income is often difficult. However, even if it is measured with error and income is pooled, the ratio of their marginal utility of income for the good should be the same for the common preference model and the Beckerian unified model, i.e., equality of the ratios cannot be rejected (Thomas, 1990).

Further tests are based on inspecting for pareto efficiency (Doss, 1996), i.e., whether there exists a constant ratio of income effects across all goods (as shown in the equation 2.15). The tests of intrahousehold resource allocation, summarized by Doss (1996), are reported in table 2.1.

Table 2.1: Tests of intrahousehold resource allocation models

Null hypothesis	Common preferences model	Unified model	Collective model	Bargaining models	
				Cooperative	Non-cooperative
Individual labor income does not affect expenditures	R	C	C	C	C
Individual exogenous income does not affect expenditures/ does not affect labor supply	R	R	C	C	C
Pareto efficiency: constant ratio of income effects across different goods/ constant ratio of marginal productivity of inputs.	R	R	R	R	C

(The table is reproduced from Doss(1996). Cells indicate whether the rejection of null hypothesis is consistent with or implies a rejection of the model).
R: Reject, C: Consistent

3. Increased bargaining of women in developing countries

Although males are often regarded as unilateral decision makers in male-dominated societies, emerging empirical evidence suggests that even within male-dominated societies such as Brazil, women have a great deal of control over

household expenditures, including the distribution of food (Neuhouser, 1989 cf Rosenzweig and Schultz, 1982). In a study in Bangladesh, Chen et al. (1981) found that family members typically ate dinner together, consuming shares allocated by women, who ensured equal shares were distributed to children of different gender. However, in cases of food shortages, the women agreed that they were likely to give male children a preference.

Table 2.2: Women's autonomy in India

Household decision	Respondent (female) made the decision by herself*	Decision made jointly (with husband or other family members)*	Husband alone made the decision*
Items to be cooked	71 (71)	15 (16)	4 (4)
Health care for self	35 (28)	24 (27)	34 (41)
Purchasing jewelry/ major household items	13 (10)	47 (44)	29 (36)
Staying with her parents/ siblings	18 (12)	37 (37)	36 (41)
Using self earned cash	57 (37)	27 (29)	14 (31)

Source: IIPS and ORC-Macro (2000)
All figures in percentages.
*Figures in parentheses show values for rural India.
Excluded category is when someone other that the husband or wife made the decisions.

In the Second National Family Health Survey (IIPS and ORC Macro, 2000) of about 90,000 ever-married women aged 19-49 in India in 1998-99, up to 91% of women reported at least some level of participation in household decision-making. Some results of this survey are reported in table 2.2. Interestingly, about 57% of the women in urban areas and 37% in rural areas said that they have autonomy in deciding how to spend their self-earned cash income. About 59% of women in urban areas and 55% of women in rural areas played some role in making decisions regarding their own health. These results highlight the fact that women do play a part in the nutrition and health outcomes of children and some women also have decision-

making power in spending decisions, and hence are in a position to bargain. Thus, issues of intrahousehold resource allocation may have implications even in countries with patriarchic setup like India.

4. Measuring income pooling through revealed health status

As discussed earlier, intrahousehold resource allocation can affect consumption and production decisions within a household. If there are biases against certain household members, these may result in lesser allocation of resources to these members, including lower investments in their health. If these differences in allocation of resources persist over a period of time, they can be observed through specific health outcomes.

A. Measuring health status through anthropometrics

One way to examine differences in health outcomes is through collection of anthropometric data. Anthropometric measurements are stock measures that have been used successfully to measure the standards of living. Anthropometric measurements are easy to measure at low cost. The biggest advantage they have over other measures is that although measures are subject to random error[3], the measurement error is not systematically correlated to respondent characteristics such as income (Strauss and Thomas, 1998). Whereas lower weight for a given height (and sex) reflects acute (wasting) and chronic (stunting) malnutrition, lower height for a given age (and sex) reflects chronic deprivation (Waterlow, 1972).

[3] The random error can be reduced if measured by a trained physiologist.

In 1995, a WHO Expert Committee (1995) compiled a report on the use and interpretation of anthropometry. According to the report, height-for-age, weight-for-age and weight-for-height are the three most commonly used indicators. Moreover, the relevant anthropometric indicator depends upon both the desired policy intervention that we want to measure and the age group of the subjects. For example, to identify areas to target health and economic interventions and to determine the priority of allocation of resources, the appropriate indicator for both children under 5 years of age and school-age children (6-10 years) is height-for-age. However to identify areas of greatest need to target interventions to reduce food and fat consumption and to recommend increases in physical exercise for the same age group, the relevant indicator is weight-for-height.

Choosing a relevant indicator can get complicated. Height for age is a good anthropometric indicator in children until age 12 and deficits may indicate long-term cumulative inadequacies in health and nutrition. But during adolescent years different children reach growth spurts and attain puberty at different times reducing the reliability of height-for-age indicator. Further, the indicator is of little use in adulthood as height is already predetermined and virtually constant throughout life of the individual (WHO Expert Committee, 1995). Weight can vary in the short run and can provide a short run indicator of nutritional status. A light person can be small and at the same time not underweight. Thus, weight (for a given height) can be used as an indicator of nutritional status in the short run. (Strauss and Thomas, 1998). One of the more common variants of the weight-height ratio is the Body Mass Index (BMI)[4].

[4] Body Mass Index, commonly referred to as BMI, is expressed as the ratio of weight (in kilograms) to height (in meters) squared.

It may be difficult to conjure a universal indicator for all age groups. One indicator that can be used under certain circumstances is the prevalence of stunting. WHO Expert Committee (1995) suggests that in cases where the prevalence of stunting is thought to be high, stunting can be used as an indicator of prior health or nutritional deficits. The indicator may not be able to pinpoint the exact ages when stunting may have occurred. Individuals having a z-score of between -2.0 and -3.0 on a height-for-age curve are classified as moderately stunted and those having a z-score less than -3.0 are identified as severely stunted. The z-score is computed using the formula,

$$Z_i = (h_i - h_m)/\sigma_x \qquad (2.1)$$

Where Z_i = z-score for individual I, h_i is height of individual I, h_m is the median height for a healthy, well nourished child from a reference population of the same age and gender, and σ_x is the standard deviation from the mean for that reference population at that height and gender.

Variation in stunting across different groups of the population can be interpreted as evidence of a history of inequity that was captured in the growth patterns. The height-for-age z-score is immune to short-term fluctuations in health (such as those caused by illnesses like diarrhea), but is affected by long-term impacts such as those caused by chronic nutrition inadequacy, neglect by care givers, frequent parasitic infections and long-term chronic diseases such as HIV/AIDS (Sahn and Stifel, 2002 cf Gaiha and Kulkarni, 2005).

B. Height-for-age as revealed indicator to measure income pooling

Thomas (1994) integrated a health production function with model of household decision-making to develop a reduced form demand model for child health to determine the relationship between parental education and child height. He hypothesized that a child's health, as measured by his height, depends upon individual non-labor income (among other things), and examines data from four different countries. Thomas's paper provides a methodology with which one can measure household resource allocation using revealed preference data. Thomas set up a simple model based on the common preference model of intrahousehold resource allocation. He modified it to include Nash bargaining setup and later simplified it for use as a co-operative bargaining model based on pareto-optimality. A brief account of Thomas's formulation is given in Appendix II . The reduced form model that Thomas arrived at is as follows:

$$h_i = h_i(\overline{\mu_i}, \overline{\mu_c}, \overline{\mu_c}, y_1, ...y_M, \mu', \xi_i) \qquad \ldots.(2.2)$$

Where, h_i = Z-score for height, μ_i = individual characteristics including sex and age, μ_f = family characteristics, μ_c = community characteristics, where μ' = any elements of μ not in the demand function.

Note here that $\frac{\partial h}{\partial y_m}$ is not same for all members, mathematically representing the possibility of non-pooling. This demand schedule is responsive to changes in individual's non-labor income.

Thomas applied this model to household survey data from the United States (4704 children), Brazil (1316 children for DHS data) and Ghana (990 children in 412 households). He found significant differences in resource allocation among gender, which reflected both technological differences in child rearing and differences in the preferences of parents. Specifically, he found that mothers are devoting more resources toward their daughters and fathers toward their sons. For example, in Brazil, women's non-labor income has a positive impact on her daughter's health but does not impact her son's health. The methodology developed by Thomas can be used to reveal the intrahousehold resource allocation using indicators of long-term health such as height (for age and gender). For example, if the height of girls depends upon the non-labor income of their mother, or if changes in the mother's education cause changes in the daughter's height alone, it indicates some level of interpersonal separability between the husband and wife and also the way in which a wife exercises her choice.

C. Use of stunting as a health indicator

Gaiha and Kulkarni (2005) examined high prevalence of stunting in rural India to study the persistence of poverty. They developed a framework based on three production functions as follows:

(1) Health of an individual is a function of the nutrients consumed by the individual, other health-related inputs, his endowments, education of the individual and his mother/wife, quality of housing, and village infrastructure.

(2) The mortality function for the individual is linked to that person's health. Mortality occurs if health falls below a threshold value (the threshold value can be different for different individuals).

(3) The nutrient intake of an individual within the household depends on food intake, time use and capacity of mother/wife, and household environment.

Based on this, Gahia et al formulated a model with the number of stunted children within the household as a dependent variable. They found that among other things, a more autonomous role for women, improvements in hygiene and sanitation facilities and more competitive local markets are important in reducing the stunting.

5. Stated preference studies and intrahousehold resource allocation

Measurement of health outcomes represent a revealed preference method to assess intrahousehold resource allocation. These techniques cannot be used to determine the differences in preferences of individual or a glimpse into the decision-making process, i.e., how individuals aggregate data. Both of these objectives can be achieved in a properly conducted stated preference experiment (Adamowicz et al., 2005). Stated preference techniques such as Contingent Valuation Method (CVM) been around for the last fifty years (Smith, 2000) and have been increasingly used to measure the value of environmental and health-related outcomes such as forest conservation (Carson et al., 1994), water supply (Whittington et al., 2002), sanitation (Whittington et al., 1993), among other things. These techniques use WTP or willingness to accept (WTA) concepts to measure incremental changes in compensating or equivalent variation associated with a policy intervention. Stated

preference studies are particularly handy in developing countries because of poor quality of existing secondary data.

Stated preference studies have, however, contributed little to our understanding of intrahousehold resource allocation. Although stated preference techniques requiring response from multiple members may help us identify differences individual preference information, the ability for these multiple members to choose independently can give rise to its biggest problem—how to aggregate the preferences of different household members? Aggregation may require a research design with potentially unrealistic settings (Adamowicz et al., 2005) and impose various logistical constraints on the fieldwork, thus limiting the scope of use of stated preference methods in studying intrahousehold resource allocation.

One of the areas where stated preference literature demonstrates potential to contribute to our understanding of household behavior is the literature on household's WTP for health[5], particularly the study of household WTP for a preventive vaccine.

A. CV studies to determine household WTP

In CV studies of household demand, the typical valuation (WTP) section of the survey instruments often includes either a direct referendum question on respondent's WTP for the entire household for a set of vaccine characteristics (Cropper et al., 2004) or a two-step approach where they initially ask a referendum

[5] Use of CVM to estimate the social benefits of health improvements is complicated by the fact that there are often positive externalities associated with health improvements (EPA, 2000). Unless designed to measure externalities, CV will almost always measure the benefits associated with an improvement in private well-being.

question for the individual WTP, followed by a question for WTP for remaining members within the household (Canh et al., 2003, Whittington et al., 2006). In a properly designed household WTP questionnaire, respondents have to state not just the number of vaccines (desired consumption) that they are willing to pay for but also for whom they plan to purchase this vaccine (desired allocation). The vaccines have an important advantage while studying allocation in that the good is divisible vis-à-vis household members.

Cropper et al. (2004) assessed the household WTP for a malaria vaccine in Tigray, Ethiopia. They found that the value of preventing malaria with vaccines to be about $36 a household a year, or about 15% of the annual imputed income. They found this to be about twice the expected household cost of illness. They interviewed a single person within a household and did not explore differences in household member preferences.

Whittington et al. (2006) interviewed multiple adults from the same household to examine the intrahousehold differences in demand for a hypothetical HIV/AIDS vaccine. They used a seemingly unrelated count regression model to explore the differences in husbands' and wives' preferences. They found that although the number of vaccines that husbands say they would purchase is not significantly different from that of wives, husbands and wives do purchase vaccines for different household members at lower prices. Both however tended to agree (to buy no vaccines) at higher prices when demand choked off. This is an important finding which underlines the differences in preferences of an individual vis-à-vis a household and illustrates that due consideration should be given to the complex problem of

intrahousehold resource allocation. They report a mean household WTP of US$ 671. This model is a first step towards demonstrating how stated preference can help us identify differences in husband and wife preferences.

6. Aggregation of individual preferences

Aggregating differences in individual preferences remains a challenge in stated preference studies. There are a few studies that have attempted to aggregate individual preferences into household preferences. Two approaches are discussed here—the heuristics and behavioral approach.

A. Heuristics Approach

The heuristics approach involves aggregation of demand using "heuristic decision rules." This approach was used by Whittington et al. (2006) to determine household WTP for a HIV/AIDS vaccine in Thailand. They examined whether husband and wife agreed or disagreed in their WTP for each member of the household. In case the husband and wife disagreed upon a household member, Whittington et al adopted simple rules or heuristic "decision criteria" to decide whether that member would receive a vaccine. This new tally of vaccines was then considered the dependent variable to determine aggregated household demand and WTP. The different decision criteria were:

1) Either agrees: The member got a vaccine if either husband or wife agreed to buy a vaccine for him/her.

2) Both need to agree: The member got a vaccine only if both husband and wife agreed to buy a vaccine for him/her.
3) Both need to agree for others: The husband or wife received a vaccine if either of them were willing to purchase a vaccine for themselves or for their partner. For other household members (including children), both had to agree.

Table 2.3 explains the outcomes of the decision rules in a simple manner:

Table 2.3: Decision rules adopted by Whittington et al (2006)*

Relation of member	Stated demand		Decision criteria and outcome		
	Husband willing to pay	Wife willing to pay	Both have to agree	Either has to agree	Both have to agree only for members other than the couple
Any	1	1	1	1	1
Any	0	0	0	0	0
Husband or wife	1	0	0	1	1
Children	1	0	0	1	0

*1 denotes WTP, 0 denotes not WTP.

This is a parsimonious model in which aggregation is not based on any economic models of intrahousehold resource allocation or sociological theory. The study highlights the problems in aggregation by demonstrating that the WTP as computed by the upper bound demand estimates of the demand curve at $200 per person per vaccine is almost six times that when computed by the lower bound estimates.

B. Behavioral Approach

Arora and Allenby (1999) examined the preference structures of husbands and wives in a university town in Virginia about purchasing two products, an electric

oven range and a lawn mover. Husbands and wives were requested to mail conjoint choice questionnaires for these two products, separately first and jointly later.

Arora and Allenby found that husbands and wives had different preference structures. In general, husbands were more sensitive to price than wives. While wives were generally more sensitive with regard to oven attributes, the husbands showed similar behavior regarding lawn mover. The authors further developed a hierarchical Bayesian model of group decision-making that takes into account individual estimates of influences at the product attribute level. They argued that such an inferred measure is more predictive than alternative measures.

Behavioral approach is also seen in the literature on group preference aggregation. The simplest technique is to allow group members to discuss among themselves and come up with a "group" probability distribution. In the Delphi technique, experts are requested to make judgments separately, which are then shared among the group. The expert is then requested to revise his judgment. This process is continued until experts agree upon a probability distribution. If the experts don't agree, which often is the case, their probability distributions are combined mathematically.

C. Weakly separable function

Adamovicz et al (2005) focus on dyads and two-person households and put forth a theoretical framework for aggregation of preferences. In the simplest model, they have utilities aggregated in an additive way (weighted average) as if a "representative agent" made the choice.

$$U^*_j = \hat{I} \pm U_{1j} + (1 - \hat{I} \pm) U_{2j} \quad \ldots.(2.3)$$

Where U_{ij} = Utility for alternative j for person i

$= V_{ij} + \varepsilon_{ij}$, V being the deterministic component

$\hat{I} \pm$ = the weight which may be positive or negative

Adamovicz et al (2005) also point out that this model suffers from parameter identification issues. In its simplest form, this setup is similar to the weakly separable household utility function proposed by Samuelson, and suffers from the setbacks of the common preference model.

7. Risky choice experiment to measure income pooling

Other methods suitable to study intrahousehold resource allocation in developing countries include choice experiments involving real money and risks. Bateman and Munro (2005), (2003) adopted such an approach for the first time to examine whether income pooling and whether member preferences conform to the axioms of Expected Utility theory.

They presented a sample of 76 established couples[6] with tasks involving binary choices between lotteries. The lotteries were designed such that both partners had a payoff in each choice card (refer Figure 2.2), and the response would vary depending upon whether the respondent were interested in income pooling within the household. Initially, each partner was interviewed separately where she/he had to make individual choices and then predict her/his partner's responses to a different set of lottery questions. Finally, the partners came back together and were asked to

[6] Bateman and Munro interviewed heterosexual couples staying in a relationship for more than a year.

choose as a couple for a third set of lottery questions. One of the lotteries was played out for real toward the end of the experiment.

Figure 2.2: Typical lottery card used by Bateman and Munro, 2005.

Lottery A			**Lottery B**		
For numbers	21-70	71-100	For numbers	21-70	71-100
You receive	£20	£20	You receive	£20	£0
Your partner receives	£0	£0	Your partner receives	£0	£40
Which lottery would you choose?					

Bateman and Munro examined the households for income pooling, interpersonal separability and pareto dominance, among other things. To examine income pooling, Bateman and Munro present the concept of income pooling equivalent (IPE) lotteries. Lotteries L^A and L^B are income pooling equivalent if:

$$m_{1s}^{A} + m_{2s}^{A} = m_{1s}^{B} + m_{2s}^{B} \quad \ldots.(2.4)$$

Where: m_{is}^{A} denotes the payment received by agent i, and s = 1,2,…S are different states of the lottery, and L^A and L^B are two different lotteries.

An example of an IPE card is one in which wife gets £20 for numbers between 1-50, zero otherwise; and the husband gets £20 for numbers between 51-100, zero otherwise. They then combined such IPE lotteries with other lotteries that were safer (or riskier) to an income pooler in a single choice card. Based on the responses to such lotteries, they found whether the respondent favored income pooling or otherwise.

They found a large proportion of individual respondents (varying from 78% to 95% for different tasks) in favor of income pooling. Overall, Bateman and Munro were unable to reject income pooling, but found that only a few households were

unanimous in their choices. They also found that couples were more risk averse than individuals. For individuals, income pooling was not related to gender or marital status, but negatively associated with number of children and quadratic relationship with age (with the youngest people in their sample most likely to pool income). They also found financial independence to be an important factor in determining women's lack of indecisiveness during joint choice. They found different financial and budget arrangements among households indicating some amount of decentralized decision-making within the household. Another interesting finding was that respondents were often unable to predict the risk preferences of their partners. The authors contended that decentralization of budget along with imperfect information about partner's risk preferences may be the reason why households were unable to achieve pareto optimality.

Although the researchers found some evidence of income pooling, they largely rejected the common preferences model of intrahousehold resource allocation, and also a model where the group utility is a simple weighted average of utility model without ex-post transfers.

Bateman and Munro provide insight into how one can examine intrahousehold resource allocation by offering risky choices to respondents. There are possible limitations to this approach especially in a developing country context. Bateman and Munro play a numbers game. To play this game properly, the respondent has to understand numbers clearly and should also have some grasp of the concepts of probability. Thus, implementation of such surveys in countries like India (with a low literacy rate of only 64% (Ministry of Finance, GOI, 2003-2004) could be difficult.

8. Risky choice in developing country context

There are a few studies that have implemented risky choice experiments successfully in developing countries. One of the early studies in this field was conducted by Binswanger (1981) on 330 individuals in rural India. The people were offered eight choices in which higher expected return could be chosen at the cost of higher risk. Each choice contained a "good luck payout" and a "bad luck payout" with equal probability of 50%, which was decided by the toss of a coin. The game was actually played over a period of six weeks at four different levels. The game started at Rs. 0.5 level and later was played at the Rs. 5 level, Rs. 50 level and Rs. 500 level. The choice cards for the Rs.50 level are shown in table 2.4. For Rs. 0.5 level, the respondent was shown a card with the hundredths of the payout of the Rs.50 level (i.e., card C became a lottery of Rs. 1.5 for good luck payout). The respondent did not know the number of times a game would be played or the level at which it would be played. He also provided respondents with a day to two weeks time between games. There were real payoffs at Rs. 0.5 to Rs. 50 level. The payouts were also large with the expected payoff of a single decision exceeding the average monthly income of an unskilled laborer.

Table 2.4: Choices shown at the Rs. 50 level with decreasing order of risk aversion

Risk aversion category	Good Luck payout (50% chance)	Bad Luck payout (50% chance)	Remarks
Extreme O	50	50	Most risk averse
Severe A	95	45	
Intermediate B	120	40	
Moderate C	150	30	
Slight-to-neutral E	190	10	
Neutral-to-preferred F	200	0	Most risky
Inefficient alternatives B*	125	35	
C*	160	20	

Binswanger found that as the size of the stakes increase, individuals tend to be less risk averse. The structure of Binswanger's lottery game is very simple to comprehend, even for people with limited knowledge of probability. By using a flip of a coin, he does not expose the respondents to the complexities induced by differential probability as in the Bateman and Munro (2003) experiment. Further, a coin toss is more clean and reliable than say a throw of a dice, which respondents can fear to be biased. Binswanger was able to implement the experiment successfully in the midst of peasants in rural India.

Variants of Binswanger's technique have been used by researchers in other developing countries such as Northern Zambia (Wik et al., 2004) and Indonesia (Miyata, 2003) to study risk aversion.

9. Exploring gaps in the literature

Empirical studies and theoretical advances suggest that issues of intrahousehold resource allocation and bargaining should be incorporated in economic analysis.

Intrahousehold resource allocation can dictate the costs and benefits of actions that members take. For example, maternal employment may have various impacts within the household, including increased autonomy for women, possible increases in the quality of diet and healthcare that a household receives, and possible reductions in time available for a mother for household work, childcare and leisure. The overall impact of maternal employment depends not only upon the tradeoffs that mothers make between time and money, but also how efficiently they and their households utilize their time and other resources.

A traditional approach for economic analysis based on the common preference model does not include issues of intrahousehold resource allocation. New approaches based on bargaining are more likely to depict situations closer to reality but need more resources and data. Evidence for bargaining is examined through income pooling. Tests on the marginal utility of individual and aggregated income for both men and women in the household can help us differentiate between different models of intrahousehold resource allocation—Common preferences model, Becker's unified model, Co-operative or Non-cooperative bargaining based models.

Different allocation of resources to different household members over a period of time can create outcomes that could reveal these differences. For example, differences in anthropometric indicators such as height-for-age z-score and stunting

can help us capture differences in long-term investment in health of children and hence, can be used as revealed indicators of intrahousehold resource allocation.

Empirical evidence and theoretical advances suggest that husband and wife preferences may be different even in developing countries and a single person's stated responses may be inadequate to represent those of the entire household. Although stated preference studies can observe differences in preferences and are increasingly common in developing countries, such studies are conspicuous by their absence in studying intrahousehold resource allocation. This is because preference aggregation in a stated preference context is difficult, could involve multiple member interviews, unrealistic scenarios, pose logistical problems and require more resources. Contingent valuation studies for household WTP for vaccines can be used to examine intrahousehold resource allocation as in a carefully designed survey, respondents have to state the consumption and allocation of vaccines that they are willing to pay for household members. So far, all but one stated preference studies of household demand for vaccines interview only a single respondent within the household. There is no study yet that attempts to aggregate member preferences in a stated preference framework.

The literature review also identifies the importance of data on exogenous changes in income and expenditure to study income pooling behavior. Exogenous changes of income are rare but small changes in such can be manipulated in a risky choice experiment with real payoffs. However, conducting such a study in a developing country may be challenging because of low literacy levels.

Although intrahousehold resource allocation affects different household members in different ways, most studies utilize a piece-meal approach where they concentrate on only one aspect of intrahousehold resource allocation based on a single technique. This may be because certain techniques do certain things better than others. For example, revealed preference techniques can best identify differences in allocation of resources to household members and stated preference techniques can best identify differences in preferences. As a result, there is lack of an integrated approach to study intrahousehold resource allocation and we do not understand enough about the linkages in multiple dimensions of intrahousehold resource allocation.

CHAPTER 3

Conceptual Framework

1. Conceptual framework

In this chapter, I develop a generic model of intrahousehold resource allocation, parts of which can be applied to the stated and revealed preference data. This model will help me take an integrated approach to the study of intrahousehold resource allocation. I then develop hypotheses for testing.

The first step is a production function for individual health. This is a modified version of Thomas's (1994) work (equations 2.2, Chapter 2, Appendix II) in that it includes the possibility that the individual can contract the disease malaria.

Individual Health, $\theta_i = \theta(N_i, \pi, \mu_i, \mu_f, \mu_c, \eta_i)$ …(3.1)

Where N_i = nutrient intake, π = chance of the individual contracting disease malaria, μ_i = individual characteristics including sex and age, μ_f = family characteristics, μ_c = community characteristics, and η_i = individual specific unobserved heterogeneity in health

Let us suppose that the decision maker within the household can reduce his and the household's risk of contracting malaria by purchasing preventive care (vaccine), which is available in the private market at a specific price.

Thus,

Individual Health, $\theta_i^* = \theta(N_i, Q_i, \pi_i^*, \mu_i, \mu_f, \mu_c, \eta_i)$ …(3.2)

Where

$Q_i = 1$ indicates that the individual is vaccinated.

$\pi_i^* = (1-\lambda).\pi$ if $Q_i = 1$

$\pi_i^* = \pi$ if $Q_i = 1$

Where λ is the efficacy of the vaccine, with a positive efficacy indicating a reduced risk of contracting malaria. Here, I assume that λ is exogenous and does not depend upon individual or community specific characteristics.

Given the health production function in 3.1 and 3.2, the household decision maker, m, wants to maximize his utility subject to a budget constraint

$V_m(X, Q, l, Z; \mu, \varepsilon)$ …(3.3)

Where, X = vector of goods demanded by each individual in the household, Q denotes the vaccines that the household member chooses to buy for different household members, l = vector of leisure, Z = vector of home produced quantities including health, μ = background characteristics such as education of all household members, ε = vector for unobserved tastes of members

This will yield:

$$px+p_fF+\sum_m \{Q_i(p_v + p_rR_i\cdot\pi_i\cdot(1-\lambda)) + (1-Q_i)\pi_i\cdot(p_rR)\} = \sum_m w_m(T_m - S_m - l_m) + y_m \ldots.(3.4)$$

Where T = amount of time available for work, S = amount of time spent ill with a disease, l = vector of leisure, w= vector of wages, and y_m is each individual's non-labor income (assumed to be exogenous).

The left hand side shows the expected household expenditures and the right hand side shows income. Here the variable X is split into a numeraire good x, vector of Food F, an indicator variable Q showing whether preventive action (vaccine) was purchased, p_f is the price of food, and p_v is the cost of prevention. The food expenditures[7] are shown explicitly in the equation to underscore the role of food intake in nutrition.

If the individual does not purchase a vaccine, Q = 0, he has a probability, π, of contracting malaria disease and having to incur treatment costs. The variable R indicates that treatment is necessary and p_r is the cost of treatment, with their product showing the expected costs of treatment. If the individual chooses to purchase a vaccine, then Q = 1, the probability of getting sick drops down to $(1-\lambda)\pi$ and the expected treatment costs reduce. However, the individual has to incur additional cost of purchasing a vaccine at price p_v.

Solving this equation gives us the optimum demand for health, along with optimal nutrition and optimal prevention.

A. Stated preference approach

In the stated approach, the decision maker will attempt to buy an appropriate number of (hypothetical) vaccines for different household members so as to minimize

[7] Gaiha(2003) shows that nutrient intake within the household depends on food intake, time use and capacity of mother/wife, and household environment.

the number of days that a person would spend ill with a disease. Depending upon a common preference or a collective approach to household decision-making, the demand function for a vaccine for individual i in household k model reduces to

$$q_{ik}^* = q_{ik}(\mu_i, \mu_f, \mu_c, \sum y_m, p_v, p_m, \lambda, \pi, \varepsilon_{ik}, \xi_i) \quad \ldots(3.5)$$

(Common preference approach)

or

$$q_{ik}^* = q_{ik}(\mu_i, \mu_f, \mu_c, y_{1 \cdots m}, p_v, p_m, \lambda, \pi, \varepsilon_{ik}, \xi) \quad \ldots(3.6)$$

(Collective approach)

ε_{ik} represents the individual specific heterogeneity and ξ_i represents the family specific heterogeneity.

B. Revealed preference approach

In the revealed model, the relevant measure of health outcome is an appropriate form of anthropometric indicator. As a result, the optimization reduces to Thomas (1994) setup and the reduced form models derived by Thomas, in which he used height-for-age as a measure of long-term health, are presented below:

$$h_i = h_i(\mu_i, \mu_f, \mu_c, \sum y_m, \xi_i) \quad \ldots(3.7)$$

and

$$h_i = h_i(\mu_i, \mu_f, \mu_c, y_1, \ldots\ldots y_M, \xi_i) \quad \ldots(3.8)$$

Once again, the symbol $\sum y_m$ and $y_1, \ldots, y_M$ in models 3.7 – 3.8 represent mathematically the common preference approach and the collective model approach respectively, a notation adopted by Thomas (1994).

2. Hypothesis for testing

This model can help us examine various aspects and impacts of intrahousehold resource allocation. The first thing that I can examine the model for is income pooling, by examining the marginal utility of income of household members differently. Secondly, if there are any biases within the household, then I can measure the differences in health outcomes for specific groups of household members, i.e., say daughters vs. sons or children of different birth order. I can also test for whether this work satisfies various economic norms such as vaccine is a normal good, or scope tests for price and efficacy of vaccine. We can also examine various factors that play a role in intrahousehold resource allocation. For example, well educated mothers are likely to have healthier children. We can also examine whether maternal employment, overall, is beneficial or not to the household.

I now develop the following specific hypotheses for testing:

<u>Hypothesis 1: The household follows the common preference model of intrahousehold resource allocation</u>

$$\text{Ho: } \frac{\partial q}{\partial y_1} = \frac{\partial q}{\partial y_2}\text{; Ha: } \frac{\partial q}{\partial y_1} \neq \frac{\partial q}{\partial y_2}$$

The symbol $\sum y_m$ in model 3.5 and 3.7 represents mathematically $\frac{\partial q}{\partial y_1} = \frac{\partial q}{\partial y_2}$, where subscripts 1 and 2 denote two different members. The null hypothesis characterizes the common preference approach. Here, y denotes non-labor income. If

the null hypothesis is rejected, (denoted by equation 3.5 mathematically) then the common preference model of intrahousehold resource allocation could be rejected.

Hypothesis 2: Vaccine is a normal good

For the vaccine to be a normal good, the demand for the vaccine should increase with income. This can be expressed mathematically as:

$$\text{Ho: } \frac{\partial q}{\partial y_1} > 0; \text{ Ho: } \frac{\partial q}{\partial y_2} > 0$$

Hypothesis 3: Scope test for vaccine price and efficacy

Economic theory dictates that as price increases, the demand for the vaccine should drop down. Similarly, as efficacy of a vaccine increases, the demand for vaccine should increase.

This can be mathematically represented as:

$$\text{Ho: } \frac{\partial q}{\partial p_v} < 0; \text{ Ho: } \frac{\partial q}{\partial \lambda} < 0$$

Hypothesis 4: Educated mothers should have healthier daughters

The literature review suggests that better educated mothers should have healthier daughters. Thus mothers who have at least some level of secondary education are likely to have taller daughters when compared to mothers who have little or no education.

Ho: $\frac{\partial \theta}{\partial \phi} > 0$, where ϕ is a variable which indicates that mother has received at least some level of secondary education.

Hypothesis 5: Impact of maternal employment on child health

Maternal employment can affect child health in two ways. First, it can contribute to child health by improved nutrition intake. It can also result in reduced time available for childcare. Thus the sign of: $\frac{\partial \theta}{\partial \kappa}$ could be positive or negative depending upon the way maternal employment affects children health.

Hypothesis 6: Impact of per-capita consumption on child health.

Children in households with higher per-capita income are likely to be healthier.

Ho: $\frac{\partial \theta}{\partial y'} > 0$, where y' = per capita consumption

Hypothesis 7: Impact of maternal employment on health of eldest children

Here, I hypothesize that the eldest daughters of women who work are likely to contribute toward the childcare of younger siblings. This may affect their health of eldest daughters but not of the eldest son.

$\theta_{Eldest} - \theta_{Others} < 0$ (for daughters) and

$\theta_{Eldest} - \theta_{Others} \geq 0$ (for sons)

3. Modeling stated preference

In this section, I first develop a probit model to examine the factors that affect decision-making and subsequently model the demand in two different ways, a traditional count model approach and a random effects approach. This is followed by a mechanism to estimate the sharing weights that husband and wife welfare estimates should be given to compute joint household welfare estimates.

A. Patterns in decision-making: The All or Nothing Approach

One of the simple patterns in decision-making is the "all or nothing" approach in which the respondent either buys for all members or for no one. The choice can be modeled on the basis of Random Utility Theory (McFadden 1974, and Ben-Akiva and Lerman 1985). Each person derives a utility U by purchasing a certain number of vaccines based on his own income y, and individual attributes X, Price of the vaccine P, and member characteristics Z (which include his age, education, relationship, income, and other features). Thus, overall utility that a person in household i derives by purchasing a vaccine for all household members is

$$U_i = V_i + \varepsilon_i \qquad \ldots(3.9)$$

The indirect utility can be modeled as

$$V_i = V(y_i - P, X_i ; \beta) \qquad \ldots(3.10)$$

The structural probit model can be written as:

$$y_i^* = \beta X_i + \varepsilon_i$$

$y_i = 1$ if $y_i^* > 0$, and 0 otherwise (Greene, 2000, pp.: 837)

$$\ldots(3.11)$$

B. A count model approach

In the conventional approach, adopted by Cropper et al (2004), to assess household demand, the optimal value for equation 3.4 is the sum of the vaccines purchased for each member within the household. Thus demand for entire household,

$$q_k^* = \sum_m q_{mk} \qquad \ldots(3.12)$$

Where $q_{mk} = 1$ if member m in household k receives a vaccine; 0 = Otherwise. This model can be estimated using a variant of the Poisson Count Model, in which

$$P[q_i = n_i] = \frac{e^{-\lambda_i}\lambda_i^{ni}}{n_i!} \text{ where } n_i = 0, 1, 2, 3,\ldots.. \qquad \ldots(3.13)$$

Where $\lambda_i = e^{Xi\beta}$,= $E[n_i|x_i]$ = expected number of events per period, β = vector of parameters, X_i= vector of individual and household independent variables.

The household WTP for a vaccine is the area underlying the demand curve.

$$WTPi = \int_{p1}^{p2} e^{(X_i\beta - p\beta_p)}dp = e^{X_i\beta}\int_{p1}^{p2} e^{-p\beta_p}dp = e^{X_i\beta}.(-\frac{1}{\beta_p}).\left[e^{-p\beta_p}\right]_{p1}^{p2} \qquad \ldots(3.14)$$

Where β is the vector of coefficients except the price coefficient.

To determine the entire consumers' surplus, integrate from price = 0 to infinity.

$$\text{Consumer's surplus} = e^{X_i\beta}.(-\frac{1}{\beta_p}).\left[e^{-p\beta_p}\right]_0^{\infty} = e^{X_i\beta}.(-\frac{1}{\beta_p}).[1-0] = -\frac{e^{Xi\beta}}{\beta_p} \qquad \ldots(3.15)$$

Limitations of the count modeling approach

The count models are conceptually sound and are well established in literature. By the virtue of the exponent involved, they predict a positive WTP, and are able to predict a smooth demand curve. However, there are certain shortcomings associated with these models when they are used to analyze household demand for vaccines.

1. Household demand can be viewed through two different lenses, a continuous choice where the respondent chooses the number of vaccines that he may purchase, and a discrete choice, which indicates the person for whom the vaccine is being purchased. The count models do not capture all the information that is collected in a stated preference survey. Specifically it does not capture the heterogeneity reflected by the term ε_{ik} in equations 3.5 and 3.6. For example, a person buying vaccines for two daughters is the same as a person buying two vaccines for sons. As a result, we are unable to determine household willingness-to-pay for different household members, or the fact that preferences may be ordered (for example, eldest son more preferable than all other children). One way to resolve this problem is to run a series of count model with the count of a certain category of household members (say children) as the dependent variables. However, this approach does not account for correlation between demand for different age groups within each household.

2. The poisson models predict the expected number of events per period (Greene, 2000). A referendum CV data analyzed by the traditional model using probit (or similar techniques) lets us estimate the probability that the specific person receives a vaccine. This probability distribution then can be used in preference

aggregation where multiple households are interviewed using linear pooling techniques (discussed later).

C. A random effects approach

The basic assumption in a random effects probit approach is that the decision to buy vaccines for members of the household is a combination of correlated decisions wherein the respondent considers each individual household member separately, and decides whether or not he will purchase a vaccine for that member. Thus the decision of a wife in a four-person household to purchase a certain number of vaccines is a result of four correlated yes-no decisions where she considers whether each individual within the household should receive a vaccine. The advantage of this design is that among other things, individual characteristics of specific household members could also be factored in the analyses.

The Random Utility Theory (McFadden 1974, and Ben-Akiva and Lerman 1985) can be used to model an individual's choice of family members who receive a vaccine. Each person derives a utility U by purchasing a vaccine for member j based on his own income y, and individual attributes X, Price of the vaccine P, and member characteristics Z (which include his age, education, relationship, income, and other features).

Thus, overall utility that a person in household i derives by purchasing a vaccine for a member of household k is

$$U_{ik} = V_{ik} + \varepsilon_{ik} \quad \ldots(3.15)$$

The indirect utility can be modeled as

$$V_{ik} = V(y_i - P, X_{ik}\,;\, \beta) \quad \ldots(3.16)$$

The structural probit model can be written as:

$$y_{ik}^* = \beta X_{ik} + \upsilon_j + \varepsilon_{ik}$$

$y_{ik} = 1$ if $y_{ik}^* > 0$, and 0 otherwise (Greene, 2000, pp.: 837)

$\ldots(3.17)$

(Here X_{ik} includes all parameters including price and income)

$$y_{ik} = \beta.\, X_{ik} + u_j + e_{ik} \quad \ldots(3.18)$$

D. Aggregating preferences and sharing weights

If multiple household members are interviewed, differences in preferences could make preference aggregation a challenge. Some preference aggregation mechanism such as behavioral aggregation is necessary.

If we have aggregated household responses for household WTP for a vaccine, these along with separate responses of individual members can help us estimate the sharing weights among household members.

The algorithm to determine sharing weights for preferences of different household members can be developed on the basis of the model proposed by Adamovicz et al (2005) (discussed in equation 2.3), in which the household utility is a weighted average sum of individual utilities.

Although the count model does not provide us with preference estimates, it does yield separate and aggregate welfare estimates in terms of WTP for a vaccine.

Assuming that the joint WTP is a function of separate husband and wife WTP as follows:

$$WTP_{Joint} = \omega.(WTP_{Husband,Separate}) + (1- \omega).(WTP_{Wife,Separate}) \quad \ldots(3.19)$$

This equation can be estimated by OLS regression (1) without a constant and (2) with a constraint that the sum of weights (i.e., sum of beta coefficients) to be equal to unity.

4. Modeling revealed preference

In the revealed model, I express height as a function of various individual, household and community-based characteristics. Since there could be multiple children in a household, a random effects regression is more appropriate to account for random individual differences in children within the household. The equations 3.7 and 3.8 are modified as follows:

$$h_{ik} = h_i(\mu_i, \mu_f, \mu_c, \mu_k, \sum y_m, \varepsilon_{ik}, \xi_i) \quad \ldots(3.20)$$

and

$$h_i = h_i(\mu_i, \mu_f, \mu_c, \mu_k, y_1, \ldots.. y_M, \varepsilon_{ik}, \xi_i) \quad \ldots(3.21)$$

where ε_{ki} = child specific heterogeneity.

When subjects include a wider range of age from newborn to teenaged children, it is difficult to conjure a universal indicator for all age groups, such as height-for-age or BMI. This is because growth spurts in adolescents may take place at

different times for different individuals. This problem can be modeled with two approaches. In the first approach, we use the height-for-age z-score as dependent variable. This is a reliable indicator of long-term investments in health until age 10. We introduce a dummy variable for children older than 10 to differentiate their growth patterns.

Equation 3.19 can be modified as:

$$h_{ik}^* = h_{ik}(\mu_i, \mu_f, \mu_c, \sum_m y_{mk}, \xi_{ik}) \qquad \ldots(3.22)$$

Where h_{ik}^* indicates the height-for-age z-score for individual i in household k

In the second approach I use stunting (height-for-age z-score less than 2.0) as the dependent variable, which is appropriate when stunting is prevalent in the population. In such a setup, we can apply Random Utility Theory (McFadden 1974, and Ben-Akiva and Lerman, 1985) to model an individual's choice of family members who do not receive proper nutrition and hence are stunted.

$$y_{ik} = 1 \text{ if } h_{ik}^* < -2, \text{ and 0 otherwise} \qquad \ldots(3.23)$$

Note that μ_f and μ_c vary only by household, μ_i varies for each individual, ξ_{ik} accounts for individual specific heterogeneity. Model 3.20 can be modified on similar lines as follows to mathematically represents households that do not pool:

$$h_{ik}^* = h_{ik}(\mu_i, \mu_f, \mu_c, y_1, \ldots, y_m, \xi_{ik}) \qquad \ldots(3.24)$$

for individual i in household k

$$y_{ik} = 1 \text{ if } h_{ik}^* < -2, \text{ and 0 otherwise.} \qquad \ldots(3.25)$$

5. The choice experiment

An individual's response to tradeoff that involves income pooling can help us assess whether the individual is an income pooler or not. Consider a hypothetical scenario involving a household with a husband and wife in which, the husband has to make choices between three situations, P, I and N in which, both husbands and wives receive payoffs. Let us suppose that the payoffs are designed as follows:

(1) Total payout for husband and wife together in state P is greater than total payout for husband and wife together in state N.

$$m_H^P + m_W^P > m_H^N + m_W^N$$

(2) Individual payout for husband in state N is less than the total payout for husband and wife together in state P.

$$m_H^N < m_H^P + m_W^P$$

(3) Individual payout for husband in state P is less than that in state N.

$$m_H^P < m_H^N$$

(4) Individual payout for wife in state P is greater than that in state N (follows from the constraints 1 and 3).

$$m_W^P > m_W^N$$

(5) The state P and N represent two extreme payouts. The payouts for state I are somewhere in between as follows:

$$m_H^P < m_H^I < m_H^N \text{ and } m_W^P > m_W^I > m_W^N$$

…..(3.26)

Where, m_i^L indicates the payout received by agent i in state L, and i=H and W indicate payouts for husband and wife respectively.

Pooling respondents using the common preference model of intrahousehold resource allocation, or any variant of the Becker's model such as the one suggested by Pollak (2003) in which both husband and wife have deferential preferences with the household utility is simply a weighted average mean of both husband and wife utilities, will always select the option that maximizes the utility possibility frontier of the household. I.e., a pooling husband will always choose a payout that yields the largest total payout (sum of payments to both husbands and wife). Based on the constraint expressed in equation 1, a pooling husband will choose state P. The same is not true about a non-pooling husband who will choose a payout that yields the largest total payout for himself. Based on constraint 3, he will choose option N.

By examining the choices made by respondents—P, I and N, one can categorize the respondent as pooling, intermediate or non-pooling.

Modeling experimental choice

The choices, an indicator of income pooling tendency, can be modeled on the basis of the random utility theory setup of McFadden (1974) and Ben-Akiva and Lerman (1985). Since the respondent has a chance to select any of the three choices presented to him, he will select the option that will maximize his expected utility. Let the expected utility for the individual i, be of the form,

$V_{ij} = X_i\beta_j + \varepsilon_{ij}$ where j = 1, 2 and 3 represent choices P, I and N respectively.

This model can be solved as a group of linked binary probits using the Multinomial probit model. A crucial assumption in the multinomial probit model is that the choices are unordered (nominal) and Independence of Irrelevant Alternatives.

If individual i is a utility maximizer, the probability that he selects a card represented by choice 1 is:

$P_{i1} = P(V_{i1}>Vi2, V_{i1}>V_{i3})$

The multinomial probit assumes that errors for εij are multivariate normal with mean 0 and covariance matrix.

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & . & \sigma_{1n} \\ \sigma_{12} & \sigma_{22} & . & . \\ . & . & . & . \\ . & . & . & . \\ \sigma_{1n} & . & . & \sigma_n^2 \end{bmatrix}$$

$$\Pr(\text{Choice}=m|x) = \int_{-\infty}^{\beta X_1} \dots \int_{-\infty}^{\beta X_{m-1}} f(\varepsilon_{i1},\dots,\varepsilon_{i,m-1})\partial\varepsilon_{i1},\dots\partial\varepsilon_{i,m-1} \qquad \dots(3.27)$$

Where m represents the probability of observing an outcome m given x and f(·) represents the density function of the multivariate normal distribution.

As a respondent had to choose multiple times, his different responses are likely to be correlated to each other. In addition, the husband and wife responses are also likely to be correlated as they live in the same household, and share many things. As a result a seemingly unrelated regression multinomial probit framework, with robust standard errors clustered at the household level is the most appropriate model to produce unbiased estimates.

