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Analyzing the Effect of Family size on Parental Health Production -Evidence from Indonesia

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Abstract

The most famous theory of family economics is probably Gary Becker's Quantity-Quality model. Assuming scarce parental resources, it predicts a negative relationship between family size and adult success. The model assumes that parents have common preferences and that income pooling takes place. However, modern theories of household allocation have shown that the assumption of common preferences is not necessarily valid and that, instead, a bargaining process takes place between the parents. This gives reason to believe that the mother and father might be affected differently to changes within the family, such as family size. To model this, the theoretical part of this thesis combines the Quantity-Quality model with theories of household allocation and hypothesizes that one can test the effect of family size on investment in parental 'quality', which in this thesis is interpreted as the level of 'good health'. To do this, it uses the Grossman models of individual and family health production, which view health as a durable stock that produces healthy time, as models of how parents can invest to increase their own 'quality'. The empirical part of this thesis uses data from Indonesia to test the relationship between parents' health levels and family size by using blood pressure as the health variable. The result from the econometric analysis is that an increase in the number of daughters living at home in the household is associated with an increase in blood pressure for the mothers but not the fathers, and therefore a special type of Quantity-Quality relationship is found. The findings also reject the common preference assumption and support the bargaining models of household allocation. Finally, the results suggest that the wife has a weaker bargaining strength in the household and therefore bears most of the cost of having children but that this cost is only associated with daughters and not for sons. This can be due to poor opportunities for women in the labor market or the sign of a gender bias of the mother towards the daughters living in the household.

Finally, the results of this thesis support policies that aim at reducing fertility and/or increasing women's position in society but does not evaluate which of the alternative policies that is the best.

Key words: Quantity-Quality model, Grossman model, fertility, health production, Indonesia, blood pressure, family size.

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1. Introduction

The first chapter of the thesis introduces the reader to the subject that it addresses. Additionally, it states the aim and research question of the essay as well as its delimitations and outline.

The role of the family attracts the attention of economists, sociologists, psychologists and researchers within medicine. In family economics, a lot of focus is put on researching the effect of childhood circumstances and adult outcomes. One socioeconomic factor that is often researched and that is extended in this thesis is how children's wellbeing is affected by sibling size. Theories of family size predict that individuals from large families will underachieve relative to their small-family counterparts because large families, ceteris paribus, have fewer resources to devote to each child (Kessler, 1991). This is referred to as the 'dilution effect'. Therefore, it is often argued that children from poor families are double disadvantaged from the beginning since their parents lack the personal resources to optimize their investments in the human capital of their children as well as face constraints in obtaining credit and flexibility in time allocation. The first consequence for these children is that investments in education and health remain low, despite the potentially high returns (Garg and Mordutch, 1998). This has been shown in empirical work where it was found that children born in large families tend to have lower educational attainment (Butcher and Case, 1994), and poorer health (Thomas, 1994; Garg and Mordutch, 1998). A second consequence is that the parents have to ration funds and time between their children. As a result, children become rivals over their parents' funds and although parents might not openly show their child preferences, the relative gender and age of siblings can be important determinants in the investment of a child. The difference in human capital between siblings from the same family has been shown to be as great as those from different families (Dunn and Plomin, 1990). Facing heterogeneous returns to investment, for example due to a pro-male bias, this might lead to a pro-male investment where both boys and girls benefit from having a sibling constellation made up entirely by girls.

Although much attention has been paid to the relationship between family size and future adult success of children, surprisingly little literature has been written about the effect of the number of children on parental 'quality', possibly because it has been difficult to find an appropriate framework to do so, or because the general notion is that such investments take place before the individuals reach the age of family formation. This paper extends the theories of parents' investments in their children by stating that the children are not the only rivals for their parents' resources. So are the parents. Since the allocation of resources within the family to

obtain either the highest individual or family achievement can be two forces that pull in different directions, the allocative outcome can depend on the preference of the decision maker in the family. The decision maker, in turn, can be the father or mother exclusively, or both parents in some form of agreement. Since traditional consumer theory cannot appropriately describe the behavior of a household with more than one adult in it, it is often assumed that the family acts as 'if it were a single agent'. This assumption is often criticized when it is difficult to identify who the consumer of the good is but few empirical examinations have been made to analyze how households *de facto* allocate resources amongst its member. This paper presents a new approach to allow us to distinguish between the theories of joint or individual utility maximization and to find results concerning the behavior of families with different amounts of children.

This thesis has several aims. Its first aim is to use theories of family and health economics to explain how the Quality-Quantity model of parental demand for children and investment in child 'quality' can be extended to include investments in parental 'quality' too, under the assumption that 'quality' is a capital that individuals allocate resources towards throughout their life, such as health capital. Its second aim is to perform an empirical investigation to answer the following research questions: *Is there a correlation between family size and parental 'quality'? If so, does this correlation depend on the gender of the parents and/or children? Finally, using family size and parental 'quality' as the basis of analysis, can the intra-household resource allocation be best described as a common preference or bargaining model?*

Analyzing the effect of fertility on health production of parents is important for two reasons. First, many developing countries have implemented policies to decrease fertility levels, one example being China's One-Child Policy that was implemented in the late 1970s (Hesketh et al, 2005). The main argument behind these policies is that economic theory suggests that there is a close link between an increase in growth and development levels and a decrease in fertility levels. However, while these changes are made in order to make future generations better off, it is important to analyze the effects on the current generation as well. Health level is an important factor in determining the amount of hours that a worker can allocate towards labor, as well as work productivity. Therefore, a positive impact on health from having fewer children compared to many can benefit the nation as a whole by increasing growth levels. Second, reductions in fertility levels can have a positive impact on women's empowerment. There are many reasons why women and men should be treated equally in society but this essay only deals with one: An equal position in society results in an equal marriage where both parents have the same bargaining power for the allocation of household resources. In many developing countries, this is

not the reality since social norms and traditions generally put women in a lower position. The 'dilution effect' of each additional child might therefore affect the parents differently, depending on who has more power to decide on how to reallocate resources within the family. The effect on the wife is thus likely to be more negative than the effect on the husband. Given this result, a policy that increases the bargaining power of women is likely to decrease the negative effect of family size. In other words; the cost of children will be shared more equally by the parents.

The theoretical part of this thesis describes and analyzes the major relevant economic theories and how they are related. They were chosen due to their large contribution to the topics that are discussed but they are not the only ones that exist. Some theories that could have been included but that are left out are the labor-leisure model and the bargaining models with strategic parents or a dominant spouse. These models would have been included if the time horizon for the essay had been longer. The empirical part of the thesis performs an Ordinary Least Squares regressions analysis using the Indonesian Family Life Survey, a continuing longitudinal socioeconomic and health survey. The results therefore only apply to Indonesia but can hopefully be extended to other developing countries. The dataset that is used is from 2000 and it is the most current one published by RAND cooperation, which was chosen as the source of data since it is a non-profit organization from USA that works towards collecting high quality global research on important and global issues (www.rand.org). The results are therefore likely to reflect real life. The 2000 survey includes a cross-sectional dataset of 7.224 households and it is not combined with earlier surveys to perform a panel-data analysis. Therefore, the effect of the macroeconomic shocks that Indonesia has experienced on family size and parental health is not analyzed. The thesis only analyzes the effect of family size on one parental health variable and not on any additional dependent variable, such as wages or economic growth, nor does it use the results to form an opinion on the optimal fertility policy.

The outline of the dissertation is as follows. *Section 2* discusses the different theories of demand for children, household allocation and health production, and the conclusions reached in previous published papers. *Section 3* describes the data used and the variables chosen, the econometric model and the parameter findings. *Section 4* makes some concluding remarks, mention policy implications and suggestions for further research.

2. Theoretical Models and Literature Review

The second chapter of this thesis introduces the reader to the theoretical background and the results of previous empirical work. The ambition is to motivate how the economic models are interdependent in order for the empirical part to be able to answer the research questions.

2.1. Introduction

The negative correlation between family size and children's outcomes is conventionally referred to as the Quantity-Quality (QQ) model (Becker; 1960; Becker and Lewis, 1973; Nigel and Tomes, 1976). The QQ model is based on an investment model where the household decides on the level of resource allocation towards each individual child. These resources can be either temporal or financial and are expected to increase child 'quality'. However, the parents' resource constraints imply that there is a trade-off between child quantity and 'quality'. This QQ-relationship has been well documented in many empirical investigations but none of them have explored the effect of family size on the 'quality' of the parents, thus ignoring one point that is emphasized in this thesis. Is there a trade-off between child 'quality' or/and 'quantity' and parental 'quality'? Just as one can argue that parents must choose how much to spend on their children, one can also argue that they must choose the amount of resources to spend on themselves. Facing an increasing family size, this means that the resources available for parents to spend on *all* members of the family are diluted, and the parents thus must make decisions on how to reallocate their resources.

Gary Becker's (1964) extension of the neoclassical model of consumer demand by families was the first published theoretical literature on allocative behavior within the household. It and the following theories of the same kind have been named 'common preference models' (CPMs). In the CPMs, the family is assumed to jointly maximize a welfare function by 'pooling' all resources and then allocate it according to a 'common preference'. This means that it does not matter who has the control over the resources and the family can be treated as if it were a single individual. Recently, however, there has been a development of alternative theories where the family members do not pool their income, because they have different preferences over which goods to consume. In these bargaining models, it does matter who controls the resources (Lundberg and Pollak, 1994). This paper aims to determine which of the allocative models that is consistent with data. To investigate this, one has to find a variable that both individuals are likely to want to continuously allocate temporal and financial resources towards even when they are adults. A variable that appears appropriate is the demand for the commodity 'good health', which

in this paper is interpreted as parental 'quality'. The demand for 'good health's was first introduced at an individual level by Grossman (1972) and then extended to family production including bargaining and strategic models (Bolin et al, 2001, 2002). The concept is that all individuals are born with a stock of health that depreciates with age but can be increased by investments (for example by going to the gym or eating healthy food). Granted, studies have shown that parents value their children's health more than their own (Agee and Crocker, 2007) but this does not suggest that they do not invest in themselves. Thus, the proposition of this paper is that by combining models of family and health economics, it is possible to investigate whether or not family size has an effect on parental 'quality' by estimating parental health outcomes and conclude whether the allocation of these resources follows a 'common preference model' or a 'bargaining model'. This thesis will also test whether or not the allocation of resources can tell us something about parents' gender preferences in their children. If the data rejects the CPM, gender preferences might be displayed via different health investments towards the parents depending on who makes the decision together with the genders of the children.

2.2. Theories of the Demand for Children

2.2.1. The Quantity-Quality Model

Arguably, the goal in marriage is to have children. One reason is biological: reproduction is necessary for the survival of the species. The other is emotional: adults want children. Why, then, do some people decide to have many children whereas others decide to have few? Gary Becker (1981) developed a model of demand for children. In doing so, he explained the special negative relationship between the number of children (quantity) and their 'quality' that had been found in many time-series and cross-sectional data worldwide (Becker and Lewis, 1973). Earlier theories suggested that the relationship was due to low substitution elasticity in the family's utility function between the parents and their children's standard of living (Duesenberry, 1960). Becker, on the other hand, theorized that the shadow price of children with respect to their number is greater the higher their 'quality' and that the shadow price of children with respect to their 'quality' is greater the greater the number of children (Becker and Lewis, 1973). The model is based on the fact that parents face two constraints; temporal and financial, which creates a trade-off between child 'quality' and quantity. These constrains mean that additional children dilute the family's limited resources and, ceteris paribus, lead to a lower per capita investment (Becker and Thomes, 1976). Becker and Tomes (1976) specify a simple utility function to model the effect (1),

(1) $U=(n, w, y)$

where n is the number of children, w is their 'quality' and y is the rate of consumption of other commodities. All children within the same household are assumed to be of the same 'quality' and it is often defined as educational or adult wage levels. Educational level has been used in research by Parish and Willis (1994) regarding Taiwan, Lillard and Willis (1994) regarding Malaysia, and Powell and Steelman (1989), Butcher and Case (1994), Kaestner (1997), and Hauser and Kuo (1996) use data from the United States. On the other hand, Muhuri and Preston (1991) and Das Gupta (1987) consider sibling composition and excess female mortality in South Asia and Gang and Mordutch (1998) use Becker's (1991) pure investment model to investigate whether children with relatively more sisters than brothers are healthier than their peers. Previous literature therefore supports the interpretation of 'quality' as the level of 'good health'. 'Quality', w, can be affected by the household itself by expenditures on children, q, but also depends on the inherited ability, e, that parents cannot affect (Becker and Tomes, 1976). The effect of household and endowed inputs on child quality can be illustrated as an additive function (2),

(2) $w= e + q,$

The household faces a budget constraint (3) where I is the total income, p_y is the price of y, p_q is the average cost of a unit increase in q, and $p_q nq$ is the total expenditure on children.

(3) $p_y y + p_q nq = I$

Assuming that e is exogenous and independent of q, the endowed contribution is given when determining the contribution from household investment to w. Given that p_q is fixed, the household maximizes the utility function (1) subject to the budget constraint (3) and the quality function (2) to get,

(4) $Mu_y = \lambda P_y = \lambda \pi_y$

$Mu_w = \lambda n p_q = \lambda \pi_w$

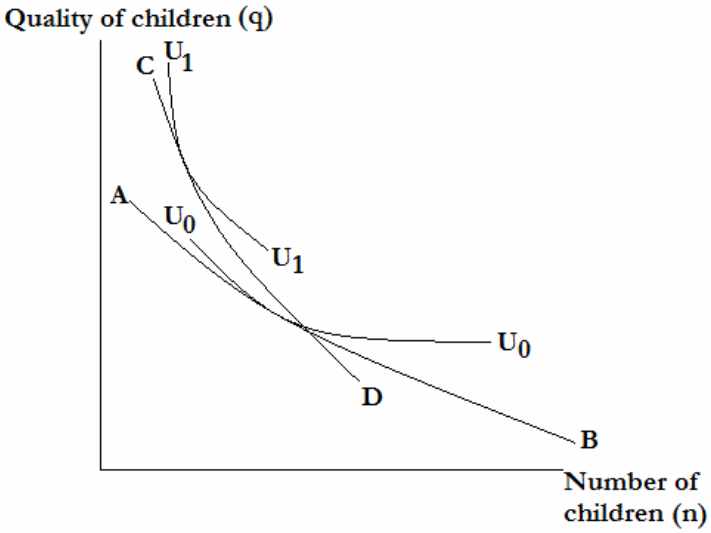
$Mu_n = \lambda q p_q = \lambda \pi_n$

Where λ is the marginal utility of income, $\pi_w = np_q$ is the shadow price of increasing 'quality', and $\pi_n = qp_q$ is the shadow price of increasing quantity (Becker and Tomes, 1976). The commodity consumption equation is obtained by substituting (3) into (2),

(5) $\pi_y y + \pi_n n + \pi_w w = I + \pi_w w = S$

where S is the household social income (Becker and Tomes, 1976). As mentioned, the key feature of the model is that the shadow price of the 'quality' of children is positively correlated with the quantity of children and that the shadow price of quantity is positively correlated with the household's own contribution of 'quality'. Becker referred to this relationship as "the interaction between 'quality' and quantity" and it exists due to the fact that an increase in the quantity of children increases the cost of increasing 'quality', since changes in 'quality' must apply to *all* children. The same reasoning applies to 'quality': an increase in 'quality' increases the cost of another child, since the cost of each child has gone up. The relationship is illustrated in Figure 1 (in Becker and Tomes, 1976).

Figure 1. The quality-quantity interaction



One of the assumptions of Becker's model is that child 'quality' is the same for all children but what happens if this is assumption is relaxed and the endowed 'quality' differs from child to child? Becker and Tomes (1976) relaxes the assumption of the same endowed quality by giving one child a greater inherited 'quality'. In a two-child family where the prices of 'quality' is pq_1 and pq_2, the parental contribution to the 'quality' is determined by the equilibrium,

(6) $(\partial U/\partial w_1) / \partial U/\partial w_2 = p_{q1}/p_{q2}$

where the amount of resources invested in child i is negatively correlated with the endowment of that child, since the parents will compensate for the differences in endowments. However, consider the case where the cost of adding 'quality' is not positively related to endowments but

negatively related. This is something that might very well be the case in developing countries, where the *perceived* endowments of sons and daughters might differ. China, a country often referred to as an emerging market due to its economic growth and potential to become a developed country, has traditionally, like many Asian countries, preference for sons. They are more helpful in farm work and provide the financial support for the parents when they become elderly. Thus, one can argue that the perceived endowed 'quality' of sons and daughters differ in developing countries (and emerging markets) compared with developed countries that the less endowed children in the developing countries might not be compensated by their parents but, rather, this effect can be reinforced by the parents themselves. Becker and Lewis (1976) indeed show that parents tend to invest more human capital in better-endowed children and more non-human capital in poorer ones, thus widening the earnings inequality.

The Quality-Quantity model is a very good generalization of how parents reason regarding family size and investment in their children. However, its weaknesses are that it assumes that parents believe that their children are of equal 'quality', irrespective of, for example, gender. It also assumes that the resources spent by parents on their children cannot be spent on themselves, which is not necessarily true. Thus, an extended Quality-Quantity model would include all the forces that affect the allocation of resources within the family to allow the different interest of the parents and the children to be considered. For this to be possible, 'quality' would have to be defined as something that resources are allocated toward throughout life.

2.2.2 The Endogeneity Problem of Family Size and the Mother's Health

Most literature that studies the effect of child quantity on child 'quality' treats family size as an exogenous variable, despite the fact that fertility is endogenous. The endogeneity of family size might explain why empirical results have both rejected and confirmed the QQ-theory (Knodel, Havanon and Sittirai, 1990). Both child quantity and 'quality' is endogenous since child bearing and investment in children are chosen by the parents and not randomly decided. Therefore, family size is affected by unobservable preferences and household characteristics. These preferences might be over the ideal family size or the ideal sex of the child. For example, poorer families might continue to have an additional child in the hope to get a son, given that the first child is a girl (Li, Zhang and Zhu, 2008). A solution to the endogeneity problem of fertility that has been used in empirical research is to use the gender of the first child or the gender composition of the first two children (Angrist, Lavy and Schlosser, 2005). This has been tested in Asian countries, due to the overt preference for sons. Another solution is to use an exogenous

chock to the family. A modern approach of using an exogenous chock is to use twins, where parents budget for one additional child but get two. The additional child that the parents did not expect allows for the analysis of the budget effect. Rozenzweig and Wolpin (1980) were the first to perform such a study. Using data from India they found that family size has a negative effect on children's educational attainment. However, their data sample is very small (25 twins out of 1.600 children). Black, Devereux and Salvanes (2005) use a large dataset from Norway and do not find this effect after controlling for birth order. Their findings question whether or not the QQ-relationship exists at all, or if a strong first-born effect has been mistaken for such a relationship. The main difference between these two studies, except from their sample size, is that while Rozenzweig and Wolpin (1980) use data from a developing country, Black, Devereux and Salvanes (2003) use data from Norway; a developed country with a good welfare state, public educational system, and government support for childbearing and childcare. The cost of having children is therefore lower in Norway. The QQ-relationship might therefore not be as easily observed in developed countries as in developing countries. To see if this is the case Li, Zhang and Zhu (2008) use Chinese data to analyze the effect of twins to isolate the effect of child quantity on child 'quality'. They use a 1% sample of the 1990 Chinese Population Census and find a negative QQ-relationship, even after controlling for birth order.

Another problem of endogeneity exists when analyzing health and fertility. One major difference between the roles of the husband and wife in a family is that the mother carries and delivers the children. There is therefore a correlation between the mother's health and family size that can work in both directions: A mother of poor health will have few children at the same time as a woman with many children will see her health depreciate with family size (Li, Zhang and Zhu, 2008). To solve the problem of endogeneity, one can use a similar approach as with fertility. One has to isolate the budget effect of parental investment in 'good health' from the biological effect by using a health variable that is similar to both women and men both before and after child birth. For example, it is not uncommon for mothers to keep some of the weight they gain during pregnancy and therefore it is not a good idea to use Body Mass Index (BMI) as an indicator of health status when looking at women or when comparing the health status of men with women.

2.3. Theories of Health Economics

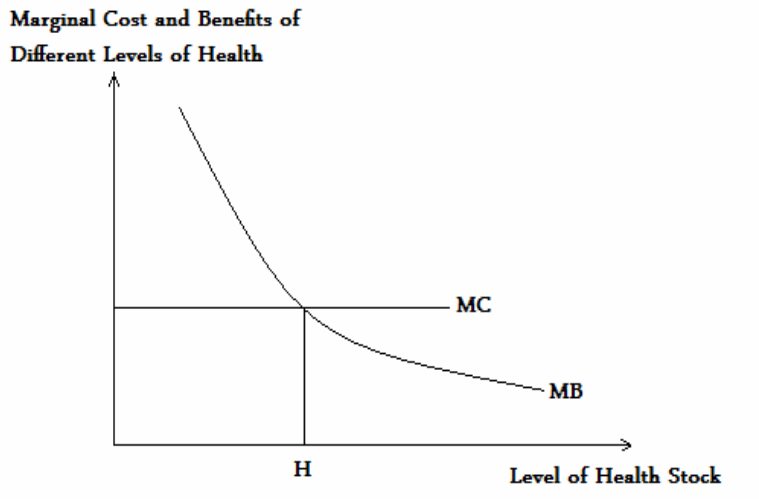
2.3.1. The Original Grossman Model of Individual Health Production

In human capital theory, investments in education and on-the-job training increases productivity in the labor market to produce earnings or in the household sector to produce commodities that enter the utility function (Grossman, 1972). This gives individuals an incentive to invest in schooling or in on-the-job training. The cost of this investment is both direct and indirect. It is direct since it includes the cost of market goods and indirect since it includes the opportunity cost of the foregone earnings that could have been made if the individual had worked instead. Grossman (1972) was one of the first economists to suggest that health can be viewed as a special form of human capital and introduced a dynamic model of demand for the commodity 'good health'. He motivated this for two reasons. The first motivation is that health differs from other forms of human capital since it affects market and nonmarket productivity as well as determines the total amount of time available for money earnings and commodity production. Thus, health is demanded as a consumption commodity (being sick enters the utility function negatively, while being healthy means alleviation from pain and anxiety, and makes people feel happier). Health is also demanded as an instrument variable or 'production benefit' since it enables an individual to be more productive in performing household and labor tasks. The most visible 'production benefit' exists in the labor market since it results in income. A person of good health looses less money due to sickness related unemployment, sick leave or a lower wages due to a chronic disability. These two types of benefits are not mutually exclusive and are produced from the same health stock (Grossman, 1972). The benefits for individuals working at home is the same as for individuals in the labor market but more difficult to measure empirically (Muurinen and Le Grand, 1985). As a result, families struggling with poverty might not perceive the benefits of good health in the home market to be as high as the benefits of good health the labor market. Since women in poorer countries tend to do most of the home market activities, it is likely that their health has a lower priority than their husbands' health.