CHAPTER 4

Research Design, Fieldwork and Ethical Aspects

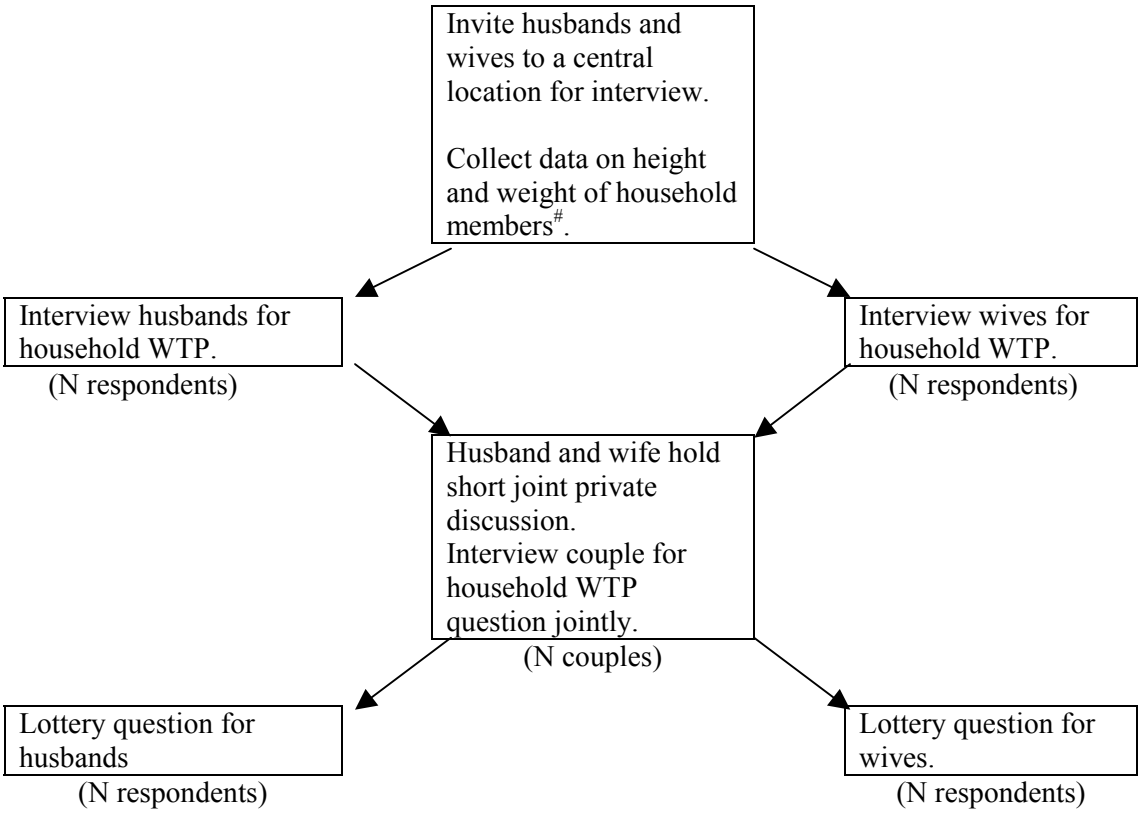
1. Research design

The research design addresses the three different components of the conceptual framework presented in Chapter 3. For the stated preference component and the choice experiment, I focused on the two-person dyad of husband and wife, one of whom is the head of the household. This dyad is perhaps responsible for most of the decision-making in the household, including decisions on health. Restricting the analyses to just two persons within a household provides us with several advantages including logistical convenience and simpler mechanisms for aggregation of preferences. But at the same time, it enables us to examine some of the fundamental questions such as whether multiple members within the household have similar preferences and other aspects of intrahousehold resource allocation.

The contingent valuation module and the lottery choice experiment were combined in the form of a survey with two distinct components—household WTP for a malaria vaccine and a lottery section with real payoffs. Husbands and wives were invited to a central office and interviewed twice—separately first and jointly thereafter for their household WTP for a vaccine. They were again separated for the lottery question. For the revealed preference component, height and weight for each individual available in the household was collected.

The research design is summarized in the figure 4.1.

Figure 4.1: Research design



N = Sample size= 422 households.
#: Multiple trips may be necessary for collection of anthropometric data

2. Site selection and malaria disease

The research design required a study site with an endemic disease where respondents feel that they are at risk of getting infected and wish to take preventive measures such as purchasing a vaccine against that disease. For a successful stated preference experiment, it was also imperative that there not exist a private market for the vaccine. Further, the region needed to offer enough variation among status of women within the household to test the hypothesis for different models of intrahousehold resource allocation. For external validity and broader policy

significance of the results, it was imperative that the disease be seen as a problem, especially in developing countries where this research was to be conducted.

The appropriate combination of disease and city was offered by the endemic nature of malaria disease in the city of New Mumbai, India located in the state of Maharashtra. Maharashtra is among the high malaria prevalence states in the country. Maharashtra is also one of the more progressive and gender equitable states in India. The overall literacy rate is 77% (86% for males and 68% for females) as compared to 65% for the nation (76% for males and 54% for females), making it more interesting to study household bargaining. A brief note on the city of Navi Mumbai and the prevalence of malaria in it is given in Appendix III. A general note on malaria disease is given in Appendix IV.

3. Design of different modules of the research

The entire survey instrument along with all the charts, invitation letters and consent letters is attached in Appendix V.

A. Willingness to Pay sequence

Respondents were assessed for their knowledge of malaria and vaccines and provided information about the symptoms of the disease, how the disease spreads, how one can protect herself from the disease, and vaccines in general. This was followed up by a presentation of the hypothetical scenario. The hypothetical scenario for this experiment was designed on the basis of that being used by the UNC-Chapel Hill Economics team headed by Prof. Whittington on their work on the DOMI program for International Vaccine Institute (IVI). The instrument mentioned above

has been pre-tested and used successfully in different countries including India for studying the WTP for cholera and typhoid vaccines. Although the instrument was customized to each region, the development of hypothetical scenario testing for comprehension of the concept of efficacy has been well tested. The charts used in the experiment are attached in Appendix V within the survey instrument.

We used the referendum question similar to the one used by Cropper et al (2004). Respondents initially were asked whether they would buy the available vaccine for one or more members of their family. If the respondent replied in the affirmative, he was asked who he would be wiling to pay the vaccine for. This was followed by questions asking the respondent why he would/or would not buy the vaccine. This was followed by the joint section in which the respondent husband and wife were asked for their household WTP jointly. They were provided with about two minutes for a private discussion[8]. The respondents were not forced to give the same answer as the joint responses to WTP of both husbands and wives was recorded for the joint interview. However, they had to respond in front of each other.

The final prices selected after the pretests were Rs. 10[9], Rs. 25, Rs. 50, Rs. 150 and Rs. 500 (approximately $0.22, $ 0.54, $1.09, $3.26, $10.87). The efficacies offered were 50% and 95%, whereas the duration offered was 10 years[10].

[8] In the first pretest, there was no time provided for discussion. However, I found that one of the husband or wife responded, and the other simply nodded. I then chose randomly a time of two minutes during the pretest and also added some cheap talk. We found that the interaction among husband and wife increased (especially if they had differences of opinion). As a result, this time of two minutes was maintained. We did not try different times for discussion during the other pretests. Some couples reached the decision faster (especially at higher prices). However, we did not keep track of how much time it took for couples to reach a decision.

[9] The exchange rate used in the dissertation is 1 US dollar = 46 Indian Rupees.

[10] As discussed in the Appendix, the recent clinical trial in Mozambican children of the Glaxo, RTS, S/ASO2A vaccine has shown efficacy of 30% for malaria and 58% for severe malaria in children.

B. Collecting anthropometric data

The height was measured with the help of a wooden staff or tape, and weight was measured by a digital or a mechanical weigh balance (with an accuracy of 0.5 kg). Length was measured for children younger than two years of age. Sometimes respondents took multiple trips to take anthropometric measurements.

The quality of anthropometric data for children under two years of age is not accurate as some of the children were not co-operative and the weighing balance did not guarantee accuracy of weight measurements under 10 kg (22 pounds).

C. Design of the lottery sequence

Based on the conceptual framework and the constraints discussed in equation 3.26, a lottery experiment was designed with real payouts for both husband and wife. The focus of the design in the lottery sequence was on the development of two extreme choices that could help us differentiate between poolers and non-poolers.

I added an element of risky choice by introducing two states g and b, each denoting a good luck payout and a bad luck payout respectively, to be decided by a toss of a coin. The extreme choices A and B offered to the husband are designed such that the good luck payouts are as follows:

$$m^{P}_{Hg} + m^{P}_{Wg} > m^{N}_{Hg} + m^{N}_{Wg}$$

$$m^{N}_{Hg} < m^{P}_{Hg} + m^{P}_{Wg}$$

$$m^{P}_{Hg} < m^{N}_{Hg}$$

$$m^{P}_{Wg} > m^{N}_{Wg}$$

$$m^{P}_{Hg} < m^{I}_{Hg} < m^{N}_{Hg} \text{ and } m^{P}_{Wg} > m^{I}_{Wg} > m^{N}_{Wg}$$

(These are the same equations as in 3.26, except with an added subscript g, which denotes payouts in good luck scenario).

…..(4.1)

The bad luck payout is always zero, i.e., $m^{A}_{ib} = m^{B}_{ib} = 0 \; \forall$ i

The addition of bad luck payouts allowed us to double our sample size for the same resources as the expected value of payout dropped by half. Maintaining bad luck payout to zero reduced cognitive burden on respondents, helped us maintain a constant coefficient of risk aversion for all levels of payout and provided an opportunity to non-pooling respondents to hide their winning (by telling their partners that they did not win the lottery).

Details of the actual payoffs offered to the respondents are reported in Table 4.1. Cards P, I and N represent the pooling, intermediate and non-pooling states respectively of the lottery described in equation 4.1 and 3.26. The certainty equivalent of the lottery reduces for the income pooler from card P to N, but increases for the non-income pooler. The intermediate card, I serves as an opt-out for respondents who are not sure which card to pick. Thus, an individual can receive a maximum amount of Rs.65 for himself if he chooses the option I at the level 16X. This is approximately

1.4 times the daily minimum wage of Rs. 45 in the state of Maharashtra (Ganesh-Kumar et al. 2004).

Table 4.1: Good luck payouts for the three levels (Rs.)

Card #	Prospect	Level X	Level Y = 4X	Level Z = 16X*
P	You win	2.50	10.00	40.00
	Your spouse wins	2.50	10.00	40.00
I	You win	3.00	12.00	50.00
	Your spouse wins	1.50	6.00	25.00
N	You win	4.00	16.00	65.00
	Your spouse wins	0.00	0.00	0.00

The game was played in three levels, level X, Y and Z, with the level of payout raised gradually for each level with a factor of 4. The game was played in ascending order of payout levels, i.e., the smallest payout level (X) was always played first and the payout level of sixteen times X played the last. This ensured that interest in the lottery game stayed throughout the experiment. The good luck payouts for the all the cards are shown in the table 4.1. An actual lottery card used is shown in figure 4.2. The cards did not display the labels of the level.

Figure 4.2: Layout of the lottery card

	Good Luck Payout	Bad Luck Payout
		
Outcome	Heads	Tails
You win	2.50	0
Your wife wins	2.50	0

Each respondent had to play all the levels, irrespective of whether the respondent was literate or not as some illiterate respondents may be able to read numbers. To make sure that the respondent understood the scenario, the lottery module started with an explanation of the experiment and a trial run was taken with different cards without any real payout. The respondents were asked three questions based on this trial run to screen respondents who did not understand the scenario.

The lottery experiment was offered to all the couples and played for real for all couples at all levels. For a particular level, all the three cards were shown simultaneously with no particular order. The husbands and wives were given coupons, which were reimbursed immediately after the end of the experiment by the supervisor in a sealed envelope. Those respondents who earned less than Rs. 10 were handed out a payment of Rs. 10.

D. Attitudinal and demographic variables

Among other things, WTP for a vaccine could be dependent upon the respondent characteristics, household characteristics, social and cultural issues. As a result, the survey instrument was designed to capture some of these variables.

Important data collected included information on composition of household members, gender and education of the household members, their relationship to the respondents, household size, etc.

The tests of intrahousehold allocation are dependent upon the quality of income data. Data were collected on labor income, wage rate, the number of hours worked, as well as non-labor income and its source. Data were also collected on variables that could indicate status of women such as whether parents had land and if so how much. Data on indicators of household socio-economic status such as assets, property, utility bills and consumption expenditures as well as type of toilets, water connections, type of roofing, flooring, and walls, number of rooms, etc. were also collected. To assess the role of social and cultural norms, data was collected on religion and dowry. Since people were reluctant to answer whether they paid dowry during their wedding, they were asked whether the practice of dowry existed in their caste. To identify attitudes towards preferential treatment of male children, respondents were also asked who they feel would support them in their old age. They also were asked their opinion on level of education that boys and girls should attain and whether they saved for the education of their sons and daughters. To examine the level of autonomy enjoyed by women, components from National Family Health Survey of India, 1998-99 (IIPS and ORC-Macro (2000)) that inquired about the

decision role played by women in cooking, health-care, purchasing jewelry and major appliances, staying with siblings were incorporated in the survey.

E. Language

The slum has an ethnic mix of people coming from different geographical areas. The local Hindus and Buddhists were native Marathi speakers. The Muslims and those coming from the north were native Hindi speakers, but some did understand Marathi well and chose to be interviewed in Marathi. As a result, the survey instrument was translated into both Marathi and Hindi. The final survey instrument was bilingual in Marathi and Hindi. All the enumerators were fluent in both Marathi and Hindi.

4. Fieldwork

The fieldwork started from October 2005, and lasted until the middle of March 2006. A team of 12 enumerators and one supervisor was assembled. Enumerators were bilingual in Marathi and Hindi.

Initially a total of three teams (of three enumerators each) were formed. At least one woman enumerator was always maintained with each team to interview female respondents. Each team also was provided with an assistant. After about a week into the survey, managing three teams was found to be difficult, and the number of teams was brought down to two. Each team was restricted from conducting more than eight interviews per day, so as to maintain quality of the work. There were two

supervisors, including myself. A consultant who had worked with a local NGO and had a master's degree in social work was hired to assist in the design of fieldwork.

A. Confidentiality of Responses & Field Protocol

It was important in this study that husbands and wives didn't know beforehand that they would have to respond jointly later to make sure then they didn't have an incentive to align their responses based on their partner's response. During separate interviews, husbands and wives were likely to answer the questions based on an assumption that their responses would remain confidential from their partner. A joint interview could be viewed as a breach of trust that the respondent had with the enumerator and hence a major issue of ethical concern in the study. The weakest link in maintaining confidentiality is perhaps the enumerator. No matter how well trained, an enumerator could directly or indirectly reveal what the wife said to the husband (and vice-versa). Overhearing children or neighbors could also compromise the confidentiality of responses.

These risks were mitigated with the help of an appropriately designed consent form, and taking extra steps to maintain a high level of confidentiality in the survey, especially the privacy of the respondent and making sure that private conversations remained private.

The IRB requires that respondents be briefed beforehand without any deception about the tasks that they have to complete. The survey required a consent form that respondents not be informed about the joint interview before the separate interviews were completed. The IRB does allows surveyors to ask respondents

whether they may be interested in follow-up surveys. Although the respondents were not told upfront about the joint survey, there was no deception in the consent form. Instead, the consent form was split into two parts. The respondents were told in the first consent form that the project had two phases and additional information about the second phase would be given only after the first stage was finished. Consent was taken for phase 1 only. The second consent form then contained information about the section where respondents have to answer jointly. In case the respondents later refused to answer the joint section they were provided with an opportunity to quit the survey.

The following fieldwork protocol was adhered to maintain both the privacy and confidentiality of the respondents.

1. Every morning, the four members of each team reported to the designated field site. They were handed a list of the households that needed to be interviewed for the day. The primary responsibility of inviting respondents to the central office lay with the supervisors and the assistants. When there were not enough interviews, enumerators also went in the field to seek appointments. The assistants were trained to seek appointments and to fill out the first three sections of the questionnaire and take measurements for height and weight. For the joint interview, husbands sometimes went into the wives' room and vice versa.
2. Husbands and wives were invited to a central location for the main interview. Except for some basic data such as measurement of height, weight of family members, household composition, and some preliminary demographic information, all other information was collected at the central location.

3. Husbands and wives were interviewed in separate rooms. Sometimes if the central office was big, temporary partitions were erected in between. Maximum effort was made to ensure that husband and wife could not hear each other's responses. In a couple of instances when one of the partners was not able to make it to the office, he/she was interviewed at home and the other partner was interviewed at the office, and joint interviews were conducted at home.
4. Husbands and wives were interviewed by different enumerators. The moment they finished their individual responses, the survey questionnaires were returned to the supervisor. An enumerator, different from the above two conducted the joint interview. Thus, a total of three enumerators formed a single interviewing team.
5. Enumerators were trained not to discuss respondent and family characteristics among themselves.
6. Enumerators local to a specific area were not allowed to conduct interviews. No enumerator was allowed to store or transfer data.
7. Completed questionnaires were not kept with the enumerators or in the site office overnight. Every evening, they were transported to the data entry office located away from any of the survey sites.
8. Collection of height and weight often required multiple trips to the household. The section that included data on height and weight was kept separate from the other part of the questionnaire (with separate and joint responses) until it was completed. This information was later shared with the household.

The data entry software was generated with provisions for double data entry. A data entry operator was hired for one set of data entry. The second data entry was contracted to another agency, Caretech.

5. Pretests

A total of four pretests were conducted on 120 households (240 respondents) in four neighborhoods. The first couple of pretests displayed tendencies of the respondents to indulge in yea saying. The structure of the questionnaire was modified and cheap talk was introduced, which reduced the amount of yea saying in the later pretests. Another problem was the poor quality of discussion in the joint section. More often than not, only one of the respondent husband or wife responded, and the other simply nodded. To ensure a good quality of discussion between male and female respondents, husband and wife had to compulsorily spend about two minutes discussing with each other whether they wanted to buy a vaccine for anyone within the household. The enumerator did not stay in front of the husbands and wives during this discussion. This worked really well as couples were discussing more actively whether to purchase a vaccine or not.

6. Sampling size and sampling frame

The vaccine offered in the hypothetical scenario had two efficacies, (95% and 50%), a single duration (10 years) and five prices. Assuming a cell size of about 35, the required sample size was about 350 households.

The Navi Mumbai Municipal Corporation identifies areas with an annual parasite index (number of cases per 1000 of population) of greater than 2 as priority areas for malaria. A list of slums having API greater than 2.0 was compiled from the different urban health posts. The Khairne UHP was selected for the survey as it was the most severely affected by malaria. The slums Shramik Nagar and Hanuman Nagar (Mahape) were selected from this UHP. Officials at the Navi Mumbai Municipal Corporation recommended that Ramabai Nagar from Belapur UHP also be included in the study. A slum with a low risk of malaria, Hanuman Nagar (Turbhe Naka), was also selected as it was near the slums interviewed in Khairne UHP.

Sampling in slums is always a difficult proposition. Slums change dynamically, both in terms of population and in the number of tenements. Local elected officials were wary of us using electoral lists, which is one possible sampling frame. This could be because of discrepancies that may exist between the population actually living in the slums and the population registered for elections. Since it is difficult to conduct fieldwork in slums without the consent of the local politicians, this sampling frame was rejected.

Fortunately, each household has a "household survey receipt" whose number is written on the door (generally in red ink). The survey receipt that bears this number is considered equivalent to a "title" by the slum dwellers. If a slum is acquired for some government project, these survey receipts help decide the duration of stay and hence whether the household qualifies for any compensation. Newly painted or replaced doors did not display these numbers, but the dwellings were numbered sequentially (as best possible in a slum) and household members were willing to

show the survey receipt. To sample within the slum, a reconnaissance survey was conducted to find the starting number and the ending number for the survey receipt, and random sampling was conducted using the "sample" command from STATA.

Finally, a total of 422 couples in 422 households living in these four slums were interviewed. The final price-cell combinations that were offered in the survey are reported in table 4.2.

Table 4.2: Actual price-efficacy cell combinations

Price (Rs.)	50% effective vaccine	95% effective vaccine	Total
10	41	45	86
25	40	45	85
50	41	43	84
150	43	49	92
500	35	40	75
Total	200	222	422

7. Managing logistics

In the field, there were two particularly difficult tasks. The first one was to find husbands and wives together at home at the same time. The second was to make sure that they come to a central place where they could be interviewed within that time frame.

In the pretests, the survey team found it difficult to recruit couples living in neighborhoods other than slums for interviews because many husbands worked full time, left home early and returned back late in the evening. With women enumerators in the team, it was difficult to work late in the evening. Similarly, it was difficult to recruit couples early in the morning, as they were busy getting ready to work.

In slums, however, recruiting was lesser of a problem because of the differences in the daily routine of residents. First of all, fewer numbers of slum dwellers had a full time job. A majority of husbands were daily wage earning laborers. Every morning, they turned up at a recruiting market where, if lucky, they got a job for the entire day (or sometimes a week). If not, they would return home before noon and remained free for the remaining of the day. Some husbands had flexible work hours (e.g. auto-rickshaw drivers) came home for their midday meal and a short nap and were willing to be interviewed in the afternoon. People who worked in quarries and construction work often had Friday as a free day whereas people working in factories had their Sunday off. As a result, we effectively had two days in a week to recruit full time workers for our survey.

Recruiting women was not much of a problem. A majority of the women stayed at home where they were housewives, or managed small in-home businesses such as tailoring, etc. The other major group of women worked as housemaids. These maids generally went for work early in the morning, served in about 8 to 10 households and returned back by late afternoon, and were available to be interviewed after returning home. Few women who worked full-time followed a similar schedule as male full-time workers, and were generally available on Fridays or Sundays.

The field supervisor and local field workers were mainly responsible for recruiting couples for interview at a central place. This resulted in enumerators spending less time traveling and searching for houses during the peak hours when people would be at home. During the pretests, we found people reluctant to travel to a central location, if the commute was more than a ten-minute walk. As a result, we had

to choose multiple central offices in a single community[11] so as to encourage participation of respondents.

8. Mitigation of ethical risks

Social and behavioral research bear risks such as psychosocial stress and discomfort, disruption of family relationships emanating from leak of data, and stress and discomfort from being asked personal questions and being deceived (Dickstein et al., 2004). Some of these risks could be harmful as their effects may be "less predictable, more subjective and variable, and less remediable than physiological harms." Whittington (2004) points out some of the issues that make ethical conflicts even more pervasive in contingent valuation studies and that such studies can "mislead, confuse or worry" respondents. Information provided could be leaked to the public resulting in stress, discomfort and loss of reputation or livelihood. Information could also be used to design policies, which affect respondents adversely. Invasive questions not disclosed in the consent form further increase the unanticipated costs on the respondent.

The risks applicable to this study other than those emanating from lack of confidentiality (already discussed) and the procedures adopted to mitigate them are described in table 4.3.

[11] There was only a single office in Ramabai Nagar, which is a relatively smaller slum. Further, the terrain was such that almost everyone going in and out of the slum had to pass near the selected central office.

Table 4.3: Generic ethical risks

Source of risk	Risk	Mitigation
Hypothetical scenario involving vaccines (deception)	Persistent belief after end of experiment may change behavioral patterns and increase respondent risk	Appropriate debriefing at the end of the experiment
Split sample design	Psychosocial risk for fact that neighbors may be offered different prices/ scenarios	Appropriate debriefing at the end of the experiment
Inappropriate sampling	Selecting specific respondents meeting a certain ethnic, racial or other profile	Random sampling
Information provided about malaria	Inflicted insight (Dickstein et al., 2004)	A positive externality of the research.
Questions on WTP, choice of lottery	Stress	By including statements such as "no right or wrong answers" and cheap talk.
Female respondents interviewed by male enumerators	Discomfort, disregarding of social norms	Make sure that there exists a female enumerator to interview a female respondent
Magnitude of compensation	Too high or too low	No gift, lottery instrument acts as compensation. Maximum and minimum levels agreed upon by IRB.
Confidentiality not maintained by local team	Local team provides escape hatch to IRB commitments	Pledge of confidentiality by the local team, proper training of enumerators. Make sure that enumerators don't carry questionnaires home with them. Proper supervision of enumerators.
Inappropriate information about costs of the survey to the respondent	Lack of "Respect for persons"	Truthful oral informed consent.
Unsafe storage of data	Loss of confidentiality of the survey	Maintain proper storage procedures for storage of questionnaire and data. Personal information to be stored separately with a key.

CHAPTER 5

Results: Profile of Sample Respondents

1. Living conditions of the respondents

The living conditions in the slums surveyed can only be termed as tough. The poorest within the slums used only plastic polythene for walls and roofs. Overall plastics covered 32% of the walls and 33% of the roofs. Two of the communities, Shramik Nagar and Ramabai Nagar, were relatively poorer, with 71% and 80% of the dwellings respectively with roofs covered with plastics. Other prominent materials in roofing included corrugated cement sheets (55% of dwellings) and Galvanized Iron or Asbestos sheets (10% of dwellings). Walls were made of plastered bricks (48% of dwellings), Galvanized Iron/ Asbestos (12% of dwellings), and mud (7% of the dwellings). The flooring material included cement floor (72%), Mosaic floor tiles (12%) and polished stones (10%) and mud. Only about 46% of the households had a window in their dwelling and a few (only 4%) of the dwellings had either an additional storey or an additional loft. The average number of rooms was low at 1.18 with about 85% of the dwellings having only a single room, and another 12% with two rooms.

Many dwellings included in our study lacked some basic amenities like electricity, piped water and sewerage. While some of the respondents had their own electricity connection from the utility, others rented electricity from their neighbors or

landlords for a monthly lump-sum fee. Again, the two communities of Shramik Nagar and Ramabai Nagar had lower electricity coverage of 22% and 60% respectively as against the other two slums, which had universal coverage. A few people in these two relatively better off slums did not have electricity in the house, as they could not afford the extra premium extorted by landlords for the electricity. For households having electricity and paying a monthly bill or rent for the same, the monthly expenditure on electricity was Rs. 298.6 (about $ 6.5) per month. Almost everyone (99% of the respondents) used shared piped water connections. Only four respondents reported having their own private water connection and one respondent reported that he pilfered water from a tap in a municipality water main. Water in public taps was available only for a few hours daily. About 31% of the households said that they did not have access to any toilet facilities and had to defecate in the open. 70% of the respondents said that they used public toilets. Some of the public toilets were not available for free and charged a Rupee for each use. These toilets did not have soap or sometimes even wash-basins for washing hands after defecation. About 4% of the respondents used a port-a-potty provided by the government (which was available for free). Again such port-a-potties did not have any wash-basins or soap. Only one respondent reported using a flush water closet shared with neighbors and five respondents reported that they had a water closet in their house for personal use.

About 13% of households had a telephone land line and 15% of the households reported having at least one member of the household possessing a mobile phone. Kerosene was the main fuel used in about 52% of the households. Another

37% relied on firewood whereas only 11% of the households used Liquefied Petroleum Gas (LPG).

Ceiling fan, pressure cooker and televisions (color and black & white combined) were the three most commonly found assets. Table 5.1 shows some of the sought after assets and the proportion of households possessing them.

Table 5.1: Assets in households

Asset	% household possessing it
Ceiling fan	61
Pressure cooker	49
Grinder	35
Color TV	29
Black & White TV	20
FM radio	19
Bicycle	15
Cabinet	15
Portable fan	13
Refrigerator	3

About 26% of the respondents did not possess any of the above-mentioned assets, with most of these having no electricity. These were indeed the poorest among the poor.

2. Demographics

The average age of husbands and wives interviewed was 36.6 and 29.8 years respectively. The mean household size was higher at 4.6 (with a minimum of three and maximum of ten members) compared to 4.3 for the Navi Mumbai Municipal Corporation (Census India, 2001). Although there were on average 4.2 persons living in each room, the density was higher in dwellings with only a single room at 4.6 persons. As many as 97% of the families were nuclear, i.e., only the respondent

couple and their children lived in the household. This is hardly surprising given the space, or rather the lack of it. There were a few instances of in-laws living in nearby or adjacent dwellings. They were not classified as household members.

42% of husbands reported receiving no schooling at all. About 9% of the husbands reported receiving some level of primary education (grade 1-4), 27% received some level of secondary education (grade 5-9), 19% received some level of higher secondary education (grade 10-12). Only ten husbands had a bachelor's degree and one respondent had professional education. Education levels reported by women were even lower with about 63% reporting no schooling, 7% reporting primary education, 23% reporting secondary education, and 6% reporting higher secondary education. No woman interviewed in the sample studied more than 12^{th} grade. Low literacy levels also can be seen by the fact that about 44% of husbands and 58% of wives said that they were unable to read a newspaper.

The low literacy rates for men and women made explanation of the hypothetical scenarios for stated preference studies challenging. To make sure that respondents understood the vaccine efficacy scenario, enumerators explained the concept of efficacy a maximum of two times and tested for respondents' understanding after each round. If respondent failed after two rounds of explanation, the enumerator proceeded with the hypothetical scenario without explaining again. However a total of 94% of men and 87% of women interviewed passed the efficacy test, of which 84% of males and 80% of females passed the efficacy test in the first round. Of the 49 women who did not pass the efficacy test, 42 (86%) had never attended school, and another three had reported having attended only primary school.

About 54% of the respondents were Hindus, followed by 31% Buddhists and about 14% Muslims. This distribution was different from that of the state of Maharashtra which has 81% Hindus, 10% Muslims and 6% Buddhists for the state of Maharashtra. As evidenced in the data, the number of Buddhists living in slums was noticeably higher. The mean household size for Muslims (5.1 persons) was significantly higher than that for Hindus (4.6 persons) and Buddhists (4.4 persons).

3. Knowledge about malaria

45% of husbands and 14% of wives knew of someone infected with malaria. About 21% of husbands reported having been infected with malaria some time in their life as against only 3% of wives. However, only 2% of the women reported that their husbands had malaria in the past. 7% of husbands and 4% of wives reported that their children had been infected by malaria in the past. Only 8% of husbands and 2% of wives knew someone who died because of malaria.

98% of husbands and 94% of wives opined that a mosquito bite could cause malaria. However, not everyone was sure how people are infected with malaria as 32% husbands and 31% for wives felt that even drinking unboiled water could also cause malaria.

Almost all of the husbands and wives felt that it was necessary to treat a person infected with malaria and that modern medicinal practices helped. About 58% of the husbands and 67% of the wives felt that malaria could also be cured using Ayurvedic practices (traditional herbal medicine). About 40% of husbands and 67% of wives felt that religious practices such as praying and drinking holy water could

also help in curing malaria. In India, chloroquine is the malarial drug of choice as there is little drug resistance to it. However, there was very low awareness about chloroquine as only 4% of husbands and 2% of wives knew about this medicine. A few respondents confused chloroquine with chlorine drops that are added to water as a disinfectant.

Respondents were asked whether the following were effective ways of protecting from malaria: 1) keeping the house and environment clean/ draining wet areas, 2) sleeping under the bed net, 3) burning cow-dung/leaves to generate smoke, 4) spraying household insecticide sprays, 5) applying mosquito repellent creams to the body, and 6) burning mosquito repellent incense (refer table 5.2).

Table 5.2: Protection from getting malaria

"What can we do to protect us from getting malaria"	% of Husbands	% of wives
Keep house and environment clean/ drain wet areas	98	91
Use a mosquito net	97	90
Burn cow-dung, leaves to generate smoke	74	79
Use household insecticide sprays	92	86
Apply mosquito repellent cream to body	58	72
Use mosquito repellent incense / mats[12]	91	85

4. Knowledge about vaccines

Almost all of the respondents (97% of husbands and 95% of wives) had heard about vaccines and more than 87% of the couples had vaccinated their children as part of the national immunization program. However, almost a third of the respondents didn't know the purpose of vaccination, and another half felt that the

[12] The popular brands used in the survey included—Tortoise (Kachwa-chaap) for mosquito repellent incense and Good-Knight for mosquito repellent mats.

purpose of a vaccine was to prevent disease in children only. 2% of husbands and 15% of wives thought that a vaccine helps to cure a disease.

In addition to illiteracy, there may be reasons why respondents felt vaccination to be the domain of children. Almost none of the persons interviewed had been vaccinated against any disease and their children were generally the first generation recipients of vaccines in their families. They probably knew no one who had received any kind of vaccine as an adult. One of the successful campaigns of the National Immunization Programme (NIP), the polio eradication campaign, is targeted toward infants, and has succeeded in creating strong public awareness, thanks to celebrity endorsements on television and other media. For many of the slum members, "vaccination" was synonymous with oral drops of polio for their children recommended by Amitabh Bachchan, their favorite Bollywood superstar on TV. This may have implications for a private market for a vaccine as the potential benefits of a vaccine to adults may have to be explained carefully.

Almost 16% of husbands and 25% of wives reported at least one child having received the hepatitis A vaccine. Husbands reported a total of 169 children (90 boys, 69 girls) had received a hepatitis vaccine and paid an average price of Rs. 42.9 (US$0.9) whereas wives reported about 225 children receiving a hepatitis vaccine (119 boys and 106 girls) and paid an average price of Rs. 46.2 (US$ 1.0).

5. Occupation and income

Poor education resulted in low quality jobs as can be seen by the occupations of the respondents. About 47% of the respondent husbands were daily wage

laborers[13] and another 29% had a salaried job that required low level of skill. 6% were factory workers, 5% of the respondents had a salaried job that required a moderate amount of skill 3% were artisans and 2% were shopkeepers. Only 3% reported themselves as unemployed. The remaining 5% of the respondent husbands worked as "*Mathadi*" workers[14], hawkers, professionals, small scale businessman, managerial level employees or housemaids. Among self-employed men, many were auto rickshaw drivers.

About 70% of the women were housewives, with the rest having low quality jobs. About 14% were daily wage laborers, 10% were housemaids[15] and 3% had a salaried job that required low level of skill. The remaining 3% of the women worked as shopkeepers, factory workers, hawkers, professionals, small-scale businesswomen, and managerial and middle level salaried employees.

For working men, the mean daily wage rate was about Rs.113.1[16] and the median daily wage rate was Rs. 100.0 (US$ 2.2). For women, the mean daily wage rate was about Rs. 52.9 (US$1.2) and the median daily wage rate was Rs. 50.0 (US$1.1). Husbands and wives who worked were working an average of 51.5 and 42.9 hours of work per week respectively. The average monthly income (labor and non-labor) was Rs. 3531.1 (US$76.8) for husbands and Rs. 748.7 (US$16.3) for wives. 7% of men and 58% of the women did not have any source of labor or non-

[13] Daily wage earners are called "bigari mazoor" literally meaning laborers who are not on a payroll.

[14] Mathadi workers are those who specialize in heavy load lifting. They work in the nearby factories, are represented by unions and can earn as high as Rs.15,000 per month.

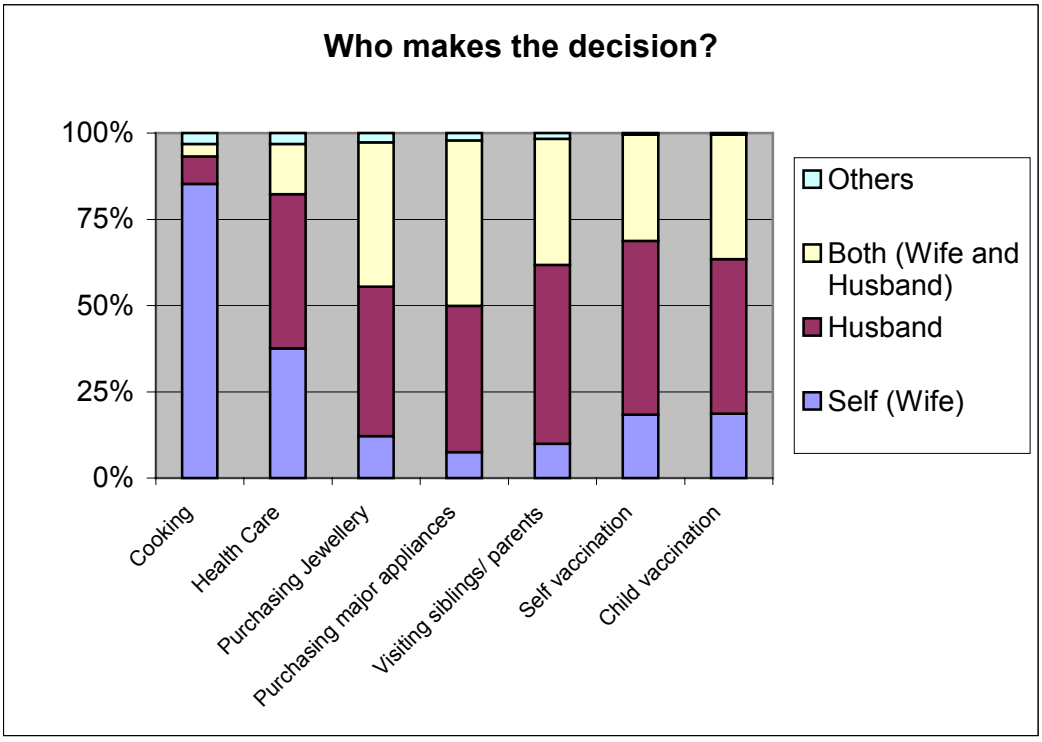
[15] Housemaid is called "Mol-karin," which literally translated means one who works for wages.

[16] Exchange rate assumed is Rs 46 = 1 US$.

labor income. Most of these women were housewives. For women earning some labor or non-labor income, the average total income was Rs.1938.2 (US$42.1). Only 4% of husbands and 6% of wives owned some land or property other than their own house. Major sources of non-labor income included annual bonus, rent income from other homes or vehicles (auto rickshaws) and transfers from children or parents. Other minor sources included transfers from friends, interest income and income from insurance policy.

6. Decision-making within the household

Figure 5.1: Household decision-making questions asked to women



In the survey, wives were asked how they made different household decisions. Figure 5.1 indicates how wives felt that decisions were made within the household. As expected, cooking was under the wife's domain with almost 85% of the women

making cooking decision by themselves. In all other intrahousehold decision-making, wives reported that husbands played an important role in decision-making and depending upon the decision to be made, almost 43% to 52% of husbands were the decision makers. At the same time, the data demonstrate some households making decisions jointly as can be seen by the proportion of wives reporting joint decision-making in health care (14%), purchasing major jewelry (42%), purchasing major appliances (31%), visiting siblings/ parents (37%), vaccination decisions for the wife (27%) and for children (36%). Table 5.3 shows that the proportion of women, who reported that they play some role in the decision-making process (those who reported making decisions themselves or jointly with their husbands) for our survey is comparable to that for the state of Maharashtra as seen in the National Family Health Survey, 1998-99 (NHFS-2).

Table 5.3: Women playing some role in household decision-making

% involved in decision-making (self or with husband)	Survey	Maharashtra (Urban)
Items to be cooked	89	87
Health care for herself	52	58
Purchasing jewelry, etc.	54	55
Staying with Parents/ siblings	46	49
Not involved in any decision-making	8	7

All figures in percentages.
* Source for Maharashtra (Urban): Center for Operations Research and Training and IIPS (2000).

Figure 5.1 and table 5.3 also indicate how the husband-wife dyad is responsible for most of the decision-making taking place in the households.

7. Household financial arrangements

To examine the issue of income pooling, husbands and wives were asked separately to describe the financial arrangements within their house[17]. These arrangements are reported in table 5.4. Of the 419 couples in which both answered the question, about 53% of the husbands and 73% of the wives said that they made managed household expenses jointly. However, only 39% of the couples agreed with their spouse's assessment of the way household finances were managed. Both the reported household financial arrangements and the extent of women's involvement in decision-making within the household indicate at least some level of decentralized decision-making within the household.

Table 5.4 Household financial arrangements

	Husband's assessment	Wife's assessment
Joint	53%	72%
Independent	0%	3%
Except for wife's personal expense, husband looks after the household	8%	4%
Except for husband's personal expenses, wife looks after household	17%	2%
Wife given a housekeeping allowance, husband makes all financial decisions	22%	16%
Husband given a housekeeping allowance, wife makes all financial decisions	0%	3%

[17] This question was adapted from Bateman and Munroe (2003a).

CHAPTER 6

Evidence from Household Demand for Malaria Vaccine

1. Module objectives

This chapter summarizes the results of the stated preference study to determine household demand for a malaria vaccine. The objectives of this chapter are as follows:

1) Examine whether the husband and wife have different preferences. Explore socio-economic factors that affect husband and wife opinions differently.
2) Explore the impact of behavioral aggregation. Compare behavioral aggregation to heuristic techniques of preference aggregation.
3) Explore different functional forms for household demand using switching regression.
4) Determine the socio-economic factors associated with women who changed their opinion in the joint survey.

2. Scenario rejecters and exclusion criteria

To identify those who did not believe in the hypothetical scenario, respondents were asked the reasons why they would not purchase a hypothetical vaccine. Of those who refused to buy a vaccine, the main reason was affordability.

49% of the husbands and 57% of the wives felt that they had no money. Another 42% of the husbands and 29% of the wives felt that the vaccine was too expensive. About 5% of the respondent husbands and 10% of the wives refused to be vaccinated for free. Some of these were respondents who dismissed the hypothetical scenario, whereas others were not in the market for a vaccine as they felt that they had no chance of getting malaria, or that malaria was not a serious disease. Since our main purpose is to compare husband and wife preferences, a household was excluded if either a husband or wife or both were scenario rejecters. As a result, a total of 17 (about 4% of total interviewed) scenario rejecters were identified and are reported in table 6.1. These households were excluded from the sample. The final sample size for the analysis was restricted to 405 households.

Table 6.1: Scenario rejecters and exclusion criteria

Particulars	Number of Husbands	Number of Wives	Number of Households
Interviews conducted	*422*	*422*	*422*
Respondents who refused to purchase a vaccine because:			
Vaccine might not be safe	4	0	4
Syringe/ container might be dirty	1	0	1
Sub-total	*5*	*0*	*5*
Additional respondents who refused to be vaccinated for free because:			
Vaccine might not be safe	1	5	6
Syringe/container might be dirty	0	1	1
Vaccine cannot really prevent malaria	1	3	4
Need doctor's advice	1	0	1
Sub-total	*3*	*9*	*12*

3. Demand for vaccines

A. <u>All or nothing approach</u>

I examined the data for patterns in the way husbands and wives answered the vaccine demand questions. When interviewed separately, almost 91% of the husbands and 88% of the wives adopted an "all or nothing" approach, i.e., either they were willing to pay for no vaccine at all or were willing to pay for a vaccine for everyone within the household. Figures 6.1 to 6.4 report the proportion of husbands and wives who took an "all or nothing" approach for both efficacies when interviewed separately. As the price increased, the number of respondents purchasing no vaccine for a household increased. It is likely that husbands and wives initially thought about whether they wanted to purchase a vaccine, and if so, wanted to purchase it for the entire household.

Figure 6.1: "All or nothing" – husband (50% effective vaccine)

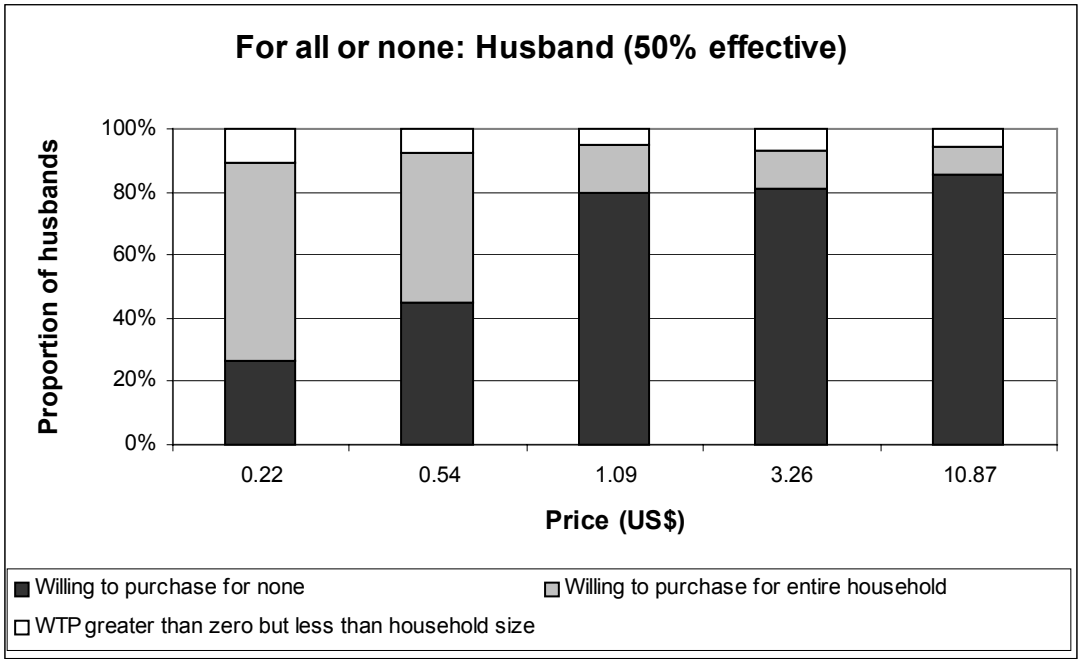


Figure 6.2: "All or nothing" – husband (95% effective vaccine)

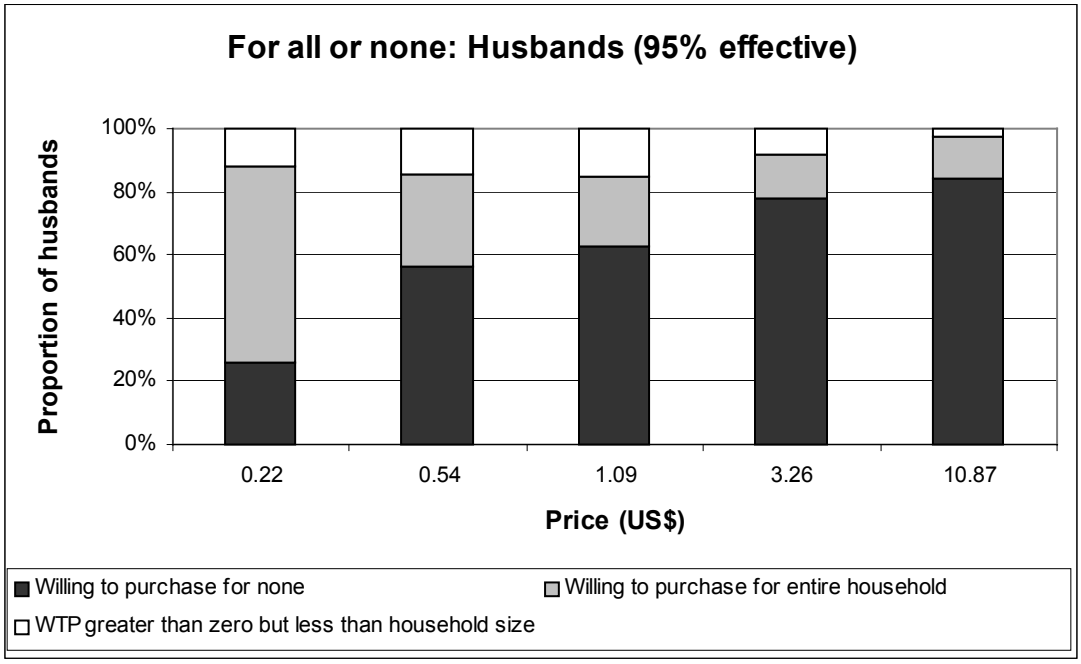


Figure 6.3: "All or nothing"- wife (50% effective vaccine)

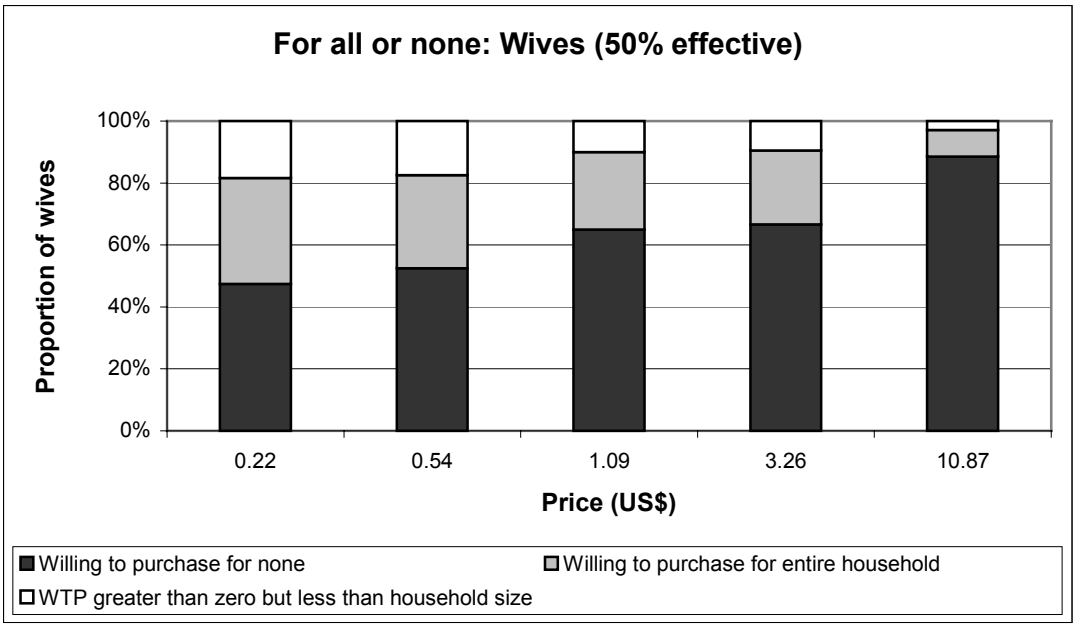
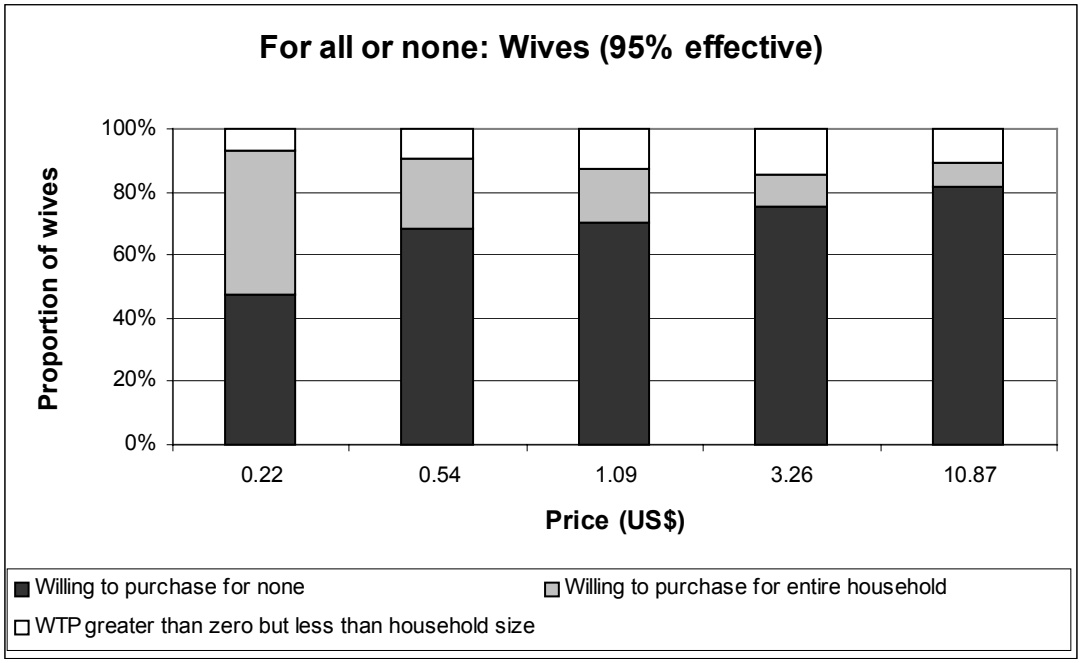


Figure 6.4: "All or nothing"- wife (95% effective vaccine)



However, this does not mean that all husbands and wives agreed with each other all the time. In fact, only 236 of the 388 couples (61%) agreed with each other regarding the number of vaccines that they would purchase when interviewed separately. About 18% of the wives reported a demand higher than their husbands and 22% of the wives said that they were willing to pay for a lower number of vaccines than their husbands.

To examine whether husbands and wives were in full agreement regarding the number of vaccines they said they would purchase for their household, and how their opinions coincided with increasing prices, I plotted the number of couples who agreed upon the number of vaccines that they purchased in figures 6.5 to 6.8, the number being zero, the full household size or some other positive number between zero and household size.

Figure 6.5: Pattern of agreement – separate interview (50% effective vaccine)

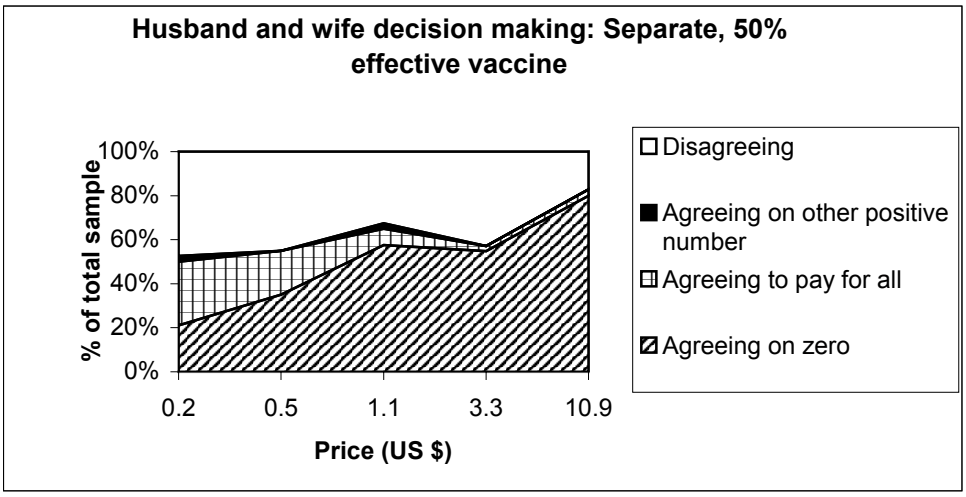
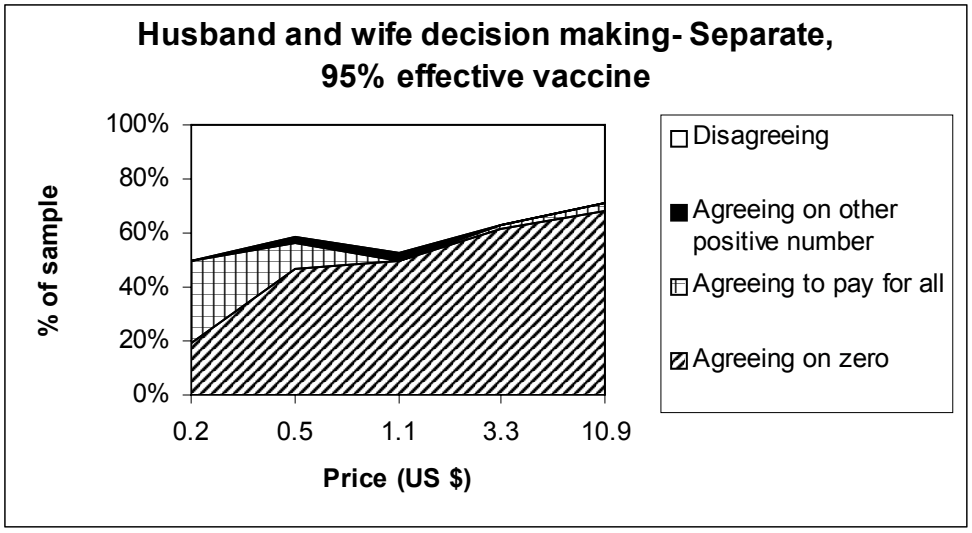


Figure 6.6: Pattern of agreement - separate interview (95% effective vaccine)



Figures 6.5 & 6.6 indicate that when interviewed separately, the number of respondents agreeing with their spouses increased from about 50% at the lowest price to about 71% at the highest price for 95% effective vaccine at 83% at the highest price for 50% effective vaccine. The proportion of couples who agreed to buy zero vaccines, increased from about 19% of the respondents at the lowest price to 80% of the respondents at the highest price, whereas the proportion of couples agreeing to purchase vaccines for their entire household decreased as price increased.

Figure 6.7: Pattern of agreement - joint interview (50% effective vaccine)

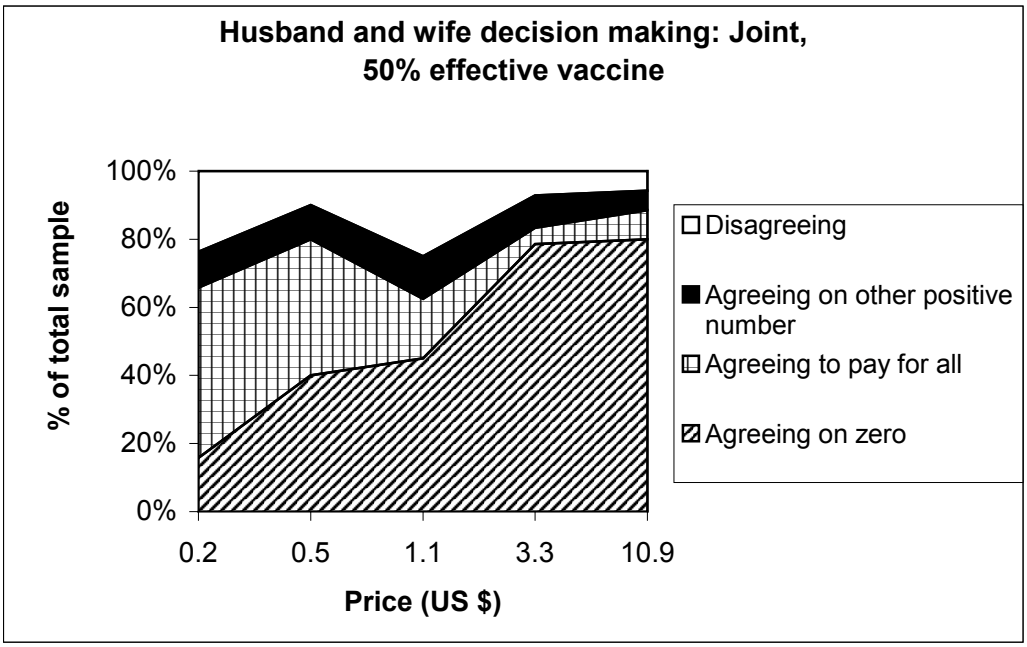
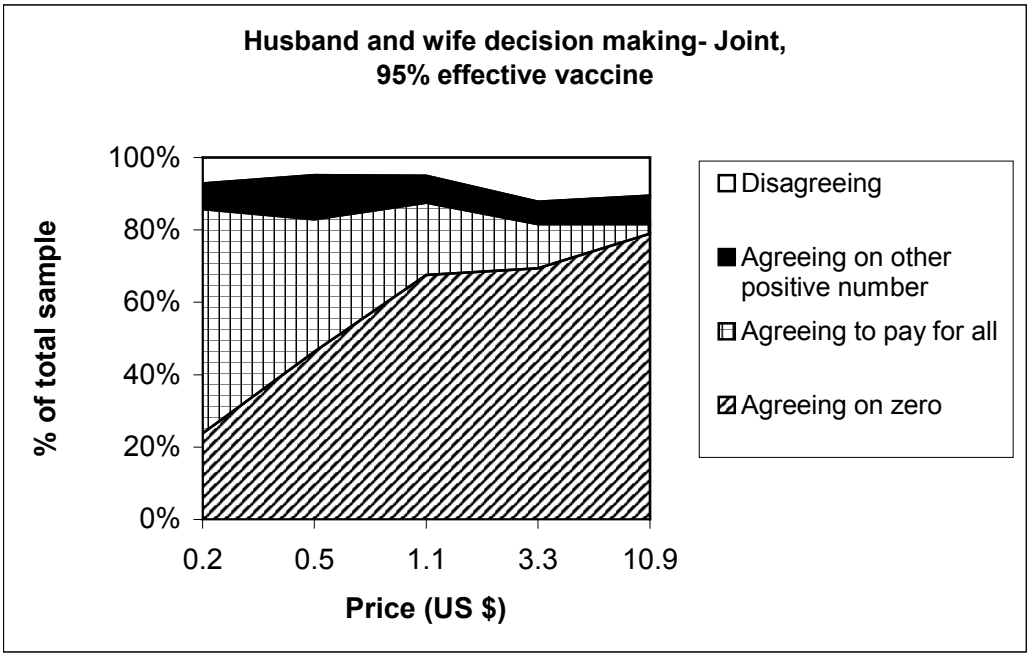


Figure 6.8: Pattern of agreement - joint interview (95% effective vaccine)



Following the joint discussion, there was a rise in the number of respondents who agreed on a positive number of vaccines for the household, including those willing to pay for vaccines for the entire household. Depending upon the price and

efficacy, 68% to 86% of the couples adopted the "all or nothing" approach, implying that not only did they agree upon the number of vaccines but also agreed on who within the household should or should not receive that vaccine.

B. Differences in husband and wife stated demand

Both husbands and wives had an opportunity to change their opinions during the joint interview. Overall 24% of the husbands changed opinion compared to 35% of the wives (table 6.2 and table 6.3). In households in which only one partner changed opinions, women were twice as likely to change their opinion for the entire sample and about 2.4 times more likely at the lowest price. Of those who disagreed in separate interviews, but changed an opinion to align their preferences with their partner, women were almost twice as likely to change opinions than their male counterparts for the full sample and 2.8 times more likely at the lowest price.

Table 6.2: Respondents who changed opinion during joint interview (full sample)

(Entire sample)	Wives who changed their opinion	Wives who didn't change their opinion	Total husbands
Husbands who changed their opinion	53 (13%)	46 (11%)	99 (24%)
Husbands who didn't change their opinion	88 (22%)	218 (54%)	306 (76%)
Total wives	141 (35%)	264 (65%)	

Table 6.3: Respondents who changed opinion during joint interview (lowest price)

(Lowest Price)	Wives who changed their opinion	Wives who didn't change their opinion	Total husbands
Husbands who changed their opinion	8 (10%)	11 (14%)	19 (24%)
Husbands who didn't change their opinion	26 (33%)	35 (44%)	61 (76%)
Total wives	34 (43%)	46 (58%)	

I examined the preference aggregation strategies and classified households according to how the husbands and wives behaved to arrive at their final decision. These aggregation strategies are noted in table 6.4.

Table 6.4: Aggregation strategies

Type of bargaining	**% of respondents (full sample)**	**% of respondents (lowest Price)**
Husband and wife agree with each other, before and after joint interview	50*	39@
Husband preferences dictate joint decision; wife changed opinion to agree with husband.	22	28
Wife preferences dictate joint decision; husband changed opinion to agree with wife.	11	10
Both agree before and after interview, but choose a different number of vaccines during separate and joint interviews.	6	5
Both chose different number of vaccines and stayed firm on their preferences before and after interview.	4	5
No specific aggregation strategy	7	13

* of these, 80 % agreed to buy zero vaccines.
@ of these, 30% agreed to buy zero vaccines

As can be seen, a majority of husbands and wives agreed with each other during both joint and separate interviews, of which about 80% agreed to buy zero vaccines. At the lowest price, however, overall agreement was lower at about 39%, of which only 30% of the couples agreed to buy zero vaccines.

C. Stated demand for vaccines

Table 6.5 and figures 6.9 and 6.10 show raw stated average number of vaccines that respondents were willing to pay, when interviewed separately and jointly.

Figure 6.9: Stated WTP when interviewed separately

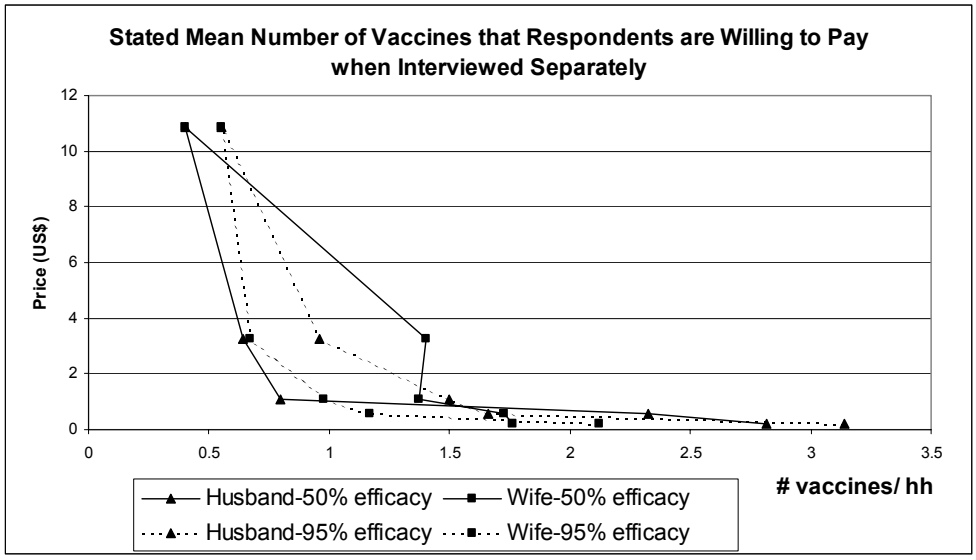


Figure 6.10: Stated WTP when interviewed jointly

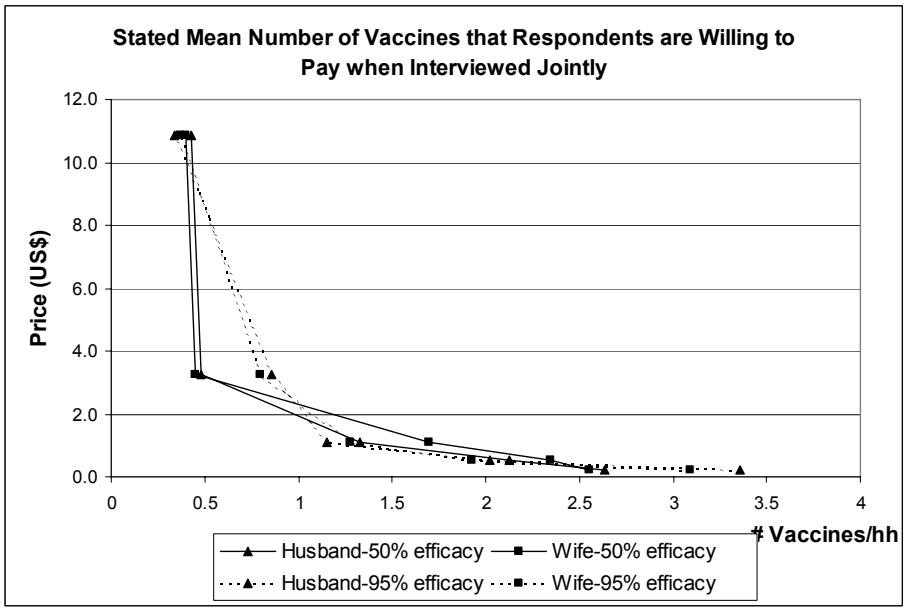


Table 6.5: Mean number of vaccines by price and efficacy

Price	Mean # vaccines WTP when interviewed separately				Mean # vaccines WTP when interviewed jointly			
(US$)	Mean husband demand m_{HS}		Mean wife demand m_{WS}		Mean husband demand m_{HJ}		Mean wife demand m_{WJ}	
	50% effective	95% effective	50% effective	95% effective	50% effective	95% effective	50% effective	95% effective
0.2	2.82	3.14	1.76	2.12	2.63	3.36	2.55	3.10
	(0.34)	(0.34)	(0.33)	(0.35)	(0.30)	(0.35)	(0.31)	(0.36)
0.5	2.33	1.66	1.73	1.17	2.13	2.02	2.35	1.93
	(0.37)	(0.33)	(0.33)	(0.31)	(0.34)	(0.33)	(0.35)	(0.33)
1.1	0.80	1.50	1.38	0.98	1.33	1.15	1.70	1.28
	(0.27)	(0.36)	(0.32)	(0.28)	(0.29)	(0.31)	(0.33)	(0.32)
3.3	0.64	0.96	1.40	0.67	0.48	0.86	0.45	0.80
	(0.23)	(0.29)	(0.33)	(0.2)	(0.19)	(0.24)	(0.19)	(0.23)
10.9	0.40	0.55	0.40	0.55	0.43	0.34	0.40	0.37
	(0.18)	(0.23)	(0.20)	(0.21)	(0.18)	(0.16)	(0.17)	(0.16)

Figures in parentheses are standard errors

The impact of price can be clearly seen for both husbands and wives for their separate as well as joint responses. The mean stated number of vaccines that respondents were willing to pay dropped down as prices increased. When offered a vaccine with lowest price of 22 cents and 50% efficacy and asked separately, the husbands and wives in each household were willing to pay for an average of 2.8 and 1.8 vaccines respectively. At a price of $10.9, the mean number of vaccines that husbands and wives were willing to pay dropped down to 0.5 and 0.6 respectively. However, the average number of vaccines that women were willing to pay was higher at 50% efficacy than that for 95% efficacy for some price levels (e.g. price of $0.5 for wives).

The stated WTP did not drop across the board for husbands and wives, but rather the husband and wife responses moved closer, with a tendency for the stated demand to increase after a joint interview at lower prices. The mean of absolute differences between husband and wife demand for 95% effective vaccine when

interviewed separately was 0.5. This dropped to 0.1 for both when interviewed jointly. At higher prices, however, the joint stated demand was more likely to drop. This findings support the possibility that at lower prices, husbands and wives were more considerate of the views of their partner and hence were willing to buy vaccines for other household members.

To assess whether husbands and wives were willing to pay for the same number of vaccines, t-tests of mean equivalence between husband demand and wife demand were conducted for different combinations of price and efficacies, for both separate and joint responses. The tests are reported in table 6.6. Tests 1 and 2 examine the differences between husband and wife responses whereas tests 3 and 4 examine the differences between separate and joint individual responses.

Table 6.6: t-tests of mean equivalence across sub-sample

Efficacy (%)	Price (US$)	Ho: Mean separate husband demand = Mean separate wife demand	Ho: Mean joint husband demand = Mean joint wife demand	Ho: Mean separate husband demand= Mean joint husband demand	Ho: Mean separate wife demand = Mean joint wife demand
		$m_{HS} = m_{WS}$	$m_{HJ} = m_{WJ}$	$m_{HS} = m_{HJ}$	$m_{WS} = m_{WJ}$
		Test 1	*Test 2*	*Test 3*	*Test 4*
50	0.2	R**	NR	NR	R+
	0.5	NR	NR	NR	NR
	1.1	NR	NR	R*	NR
	3.3	R*	NR	NR	R*
	10.9	NR	NR	NR	NR
95	0.2	R*	NR	NR	R*
	0.5	NR	NR	NR	R*
	1.1	NR	NR	NR	NR
	3.3	NR	NR	NR	NR
	10.9	NR	NR	NR	NR

**:$\alpha = 0.01$, *:$\alpha = 0.05$, +:$\alpha = 0.10$.
R = Null hypothesis rejected, NR = Null hypothesis not rejected.
Subscripts H and W indicate Husband and Wife respectively.
Subscripts S and J indicate that respondents were interviewed Separately and Jointly respectively.

In the first t-test, the mean stated demand of husbands (m_{HS}) when interviewed separately was compared with that of wives (m_{WS}) when interviewed separately. Overall, the data show significant differences in husband and wife demand when interviewed separately in three out of the ten cells. At the lowest price of 22 cents, husband mean stated demand was significantly higher than that for wife for both efficacies. Wife mean stated demand was significantly higher than that for husband for price of $3.3 and efficacy of 50%. However, at the highest price of $10.9, the notion that husband and wife demand were the same could not be rejected. This may be because lower prices gave husbands and wives the freedom of budget space and hence a chance to express their choice. At the highest price, demand was choked out, and the majority of husbands and wives agreed with each other not to buy a vaccine. This phenomenon of husbands and wives agreeing at higher prices to not buy a vaccine repeats itself throughout our analyses, whatever the efficacy or the nature of the interview (separate vs. joint). In the second t-test, the mean stated demand of husbands when interviewed jointly was compared with that of wives when interviewed jointly. The null hypothesis could not be rejected for even a single price-efficacy combination. This brings up the possibility that more husbands and wives are likely to have the same stated demand for a malaria vaccine after a short private discussion.

To examine the influence of the short private discussion on individual behavior, t-tests of mean equivalence between separate demand and joint demand were conducted for different combinations of price and efficacies. The stated demand for wife when interviewed separately was significantly different from that for wife

when interviewed jointly in four out of ten price-efficacy combinations. Stated demand when interviewed jointly was significantly higher than that when interviewed separately for the lowest prices of 22 cents (both 50% and 95% efficacy) and second-lowest price of 54 cents (95% efficacy) when interviewed jointly. However, stated demand when interviewed jointly was significantly lower at price of $3.3 and efficacy of 50%. As in the case of previous t-tests, the null hypothesis of mean equivalence could not be rejected for the highest price level. For husbands, joint demand was significantly different from separate demand only for one price-efficacy combination.

The t-tests also show that at the lowest price, stated demand was higher in the joint interview compared to that during a separate interview (except husband 50% effective vaccine), with the increase significant for wives offered a 95% effective vaccine and not significant for others. On the other hand, at the highest price, stated demand was lower in the joint interview for wives but the differences were not significant.

The analyses of raw data provide evidence in the following direction:

1) The stated number of vaccines that husbands and wives were willing to pay for, when interviewed separately, is significantly different from their spouses', especially at lower prices.
2) At higher prices, the demand chokes for both husband and wife, and they tend to agree to buy zero vaccines.
3) At least a few husbands and wives are able to resolve their differences in a joint discussion, and express a WTP for the same number of vaccines.
4) Many respondents adopted the "all or nothing" approach.

5) When provided with an opportunity to interact with their husbands, more wives (about 35% of total) changed their opinion than husbands (about 24% of total).

4. Multivariate analyses

A. Analysis of patterns in decision-making

Because of the predominant "all-or-nothing" approach among respondents, I analyzed the decision pattern of whether husbands and wives were willing to pay for the entire household using a probit model. The summary of variables used for this and subsequent analyses in this section is given in table 6.7.

Table 6.7: Summary of variables used

	Full sample (random effects)		Full sample (probit model)		Full sample (count model)		Restricted sample higher prices (count model)		Restricted sample lower prices (count model)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dependent variables										
1=Husband WTP for member when interviewed separately; 0=Otherwise	0.32	0.47								
1=Wife WTP for member when interviewed separately; 0=Otherwise	0.27	0.44								
1=Husband WTP for member when interviewed jointly; 0=Otherwise	0.33	0.47								
1=Wife WTP for member when interviewed jointly; 0=Otherwise	0.33	0.47								
1=Husband WTP for all household members when interviewed separately; 0=Otherwise			0.29	0.45						
1=Wife WTP for all household members when interviewed separately; 0=Otherwise			0.22	0.42						
1=Husband WTP for all household members when interviewed jointly; 0=Otherwise			0.27	0.44						
1=Wife WTP for all household members when interviewed jointly; 0=Otherwise			0.28	0.45						
Aggregate of count of stated demand-husband interviewed separately					1.48	2.12	2.04	2.27	0.66	1.57
Aggregate of count of stated demand-wife interviewed separately					1.22	1.92	1.52	2.05	0.77	1.61
Aggregate of count of stated demand-husband interviewed jointly					1.48	2.01	2.11	2.16	0.55	1.30
Aggregate of count of stated demand-wife interviewed jointly					1.49	2.03	2.15	2.19	0.52	1.27
Independent variables										
Vaccine characteristics										
Price in US $	2.99	3.78	3.06	3.83	3.06	3.83	0.61	0.36	6.63	3.79
Efficacy (1= 95% effective ; 0= Otherwise)	0.52	0.50	0.52	0.50	0.52	0.50	0.51	0.50	0.53	0.50
Respondent characteristics										
1=Husband has secondary education;	0.26	0.44	0.27	0.44	0.27	0.44	0.23	0.42	0.32	0.47
1=Husband has higher secondary or college education; 0=Otherwise)	0.18	0.39	0.22	0.41	0.22	0.41	0.22	0.41	0.22	0.42
Husband's age	36.95	8.40	36.83	9.03	36.83	9.03	37.06	9.38	36.14	7.98
Husband's age squared	436.10	698.30	437.80	760.51	437.85	760.52	461.26	789.90	369.41	653.78

(Table 6.7 continued)	Full sample (Random effects)		Full sample (Probit model)		Full sample (Count model)		Restricted sample higher prices (Count model)		Restricted sample lower prices (Count model)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1=Wife has secondary education; 0=Otherwise	0.22	0.42	0.23	0.42	0.23	0.42	0.22	0.42	0.25	0.43
1=Wife has higher secondary or more education; 0=Otherwise	0.05	0.22	0.06	0.24	0.06	0.24	0.06	0.24	0.06	0.24
Wife's age	30.42	6.80	30.14	7.06	30.14	7.06	29.97	7.09	30.29	6.99
Wife's age squared	971.47	461.75	958.30	479.22	958.30	479.22	948.44	478.27	966.06	482.94
Household characteristics										
1=Dowry practice common in caste; 0=Otherwise	0.73	0.45	0.72	0.45	0.72	0.45	0.72	0.45	0.73	0.44
Household size	4.92	1.24	4.63	1.16	4.63	1.16	4.70	1.16	4.52	1.14
Household size squared	25.69	13.69	22.80	12.09	22.80	12.09	23.48	12.00	21.71	12.01
Number of children							2.68	1.17	2.47	1.13
1=Hindu religion (Muslim excluded); 0=Otherwise;	0.55	0.50	0.54	0.50	0.54	0.50	0.57	0.50	0.51	0.50
1=Buddhist religion (Muslim excluded); 0=Otherwise;	0.29	0.45	0.32	0.47	0.32	0.47	0.30	0.46	0.34	0.47
1=Both husband and wife pooling; 0=Otherwise			0.08	0.28	0.08	0.28				
1=Husband pooling & wife non-pooling; 0=Otherwise			0.22	0.42	0.22	0.42				
1=Husband non-pooling, wife pooling; 0=Otherwise			0.22	0.42	0.22	0.42				
Risk of malaria										
1= Slum has malaria API >2.0; 0 = Otherwise	0.59	0.49	0.60	0.49	0.60	0.49	0.61	0.49	0.60	0.49
1=Husband knows person infected with malaria; 0=Otherwise	0.46	0.50	0.46	0.50	0.46	0.50	0.45	0.50	0.48	0.50
1=Wife knows person infected with malaria; 0=Otherwise	0.14	0.34	0.14	0.35	0.14	0.35	0.11	0.32	0.17	0.38
1=At least one child in household is stunted; 0=Otherwise			0.55	0.50	0.55	0.50				
Socioeconomic										
Monthly household income in 1000 US$	0.08	0.04	0.09	0.06	0.09	0.06	0.09	0.06	0.10	0.06
Husband total monthly income in 1000 US$			0.08	0.04	0.08	0.04	0.08	0.04	0.08	0.05
Husband monthly non-labor income in 1000 US$			0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
Wife total monthly income in 1000 US$			0.02	0.03	0.02	0.03	0.02	0.04	0.02	0.03
Wife monthly non-labor income in 1000 US$			0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.02
Land owned by husband's parents In 100 acres	0.76	1.41	0.71	1.33	0.71	1.33	0.71	1.37	0.73	1.30
Land owned by wife's parents In 100 acres.			0.58	1.69	0.58	1.69	0.49	1.10	0.76	2.35
Findep (1=Wife has no source of income; 0=Otherwise)			0.61	0.49	0.61	0.49	0.61	0.49	0.60	0.49
Number of observations	1797		405		405		241		164	

The probit regressions are reported in table 6.8. Specifications 1-3 show results of the probit model for separate interviews and specifications 4-6 show the results for joint interviews. I adopted the seemingly unrelated approach to account for any correlation that may exist between husband and wife responses (given that they live in the same house).

The different independent variables considered were vaccine characteristics (price and efficacy), individual characteristics (education, age, age squared), household characteristics (religion, household size and whether the practice of dowry was common in their caste) and risk of getting infected with malaria (knowing people infected with malaria, living in a location with Annual Parasite Index>2.0).

I also used information from other parts of our research. I used a dummy variable to indicate if there was any child stunted and three dummy variables to examine how households pool their income. I assumed that the card chosen in the third (highest price) level of the lottery experiment indicates pooling behavior of husbands and wives. I categorized respondents choosing a pooling card as “pooling” and those choosing any other card (intermediate or non-pooling card) as “non-pooling”. The three dummy variables included indicate (1) pooling husband and wife, (2) pooling husband and non-pooling wife, and (3) non-pooling husband and pooling wife. Details about height related data and lottery related data are discussed in subsequent chapters.

Table 6.8: Probit model: buying for all household members

Husband decision-making **Dependent variable: 1= Willing to pay for all household members; 0= Otherwise**	**Separate interview**			**Joint interview**		
	(1)	(2)	(3)	(4)	(5)	(6)
Price in US$	-0.132	-0.139	-0.128	-0.219	-0.226	-0.209
	(4.97)**	(5.29)**	(4.91)**	(4.41)**	(4.52)**	(4.43)**
1=Efficacy of vaccine is 95%; 0= Efficacy	-0.011	-0.002	-0.021	0.172	0.188	0.143
of Vaccine is 50%	(0.07)	(0.01)	(0.15)	(1.10)	(1.20)	(0.94)
1=Husband has secondary education;	-0.002	0.006	0.045	0.231	0.221	0.251
0=Otherwise	(0.01)	(0.03)	(0.26)	(1.23)	(1.16)	(1.35)
1=Husband has higher secondary or	0.030	-0.017	0.086	0.074	0.051	0.153
college education; 0=Otherwise	(0.15)	(0.09)	(0.44)	(0.34)	(0.24)	(0.71)
Husband's age	0.066	0.057	0.065	0.051	0.047	0.057
	(1.16)	(1.01)	(1.18)	(0.76)	(0.70)	(0.91)
Husband's age squared	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(1.23)	(1.12)	(1.32)	(0.91)	(0.86)	(1.14)
1=Dowry custom prevalent in caste;	0.383	0.395	0.421	0.367	0.386	0.404
0= Otherwise	(2.26)*	(2.32)*	(2.54)*	(1.98)*	(2.07)*	(2.26)*
Household size	0.056	-0.019	-0.001	0.365	0.284	0.268
	(0.15)	(0.05)	(0.00)	(0.59)	(0.48)	(0.45)
Household size squared	-0.015	-0.009	-0.010	-0.061	-0.055	-0.052
	(0.41)	(0.25)	(0.28)	(0.94)	(0.90)	(0.82)
1=Husband knows person infected with Malaria;	0.028	0.020	0.036	0.245	0.254	0.249
0=Otherwise	(0.19)	(0.14)	(0.25)	(1.56)	(1.59)	(1.59)
1=Location has high risk of Malaria (API>2.0);	0.000	0.002	-0.040	0.607	0.613	0.521
0=Otherwise	(0.00)	(0.01)	(0.27)	(3.80)**	(3.80)**	(3.24)**
1=Religion is Hindu (Muslim excluded);	0.331	0.243	0.266	0.617	0.553	0.533
0=Otherwise	(1.47)	(1.07)	(1.16)	(2.47)*	(2.20)*	(2.06)*
1=Religion is Buddhist (Muslim excluded);	0.210	0.163	0.132	0.569	0.546	0.463
0=Otherwise	(0.88)	(0.68)	(0.54)	(2.15)*	(2.06)*	(1.69)+
1=Both husband and wife chose pooling card;	0.318	0.412	0.371	0.390	0.446	0.413
0= Otherwise	(1.26)	(1.64)	(1.46)	(1.37)	(1.59)	(1.46)
1=Husband chose pooling card, wife did not	0.148	0.235	0.143	0.150	0.246	0.141
Choose pooling card; 0= Otherwise	(0.78)	(1.26)	(0.78)	(0.74)	(1.26)	(0.73)
1=Husband did not choose pooling card, wife	0.022	0.086	0.052	-0.049	-0.023	-0.042
chose pooling card; 0= Otherwise	(0.12)	(0.48)	(0.29)	(0.25)	(0.11)	(0.21)
1=At least one child stunted in household;	-0.124	-0.137	-0.135	0.013	0.013	0.017
0=Otherwise	(0.83)	(0.91)	(0.91)	(0.08)	(0.08)	(0.11)
Household income in 1000 $	3.237			4.542		
	(2.30)*			(2.74)**		
1=Wife financially dependent on husband;	0.502			0.411		
0=Otherwise	(3.08)**			(2.32)*		
Husband total income in 1000 $		5.988			6.961	
		(3.61)**			(3.68)**	
Husband non-labor income in 1000 $			2.918			6.271
			(0.88)			(1.68)+
Constant	-2.558	-1.953	-1.700	-3.543	-3.068	-2.632
	(1.88)+	(1.48)	(1.32)	(1.96)+	(1.79)+	(1.56)

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

(Table 6.8 continued)

Wife Decision-Making Dependent variable: 1= Willing to pay for all household members; 0= Otherwise	**Separate interview**			**Joint interview**		
	(1)	(2)	(3)	(4)	(5)	(6)
Price in US$	-0.118	-0.118	-0.117	-0.215	-0.204	-0.204
	(4.37)**	(4.35)**	(4.30)**	(4.99)**	(5.00)**	(4.96)**
1=Efficacy of vaccine is 95%;	-0.087	-0.092	-0.094	0.072	0.036	0.033
0= Efficacy of vaccine is 50%	(0.56)	(0.59)	(0.60)	(0.46)	(0.23)	(0.22)
1=Wife has secondary education; 0=Otherwise	0.410	0.441	0.438	0.187	0.258	0.236
	(2.22)*	(2.40)*	(2.36)*	(1.02)	(1.42)	(1.29)
1=Wife has higher secondary or college	0.635	0.678	0.678	-0.096	0.095	0.095
education; 0=Otherwise	(1.96)*	(2.13)*	(2.13)*	(0.31)	(0.30)	(0.30)
Wife's age	0.269	0.262	0.263	0.114	0.131	0.127
	(2.47)*	(2.49)*	(2.50)*	(0.97)	(1.26)	(1.21)
Wife's age squared	-0.004	-0.004	-0.004	-0.002	-0.002	-0.002
	(2.61)**	(2.63)**	(2.66)**	(1.03)	(1.33)	(1.30)
1=Dowry custom prevalent in caste;	-0.215	-0.192	-0.192	0.482	0.549	0.548
0= Otherwise	(1.19)	(1.07)	(1.07)	(2.75)**	(3.17)**	(3.19)**
Household size	1.136	1.125	1.120	0.249	0.140	0.175
	(1.66)+	(1.64)	(1.64)	(0.39)	(0.22)	(0.28)
Household size squared	-0.134	-0.133	-0.132	-0.053	-0.042	-0.045
	(1.82)+	(1.80)+	(1.79)+	(0.78)	(0.63)	(0.67)
Wife knows person infected with malaria;	0.198	0.201	0.183	0.342	0.333	0.315
0=Otherwise	(0.86)	(0.88)	(0.80)	(1.52)	(1.51)	(1.44)
1=Location has high risk of malaria (API>2.0);	1.152	1.116	1.126	0.563	0.456	0.467
0=Otherwise	(6.11)**	(5.85)**	(5.91)**	(3.55)**	(2.90)**	(2.96)**
1=Religion is Hindu (Muslim excluded);	0.250	0.243	0.237	0.475	0.433	0.421
0=Otherwise	(0.87)	(0.85)	(0.83)	(1.96)*	(1.68)+	(1.63)
1=Religion is Buddhist (Muslim excluded);	0.301	0.287	0.279	0.499	0.455	0.441
0=Otherwise	(1.04)	(0.99)	(0.96)	(1.93)+	(1.70)+	(1.64)
1=Both husband and wife chose pooling card;	0.388	0.409	0.408	0.409	0.408	0.412
0= Otherwise	(1.31)	(1.39)	(1.39)	(1.45)	(1.44)	(1.46)
1=Husband chose pooling card, wife did not	0.624	0.620	0.617	0.149	0.147	0.135
choose pooling card; 0= Otherwise	(3.15)**	(3.11)**	(3.10)**	(0.75)	(0.77)	(0.71)
1=Husband did not choose pooling card, wife	0.009	0.011	0.012	-0.009	0.001	0.007
chose pooling card; 0= Otherwise	(0.04)	(0.05)	(0.06)	(0.05)	(0.01)	(0.03)
1=At least one child stunted in household;	-0.266	-0.262	-0.261	0.170	0.197	0.187
0=Otherwise	(1.59)	(1.56)	(1.56)	(1.10)	(1.27)	(1.21)
Monthly household income in 1000 US$	1.129			4.674		
	(0.80)			(2.73)**		
1=Wife financially dependent on husband;	0.162			0.410		
0=Otherwise	(0.90)			(2.37)*		
Wife total income in 1000 US$		-2.145			-2.190	
		(0.98)			(1.16)	
Wife non-labor income in 1000 US$			-1.915			0.060
			(0.74)			(0.02)
Constant	-7.983	-7.610	-7.627	-3.879	-3.148	-3.177
	(3.50)**	(3.45)**	(3.47)**	(1.81)+	(1.63)	(1.64)
Observations	405	405	405	405	405	405

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Since the main purpose of our research is to examine issues of intrahousehold resource allocation, considerable attention was given to the income variable. I ran

three different specifications[18], each with a different indicator for income for both separate (specification 1, 2 and 3) and joint demand (specification 4, 5 and 6) to examine evidence for income pooling. I included the total household income variable and a variable, findep, which indicates that wife has no source of any income as independent variables in specification 1. In specifications 2 and 3, I used total individual income (labor and non-labor combined) and individual non-labor income respectively. Specifications 4, 5 and 6 are similar to specifications 1, 2 and 3 respectively except that the dependent variable indicates choices made during the joint interview.

To examine whether husbands and wives behaved differently from each other and whether they changed their behavior after the short private discussion, I conducted tests of equivalence of coefficients for husband vs. wife and joint vs. separate coefficient estimates. The tests were conducted only on the specifications with household income (i.e., specifications 1 and 4) and are reported in table 6.9. This is a more reliable method of comparing responses than the tests of mean equivalence conducted on raw data earlier. The last row in each column reports the test for equivalence of all coefficients for that specification tested jointly.

Price was significant at 1% or less for all the specifications for both separate and joint responses and both husbands and wives whereas efficacy was not significant for any of the specifications. Husband education and age were not significant covariates. However, wife education was significant and positive and age was

[18] Regressions also was run on possible instruments of bargaining power of women such as acres of land owned by parents, and parental education. The regressions with these variables are not included as the variables were not significant.

significant and curvilinear (both age and age squared were significant) for separate interview but neither variable was significant for the joint interview.

The dummy variable for respondents living in a high risk area (malaria API > 2.0) was positive and significant for both husbands and wives when interviewed jointly, implying that other things equal, people living in high risk areas were more likely to buy vaccines for the entire household when interviewed jointly. Religion variables for Hindu and Buddhist were significant and positive for both husbands and wives when interviewed jointly implying that on average Hindu and Buddhists were more likely to buy vaccines for the entire household than Muslims.

Household income variable and variable findep were significant and positive for husbands when interviewed separately or jointly, but only for wives when interviewed jointly. Thus, other things being equal, husbands and wives living in households with higher income and in households in which the wife does not have any source of income are more likely to buy vaccines for all household members. Total individual income for husbands (specification 2, 5) was also significant for husbands in both separate and joint interviews, but not for wives during either separate or joint interviews. Non-labor income was significant only for husbands at 10 percent or less when interviewed jointly.

Tests of equivalence of coefficients for income between husbands and wives when interviewed jointly showed that the coefficient for total household income for husbands was not significantly different from that for wives but the coefficient for non-labor income for husbands was significantly different from that for wives at 10% or less. This implies that marginal funds in hands of husbands could result in different

consumption patterns as compared to wives. This is evidence in favor of rejection of the common preference model and in favor of non-pooling. However, it should be noted that there is not enough resolution on the non-labor income variable for women with only 19% of the women reporting a non-zero non-labor income.

None of the pooling variables were significant for husbands for models examining choice for all household members. However, a non-pooling wife with a pooling husband was on average more likely to buy vaccines for the entire household.

Test of equivalence of coefficients in table 6.9 shows that, overall, there were significant differences between husband and wife decision-making when interviewed separately. However none of the coefficients could be rejected for equivalence when interviewed jointly.