The second motivation for a model of demand for health capital is that when consumers purchase medical services, it is not the services *per se* that they demand but the commodity 'good health'. Thus, the demand for health care is a derived demand. Additional reasons that have been presented in other papers is that a model is needed to explain the behavior related to health, for example why some people use tobacco or not, and why individuals differ in their production of health levels and their utilization of medical care (Muurinen and Le Grand, 1985). One can therefore think of an individual as weighing the benefits and costs of

different stocks of health capital when deciding on the desired capital stock and investing as long as the marginal benefit (MB) exceeds the marginal cost (MC) (Figure 2, in Jacobson, 2000). The depreciation rate and the price of health investments are assumed to be independent of the health stock, making the MC horizontal while the MB is downwards sloping due to diminishing marginal benefits (Jacobson, 2000). Thus, 'good health' has a price, since increasing the health stock results in a lost income or less production of goods at home. This price differs between individuals, which explains why individuals have different health related behavior or medical service utilization. Knowing how family size affects the production of health and thus the labor supply in the market or home market productivity can help to determine whether or not a fertility program has a positive impact on the population and economy.

Figure 2: A Diagram over how the Optimal Stock of Health is Decided



Let us now illustrate the Grossman model of health production algebraically. It is not described in mathematical detail since the idea is to get a general understanding of the model. An individual has the intertemporal utility function (7).

(7) $U = U(\phi_0 H_0, \ldots, \phi_n H_n, Z_0, \ldots, Z_n)$

where H_0 is the initial stock of health, H_i is the stock of health at time period i, ϕ is the service flow per unit stock, $h_i = \phi_i H_i$ is the total consumption of 'health services' and Z_i is the total consumption of other commodities in the i^{th} period. The assumption is that individuals inherit an initial stock of health that depreciates with time until a certain value is reached, H_{min}, at which the individual dies. The rate of depreciation increases with time but the stock of health can be increased via investments. In that sense, the individual can 'choose' their life span by making

investments, making life span an endogenous variable and not exogenous. These investments are produced by household production functions whose inputs are time and market goods such as exercise and healthy food. Other factors that are important determinants are 'environmental factors', such as education, that affect the efficiency of production. The model shows that the shadow price of health increases with age and falls with education, given that more educated people are more efficient in producing good health (Grossman, 1972). Net investment in the health stock (8) depends on the gross investment minus depreciation,

(8) $$H_{i+1} - H_i = I_i - \delta_i H_i$$

where I_i is gross investment and δ_i is the depreciation rate at time period i. δ_i is assumed to be exogenous but can vary with age. In the utility function, consumers produce gross investments in health and other commodities according to a set of household production functions (9),

(9) $$I_i = I_i(M_i, TH_i; E_i)$$

$$Z_i = Z_i(X_i, T_i; E_i)$$

where M_i is medical care, X_i is the input of goods in the production of Z_i, TH_i and T_i are time inputs, and E_i is the human capital stock. In Grossman's (1972) model, the individual determines the optimal stock of health capital by equating the marginal efficiency of the health capital to the cost, which depends on the price of gross investment. The equilibrium is determined where the demand curve for health capital intersects with the infinitely elastic health curve (Grossman, 1972).

2.3.2. The Extended Grossman Model of Family Health Production

The Grossman model of health production has had a significant impact on economic thought of human capital and the demand for health. However, it has weaknesses since it only applies to one individual when the majority of individuals live in families with more than one member. Also, it can only analyze adults' and not children's demand for health and health care and it ignores the fact that individual demand can be influenced by other family members. Empirical evidence suggests that there is a need for a different perspective. Currie and Gruber (1996) found that parents with a college education are more likely to take their children to see the doctor, and that this effect is stronger for mothers than fathers. Interestingly, they found that this effect was greater for children in smaller families. Also, families with no male head tend to have higher

utilization levels (Jacobson, 2000). To make Grossman's model more realistic, Jacobson (2000) extends it to include a two- and three-person family. A life-time perspective that includes children is needed when analyzing the factors that determine health inequalities since the decision of resource allocation towards child health, adult health, education and on-the-job training are made by the family (Wadsworth, 1996, 1997). In Jacobson's (2000) model, each family member can be said to produce their own health but also the health of other family members, using the income of all family members. An individual might investment in other family members if they have utilities that are positively correlated with their own health as well as the health of other family members. Also, increased adult (child) health decreases the time spent ill (taking care of an ill child), which means that the parents can increase their time available for market work, which increases the family income and all family members' consumption and investment possibilities (Jacobson, 2000). Income pooling and a common preference are assumed but this is not necessarily true. In a family with more than one person, one has to consider the fact that individuals have common and non-common interests.

The husband-wife family:

The utility function (excluding time subscripts) of the family is:

(10) $U=U(H^m, H^f, Z)$

U is family utility at time period t, H^m and H^f are the husband and wife's utilities and Z is a vector of commodities consumed. As with the Grossman model, investments can be made by the two individuals to offset the depreciation of their health stock according to the production functions

(11). $I^m = I^m(M^m, h^{Hm,m}, h^{Hm,f}; E^{H,m}, E^{H,f})$

$I^f = I^f(M^f, h^{Hf,m}, h^{Hf,f}; E^{H,m}, E^{H,f})$

In the production functions, M^m and M^f indicate the market goods used in the production of male and female health. Time used producing health is given by $h^{Hm,m}$, $h^{Hm,f}$, $h^{Hf,m}$ and $h^{Hf,f}$. The first superscript indicates what is produced, female health or male health, and the second superscript indicates who is the producer, the husband or wife. $E^{H,m}$ and $E^{H,f}$ indicate the husband and wife's productivity in producing health. Similar to (8) net investments of health are:

(12) $H^m_{i+1} - H^m_i = I^m_i - \delta^m_i H^m_i$

$$H^f_{i+1} - H^f_i = I^f_i - \delta^f_i H^f_i$$

The development process of family wealth (13) depends on the husband and wive's wage rates; $\omega_m(H_m, E_{w,m})$ and $\omega_f(H_f, E_{w,f})$, and their level of education and on-the-job training; $E_{w,m}$ and $E_{w,f}$, together with the time spent on market work; $h_{w,m}$ and $h_{w,f}$:

(13) $$\partial W/\partial t = rW + \omega_m(H_m, E_{w,m})h_{\omega,m} + \omega_f(H_f, E_{w,f})h_{\omega,f} + B - p(M_m, M_f) - qX$$

The total time available for each spouse (14); Ω_i, is made up by time spent on market work; $h_{w,i}$, in production of health and other commodities; $h_{Hm,i} + h_{Hf,i}$; $h_{Z,i}$, and time being sick; $h_{S,i}$. Time being sick is a function of health levels; $h_{S,i} = h_{S,i}(H_i)$.

(14) $$\Omega_i = h_{w,i} + h_{Z,i} + h_{H,m,i} + h_{Hf,i} + h_{S,i} \qquad i = m, f$$

The family faces the problem to maximize lifetime utility and the important result in the two-family model is that the husband and wife invest in health together until the rate of marginal consumption benefits equals the rate of marginal net effective cost of health capital. The result can be derived for lifetime utility of health (15):

(15) $$\lambda_W = \lambda_{Hm}/\pi_m = \pi_{Hf}/\pi_f$$

(15) means that the family members invest until the rate of marginal utility of health to the effective price of health is equal for all members, and equal to the marginal utility of wealth.

The Parents-Child Family:

Adding a child to the two-member family gives the following result. The child's health (H^c) is included in the family utility function (16),

(16) $$U = U(H^m, H^f, H^c, Z)$$

The child's health changes according to the equation:

(17) $$H^c_{i+1} - H^c_i = I^c_i - \delta^c_i H^c_i$$

Health is produced by parental time ($h_{Hc,m}$ and $h_{Hc,f}$) and market goods (M_c) in the production function,

(18) $$I^c = I^c(M^c, h^{Hc,m}, h^{Hc,f}; E^{H,m}, E^{H,f})$$

The time restriction for each parent is:

$$(19) \qquad \Omega_i = h_{w,i} + h_{Z,i} + h_{Hm,i} + h_{Hf,i} + h_{Hc,i} + h_{S,i} + h_{Sc,i} \qquad i = m, f$$

where $h_{Sc,i}$ is the time spent taking care of a sick child for parent *i*. (15) is extended to include the child and the result is that the family will invest in health until the rate of marginal utilities of health to the effective price of health for all family members is equal, and equal to marginal health (20).

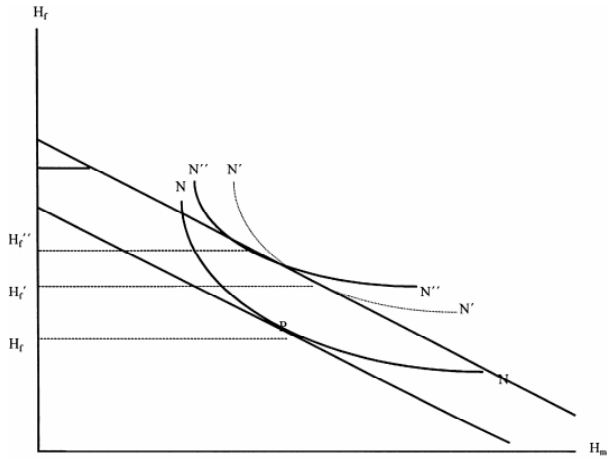
$$(20) \qquad \lambda_W = \lambda_{Hm}/\pi_m = \pi_{Hf}/\pi_{f=} = \pi_{Hc}/\pi_c$$

The important result of the model is that the family will not equalize health between all family members. Additional results of the extended model are that an increase in the rate of depreciation increases the health levels and that investment in health levels increases if the wage levels are dependent on health levels. Also, poorer families will value child health more than richer since the benefit of being healthy and capable to perform labor is greater.