Table 6.9: Tests for equivalence of coefficients (specification 1 & 4)

Coefficient for	Hypothesis for			
	β(Husband separate demand) = β(Wife separate demand	β(Husband joint demand) = β(Wife joint demand	β(Husband separate demand) = β(Husband joint demand)	β(Wife separate demand) = β(Wife joint demand)
	$H_o: \beta_{HS} = \beta_{WS}$	$H_o: \beta_{HJ} = \beta_{WJ}$	$H_o: \beta_{HS} = \beta_{HJ}$	$H_o: \beta_{WS} = \beta_{WJ}$
	(1)	(2)	(3)	(4)
Price	NR	NR	R+	R*
Efficacy	NR	NR	NR	NR
Respondent has secondary education	R+	NR	NR	NR
Respondent has higher secondary education	R+	NR	NR	R+
Age of respondent	R+	NR	NR	NR
Age squared of respondent	R*	NR	NR	NR
Dowry	R*	NR	NR	R**
Household size	NR	NR	NR	NR
Household size squared	NR	NR	NR	NR
Know a person infected with malaria	R+	NR	NR	NR
Slum has high malaria API	R**	NR	R**	R*
Hindu	NR	NR	NR	NR
Buddhist	NR	NR	NR	NR
Household income	NR	NR	NR	R+
Both pooling	NR	NR	NR	NR
Husband pooling, wife non-pooling	R+	NR	NR	R+
Husband non-pooling, wife pooling	NR	NR	NR	NR
Financially dependent wife	NR	NR	NR	R**
Joint (all coefficients together)	R**	NR	R**	R**

R: Null hypothesis rejected, NR: Null hypothesis not rejected. + significant at 10%; * significant at 5%; ** significant at 1%

Joint responses of husbands were more consistent with their separate responses than joint responses of wives with wives' separate responses as the test of equivalence of coefficients between separate responses and joint responses could be rejected only for two coefficients for husbands (price and risk) as against seven coefficients for wives. Since this is a stated preference experiment, it is difficult to

say whether true preference aggregation took place or whether wives simply acquiesced to their husbands' wishes. However, analyses of raw data showed that some husbands also changed opinions during the joint interview. But husbands' opinions after the private discussion were not significantly different from their opinions during separate interviews to the extent that wives' were. Since both husbands and wives did change opinion after the joint interview, some level of preference aggregation cannot be ruled out.

Coefficients for variable findep are significantly different for husband and wife demand when interviewed separately but are not significantly different when interviewed jointly. Further, the coefficient for findep for wife separate demand is significantly different from that for wife joint demand. It is likely women who are financially dependent upon their husbands are likely to change their opinion and acquiesce to their husband's wish as the equivalence of coefficients for wife and husband joint demand could not be rejected. This is some evidence in favor of women having no source of income having less bargaining power.

Table 6.10: Change in predicted probability for a discrete change

	Husband separate	Husband joint	Wife separate	Wife joint
Price	-16%	-21%	-10%	-22%
Efficacy	0%	2%	-1%	2%
Respondent has secondary education	0%	6%	10%	5%
Respondent has higher secondary education	0%	2%	17%	2%
Age (@ 19 years)	-7%	-4%	-10%	-5%
Age (@60 years)	8%	7%	0%	3%
Dowry	5%	9%	-5%	12%
Household size (@ 3 members)	-6%	-14%	-36%	-8%
Household size (@ 8 members)	-5%	-6%	-11%	-3%
Know infected person	1%	6%	5%	10%
High risk area	11%	14%	22%	14%
Hindu	10%	15%	5%	12%
Buddhist	6%	15%	7%	14%
Both Pool	11%	11%	10%	12%
Husband Pool, Wife Non Pool	4%	4%	16%	4%
Husband Non Pool, Wife Pool	1%	-1%	0%	0%
Stunting	-4%	0%	-6%	5%
Income	6%	7%	1%	7%
Wife has no income	15%	10%	3%	11%

For continuous variables, change in one standard deviation, for dummy variables from 0 to 1

To examine the magnitude of impact of different independent variables on the probability that a respondent would buy for the entire household, I examined the change in predicted probability for a change in the independent variable (a standard deviation change in continuous variables and a change from zero to unity for a dummy variable). The results of this exercise are reported in table 6.10. I found that a unit standard deviation increase in price ($3) caused 10% to 22% reduction in the probability that the respondent chose to buy a vaccine for the entire household (and about 3-6% reduction for a dollar increase in price). Efficacy, on the other hand, did not have a substantial impact on the predicted probability. Among variables that are

significant and seem to have an impact on joint demand include living in a high risk area (14%), religion variables (Hindu and Buddhist dummy variables at about 12-15%), and whether a wife had no source of income (findep at about 10-11%). A standard deviation increase in income ($58) increased by about 7% the probability that household bought for the entire household.

Since age and household were quadrilinear, the magnitude of the impact depended upon the age of the individual. The size of the impact for ages 19 and 60 years and household size of 3 and 8 households is reported in the table 6.10. The impact of age varied from –5% to 10% and for household size varied from –36% to –3%.

Among pooling variables, only households in which both husband and wife were pooling had an impact of about 11-12% during joint interview, but the effect was not statistically significant. A pooling husband with a non-pooling wife had significantly coefficient for demand for separate interview, however the magnitude of this effect was low (4%). Thus, whether a household is pooling or non-pooling does not have a significant impact on demand. This raises the possibility that husbands and wives who do not pool income may not be bargaining non-cooperatively.

B. Estimation of Demand (Random Effects)

As defined in the conceptual framework, I adopted a seemingly unrelated random effects probit model computed for both husbands and wives to estimate demand. The data were stacked so that each row represented each member within the household, with the binary dependent variable indicating whether a vaccine was

purchased for that individual by the respondent. The different variables used in the random effects probit models are summarized in table 6.7, and the results of the random effects approach are reported in table 6.11.

The results of the random effects model were inconsistent across different specifications and sometimes both the magnitude and sign of the estimates were subject to change with a slight change in specification. This could be because of the high value of rho (the share of total variance that is within individual) at over 95% for both husbands and wives. The reason for this high rho value is perhaps the prevalence of an "all or nothing" approach within the respondents[19]. The failure of the random effects model restricted our analyses to the traditional count models.

[19] The command -quadchk- run in Stata showed that some coefficients drop by as much as 37% when the number of fitted quadratures change in the maximization procedure. This could be because of high value of rho and that the model does not fit reliably. In such cases, the Gauss-Hermite quadrature maximization procedure adopted in random effects models may not be appropriate.

Table 6.11: Results of random effects models

	Husband Separate Demand		Wife Separate Demand	
	(H1)	(H2)	(W1)	(W2)
Price	-0.021	-0.011	-0.010	-0.011
	(11.94)**	(8.60)**	(9.62)**	(10.28)**
Efficacy ↗	2.093	-0.516	-1.767	0.093
	(6.17)**	(1.47)	(6.75)**	(0.43)
Respondent has primary		-0.787		1.913
education; 0=Otherwise		(0.63)		(5.16)**
Respondent has secondary	0.883	0.969	1.026	3.125
education; 0=Otherwise	(2.98)**	(2.97)**	(3.94)**	(9.87)**
1=Wife has higher secondary or ↗	1.723	-0.449	2.846	2.076
college education; 0=Otherwise	(4.05)**	(1.19)	(6.40)**	(5.25)**
Respondent's age (years)	0.211	0.265	0.771	0.734
	(1.88)+	(2.43)*	(5.76)**	(5.52)**
Respondent's age squared	-0.003	-0.002	-0.013	
	(1.79)+	(1.46)	(6.53)**	
1=Dowry practice common in caste; ↗	-0.524	0.658	-1.423	-0.497
0=Otherwise	(2.12)*	(2.80)**	(5.12)**	(2.06)*
1= Respondent's spouse; 0 = otherwise	-0.024	0.081	-0.231	-0.061
	(0.10)	(0.34)	(0.90)	(0.27)
1=Respondent's son; 0=Otherwise ↗	0.255	0.469	0.896	0.912
	(1.06)	(1.98)*	(3.77)**	(4.01)**
1=Respondents daughter; 0=Otherwise ↗	0.413	0.349	0.883	0.842
	(1.71)+	(1.40)	(3.68)**	(3.73)**
1=Religion is Hindu (Muslim excluded);	-0.048		2.490	
0=Otherwise	(0.13)		(5.63)**	
1=Religion is Buddhist (Muslim excluded);	-0.444		3.894	
0=Otherwise	(1.00)		(7.20)**	
Monthly household income ($ 1000)	7.834		6.530	
	(2.76)**		(2.39)*	
1=Member likely to support in old age;	0.176		0.265	
0=Otherwise	(0.82)		(1.22)	
1=Respondent knows person infected ↗	-0.404	2.011	2.613	2.239
with malaria; 0 = Otherwise	(1.65)+	(6.59)**	(7.30)**	(6.98)**
1=Slum has higher risk of malaria;	0.754		3.350	
0 = Otherwise	(2.43)*		(10.11)**	
Wife's age squared				-0.013
				(6.32)**
Parental land		0.004		-0.003
		(3.39)**		(3.06)**
1=Spouse; 0=Otherwise				
Constant	-5.521	-9.194	-17.635	-13.241
	(2.23)*	(4.42)**	(7.40)**	(6.00)**
Observations	1797	1797	1797	1797
Rho value	0.96	0.95	0.96	0.96
Number of households	388	388	388	388

Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
↗ Coefficient changes sign or significance or both

C. Estimation of Demand (Negative Binomial Count Model)

In the count modeling approach, the sum of the count of the number of vaccines that an individual was willing to pay was adopted as the dependent variable. The research setup let me collect four types of WTP responses—Responses by husbands interviewed separately, wives interviewed separately, husbands interviewed jointly and wives interviewed jointly. To account for any correlation between husband and wife demand, a seemingly unrelated regression was run using the "suest" command in STATA, and robust standard errors were computed at the household level. Because of the over-dispersion in the data, the negative binomial regression was preferred over a poisson regression[20,21]. The results of seemingly unrelated negative binomial count regressions for husband and wife demand for both separate and joint responses are reported in tables 6.12. The same three specifications and set of independent variables used in the probit models were used for this model. The sign and significance of the coefficients for most variables are consistent with those in the probit models. The tests for mean equivalence between coefficients were also conducted for these models in a way similar to the earlier probit models and are reported in table 6.13

[20] A truncated poisson regression (truncating at household size) was deemed unnecessary, as none of the households have stated willingness to pay higher than the household size. The truncated poisson regression model yielded all coefficients to be significant, a finding that is counter intuitive and not in agreement with the results of the previously used probit model. Further, the negative binomial models do not over-predict demand for any households. Hence the negative binomial regression has been persisted with.

[21] A zero inflated poisson model was also computed. However, the model over fitted the zeros resulting in very low coefficient for price and very high willingness to pay for joint interview. WTP could not be computed for separate interviews as coefficient for price was not significant for count model (reciprocal of coefficient of price is needed to determine WTP).

Table 6.12: Seemingly unrelated negative binomial regressions

Husband Demand	Separate interview			Joint interview		
	(1)	(2)	(3)	(4)	(5)	(6)
Price in US$	-0.162	-0.168	-0.158	-0.203	-0.208	-0.196
	(5.40)**	(5.83)**	(5.28)**	(6.69)**	(6.74)**	(6.16)**
1=Efficacy of vaccine is 95%; 0=	0.118	0.123	0.127	0.071	0.092	0.055
Efficacy of vaccine is 50%	(0.73)	(0.76)	(0.79)	(0.50)	(0.66)	(0.39)
1=Husband has secondary education;	0.115	0.143	0.153	0.264	0.258	0.269
0=Otherwise	(0.61)	(0.76)	(0.83)	(1.57)	(1.54)	(1.57)
1=Husband has higher secondary or	0.086	0.027	0.160	0.193	0.175	0.283
college education; 0=Otherwise	(0.42)	(0.13)	(0.77)	(1.07)	(0.96)	(1.46)
Husband's age	0.008	-0.010	0.011	0.066	0.046	0.070
	(0.12)	(0.14)	(0.16)	(0.84)	(0.63)	(1.07)
Husband's age squared	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001
	(0.22)	(0.02)	(0.32)	(0.92)	(0.78)	(1.23)
1=Dowry custom prevalent in caste;	0.308	0.285	0.355	0.145	0.172	0.249
0= Otherwise	(1.71)+	(1.56)	(2.00)*	(0.86)	(1.04)	(1.49)
Household size	0.646	0.588	0.618	0.703	0.770	0.689
	(1.41)	(1.26)	(1.34)	(1.41)	(1.65)+	(1.38)
Household size squared	-0.052	-0.047	-0.051	-0.073	-0.080	-0.072
	(1.13)	(1.00)	(1.12)	(1.39)	(1.67)+	(1.39)
1=Husband knows person infected with	0.115	0.093	0.108	0.248	0.246	0.263
malaria; 0=Otherwise	(0.70)	(0.57)	(0.67)	(1.76)+	(1.72)+	(1.84)+
1=Location has high risk of malaria	0.189	0.170	0.124	0.787	0.801	0.636
(API>2.0); 0=Otherwise	(1.02)	(0.93)	(0.68)	(4.83)**	(4.79)**	(3.84)**
1=Religion is Hindu (Muslim excluded);	0.177	0.089	0.068	0.551	0.447	0.464
0=Otherwise	(0.67)	(0.33)	(0.24)	(2.34)*	(1.86)+	(1.84)+
1=Religion is Buddhist (Muslim	-0.091	-0.155	-0.200	0.502	0.415	0.367
excluded); 0=Otherwise	(0.32)	(0.54)	(0.69)	(1.95)+	(1.59)	(1.38)
1=Both husband and wife chose pooling	0.218	0.297	0.273	0.563	0.627	0.618
card;						
0= Otherwise	(0.81)	(1.11)	(0.97)	(2.34)*	(2.79)**	(2.46)*
1=Husband chose pooling card, wife did	0.408	0.414	0.333	0.348	0.386	0.287
not choose pooling card; 0= Otherwise	(1.95)+	(2.04)*	(1.64)	(1.84)+	(2.06)*	(1.52)
1=Husband did not choose pooling card,	-0.066	-0.009	-0.019	0.004	0.034	0.037
wife chose pooling card; 0= Otherwise	(0.32)	(0.04)	(0.09)	(0.02)	(0.18)	(0.20)
1=At least one child stunted in	-0.199	-0.246	-0.226	-0.004	-0.065	-0.017
household; 0=Otherwise	(1.16)	(1.40)	(1.30)	(0.03)	(0.43)	(0.11)
Household Income in 1000 $	3.605			5.403		
	(2.57)*			(3.84)**		
1=Wife financially dependent on	0.511			0.607		
husband; 0=Otherwise	(2.91)**			(3.58)**		
Husband total income in 1000 $		5.529			7.473	
		(3.58)**			(4.61)**	
Husband non-labor income in 1000 $			0.977			3.124
			(0.30)			(1.01)
Constant	-2.384	-1.465	-1.521	-4.398	-3.704	-3.379
	(1.45)	(0.88)	(0.94)	(2.63)**	(2.43)*	(2.24)*

Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table (continued)

Wife Demand	Separate interview			Joint interview		
	(1)	(2)	(3)	(4)	(5)	(6)
Price in US$	-0.136	-0.134	-0.134	-0.215	-0.207	-0.205
	(5.05)**	(4.94)**	(4.90)**	(7.66)**	(7.13)**	(6.94)**
1=Efficacy of vaccine is 95%; 0=	-0.171	-0.191	-0.194	0.021	0.017	0.011
Efficacy of vaccine is 50%	(1.00)	(1.12)	(1.14)	(0.14)	(0.11)	(0.08)
1=Wife has secondary education;	0.290	0.320	0.300	0.041	0.158	0.115
0=Otherwise	(1.66)+	(1.86)+	(1.73)+	(0.25)	(0.97)	(0.69)
1=Wife has higher secondary or college	0.449	0.538	0.545	-0.245	0.053	0.058
education; 0=Otherwise	(1.55)	(1.92)+	(1.94)+	(0.93)	(0.17)	(0.19)
Wife's age	0.302	0.302	0.302	0.150	0.178	0.170
	(2.59)**	(2.79)**	(2.75)**	(1.08)	(1.56)	(1.52)
Wife's age squared	-0.005	-0.005	-0.005	-0.002	-0.003	-0.003
	(2.63)**	(2.87)**	(2.83)**	(1.05)	(1.55)	(1.54)
1=Dowry custom prevalent in caste;	-0.121	-0.087	-0.096	0.259	0.373	0.379
0= Otherwise	(0.63)	(0.46)	(0.50)	(1.60)	(2.32)*	(2.37)*
Household size	1.933	1.933	1.968	0.570	0.396	0.483
	(2.90)**	(2.95)**	(2.98)**	(0.98)	(0.64)	(0.80)
Household size squared	-0.190	-0.190	-0.194	-0.064	-0.049	-0.056
	(2.67)**	(2.72)**	(2.75)**	(1.05)	(0.75)	(0.89)
1=Wife knows person infected with	0.410	0.451	0.444	0.164	0.111	0.072
malaria; 0=Otherwise	(1.74)+	(1.85)+	(1.83)+	(0.83)	(0.56)	(0.36)
1=Location has high risk of malaria	1.387	1.331	1.342	0.774	0.610	0.615
(API>2.0); 0=Otherwise	(6.71)**	(6.37)**	(6.48)**	(4.68)**	(3.75)**	(3.75)**
1=Religion is Hindu (Muslim excluded);	0.707	0.693	0.683	0.611	0.479	0.464
0=Otherwise	(2.01)*	(1.98)*	(1.95)+	(2.45)*	(1.78)+	(1.70)+
1=Religion is Buddhist (Muslim	0.667	0.658	0.648	0.604	0.463	0.444
excluded); 0=Otherwise	(1.90)+	(1.87)+	(1.84)+	(2.26)*	(1.66)+	(1.58)
1=Both husband and wife chose pooling	0.330	0.344	0.353	0.635	0.678	0.681
card; 0= Otherwise	(1.08)	(1.12)	(1.15)	(2.72)**	(2.77)**	(2.80)**
1=Husband chose pooling card, wife did	0.461	0.450	0.444	0.404	0.381	0.371
not choose pooling card; 0= Otherwise	(2.22)*	(2.20)*	(2.16)*	(2.16)*	(2.03)*	(1.97)*
1=Husband did not choose pooling card,	-0.077	-0.073	-0.074	0.033	0.061	0.071
wife chose pooling card; 0= Otherwise	(0.31)	(0.30)	(0.31)	(0.17)	(0.31)	(0.36)
1=At least one child stunted in	-0.088	-0.073	-0.086	0.065	0.083	0.073
household; 0=Otherwise	(0.50)	(0.41)	(0.48)	(0.42)	(0.53)	(0.46)
Household Income in 1000 $	2.613			5.700		
	(1.76)+			(4.03)**		
1=Wife financially dependent on	0.163			0.653		
husband; 0=Otherwise	(0.88)			(3.87)**		
Wife total income in 1000 $		-0.353			-3.626	
		(0.18)			(1.90)+	
Wife non-labor income in 1000 $			1.390			0.068
			(0.89)			(0.04)
Constant	-10.818	-10.452	-10.526	-5.136	-4.015	-4.114
	(4.80)**	(4.94)**	(4.94)**	(2.35)*	(2.08)*	(2.16)*
	405	405	405	405	405	405

Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Once again, the coefficient for price was significant at 1% or less and negative for all specifications for both separate and joint interviews for both husbands and wives, indicating that other things being equal, respondents were willing to purchase fewer vaccines at a higher price. The coefficient for efficacy was not significant for

either husbands or wives for either separate or joint interviews. Husband's education and age was not significant either for separate or joint interviews. The coefficient for age was positive and significant, and for age squared was negative and significant only for wives for separate interviews such that a wife with age of 30 years would have the maximum household demand. Household size was positive and significant, whereas household size squared was negative and significant for wives for separate interviews and for husbands only for joint interviews (specification 5 only). Knowing a person infected with malaria was not significant, but people living in areas with a higher risk of malaria (API >2.0) were more likely to be willing to pay for more vaccines when interviewed jointly. The coefficient for religion was positive and significant for Hindu husbands for joint interview, whereas for Hindu wives, was significant and positive for both the separate and joint interviews. The coefficient for dowry for husbands was positive and significant for husbands when interviewed separately and not significant for the joint interview. For wives, the coefficient was significant and positive only for the joint interview.

Table 6.13: Tests for equivalence of coefficients (specification 1)

Coefficient for	Hypothesis for			
	β(Husband separate demand) = β(Wife Separate demand	β(Husband joint demand) = β(Wife Joint demand	β(Husband separate demand) = β(Husband joint demand)	β(Wife separate demand) = β(Wife joint demand)
	$H_o: \beta_{HS} = \beta_{WS}$	$H_o: \beta_{HJ} = \beta_{WJ}$	$H_o: \beta_{HS} = \beta_{HJ}$	$H_o: \beta_{WS} = \beta_{WJ}$
	(1)	(2)	(3)	(4)
Price	NR	NR	NR	R**
Efficacy	NR	NR	NR	NR
Respondent has secondary education	NR	NR	NR	NR
Respondent has higher secondary education	NR	NR	NR	R*
Age of respondent	R*	NR	NR	NR
Age squared of respondent	R+	NR	NR	NR
Dowry	R+	NR	NR	R+
Household size	R+	NR	NR	R+
Household size squared	R+	NR	NR	NR
Know a person infected with malaria	NR	NR	NR	NR
Slum has high malaria API	R**	NR	R**	R*
Hindu	NR	NR	NR	NR
Buddhist	R+	NR	R*	NR
Both pool	NR	NR	NR	NR
Husband Pool, wife non-pool	NR	NR	NR	NR
Wife pool, Husband non-pool	NR	NR	NR	NR
Stunting	NR	NR	NR	NR
Household income	NR	NR	NR	NR
Findep	NR	NR	NR	R*
Joint (all coefficients together)	R**	NR	R*	R**

R: Null hypothesis rejected, NR: Null hypothesis not rejected. + significant at 10%; * significant at 5%; ** significant at 1%

Tests of equivalence of coefficients supported the findings of the probit model. When both are interviewed jointly, the null hypothesis that the coefficient for husband demand is equivalent to coefficient for wife demand (column 2) could not be rejected for any of the coefficients. This was not the case when interviewed separately (column 1) where the coefficients for age, age-squared, dowry, household size, household size squared, religion and whether the slum was located in a high risk area were significantly different for husbands and wives. This suggests that husbands and wives had different preferences when interviewed separately, but were able to sort out some their differences and aggregate their preferences during the joint interview. This is evidence in favor of behavioral aggregation.

To identify those among husbands and wives who did change their behavior, I compared the individual coefficients before and after the joint meeting for husbands and for wives. The results for husbands are documented in column 3, and for wives in column 4. It can be seen that the joint equivalence of all the coefficients for separate and joint demand for husbands is rejected at 5% or less and for wives is rejected at 1% or less. A further inspection of tests between separate and joint coefficients reveals that the equivalence of coefficients for husbands could be rejected only for coefficient for slums located in high-risk areas and Buddhist families, where as for wives, the equivalence of coefficients could be rejected for coefficients for price, higher education, dowry, household size, whether the slum had a higher API and whether wife had any source of income (findep). This indicates that more factors affect wives differently than husbands while making a decision after the joint interview as compared to making a decision during the separate interview.

The coefficient of income deserves special inspection in this study. The coefficients for both total household income (specification one) and variable findep were positive and significant for husbands when interviewed separately and jointly. However, for wives, they were positive and significant only when interviewed jointly. This may be because couples were more aware of their budget constraints when discussing jointly. However, hypotheses of equivalence of coefficient for any of the four tests discussed in table 6.13 could not be rejected for the household income variable in husband and wife demand.

The next variable tested for equivalence for husband and wife demand was the total individual (sum of labor and non-labor) income. The coefficient for husband's (individual) monthly income (specification two) was positive and significant at 1% or less for both separate and joint interviews. However, the coefficient for (individual) income for wives was not significant for separate interview, but was significant and negative at 10% or less for joint interview. Usually, husbands and wives having coefficients for income significantly different from each other would be evidence enough to reject the common preferences model of intrahousehold resource allocation as it indicates that marginal funds in the hands of husbands could result in different consumptions patterns when compared to wives. The result seems counter intuitive in that it implies that other things being equal, a wife with higher individual income is likely to buy fewer vaccines than a wife with lower income, which refutes the possibility of vaccine being a normal good and violates the principles of construct validity. This may be because household income rather than individual income is the appropriate budget constraint for some wives implying that income pooling does take

place. On the other hand, wives with more income may be better at taking other precautions resulting in reduced risk of the disease for household members and the negative coefficient may be indicative of bargaining within the household.

Unlike in the probit model, non-labor income was not significant for either husbands or wives and I was not able to confirm existence of bargaining within the household on the basis of the count model.[22]

Table 6.14: Marginal effects of unit increase in independent variable on predicted demand

	Husband separate	Wife separate	Husband joint	Wife joint
Price	-0.74	-0.39	-0.79	-0.84
Efficacy	0.14	-0.13	0.07	0.02
Respondent has secondary education	0.14	0.23	0.28	0.04
Respondent has higher secondary education	0.10	0.41	0.20	-0.22
Age (@ 19 years)	0.01	-0.63	-0.30	-0.45
Age (@60 years)	0.16	0.03	0.35	0.19
Dowry	0.34	-0.09	0.14	0.24
Household size (@ 3 members)	-0.40	-0.66	-0.30	-0.19
Household size (@ 8 members)	0.37	0.25	0.37	0.33
Know infected person	0.14	0.36	0.25	0.17
High risk area	0.22	0.97	0.74	0.73
Hindu	0.21	0.52	0.54	0.60
Buddhist	-0.11	0.57	0.55	0.68
Both Pool	0.28	0.28	0.71	0.84
Husband pool, wife non-pool	0.54	0.39	0.38	0.45
Husband non-pool, wife pool	-0.08	-0.06	0.00	0.03
Stunt	-0.24	-0.07	0.00	0.06
Income	0.24	0.11	0.31	0.33
Wife has no income	0.58	0.12	0.57	0.62

For continuous variables, change in one standard deviation, for dummy variables from 0 to 1

[22] Other proxies for income such as land owned by parents were not significant for either separate or joint interviews (specifications 3 and 4). However, this could be because of lack of enough resolution on these variables. Other variables such as parental education were also not significant, mainly because of the lack of variation in the level of education achieved by parents

To determine the policy impact of the independent variables, I estimated the change in the predicted number of vaccines for a unit change in the independent variables. For continuous variables the impact of a standard deviation change was computed and for dummy variables, the impact of the change in variable from 0 to 1 was computed. The marginal impacts are reported in table 6.14. As in the analysis using the probit model, price variable had a high impact with a standard deviation increase in price reducing the demand for husbands and wives by 0.7 and 0.3 vaccines respectively during separate interviews and about 0.8 vaccines for both during joint interviews (the impact of a dollar increase in price was 0.1 and 0.2 vaccines for husbands and wives respectively when interviewed separately and 0.2 vaccines for both during the joint interview. Other significant variables that also had an impact on predicted demand include risk (+0.7 for joint interviews for both), wife having no source of income (findep) (+0.1 to +0.6), a pooling husband and non-pooling wife (+0.4 to +0.5) and religion dummies(-0.1 to 0.7). Since age and household size were curvilinear, the impact depended upon the age of respondent and household size. The impact of a unit standard deviation ($57) increase in monthly household income variable was about +0.3 vaccines for the joint interview.

Since specification 1 was the most compelling one, I used it in subsequent analyses. The WTP for husbands and wives for separate and joint interviews for specification 1 is reported in Table 6.15. The mean as well as median values of WTP after the joint interview are lower than those for a separate interview, for both husbands as well as wives. The median values are lower than the mean values indicating a flatter tail for the demand curve at higher prices.

Table 6.15: Mean and median household WTP (US$)

	Mean household WTP				Median household WTP			
	Separate		Joint		Separate		Joint	
	50	95	50	95	50	95	50	95
Husband	12.36 (11.82-12.90)	13.91 (13.30-14.52)	10.87 (10.20-11.55)	11.68 (10.95-12.40)	12.25	12.28	10.01	11.03
Wife	14.15 (12.97-15.35)	11.93 (10.93-12.94)	11.00 (10.31-11.70)	11.23 (10.52-11.95)	10.64	9.23	10.93	11.57

All figures in US$
Figures in parentheses are 95% confidence intervals for mean Household WTP.

The Mean and Median WTP values for a 95% vaccine were computed for different children/sons/daughters within the household. To do this, negative binomial regression was performed with the count of the number of vaccines purchased for children/sons/daughters as the dependent variable. The values are reported in 6.16. The expected WTP value was divided by the average number of children/sons/daughters within that household to arrive at the value of WTP per child, reported in columns 5-8. The median WTP for sons is higher than that for daughters for both husbands and wives, for both separate and joint interviews. While the median WTP for children dropped after a joint interview, the median WTP for daughters actually increased.

Table 6.16: Median WTP (US$) for children (95% effective vaccine)

	Median WTP				Median WTP per child			
	Husband		Wife		Husband		Wife	
	Separate	Joint	Separate	Joint	Separate	Joint	Separate	Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Son	2.89	2.59	2.62	2.54	2.28	2.17	2.53	2.07
Daughter	1.91	2.25	1.80	2.20	1.89	2.01	1.72	1.99
Children	6.34	5.92	6.14	6.13	2.67	2.66	3.28	2.70

Overall, the results did follow the norms of principles of economics and did not violate the principles of construct validity. Joint demand dropped with an increase in price and increased with increase in household income. The scope test on efficacy failed as the coefficient for efficacy was not significantly different from zero.

5. Switching regression

To explore any differences in the pattern of behavior (and bargaining) at higher prices and lower prices, I formulated a switching regression model.

To check for discontinuity in preferences, the sample was divided into two bins on the basis of price. Respondents who were offered the lower three prices ($0.22, $ 0.54, $1.09) were pooled in restricted sample one, whereas respondents offered the higher two prices ($3.26, $10.87) were pooled in restricted sample two. The analyses were restricted to joint demand. The results of the switching regression conducted for responses to the joint interview are presented in table 6.17. The full sample results for joint demand from the previous tables are also reproduced for convenience. Price was significant for the lower price bins, but not significant for the higher prices, for both husbands and wives.

Table 6.17: Results of switching regression

Husband's Coefficients	Restricted sample with lower prices	Restricted sample with higher prices
	(1)	(2)
Price in US $	-1.003	-0.070
	(4.60)**	(1.43)
Efficacy (1= 95% effective ;	0.067	0.146
0=Otherwise)	(0.49)	(0.42)
1=Husband has secondary education;	0.412	0.855
0=Otherwise	(2.41)*	(2.06)*
1=Husband has higher secondary or	0.327	0.531
college education; 0=Otherwise	(1.90)+	(1.11)
Husband's age	0.015	0.413
	(0.21)	(1.79)+
Husband's age squared	-0.000	-0.006
	(0.27)	(1.96)*
1=Dowry practice common	0.124	0.227
in community; 0=Otherwise	(0.78)	(0.56)
Household size	1.091	1.723
	(2.37)*	(1.26)
Household size squared	-0.107	-0.199
	(2.23)*	(1.41)
1=Husband knows person infected	0.243	-0.169
with malaria; 0=Otherwise	(1.66)+	(0.44)
1= Slum has malaria API >2.0;	0.574	1.408
0 = Otherwise	(3.42)**	(3.55)**
1=Hindu religion (Muslim excluded);	0.444	-0.211
0=Otherwise;	(1.94)+	(1.92)+
1=Buddhist religion (Muslim	0.307	0.318
excluded); 0=Otherwise;	(1.21)	(2.10)*
Monthly household income	2.528	7.050
in 1000 US$	(1.93)+	(2.12)*
Constant (husband)	-2.937	-12.790
	(2.01)*	(2.94)**

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 6.17 continued

Wife's Coefficients	Restricted sample with lower prices	Restricted sample with higher prices
	(1)	(2)
Price in US $	-0.817	-0.072
	(3.77)**	(1.40)
Efficacy	-0.034	0.460
	(0.25)	(1.28)
1=Wife has secondary education;	0.207	0.045
0=Otherwise	(1.50)	(0.10)
1=Wife has higher secondary or	-0.026	-0.093
more education; 0=Otherwise	(0.10)	(0.09)
Wife's age	0.175	-0.033
	(1.18)	(0.16)
Wife's age squared	-0.003	-0.000
	(1.08)	(0.12)
1=Dowry practice common	0.119	0.846
in community; 0=Otherwise	(0.78)	(1.73)+
Household size	0.930	4.815
	(1.74)+	(2.64)**
Household size squared	-0.095	-0.578
	(1.69)+	(2.73)**
1=Wife knows person infected with	0.099	-0.387
malaria; 0=Otherwise	(0.56)	(0.78)
1= Slum has malaria API >2.0;	0.558	1.439
0 = Otherwise	(3.29)**	(3.21)**
1=Hindu religion (Muslim excluded);	0.274	1.058
0=Otherwise	(1.04)	(0.33)
1=Buddhist religion (Muslim	0.230	1.251
excluded); 0=Otherwise;	(0.82)	(0.48)
Monthly household income	2.830	8.604
in 1000 US$	(2.55)*	(2.01)*
Constant (wife)	-4.742	-12.313
	(2.24)*	(2.62)**
Number of Observations	241	164

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

The tests for equivalence of coefficients are reported in table 6.18. The last row of this table reports the results for tests of equivalence for coefficients conducted jointly for all coefficients. The joint test of equivalence is rejected for tests between coefficients for lower price bins and higher price bins for both husbands and wives.

Table 6.18: Test of equivalence of coefficients: switching regression

Coefficient for	Hypothesis for Joint Demand[#]			
	β(Husband @ lower prices) = β(Husband @ higher prices) $\beta_{HL} = \beta_{WL}$	β(Wife @ lower prices) = β(Wife @ higher prices) $\beta_{HH} = \beta_{WH}$	β(Husband @ lower prices) = β(Wife @ lower prices) $\beta_{HL} = \beta_{WL}$	β(Husband @ higher prices) = β(Wife @ higher prices) $\beta_{HH} = \beta_{WH}$
Price	R**	R**	NR	NR
Respondent has higher secondary education	NR	NR	NR	NR
Age of respondent	R+	NR	NR	R*
Age squared of respondent	R+	NR	NR	R+
Dowry	NR	NR	NR	R+
Household size	NR	R*	NR	R*
Household size squared	NR	R*	NR	R*
Location has higher risk of malaria	R+	R+	NR	NR
Hindu	NR	NR	NR	R+
Buddhist	NR	NR	NR	NR
Monthly household Income	NR	NR	NR	NR
Joint (all coefficients together)	R**	R**	NR	NR

[#] For β_{XY}, the first suffix X, indicates husband/wife and second suffix Y, indicates high or low prices.

The tests show that the coefficient of price for lower prices is significantly different from that for higher prices. A non-significant coefficient for price could be because demand for the vaccine has choked (slope for price equal to zero) and that the price set during the pretest was accurate. The demand curve at higher price bins has some significant coefficients implying that there may be some other factors that influence demand even when price ceases to have an impact. Thus, for example, even at high price, a husband having at least some higher secondary education is likely to have a significantly higher stated demand than an illiterate husband, other things being equal. The non-significant coefficient for price is accompanied with a significant coefficient for the constant term which may raise a concern that there is some amount of yea-saying in the data. However, this constant could be a result of

other independent variables, some of which are also significant. To test for existence of yea-saying, I estimated demand for a representative household that is likely to have the least demand. Such household had a Hindu husband with no formal education, aged 60, knew people infected with malaria, did not live in a high risk area, belonged to a community where dowry was common, had a household size of 8 and was offered a 50% effective vaccine at a price of $10.9. As per the switching regression, the estimated demand for such household was 0.0001 vaccines (although significantly different from zero). This implies that the constant term is the result of other variables and yea saying can be ruled out. Efficacy is not significant in any specification implying that scope test for efficacy fails for both lower and higher price bins.

The results present evidence in favor of splitting the demand curve. However, whether a switching regression should be used can only be guided by underlying economic theory. If there is reason to believe that household members will approach bargaining in a different manner at higher prices (i.e., the residual error terms at higher prices and lower prices are different in structure) then switching regression should be adopted. If bargaining approaches remain the same, discontinuity can be introduced if necessary in the form of a high-price dummy variable and maintaining a uniform structure for the error term.

Figure 6.11: Predicted demand (simple vs. switching regression) for 95% effective vaccine

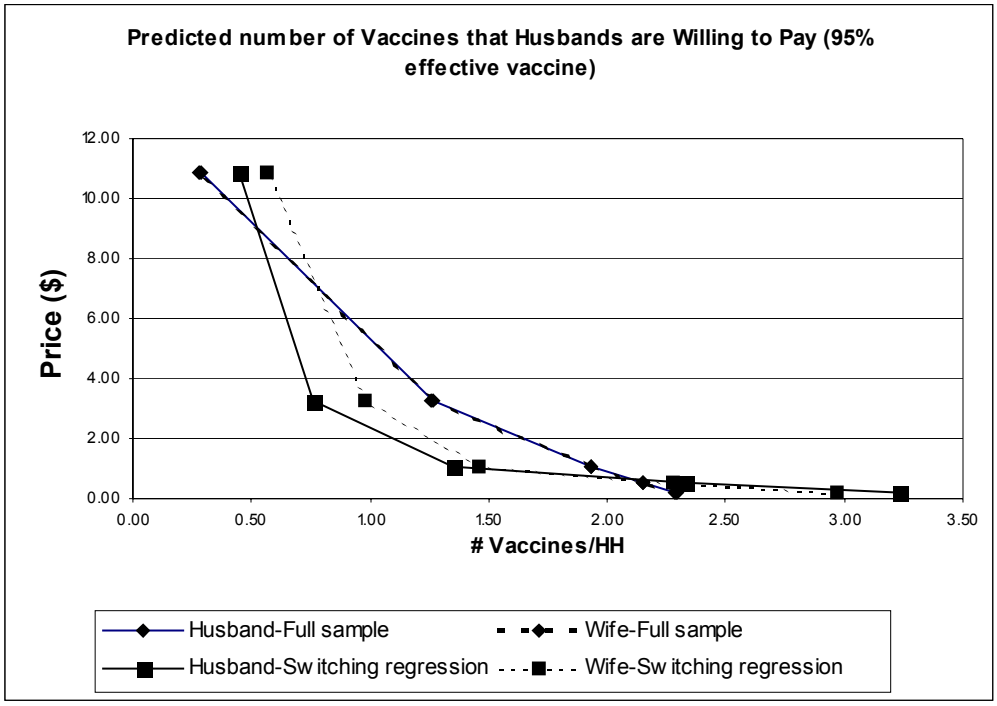
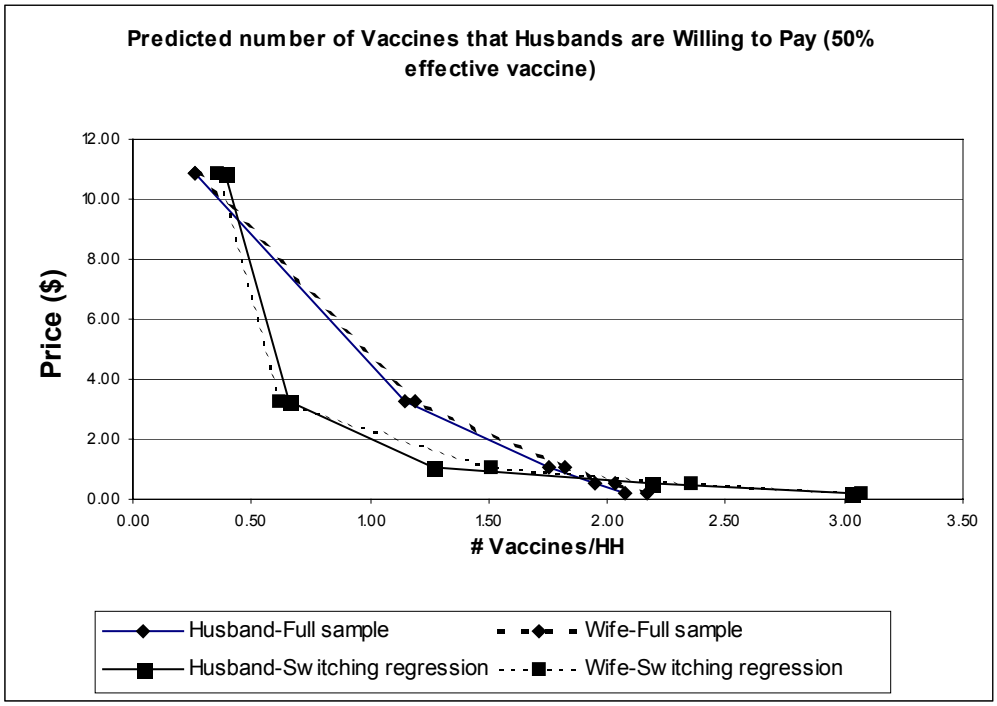


Figure 6.12: Predicted demand (simple vs. switching regression) for 50% effective vaccine



The predicted demand curves for full sample regression vs. a switching regression are shown in figures 6.11 and 6.12. The figure confirms that the switching regression predicted demand curve is more sensitive to price at lower prices compared to the full sample predicted demand curve. At lower prices, the predicted demand is higher for a switching regression model. At higher prices, demand is less sensitive to price as compared to the full sample predicted demand.

Since the coefficient for price at higher price is not significant, WTP could not be computed for the switching regression (as the formula for WTP has reciprocal for the coefficient for price).

6. Women who changed their opinion

To identify the characteristics of women who changed their opinion, I created a dummy variable for women who changed their opinion and ran a probit with individual characteristics of wives as the independent variables. The results of this regression are reported in table 6.19. To study the impact of independence of women on their decision-making, I closely examined the impact of education and economic independence of the women. To study the impact of education, of wife relative to her husband, I included a dummy variable equal to unity when wife had more education than her husband and indicator of wife's income. To study the impact of income, I formulated two specifications—specification one with a variable "findep," which is equal to unity when wife has no source of income and specification two with a dummy equal to unity if the wife were a housewife. To assess the influence of the husband's bargaining power, the (individual) income of the husband was also

included as a dependent variable in specifications 3 and 4. To account for the fact that more women and men are likely to agree with each other at higher prices, price was also included as a dependent variable.

Table 6.19: Women who changed their opinions

	(1)	(2)	(3)	(4)
Price in US$	-0.060	-0.063	-0.064	-0.066
	(3.17)**	(3.27)**	(3.33)**	(3.40)**
Efficacy (%)	-0.050	-0.050	-0.033	-0.032
	(0.37)	(0.37)	(0.24)	(0.23)
Number of children	-0.140	-0.132	-0.139	-0.134
	(2.16)*	(2.00)*	(2.13)*	(2.03)*
Age of wife	0.204	0.199	0.195	0.189
	(2.75)**	(2.66)**	(2.61)**	(2.52)*
Age of wife squared	-0.003	-0.003	-0.003	-0.003
	(2.63)**	(2.48)*	(2.50)*	(2.36)*
1=Wife had more education than husband; 0= Otherwise	0.289	0.277	0.268	0.263
	(1.30)	(1.24)	(1.19)	(1.17)
1 = Religion is Hindu; 0= otherwise (Muslim excluded)	0.379	0.372	0.373	0.359
	(1.77)+	(1.74)+	(1.72)+	(1.66)+
1 = Religion is Buddhist; 0= otherwise (Muslim excluded)	0.112	0.121	0.138	0.136
	(0.48)	(0.52)	(0.59)	(0.58)
1= Wife's occupation is housewife; 0 = Otherwise		0.413		0.373
		(2.61)**		(2.32)*
1=Wife completely financially dependent upon husband; 0=Otherwise	0.250		0.278	
	(1.75)+		(1.93)+	
Total monthly income of husband('000$)			4.806	4.248
			(3.00)**	(2.66)**
Constant	-3.699	-3.825	-3.941	-3.944
	(3.06)**	(3.16)**	(3.24)**	(3.25)**
# of observations	405	405	405	405

Absolute value of z statistics in parentheses.
+ significant at 10%; * significant at 5%; ** significant at 1%.
Dependent variable equals unity if wife changed her opinion in a joint interview.

Both the variables findep and housewife were significant and positive indicating that if the wife did not have any source of income or if she was a housewife, she was more likely to change her opinion in the joint interview. This is indirect evidence in favor of some level of bargaining taking place in households where women earned some income, and weak evidence against the common preference model of intrahousehold resource allocation in households where women

earn something. Wives having a higher education than husbands did not behave in a manner significantly different from those who did not have higher education than their husbands for any of the specifications

The variable for number of children was negative and significant at 10% or less, implying that a woman with more children was more likely to not change her opinion. Coefficient for age was positive and significant and for age squared was negative and significant. The coefficients were such that a woman aged about 34 is most likely to change her opinion in a joint interview than women who are older or younger than she is, other things being equal. The coefficient for monthly income of husband was positive and significant, implying that other things being equal, a wife with a husband with higher monthly income was more likely to change her opinion. The coefficient for price was negative and significant, as fewer wives had to change their opinion at higher prices when demand for both husbands and wives was choked out.

The coefficient for Hindu women was significant and positive indicating that Hindu women were more likely to change opinion than Buddhist or Muslim women. In other specifications I had included the coefficient for dowry but it was not significant.

7. Estimating sharing weights

As discussed in the conceptual framework, I ran the OLS regression,

$$WTP_{Joint} = \alpha.(WTP_{Husband,Separate}) + \beta.(WTP_{Wife,Seperate})$$

without a constant and with a constraint that the coefficient of husband separate WTP and wife separate WTP sum to unity ($\alpha+\beta = 1$). I found the weight, α, to be significant at 1% or less with a value of 0.7. Thus, if we have demand curves for husbands and wives interviewed separately, we can compute their WTP estimates and the resulting household WTP can be obtained by weighing husband's WTP by 0.7 and wife's WTP by 0.3.

Table 6.20: Estimating sharing weights

Independent variables	Husband joint WTP as dependent variable
Husband separate WTP (US$)	0.67
	(32.8)**
Wife separate WTP (US$)	0.33
	(16.2)**

Absolute value of z statistics in parentheses
** significant at 1%
Value of constant was forced to zero.
Value of sum of coefficients constrained to be unity.

Thus,

$$WTP_{Joint} = 0.7.(WTP_{Husband,Separate}) + 0.3 .(WTP_{Wife,Seperate})$$

8. Comparing with heuristic rules

I will now examine how the joint response compares with aggregation based on heuristic rules developed by Whittington et al (2006). In households where husbands and wives disagree upon who receives a vaccine, I used five rules—husband dictator (husband separate demand), wife dictator (wife separate demand), either husband or wife agrees, both husband and wife need to agree, and both need to

agree for other household members only—to decide which individual household member receives a vaccine. In addition, I developed two more heuristic criteria—(1) a husband or wife was chosen randomly (with equal weights) to be the decision-maker. This process was repeated 5000 times and the mean stated demand was computed and (2) one of the first five rules mentioned above was selected randomly to be the decision-making criteria. This too was repeated 5000 times to compute mean stated demand.

Figure 6.13 shows the different stated demand curves obtained using the different rules for a 95% effective vaccine. The stated demand as a result of these heuristic rules is tabulated in table 6.21. The figure shows that the "either agree" criteria yields the upper bound of household WTP whereas "both have to agree" yields the lower bound of household WTP. The remaining criteria yield demand curves somewhere in between.

Table 6.21: Comparing husband's joint demand with heuristic rules (95% effective vaccine)

Price US ($)	Husband dictator	Wife dictator	Either agrees	Both have to agree	Both have to agree for other members	(1) & (2) randomly selected	(1) to (5) randomly selected	Husband (joint)	Wife (joint)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.2	3.14	2.12	3.64	1.62	2.38	2.63	2.58	3.36	3.10
0.5	1.66	1.17	2.15	0.68	1.37	1.42	1.41	2.02	1.93
1.1	1.50	0.98	2.18	0.18	1.03	1.24	1.18	1.15	1.28
3.3	0.96	0.67	1.41	0.22	0.76	0.82	0.81	0.86	0.80
10.9	0.55	0.55	1.03	0.11	0.45	0.55	0.54	0.34	0.37

To find the differences between the different demand curves, the stated demand was tested for mean equivalence with behavior aggregated stated demand

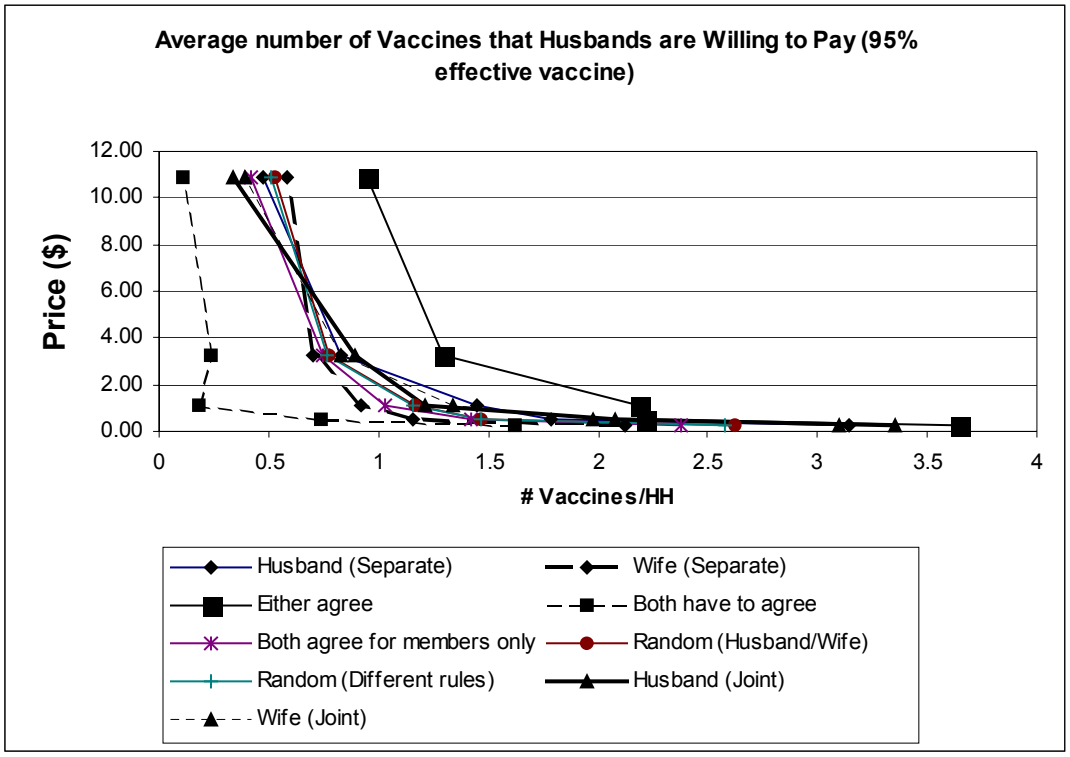
(joint stated demand for husband) for different prices for both husband and wife. The results for 95% effective vaccine are reported in table 6.22.

Table 6.22: Tests of mean equivalence, husband's joint demand and heuristic rules (95% effective vaccine)

Price US ($)	Test of mean equivalence between stated husband joint demand and stated demand when						
	Husband dictator	Wife dictator	Either agrees	Both have to agree	Both have to agree for other members	(1) & (2) randomly selected	(1) to (5) randomly selected
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.2	NR	R**	NR	R**	R**	R*	R*
0.5	NR	R+	NR	R**	R+	R+	R+
1.1	NR	NR	R**	R**	NR	NR	NR
3.3	NR	NR	NR	R*	NR	NR	NR
10.9	NR	NR	R*	R+	NR	NR	NR

R: Null hypothesis rejected at **:$\alpha = 0.01$, *:$\alpha = 0.05$, +:$\alpha = 0.10$. NR: Null hypothesis not rejected.

Figure 6.13: Comparing behavioral aggregation and heuristics



The upper bound estimate (either agrees, column 3) is significantly higher than joint husband demand at middle and highest price, where as the lower bound estimate (both have to agree, column 4) is significantly lower than joint husband demand at all price levels.

The heuristics represented by column 6 help us simulate the conditions under which surveys are generally conducted—husbands or wives selected randomly from the household for interview. Inspection reveals that the test of mean equivalence is rejected at lower prices, with a random survey underestimating the stated demand curve at lower prices. At higher prices, where demand is likely to have choked out, the mean equivalence could not be rejected. This trend continues in case of most of the other decision rules where WTP is underestimated at lower prices implying that in reality, husbands and wives are more considerate of their partner's choices when not constrained by the budget set.

9. Conclusions

The research provides insights into how husbands and wives make household decisions. In the analysis based on a probit model that assessed the willingness of a respondent to pay for vaccines for the entire households, coefficients for age (and age squared), education, dowry and risk of getting infected with malaria were significantly different for husbands and wives. In the analysis of demand based on a count model, coefficients for age (and age squared), dowry, household size (and household size squared), risk of getting infected with malaria and being a Buddhist were significantly different for husbands and wives. Thus, different socio-economic

coefficients affect husband and wife demand in a different manner (although causality cannot be established through a stated preference technique). Coefficient for price was significant (generally at 1% or less) and negative for both husbands and wives for both separate and joint interviews. The same cannot be said for efficacy, which was not significant throughout the analysis. Overall, the coefficients were significantly different for husband and wife demand for the joint interview. The research shows that differences in stated demand of husbands and wives can be reduced by a short private discussion. Although a stated preference cannot establish for a fact whether behavioral aggregation took place or whether wives simply acquiesced to their husbands' wishes, data suggest that some form of behavioral aggregation cannot be ruled out, as both husbands and wives did change their stated opinion during a joint interview.

A majority of the respondents adopted an "all or nothing" approach, more so after the short private discussion implying that couples were agreeing on the total number of vaccines that they were willing to pay for as well as the allocation among household members.

I found evidence of bargaining in the probit model that examined respondent behavior to purchase vaccines for the entire household as the coefficient for non-labor income was significant for husbands and not significant for wives. Results in a count model were mixed.

Variables such as price, age, household size, living in a high risk area and wife having no source of income were not only significant in some of the multivariate

results, but also high in terms of the magnitude of their impact on stated demand vis-à-vis other variables.

I examined the characteristics of women who changed their opinion and found that women without any source of income, who had fewer children, were aged about 34 years, had high-earning husband and were Hindu were more likely to change their opinion.

Other than these findings, I also examined some technical aspects of the analyses. The random effects probit model failed but that may be simply because of the nature of decision-making in the households. Comparison of joint stated demand with that produced by heuristic criteria randomly selecting husband and wife separate demand found that normal survey procedures in which either a husband or wife is interviewed randomly from each household are likely to underestimate stated demand at lower prices. This may be because individuals are more likely to accommodate their spouse's demand when they have space of budget constraint to do so.

The switching regression displayed a lot of promise in that the slope of the demand curve did differ at higher and lower prices. A non-significant coefficient for price at higher prices indicates that demand has choked out at that price. Although, adoption of the switching regression to determine private benefits can only be justified on the basis of underlying economic theory, the switching regression model can help us identify the threshold price where demand chokes off, i.e., the coefficient for price is not significant for the higher price bin.

CHAPTER 7

Evidence from revealed data

1. Module objectives

This chapter summarizes the results of the revealed preference module of the research. It examines the data on health status outcomes for gender discrimination among children in the slums of Navi Mumbai, India.

2. Exclusion criteria

The analyses use both z-score for height and stunting as an indicator of intrahousehold resource allocation within the household. A person having a height-for-age z-score of less than –2.0 was classified as stunted. The height-for age z-scores were computed using the "zanthro" command in Stata[23], with reference to the 2000 Centers for Disease Control and Prevention (CDC) growth reference height-age data. The CDC data were preferred over the UK data (also available in Stata command) as they were collected more recently.

The CDC growth reference has height data for individuals from age 2 to age 20 and length data for children less than age 2. However, the data collected for children under the age of 2 were not accurate as some young children did not

[23] The "zanthro" function transforms height data to height-for-age z-scores computed with respect to two reference data—the 1990 British growth reference and 2000 CDC Growth Reference (Vidmar et al., 2004).

cooperate while measuring length and sometimes measuring the height of children under 2 in slums proved to be a difficult task. As a result, the z-scores were not computed for individuals younger than 2 years and older than 20 years. Out of a total of 1092 children[24] in 422 households, 84 (8%) were younger than 2 and 34 (3%) were older than 20. Since adolescent children may reach their growth spurts at different points in time, the analysis was restricted to children only until the age of 12. As a result, another 258 children were dropped and the final sample size for the analysis was 716 children in 337 households.

Height data were missing for another 47 children (4%), thus reducing the available dataset to 669 children. As per the recommendations of the World Bank Technical Note #2 on Antropometrics (World Bank, 2007), I dropped another 50 children (5%) with extreme z values of less than –5 (42 observations) or greater than 3 (8 observations)[25] to eliminate outliers.

Another 13 children (1%) from six households were dropped as the age of wife during first birth was deemed to be too low (less than 13 years) thus questioning the reliability of these responses. This left a total of 606 children from 308 households for our analyses, of which 51% were sons.

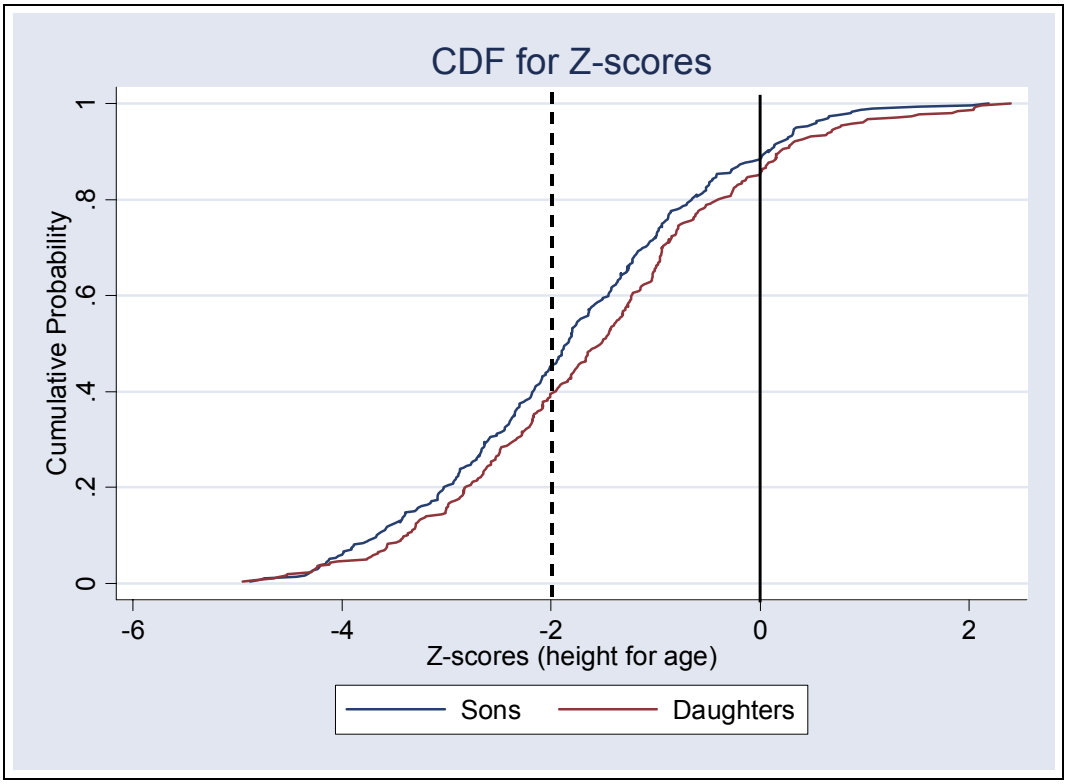
[24] In this analysis, the use of "children" refers to children by relation and not a specific age group. As a result, some children may be older than 20 .

[25] The extreme z-score limits were set as values beyond these limits were susceptible to measurement error. Inclusion of these data did not have any significant impact on the stunting regression. There were 10 respondents with z-value between –5 and –6, 7 between –6 and –7, 15 between –7 and –8, 1 between –8 and –9, 7 between –9 and –10 and 8 with z-score less than –10.

3. Evidence of stunting?

In our restricted sample of 606 children, sons and daughters had an average height (not controlled for age) of 110.4 cm and 110.5 cm respectively. The average z-score for daughters at –1.6 was significantly higher (at 5% or less) than that for sons at –1.8. The median z-score was also higher for daughters at –1.6 than that for sons at –1.8. The cumulative distrubution of z-scores for sons and daughters in the restricted sample is shown in figure 7.1. The negative values for mean and median z-scores, along with the cumulative density function (CDF) curve showing subjects in excess of 80% with a negative z-score implies that overall the population was shorter than the reference population in the CDC growth data. The CDF curve also shows that for almost all cumulative probabilities, the z-score for daughters is higher than the z-score for sons. This implies that when compared with a well nourished population of a similar age and gender, the daughters were taller than sons.

Figure 7.1: CDF for z-score (height-for-age) for children



The stunted population is indicated by the part of the cumulative distribution to the left of the vertical dotted line (representing a z-score of –2) shown in figure 7.1. In the restricted sample, about 39% of daughters and 45% of the boys were stunted, whereas about 16% of the daughters and 20% of the sons were severely stunted (z-score less than –3). The proportion of stunting is lower than that found by Gaiha and Kulkarni (2005)[26] for young children in rural India and higher than that found in middle class adolescent boys in Kolkata by de Onis et al. (2001). The stunting rates for Gaiha et al and de Onis et al are reported in table 7.1.

[26] Gaiha studied children under 5 years, whereas our sub-sample includes children from age 2 to 20 years.

Table 7.1 Prevalence of stunting in other studies

	Navi Mumbai, 2007: current dataset (age 2-20)		de Onis et al., 2001, Kolkata (age 7 – 16)	Gaiha and Kulkarni, 2005, rural India (age <5)	
	Sons	Daughters	Boys	Boys	Girls
Severely stunted	20.0	15.6	-	43.4	42.4
Moderately stunted	25.1	23.8	9.4	16.4	14.8
Total stunted	45.1	39.4	-	59.8	57.2

The proportion of stunting varied by gender and slum. The proportion of children stunted is reported by slum and gender in table 7.2. In a healthy population with normally distributed heights, only about 2% of the population, are likely to have a z-score of less than –2, indicating that stunting in the surveyed area is pervasive. Hence, as per the directive of WHO Expert Committee (1995), stunting can be used as a dependent variable in our analyses.

Table 7.2: Proportion of children stunted

	Shramik Nagar	Hanuman Nagar-Mahape	Ramabai Nagar	Hanuman Nagar-Turbhe
Proportion of sons stunted (%)	45	55	50	38
Proportion of daughters stunted (%)	38	54	30	35

4. Econometric results

As discussed in the conceptual framework (equation 3.19, 3.20, 3.23 and 3.24), I ran (1) a random effects regression with z-score for height (for age) as a continuous dependent variable and (2) a random effects probit regression with stunting as a binary dependent variable. Data were stacked with each row corresponding to a child within a household. Thus, a household with data on height of

three children was stacked in three rows. Summary statistics for different variables used in the regression are reported in Table 7.3.

Table 7.3: Summary of variables used

Variable	All children		Children in families with at least two children		Daughters in families with at least two children		Sons in families with at least two children	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Z-score (height for age)	-1.69	1.39	-1.69	1.39	-1.60	1.42	-1.79	1.35
1=Child is stunted; 0= Otherwise	0.42	0.49						
Sex: 1= Child is male; 0=Child is female	0.49	0.50						
Age of child in years	6.84	2.95	6.85	2.84	6.89	2.83	6.80	2.85
Age of child squared	55.53	42.44	54.90	40.68	55.42	40.46	54.33	40.99
Age of mother during childbirth	21.97	4.65	21.86	4.74	22.07	4.98	21.63	4.46
Age of mother during childbirth squared	504.31	227.99	500.28	232.84	511.73	247.97	487.55	214.54
Log of consumption (Rs.) per capita	6.30	0.49	6.27	0.48	6.27	0.46	6.26	0.50
Height of father	163.21	7.40	163.26	7.55	163.65	7.65	162.84	7.43
Height of mother	150.39	9.46	150.46	9.91	150.52	9.90	150.39	9.95
1=Mother has at least some secondary education; 0=Otherwise	0.28	0.45						
1=Women have no source of income;0=Otherwise	0.61	0.49						
1=Location has high risk of malaria; 0=Otherwise	0.55	0.50	0.54	0.50	0.53	0.50	0.56	0.50
1=Height of at least one sibling missing; 0= Otherwise	0.45	0.50						
Interaction: Educated mother dummy & daughter dummy	0.12	0.33						
Interaction: Educated mother dummy & son dummy	0.16	0.37						
Interaction: Not educated mother & daughter dummy	0.38	0.49						
1=Both Husband and Wife Pooling; 0= Otherwise	0.09	0.29						
1=Husband pooling, wife non-pooling; 0=Otherwise	0.18	0.39						
1=Husband non-pooling, wife pooling; 0=Otherwise	0.21	0.41						
Interaction: Mother with some source of income dummy & daughter dummy	0.19	0.39						
Interaction: Mother with some source of income dummy & son dummy	0.20	0.40						
Interaction: Mother without some source of income dummy & daughter dummy	0.32	0.47						
Interaction: Log consumption per captia & findep variable	3.84	3.08						
Interaction: Log consumption per captia & (1-findep)	2.45	3.10						
Interaction: Non-housewife & daughter dummy	0.15	0.36						
Interaction: Non-housewife & son dummy	0.15	0.36						
Interaction: Housewife & daughter dummy	0.35	0.48						

Interaction: Eldest child and (1-findep)		0.11	0.31				
Interaction: Other children and findep		0.40	0.49				
Interaction: Other children and (1-findep)		0.28	0.45				
Interaction: Eldest daughter and (1-findep)				0.16	0.37		
Interaction: Other daughters and findep				0.36	0.48		
Interaction: Other daughters and (1-findep)				0.21	0.41		
Interaction: Eldest son and (1-findep)						0.18	0.38
Interaction: Other sons and findep						0.30	0.46
Interaction: Other sons and (1-findep)						0.24	0.43
Number of children	606	528		278		250	

Results of random effects regression with z-score as dependent variable are reported in table 7.4 and random effects probit regression with stunting as dependent variable are reported in table 7.5. The specification in table 7.4 and 7.5 is identical, except for the dependent variable (z-score for height-for-age vs. binary variable indicating stunting) and type of regression (random effects vs. random effects probit).

Table 7.4: Results of random effects regression (all children)

Z-scores (height for age)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sex: 1= Child is male;	-0.241						
0=Child is female	(2.33)*						
Age of child in years	-0.009	-0.051	-0.005	-0.052	-0.006	-0.007	-0.005
	(0.10)	(0.57)	(0.05)	(0.57)	(0.07)	(0.08)	(0.05)
Age of child squared	0.004	0.004	0.003	0.005	0.004	0.004	0.004
	(0.67)	(0.70)	(0.53)	(0.73)	(0.58)	(0.59)	(0.58)
1=Mother has at least some secondary	-0.105						
education; 0=Otherwise	(0.68)						
1=Women have no source of	0.032						
income;0=Otherwise	(0.23)						
Interaction: not educated mother &		0.318	0.317				
daughter dummy		(2.58)**	(2.61)**				
Interaction: educated mother dummy		-0.030	0.050				
& daughter dummy		(0.15)	(0.25)				
Interaction: educated mother dummy		-0.043	0.029				
& son dummy		(0.23)	(0.16)				
Interaction: mother without some				0.335	0.318	0.315	
source of income & daughter				(2.46)*	(2.37)*	(2.35)*	
Interaction: mother with some source				0.269	0.183	-1.275	
of income dummy & daughter				(1.48)	(1.03)	(0.73)	
Interaction: mother with some source				0.156	0.056	-1.403	
of income dummy & son				(0.89)	(0.33)	(0.81)	
Interaction: housewife & daughter							0.209
							(1.67)+
Interaction: non-housewife &							0.213
daughter							(1.13)
Interaction: non-housewife & son							-0.097
							(0.52)
Age of mother during childbirth	0.383		0.364		0.366	0.362	0.365
	(4.31)**		(4.13)**		(4.15)**	(4.10)**	(4.14)**
Age of mother during childbirth	-0.007		-0.007		-0.007	-0.007	-0.007
squared	(3.93)**		(3.78)**		(3.77)**	(3.70)**	(3.75)**
Height of father	0.029	0.030	0.029	0.031	0.029	0.029	0.029
	(3.08)**	(3.03)**	(3.00)**	(3.15)**	(3.02)**	(3.03)**	(3.06)**
Height of mother	0.005	0.004		0.003			
	(0.75)	(0.53)		(0.38)			
Log of consumption (Rs.) per capita	0.027	0.095	0.051	0.068	0.043		0.038
	(0.19)	(0.67)	(0.37)	(0.49)	(0.32)		(0.28)
Interaction: log consumption per						-0.055	
capita & findep variable						(0.31)	
Interaction: Log consumption per						0.174	
capita & (1-findep)						(0.85)	
1=Location has high risk of malaria;	-0.255	-0.268	-0.234	-0.284	-0.243	-0.254	-0.245
0=Otherwise	(1.81)+	(1.86)+	(1.70)+	(1.98)*	(1.77)+	(1.84)+	(1.76)+
1=Height of at least one sibling	-0.226	-0.103		-0.112			
missing; 0= Otherwise	(1.62)	(0.73)		(0.80)			
1=Both husband and wife pooling;		0.062		0.079			
0= Otherwise		(0.25)		(0.32)			
1=Husband pooling, wife non-		-0.249		-0.259			
pooling; 0=Otherwise		(1.35)		(1.41)			
1=Husband non-pooling, wife		0.082		0.102			
pooling; 0=Otherwise		(0.46)		(0.58)			
Constant	-12.064	-7.486	-11.372	-7.407	-11.400	-10.756	-11.387
	(5.22)**	(3.58)**	(5.52)**	(3.53)**	(5.55)**	(4.91)**	(5.53)**
Number of children	602	602	602	602	602	602	602
Number of households	306	306	306	306	306	306	306

Absolute value of z statistics in parentheses, + significant at 10%; * significant at 5%; ** significant at 1%

In specification 1, I included children characteristics such as their sex, age and square of age and household characteristics (including parental characteristics) such as mother's and father's height to account for genetic variations, age of mother during childbirth.(and its square), log of per capita consumption [27] and whether the slum was located in a high risk location (API > 2.0) as independent variables. The education variable for children was not considered as most of the children went to school resulting in high correlation between child education and child age. I included two variables that might be associated with bargaining power of women: (1) a dummy variable for mother's education (secondary or higher) and (2) a dummy variable for mothers who did not have any source of income (findep:1=mothers have no source of income;0=otherwise). In addition, I included a variable, which indicated that the z-score for at least one of the siblings in the household could not be included in the analysis. This could be because the sibling was older than 12 years or younger than 2 years, or the height data for him/her was missing.

In specification 1 for the height-for-age model (table 7.4), I found that sex was negative and significant, implying that girls were on average taller than the referred well nourished population than boys, when controlled for age. This is a surprising result given the literature and empirical evidence pointing towards the gender bias against women in South Asia. In their analyses of anthropometric data from rural India, Gaiha and Kulkarni (2005) did find a higher proportion of male children

[27] I ran different specifications (not reported) with different indicators for income such as total household income, total income of fathers and mothers, non-labor income of fathers and mothers, and land (in acres) of grandparents, per capita consumption, log of per capita consumption. I found the log of per capita consumption to be the only variable with a relatively high p-value and all regressions are reported with this variable.

stunted vis-à-vis female children. However, the effect was not significant in the multivariate analyses.

Among other variables, I found that mother's age during birth had a curvilinear relationship with the z-scores of children with both age at birth and its square significant at 1% or less. Children born when their mothers were about 27 years old are likely to be the tallest compared to mothers who were younger or older then 27 years during childbirth, other things being equal. Height of mother was positive but not significant, but height of father was positive and significant implying that taller fathers were, on average, more likely to have taller children. The coefficient for log of consumption per capita was positive but not significant. The variable that indicated the risk of getting malaria was significant and negative. It may be possible that some of the stunting may be the result of illnesses in the slums and that slums with higher risk of malaria may also have high risk of other diseases (although there is no additional data to substantiate that claim).

To investigate why girls are likely to be taller, I interacted the gender variable with the education variable (specifications 2 and 3) and findep variable (specification 4, 5 and 6) and housewife variable (specification 7). I added information from other parts of our research. This includes variables indicating pooling status of the household. As was the case in analyses of household demand data, I added dummy variables indicating whether the household had (1) pooling husband and wife, (2) pooling husband and non-pooling wife or (3) non-pooling husband and pooling wife, with pooling defined as those respondents who chose a "P" card in the highest payout level of the lottery question, in specifications 2 and 4. In specification 2 and 4, I

removed age of mother during childbirth and in specification 3. In specification 6, I interacted the findep variable with the log of consumptions per capita variable.

I found that in specifications 2 and 3, the interaction of a daughter with a non-educated mother was positive and significant at 1% or less, indicating that daughters of women who had primary education or less were more likely to be taller than the reference population compared to their sons. Coefficient for interaction term for daughters with less-educated (primary education or less) mothers was significantly different from that for daughters with more-educated mothers with less-educated mothers more likely to have taller daughters compared to women with higher education. Similarly, in specifications 4, 5 and 6, the interaction of a daughter with a mother who had no source of income was positive and significant at 10% or less, indicating that women who did not have any source of income were more likely to have daughters taller than their sons (with respect to reference population). Interacting the gender of the child with mother occupation (housewife) also yielded similar results with the coefficient for the interaction of housewife and daughter being positive and significant at 10% or more.

The other results in specifications 2-5 were consistent with findings of specification 1. Log of consumption per capita remained positive but not significant, the variable that indicated risk of malaria remained negative and significant, and age of mother during childbirth remained curvilinear with women aged 26 during childbirth most likely to give birth to taller children.

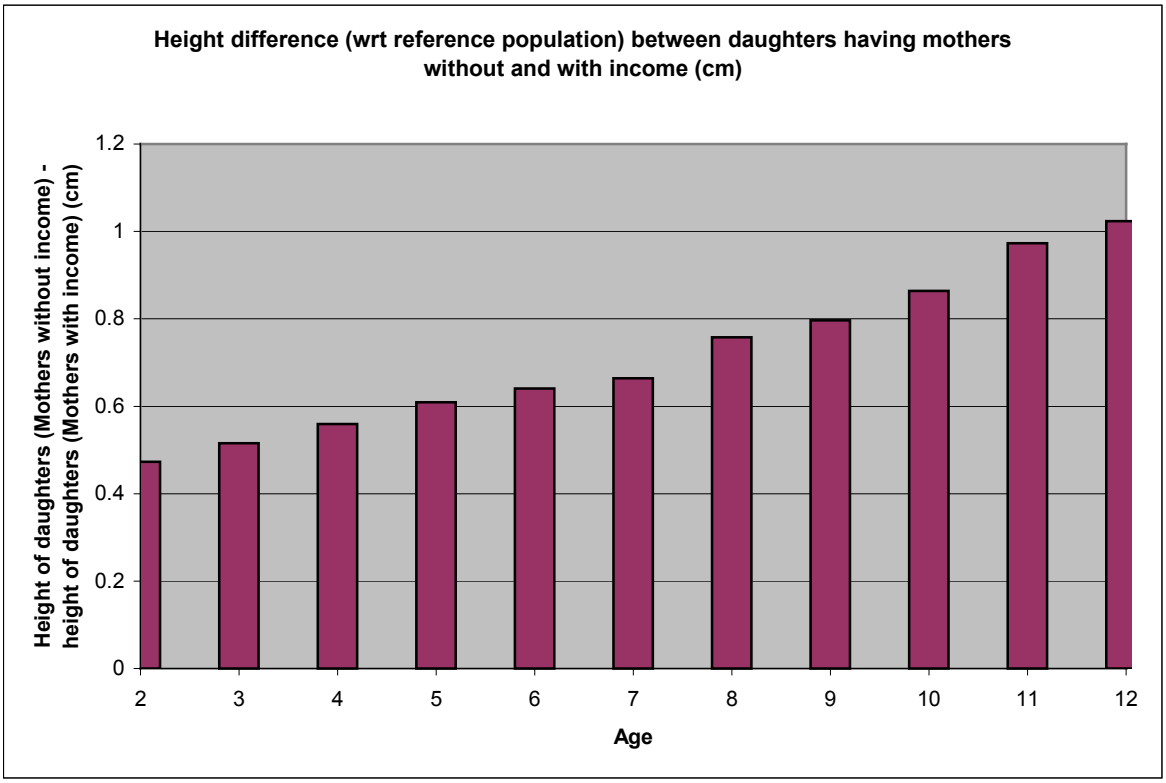
I also ran regressions with variables for infrastructure (such as electricity) and assets but these variables were not significant. I also ran all the specifications with a

dummy variable indicating missing data for children height within the household and religion dummies but these variables were not significant in any of the regressions[28].

The value of the coefficient for random effects regression with z-score as dependent variable also indicates the marginal impact that a unit increase in the independent variable will have on the z-score. The mean z value (one standard deviation) for girls gradually increases from about 3.5cm at the age of 2 to about 7.5 cm at the age of 12 and then remain almost constant at about 6.5 cm. Variables such as being a daughter of a mother without some source of income, a daughter of a mother with little education, living in a slum with high risk of malaria, age of mother during childbirth and per capita consumption have a higher impact on the z-score in terms of magnitude than variables such as age of child and height of the mother.

[28] Missing data for children height include (1) height for children aged 0-2, which could not be included because of measurement error and because the CDC data does not have information to compute z-scores in this age range, (2) height for children who could not be found in spite of multiple trips. This included children who were living with relatives (permanently or for vacation) or were funded for (primary or secondary) studies by charitable organizations and lived in hostels.

Figure 7.2: Height difference between daughters having mothers with and without income



In figure 7.2, I plotted the average difference in height of daughters with mothers having no income and those with mothers having some income. I found that at the age of 2 years, daughters of mothers having no source of income were on average taller by about 0.5 cm (specification 5). This difference peaked to about 1.0 cm at age of 12.

Table 7.5 Results of random effects probit regression (all children)

Dep. Variable: Child Stunted	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sex: 1= Child is male;	0.171						
0=Child is female	(1.43)						
Age of child in years	0.025	0.053	0.016	0.056	0.022	0.024	0.021
	(0.24)	(0.52)	(0.15)	(0.55)	(0.21)	(0.23)	(0.20)
Age of child squared	-0.007	-0.007	-0.006	-0.007	-0.006	-0.006	-0.006
	(0.94)	(0.92)	(0.78)	(0.98)	(0.87)	(0.88)	(0.88)
1=Mother has at least some secondary	0.122						
education; 0=Otherwise	(0.81)						
1=Women have no source of	0.012						
income;0=Otherwise	(0.09)						
Interaction: not educated mother &		-0.269	-0.285				
daughter dummy		(1.90)+	(1.97)*				
Interaction: educated mother dummy		0.134	0.049				
& daughter dummy		(0.63)	(0.23)				
Interaction: educated mother dummy		-0.001	-0.079				
& son dummy		(0.01)	(0.41)				
Interaction: mother without some				-0.314	-0.305	-0.303	
source of income & daughter				(2.05)*	(1.97)*	(1.95)+	
Interaction: mother with some source				-0.215	-0.133	1.489	
of income dummy & daughter				(1.16)	(0.71)	(0.85)	
Interaction: mother with some source				-0.261	-0.157	1.465	
of income dummy & son				(1.45)	(0.86)	(0.84)	
Interaction: housewife & daughter							-0.149
							(1.04)
Interaction: non-housewife &							-0.117
daughter							(0.58)
Interaction: non-housewife & son							0.110
							(0.56)
Age of mother during childbirth	-0.343		-0.332		-0.332	-0.326	-0.331
	(3.49)**		(3.37)**		(3.39)**	(3.33)**	(3.40)**
Age of mother during childbirth	0.006		0.006		0.006	0.006	0.006
squared	(3.23)**		(3.13)**		(3.13)**	(3.05)**	(3.12)**
Height of father	-0.037	-0.036	-0.037	-0.038	-0.037	-0.037	-0.037
	(3.77)**	(3.68)**	(3.71)**	(3.85)**	(3.77)**	(3.79)**	(3.81)**
Height of mother	-0.010	-0.009		-0.008			
	(1.50)	(1.31)		(1.15)			
Log of consumption (Rs.) per capita	0.113	0.067	0.101	0.097	0.111		0.113
	(0.82)	(0.49)	(0.73)	(0.72)	(0.82)		(0.83)
Interaction: Log consumption per						0.224	
capita & findep variable						(1.23)	
Interaction: Log consumption per						-0.032	
capita & (1-findep)						(0.16)	
1=Location has high risk of malaria;	0.107	0.113	0.107	0.128	0.116	0.129	0.125
0=Otherwise	(0.77)	(0.81)	(0.77)	(0.93)	(0.84)	(0.93)	(0.90)
1=Height of at least one sibling	0.151	0.048		0.060			
missing; 0= Otherwise	(1.09)	(0.35)		(0.44)			
1=Both husband and wife pooling;		-0.099		-0.127			
0= Otherwise		(0.42)		(0.54)			
1=Husband pooling, wife non-		0.142		0.154			
pooling; 0=Otherwise		(0.80)		(0.87)			
1=Husband non-pooling, wife		-0.213		-0.246			
pooling; 0=Otherwise		(1.25)		(1.43)			
Constant	10.806	6.577	9.531	6.560	9.555	8.799	9.481
	(4.34)**	(3.17)**	(4.17)**	(3.17)**	(4.22)**	(3.70)**	(4.22)**
Number of children	602	602	602	602	602	602	602
Number of households	306	306	306	306	306	306	306

Absolute value of z statistics in parentheses, + significant at 10%; * significant at 5%; ** significant at 1%

Results of the stunting model (table 7.5) were generally consistent with the z-score based model with the sign generally opposite of the z-score (higher probability of a tall child implies lesser probability of stunting), except that standard errors were slightly higher resulting in lower p-values and less number of significant variables. The coefficients for the gender variable in specification 1 and variable denoting risk of malaria in a particular location in all specifications were not significant. However, interaction between daughters and non-educated mothers and between daughters and mothers without sources of income was negative and significant (at 5-10% or less for various specifications), a result consistent with our previous models. Age and age squared of mother during childbirth was significant at 1% or less and height of mother was significant at 5% or less (10% or less in specification 5). Coefficient for log of consumption per capita was not significant. Age of mother during child birth was curvilinear and significant with children born when mothers are about 27-29 years old most likely to have the tallest children, other things being equal.

5. Impact of parental occupation and birth order

Overall, the data suggest that employment of women may be having a negative welfare effect on daughters. This raises some new questions. Is this negative welfare effect a result of reduced time that a mother spends with her children? If so, do other family members, including elder children take care of younger siblings? If so, how does it affect the health of elder children? Further, are children of mother's working on daily wages worse off than those of mother's working as housemaids? What is the impact of father's occupation on the decision of mother's to work or on

children height? Unfortunately, the data cannot causally answer any of these questions. However, I have tried to examine the association between birth order and occupation and the height of children.

A. Impact of birth order

If the eldest child provides childcare when her mother is working, it may create negative welfare effects for this child. To examine whether height of the eldest child of a working mother is significantly different from that of a non-working mother, I created a dummy variable for the eldest child in the household (having at least one younger sibling) and interacted it with the dummy variable findep (1= mother has no source of income;0=otherwise). I ran a random effects regression with z-score as a dependent variable for households which had at least two children in specification 1. The results are reported in table 7.6.

In addition, I examined the birth order of girls and boys separately, i.e., whether the height of the eldest daughter is significantly different from that of other female siblings (specification 2) and whether the height of the eldest son is different from that of other male siblings (specification 3), by restricting the analysis to girls and boys respectively.

The other independent variables used in this analysis include child characteristics such as age (and age squared), household characteristics such as age of mother during childbirth (and square of age during childbirth), log of consumption per capita, height of mother (specification 1-3) and height of father and locations with risk of malaria (specification 4-6).

Table 7.6: Regression results for daughters

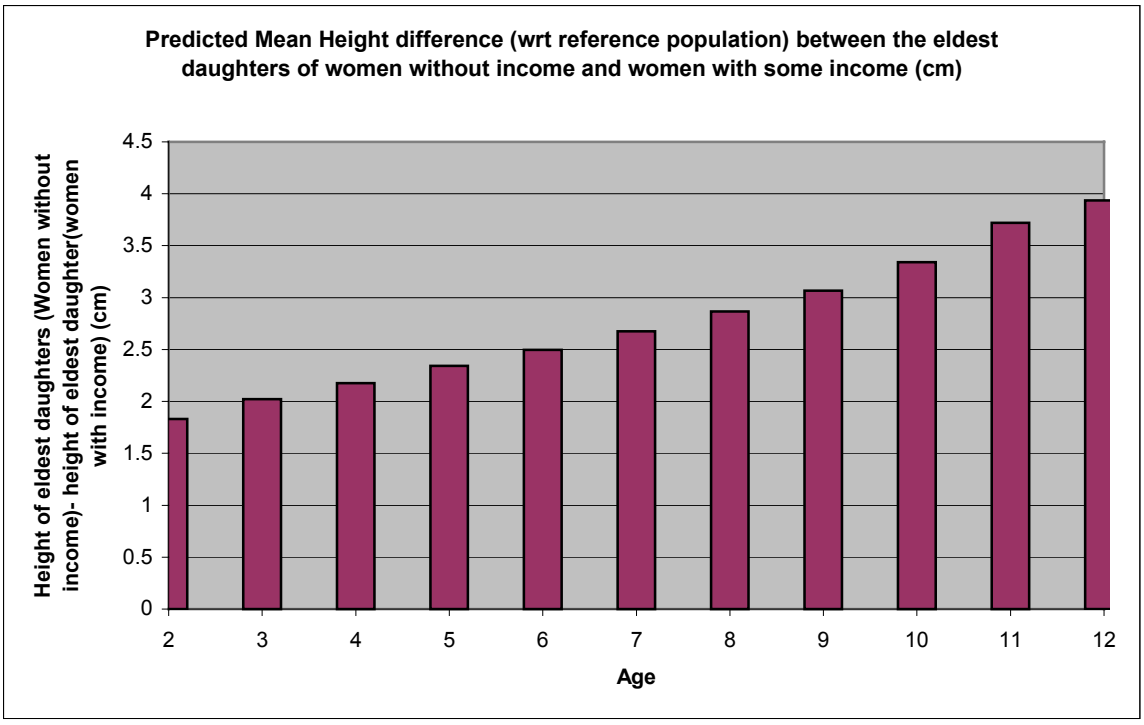
	(1)	(2)	(3)	(4)	(5)	(6)
Interaction: eldest child and (1-findep)	-0.034			-0.035		
	(0.15)			(0.16)		
Interaction: other children and findep	-0.088			-0.130		
	(0.53)			(0.78)		
Interaction: other children and (1-findep)	-0.108			-0.170		
	(0.51)			(0.81)		
Interaction: eldest daughter and (1-findep)		-0.526			-0.523	
		(1.99)*			(1.97)*	
Interaction: other daughters and findep		-0.276			-0.307	
		(1.20)			(1.33)	
Interaction: other daughters and (1-findep)		-0.153			-0.185	
		(0.54)			(0.66)	
Interaction: eldest son and (1-findep)			0.434			0.360
			(1.65)+			(1.39)
Interaction: other sons and findep			0.010			-0.048
			(0.04)			(0.20)
Interaction: other sons and (1-findep)			-0.095			-0.218
			(0.35)			(0.83)
Age of child in years	0.083	0.157	-0.036	0.078	0.136	-0.012
	(0.84)	(1.07)	(0.23)	(0.79)	(0.92)	(0.08)
Age of child squared	-0.002	-0.005	0.002	-0.003	-0.005	-0.001
	(0.33)	(0.53)	(0.15)	(0.43)	(0.49)	(0.10)
Age of mother during childbirth	0.383	0.411	0.281	0.386	0.392	0.321
	(3.76)**	(3.05)**	(2.14)*	(3.83)**	(2.91)**	(2.50)*
Age of mother during childbirth squared	-0.007	-0.008	-0.005	-0.007	-0.007	-0.006
	(3.42)**	(2.82)**	(1.87)+	(3.54)**	(2.72)**	(2.28)*
Log of consumption (Rs.) per capita	0.112	0.227	0.008	0.071	0.187	-0.028
	(0.70)	(1.10)	(0.04)	(0.45)	(0.92)	(0.16)
Height of mother	0.005	0.005	0.005			
	(0.66)	(0.55)	(0.55)			
Height of father				0.029	0.023	0.032
				(2.77)**	(1.79)+	(2.74)**
1=Location has high risk of malaria;				-0.314	-0.266	-0.358
0=Otherwise				(1.98)*	(1.33)	(1.98)*
Constant	-8.426	-9.554	-6.093	-11.878	-11.760	-10.482
	(4.26)**	(3.76)**	(2.56)*	(5.07)**	(3.87)**	(3.93)**
Observations	528	278	250	525	275	250
Number of households	230	179	175	229	178	175

Dependent variable is z-score for height
Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

The interaction term between mothers who had some source of income and the eldest child (specification 1, 4) was not significant but interaction of mothers who had some source of income was significant and negative for eldest daughters at 10% or less (specification 2, 5) and significant and positive at 10% or less for eldest sons

(specification 3) or not significant for eldest sons (specification 6). This indicates that eldest daughters of women who have any source of income are more likely to be shorter (or more likely to be stunted) than the eldest daughters of women who do not have any source of income. Eldest sons of women who have some source of income, on the other hand, are no more likely to be shorter than those of women who have no source of income. Data reveal gender disparities between sons and daughters.

Figure 7.3: Height difference between eldest daughters of women with and without income



The average differences in height of the eldest daughters of women who do not work and women who work for different ages are reported in figure 7.3. The difference is the least at age 2 at about 1.8 cm and gradually increases to about 3.9 cm at age 12.

B. Impact of occupation on child stunting

To assess the impact of occupation, I tabulated proportion of children stunted and total children by mother's and father's occupation (tables 7.7 and 7.8 respectively). Table 7.7 shows that, for example, 48% of all children had their fathers working as laborers for daily wages, but only 44% of the stunted children had their fathers working as laborers for daily wages. The tables show that the proportion of stunted children and total children is very similar for different parental occupations. In addition, I used various mother and father occupation dummies in the previously conducted multivariate exercise, but none of the coefficients was significant.

Table 7.7: Stunted children tabulated by father's occupation

Father's occupation	Proportion of stunted children	Proportion of total children
Unemployed	2%	2%
Laborer/daily wages	44%	48%
Mathadi	2%	1%
Artisan	4%	4%
Shopkeeper	1%	2%
Worker	7%	5%
Professional	1%	1%
Small business	1%	1%
Upper level job	1%	1%
Mid-level job	4%	5%
Low-level job	33%	30%
Housemaid	0%	0%
	100%	100%

Table 7.8: Stunted children tabulated by mother's occupation

Mother's occupation	Proportion of stunted children	Proportion of total children
Housewife	74%	71%
Laborer/ daily wages	9%	11%
Shopkeeper	0%	1%
Worker	1%	1%
Professional	1%	1%
Trader	1%	0%
Small business	0%	1%
Mid-level job	0%	0%
Low-level job	2%	2%
Housemaid	12%	11%
	100%	100%

6. Height certificate as a "gift"

Because of resource and ethical constraints, researchers struggle to arrive at the right "gift" to offer to respondents in a survey. I found a majority of our respondents eager to learn their exact weight and height and appreciated the concept of a height certificate for safe-keeping. In my opinion, this represents a perfect gift, which is not expensive to give, is appreciated by respondents, and at the same time provides the research team with invaluable data.

7. Conclusions

I found evidence that daughters of women who had no source of income or who had little education (primary education or less) were significantly taller (compared to their reference population) than other children. Further, the eldest daughters (with at least one younger sibling) of women who have some source of income were on average shorter compared to their reference population as against other daughters whereas the eldest son (with at least one younger sibling) was taller.

None of the income variables were a significant indicator of height. Further, the per capita consumption in households in which women had some source of income was not significantly different from that in households in which women did not have any source of income. This may be because women working in low-paying, low-quality jobs did not receive sufficient compensation to counteract the detriment effects of their absence from their home on the well-being of their children, especially daughters. Further, eldest daughters were more likely to be shorter than other daughters, but the same could not be said about the eldest sons. This may be because the eldest daughter assumes responsibility for the childcare of younger siblings or may be contributing in some way in household work. Because of the nature of the data, however, causality cannot be established.

CHAPTER 8

Evidence from Risky Choice Experiment

1. Module objectives

This chapter summarizes the results of the risky choice module of the research. The objectives of this chapter are:

1. To examine the differences in pooling behavior of husbands and wives.
2. To examine whether all households can be classified as pooling or non-pooling, or whether there exists a variety of pooling behavior displayed by different households.
3. To examine the impact of increased levels of payout on risky choice and income pooling behavior.

2. Exclusion criteria

Of the interviewed couples, 20 husbands (5% of the sample interviewed) and 65 wives (15% of the sample interviewed) were unable to comprehend the lottery. About 75% of these husbands and 80% of these wives did not have even a single year of formal education. Further, two husbands and nine wives refused to play the game. As a result, a total of 79 households representing about 19% of the sample were

excluded from the analyses. The final analysis was restricted to 334 households. Details of exclusion criteria are reported in Table 8.1.