Jacobson's (2000) extended models assume common preferences but what happens when this assumption is relaxed? An increase in the non-earned income of the wife shifts the production possibility curve outwards (just as in the case of common preference). However, it also changes the bargaining power of the wife, since the utility of the wife in the case of a divorce has increased. This can be shown graphically by a change in the iso-gain curve from NN to N"N" (Figure 3, from Jacobson, 2000). The result is that the increase in the wife's health is greater now than under the common preference assumption (N'N'). This increases the child's health if the mother cares more about the child than the father does or increases everybody's health if she prefers healthier goods (Jacobson, 2000). Using this line of reasoning, let us now assume that an additional child is born into the family or that the family decides to increase the 'quality' of all children. Put simply, this can be observed as an additional cost to the family, and therefore as a fall in the disposable income of the parents. If we have a bargaining model and the benefit of good health in home production is not be as clearly observed by the parents as the income brought home by the father, then the mother's iso-gain curve shifts in the opposite direction compared to before. The result is that the mother experiences a greater fall in health levels than the father due to an increase in child quantity or child 'quality'. In other words, she is not able to allocate the same amount of resources towards her own health as before. The degree to which this effect also applies to the father depends on the two individual's bargaining power

and the next part in our theoretical discussion therefore explains the alternative theories of marriage allocation.

Figure 3: The effect of a wage increase on the wife's health production



2.4. Theoretical Models of Marriage Allocation

2.4.1. The Common Preference Model and Income Pooling Assumption

Samuelson's (1956) consensus model and Becker's (1974, 1981) altruist model are the two dominating CPMs. Samuelson's model uses a two-member family, the husband and the wife. They have separate utility functions that depend on their private consumption of *m* goods (21).

(21) *Husband's utility:* $U^h(x_1^h, \ldots, x_m^h)$

Wife's utility, $U^w(x_1^w, \ldots, x_m^w)$

Despite the fact that the family members have separate utility functions, they decide to maximize a consensus welfare function, $W[U^h, U^w]$. The family therefore act as a single individual that maximizes the utility function $U(x_1,\ldots, x_m)$ subject to the budget constraint (22). The budget constraint is made up by the pooled income earned separately by the individuals.

(22) $\Sigma^m{}_{i=j}\, p_j x_j = I = I^h + I^w$

For the family to act as one agent either *a)* all members of the household must have the same preferences or *b)* one family member makes all the decisions. The latter is often referred to as the dictator-model. For the analysis in this thesis, it does not matter whether *a)* or *b)* is true since in both cases the household acts as if it pools all unearned income. As a result, the demand function does not depend on the components but the total household income (Tomas, 1990). Thus, in the

event of a change in nonwage income, it does not matter which family member that is subject to the change since the household demand will be affected in the same way under the control of different household members. This is the key assumption of the consensus model and it can be tested against alternative models (Thomas, 1990).

Samuelson's model is simple but it neither explains how the joint welfare function is achieved nor how it is maintained. Becker's altruist model (1981) was developed to address these two remaining questions and to account for how resources are allocated within the family. In the model (23), the household consists of rational and purely selfish 'kids' and one altruistic parent, h, whose utility depends on the utility of other members (Becker, 1991).

$$(23) \qquad U_h = U[Z_{1h}, \ldots, Z_{mh}, \psi_1(Z_{11}, \ldots, Z_{m1}), \ldots, \psi_p (Z_{1p}, \ldots, Z_{mp})]$$

In the model, Z_{ij} is the consumption of commodity i by the j^{th} family member, for $i=h, 1, \ldots, p$, and ψ_k increases with the utility of the selfish beneficiary. The altruist therefore increases its own utility by increasing the utility of the other family members. The altruistic parent's budget equation is,

$$(24) \qquad I_h = \Sigma \pi_i Z_{ih} + \Sigma^{p}_{k=1} y_k$$

Where π_i is the price of the i^{th} commodity and y_k is the money allocated towards the k^{th} beneficiary. Substituting y_k from the budget equation of k, the altruist's family income is,

$$(25) \qquad \Sigma^{m}_{i=1} \pi_i Z_{ih} + \Sigma^{p}_{k=1} \Sigma^{m}_{i=1} = I_h$$

Becker's altruist model (1981) guarantees that all beneficiaries voluntary maximizes family income and the utility of the altruist, even if he is not a dictator. This is because their utilities are positively correlated with his.

The CPMs are easy to understand and the assumption of unitary preferences, given that it is true, makes it easy for economists to perform empirical studies of consumption behavior and labor supply. CPMs also ensure Pareto optimality since they assume that the family social welfare function is an increasing function of the utilities of all family members. Therefore, no family member can be made better off without making another family member worse off (Lundberg and Pollak, 1996). However, the CPMs started to become criticized when economists began to analyze marriage and divorce models. These require that agents can compare their expected utilities within the marriage with their expected utilities outside marriage. The models therefore needed the individual utility functions rather than the consensus social welfare function,

making the CPM inapplicable. The problem of CPMs is supported by recent empirical work that tends to reject the income pooling assumption and suggest that it does matter who earns the income in the family. This observation has been made when considering both earned and unearned income. For example, it has been shown that mothers invest more in their children's health than fathers do and that parents tend to favor children of the same gender as themselves (Duncan, 1994). One can interpret the former finding as that the mother tends to be more altruistic than the father and the latter finding might be due to the fact that sons tend to help their father in their work, whereas daughters aid their mother. The utility of the parent can therefore be more positively correlated with the utility of a child of the same gender. Therefore, household allocation can depend on the decision-power that each parent has and the sex-composition of the children. In the light of recent empirical evidence, it therefore appears naïve to assume that families pool their income and that their preferences over the allocation of resources are identical. The next theories that we consider, the bargaining models, were developed as alternative models to the CPMs.

2.4.2. The Bargaining Models

The bargaining models were developed to see what happens when the assumption of income pooling is relaxed and it is recognized that a household with two or more individuals contain as many different preferences of family consumption. The literature that examines the family interaction can be categorized into two strands of economic models: *non-cooperative* and *cooperative bargaining models*. In the non-cooperative model, each individual maximizes their utility while taking the behavior of others as given, while in the latter model there is a need for a mechanism of contract enforcement to ensure that the partners move to the bargaining solution. Most models of game theories used in marriage allocation use cooperative bargaining models and the most famous one is the Nash bargaining solution. The assumption is that the players can communicate freely with each other and make easily enforced and costless agreements. The cooperative bargaining models are similar to the unitary models in the sense that they imply Pareto optimality (Lundberg and Pollak, 1994). Chen and Wooley (2001) argue that family decision should be viewed as an outcome of a cooperative bargaining process since family formation is a long term commitment.

Non-cooperative games allow for more flexibility in the rules of the game and have fewer *a priori* restrictions on the nature of the equilibrium outcomes (Lundberg and Pollak, 1994). The leading solution of non-cooperative behavior is a Nash solution, where each player chooses

his or her 'best response' to the other player's strategy. Unlike the CPM and non-cooperative models, the outcome of the model is not necessarily Pareto optimal and can be affected by history and culture as well as who controls the resources. The models describing the bargaining process have the important feature that the allocation reached in equilibrium depends on what happens in the event of disagreement. This is often referred to as the 'threat point', 'disagreement point' or the 'status quo', and can be determined by various factors. McElvoy and Horney (1981) and Manser and Brown (1980) use divorce-threat models where the distribution within marriage gives the solution to the cooperative game. For example, when partners divorce and are allowed to keep their separate income earned while married, the bargaining points depend on the income received by the wife and husband. On the other hand, Lundberg and Pollak (1993), Hadad and Kanbur (1994) and Konrad and Lommerud (2000) use non-cooperative behavior. To analyze the effect of redistribution between the husband and wife, Lunberg and Pollak (1993) consider two child-allowance schemes: one where the father receives the government cash transfer and one where the mother receives it. Assuming that the mother gets custody and the child allowance in the event of a divorce, the result is that there are identical distributions within marriage in both the altruist model and the divorce-threat bargaining model. In the altruist model, the equilibrium is independent of who receives the child allowance and as a result, targeted governmental policies are predicted to be ineffective. In the divorce-threat bargaining model, the equilibrium depends on the consumption set and the treat point corresponding to the utility in the event of a divorce (Lundberg and Pollak, 1994). Child benefits in the UK and Canada are received by the mothers since it has been shown that the effect of these transfers are different depending on the recipient. This adds empirical evidence against the CPM (Konrad and Lommerud, 2000).

The models can be illustrated as follows. There are two members in the family; the husband (m) and the wife (w). The resource allocation within the family is determined by a two-stage process. First, the spouses decide on the transfers between the two of them. This can either be done via a bargaining process or voluntary. Second, each family member decides on their consumption, which depends on the transfer received. The utilities (U^w, U^h) depend on the consumption of private goods. In the event of a disagreement, the threat points (T^h, T^w) make the solution. As a result, the higher the utility one receives at the threat point, the higher the utility one receives in agreement. The Nash bargaining solution therefore implies that not only does family demand depend on prices and total family income but also on the threat points. The solution to the problem occurs where the product of the gains to cooperation is maximized (26),

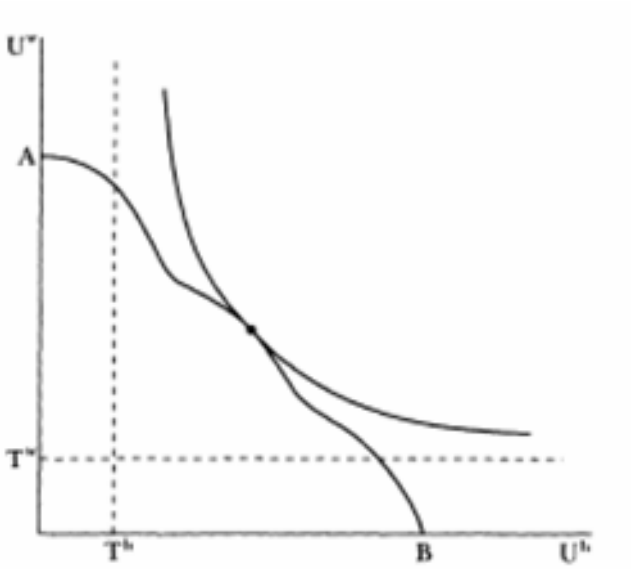
subject to the constraint that the family's total income must equal total expenditure (27) (Lundberg and Pollak, 1993).

(26) $N = (U^h - T^h)(U^w - T^w)$

(27) $px = I^h + I^w$

The solution to the game is illustrated graphically in Figure 4 (in Lundberg and Pollak, 1993). One should note that the day-to-day marital bargaining that occur in a non-cooperative marriage might be a more likely threat than the divorce-threat (Lundberg and Pollak, 1993). These 'separate spheres' bargaining models are 'internal' to the marriage, rather than 'external', and the solution is the cooperative bargaining solution where a household public good is provided by voluntary contributions. These solutions are more likely to occur in societies that are very traditional and have well defined gender roles, such as developing countries (Lundberg and Pollak, 1994).