Table 8.1 Exclusion criteria for the lottery experiment

Households where respondents did not understand the lottery	Respondents who did not understand the game	Additional respondents who refused to play the game
Husband only	14	0
Wife only	58	8
Both Husband and wife	7	1
Total Households excluded	*79*	*9*

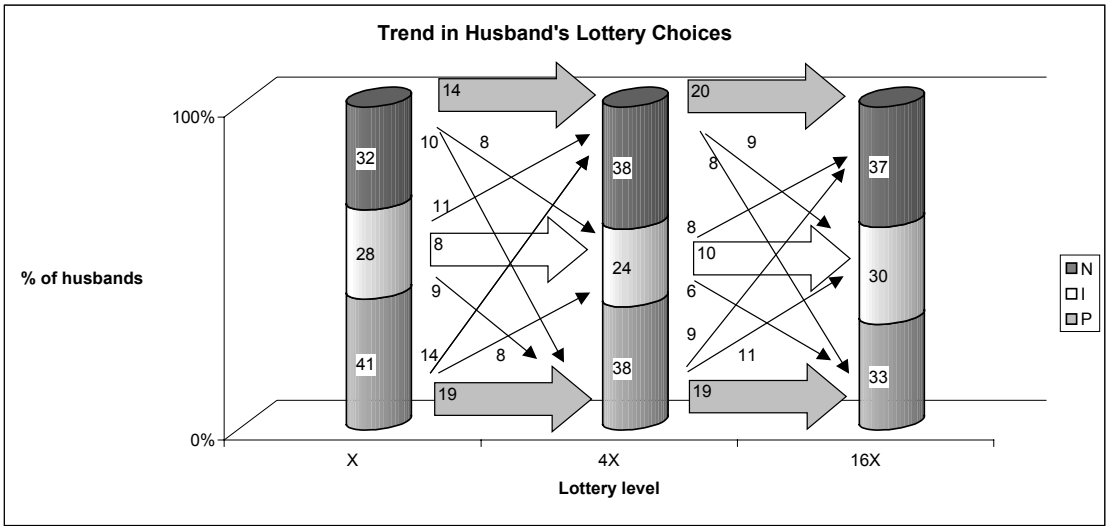
3. Individual responses to the lottery question

Figures 8.1 and 8.2 display the proportion of respondents choosing the pooling (P), intermediate (I) and non-pooling (N) choice for both husbands and wives at levels X, 4X and 16X. The stacked tubes show the proportion of respondents who chose a particular lottery option. The bold white and gray horizontal arrows show the proportion of respondents who did not display a change in their income-pooling tendency while moving from one level to the next level, whereas the thin diagonal arrows show respondents who selected a different card in the next level.

From level X to level 4X, the proportion of respondents displaying pooling behavior by choosing option P dropped from 40% to 38% for husbands and from 37% to 34% for wives, with the drop not significant for either husbands or wives. This was associated with a significant increase (at 10% or less) for husbands choosing a non-pooling card (card N) from 32% to 38% and a non-significant drop for wives from 35% to 32%. From level 4X to level 16X, the proportion of respondents choosing a pooling card dropped significantly to 33% for husbands and to 30% (not-significant) for wives). This was associated with a non-significant drop with 38% of the husbands choosing a non-pooling card and a significant increase (at 1% or less) for wives

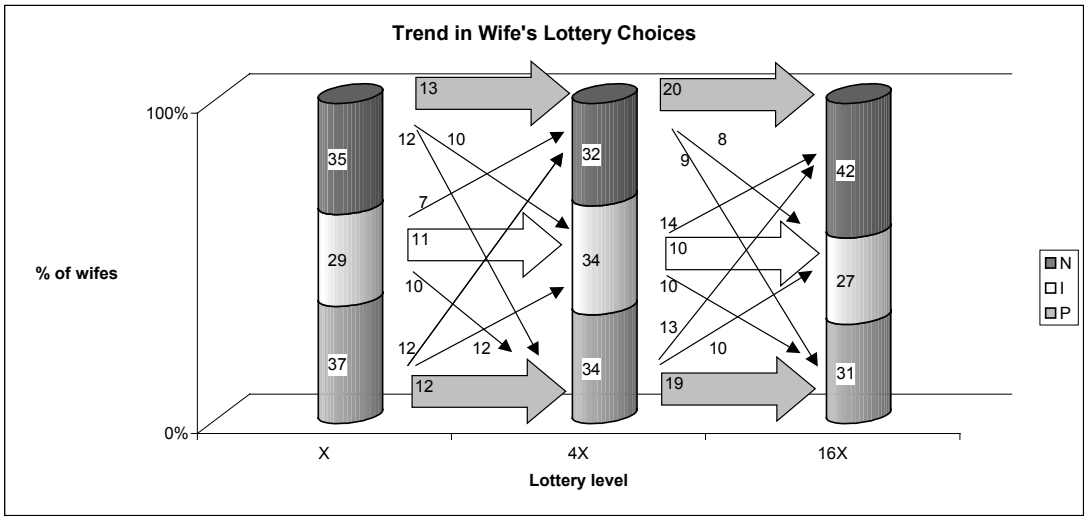
choosing the non-pooling card. The proportion of respondents changing their opinion as they moved to the next level (aggregate of the respondents represented by thin diagonal arrows) declined overall as stakes grew from 4X to 16X (51% for both husbands and wives) as compared to when the stakes grew from X to 4X (59% and 64% for husbands and wives respectively). This may be because many respondents were not decided at the 4X level.

Figure 8.1: Trend in husband's lottery choices



Note: Figures may not aggregate to 100 because of round off errors.

Figure 8.2: Trend in wife's lottery choices



Note: Figures may not aggregate to 100 because of round off errors.

Table 8.2: Respondent card choices (raw data)

	All three levels				Levels Y & Z only			
	Husbands		Wives		Husbands		Wives	
	#	%	#	%	#	%	#	%
Respondents who chose same card								
Card 3 (Non-income pooler)	24	*7*	26	*8*	67	*20*	50	*15*
Card 2 (Intermediate)	11	*3*	9	*3*	33	*10*	32	*10*
Card 1 (Income pooler or co-operative Bargainer)	36	*11*	16	*5*	62	*19*	38	*11*
Sub-Total	***71***	***21***	***41***	***15***	***162***	***49***	***120***	***36***
Respondents who chose different cards								
Leaning toward non-pooling extreme at higher stakes	97	*29*	91	*27*	78	*28*	122	*37*
Leaning toward pooling extreme at higher stakes	70	*21*	65	*20*	93	*23*	91	*27*
Others (not decisive)	95	*29*	126	*38*				
Sub-Total	262	*79*	282	*85*	171	*51*	213	*64*
Total	**333**	***100***	**333**	***100***	**333**	***100***	**333**	***100***
Non-pooling or leaning toward non-pooling	121	*36*	117	*35*	145	*48*	172	*52*
Pooling or leaning toward pooling	106	*32*	81	*25*	155	*42*	129	*38*
Others	106	*32*	125	*40*	33	*10*	32	*10*
Total	**333**	***100***	**333**	***100***	**333**	***100***	**333**	***100***

(percentages are with respect to total respondent husbands or wives, i.e., 333)

Table 8.2 shows raw data on the pattern of card choices for all three levels. Respondent choices for the last two levels are also displayed separately. Only 21% of the respondent husbands and 15% of the respondent wives chose the same card all three times though. This implies that a substantial majority of the respondents did change the type of card that they selected at least once as the level of stakes increased.

To understand underlying patterns in the behavior of respondents who did not choose the same card all three times, I examined their tendency to decisively move in the direction of a particular extreme (i.e., toward the P or N card). Respondents who

chose card P at lower levels and card I or card N at higher levels were classified as those with tendency to non-pool as the stakes rise. Respondents who chose I at lower levels but N at higher levels were also classified in this group. Thus, respondents who chose P-I-I, P-I-N, P-N-N, I-I-N or cards in similar sequence for the levels X-4X-16X were classified into this group. These are respresented by the respondents who followed the upward moving arrow in figures 8.1 and 8.2 at least once but never followed the downward moving arrow. Similarly, respondents who chose card N at lower levels and card I or P at higher levels were classified as those with tendency to pool as stakes rose. These are respresented by the respondents who followed the downward moving arrow in figures 8.1 and 8.2 at least once but never followed the upward moving arrow. The remaining respondents such as those who chose P-N-I, N-P-I, N-P-N, or cards in similar sequence were those who did not decisively move in a particular direction and were classified as undecided. These are respondents who chose both the upward and the downward moving arrows once in figures 8.1 and 8.2.

Overall, husbands tend to pool their income more often as seen by the fact that about 11% of the husbands who pooled consistently in all the three cards and another 21% showed a tendency to pool at higher stakes, as compared with only about 5% of wives who pooled consistently and another 20% who tended to pool at higher prices. A higher proportion of husbands (compared to wives) did not change their preference for a particular type of card, which resulted in a lower proportion of husbands (compared to wives) who were not decisive in their tendency to pool income.

Although, I could identify some trends in individual tendencies towards pooling, I was not able to categorize households into pooling or non-pooling

categories. This is because husband and wife made the same choice for each level only 14 (4%) times. Of these, only two couples chose the P card consistently all three times, and a single couple chose the N card consistently.

When data from only the last two levels were analysed, the proportion of respondents choosing consistently for the last two levels increased to 49% of husbands and 36% of wives. Overall, wife behavior was not significantly different from that of husband's with about 52% of wives likely to be either non-pooling or leaning to non-pooling compared to 48% of husbands and 38% of wives likely to be either pooling or leaning towards pooling as against 42% of husbands. The proportion of wives choosing non-pooling or tending to choose the non-pooling card was significantly higher than those choosing a pooling card or tending to pool. However, equivalence of proportion of husbands choosing non-pooling card or tending to non-pooling and those choosing pooling card or tending to pooling could not be rejected. Of the 333 couples, only 40 husbands selected the same cards as their wife for the last two levels. Of these, 9 chose the pooling card, 2 chose the intermediate card and 11 chose the non-pooling card consistently at each level.

4. Choosing a different card

The raw data establish that a majority of respondents did not choose the same card all the three times. This may be because some of the respondents may be learning the experiment at the lower levels. I have examined this possibility of learning in two ways. First, I study the differences in multivariate results for each level separately. I also examine the impact of education on card switching.

A. Multivariate results for each level

I conducted multivariate analysis for each level in form of a multinomial probit model with the dependent variable equal to 1, 2 or 3 if a Pooling, Intermediate or Nonpooling card was chosen respectively and examined the standard errors of the covariates and the trend in the proportion of variability in our data that is explained by the econometric models (pseudo R^2). I hypothesized that higher learning should result in lower standard errors and higher R^2 and higher number of significant variables.

The different independent variables considered were education levels of husbands and wives, respondent's age and age squared, religion dummies. Consistent with the specifications used in other analyses in the dissertation, I used aggregate household income and variable findep (a dummy variable indicating that wife did not have any source of income). I included a dummy variable, which indicated at least one child in the household was stunted. I also included the predicted WTP for joint response of the respondent for a 95% effective vaccine.

The Pseudo R^2 and number of significant variables for the three levels are reported in table 8.3 and the multivariate results for wives and husbands are posted in tables 8.4 and 8.5 respectively. I found that the R^2 for wife was highest at the card Z level for the highest payout. The R^2 for husbands remained almost the same. Thus, there may be some learning going on for wives.

Table 8.3: Variance levels for card X,Y,Z

	Wife			Husband		
	Card X: lowest payout	Card Y: intermediate payout	Card Z: highest payout	Card X: lowest payout	Card Y: intermediate payout	Card Z: highest payout
Pseudo R^2	0.05	0.01	0.09	0.03	0.03	0.04
# of significant variables	4	0	8	0	5	3

Note that standard errors for variables remained almost the same.

Table 8.4: Multinomial probit results for wife choices (one card at a time)

	Card X: lowest payout	Card Y: intermediate payout	Card Z: highest payout
Outcome P, Base N			
1= Husband has secondary education or more;	0.215	-0.058	0.064
0=Otherwise	(0.91)	(0.24)	(0.26)
Wife has secondary education or more; 0=Otherwise	-0.156	0.124	-0.982
	(0.61)	(0.49)	(3.69)**
Wife's age	0.093	-0.056	-0.277
	(0.84)	(0.49)	(2.28)*
Wife's age squared	-0.001	0.001	0.004
	(0.71)	(0.51)	(2.41)*
Number of children	-0.019	0.377	0.017
	(0.05)	(1.10)	(0.05)
Number of children squared	-0.004	-0.055	-0.002
	(0.07)	(1.07)	(0.04)
1=Religion is Hindu (Muslim excluded);	-0.298	0.074	-0.333
0=Otherwise	(0.85)	(0.21)	(0.95)
1=Religion is Buddhist (Muslim excluded);	-0.392	0.150	0.112
0=Otherwise	(1.08)	(0.41)	(0.31)
1=Household with at least one child stunted;	0.404	-0.135	0.297
0=Otherwise	(1.82)+	(0.60)	(1.31)
Monthly household income in '000$	-1.672	-1.411	0.257
	(0.71)	(0.59)	(0.11)
1=Wife financially dependent on husband;	0.287	-0.106	0.698
0=Otherwise	(1.17)	(0.42)	(2.67)**
Predicted wife joint WTP (95% effective)	0.003	-0.011	0.026
	(0.10)	(0.42)	(0.96)
Constant	-1.625	0.674	3.373
	(0.92)	(0.37)	(1.78)+
Outcome I, Base N			
1= Husband has secondary education or more;	0.101	0.086	0.376
0=Otherwise	(0.41)	(0.36)	(1.52)
Wife has secondary education or more; 0=Otherwise	-0.205	-0.040	-0.950
	(0.77)	(0.16)	(3.55)**
Wife's age	0.101	-0.031	0.003
	(0.87)	(0.27)	(0.02)
Wife's age squared	-0.001	0.001	0.000
	(0.67)	(0.43)	(0.16)
Number of children	-0.746	0.266	0.111
	(2.14)*	(0.78)	(0.31)
Number of children squared	0.107	-0.039	-0.004
	(2.02)*	(0.77)	(0.08)
1=Religion is Hindu (Muslim excluded);	-0.417	0.012	0.592
0=Otherwise	(1.11)	(0.03)	(1.47)
1=Religion is Buddhist (Muslim excluded);	-0.008	0.111	0.895
0=Otherwise	(0.02)	(0.30)	(2.13)*
1=Household with at least one child stunted;	0.349	-0.173	0.390
0=Otherwise	(1.51)	(0.77)	(1.68)+
Monthly household income in '000$	-1.755	-0.689	-1.343
	(0.72)	(0.30)	(0.55)
1=Wife financially dependent on husband;	0.764	-0.149	0.298
0=Otherwise	(2.87)**	(0.59)	(1.17)
Predicted wife joint WTP (95% effective)	0.040	-0.007	0.040
	(1.44)	(0.25)	(1.48)
Constant	-1.808	0.199	-2.223
	(0.98)	(0.11)	(1.05)
# Observations	333	333	333

Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 8.5: Multinomial probit results for husband choices (one card at a time)

	Card X: lowest payout	Card Y: intermediate payout	Card Z: highest payout
Outcome P, Base N		5	3
1= Husband has secondary education or more;	0.143	-0.544	-0.181
0=Otherwise	(0.57)	(2.20)*	(0.72)
1=Wife has secondary education or more;	-0.073	0.081	-0.136
0=Otherwise	(0.29)	(0.33)	(0.54)
Husband's age	-0.005	0.057	0.014
	(0.06)	(0.61)	(0.15)
Husband's age squared	0.000	-0.001	-0.000
	(0.13)	(0.70)	(0.18)
Number of children	-0.310	-0.388	-0.048
	(0.80)	(1.15)	(0.13)
Number of children squared	0.075	0.073	-0.005
	(1.22)	(1.45)	(0.08)
1=Religion is Hindu (Muslim excluded);	-0.068	-0.488	0.081
0=Otherwise	(0.19)	(1.39)	(0.23)
1=Religion is Buddhist (Muslim excluded);	-0.143	0.042	0.382
0=Otherwise	(0.40)	(0.12)	(1.04)
1=Household with at least one child stunted;	0.235	0.044	-0.260
0=Otherwise	(1.07)	(0.20)	(1.17)
Monthly household income in '000 US$	-1.172	-6.201	-4.312
	(0.49)	(2.50)*	(1.77)+
1=Wife financially dependent on husband;	0.030	0.130	-0.437
0=Otherwise	(0.12)	(0.52)	(1.73)+
Predicted husband joint WTP (95% effective)	-0.004	0.049	0.026
	(0.14)	(1.98)*	(1.05)
Constant	0.432	-0.193	0.297
	(0.25)	(0.11)	(0.17)
Outcome I, Base N			
1= Husband has secondary education or more;	0.222	-0.189	-0.430
0=Otherwise	(0.86)	(0.71)	(1.70)+
1=Wife has secondary education or more;	-0.033	0.251	-0.144
0=Otherwise	(0.12)	(0.93)	(0.56)
Husband's age	0.092	-0.033	-0.023
	(0.94)	(0.33)	(0.24)
Husband's age squared	-0.001	0.001	0.000
	(0.92)	(0.64)	(0.23)
Number of children	-0.271	0.579	0.177
	(0.67)	(1.42)	(0.52)
Number of children squared	0.051	-0.044	-0.011
	(0.79)	(0.72)	(0.23)
1=Religion is Hindu (Muslim excluded);	0.040	-0.890	-0.197
0=Otherwise	(0.11)	(2.40)*	(0.57)
1=Religion is Buddhist (Muslim excluded);	-0.345	-0.317	-0.109
0=Otherwise	(0.92)	(0.83)	(0.30)
1=Household with at least one child stunted;	-0.133	0.191	-0.277
0=Otherwise	(0.58)	(0.81)	(1.23)
Monthly household income in '000 US$	1.780	-3.188	-0.737
	(0.73)	(1.31)	(0.31)
1=Wife financially dependent on husband;	0.100	0.146	-0.299
0=Otherwise	(0.38)	(0.55)	(1.17)
Predicted husband joint WTP (95% effective)	-0.018	0.061	0.022
	(0.71)	(2.31)*	(0.89)
Constant	-1.585	-1.444	0.481
	(0.86)	(0.77)	(0.27)
# Observations	333	333	333

Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

B. Impact of education on card choice switching

The concern about learning is a valid one particularly because of the lottery choice being essentially a numbers game and the high proportion of illiterate women within the household. In other words, is switching of cards by less literate persons a genuine response or is the data the result of a random process? However, regression analysis in tables 8.4 and 8.5 demonstrates that higher education variable is not significant. Thus, higher educated respondents, who are more likely to understand the experiment, have switched in a manner not significantly different from less educated respondents.

5. Multivariate results

Since the value of payout at level X was very low, I discarded this from the analyses. To explore the possibility of learning, I ran the multinomial probit models for level Y and Z data pooled together (666 observations, specifications 1 and 2) and for level Z only (333 observations, specifications 3 and 4).

I used the same set of independent variables that I used to examine learning. Consistent with the specifications used in other analyses in the dissertation, I used different variables for income. In specification 1 and 3, I used aggregate household income and variable findep (a dummy variable indicating that wife did not have any source of income) and in specification 2 and 4, I used respondent's total income (labor and non-labor) as the independent variable.

The sample characteristics of the variables used for the exercise are reported in Table 8.6. The results for the multinomial probit regression for husbands and wives

for outcome P vs. N (with N= Non-pooling as base category) and outcome I vs. N (with N=Non-pooling as base category) are reported in tables 8.7 and 8.8 respectively[29].

Since each respondent chose a card two times (for level Y and Z combined), one for each level, I had three responses that were stacked one above the other. A seemingly unrelated multinomial probit regression was utilized to account for correlation between husband and wife responses, and robust standard errors were predicted at the household level.

By the nature of this particular setup of the multinomial regression with three discrete choices, there are two sets of non redundant coefficients associated with each independent variable, (1) for P vs. N outcome and (2) for I vs. N outcome. I will discuss the results of specifications 1 and 2 initially and 3 and 4 subsequently.

In specification 1 and 2, the payout variable was not significant for husbands but was significant and negative for wives (at 10 % or less for outcome P, base N and 1% or less for outcome I, base N). This implies that when payout increased from level Y to level Z, only wives were on average, more likely to choose a non-pooling card vis-à-vis a pooling or an intermediate card. The variable indicating respondent possessing secondary education or more was significant and negative for both husbands and wives in specifications 1 and 2 for both the P vs. N outcome and I vs. N outcome. This implies that both husbands and wives who had primary education or less were more likely to choose a pooling card. It should be noted that spouse's

[29] To test for violation of the assumption of IIA, Hausman test (Hausman and McFadden, 1984) and Small and Hsiao's test (Small and Hsiao, 1985) were conducted for both husbands and wives. The null hypotheses that IIA is maintained could not be rejected in either of the cases.

education variable was not significant for either husbands or wives. Both household income and individual total income were significant and negative for husbands for P vs. N outcome implying that husbands in households having higher household income as well as those earning higher (total earned and unearned) incomes were on average more likely to non-pool income. Household income was not significant for wives (specification 1), but total income of wives was significant and negative for wives for the P vs. N outcome (in specification 2) implying that wives having higher individual incomes were more likely to non-pool. Age was significant and curvilinear for wives for both the P vs. N outcome and the P vs. I outcome with the coefficient for age being negative and that for age squared being positive. The coefficient for age squared however was very low implying that older women were more likely to not-pool income. The dummy variable for Hindu religion was negative and significant for husbands for the I vs. N outcome implying that Hindu husbands were more likely than Muslim husbands to choose the non-pooling card vis-à-vis the intermediate card. The dummy variable for Buddhist religion was significant for wives for specification 2 only, implying that Buddhist wives were more likely to choose the pooling card when compared to Muslim wives. The variable for predicted WTP for a 95% vaccine was positive and significant for husbands for the P vs. N outcome.

When only the choices for level Z were considered (specifications 3 and 4), the sign of the coefficients for both husbands and wives remained identical for most of the variables. However, the significance of coefficients dropped down for husbands with only household income and findep variable (specification 3) and total income variable (specification 4) significant for the P vs. N outcome. Only the

coefficient for husband's secondary education was negative and significant for the I vs. N outcome. For wives results were identical to those with level Y and Z, except for varaible findep and total income. This is evidence against additional learning occuring between level Y and Z and in favor of a possibility that wives were indeed switching choices to a more non-pooling extreme when payout levels increased. The variable findep was negative and significant for husbands and positive and significant for wives in the P vs. N outcome implying that wives who did not have any source of income were more likely to pool income but their husbands were more likely to not pool their income, other things equal.

I tested the the coefficients of husband and wife for the P vs. N outcome for equivalence. The tests of mean equivalence for coefficients is reported in table 8.9. The last row indicates tests where all coefficients were tested jointly to be equal..

Table 8.6: Sample characteristics for restricted sample

Variables	Level Y and Z (666 observations)		Level Z only (333 observations)	
	Mean	Std. Dev.	Mean	Std. Dev.
Card chosen by husband (1=P chosen, 2= I chosen, 3=N chosen)	2.02	0.85	2.05	0.84
Card chosen by wife (1=P chosen, 2= I chosen, 3=N chosen)	2.05	0.83	2.11	0.85
Payout in US $	1.09	0.65	1.74	0.00
1= Husband has secondary education or more;0=Otherwise	0.51	0.50	0.51	0.50
1=Wife has secondary education or more; 0=Otherwise	0.33	0.47	0.33	0.47
Age of husband	35.70	8.35	35.70	8.36
Age of husband squared	1343.95	687.28	1343.95	687.80
Age of wife	29.42	6.91	29.42	6.91
Age of wife squared	913.38	472.90	913.38	473.26
Number of children	2.60	1.18	2.60	1.18
Number of children squared	8.14	7.83	8.14	7.83
1=Religion is Hindu (Muslim excluded); 0=Otherwise	0.56	0.50	0.56	0.50
1=Religion is Buddhist (Muslim excluded); 0=Otherwise	0.29	0.45	0.29	0.45
1=Household with at least one child stunted; 0=Otherwise	0.55	0.50	0.55	0.50
Predicted husband joint WTP (95% effective)	12.40	6.52	12.40	6.52
Predicted wife joint WTP (95% effective)	11.50	5.69	11.50	5.70
Household income in'000$	0.09	0.06	0.09	0.06
Husband total income in '000$	0.08	0.05	0.08	0.05
Wife total income in '000$	0.01	0.03	0.01	0.03
1=Wife completely financially dependent on husband; 0=Otherwise	0.67	0.47	0.67	0.47
1=Location is Shramik Nagar; 0=Otherwise	0.28	0.45	0.28	0.45
1=Location is Mahape; 0=Otherwise	0.26	0.44	0.26	0.44
1=Location is Belapur; 0=Otherwise	0.09	0.28	0.09	0.28

Table 8.7: Multinomial probit results (outcome P vs. N)

Husband's results (Outcome P, Base N)	Level Y and Z		Level Z only	
	(1)	(2)	(3)	(4)
Payout in US $	-0.089	-0.090		
	(0.92)	(0.93)	.	.
1= Husband has secondary education or more;	-0.361	-0.328	-0.181	-0.175
0=Otherwise	(1.79)+	(1.62)	(0.73)	(0.70)
Wife has secondary education or more; 0=Otherwise	-0.028	-0.057	-0.136	-0.160
	(0.14)	(0.28)	(0.53)	(0.62)
Husband's age	0.036	0.024	0.014	0.011
	(0.54)	(0.37)	(0.15)	(0.12)
Husband's age squared	-0.000	-0.000	-0.000	-0.000
	(0.65)	(0.51)	(0.18)	(0.13)
Number of children	-0.253	-0.164	-0.048	-0.010
	(0.91)	(0.62)	(0.14)	(0.03)
Number of children squared	0.040	0.026	-0.005	-0.009
	(0.98)	(0.66)	(0.09)	(0.17)
1=Religion is Hindu (Muslim excluded);	-0.215	-0.142	0.081	0.111
0=Otherwise	(0.79)	(0.53)	(0.23)	(0.31)
1=Religion is Buddhist (Muslim excluded);	0.195	0.227	0.382	0.367
0=Otherwise	(0.70)	(0.82)	(1.05)	(1.01)
1=Household with at least one child stunted;	-0.103	-0.099	-0.260	-0.238
0=Otherwise	(0.59)	(0.57)	(1.18)	(1.08)
Monthly household income in '000 US$	-5.193		-4.312	
	(2.65)**		(1.68)+	
Husband total income in '000$		-5.294		-6.414
		(2.39)*		(2.28)*
1=Wife financially dependent on husband;	-0.158		-0.437	
0=Otherwise	(0.80)		(1.73)+	
Predicted husband joint WTP (95% effective)	0.037	0.027	0.026	0.030
	(1.89)+	(1.53)	(1.08)	(1.30)
Constant	0.199	0.234	0.297	-0.004
	(0.16)	(0.19)	(0.17)	(0.00)
Wife's results (Outcome P, Base N)				
Payout in US $	-0.222	-0.220		
	(1.96)+	(1.95)+		
1= Husband has secondary education or more;	-0.009	-0.016	0.064	0.066
0=Otherwise	(0.05)	(0.09)	(0.27)	(0.28)
Wife has secondary education or more; 0=Otherwise	-0.401	-0.384	-0.982	-0.949
	(2.07)*	(1.99)*	(3.71)**	(3.58)**
Wife's age	-0.156	-0.157	-0.277	-0.271
	(1.84)+	(1.85)+	(2.13)*	(2.11)*
Wife's age squared	0.002	0.002	0.004	0.004
	(2.01)*	(2.01)*	(2.26)*	(2.22)*
Number of children	0.200	0.182	0.017	-0.041
	(0.74)	(0.68)	(0.05)	(0.12)
Number of children squared	-0.029	-0.026	-0.002	0.006
	(0.71)	(0.64)	(0.04)	(0.13)
1=Religion is Hindu (Muslim excluded);	-0.135	-0.164	-0.333	-0.420
0=Otherwise	(0.54)	(0.65)	(0.95)	(1.22)
1=Religion is Buddhist (Muslim excluded);	0.107	0.097	0.112	0.076
0=Otherwise	(0.41)	(0.37)	(0.31)	(0.21)
1=Household with at least one child stunted;	0.077	0.058	0.297	0.246
0=Otherwise	(0.47)	(0.36)	(1.29)	(1.09)

Monthly household income in ’000$	-0.567	-4.645	0.257	-6.099
	(0.39)	(1.91)+	(0.11)	(1.63)
Wife total income in ’000$				
1=Wife financially dependent on husband;	0.279		0.698	
0=Otherwise	(1.52)		(2.71)**	
Predicted wife joint WTP (95% effective)	0.008	0.008	0.026	0.028
	(0.40)	(0.44)	(0.94)	(1.07)
Constant	2.135	2.396	3.373	4.046
	(1.61)	(1.86)+	(1.67)+	(2.07)*
# Observations	666	666	333	333

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 8.8: Multinomial probit results (outcome I vs. N)

Husband's results (Outcome I, Base N)	Level Y and Z		Level Z only	
	(1)	(2)	(1)	(2)
Payout in US $	0.144	0.146		
	(1.33)	(1.34)		
1= Husband has secondary education or more;	-0.327	-0.316	-0.430	-0.445
0=Otherwise	(1.70)+	(1.66)+	(1.73)+	(1.80)+
Wife has secondary education or more;	0.036	0.028	-0.144	-0.136
0=Otherwise	(0.18)	(0.14)	(0.56)	(0.53)
Husband's age	-0.022	-0.028	-0.023	-0.023
	(0.30)	(0.38)	(0.24)	(0.25)
Husband's age squared	0.000	0.000	0.000	0.000
	(0.48)	(0.55)	(0.22)	(0.25)
Number of children	0.325	0.364	0.177	0.185
	(1.20)	(1.36)	(0.50)	(0.53)
Number of children squared	-0.021	-0.028	-0.011	-0.011
	(0.54)	(0.72)	(0.22)	(0.21)
1=Religion is Hindu (Muslim excluded);	-0.519	-0.486	-0.197	-0.185
0=Otherwise	(1.93)+	(1.84)+	(0.57)	(0.55)
1=Religion is Buddhist (Muslim excluded);	-0.200	-0.186	-0.109	-0.122
0=Otherwise	(0.72)	(0.67)	(0.31)	(0.35)
1=Household with at least one child stunted;	-0.055	-0.050	-0.277	-0.256
0=Otherwise	(0.31)	(0.29)	(1.23)	(1.13)
Monthly household income in '000$	-1.936		-0.737	
	(1.03)		(0.32)	
Husband total income in '000$		-1.502		-0.438
		(0.75)		(0.18)
1=Wife financially dependent on husband;	-0.081		-0.299	
0=Otherwise	(0.41)		(1.18)	
Predicted husband joint WTP (95% effective)	0.040	0.036	0.022	0.025
	(2.10)*	(2.00)*	(0.86)	(1.07)
Constant	-0.627	-0.632	0.481	0.164
	(0.45)	(0.46)	(0.28)	(0.10)
Wife's results (Outcome I, Base N)				
Payout in US $	-0.296	-0.296		
	(2.58)**	(2.59)**		
1= Husband has secondary education or more;	0.221	0.213	0.376	0.369
0=Otherwise	(1.29)	(1.25)	(1.54)	(1.53)
Wife has secondary education or more;	-0.489	-0.496	-0.950	-0.933
0=Otherwise	(2.67)**	(2.70)**	(3.62)**	(3.55)**
Wife's age	-0.025	-0.022	0.003	0.013
	(0.34)	(0.31)	(0.02)	(0.10)
Wife's age squared	0.001	0.001	0.000	0.000
	(0.66)	(0.59)	(0.16)	(0.06)
Number of children	0.162	0.186	0.111	0.103
	(0.69)	(0.80)	(0.33)	(0.31)
Number of children squared	-0.019	-0.024	-0.004	-0.004
	(0.54)	(0.70)	(0.08)	(0.09)
1=Religion is Hindu (Muslim excluded);	0.221	0.251	0.592	0.577
0=Otherwise	(0.82)	(0.96)	(1.48)	(1.50)
1=Religion is Buddhist (Muslim excluded);	0.414	0.444	0.895	0.899
0=Otherwise	(1.55)	(1.69)+	(2.22)*	(2.28)*
1=Household with at least one child stunted;	0.109	0.102	0.390	0.369
0=Otherwise	(0.68)	(0.64)	(1.69)+	(1.61)

Monthly household income in '000$	-0.886		-1.343	
	(0.58)		(0.52)	
Wife total income in '000$		-0.289		-4.195
		(0.17)		(1.23)
1=Wife financially dependent on husband;	0.093		0.298	
0=Otherwise	(0.51)		(1.13)	
Predicted wife joint WTP (95% effective)	0.016	0.010	0.040	0.036
	(0.86)	(0.59)	(1.48)	(1.51)
Constant	-0.409	-0.391	-2.223	-2.127
	(0.34)	(0.34)	(1.08)	(1.07)
Observations	666	666	333	333

Robust z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 8.9: Tests of mean equivalence of coefficients for husband and wife (P vs. N outcome)

Coefficient for	Hypothesis : β(husband) = β(wife)			
	Level Y and Z		Level Z only	
	(1)	(2)	(3)	(4)
Payout	NR	NR	-	-
Respondent has higher secondary education	NR	NR	R*	R*
Respondent's spouse has higher education	NR	NR	NR	NR
Age of respondent	R+	NR	R+	R+
Age squared of respondent	R*	R+	R+	R+
# children	NR	NR	NR	NR
# children squared	NR	NR	NR	NR
Hindu	NR	NR	NR	NR
Buddhist	NR	NR	NR	NR
Stunted	NR	NR	R+	NR
Household income	R+	-	NR	-
WTP	NR			
Respondent income	-	NR	-	NR
Findep	NR	-	R**	-
Joint (all coefficients together)	NR	NR	NR	NR

R: Null hypothesis rejected at **:$\alpha = 0.01$, *:$\alpha = 0.05$, +:$\alpha = 0.10$. NR: Null hypothesis not rejected.

I found that only the coefficient for age squared was consistently significantly different for husbands and wives and age was significantly different in 3 out of 4 specifications. Equivalence for coefficient for household income was rejected for

specification 1 but not for specification 3 and for variable findep was rejected for specification 3 but not for specification 1. Equivalence of coefficient for education was rejected for specifications 3 and 4. Specification 1 (level Y and Z pooled) suggests that household income and age may affect husbands and wives in a different manner while making pooling choices, whereas specification 3 (level Z only) suggests that whether wives earn any income, age and education may affect husbands and wives in a different manner. Although the coefficient for payout was significant for wives and not significant for husbands, the equivalance of coefficient for payout for husbands and wives could not be rejected. Joint equivalence of coefficients could be rejected only for specification 3.

The predicted probabilities (not reported) for both choosing a pooling card and choosing a non-pooling card were positive and significantly different from zero for all specifications. This implies that it is difficult to categorize all households as either income pooling or non-pooling.

A. Impact of different variables

To distill the amount of information produced by the multinomial probit, discrete change coefficients were computed and Discrete Change (DC) plots were plotted for both husbands and wives. The results of these plots for levels Y and Z together are shown in figure 8.3. In DC plots, the independent variables are represented on a separate row. If a letter is to the right of another letter, increases in independent variable make the outcome at the right more likely. In each figure, the

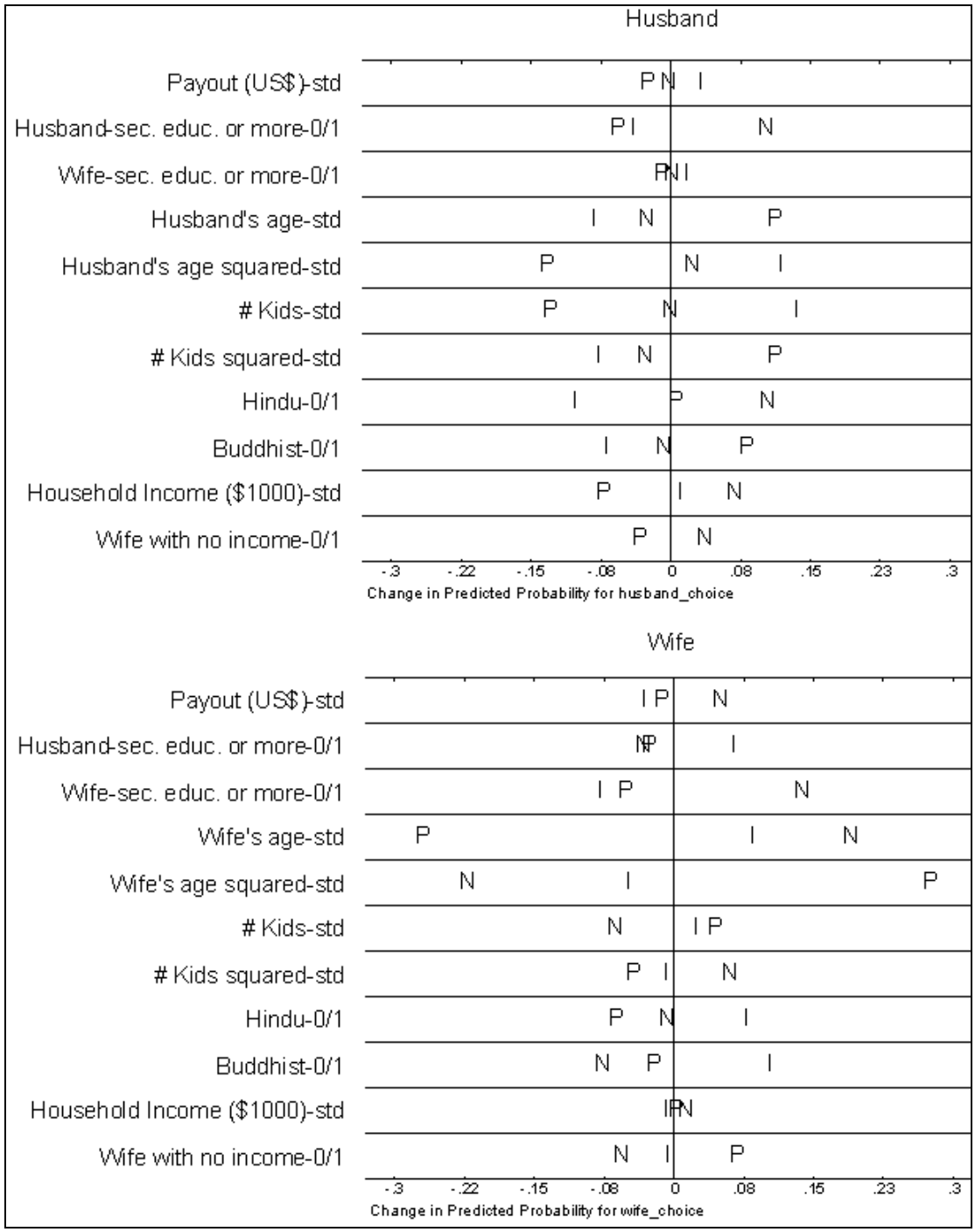
plots for the husband are on the top and for wife are on the bottom. The same scale was adopted along the horizontal axis to facilitate comparison.

In a DC plot, the horizontal axis displays the change in predicted probability that a pooling card (P), Intermediate card (I) or a Non-pooling card (N) are chosen for a unit increase[30] in a particular independent variable. For example, for a husband with other things being equal, an increase in payout by a standard deviation (US$0.70) is likely to increase the predicted probability of a husband choosing card I by about 3%, mainly at the expense of reduction in probability of choice of card P (and small reduction in the probability of choice of N). For a wife, the same increase in payout is likely to increase the probability of her choosing card I by about 5% at the expense of reduction in probability of choice of card P by about 3%. Thus, for both husbands and wives, as the payout increases, the probability that a P card is chosen drops down.

My interest is in comparing the change in probability of choices P vs. I as these are the two extremes of the choice spectrum that the respondents can make.

[30] For continuous variables like payout and income the chart displays effects of a unit standard deviation change in these variables. For dummy variables, it displays the effect of a change in the variable from zero to unity.

Figure 8.3: Husband and wife discrete choice plots (levels Y & Z)



-std denotes a change of one standard deviation, 0/1 represents change in dummy variable from 0 to 1.

Examination of the DC plot for husband choices revealed that an increase in independent variables education, being a Hindu (as compared to being a Muslim), higher household income and having a wife with no income are likely to increase the

chances that a non-pooling card is chosen. On the other hand, being a Buddhist is likely to increase the chances that a husband chooses a pooling card. The plot also demonstrates that age and number of children impact husband choices in a curvilinear manner. The magnitude of impact for the P vs. N comparison can be measured by identifying variables in which the distance between the letter P and N is higher. The magnitude of impact of the education variable and the household income variable are the highest for the P vs. N comparison as a unit increase in these independent variable, the change in probability of P is at behest of the change in probability of I. Some variables such as being a Buddhist or having an educated wife have little impact on the probability of choice N and cause tradeoffs between choice I and N.

For women, the DC plot shows that an increase in unit standard deviation of payout results in about 6% increase in the probability of a wife choosing a non-pooling card, at the expense of both pooling and intermediate cards. The magnitudes of the impact of age and age squared and number of children and number of children squared are of an opposite sign vis-à-vis husband. There are also some similarities with husband behavior. For example, increase in education of self is likely to increase the probability of choosing a non-pooling card, and the effect is significant. Increase in household income is likely to increase the probability of wife choosing a non-pooling card vis-à-vis a pooling card. However, the magnitude is much less for wives (about 1% increase in the probability of non-pooling for an increase in unit standard deviation of household income, about US$58) as against husbands (about 3% increase in probability of choosing a non-pooling card). The impact of household income, however, is not significant for wives. Like husbands, the impact of increase in spousal

education on the outcome is of a lower magnitude than the impact of self education and not significant. The magnitude of the impact for P vs. N comparison is higher for variables such as education, age, age squared, and having a wife with no income. Except for payout, higher education of wife and age, none of the P vs. N coefficients are significant.

Comparison between husband and wife plot reveals that the impact of higher education on wife and husband is about the same. Impact of age and age squared is almost three times for wife as compared to the husband and of opposite sign (however, the net impact of age and age squared combined is difficult to find). Impact of number of children and number of children squared is about the same for husbands and wives but of opposite sign. The impact of religion variables is slightly higher for husbands and of the same sign for the P vs. N comparison. Impact of household income for the P vs. N comparison is very small for wives as compared to husbands. The magnitude of variable findep is about the same for both husbands and wives, but of opposite sign. Overall, the variable education seems to have the most and significant impact for both husbands and wives. The impact of payout is about half that of education for wives and very small for husbands.

In addition to the analysis of significance of coefficients, I also examined how much a unit standard deviation increase (unit increase for dummy 1-0) variables) affected the probability of the outcome. Husbands with higher education are likely to have about 12% higher probability of choosing a non-pooling card compared to less educated husbands and wives are likely to have about a 15% higher probability of choosing a non-pooling card compared to less educated wives. The effect is

significant for both husbands and wives. Individuals in households with higher aggregate income are more likely to choose a non-pooling card. A US$ 58 (standard deviation) increase in the household income is likely to increase the probability of choosing a non-pooling card by about 8% for husbands and about 1% for wives. The effect is significant only for husbands. If a wife has no source of income, her probability of choosing a pooling card increases by about 7% and her husband's probability of choosing a pooling card drops by about 5%. The effect is significant for husbands only. Older women were more likely to not pool income.

6. Conclusions

The data reveal that a specific rule of intrahousehold resource allocation does not apply universally to all households. There are some that will pool and others that will not pool income. Overall the results indicate that both husbands and wives with higher individual income or higher household income are more likely to choose a non-pooling card. An older woman is more likely to choose a non-pooling card. Differences in husband and wife behavior with respect to parameters such as income and education provide evidence in favor of bargaining and against common preference model of intrahousehold resouce allocation.

Although it is difficult to test if learning takes place at each stage, given the consistency of most of the coefficients between model involving two levels (Y and Z) and the fact that almost half of the educated respondents also switched cards, switching of cards cannot be ruled out as a genuine choice.

CHAPTER 9

Conclusions

1. Findings

This research presents a multidimensional approach to study intrahousehold resource allocation. I examined data on demographics, socio-economic aspects, women's autonomy, household financial arrangements, anthropometrics and responses to a stated preference survey and a (lottery) choice experiment. A few variables stood out in terms of significance and magnitude of impact in this analysis of bargaining and household decision-making. These include income, financially dependent women, education and age.

A. Income:

In the probit model that analyzed respondent WTP for a malaria vaccine, the coefficients for individual's labor and non-labor income were both positive and significant for husband when interviewed jointly but not significant for wife when interviewed jointly. In the negative binomial regression models, non-labor income was not significant for husbands and wives. Total income, however, was significant and positive for husbands and significant and negative for wives, not a decisive verdict on non-pooling because of the normal good characteristics of a vaccine. In the analysis of decisiveness of women, I found that women with husbands having higher income were more likely to change their opinion during the joint interview.

In analysis of stunting data, income or per-capita income was not a significant determinant of height. However, per capita consumption was significant in one of the specifications indicating that households having higher per capita income, were on average likely to have taller children.

In the lottery experiment, I found that husbands in households having higher income were more likely to choose a non-pooling card. Individuals having higher income were also more likely not to choose a pooling card.

B. Financially dependent women

Throughout the analysis, I used the variable "findep", which is equal to unity when the wife has no source of income and is completely financially dependent on someone else (generally the husband). This variable had an impact throughout the analysis, sometimes with surprising results.

As expected, in the study of decisiveness, women who did not have any source of income were more likely to change their opinion during a joint interview and to acquiesce to their husbands' wishes. In the risky choice experiment, I found that women who did not have any source of income were more likely to choose a pooling card, but their husbands were more likely to choose a non-pooling card.

However, I also found that husbands in households in which women did not earn any income were on average more likely to purchase vaccines for every member within the household and also more likely to purchase a greater number of vaccines, other things being equal. The most surprising impact of the variable findep can be observed in the analysis of revealed data. I found that daughters of women who did

not have any source of income were more likely to be taller (compared to reference population) than sons and daughters of women who had some source of income. I also found the eldest daughters of women who had some source of income to be shorter (compared to reference population) as compared to younger daughters, though the same did not apply to eldest sons. It is likely that women who stay at home were able to provide their daughters with better nurture and nutrition because of additional time at their disposal in the household. It is also likely that when women were working, day care responsibilities were taken by the eldest daughter. There is however, no information to substantiate these speculations.

C. Education

Higher education was associated with higher demand for vaccines for women, but not for men. However, education did not seem to affect the decisiveness of wives during the joint interview. Respondents who were more educated were more likely to not pool income in the lottery experiment.

To an extent, education behaved like findep variable in the analysis of revealed preference data. Women having little education (primary or less) were more likely to have taller daughters (compared to reference population) than sons or daughters of women with more education. It should be noted that overall, the education of women in our sample was low with a majority of the respondents illiterate, and none having any college education. As a result, the jobs that this education fetched were most likely to be those in the informal sector with low pay.

D. Age

In the analysis of household demand, I found age to be quadratic and significant for women, with women aged 30 likely to have maximum household malaria vaccine demand. However, the variable was not significant in joint demand or for husbands. In study of decisiveness, I found age to be significant and quadratic, with women aged 34 most likely to change their opinion during a joint interview.

Age of mother during childbirth was significant and quadratic with children of women aged 28 during childbirth likely to be the tallest compared to other children.

In the lottery experiment, I found older women more likely not to pool income than younger women.

2. Conclusion

My first conclusion is that an integrated approach to study intrahousehold resource allocation is necessary. In my study, I found that daughters in general, and eldest daughters in particular, are likely to suffer the most when a mother joins the workforce. This may be because the eldest daughter takes up a role in housework and provides childcare for other children. Women who work were, however, less likely to change their stated responses during the follow-up joint interview, indicating that they were less likely to align their responses with their husbands' and probably had more autonomy in decision-making. This research demonstrates why it is necessary for an analyst to take intrahousehold resource allocation into account. While a job may improve a woman's autonomy in the household, the quality of job and the wages

should be good enough to compensate the mother for any ill effects that arise from lesser time available for cooking or childcare.

My second conclusion is that, overall, the common preference model of intrahousehold allocation can be rejected. In the probit model where I examined the willingness to take up an "all or nothing" approach, I found that marginal utility of labor and non-labor income is different for a husband and wife during a separate interview. This is evidence in favor of at least some bargaining taking place within the household. However, the marginal utility of income was not significantly different for husband and wives for all other analysis (negative binomial regression, seemingly unrelated regression, etc.). In the lottery experiment, I found that different households behave in a different manner in regard to pooling behavior, and it is difficult to classify all households as pooling or non-pooling. Having said that, the variables income, findep, education and age did impact outcomes in a variety of ways, indicating that common preference model of intrahousehold model does not apply. In the analysis of height data, I found that women having some work did alter the allocation of resources. Further, many household members reported different financial arrangements (e.g., separate budget arrangements), and varying levels of decision-making for women, implying that there was some degree of decentralization in decision-making.

In my survey I found that husbands and wives have significantly different stated demands when interviewed separately. I also found a short private discussion to be a useful technique to reduce differences in stated demand of husbands and wives. If the husbands and wives have significantly different demands and if the

common preference model is to be rejected, what then are the implications for results of willingness-to-pay surveys that have been conducted? Is it necessary to, henceforth, interview multiple respondents in the household? I found that normal survey procedures for WTP for a vaccine, in which a husband or wife is interviewed randomly from each household, are likely to underestimate stated demand at lower prices. Hence, welfare estimates based on traditional analysis are likely to be conservative.

Appendix 1

Models of intrahousehold resource allocation

The profession of economics is motivated by the behavior of the individual. At the same time, data are often acquired at the household[31] level. Researchers that measure only aggregate consumption or aggregate income in the household, or those who interview only a single respondent for household demand, implicitly use the common preference model in their work. In this section, I will describe the common preference model of intrahousehold resource allocation, followed by a discussion on other models and then summarize how to differentiate among them.

A. Common preferences model

The common preference model enables us to utilize the household as the unit of analysis. It treats the household like a black box. For example, one does not know who makes the consumption decisions. But the parsimony of this model affords us several benefits, notably the ability to apply tools of economic theory to this household as if it were a single individual with pooled household income as the budget constraint (Doss, 1996). All this comes at the cost of an extremely restrictive assumption that either all the household members have homothetic preferences[32], or that there exist some simple rules[33] to aggregate the individual utility functions into a

[31] In general, households can be defined as a group of two or more closely related persons living together (Kirchler, 1988) or simply those that share a kitchen.

[32] Recent advances in the literature on intrahousehold resource allocation have challenged the assumption of homothetic preferences. This literature is discussed in subsequent sections.

[33] Arrow (1951) has demonstrated that preference aggregation under some set of rules is possible only if we sacrifice some preference information (such as assuming that a household member is a "dictator" who makes all the decisions.

household one (Doss, 1996). The common preference model asserts that households respond to only changes in aggregate household income. Different sources of income (labor or non-labor) will have the same impact on demand.

$$\text{Thus, } \frac{\partial g}{\partial y_1} = \frac{\partial g}{\partial y_2} \qquad \ldots.(A1.1)$$

Where, g = any demand equation, and y_1, y_2 = labor or non-labor incomes of different members.

The parsimony of the model can be seen in Samuelson's (1956) paper on trade where he develops the social welfare function of the government. Samuelson imposes a weakly separable household utility function, with the individual's utility functions as sub-utility functions translating into a simplistic formulation of a common preference model, with the primary objective being the ability to continue with demand analysis without examining issues of intrahousehold resource allocation (Lundberg and Pollack, 1993).

B. Unified household model

The unified household model created a paradigm shift in the way economists looked at households and is based on the "Rotten Kid theorem" put forth by Becker, (1974), (1981). At the heart of the theorem is an altruistic parent (or husband) who has egoistic but rational rotten kids (or wife). The parent manipulates the transfers such that each kid, no matter how selfish, behaves in such a manner that household income is maximized. In his review of Becker's contributions to family and household economics, Pollak (2003) summarizes the following assumptions that make the Rotten Kid theorem restrictive:

1. All goods can be bought and sold.
2. There is a single time period.
3. Parents (or husband) provide gifts to children (or wife) and choose after the children (or wife) choose in a two-stage game.
4. There is no scope for bargaining, commitments or threats.

Pollack also develops a simple formulation of Becker's model with egoistic wife and altruistic husband. Their utility function can be represented as:

$$U^w(Y) = U^{*w}(Y^w) \quad \text{....(A1.2)}$$

$$U^h(Y) = U^h(Y^h, Y^w) = W^h(Y^h, U^{*w}(Y^w)) \quad \text{....(A1.3)}$$

Where U^w and U^h are wife and husband's utilities respectively, and Y^w and Y^h are their consumption vectors.

Becker's model has been critiqued widely (Lindbeck and Weibull, 1988, Bergstorm, 1989, Bruce and Waldman, 1990). However, this model was the first attempt to give structure to the household decision-making process. It made economists think beyond the individual. It incorporated both production and consumption decisions and households made decisions subject to a production possibility frontier (Doss, 1996).

Pollak (2003) promotes the use of the term "deferential" preferences for the husband over the often-misunderstood "altruistic" preferences, and a house in which both husband and wife care about their own utility and other's self-regarding utility as shown below:

$$U^h(Y) = W^h[U^{*h}(Y^h), U^{*w}(Y^w)] \text{ and } U^w(Y) = W^w[U^{*h}(Y^h), U^{*w}(Y^w)]$$

...(A1.4)

This setup is similar to the Samuelson-Bergson social welfare[34] function. Economists studying family decisions based on the Becker's model often use some variant of the Samuelson-Bergson household social welfare function (Pollak, 2003).

C. Co-operative Bargaining Models

Bargaining models (McElroy and Horney, 1981, Manser and Brown, 1980) provided the first real alternative to Becker's collective choice model. These models assume both the husband and wife to be independent entities with their own rational preferences and individual utilities that depend upon their own consumption. The husband and wife indulge in a game of Nash Bargaining. If they do not come to an agreement until they reach the "threat point," then they fall back on their default utilities.

In her paper, "The Empirical content of the Nash-Bargained Household Behavior," McElroy (1990) has explained the formulation of the Nash model of household behavior in detail.

Let $U_0^m(x_0,x_1,x_3)$ and $U_0^f(x_0,x_2,x_4)$ be the male and female utility function before marriage respectively, where m and f are two unmarried individuals, x_1 and x_2 are goods consumed by m and f respectively, x_3 and x_4 are leisure times of m and f respectively and x_0 is a private good that will become a household commonly owned good after marriage.

[34] Bergson-Samuelson social welfare function, W: $R^I \rightarrow R$, assigns utility values to possible vector $(U^1,\ldots U^N) \in R^I$ (Mas-Colell et al., 1995). It lets us define a representative customer for aggregated demand function.

If not married, both m and f maximize their separate utilities subject to income constraints, $PX = I_m + p_3T$ for m, and similarly for f. …(A1.5)

Optimizing to obtain their respective individual indirect utility functions,

$$V_0^m(p_0,p_1,p_3,I_m;\alpha_m) \text{ and } V_0^f(p_0,p_2,p_2,I_f;\alpha_f). \quad \ldots(A1.6)$$

Further, if these two people get married to each other, they indulge in a two-person, cooperative Nash game, to jointly decide the allocation of goods.

$$N \equiv [U_0^m - V_0^m(p_0,p_1,p_3,I_m;\alpha_m)][U_0^f - V_0^f(p_0,p_2,p_2,I_f;\alpha_f)] \quad \ldots(A1.7)$$

Subject to full household expenditures equaling full household income,

$$P'X = (p_3 + p_4)T + I_m + I_f \quad \ldots(A1.8)$$

V_0^m and V_0^f are their respective threat points. α's are the extrahousehold environmental parameters, changes in which can affect the individual utility obtained before marriage. U_0^m and U_0^f are the nonnegative utilities defined over own and spouse's consumption after marriage. The solution to this optimization is a system of demand equations,

$$x_i = hi(p,I_m,I_f;\alpha_m,\alpha_f), \quad i = 0, 1, 2, 3, 4. \quad \ldots.(A1.9)$$

As it can be seen, the husband and wife solve a Nash problem where the solution depends upon the utilities that husband and wife receive at the "threat point"; with a higher utility at threat point implying a higher utility at Nash solution. In these models, the household maximizes gains from joint decisions of production and consumption and the solution generated is a Pareto efficient outcome.

The appropriate threat point

Much consideration has been given to determine the appropriate threat point. The threat point depends on various "extrahousehold environmental parameters"

(McElroy, 1990) such as institutional, demographic and legal factors and gender specific environmental factors (Folbre, 1982 cf Pollak, 2003). McElroy and Horney (1981) defined the threat point as the utility derived outside of marriage. While most initial models focused on divorce as the threat point, subsequent versions use threat points with less drastic results as each disagreement may not result in a divorce (Bergstorm, 1996). McElroy (1990) also acknowledges the fact that in certain countries like India, divorce may be a non-existent option for the women. However, many women do choose to return to their parent's family. In such cases, the extrahousehold environmental parameters could include her parent's wealth, or unexpected increment in their wealth.

Lundberg and Pollack (1993) put forth the "Separate Spheres Bargaining" framework in which the threat point is some inefficient non-cooperative outcome rather than divorce. Here, the couple bargains over gains from marriage such as joint production of household goods and children indicating that it is important to assess the power structure inside of the marriage rather than the incomes that the husband and wife will receive if they split. This model also acknowledges the role played by gender, social norms and commonly owned goods. For example, men may provide housing and women may provide childcare, something that reflects social norms rather than preferences. The commonly owned goods may be underprovided as they are to be provided voluntarily and reflect "socially sanctioned allocation of marital responsibilities." There is no pooling of income.

D. Collective household model

The cooperative bargaining models that solve for a Nash solution require information difficult to acquire (Chiappori, 1988a, 1991). Particularly difficult is the data on extrahousehold environmental parameters that would determine a threat point. Chiappori suggests that simply focusing our energy on a co-operative bargaining solution which results in a pareto efficient outcome rather than a specific Nash equilibrium is sufficient to generate testable restrictions on labor supply functions and recover individual preferences and outcomes (Chiappori, 1992, 1988b). The collective model enables us to recover the "sharing rule" from household expenditure data, if we have private goods, caring preferences, members' sub-utility function separable with respect to consumption and at least one assignable private good (cf Doss, 1996). The collective bargaining model is relatively easy to formulate and test for compared to Nash equilibrium as information about a specific threat point is not required. Chiappori initially focused on labor supply, but the collective model has been extended to describe household consumption (Browning et al., 1994) and household production (Chiappori, 1997).

Analytics of the Collective model

In his work on the analysis of household survey data (in developing countries), Deaton (2000) described the collective model in detail.

Let $v^A(q^A, z)$ and $v^B(q^B,z)$ be the utility functions of two household members A and B, where q^A and q^B are private consumption vectors and z is a vector of public goods.

The collective model requires that allocation is efficient. Thus optimizing for A,

$$\text{Max } v^A(q, \bar{z}) \text{ s.t. } p^A.q = \theta^A(p, p_z, y) \quad \text{....(A1.10)}$$

Where $\bar{z}$ is the optimal choice of public good, p^A is price of goods consumed by A, $\theta^A(p, p_z, y)$ = sharing rule, a function that decides how much A gets conditional on the prices of goods.

This optimization results in the following set of demand equations for A,

$$q_i^A = g_i[\theta^A(p, p_z, y), p^A, \bar{z}]. \quad \text{....(A1.11)}$$

At the same time, B tries to optimize his utility subject to his budget constraint, resulting in the following sharing rule for B:

$$\theta^B(p, p_z, y) = y - p_z.\bar{z} - p^A q^A. \quad \text{....(A1.12)}$$

Note the nature of the budget constraint. The model specification clearly displays the efficiency criteria that one person could not be better off without making other person worse-off.

To develop a testable hypothesis, Deaton assumes a situation where total income, y is made of three components,

$$y = y^A + y^B + y^O. \quad \text{....(A1.13)}$$

Where y^A and y^B is individual income, and y^O is income pooled from jointly owned assets.

Eliminating y^O to consider the effects of y^A and y^B, the household demand for good *i* can be written as,

$$q_i = g_i^A[\theta^A(y^A, y^B, y)] + g_i^B[y - \theta^A(y^A, y^B, y)] \qquad \text{....(A1.14)}$$

Differentiating with respect to y^A and y^A, simplifying and generalizing across all goods,

$$\left[\frac{\frac{\partial q_i}{\partial y^A}}{\frac{\partial q_i}{\partial y^B}}\right] = \left[\frac{\frac{\partial q_j}{\partial y^A}}{\frac{\partial q_j}{\partial y^B}}\right] \quad \forall i, j \qquad \text{....(A1.15)}$$

This implies a constant ratio of income effects across all pair of goods. A1.15 is a test of efficiency. If this equation does not hold then the collective and cooperative bargaining models are rejected. When a household pools income, it does not matter who the source of income is, and either side of the above equation reduces to unity.

E. Non-cooperative bargaining models

As the name suggests, non-cooperative bargaining models (Chen and Wooley, 2001) use a non-cooperative bargaining framework such as Cournot-Nash bargaining, where each person maximizes his or her welfare, given the expected actions of others and their own resource constraints. This model has the least restrictions as individuals have different preferences, do not pool their income, and make their own consumption and production decisions.

Appendix II

Height-for-age as revealed indicator to measure income pooling

Thomas (1994) defined a health production function as follows:

$$\text{Child health, } \theta_i = \theta(N, \mu_i, \mu_f, \mu_c, \eta_i) \qquad \ldots.(A2.1)$$

Where, N = nutrient intake and the quality and quantity of childcare, μ_i = individual characteristics including sex and age, μ_f = family characteristics, μ_c = community characteristics, and η_i = individual specific unobserved heterogeneity in health.

Each household member m = 1,…,M wants to maximize his utility

$$V_m(x, l, \theta; \mu, \varepsilon) \qquad \ldots.(A2.2)$$

Where, x = vector of goods demanded by each individual in the household, l = vector of leisure, θ = vector of home produced quantities (child health), μ = background characteristics such as education of all household members, and ε = vector for unobserved tastes of members.

By the common preferences model, household welfare function is maximized as

$$px = \sum_m w_m(T_m - l_m) + y_m \qquad \ldots.(A2.3)$$

Where T = amount of time available for work, w is a vector of wages and y_m is each individual's non-labor income (assumed to be exogenous).

This optimization results in a value of household demand for each of x, l and θ. Thomas particularly looks at height (θ). Thus,

$$h_i = h_i(\overline{\mu_i}, \overline{\mu_c}, \overline{\mu_c}, \sum y_m, \xi_i) \quad \text{....(A2.4)}$$

Where ξ_i = individual specific heterogeneity such as family specific health variation.

Income pooling can be clearly seen in this setup. The source of different individual non-labor income does not matter. Thomas denotes this by using $\sum y_m$ instead of $y_1, y_2 \ldots y_m$. It is the pooled income that counts.

$$\text{Thus, } \frac{\partial h}{\partial y_1} = \frac{\partial h}{\partial y_2} \quad \text{....(A2.5)}$$

Thomas applied the Nash Equilibrium model of McElroy and Horney (1981) where each individual seeks to maximize the difference between the utility achieved by co-operation and some other reservation utility (V_m). Thus the household maximizes:

$$\prod_{i}^{m=1} v_m(x, l, \theta; \mu, \varepsilon) - V_m(p, y_m, \overline{\mu}_m) \quad \text{....(A2.6)}$$

It is difficult to implement this model without enough information about the reservation utility, as mentioned in the previous sections of the literature review. Following Chiappori (1988), Thomas assumed pareto-allocation instead of imposing Nash equilibrium. In such as scenario, there exists welfare weights, w, such that the household welfare function could be written as the sum of all individual utility functions. Relaxing the assumptions of the household model in this direction,

$$h_i = h_i(\overline{\mu_i}, \overline{\mu_c}, \overline{\mu_c}, y_1, \ldots\ldots y_M, \mu', \xi_i) \quad \text{....(A2.7)}$$

where μ' = any elements of μ not in the demand function.

Appendix III

Navi Mumbai & malaria

A. The city of Navi Mumbai

The city of Navi Mumbai is a satellite town located north east of the city of Mumbai, located on the mainland between the Thane creek on the west and small hills running along the east. Traditionally an agrarian economy, the area has rapidly urbanized and industrialized over the past few decades. Development accelerated in the mid and late 90s after the commissioning of the Mankhurd-Vashi mass transit rail link to mainland Mumbai. (http://www.cidcoindia.com, accessed Friday, May 19, 2006)[35]. According to the 2001 census preliminary report, the city had a population of about 722,000 and a floating population of about 75,000. Approximately 40% of the city's population lives in slums.

B. Malaria in Navi Mumbai

Although malaria has declined steadily, in general, over the past few years in Navi Mumbai, it has risen or remained constant in certain pockets. For example, the number of cases of malaria grew about 15% last year in Khairne and above 80% in Airoli. Navi Mumbai Municipal Corporation (NMMC) analyzes blood samples collected in the field or from any person reporting with fever to one of the fourteen primary health care centers to collect incidence data on the disease (known as Urban

[35] More information about Navi Mumbai is available on the cidcoindia.com Website.

Health Posts (UHPs)[36]). The case incidence rates are understated as they include blood samples tested only by the urban health posts, mainly frequented by the poor and the lower middle class. Instances of malaria occurring in the more affluent classes often go unreported as they visit private physicians, who are not required to report positive cases of malaria. The number of positive cases confirmed by blood tests is reported in the table A1. Recently, there has been a rise of other vector borne diseases such as Dengue in the region.

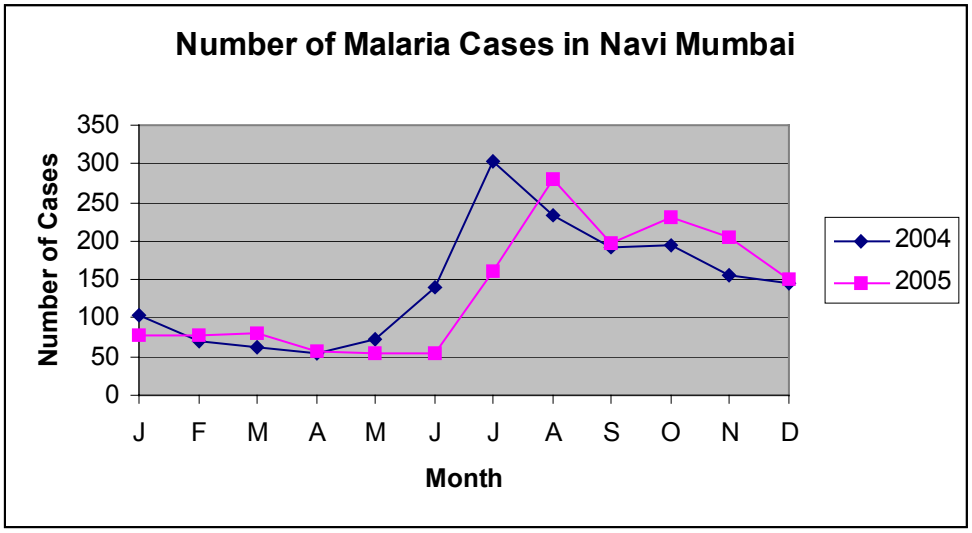
Table A1: Number of positive malaria cases

Year	Annual Number of malaria Positive Cases				Annual parasite index (total number of cases per 1000 of population)
	Plasmodium Vivax	Plasmodium Falciparum	Mix	Total	
1997	5060	3869	95	9024	18.0
1998	4383	2157	53	6593	11.6
1999	2576	1078	40	3694	6.0
2000	1760	1033	30	2823	4.0
2001	1824	907	48	2779	3.9
2002	1524	525	31	2080	2.6
2003	1497	349	32	1878	2.3
2004	1406	299	20	1725	2.0

Source: NMMC

[36] The city of Navi Mumbai has a three-tier health care system with about fourteen primary health care centers called Urban Health Posts (UHPs), five secondary health care centers call Maternity and Children Hospitals (MCH) and a single tertiary general hospital. If a person is sick with a fever, she is generally treated by the UHPs. Each UHP also has a Malaria cell, which carries Anti Larva activities, Surveillance, and Follow-up of active cases.

Figure A1: Number of Malaria Cases in Navi Mumbai



Source: NMMC

Figure above shows the endemic nature of malaria in Navi Mumbai, and how infections peak during the monsoon season (July to October), and stays high during the early months of winter. The survey was conducted in the months of January and February, during which there is a relative lull in the malaria menace.

There are various factors that contribute to the nuisance of mosquitoesin general, and malaria in particular in Navi Mumbai. The sub-tropical humid climate and marshy land contribute to the availability of ample breeding sites within the city. The female Anopheles mosquito lays eggs in fresh pools of stagnant water, which are available aplenty especially during the monsoon season. As is common in other Indian cities, Navi Mumbai does not have a twenty-four hour water supply. People, especially those living in slums, have to store water in drums, which are sometimes left open and not emptied regularly. Slum dwellings often use plastic polythene as a roofing material. To provide protection to this fragile roofing from winds, households

often place tires on the top of such roof. Such open tires provide ample space where rainwater collects and stays stagnant. Further, these polythene roofs sag because of the weight of rainwater, once again providing a pool of stagnant water. People living in affluent neighborhoods contribute to the pools of standing water by not replacing the petri dishes under regularly watered indoor plant pots. Poor sanitation and inadequate drainage of storm water in slums and quarries further contributes to the pools of stagnant fresh water during monsoon.

Rapid development also has contributed by providing a steady pool of immigrant and temporary workers in nearby construction, quarry sites and agricultural produce wholesale markets. These workers have the least immunity against the disease but are the most exposed to it because of poor working conditions and inadequate preventive procedures, such as abundance of open water tanks that are not emptied regularly, or sleeping in the open or temporarily built construction camps.

Appendix IV

A note on malaria

Malaria on the global scene

Malaria is caused by a one-cell parasite called plasmodium, which is transmitted from person to person through the bite of a female Anopheles mosquito, which requires blood to nurture her eggs. We can avoid the spread of malaria if we can prevent mosquitoes from biting people. The Roll Back Malaria (RBM) campaign has compiled a comprehensive report on the issues related to malaria in the World Malaria Report, 2005 (Roll Back Malaria et al., 2005). Some of the key highlights of the global burden of malaria as mentioned in the World Malaria Report are as follows:

- Worldwide, 3.2 billion people in 107 countries live in areas at risk of malaria transmission.
- About 350 – 500 million episodes of malaria occur each year, caused by P. falciparum and P. vivax infection.
- The falciparum malaria infection kills at least one million people each year, with the poor people being the most affected by the disease (ibid). This is a conservative estimate of the number of deaths because of the indirect effects on nutrition and health. (Greenwood et al., 2005). The menace is worst in Sub-Saharan Africa. About 80% of these deaths occur in Africa.
- Malaria also causes anemia in children and pregnant women, low birth weight, premature birth and infant mortality.

- Malaria accounts for about 25-35% of all outpatient visits, 20-45% of hospital admissions and 15-35% of hospital deaths in malaria endemic countries in Africa, thus imposing a huge burden on the health care systems.
- In Africa alone, the disease costs about US$12 billion every year, with the poor disproportionately bearing a higher burden of the disease (Barat et al., 2004 cf Greenwood et al., 2005).
- Over the last 35 years, the countries endemic with malaria have shown a 2% slower growth of rate than other countries with similar background (Sachs and Malaney, 2002 cf Greenwood et al., 2005).
- The RBM campaign asserts that adults infected with HIV, children under 5 years of age, and pregnant women should be targeted for malaria-based interventions.

Because of the high level of morbidity and mortality associated with the disease, controlling malaria is one of the key policy targets set up by the millennium development goals[37]. The Millennium Development goals also has identified indicators such as prevalence of death rates associated with malaria, and proportion of population in malaria-risk areas using effective malaria prevention and treatment measures. The RBM campaign goals are more ambitious, and plans to halve malaria associated mortality by 2010 and again by 2015.

Treatment, vector control and drug resistance

[37] Target 8 of the Millennium Development Goals: To have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.

There are essentially two strategies for malaria control, viz., treatment and vector control. The traditional method of treatment for malaria infection was the use of drugs such as chloroquine and sulfadoxine-primethamine. The traditional method of vector control included indoor residual spraying and larviciding.

One of the emerging issues in malaria is the increasing drug resistance to the above-mentioned traditional methods of treatment, especially by the P. falciparum infection. In a study of reemergence of malaria in India, Sharma (1996) found that the traditional approaches to vector control have become redundant as malaria vectors have become resistant to insecticide and the parasites are becoming resistant to chloroquine. With due regard to the increasing drug resistance, the Roll Back Malaria (RBM) campaign (Roll Back Malaria et al., 2005) has modified the key strategies for the control of malaria disease (such as use of Artimisinin-based combination therapy) and vector control. In addition, the RBM campaign also recommends monitoring of the malaria situation and taking timely actions to reduce the onslaught of malaria epidemics.

Development of a malaria vaccine

In a review article on malaria vaccines, Targett (2005) has looked at different malaria vaccine technologies currently employed in clinical trials. Among different vaccine candidates, the recent clinical trial in Gambian adults and Mozambican children of the Glaxo, RTS, S/ASO2A vaccine has shown encouraging results with a reported efficacy of 30% for malaria and 58% for severe malaria in children (ibid). Targett assesses that the goal of prevention of all parasite development remains elusive, and expresses doubt over whether any of the current vaccine candidates have

the efficacy and long-term effectiveness to justify wide scale use. He feels that the first generation vaccine would be used only to supplement strategies of vector control and on the basis of existing scientific evidence does not foresee a vaccine good enough to be an effective alternative to treatment for the next two decades.

Malaria situation in India

The Indian health system is in "transition" with declining mortality and fertility rates, aging population, and a shift in pattern of illness from malnutrition and communicable diseases to chronic illnesses of adulthood (Peters et al., 2002). In spite of this transition, a high proportion of the population continues to suffer and die from preventable infections, pregnancy and childbirth related complications (ibid). Malaria is one such infection, which is a major public health problem in India.

Of the 5 million confirmed cases of malaria outside of Africa, about 3 million are from India and Pakistan (India- controlling malaria in India). Nationwide, the reported incidence of laboratory confirmed cases of malaria stood at 1.78 million in 2003, down from 3.0 million in 1996 (Roll Back Malaria et al., 2005). About 45% of the cases are infected with the P. falciparum. About 1000 people die annually from malaria (ibid).

In India, 20% of the population accounts for about 80% of the cases of malaria. The remaining 80% of the population lives in an area with low incidence of malaria (The World Bank, 2005). The case rate was lowest for children under 15 years of age. A further look at malaria cases reported by age by the World Malaria report shows that case rate increased with age similar to the rates in countries like

Bhutan, Cambodia and Nepal. In countries such as Bangladesh, Lao People's Democratic Republic and Sri Lanka, children under 5 years had the highest case rate.

Table A2: Reported malaria cases by age (year 2002)

Age	# of cases	% of total # of cases
< 5 years	150605	8%
5 – 14 years	462062	25%
15+ years	1229352	67%
Total	***1842019****	***100%***

Source: Roll Back Malaria et al. (2005)
* With a population of about a billion, this amounts to annual parasite index of about 1.84 per 1000 of population.

The malaria situation varies by states and also by season. The high burden states include Orissa, Gujarat, West Bengal, Chattisgarh, Madhya Pradesh, Rajasthan, Uttar Pradesh, Karnataka, Jharkand, and Maharashtra (India- controlling malaria in India). The state of Maharashtra accounted for about 4% of the total cases reported in year 2002.

Malaria and gender

According the World Malaria Report 2005, about 59% of the people infected with malaria in India were males. The higher number of infections among males is consistent with the rest of Asia. In seven Asian countries that have data on the gender of those infected with malaria, the proportion of males infected varied from 52% to 71% (ibid). The NFH Survey of 1998-99, on the other hand, found that the incidence rate did not vary much by gender (3734 for males vs. 3658 for females).

There are various ways in which malaria could infect males and females differently. In urban areas, males often sleep outside their tenements thus having a

higher risk of infection. Migrant labor (generally males) with low immunity working in swampy areas may be exposed to the risk of malaria. The World Malaria report notes that higher number of infections in males could be the result of differential occupational exposure of gender, but acknowledges the fact that differences in treatment seeking behavior might also be a contributing factor. Differential treatment behavior could be the result of intrahousehold resource allocation.

There could be other reasons why malaria could infect males and females differently. This is because household members can take action to reduce the risk of infection such as using insecticide treated nets (ITNs). If there is only a single ITN in a household, then intrahousehold power dynamics could play a role in deciding who sleeps under the ITN. To study the cost-effectiveness of permethrin impregnated bed-nets, Binka et al. (1997) provided ITNs in Kassena-Nankana district of Ghana to women of child bearing age and children under 10 years. Nets were available in different sizes and distribution of nets was based on the number of women of child-bearing age and children under 10 years of age. Initially men were not allocated any nets. However, the researchers had to modify their research design and accommodate males to ensure that nets were not diverted for male use. This shows how intrahousehold power dynamics can affect the risk of infection to different household members.

Appendix V

Survey instrument

Malaria study

Questionnaire Serial Number	
Enumerator Code	☐☐
Survey ID (efficacy-price)	95 - 0150
Survey receipt Number	

Date**:** _____

==========

Name of respondent : _____

Address:

Line 1 :_____
Line 2 :_____
Sector :_____
City :_____
Line 5 :_____

[Enumerator: Note that the name/ address or any other identifying information of the respondent, his/her family and home should not appear beyond this point].

For office use only:

[*Office manager: **Detach** the front page from the main survey. This data will be entered and stored separately. Maintaining privacy and confidentiality of this document is essential. It should never appear with the main survey again*].

	Husband	Wife
Oral consent:		
Oral consent:		

Checked by: ___ ___ on _____

Data entry 1: ___ ___

Data entry 2: ___ ___

Remarks

Section 1: Introduction and seeking appointment

[*Enumerator: This section has to be (partially) completed even if the respondent refuses to be interviewed. For correct answer, check the relevant option, do not circle or cross the option*].

1.1	Date and time of interview			
Home interview details	First Visit	Second Visit	Third Visit	Fourth Visit
1.1A Time home interview starts	___ : ___	___ : ___	___ : ___	___ : ___
1.1B Time home interview ends	___ : ___	___ : ___	___ : ___	___ : ___
1.1C Date of interview (dd/mm/yy)				

1.2	Questionnaire Serial Number	
1.3	Enumerator Code	☐☐
1.4	Survey ID (efficacy-price)	95 - 0150

1.5	Are both the head of household or spouse of the head of household present?	1	☐	Head of household couple- husband	
		2	☐	Head of household couple- wife	
		3	☐	No couple in household (Terminate Interview, Go to 1.12-9)	1.12 (9)

		Yes	No
1.6	Do you have at least one child less than age of 18 years?	1	2 No (Terminate interview. Go to 1.12 (11)).
1.7	Are you and your partner fluent in Marathi or Hindi?	1	2 No (Terminate interview. Go to 1.12 (12)).

1.8	Are you or any of your family member currently infected with Malaria? Or do you think that any of you or your family members are infected with Malaria?	1	☐	Yes (Terminate interview), mark (10) on 1.12. [Enumerator: say the following things. "*Since this survey is on vaccines, we may not be able to interview a family with anyone who has Malaria. We are extremely sorry for this. We thank you for your support. We assure you that the information that you have provided us* ***will be kept completely confidential****.We hope that you get healthy soon. Thank you for your time*".]	1.12 (10)
		2	☐	No.	

[Now, give the information and consent request to the respondent and allow him/her to read it. Make sure that he/she understands the information.]

Consent Letter:

Vimalanand S. Prabhu
Graduate Student
Department of Public Policy
The University of NC at Chapel Hill
CB#3435, Chapel Hill, NC 27599, USA.
E-mail: prabhu@unc.edu

Date: October 26, 2005

Subject: Information about Phase 1 of the Malaria Socio-Economic Study

Introduction to the Study:

- We are collecting data about people in the community to learn what they think and know about malaria, vaccines and health care. We are also interested in how much people would pay for a malaria vaccine.
- We also want to learn how husbands and wives make decisions in the household.
- We are collecting data on behalf of Mr. Vimalanand S. Prabhu, who is doing his Ph.D. in Public Policy from the University of North Carolina at Chapel Hill.
- Mr. Prabhu is doing this study in the city of New Mumbai.

What Will Happen During the Study:

We will ask you to answer some questions on malaria, health care, and vaccines. This study will be conducted in two phases. In the first phase we will interview you and your spouse separately. Phase 1 will take about 20-30 minutes. Phase 2 will require 10 minutes. Details of phase two will be given after we finish phase 1.

We will also take measurement of height and weight for each of you and your children and other family members. For some of the questions, we will give you a list of possible responses. For some other questions, we will ask you to say what you think best answers the question. Your name will not be recorded on the completed questionnaire form, and all of the questionnaires will be kept in a safe place with Mr. Prabhu until the information is entered in a computer. After that your questionnaires will be destroyed. Only Mr. Prabhu will have access to your contact information, which will be stored in a secure place separate from where the data is stored.

Your Privacy is Important:

- We will make every effort to protect your privacy, even from your other family members, so we must interview you separately.
- We will not use your name in any of the information we get from this study or in any of the research reports.
- Any information we get in the study will be recorded with a code number that will let only Mr. Prabhu know who you are.
- This study will not be used for any marketing purposes.

Your Rights:

- You decide on your own whether or not you want to be in this study.
- You will not be treated any differently if you decide not to be in the study.
- If you decide to be in the study, you will have the right to stop being in the study at any time, and to not answer specific questions.

You will receive the following:

- Information about malaria.
- Information about height and weight of your family members.
- You will automatically be eligible to participate in a game that has real payoffs for you and your husband. You can get a minimum of Rs. 10 and a maximum of Rs. 100.

Questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact please contact Mr.Prabhu at prabhu@unc.edu, tel. +91-98676 00916 (India),+1-919-225-0991 (USA).

Questions about your rights as a research participant?
All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 001-919-966-3113 or by email to IRB_subjects@unc.edu with Malaria study reference number PPA 05-007.

1.9	Respondent- wife has listened to the consent form and given oral consent	1	☐	Yes	
		2	☐	No (Terminate interview)	1.12

1.10	Respondent- wife has listened to the consent form and given oral consent	1	☐	Yes	
		2	☐	No (Terminate interview.)	1.12

(Enumerator: Please invite the couple to the field office)

1.11 Appointment schedule	First Visit	Second Visit	Third Visit	Fourth Visit	Fifth Visit
1.11A Date of appointment (dd/mm/yy)	___/___/__ _	___/___/__ _	___/___/__ _	___/___/__ _	___/___/__ _
1.11B Time of appointment	___ : ___	___ : ___	___ : ___	___ : ___	___ : ___

1.12	If the survey is not completed, please indicate the reason why	1	☐	Respondent moved	
		2	☐	Respondent seriously ill, cannot reschedule	
		3	☐	Respondent deceased	
		4	☐	Respondent refused to be interviewed	
		5	☐	Respondent did not permit his wife to be interviewed	
		6	☐	Respondent refused to hear information and consent	
		7	☐	Respondent decided to stop before finishing interview (Complete Section 10)	10
		8	☐	Absent	
		9	☐	No couple in the household	
		10	☐	Respondent/ family member infected with Malaria	
		11	☐	No children between 1 and 18 years	
		12	☐	Not fluent in Marathi or Hindi	
		-95	☐	_____ Others, Please Specify ☐☐	

(Part 2: Enumerator observations
[*Enumerator: In this section note what you observe. You need not have to ask the respondent questions for this section*]

2.1	Is there a business on the premises?	1	☐	Yes.	
		2	☐	No	

2.2	Please note the flooring material.	1	☐	Mud	
		2	☐	Brick	
		3	☐	Stone	
		4	☐	Cement/ Coba	
		5	☐	Mosaic/ floor tiles, etc.	
		6	☐	Polished stones	
		-95	☐	Others Please Specify_____	

2.3	Please note the type of material used in the Wall	1	☐	Grass/ bamboos	
		2	☐	Plastic/ polythene	
		3	☐	Mud/ unburnt brick	
		4	☐	Wood	
		5	☐	GI/ Metal/ Asbestos	
		6	☐	Burnt Brick	
		7	☐	Stone	
		8	☐	Plaster	
		9	☐	Plaster and paint	
		-95	☐	Others Please Specify_____	

2.4	Please note the type of material used in the roof	1	☐	Corrugated cement sheets	
		2	☐	Plastic/ polythene	
		3	☐	Manglore/ other Tiles	
		4	☐	GI/ Metal/ Asbestos	
		5	☐	Grass/ thatch/ bamboo/ wood/ mud, etc	
		6	☐	Concrete slab	
		-95	☐	Others Please Specify_____	

2.5	Are there windows in the house?	1	☐	Yes.	
		2	☐	No	

2.6	What type of house does the respondent live in?	1	☐	Slums	
		2	☐	Chawls	
		3	☐	government quarters	
		4	☐	Bungalow (single family home)	
		6	☐	Multi-storey building/ apartment complex	
		-95	☐	Others Please Specify_____	

2.7	Is there an additional storey in the house	1	☐	Yes.	
		2	☐	No	

2.8	Is there an big-loft in the house?	1	☐	Yes.	
		2	☐	No	

Section 3: <u>Some questions about the household</u>

3.1	Can wife in the household read a newspaper (in any language)? *(If no, record 3, if yes, probe to find out if they can read a newspaper easily, or with difficulty.)*	1	☐	Yes, Easily	
		2	☐	Yes, with difficulty	
		3	☐	No, cannot read a newspaper	

3.2	Can husband in the household read a newspaper (in any language)? *(If no, record 3, if yes, probe to find out if they can read a newspaper easily, or with difficulty.)*	1	☐	Yes, Easily	
		2	☐	Yes, with difficulty	
		3	☐	No, cannot read a newspaper	

3.3	How many rooms does your house have?	-85		_____	
		-98	☐	Don't know/ Not Sure	
		-99	☐	No response	

3.4	What is the main fuel used for cooking in the house? *(Enumerator: Read response, record only main fuel)*	1	☐	Gas (LPG)	
		2	☐	Firewood	
		3	☐	Kerosene	
		4	☐	Charcoal	
		5	☐	Electricity	
		6	☐	Cow dung	
		-99	☐	No response	
		-98	☐	Don't know/ Not sure	
		-95	☐	Others, please specify	

3.5	Respondent is	1	☐	Husband	
		2	☐	Wife	

Household Assets

No.	(yes)	(no)	
3.6	1	2	Refrigerator
3.7	1	2	Color TV
3.8	1	2	Black and White TV
3.9	1	2	Ceiling fan
3.10	1	2	FM Radio/2 in one/ 3 in one (Tape/CD/ Radio)
3.11	1	2	Portable fan
3.12	1	2	Bicycle
3.13	1	2	Motorbike
3.14	1	2	Pressure Cooker
3.15	1	2	Mixer/ Grinder
3.16	1	2	Steel Cabinet (Cupboard)
3.17	1	2	Cot
3.18	1	2	Washing machine
3.20	1	2	Plastic ghagar

3.21	Does the household have electricity	1	☐	Yes	
		2	☐	(Go to 3.24	3.24

3.22	Does your household pay the electricity bill entirely yourself or share it with someone else	1	☐	Paid entirely	
		2	☐	Shared	
		3	☐	Don't have to pay/ included in rent (Go to 3.24)	3.24
		-99	☐	No response (Go to 3.24)	3.24

3.23	How much was your electricity bill last month? Or, if you share the bill, how much was your share?	-85	☐	_____Rs. per month	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	
		-95	☐	Others, Please Specify_____ ☐☐	

3.24	What is the primary source of drinking water in your household?	1	☐	Private tap	
		2	☐	Shared Public Tap/ standpost	
		3	☐	Own shallow well	
		4	☐	Own hand pump	
		5	☐	Water tanker	
		-95	☐	Others, Please Specify_____ ☐☐	

3.25	Do you pay the bill entirely or share it with someone else	1	☐	Paid entirely	
		2	☐	Shared	
		3	☐	Don't have to pay/ included in rent (Go to 3.27)	3.27
		-99	☐	No response(Go to 3.27)	3.27

3.26	How much was your bill last month? Or, if you share the bill, how much was your share?	1	☐	Rs. per month	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	
		-95	☐	Others, Please Specify_____ ☐☐	

3.27	Is there a telephone in the household	1	☐	Yes	
		2	☐	No (Go to 3.30)	3.30

3.28	Do you pay the bill entirely or share it with someone else	1	☐	Paid entirely	
		2	☐	Shared	
		3	☐	Don't have to pay/ included in rent (Go to 3.30)	3.30
		-99	☐	No response(Go to 3.30)	3.30

3.29	How much was your bill last month? Or, if you share the bill, how much was your share?	1	☐	_____Rs. per month	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	
		-95	☐	Others, Please Specify_____ ☐☐	

3.30	What type of toilet does the household use for defecation? [Enumerator: Spontaneous response; one response permitted]	1	☐	Water closet used alone	
		2	☐	WC shared with 2 - 10 households	
		3	☐	Go into the bush, river, lake or canal?	
		4	☐	Public flush toilet/ public latrine	
		-95	☐	Others, Please Specify_____ ☐☐	

3.31	What transportation means does wife mainly use? [Enumerator: Spontaneous response; one response permitted]	1	☐	Private car	
		2	☐	Private auto rickshaw	
		3	☐	Company car	
		4	☐	Motorbike	
		5	☐	Bus	
		6	☐	Auto Rickshaw	
		7	☐	Train	
		8	☐	Taxi	
		9	☐	Bicycle	
		10	☐	Walk	
		-95	☐	Others, Please Specify_____ ☐☐	

3.32	What transportation means does husband mainly use? [Enumerator: Spontaneous response; one response permitted]	1	☐	Private car	
		2	☐	Private auto rickshaw	
		3	☐	Company car	
		4	☐	Motorbike	
		5	☐	Bus	
		6	☐	Auto Rickshaw	
		7	☐	Train	
		8	☐	Taxi	
		9	☐	Bicycle	
		10	☐	Walk	
		-95	☐	Others, Please Specify_____ ☐☐	

Section 4: Demographics

[This section should be started at home after at least one member has listened to the consent information and given oral consent].

4.1		[Enumerator: Please fill in the following table for all household members. To protect privacy and confidentiality, no name, address or any other indicator should appear on the final survey document. If some children are not present, you may need to come later for height/weight measurements].

4.11	Does anyone within the household have a mobile phone?	1	☐	Yes (Enter in table 4)	4
		2	☐	No (Go to 4.13)	4.13

4.12	4If yes, note the monthly expenses in Table 4.	