Figure 4: The Nash-Bargaining Solution



Questions that are often analyzed by using a game theoretic approach to household allocation are the effect of the control over resources by the husband or wife on the wellbeing of their children, as well as the effect of social norms and the relationship between the marital distribution and the marriage market (Lundberg and Pollak, 1996). However, few if any, have considered the effect of children on their parents. Studies have shown that children benefit from having a mother in control of the resources, but few have concluded how resource allocation towards the parents is

affected by changes in the income distribution, threat-points and family size. Might it be the case that the society and culture in developing countries puts fathers in such strong bargaining positions that the income dilution effect of an additional child does not affect him at all, or to a less degree compared to the mother.

2.4.3. The Nash-Bargaining Models and Family Production of Health

Although Jacobson (2000) contributed to the household production of health by using the family, instead of the individual, as the producer, she produced a family utility function using the common preference assumption. Bolin, Jacobson and Lindgren (2001) combine the Grossman model with household allocation theories of conflicting preferences within a family. They use the Nash bargaining household allocation model to analyze the effect of income and family structure on health production and they develop a dynamic model where the spouses bargain for the allocation of the resources within the family. The model is important in our analysis because it takes into consideration the fact that the mother and father can have different interests when it comes to parental investment. One of the key points in their model is that the labor market opportunities determine the threat points of the spouses. The model does not consider the effect of conflicting interests between parents and children.

The Nash-Bargaining model:

The family consist of a husband, h, wife, w, and a child, c. Utility for each spouse, i, is derived from the stock of health capital, H^i_t, and the other spouse's health stock, H^j_t, and child health, H^c_t, and from a consumption of commodity, Z_t (28). The child does not have a utility function.

(28) $U(U^h_t, H^w_t, H^c_t, Z^h_t, Z^c_t)$

$U(U^w_t, H^h_t, H^c_t, Z^w_t, Z^c_t)$

Before continuing with the model presented by Bolin et al (2001) it is useful to note one thing. This thesis uses theory and empirical results to argue that children's gender might affect parent's health production. As a result, it might be a good idea to distinguish between the female and male children in the utility functions. In China, it might be that the utility from a son's health capital is greater than the utility from the daughter's health capital, whereas in other developing countries where there is no fertility limit, the mothers get a higher utility from their daughters and the fathers get a higher utility from their sons. As already noted, empirical results argue that it is very

important to analyze the dynamics of the family when analyzing child health and that culture and society might influence the results greatly.

Returning to Bolin el al's (2001) model, the investment over time for the each individual in the family is the same as (8). The marginal cost of gross investment in health and the consumption commodity is constant and the sum of the family's return on financial capital, income, cost of investment in health capital and the cost of the consumption commodity must be the same as the growth rate of the stock of financial capital. The marginal (average) cost of the consumption commodity, p_t^Z, and the marginal (average) cost of gross investment in health, p_t^I, and earned income, y_t, follow an asset accumulation constraint (29) (Bolin et al, 2001).

$$(29) \qquad W^*_t = rW_t + y_t^h(H_t^h, H_t^c) + y_t^w(H_t^w, H_t^c) - p_t^I(I_t^h + I_t^w + I_t^c) - P_t^Z(Z_t^h + Z_t^w + Z_t^c)$$

Where W is the total asset and r is the rate of interest. The market income (30) is a function of health, while sick time, $\tau_t^s(H_t^i)$ and nursing time, $\tau_t^{s,c,i}$, are functions of own health and child health. Given that: ω_t is the wage rate, Ω is the total time available, $\tau_t^{Z,I}$ is the time allocated to producing the consumption commodity, $\tau_t^{I,I}$ is the time allocated to investing in the production of health capital and $\tau_t^{M,i}$ is the time allocated to the labor market, Bolin et al (2001) present the following equation (30)

$$(30) \qquad Y_t^i = \omega_t(\Omega - \tau_t^s(H_t^i) - \tau_t^{s,c,i}(H_t^c) - \tau_t^{I,i} - \tau_t^{Z,i}) = \omega_t\tau_t^{M,i} \qquad i = h, w$$

From the equation one can see that an increase in health leads to an increase in the time available for labor work. One important feature is that the time available for market work in the future depends on health investments that take place today. The family must therefore decide on how to invest in their health capital and consumption commodity to maximize their lifetime utility. This decision process takes place in a Nash-bargaining framework, where the threat points depend on the expected maximum utility that each spouse can get in the event of a divorce. The framework is similar to (26) and the solution occurs where each spouse's additional utility from being married compared to divorce is maximized (31).

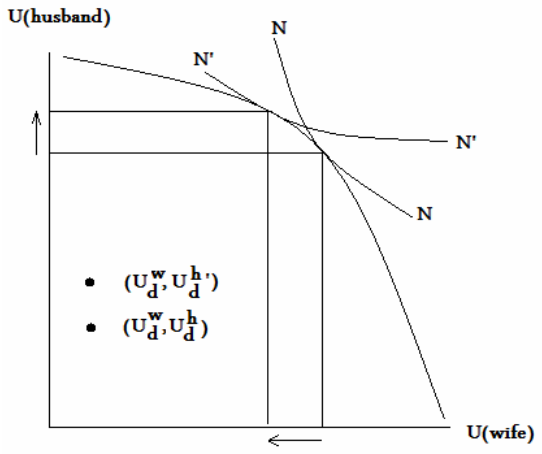
$$(31) \qquad \textit{Husband:} \quad V^h = U(H_t^h, H_t^w, H_t^c, Z_t^h, Z_t^c) - U_d^h(H_t^h, 0, H_t^c, Z_t^{hd}, Z_t^{cd})$$

$$\textit{Wife:} \qquad V^w = U(H_t^w, H_t^h, H_t^c, Z_t^w, Z_t^c) - U_d^w(H_t^w, 0, H_t^c, Z_t^{wd}, Z_t^{cd})$$

The result of the model depends on the threat points, which may develop over time to reflect changes in opportunities as a result from investments in human capital, due to depreciation,

changes in labor market opportunities etcetera. A change in the treat points is illustrated in graph 5. The change twists the level curve from NN to N'N', which increases the utility for the husband and decreases it for the wife (Figure 5, in Bolin et al, 2001).

Figure 5: The result of a change in the threat points



Bolin, et al's (2001) model allows for the opportunities outside marriage to play a role in the allocation of health and consumption inside the marriage. In that sense, they successfully merge economic theories of household allocation and family health production together. If the family specializes as Becker (1981) suggests, then the father will typical invest in market-related human capital, whereas the mother will invest in household related capital. Although their work should be valued equally, this most likely increases the utility of the husband in the event of a divorce and increases his bargaining power. A higher wage has the same effect, it leads to more investment in the husband's health and less in the wife' health (Bolin et al. 2001).

Summary:

Economists have developed different models of how parents reason when they invest in child 'quality' and quantity, how parents allocate resources between themselves and what affects individual and family demand for health. However, little focus has been put on the interaction between family size and parental investment in their own 'quality', as well as how this is decided. Facing a budget constraint, the allocation of health production within a family is ambiguous because each party in the family has both common and different interests. Complete or partial altruism by parents, gender bias etcetera are important factors that determine the outcome. This paper has shown, by combining theories of family and health

economics, how one can develop a question and theory of how fertility affects parental 'quality' investment, and how this depends on bargaining positions within the family. This is an important question in developing countries where fertility is high, gender inequality is large and where high labor productivity and good health is important since well developed welfare systems are rare. If household allocation takes place after a bargaining model setting, a QQ-relationship that includes parents suggests that women in developing countries are more disadvantaged by family size on investment in themselves than the men are. If this effect is found, there are grounds to believe that fertility policies increase the labor force participation of women and their wages. This in turn increases their bargaining power and enables them to increase their health investments, thus lessen the negative effect of family size on the mother's 'quality'. The next part of this paper uses a dataset from a Indonesia to perform a proper empirical investigation to answer the research questions in this thesis.

3. Empirical analysis

In this third part of the thesis the choice and source of data is discussed. Arguments are made regarding the choice of the dependent and independent variables and the empirical analysis is made to answer the research questions stated in the beginning.

3.1 Structure and Source of Data

The empirical analysis in this thesis is based on the 2000 Indonesia Family Life Survey (IFLS), a continuing longitudinal socioeconomic and health survey. It is very difficult to get high quality data in developing countries, since high costs and organization problems make it difficult for these countries to gather and update a good data set. Therefore, a dataset that has been collected by an American non-profit organization was chosen. The survey was developed by the *Lembaga Demografi* (LD) of the University of Indonesia and the RAND Corporation. It has data regarding fertility, health, education, migration, and employment at individual and family level. The IFLS is a nationally representative survey covering 7.224 households across 13 provinces on the islands on the islands of Java, Sumatra, Bali, West Nusa Tenggara, Kalimantan, and Sulawesi (covering a total of 83% of Indonesia) (Figure 6, from Strauss el al, 2004). The survey defines a household by the standard definition: It is a group of people whose members live in the same dwelling and share food from the same cooking pot. The data has 3.436 households living in urban areas and 3.788 households living in rural areas (Strauss et al 2004).

The IFLS is not the only survey that has been made in Indonesia and its purpose is to complement and extend previous studies by collecting information regarding many different areas. The benefit of this is that researchers within different fields of work can use the same data and perform analysis on interrelated issues. The data also allows for time series analysis of government programs, household decisions and intergenerational relations. The IFLS was chosen due to its detailed data on adult respondents on education, health status, fertility as well as the characteristics of the children. It is therefore possible to capture the complex interaction between the members of the family and the surrounding conditions that affect family behavior developing countries.

3.2. Indonesia at a Glance

Figure 6: Map of Indonesia

Indonesia is a very interesting country to analyze. With its 181 million inhabitants (in 1990) Indonesia is the fourth most populous country in the world (Strauss et al, 2004). Is very heterogeneous in its demographic, economic and health outcomes, and the islands have varied culture, geography, environment and diversity. There are circa 300 ethnolinguistic groups across the 27 provinces and this is reflected by Indonesia's motto 'Unity in Diversity'. As a result, the several government development policies and demographic and economic shocks that have affected the country have done so with regional and temporal differences in economic growth and development of educational systems and health services. Looking at family size, total fertility rates (TFR) have fallen from 5.6 in the 1970s to 3.0 in 1990, but there are still large variations

across regions. Nonetheless, Indonesia has the lowest TFR amongst low income countries, with the exception of Sri Lanka (2.5) and China (2.4). This change has been accompanied by an increase in the use of contraception methods (Strauss et al, 2004). This means that the endogeneity effect of family size is likely to be stronger in Indonesia than in other developing countries since families in Indonesia to a greater extent 'choose' their family size now than before, but it also makes it easier to compare the correlation of small and large families on health.

In the 70s, Indonesia's annual growth rates were 8%. This was mainly due to the increase in economic activity as a result from the oil crisis in 1973 and 1979 where the Organization of the Petroleum Exporting Countries (OPEC), which includes Indonesia, quadrupled its price of crude oil. The increase in growth rates allowed Indonesia to increase its investments in their educational system and the medical services. Since 1954, there is now six years universal primary education and enrollment rates in secondary schools are now more than 90%. The gender ratio is almost 50:50 at primary and secondary levels. As the number of primary schools has increased, the focus has changed towards increasing the quality of the primary educational system and to increase the number of secondary schools. In the 1970s, the National Family Planning Coordinating Board (BKKBN) introduced the availability of family planning services by building clinics and community distribution posts (Strauss et al, 2004).