4.13	1.1 B Please enter time the home interview ends in 1.1B

Table 4:

MEMBER #	4.1 Member description	4.2 Age		4.3 Sex 1= Male 2= Female		4.4 Relation to husband	4.5 Marital status 1= Unmarried 2= Married 3= Divorced 4= Widowed	4.6 Education	4.7 Currently in school? 1= Yes 2= No		4.8 Occupation	4.9 Height (cm)	4.10 Weight (kg)	4.11 Does member have mobile phone? 1= yes 2= no		4.12 Mobile Phone monthly bill -98= Don't know/Not sure	
		Y	M	M	F												
1				✓	2	1	2		1	2				1	2		-98
2				1	✓	7	2		1	2				1	2		-98
3				1	2				1	2				1	2		-98
4				1	2				1	2				1	2		-98
5				1	2				1	2				1	2		-98
6				1	2				1	2				1	2		-98
7				1	2				1	2				1	2		-98
8				1	2				1	2				1	2		-98
9				1	2				1	2				1	2		-98
10				1	2				1	2				1	2		-98
11				1	2				1	2				1	2		-98
12				1	2				1	2				1	2		-98
13				1	2				1	2				1	2		-98
14				1	2				1	2				1	2		-98

For less than 1 years, also write month

4.6 Education	
1= Illiterate 2 = Kindergarten 3= Grade 1-4 4= Grade 5-9 5= Grade 10 to 12	6= Diploma 7= Degree (B.Com., B.Sc, BA) 8= Post Graduate (M.Com.) 9= Professional qualification

4.4 Relation to Husband		
	1=Self 2=Son/Daughter 3=Grand-son/daughter 4= Brother/Sister 5= Mother/Father 6= Wife's brother/sister 13= Cousins/ Other Extended family	7= Wife 8= Son /Daughter in Law 9= Grand Son/daughter in law 10= Wife of brother/Husband of sister 11= Mother/Father in Law (-95)= Others

4.8 Occupation

1= Student
2= Retired
3= Housewife
4= Unemployed

5=Laborer/Daily wages
6= Mathadi Worker
7= Artisan
8= Shopkeeper
9= Worker
10= Hawker

11= Farmer
12=Professional
13=Trader
14= Industrialist
15= Small business
16= Upper level job (Manager, Doctor, Engineer, etc.)
17= Mid-level job (Clerk, Soldier, Police constable, etc.)
18= Low level job (Driver, cook, security guard, etc.)
19 = Housemaid

Certificate of Height and Weight

Household Member	Height (cm)	Weight (kg)

Section 5: Information for husband/wife

5.1 Questionnaire Serial Number	
5.2 Enumerator Code	
5.3 Survey ID (efficacy-price)	95-0150

Table 5: Household Table

MEMBER #	Member Description	4.2 Age		4.3 Sex 1= Male 2= Female		4.4 Relation to husband	6.6a Did any member receive Hepatitis Vaccine		6.6b If Yes, For How Much?		7.15 Are you WTP for Member 1= Yes 2= No		7.24 For whom will partner be WTP? 1=Yes 2=No		7.28 Order for Free Vaccination	7.29 Who will take care in old age	9.47 Monthly income of members
		Y	M				Y	N	Rs.	-98	Y	N	Y	N			
1				✓	2	1	1	2		-98	1	2	1	2			
2				1	✓	7	1	2		-98	1	2	1	2			
3				1	2		1	2		-98	1	2	1	2			
4				1	2		1	2		-98	1	2	1	2			
5				1	2		1	2		-98	1	2	1	2			
6				1	2		1	2		-98	1	2	1	2			
7				1	2		1	2		-98	1	2	1	2			
8				1	2		1	2		-98	1	2	1	2			
9				1	2		1	2		-98	1	2	1	2			
10				1	2		1	2		-98	1	2	1	2			
11				1	2		1	2		-98	1	2	1	2			
12				1	2		1	2		-98	1	2	1	2			
13				1	2		1	2		-98	1	2	1	2			
14				1	2		1	2		-98	1	2	1	2			

[Enumerator: Section 5 – 10 are to be completed for husband and wife. Of these, section 8 is to be completed for wife only]

Section 5: Awareness of Malaria (for Both husband and wife)

	First Visit	Second Visit	Third Visit	Fourth Visit
5.3 Date of field interview(dd/mm/yy)	___/___/___	___/___/___	___/___/___	___/___/___
5.4 Time start	___:___	___:___	___:___	___:___
5.5 Time end	___:___	___:___	___:___	___:___

5.6	Respondent is	1	☐	Husband	
		2	☐	Wife	

5.7	Have you ever heard of Any illness called Malaria?	1	☐	Yes.	
		2	☐	No (Go to 5.9)	5.9

5.8	What are the symptoms of Malaria [*Spontaneous response, multiple responses permitted*]	1	☐	Tiredness	
		2	☐	Headache	
		3	☐	Fever	
		4	☐	Shivering	
		5	☐	Fever with Shivering	
		6	☐	Convulsions	
		7	☐	Backache	
		8	☐	Anemia	
		9	☐	Stomach ache	
		10	☐	Vomiting	
		11	☐	Diarrhea	
		12	☐	Joint pain	
		13	☐	Loss of appetite	
		-95	☐	Others, Please Specify_____ ☐☐	
		-98	☐	Don't know/ Not sure	

5.9 [*Enumerator: Read the following statement to ALL respondents*] Malaria is a disease often characterized by fever, chills, sweating, headaches, muscle pains, nausea and vomiting. In severe malaria, the infected person may have confusion, coma, severe anemia and respiratory difficulties.

	Is it possible for a person to become infected with Malaria by.: *(read responses; allow respondent to answer yes/no/don't know/not sure)*	Yes	No	Don't know/not sure
5.10	Drinking unboiled water	(1)	(2)	(-98)
5.11	Mosquito bite	(1)	(2)	(-98)
5.12	Using unhygienic latrines	(1)	(2)	(-98)
5.13	Flies touching food	(1)	(2)	(-98)
5.14	Living in marshy land	(1)	(2)	(-98)
5.15	Living in dirty unhygienic environment	(1)	(2)	(-98)

5.16	Is it necessary to treat someone infected with Malaria	1	☐	Yes, treatment is necessary.	
		2	☐	No, treatment is necessary. (Go to 5.21)	5.21
		-98	☐	Don't know/Not sure (Go to 5.21)	5.21

	If someone is sick with malaria, what are the best ways to cure this person? *[Enumerator: read all options, select one only]*	Yes	No	Don't know/not sure
5.17	Injections	(1)	(2)	(-98)
5.18	Cleaning house, environment, or body	(1)	(2)	(-98)
5.19	Religious healing: Holy water	(1)	(2)	(-98)
5.20	Herbal (Ayurvedic) medicine	(1)	(2)	(-98)

5.21	Can we take any precautions to avoid getting malaria?	1	☐	Yes	
		2	☐	No (Go to 5.28	5.28
		-98	☐	Don't know/ not sure (Go to 5.28)	5.28

	What are the best ways to avoid getting Malaria? *[Enumerator: read all options, one response permitted]*	Yes	No	Don't know/ not sure
5.22	Cleaning the house or environment, including draining wet areas	(1)	(2)	(-98)
5.23	Sleeping under a bednet	(1)	(2)	(-98)
5.24	Burning leaves, dung and other material	(1)	(2)	(-98)
5.25	Spraying insecticides inside house	(1)	(2)	(-98)
5.26	Using a mosquito repellent for body like odomos.	(1)	(2)	(-98)
5.27	Burning mosquito incense/ Good Knight	(1)	(2)	(-98)

5.28	Have you heard of chloroquine?	1	☐	Yes.	
		2	☐	No (Go to 5.30)	5.30
		-98	☐	Don't Know/ Not Sure (Go to 5.30)	5.30

5.29	What is chloroquine? [Enumerator: Spontaneous response]	1	☐	Yes	
		2	☐	No	
		-95	☐	Others, Please Specify _____ ☐☐	
		-98	☐	Don't Know/ Not Sure	

5.30 Chloroquine is the medicine (tablets) generally used to cure Malaria.

5.31	Do you know of any person infected with Malaria?	1	☐	Yes.	
		2	☐	5.35No (Go to 5.35)	5.35
		-98	☐	Don't Know/ Not Sure 5.35	5.35

5.32	Was anyone in your household ever infected with Malaria disease?	1	☐	Self	
		2	☐	Spouse	
		3	☐	Children	
		4	☐	None in the family	
		-95	☐	Others, Please Specify_____ ☐☐	

5.33	Do you know of any person who has died because of Malaria?	1	☐	Yes.	
		2	☐	5.35No (Go to 5.35)	
		-98	☐	Don't Know/ Not Sure 5.35	

5.34	Has anyone in your household ever died because of being infected with Malaria?	2	☐	Spouse	
		3	☐	Children	
		4	☐	None in the family	
		-95	☐	Others, Please Specify_____ ☐☐	

5.35 [*Enumerator: Please provide and explain the following Malaria information to the respondent to make sure that he/she understands the situation. Show Chart*]

Now I would like to talk with you about the ways that Malaria can be transmitted and how people can protect themselves.

In India, Malaria affects about 1.75 million annually, of which about a 1000 die. Malaria is transmitted from person to person through the bite of a female Anopheles mosquito, which requires blood to nurture her eggs (Show Chart 1).

The female Anopheles mosquito lays her eggs in clean standing water. In urban areas such opportunities are provided by standing water in open water tanks, open drums, in petri-dishes below plant vases, etc. (Show Chart 2 (to be compiled). Anopheles breeding ground is also found when rain water pools in small places such as tires and other materials on top of roofs.

We can avoid getting malaria if we can prevent ourselves from getting a mosquito bite. Thus, if we sleep inside an insecticide treated net at night (Show Chart 3), we can reduce the risk of malaria. Malaria can be controlled by public authorities by spraying insecticides at locations where mosquitoes breed or rest. Traditionally, people infected with Malaria were treated using chloroquine, which is available at a low cost. However, in recent years, there is an increases drug resistance to chloroquine, and more expensive treatments such as Artimisinin-based combination therapy (ACT) may be necessary. Similarly, the mosquitoes have also developed resistance to low cost insecticides. As a result, treatment and control of malaria has become difficult. (Charts on next page)

5.36	Do you have any questions or anything you are not clear about?	-95	☐	*If Yes, record the respondent's questions*:	
		2	☐	No	
	[*Enumerator: If you know the answer to the respondent's questions, please answer them truthfully and briefly. If you are not sure you know the answer, please tell the respondent politely that you are not sure.*]				

5.37	How do you think the Malaria situation in your community will change in the future? [Read all responses, single response permitted]	1	☐	Better, prevalence of malaria will reduce	
		2	☐	Same	
		3	☐	Worsen, prevalence of malaria will increase	
		-98	☐	Don't Know/ Not Sure	

5.38	How much are you and your spouse likely to be infected with Malaria in the future.	1	☐	No, impossible	
		2	☐	Some chance	
		3	☐	Large chance	
		-98	☐	Don't Know/ Not Sure	

5.39	How much are your children likely to be infected with Malaria in the future.	1	☐	No, impossible	
		2	☐	Some chance	
		3	☐	Large chance	
		-98	☐	Don't Know/ Not Sure	

5.40	Language of interview	1	☐	Marathi	
		2	☐	Hindi	

Malaria is transmitted from person to person through the bite of a mosquito. (Chart 1)

The female Anopheles mosquito lays her eggs in clean standing water (Chart 2)

A photograph of a mother sleeping inside a mosquito net with her children (Chart 3)

Section 6: Perceptions and Attitudes Regarding Vaccination (Both husband and wife)

I would like to ask you the following questions about vaccines

6.1	Have you ever heard about vaccines?	1	☐	Yes.	
		2	☐	No (Go to 6.3)	6.3

6.2	In your opinion, what is the purpose of a vaccine? (spontaneous response; multiple responses permitted)	1	☐	Prevent disease for children	
		2	☐	Prevent disease for pregnant women	
		3	☐	Prevent disease for all people	
		4	☐	Cure disease	
		-95	☐	Others, Please Specify	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	

6.3	[*Enumerator: Read the following statement to ALL respondents*] Vaccine is for "prevention", not for treatment. You have to take a vaccine before you get sick. An example of the vaccine is the polio vaccine that we give to young children to protect them from the disease.

6.4	Have you or any of your family members ever been vaccinated before [Enumerator: Record the persons who are vaccinated]	1	☐	Self	
		2	☐	Spouse	
		3	☐	Children	
		4	☐	None in the family	
		-95	☐	Others, Please Specify _____ ☐☐	

6.5	Have you purchased the Hepatitis A vaccine for any of your family members?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't know/ Not sure	

6.6	If yes, for whom did you buy this vaccine and at what price? (Fill table 5.)

Section 7: Assessment of willingness to pay for Malaria (CV scenario)

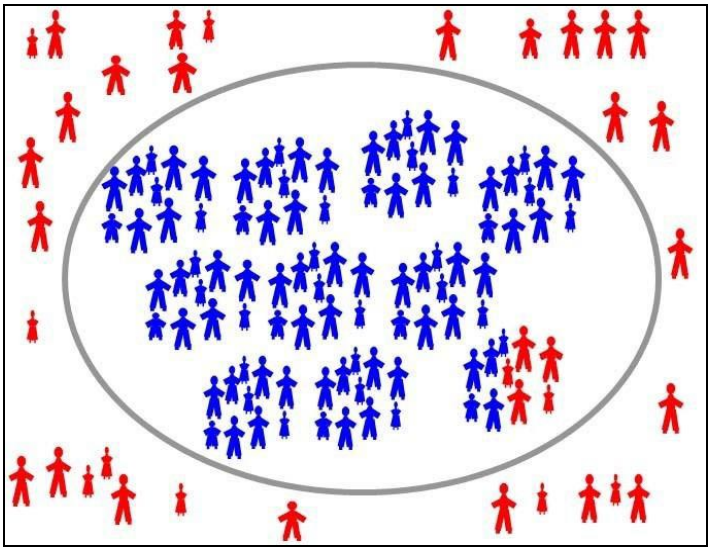
Doctors and scientists have been working for several years to develop a vaccine that can prevent people from getting Malaria. We'd like to know what you would do if the Malaria vaccine were available in the market. This vaccine would be given to individuals who don't currently have Malaria to prevent him/her having Malaria in the future. It would not be effective in treating someone already infected with Malaria. This vaccine cannot be used for **children under 1 year and pregnant women**.

Suppose that this vaccine has no side effects and is safe, that is, after you were vaccinated you would have no chance to get Malaria from the vaccine. Suppose that you could drink the vaccine (like the polio vaccine). Assume that a single dose of the vaccine would be required taken. Suppose that taking the dose of Malaria vaccine would be [~~50% effective for 10 years~~/ 95% effective for 10 years].

7.1 Now I want to explain exactly what I mean when I say the vaccine would be [~~50%~~/ 95%] effective. Suppose that each of these little blue or red figures (*Enumerator: show the picture*) represents a person. (*Enumerator: point out the circle*). The 100 figures inside this circle represent 100 persons who have got the vaccine, while the figures outside the circle represent those who have not got the vaccine. The Malaria vaccine is not 100% effective; that is the vaccine is only (~~50%~~ / 95%) effective. Therefore, of the 100 people getting the vaccine in the circle, there will be (~~50%~~ /95%) of the people who get the vaccine that are protected (i.e., the vaccine works for them) for a period of 10 years. The blue figures inside this circle represent these people.

The rest of the people (the red ones inside the circle) who have been vaccinated [~~50~~, 5] will not be protected against Malaria even though they have got the vaccine, because the vaccines did not work for them. They will still be at risk of getting malaria just like they were before they got the vaccine --or just like the people outside the circle who haven't received vaccines, although the symptoms may not be quite as severe. The people who receive the Malaria vaccine will not be able to know if the vaccine works for them. Of course, we don't know who would actually get Malaria. A red person outside the circle who does not get a vaccine still has relatively small risk of being infected.

Chart showing 95% Vaccine Efficacy



Assess understanding about the vaccine effectiveness

Now I am going to ask you some questions to make sure that the information we told you is clear.

First round

7.2	Please point to all the people who have received the vaccine [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	Respondent didn't give the correct answer	
		-98	☐	Respondent did not know/not sure	

7.3	Please point to all the people who have got the vaccine and it works for them. [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	Respondent didn't give the correct answer	
		-98	☐	Respondent did not know/not sure	

7.4	How many years would the Malaria vaccine work for them?	-85		_____ Years	
		-98	☐	Don't Know/ Not Sure	

[Enumerator: If the respondent gives wrong answer, please read the following statement]
Malaria vaccine would work for them for a period of 10 years.

7.5	How many people have already received the vaccines but can still get Malaria ? [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	If respondent gives wrong answer, please correct it.	
		-98	☐	Respondent did not know/not sure	

7.6	If an unvaccinated person gets infected by Malaria, can the vaccine be used to cure them? [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	If respondent gives wrong answer, please correct it.	
		-98	☐	Respondent did not know/not sure	

7.7	Did the respondent give the correct answer to effectiveness questions (7.2, 7.3, 7.5)?	1	☐	Yes (Go to 7.12)	7.12
		2	☐	No	

7.7 [Enumerator: If the answer to question 7.7 is no, please go to 7.1 and ask questions 7.8-7.10.

Second round

7.8	Please point to all the people who have received the vaccine [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer.	
		2	☐	Respondent did not give correct answer	
		-98	☐	Respondent did not know/not sure	

7.9	Please point to all the people who have got the vaccine and it works for them. [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	Respondent did not give correct answer	
		-98	☐	Respondent did not know/not sure	

7.10	How many people have already received the vaccines but can still get Malaria ? [Enumerator: put a mark into a relevant place]	1	☐	Respondent did give the correct answer	
		2	☐	Respondent did not give correct answer	
		-98	☐	Respondent did not know/not sure	

7.11 Note: Whether respondent did give correct answers or not, please go to 7.12).

(Willingness-to-pay scenario)

7.12 Suppose that the vaccine was in limited supply and that those who wanted a vaccine would have to pay a fixed price for the vaccine. Everyone would pay the same price. Assume that you would have to pay for the vaccine from your own pocket. Assume that the government clinic will not be supplying this vaccine for free.

Now I'd like to know whether you would buy the vaccine if it were available at a specified price. Some people say they cannot afford the price of the vaccine or that they are actually not at risk of getting this disease. Other people say that would buy the vaccine because the protection is really worth it to them. In other studies about vaccines, we have found that people sometimes say they want to buy the vaccine. They think: "I would really like as much protection from this disease as possible." However, they may forget about other things they need to spend their money on. Please try to think carefully about what you would actually do if you had to spend your own money. **There are no right or wrong answers**. We really want to know what you would do.

When you give your answer about whether you would or would not buy the vaccine, please keep in mind the following: yours and your family's income and economic status compared with the price of the vaccine, and your risk of getting Malaria. Apart from the vaccine, remember that Malaria can be cured but we still have other ways to reduce the risk of Malaria such as use of insecticide treated nets and indoor residual spraying. Applying mosquito repellents such as Odomos may also help. Also, remember that the benefit of the vaccine in preventing Malaria is [~~50% effective for 10 years~~/ 95% effective for 10 years]. Again, **children under 1 year and pregnant women** cannot use the Malaria vaccine.

[*Enumerator: Please hand the laminated reminder card to the respondent, to remind the respondent of the important information for their decision. Also show them the relevant effectiveness card. If a respondent is illiterate, show them only the relevant effectiveness card*.]

(Laminated Card)

Please Keep In Mind

- Yours and your family's income and economic status compared with the price of the vaccine
- Your risk of getting Malaria.
- We still have other ways to reduce the risk of Malaria such as use of insecticide treated nets and indoor residual spraying. Applying mosquito repellents may also help.
- **Children under 1 year and pregnant women** cannot use this vaccine

7.13	Do you have any questions or anything you are not clear about?	-95	☐	*If Yes, record the respondent's questions*:	
		2	☐	No	
	[*Enumerator: If you know the answer to the respondent's questions, please answer them truthfully and briefly. If you are not sure you know the answer, please tell the respondent politely that you are not sure.*]				

(Questions on respondent's willingness to pay)

As you may be aware, towards the end of this survey you will get an opportunity to play a game where you can win some money. Please remember that your responses to the following questions have no bearing on the amount of money that you can win. You can win the maximum amount irrespective of whether you are willing to pay or not pay for the vaccine. There is no right or wrong answer. We only want to see what you would do if had to spend your own money on this vaccine. Also, remember that the benefit of the vaccine in preventing Malaria is [~~50% effective for 10 years~~/ 95% effective for 10 years]. Again, **children under 1 year and pregnant women** cannot use the Malaria vaccine.

7.14 ☒	Suppose that this Malaria vaccine costs (Rs. ~~10/25/50~~/150/~~500~~) for the single dose needed for one person. Would you buy one or more of this vaccine for the members of your family? (Spontaneous response; one response permitted)	1	☐	Yes	
		2	☐	No	7.17
		3	☐	Yes, if I had the money	7.17
		4	☐	Yes, but too expensive	7.17
		5	☐	Yes, but I am too old	7.17
		6	☐	Yes, but only for someone else	7.17
		7	☐	Yes, only if many people around me get Malaria and mark option (5))	7.17
		8	☐	Yes, only if it is very convenient	7.17
		-98	☐	Don't know/Not sure	7.17

7.15 Who would you buy this vaccine for? (Fill table 5.)

7.16 ☒	What is the main reason that you would buy the vaccine? [Enumerator: Do not read choices; record only the most important reason]	1	☐	Vaccine is useful for me because it is good for prevention and safety	7.23
		2	☐	Price is reasonable, can afford easily	7.23
		3	☐	I think I have a chance of getting Malaria	7.23
		4	☐	Malaria is a dangerous disease	7.23
		5	☐	It is recommended by the commune health center staff and/or the government	7.23
		-95	☐	Others, Please Specify	7.23
		-98	☐	Don't know/ Not sure	7.23

7.17 ☒	What is the main reason that you will not pay / you are not sure that you will pay for the vaccine [Enumerator: Do not read choices, record only the most important reason]?	1	☐	No money	
		2	☐	Too expensive	
		3	☐	I would buy this vaccine only if many people around me get Malaria	
		4	☐	I would buy this vaccine only if it is very convenient	
		5	☐	Do not think that vaccine is useful for me	
		6	☐	Do not think that we'd have a chance to get Malaria	
		7	☐	Afraid that the vaccine might not be safe	
		8	☐	Afraid that the syringe/container might be dirty	
		5	☐	Do not think that the vaccine can prevent Malaria	
		6	☐	Concerned that the vaccine will cause the Malaria	
		-95	☐	Others, Please Specify	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	

7.18	Why would you not want anyone to receive a vaccine if you could get it for free? (Do not read choices, record only the most important reason)	1	☐	Yes (Go to 7.20)	7.20
		2	☐	No	
		-98	☐	Don't Know/ Not Sure	

7.19 ☒	Why would you not want anyone to receive a vaccine if you could get it for free? (*Do not read choices, record only the most important reason*)	1	☐	Vaccine has little use or not useful (Skip to 7.25)	7.25
		2	☐	I don't think I have a chance to get Malaria (Skip to 7.25)	7.25
		3	☐	Afraid that the vaccine might not be safe(Skip to 7.25)	7.25
		4	☐	Afraid that the syringe/container might be dirty(Skip to 7.25)	7.25
		5	☐	Do not think that vaccine can really prevent Malaria (Skip to 7.25)	7.25
		6	☐	Concerned that the vaccine will cause the disease. (Skip to 7.25)	7.25
		7	☐	Have previously had a Malaria vaccine, and therefore do not need this vaccine. (Skip to 7.25)	7.25
		-95	☐	_____Others, Please Specify_____ ☐ ☐ (Skip to 7.25)	7.25
		-98	☐	Don't know/ Not sure (Skip to 7.25)	7.25

7.20	What is the main reason that you would want someone to be vaccinated if the vaccine is free? [*Enumerator: Do not read choices; record only the most important reason*]	1	☐	Vaccine is useful because it is good for prevention and safety	
		2	☐	If it is free, I don't have to worry about cost	
		3	☐	I think I have a chance of getting Malaria	
		4	☐	Malaria is a dangerous disease	
		5	☐	It is recommended by the commune health center staff and/or the government	
		-95	☐	_____Others, Please Specify_____ ☐ ☐.	
		-98	☐	Don't know/ Not sure	
		-99	☐	No response	

7.21	Would you get someone in the house vaccinated if the price is very low?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't Know/ Not Sure	

7.22	How certain are you of your answer?	1	☐	Very certain of my answer (Skip to 7.24)	7.24
		2	☐	Somewhat certain (Skip to 7.24)	7.24
		3	☐	Not certain; unsure (Skip to 7.24)	7.24
		-95	☐	Others, Please Specify ☐☐(Skip to 7.24)	7.24
		-98	☐	Don't know/ Not sure	7.24
		-99	☐	No response	7.24

# Vaccines	1	2	3	4	5	6	7	8	9	10
Cost	150	300	450	600	750	900	1050	1200	1350	1500

7.23	*[Enumerator: multiply the number of household members respondent said they would purchase by the price of the vaccine to obtain the total amount*]. You've said that you would buy vaccines for a total of _____ household members including yourself at this price. This would amount to a total cost to you of _____. How confident are you that you would be able to afford this amount of money?	1	☐	Very confident of my answer	
		2	☐	Somewhat Confident	
		3	☐	Not Confident; unsure	
		-98	☐	Don't know/ Not sure	

7.24	[*Enumerator: Check mark in table 5*] For the same vaccine i.e., vaccine efficacy [~~50%~~/95%] and duration of 10 years, and a price of price [Rs. ~~10/25/50~~/150/~~500~~] which household members do you think your husband/ wife would buy the vaccines for?

7.25 <u>Please give consent letter 2 to respondent</u>

[Enumerator: Now read the consent form for the respondent. Make sure that he understands what is in the consent letter].

---Consent Letter before Joint Interview---

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Date: October 26, 2005

Consent form for Phase 2 of Malaria Socio-Economic Study

We have just finished phase 1 of the interview. We thank you for answering our questions. We now plan to begin phase two of the interview. Phase 2 will take 15 more minutes.

Discussion with your spouse: Just to remind you, we are not going to reveal what you told us before to your spouse or any other person, but we will ask you some of the same questions about your willingness to pay that we asked you before. You have to answer these questions jointly. Both of you will be interviewed together by another person. Sometimes people want to revise their answers after their initial response and sometimes they don't. There is no right or wrong way to do this. We just want you to discuss with your spouse as if we had not asked this question to you before and if you were presented with a household demand question for malaria vaccines.

Your Rights:

- You decide on your own whether or not you want to be in this study.
- You will not be treated any differently if you decide not to be in the study.
- If you decide to be in this part of the study, you will have the right to stop being in the study at any time, and to not answer specific questions.

Compensation

- There is no extra compensation for this portion of the study.

7.26	Respondent- wife has listened to the consent form and given oral consent	1	☐	Yes	
		2	☐	No (Terminate interview, Go to 1.12)	1.12

7.27	Respondent- Husband has listened to the consent form and given oral consent	1	☐	Yes	
		2	☐	No (Terminate interview, Go to 1.12)	1.12

After getting consent, send respondent for joint interview. There another enumerator will conduct the joint interview (Section 11).

Section 7 Continued

[Enumerator: Make sure that joint interview is over]

7.28	If there is only one vaccine available for free, whom would you vaccinate? (Mark preference order against selected member in table 5). If there are only two vaccines available for free, whom would you vaccinate? (Mark preference order against selected member in table 5) If there are only three vaccines available for free, whom would you vaccinate? (Mark preference order against selected member in table 5) If there are only four vaccines available for free, whom would you vaccinate? (Mark preference order against selected member in table 5).

7.29	Who in your opinion is most likely to take care of you in your old age? [*Enumerator: record only the most important person*]	1	☐	Savings of self	
		2	☐	Household Member (go to table 5)	5
		3	☐	Others, Please Specify_____ ☐ ☐	

Gender Preference (Ask this section to wives only)

7.30	In your opinion, up to which grade should girls and boys be educated?	1	☐	No education	
		2	☐	Grade 1 to 5	
		3	☐	Grade 6 to 9	
		4	☐	Grade 10 to 12	
		5	☐	Graduate and above	
		6	☐	Until the son wishes to study	

7.31	In your opinion, up to which grade should girls and boys be educated?	1	☐	No education	
		2	☐	Grade 1 to 5	
		3	☐	Grade 6 to 9	
		4	☐	Grade 10 to 12	
		5	☐	Graduate and above	
		6	☐	Until the son wishes to study	

7.32	Have you started saving for the education of your son (if couple has a son)?	1	☐	Yes	
		2	☐	No	
		3	☐	Don't know/Not sure	

7.33	Have you started saving for the education of your daughter (if couple has a daughter)?	1	☐	Yes	
		2	☐	No	
		3	☐	Don't know/Not sure	

Section 8: Women's autonomy/ preferred gender (To be asked to women only).

	Who makes the following decisions in your household for the following activities?	Self	Husband	With husband	In-laws	With In-laws	Others
		1	2	3	4	5	6
8.1	What items to cook						
8.2	Obtaining health care for yourself						
8.3	Purchasing jewelry						
8.4	Purchasing major household item like fridge, TV						
8.5	Your going and staying with parents and siblings						
8.6	Vaccinating self						
8.7	Vaccinating children						

8.8	Is the practice of "Dowry" common in your caste?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't know/Not sure	

8.9	What was the type of your marriage?	1	☐	Arranged by Parents	
		2	☐	Love Marriage	
		3	☐	Arranged & love marriage	
		-95		Others, Please Specify_____ ☐☐	

Section 9: Socio-economic information

9.1	What is your primary occupation?	1	☐	Job (Go to 9.3)	9.3
		2	☐	Daily work (Go to 9.2)	9.2
		3	☐	Business (Go to 9.15)	9.15
		-95	☐	Other (Go to 9.2)	9.2
		4	☐	No occupation (Go to 9.21)	9.21

9.2	If laborer, how much is your daily wage rate?	-85		Rs. _____ per day	
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.3	How many hours a week did you work in your primary occupation?	-85		_____ hours	
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.4	On the average, what was your monthly wage/ salary last year, excluding bonuses?	-85		_____ (Go to 9.9)	9.9
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.5	Would it amount to Rs. 3000 or more?	1	☐	Yes (Go to 9.6)	9.6
		2	☐	No (Go to 9.8)	9.8
		-98	☐	Don't Know/ Not Sure (Go to 9.8)	9.8
		-99	☐	No response (Go to 9.8)	9.8

9.6	Would it amount to Rs. 6000 or more?	1	☐	Yes (Go to 9.9)	9.9
		2	☐	No (Go to 9.7)	9.7
		-98	☐	Don't Know/ Not Sure (Go to 9.7)	9.7
		-99	☐	No response (Go to 9.7)	9.7

9.7	Would it amount to Rs. 4500 or more?	1	☐	Yes (Go to 9.9)	9.9
		2	☐	No (Go to 9.9)	9.9
		-98	☐	Don't Know/ Not Sure (Go to 9.9)	9.9
		-99	☐	No response (Go to 9.9)	9.9

9.8	Would it amount to Rs. 1500 or more?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.9	Did you receive a bonus last year?	1	☐	Yes (Go to 9.10)	9.10
		2	☐	No (Go to 9.15)	9.15
		-98	☐	Don't Know/ Not Sure (Go to 9.15)	9.15
		-99	☐	No response (Go to 9.15)	9.15

9.10	What was the total value of bonuses for the entire year?			Rs. _____ (Go to 9.15)	9.15
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.11	Would it amount to Rs. 3000 or more?	1	☐	Yes (9.12)	9.12
		2	☐	No (9.14)	9.14
		-98	☐	Don't Know/ Not Sure (Go to 9.14)	9.14
		-99	☐	No response (Go to 9.14)	9.14

9.12	Would it amount to Rs. 6000 or more?	1	☐	Yes (Go to 9.15)	9.15
		2	☐	No (Go to 9.13)	9.13
		-98	☐	Don't Know/ Not Sure (Go to 9.13)	9.13
		-99	☐	No response (Go to 9.13)	9.13

9.13	Would it amount to Rs. 4500 or more?	1	☐	Yes (Go to 9.15)	9.15
		2	☐	No (Go to 9.15)	9.15
		-98	☐	Don't Know/ Not Sure (Go to 9.15)	9.15
		-99	☐	No response (Go to 9.15)	9.15

9.14	Would it amount to Rs. 1500 or more?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

9.15	Did you operate a small handicraft or small commercial business last year	1	☐	Yes (Go to 9.16)	9.16
		2	☐	No (Go to 9.21)	9.21
		-98	☐	Don't Know/ Not Sure (Go to 9.21)	9.21
		-99	☐	No response (Go to 9.21)	9.21

9.16-9.20 Small Business

#	9.16	9.17		9.18		9.19		9.20		
	Business type	Average monthly Revenue Rs.		Average monthly expenses Rs.		Overall profit/loss -98 = don't know/ not sure		Whose income 1= husband's income 2 = wife's income 3 = shared		
		Rs.	-98	Rs.	-98	Rs.	-98	1=	2=	3=
1			-98		-98		-98	1	2	3
2			-98		-98		-98	1	2	3
3			-98		-98		-98	1	2	3
4			-98		-98		-98	1	2	3

9.21	Do you work part-time in addition to the above mentioned work?	1	☐	Job (Go to 9.23)	9.23
		2	☐	Daily Work (Go to 9.22)	9.22
		-95	☐	Other (Go to 9.22)	9.22
		4	☐	No additional job (Go to 9.29)	9.29

9.22	If laborer, how much is your daily wage rate?			Rs._____ /day	
		-98	☐	Don't Know/ Not Sure	
		-99	☐		

9.23	How many hours a week did you work in your primary occupation?			_____ hours	
		-98	☐	Don't Know/ Not Sure	
		-99	☐		

9.24	On the average, what was your monthly wage/ salary last year, excluding bonuses?			Rs. _____(Go to 9.29)	9.29
		-98	☐	Don't Know/ Not Sure	
		-99	☐		

9.25	Would it amount to Rs. 3000 or more?	1	☐	Yes (Go to 9.26)	9.26
		2	☐	No (Go to 9.28)	9.28
		-98	☐	Don't Know/ Not Sure (Go to 9.28)	9.28
		-99	☐	No response (Go to 9.28)	9.28

9.26	Would it amount to Rs. 6000 or more?	1	☐	Yes (Go to 9.29)	9.29
		2	☐	No (Go to 9.27)	9.27
		-98	☐	Don't Know/ Not Sure (Go to 9.27)	9.27
		-99	☐	No response (Go to 9.27)	9.27

9.27	Would it amount to Rs. 4500 or more?	1	☐	Yes (Go to 9.29)	9.29
		2	☐	No (Go to 9.29)	9.29
		-98	☐	Don't Know/ Not Sure (Go to 9.29)	9.29
		-99	☐	No response (Go to 9.29)	9.29

9.28	Would it amount to Rs. 1500 or more?	1	☐	Yes	
		2	☐	No	
		-98	☐	Don't know/Not sure	
		-99	☐	No response	

Enumerator, ask about each income source and record the answers in the table below:

Income source	9.29 Did you receive income from this source during the past 12 months? 1 = yes, 2 = no		9.30 How much money did you receive?		9.31 Who keeps the earned income 1= husband's income 2 = wife's income 3 = shared		
	1=	2=.	Rs.	DKNS	1=	2=	3=
1) Rental of household assets	1	2		-98	1	2	3
2) Rental of Auto rickshaw vehicles	1	2		-98	1	2	3
3) Retirement pensions	1	2		-98	1	2	3
4) Money from children	1	2		-98	1	2	3
5) Money from parents	1	2		-98	1	2	3
6) Money from friends or relatives	1	2		-98	1	2	3
7) Do you give money to your parents or friends?	1	2		-98	1	2	3
8) Interest income	1	2		-98	1	2	3
9) LIC policy	1	2		-98	1	2	3
10) Cash income from other sources	1	2		-98	1	2	3

9.32	Do your parents own any land/ property?	1	☐	Yes (Go to 9.33)	9.33
		2	☐	No (Go to 9.38)	9.38
		-98	☐	Don't Know/ Not Sure (Go to 9. 38)	9.38
		-99	☐	No response (Go to 9. 38)	9.38

	9.33		9.34		9.35		9.36			9.37	
	Type of land 1 = Non Agricultural 2 = agricultural		Grow crops 1= Yes 2 = No		Where is it located 1 = Urban 2 = Rural		Area in acres			Value of land (Rs.)	
	1 =	2 =	1=	2 =	1 =	2 =	Acre	Guntha (1/40 acres)	-98	Rs.	-98
1	1	2	1	2	1	2			-98		-98
2	1	2	1	2	1	2			-98		-98
3	1	2	1	2	1	2			-98		-98

9.38	Where do your parents live?	1	☐	Mumbai/ Navi Mumbai/ Thane
		2	☐	In other cities
		-98	☐	In villages
		-99	☐	Parents not alive

9.39	Do you own any land/ property?	1	☐	Yes (Go to 9.40)	9.40
		2	☐	No (Go to 9.45)	9.45
		-98	☐	Don't Know/ Not Sure (Go to 9.45)	9.45
		-99	☐	No response (Go to 9.45)	9.45

	9.40		9.41		9.42		9.43			9.44	
	Type of land 1 = Non Agricultural 2 = agricultural		Grow crops 1= Yes 2 = No		Where is it located 1 = Urban 2 = Rural		Area in acres			Value of land (Rs.)	
	1 =	2 =	1=	2 =	1 =	2 =	Acre	Guntha	-98	Rs.	-98
1	1	2	1	2	1	2			-98		-98
2	1	2	1	2	1	2			-98		-98
3	1	2	1	2	1	2			-98		-98

9.45	Please note the Monthly Income of other household members in table 5.	

9.48	What is the most accurate description of financial arrangements in your household? [*Enumerator: Read all the answers*].	1	☐	I look after household money except my partner's personal spending money.	
		2	☐	My partner looks after household money except my personal spending money.	
		3	☐	My partner is given a housekeeping allowance. I look after the rest of the money.	
		4	☐	I am given a housekeeping allowance. My partner looks after the rest of the money.	
		5	☐	We manage and share our finances jointly.	
		6	☐	We keep our finances completely separate.	
		-95	☐	Other arrangement, Please specify.	

9.40	Mother's education	1	☐	No education	
		2	☐	Grade 1 to 5	
		3	☐	Grade 6 to 9	
		4	☐	Grade 10 to 12	
		5	☐	Graduate and above	

9.50	Father's education	1	☐	No education	
		2	☐	Grade 1 to 5	
		3	☐	Grade 6 to 9	
		4	☐	Grade 10 to 12	
		5	☐	Graduate and above	

9.51	What is your religion?	1	☐	Hindu	
		2	☐	Muslim	
		3	☐	Sikh	
		4	☐	Christian	
		5	☐	Buddhist	
		6	☐	Jain	
		7	☐	No Religion	
		-95	☐	Other specify	
		-99	☐	No Response	

Game with payoffs.

In this section you will be shown choices involving a series of cards as shown below. Each card indicates a game with a payoff. [*Enumerator: show the two choice cards below*]. Each choice card will have a good luck payout and a bad luck payout. The good luck and bad luck payouts will be decided by the toss of a coin. If you have heads, you will receive good luck payout shown in green and if it is tails, you will be entitled to bad luck payout shown in red. Each payout has a payment for you and your husband. You will receive your prize corresponding to that card that you chose and the flip of the coin. Your partner will also receive the prize corresponding to the same number. You will be paid immediately, whereas your spouse will be paid after the end of the survey. Similarly, if you spouse wins some money for you, you will be paid at the end of the survey.

As it is about all other questions, your choices are confidential - we will not reveal them anyone, including your partner. Even when receiving the payment, your partner will not know what choices the game contained. The options you will face will be similar to the one shown here (Enumerator show L1 and L2).

Please select one of the cards

9.52	What would you receive if the coin flipped to "head"?	1	☐	Respondent did give the correct answer	
		2	☐	Respondent didn't give the correct answer	
		-98	☐	Respondent did not know/not sure	

⇨ *If respondent gave incorrect answer, please correct it.*

9.53	What would your spouse receive if the coin flipped to "tails"?	1	☐	Respondent did give the correct answer	
		2	☐	Respondent didn't give the correct answer	
		-98	☐	Respondent did not know/not sure	

⇨ *If respondent gave incorrect answer, please correct it.*

9.54	What would you receive if the coin flipped to "tails"?	1	☐	Respondent did give the correct answer	
		2	☐	Respondent didn't give the correct answer	
		-98	☐	Respondent did not know/not sure	

⇨ *If respondent gave incorrect answer, please correct it.*

9.55 Start of the game

We have shown cards like these to various people. Some people said, I want to play the game that can give my household the maximum money. Others have said that I want to play the game that can give me the maximum money. Remember, in a bad-luck payout, i.e., if you don't get a "Heads" on the coin flip, neither you nor your husband will get anything. Some people said that they will share their income, others said that they would use it for themselves. There is **no right or wrong answer.** Please select one card from the three cards shown below. Please carefully think about different options and then decide what you want to select. Remember that the choice will be played for real. Now choose one card from the following three options.

(Trial one)

	Good Luck Payout	Bad Luck Payout
		
Outcome	Heads	Tails
You Win	Rs. 8	Rs. 0
Your Spouse Wins	Rs. 2	Rs. 0

	Good Luck Payout	Bad Luck Payout
		
Outcome	Heads	Tails
You Win	Rs. 6	Rs. 0
Your Spouse Wins	Rs. 5	Rs. 0

Enumerator: Please note the Reponses in table below

9.56	Enumerator: Please note the selected card.		Heads	Tails
		X1 Card X1 (2.5 + 2.5 = 5.0)	1	2
		X2 Card X2 (3.0 + 1.5 = 4.5)	3	4
		X3 Card X3 (4.0 + 0.0 = 4.0)	5	6

9.57	Enumerator: Please note the selected card.		Heads	Tails
		Y1 Card Y1 (10 + 10 = 20)	1	2
		Y2 Card Y2 (12 + 6 = 18)	3	4
		Y3 Card Y3 (16 + 00 = 16)	5	6

9.58	Enumerator: Please note the selected card.		Heads	Tails
		Z1 Card Z1 (40 + 40 = 80)	1	2
		Z2 Card Z2 (50 + 25 = 75)	3	4
		Z3 Card Z3 (65 + 0.0 = 65)	5	6

9.59	Total expenses for husband		-85	_____ _____ _____ Rs. _____	

9.60	Total expenses for wife		-85	_____ _____ _____ Rs. _____	

10 Interviewer's opinion

10.1 Time Finish (*record in 5.5*) _____

10.2	How reliable do you think is the information you got from the respondent?	1	☐	Very reliable	
		2	☐	Reliable	
		3	☐	Fairly reliable	
		4	☐	Not reliable	
		5	☐	Very unreliable	

10.3	[*Enumerator: This question is not to be asked, just record your comments*]Do you think the respondent understood about the vaccine efficacy scenario?	1	☐	Did not understand	
		2	☐	Understood	
		-98	☐	Don't know/not sure	

10.4		Other suggestions/ comments

12 End of Questionnaire

This is the end of the interview. Thank you very much for your participation. We'd like to stress that it is necessary for you to protect yourself from contracting Malaria. The objective of this survey is to learn about your willingness to pay for Malaria vaccines either for yourself or your household members. We need to ask different households their willingness to purchase at different prices. Thus, don't worry if you hear that other people in your community have been asked about purchasing the vaccines at different prices. However, until today, a commercially available vaccine does not exist for Malaria. It may take another 10-20 years to develop a good commercially available malaria vaccine.

12.1		How long do you think it may take to develop a good commercially available malaria vaccine?
	1	10-20 years [*Enumerator read the following: "Thank you for your response. As you have noted, the Malaria vaccine does not exist]*.
	2	No [*Enumerator: Until today, a commercially available reliable Malaria vaccine does not exist. This survey was conducted to estimate the WTP for a hypothetical Malaria vaccine. Since there is no such vaccine, we urge you to protect yourself from contracting Malaria. It may take 10-20 years to develop a good Malaria vaccine*

Repeat 12.1 until the respondent replies "Yes".

[Enumerator: Return this filled form to the Manager. You will not be able to see this form again, except if you have made some errors, where the form may be used to explain to you the error. Do not copy or make any notes from this survey instrument].

Section 11: Joint responses

11.1 Questionnaire Serial Number	
11.2 Enumerator Code	
11.3 Survey ID	95-0150

Table 11: Husband and Wife Joint Interview Table

MEMBER #	Member	4.2 Age		4.3 Sex 1=Male 2=Female		4.4 Relation to Respondent	11.8 1 Husband is Willing to Pay for 1=yes 2= no		11.8 2 Wife is Willing to Pay for 1= Yes 2= No	
		Y	M	M	F		Y	N	Y	N
1				✓	2	1	1	2	1	2
2				1	✓	7	1	2	1	2
3				1	2		1	2	1	2
4				1	2		1	2	1	2
5				1	2		1	2	1	2
6				1	2		1	2	1	2
7				1	2		1	2	1	2
8				1	2		1	2	1	2
9				1	2		1	2	1	2
10				1	2		1	2	1	2
11				1	2		1	2	1	2
12				1	2		1	2	1	2
13				1	2		1	2	1	2
14				1	2		1	2	1	2

11.4	I would like to remind you briefly about the Malaria vaccine. As you may remember, the Malaria vaccine was [~~50% effective~~ /95% effective] and had a duration of 10 years. A single dose of this vaccine cost [Rs. ~~10/25/50~~/150/~~500~~]. I will ask you some of the same questions that I asked before. In the previous section, you had to take the decision individually. But sometimes, people think differently when they are together? We asked this question to many couples. Some had agreed on the individual responses. Others had not. They thought about the vaccine, the risk of the disease, and whether the protection is worth to them and their household members. Sometimes they thought, "I would like my family to have as much protection from this disease as possible". However, they may forget about other things they need to spend their money on. Please try to think carefully about what you would actually do if you had to spend your own money. **There are no right or wrong answers**. We really want to know what you would do if you were to purchase this vaccine jointly in a real life situation. When you give your answer about whether you would or would not buy the vaccine, please keep in mind the following: yours and your family's income and economic status compared with the price of the vaccine, and your risk of getting Malaria. Apart from the vaccine, remember that Malaria can be cured but we still have other ways to reduce the risk of Malaria such using insecticide treated nets and indoor residual spraying. As you may be aware, towards the end of this survey you will get an opportunity to play a game where you can win some money. Please remember that your responses to the following questions have no bearing on the amount of money that you can win. You can win the maximum amount irrespective of whether you are willing to pay or not pay for the vaccine. There are no right or wrong answers. We only want to see what you would do if had to spend your own money on this vaccine. Before answering the question, please discuss with your spouse. If you are changing your decision, please think and discuss why you are changing your decision. I will be back after 2 minutes to ask you about your joint decisions. Also, remember that the benefit of the vaccine in preventing Malaria is [~~50% effective for 10 years~~ / 95% effective for 10 years]. Again, **children under 1 year and pregnant women** cannot use the Malaria vaccine.

11.5 Suppose that this Malaria vaccine costs [Rs. ~~10/25/50~~/150/~~500~~].for the single dose needed for one person. Would you buy one or more of this vaccine for the members of your family?
(*Spontaneous response; one response permitted*

11.6	Husband's response	1	☐	Yes	
		2	☐	No	

11.7	Wife's response	1	☐	Yes	
		2	☐	No	

11.8 For whom would you like to purchase the vaccine (Table 10) ?

11.9	How did the husband and wife take the decision?	1	☐	Husband took the decision and wife agreed	
		2	☐	Wife took the decision and husband agreed	
		3	☐	Husband and wife discussed among themselves and then took the decision	

House Characteristics

11.12	Who owns this house?	1	☐	11.13Own-husband (Go to 11.13)	11.13
		2	☐	11.13Own-wife(Go to 11.13)	11.13
		3	☐	11.13Own-joint(Go to 11.13)	11.13
		4	☐	11.14 Rent (Go to 11.14)	11.14
		5	☐	11.15	11.15
		-95	☐	_____11.15	11.15

11.13	What would someone expect to pay to purchase a house like yours?	1	☐	Rs. _____ (Go to 11.15)	11.15
		-98	☐	Don't know/ not sure (Go to 11.15)	11.15
		-99	☐	No response (Go to 11.15)	11.15

11.14	What is your monthly rent?	1	☐	_____ Rs/month	
		-98	☐	Don't know/not sure	
		-99	☐	No response	

11.15	In the last month, what were you approximate household expenses. This includes food, health care, loan payments, etc.	1	☐	_____ Rs/month	
		-98	☐	Don't know/not sure	
		-99	☐	No response	

11.16	How would you classify the economic status of your household relative to others in this neighborhood? (Enumerator: read responses)	1	☐	Much better than most people	
		2	☐	Better than most people	
		3	☐	About average	
		4	☐	Below average	
		5	☐	Much worse than average	
		-98	☐	Don't know/not sure	

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