In the 1990s, Indonesia's economic growth began to change due to the economic crisis that hit Asia. The Rupiah collapsed in 1991 and the gross domestic product (GDP) fell by circa 13%, followed by a 0% increase in 1999 and a 4.9% in 2000. As with the economic growth that Indonesia had just had, the decline in growth levels affected the regions differently. The changes have been captured by the IFLS due to the massive amount of information gathered in the survey (Strauss et al 2004).

3.3. Choosing an Appropriate Health Indicator

A health indicator can be either a direct (proximal) or indirect (distal) measure of health (Larson and Mercer, 2004). Examples of direct measures of health are diseases, deaths, and the use of medical services and examples of indirect measures of health are education and poverty indicators. Most developing countries use morbidity and/or mortality, while developed countries use indicators that reflect behavior, such as smoking and alcohol usage. Developing countries face an additional problem in that the data might not be representative of the nation as a whole. Access to medical services might be limited to urban, wealthy and educated people, whereas the poorer and rural population might have access to local doctors that are closer to medicine men

than educated doctors. Thus, a result might not be applicable to the whole nation (Larson and Mercer, 2004). According to the Canadian Medical Association a good indicator is one that (Larson and Mercer, 2004):

1. *Is easily defined:* It must be universally understood what the indicator stands for, measures and does not measure.
2. *Has validity*: The indicator should measure what it is supposed to measure, be consistent and easy to interpret.
3. *Is feasible*: For the indicator to be used, it must be possible to collect its data without financial or technological obstacles.
4. *Has utility*: the result of the indicator should matter when it comes to decision-makers at the local, national and international level.

Finding an indicator that fulfills all of these criteria is very difficult. Additionally, it is important that the variable can capture the effect of changes through time. The health of people around the world has changed the last 20 years, with the death amongst children under the age of five having decreased by 50% the last 40 years. However, in most Sub-Saharan Africa and South Asia, mortality reductions have slowed down or even increased the last couple of years. In terms of diseases, HIV/AIDS and tuberculosis have become a global health problems, and chronic diseases (coronary artery disease etcetera) that have been more prevalent in developed countries have become more frequent in developing countries. Naturally, health indicators should reflect this development (Larson and Mercer, 2004).

3.4. The Variables

The main framework to examine the correlation of family size and parental health level is to begin with a small original equation, extend it and check for robustness by looking at t- and F-values, as well as performing diagnostic tests. There are many factors that can be thought to correlate to health outcomes; income levels, health service inputs, biological factors, education, water supply, and the structure of the health services. Many of these factors have been found to be correlated to health in empirical studies, but unfortunately, most of them are also correlated with each other. This give reason to doubt some of the significant results found earlier. For simplicity, one can assume that they are all independent and run the regression anyway but it might be difficult to argue in favor of this. (Gutema, 2005).

3.4.1. The Dependent Variable

The dependent variable that was chosen to indicate health is blood pressure (systolic value). The main problem in developed countries has for a long time been chronic diseases such as heart disease and stroke. On the other hand, the major diseases in developing countries have traditionally been those caused by malnutrition, poor sanitation and infection. However, the recent development is the movement towards both infectious and chronic diseases in developing countries due to the increase of alcohol consumption, smoking, obesity and low fruit and vegetable intake. Additionally, there has been a large increase in high blood pressure (hypertension) and high cholesterol. In 1990, 5.8% of deaths worldwide were due to high blood pressure and this percentage increased to 7.2% in 2000 (Reid and Thrift, 2005). Today, 80% of the deaths attributable to high blood pressure occur in developing countries, including Eastern Europe and Asia (Preidt, 2008). Thus, hypertension has gone from being a problem of the West, to a global problem.

Blood pressure is a good indicator since it is easily defined and has validity: it measures the pressure in the arteries, the vessels that carry the blood from the heart to the tissues and organs of the body. It is also feasible to collect data for: a qualified nurse measures the systolic (the pressure when the heart contracts) and diastolic (the pressure when the heart relaxes) value. Normal blood pressure lies below 120/80 millimeters of mercury and blood pressure above 140/90 millimeters of mercury is considered as high. A high systolic value is considered as representing a higher risk for the individual than a high diastolic value (Preidt, 2008) and therefore the systolic value was chosen as the dependent variable. Since blood pressure is a global issue it also has validity, thereby fulfilling the criteria needed for a good health indicator. However, it should be noted that, like BMI, blood pressure has a bandwidth within which a range of ideal values lie. If one has a blood pressure above or below this, ones blood pressure is not good. Therefore one can critique the treatment of blood pressure as a continuous dependent variable instead of a binary variable in this thesis. However, since the problem that has emerged in developing countries is the increasing prevalence of high blood pressure and not low, it was decided that the possibility to interpret the effect of family size on health levels by the size of the coefficient and significance of the variable was a good approach.

There are two types of high blood pressure. One is essential (primary), which occurs without a medical cause to explain it. The other, secondary hypertension is the result of another condition such as kidney disease or tumors. High blood pressure can result in strokes, heart attacks, heart failure and arterial aneurysm as well as chronic renal failure. It is therefore

associated with a fall in life expectancy. The problem with using blood pressure as a measure of health is that individuals often do not know that they have high blood pressure until they suffer from one of the diseases associated with it. However, since the survey that is used is a longitudinal collection of data, previous measurements of blood pressure in earlier surveys would have made individuals aware of their health problems. Therefore, one can expect that the individuals have continuous knowledge of their health status and therefore can make an informed choice of health investment. The sample used does not include pregnant women, people of a very old age or of very poor health due to for example cancer.

The survey provides an alternative health indicator, a self-assessment of health on a scale from 1-4, but this was not chosen. This is because the answer is based on the individuals own self-assessment of health, which is often used in empirical research (Smith, 1999, Kennedy et. al., 1998; Deaton and Paxon, 1998). Mossey and Shapiro (1982) found that elderly Canadians were better predictors of 7-year survival rate than their medical records and/or the self-reports of medical conditions. This result was also found in other empirical work conducted on adults in California (Kaplan and Camacho, 1983), Lithuania (Apples et al., 1996), Finland (Miilunpalo et al, 1997), and Sweden (Sundquist and Johansson, 1997); Austria (McCallum et al. 1994), and New Haven (Schoenfeld et al., 1994). However, the assessment is subjective since different people have different tolerance levels when it comes to pain or agony and might therefore over/underestimate their health status. Additionally, since education affects people's awareness of diseases uneducated people might not know about their health problems, or do not regard them as problematic. A related issue is the effect of income on health awareness. Individuals with high income are able to go for medical consultations which can lead to early discoveries of health related issues. On the other hand, the doctors might use their knowledge and status to influence the behavior of the patients; this is called 'supplier induced demand'. In conclusion, the perception of the health status might be very different from what the actual health status is. Indeed, in a paper by Crossley and Kennedy (2000) it was found that by getting respondents to answer a standard assessed heath question twice – before and after having asked additional health related questions – 28% of the respondents change their reported health status. They find that response instability is correlated to age, income and occupation and that the results depend on whether the survey is verbal or written and the sequence of the questions, given that there are many health related questions. Their result also suggests that there are there might be measurement error or uncertainty in individual self assessment of health. It was therefore decided that self-assessed health was inferior to blood pressure as a health indicator.

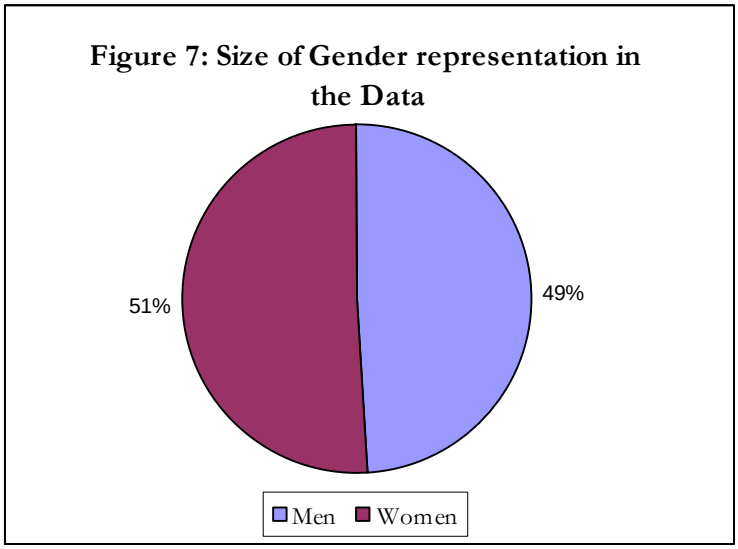
3.4.2. The Independent Variables

Age

The Grossman model predicts that age is an important factor when determining health and allows for the depreciation rate of health capital to vary with it. For example, the rate of depreciation can decrease with age in the beginning of life, or be non-monotonic (increases in some periods and increases in others). However, the correlation between age and the depreciation rate of health is assumed to be positive after some point in life (Grossman, 1972). Since we are interested in adults in this research, we therefore expect that health decreases with age until H_{min} is reached and the individual dies but we do not know if it does so in a linear or non-linear way. Therefore, both *Age* and Age^2 is included in the econometric model.

Sex

Since one of the hypotheses in this essay is that the effect of family size on health production will differ between the genders due to the different bargaining powers between the sexes or due to traditional gender roles and culture, this is an important variable to have. The depreciation rate between women and men might also differ, which raises the question of whether or not the regressions should be run separately for the genders. In our data, the default is male and the dummy variable *Sex* takes the value of 1 if the individual is a female. 49% in the sample are men and 51% are female (Figure 7). None of the females in the dataset were pregnant at the time of which the data on their health status was collected. This is good because pregnant women can develop preeclampsia, a status of high blood pressure caused by the pregnancy itself. Pregnancy induced hypertension generally dissipates after the children are delivered and removing the pregnant women from the data sample thus allows us to compare the results of men with women.

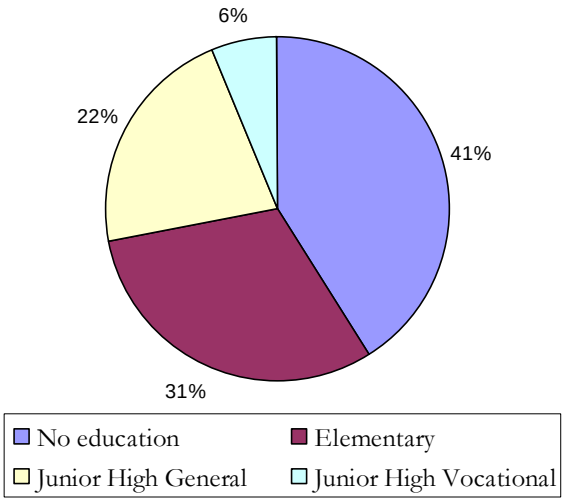


Education

The effect of education will be captured by the variable *Edu* that stands for the highest level completed at school. Education is expected to have a positive correlation with health. Wolfe and Behrman (1981) argue that education can be considered as a catalyst that increases the efficiency of other inputs. Grossman (1972) and others argued that it influences other decisions such as the choice to avoid unhealthy habits, the efficient use of medical care, knowledge of diseases and hygiene, and the choice of a job; factors that are thought to increase individuals' quality of life. This relationship has been found empirically (Grossman, 2004; Berger and Leigh, 1989; Rosen and Taubman, 1982). Education also increases the earning power of the individual and enables him to spend more income on medical services and healthy food.

As many empirical results have shown, education is a good predictor of income levels and it is one of the determinants of earnings power in human capital theory. Being able to go to a doctor might lead to discoveries of earlier unknown health problems. However, it can also lead to supplier induced demand. Thus, the effect of income can work in both directions. As a result of the correlation between education and income, and the fact that the effect of income can work in both directions, only education is included in the model. When looking at the educational levels of the adults, the difference between the elderly and the young generation becomes apparent. Although the questionnaire has alternatives up to doctorate level at university, the highest educational level attained by the adults is Junior High Vocational. Since education levels are quite low, the effect of education might not be visible. Therefore it would be interesting to perform a study on the younger generation which, generally, has a higher educational level to test this relationship. The distribution of educational levels is given in Figure 8.

Figure 8: Educational level



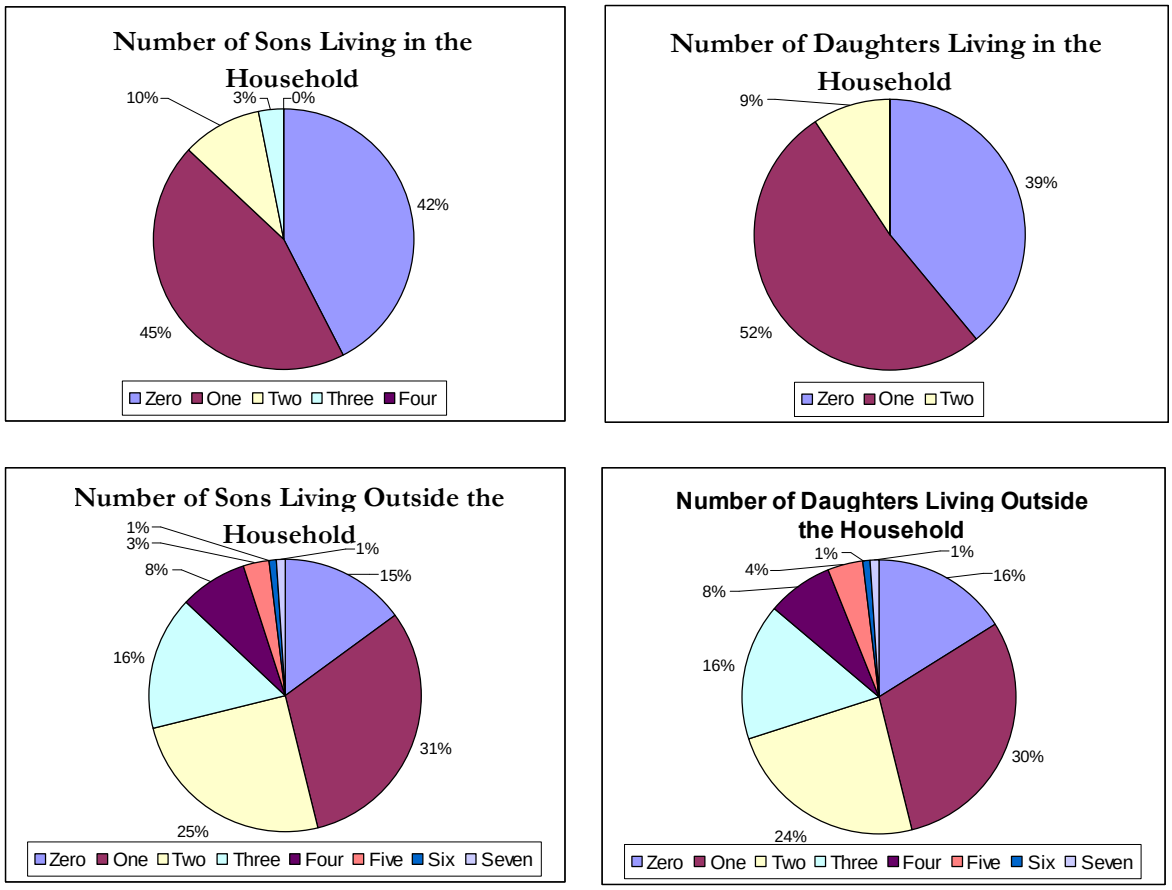
Occupation

People working in different occupations receive different wages. Therefore the dummies for occupation try to capture the income effect without the problem of correlation with education. Also, some occupations are more hazardous, such as mining and agricultural work, which can affect health negatively. The dummy categories for occupation that are included are *Agriculture, Retail*, *Finance* and the default is *Others*.

Family structure

Due to the complex nature of the survey, there are many variables regarding the structure of the family, including the number of sons/daughters that live in the household or away. Since the parents are subject to the cost of children mainly when they live at home, it is important to differentiate between whether or not the children live in the household. For example, daughters in developing countries tend to marry and help the husband to provide for his parents. On the other hand, sons tend to provide for their parents even when they live away from home. As a result, the impact of children on their parents' resources might differ between their genders and depend on if they live at home or away from the household (Figure 9). The variables only consider the living children and not those which are no longer alive.

Figure 9: The number of daughters and sons living at home or away from home



Regarding the birth order effect

There is no consensus on the effect of birth order on adult wage levels, and a study on the impact of first born children compared to latter born children on their parents was not found during the background research of this paper. First-born children naturally have less competition of the attention and resources of their parents. On the other hand, first born children arrive at the beginning of the parent's potential careers, while later born children arrive when parents are closer to the peak of their career and earnings profile (Behrman and Taubman, 1986). Therefore, the effect of family size on the parents might differ between the first child and the fourth, but the effect is likely to be the same for all parents. The effect of family size might thus be non-linear and the empirical part of this essay tests this but without considering the sex-composition of the children.

3.5. Linear and Non-linear Specification of Family Size

The first equation is conditioned on age, gender and family size.

(32) $$Blood\ pressure = a_i + \beta_{i1} Age + \beta_{i2} Age^2 + \beta_{i3} Sex + \beta_{i4} FamilySize + \varepsilon_i$$

The results are given in Appendix A. Let us start with *Age* and Age^2 which Grossman's model predicted to be negatively correlated with health (which in our data means that it is positively correlated with blood pressure). In the results, only Age^2 is significant, at the 1% significance level, suggesting that the effect of age on blood pressure is non-linear. The coefficient of age^2 is positive which was expected. The results are in line with theories of medicine: Blood pressure tends to increase with age and occurs more often in people above the age of 35 (Cuncha, date unknown). The coefficient is however, not very large. The gender coefficient is much larger (-3.5) and significant. The result suggests that women have a lower blood pressure than men. In reality, women traditionally do have lower blood pressure until menopause, where the trend reverses and women tend to have higher blood pressure than men (Pruthi, 2008). Since our data only have records on women up until the age of 55, the results match expectations made from medical results (Cuncha, date unknown).

The equation is extended by adding education and occupational status, one by one in two separate equations (Appendix A). Surprisingly, education does not enter significantly in either of the regressions. Following Grossman's (1972) reasoning, education is thought to increase awareness of health problems. However, one should remember that none of the interviewed people had an educational level beyond Junior High Vocational. This means that education on health might be passed on from the parents to the children or by someone else in the community, who often do not have a good understanding of health and medicine themselves. The effect of education might be more visible in developed countries or in a generation with more highly educated people, which allows for a better comparison with lower educated people's health status. The result of the occupational dummies is that working in the retail sector significantly decreases blood pressure with 3.8 points compared to working in the 'others' sector. The other occupational dummies do not enter significantly. The variable that is of interest, *FamilySize,* is not significant in any of the equations and its t-value ranges between 1.2 and 1.3. Therefore, the first results suggest that there is not a general effect of the number of children on both parents health. The *p-value* of the *F-statistics* (testing the null hypothesis that all coefficients are jointly equal to zero against the alternative hypothesis that they are not jointly equal to zero) is

null in all three equations, meaning that the H_0 is rejected and H_1 is accepted. The model passes White's Heteroscedasticity test at the 1% significance level.

To test whether or not the effect of family size on blood pressure differs between the mother and father, the regressions are made separately for men and women (Appendix B and C). For men, *FamilySize* is insignificant whereas for women, the variable is significant in the final extended equation. The model passes White's Heteroscedasticity test but does not pass Ramsey's Reset test where the null hypothesis that all regression coefficients of the non-linear terms are equal to zero is rejected. Therefore, there is an indication that the *SiblingSize* variable is misspecified.

Björklund and Jäntti (1995) ran regressions where they used a dummy variable to capture the effect on adult success of children from coming from a small family compared to being from a large family. They found that children with no, one or two siblings have 21% higher income levels than those from larger families. To test whether or not the relationship of family size and parental health is non-linear, another variable is introduced; *Large*, which is a dummy variable that takes the value 1 if the number of children is larger than 4 (33)

(33) $$Blood\ pressure = a_i + \beta_{i1}Age + \beta_{i2}Age^2 + \beta_{i3}Sex + \beta_{i4}Large + \varepsilon_i$$

The variable *Large* enters insignificantly in the all regressions of the extended equation for both parents (Appendix D). The regression is made separately for men and women to see if there is a non-linear effect of family size that is significant for the mother or the father separately (Appendix E and F). However, the insignificance of number of children remains for both parents even when regressed separately.

Since the original Grossman model of health production and its extensions are dynamic, it is important to remember that the household size is dynamic when looking at the QQ-model. Children become adults and eventually become more independent and move away from home. This does not mean that they do not contribute to their parents' resources. On the contrary, one of the reasons why large families in developing countries is very common is that, crudely put, the children act as a substitute for a pension system. In other words, when the children start to earn an income of their own, some of it is transferred to the parents. Generally, in developing countries the sons will do the transferring to the parents whereas the daughters will transfer money to her husband's parents. Therefore one can expect that only the number of children living at home will be associated with a negative change in the parents' health status. To

see whether or not this is the case, a regression is made where the children living at home or away are included separately (Appendix G).

(34) $$Blood\ pressure = a_i + \beta_{i1} Age + \beta_{i2} Age^2 + \beta_{i3} Sex + \beta_{i4} Home + \beta_{i5} Away + \varepsilon_i$$

In all equations, the model supports the theory of a more dynamic relationship between family size and health level. It is only the number of children that live at home that is associated with an increase in blood pressure for the parents, whereas the number of children living away from home is not associated with a change in blood pressure of the parents. The variable capturing the effect of the number of children living at home has a coefficient that ranges between 1.6 and 1.8 and a t-value of circa 1.8 in the different equations. To see whether or not whether or not the effect is gender specific, the model is divided between men and women (Appendix H and I). The results indicate that there is a QQ-relationship between children living at home and parents, but that it actually only exists for mothers: The results are insignificant for men but for women the coefficient indicates an increase in blood pressure of 2.7-3.1 points per child at the 5%-significance level. The p-value of the F-statistic is null and the results pass White's Heteroscedasticity and RAMSEY's Reset test. The results are therefore robust.

The different results that are obtained when looking at mothers and fathers separately indicate that the relationship between parents and children is complex and the next section separates the sons and daughters to test the effect of the genders of the children on their parents.

3.6. The Effect of the Gender of the Children

As it was discussed in the theoretical section of this thesis, the effect of having a son or daughter might not be the same for the parents. To see whether or not this is the case, the children are divided up into sons and daughters. The equation that we begin with includes both parents and a linear specification of the number of sons and daughters.

(35) $$Blood\ pressure = a_i + \beta_{i1} Age + \beta_{i2} Age^2 + \beta_{i3} Sex + \beta_{i4} Daughters + \beta_{i5} Sons + \varepsilon_i$$

The variable *Daughters* enters significantly in all regressions with the coefficient being stable at circa 0.9 and the t-value at about 1.8 (Appendix J). On the other hand, *Sons* does not enter significantly. To check robustness, a White Heteroscedasticity test is performed, which the model passes (*p-value* of 0.86). The results also passes RASEY's reset test of misspecification. These initial results that distinguish between sons and daughters thus suggest that both parents are

negatively affected by having daughters but not by having sons. When further changing the equation to be regressed separately for men and women, the relationship does not appear to be specific to either parent (Appendix K and L).

When the equation is changed to see whether it matters if the children living at home or away are daughters or sons, the findings indicate that for mothers, each daughter living at home significantly increases blood pressure by circa 4 points whereas each daughters living away do not (Appendix M).

(36) $$Blood\ pressure = a_i + \beta_{i1}Age + \beta_{i2}Age^2 + \beta_{i3}DaughtersAway + \beta_{i4}DaughtersHome + \beta_{i5}SonsAway + \beta_{i6}SonsHome + \varepsilon_i$$

The variables for sons living at home or away do not enter significantly for the mother. For the father, none of the variables that capture the effect of the children enters significantly (Appendix N). The equation passes both test of misspecification. The result partly supports the theory that was hypothesized earlier; that the children living away from home do not require financial support by their parents and therefore they do not 'cost' them anything. The resources can therefore be reallocated from the children that move away from home towards the parents. However, this special negative QQ-effect only appears to exist for mothers and daughters. For fathers, blood pressure is not affected by either sons or daughters or whether they live at home or away.

The results of the empirical part of this essay provide us with some interesting answers to the research questions asked in this thesis. With respect to Becker's model of a 'Quality'-Quantity interaction, the results do not indicate that there is a linear relationship similar to the QQ-tradeoff for fathers, but that there is one for mothers when only looking at children living at home and not the total size of the household. Each additional child living at home is associated with an increase in the mother's blood pressure by 2.7-3.1 points, which is quite a lot if the mother has many children living at home. This QQ-effect appears to be linear, and not non-linear.

The most interesting results are found when the regression is run separately for the mother and father using variables to indicate the gender of the child. Since the negative correlation between the mother's health and the number of daughters living at home was not found between the mother and the number of sons living at home, one can conclude that the effect that has been found is not the biological, but rather it is the budget effect. Also, in countries with strong traditions and a culture of distinct gender roles, the cost of having a daughter might be greater than having a son because the daughter will not be able to aid her

parents as the son is. If society does not allow women to enter the labor market, the daughter will not be able to contribute to the family income by doing a paid job and it is more likely that she aids her mother in household work instead. This could offset the negative effect on the mother's health since her share of the labor falls, but the explanation why this might not be the case could be that the contribution of daughters in the home market does not affect health levels, or because the mother has a gender bias towards her daughters and therefore choose to reallocate some of the resources from her towards them (as previous empirical results propose). Additionally, since the father's health is not associated with changes in the number of either sons or daughters, the results rejects the commonly used assumption of income pooling and the common preference models, and argues in favor of the more nowadays more often used bargaining models. It also support the need to use the extended models of family production of health since the results show that the number of children and their gender matters, as does the bargaining power of the parents.

4. Conclusion

The final part of this thesis sums up the results found in the theoretical and empirical part to answer the research questions of this thesis and what they mean for governmental policies. The limitations of the model are discussed and suggestions for improvements and further research are made.

4.1. Summary and interpretation of results

The aim of this thesis was to use theories of family and health economics to explain how the Quality-Quantity model of parental demand for children and investment in child 'quality' can be extended to include investments in parental 'quality'. Also, it aimed to perform an empirical investigation to answer the following research questions: Is there is correlation between family size and parental 'quality'? If so, does this correlation depend on the gender of the parents and/or children? Finally, using family size and parental 'quality' as the basis of analysis, can the intra-household resource allocation be best described as a common preference or bargaining model.

What do the results in this thesis indicate? The theoretical part and literature review explained why the models of health production, demand for children and their 'quality', and the different models of household allocation might not be as independent as one might first believe, and why their interdependence is of importance to analyze. If 'quality' is defined by a variable that both children and adolescents invest in, whether they are single or live in a family, then one can

imagine that 'quality' investment in the parents depend on the household allocation process and the family size.

The most important result in the empirical part of this thesis is the indication that, in terms of health status measured by blood pressure, there appears to be a correlation between the number of children living at home and the health status of the mother but not the father. Additionally, there appears to be a cost of having daughters that do not exist for sons and this cost is borne by the mother and not jointly by the parents. This causes a negative correlation between the mother's health and the number of daughters living at home. Since the direct cost of having sons is often higher than having daughters due to more nutritional need, the absence of such a result in our regressions suggests that it is the indirect cost of having children that needs our attention. This indirect cost is affected by for example earnings opportunities of the children (either when they are young or when they are adults and provide for their parents), or in other word, the perceived endowed quality of the child. The higher the previewed endowed quality, the lower the perceived cost. Daughters can therefore be thought to be perceived as having a higher indirect cost since the sons are able to 'repay' some of their costs to the parent(s) by performing paid work and entering the labor market as adults. Since it is the mother that bears the cost in our results whereas the father's level of investment is largely exogenous to the number of children in the family, this thesis concludes that the common preference models do not apply and that mothers have a weaker bargaining position within the marriage. The results can also be due to a gender bias of mothers towards the daughters.

When it comes to the Grossman model of demand for health capital, the age effect was confirmed and so was its non-linear nature. However, the expected positive correlation between education and health levels was not found in the data. This might be because the individuals in the sample were fairly uneducated and therefore the effect could not be confirmed. Also it appears that the type of occupation does affect health levels.

4.2. Policy implications

One of the reasons why this study was made was the fact that there are many policies in poorer countries that are designed to create an incentive for parents to have fewer children. Some of these policies force people to have fewer children, whereas others focus on increasing the level of knowledge to its population about birth control to give people the chance to make an informed decision on the number of children to have. Irrespectively of the method that the countries use, this thesis concludes that having a smaller number of daughters living at home is associated with

a better health status of the mother. Since many of the poorer countries nowadays have high prevalence of hypotension, the positive effect of reducing the average family size is evident; it can lead to a decrease in the number of death related to hypotension such as strokes, heart attacks, heart failure and arterial aneurism and, as a result, increase life expectancy of women. The results therefore imply that it is beneficial for both current and future generations that the mean number of children in the family is small rather than large. On the other hand, the aim of this essay is not to decide whether this should be done via a policy that directly regulates the number of children allowed in each family, or via the indirect method of increasing knowledge of birth control.

When it comes to the bargaining positions of the parents, the results suggested that the mothers are more disadvantaged of having many children than the fathers are and that this is due to a budget effect and not due to a biological affect from her having carried and born the child. This is likely to be due to a weaker bargaining power and therefore the results support policy methods that improve the threat point of the mother by for example implementing policies that increase women's wage levels. The result of this would be that the mother and father are equally affected by the interaction effect between the children and the parents. When it comes to the relationship between the genders of the parents and children the data supports the theory that the perceived cost of daughters is higher than the cost of sons, probably due to a lower earnings capacity to the household. To try to combat this effect, the government can make efforts to increase the perceived endowed quality of girls, due to for example increasing wage levels of women, or by increasing the awareness of the benefits from household work.

4.3. Limitations and Extensions

This thesis is not without limitations. First, its sample size fell a lot due to the fact that the information required was not available in all the dataset (the total number of observations was 570). Since the collected data in the IFLS are taken from various books that have different topics, it is natural that not all information will be available for all individuals. Nonetheless, the empirical results are very important for future development of policies and therefore developing countries need to put more attention on collecting large data sets of good quality. When this is done, the quality and reliability of future studies on developing countries will increase as a result.

Another limitation in the methodology is that important variables might have been left out. Potentially important variables are the socioeconomic background and health of the parents, which could not be found, and how flourished the regional area is. Data had been collected on the regional occupancy of the individuals, but since there was circa 20 regions and it

was difficult for the author to find information about which islands that were more economically developed, these were not included. Additionally, not all respondents had given the information. One of the variables that would have increased the validity of the result would be one that captured the general lifestyle of the individual; if he/she smokes, drinks alcohol regularly etcetera. One of the variables collected in the study was regarding alcohol, which usually increases the blood pressure of the individual. However, when this variable was further analyzed, it was shown that very few individuals had responded to that specific question. The thesis is also limited by only using one health variable due to the time constraint and it is suggested that alternative health variables are used to compare the results with.

Another suggestion for further research is to perform a so-called "Minor Field Study", where a person is allowed to travel to a developing country and do first-hand research. With a detailed plan of which variables to ask for and the ability to receive primary data from a larger number of respondents, it is possible to verify (or reject) the results obtained in this study. A confirmation or a rejection of theories when using alternative methods of data collection and method of analysis can only be beneficial when looking at it from a perspective of development of economic thought. Also it would be interesting do use a dataset where the variable *Age of Death* can be used as a health indicator. Age of death is a very good health indicator since, as Grossman (1972) pointed out, when someone's health stock reaches a minimum level, that individual dies. However, this variable is rare to find in datasets. Also, this thesis does not put any judgment of which policy that is the best one to use when wanting to decrease fertility rates in a country. It is therefore suggested that future research try to analyze whether a law on the number of children allowed in each family or fertility information is the best way to handle the problem of high population growth rates. Finally, one of the reasons why the empirical work on the QQ-has resulted in conflicting results might be due to the fact that the total number of children is not the appropriate variable to use but the number of children living in the household is. Therefore, it would be interesting to redo an empirical study that did not confirm the QQ-relationship in a country and only include the number of children living at home to see if the result changes.

Family and health economics are two topics that are often discussed. The results in this thesis show the importance of considering their interdependence when making policy decisions and the mentioned ideas are just a few that would be interesting to explore further.

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6. Appendix

Appendix A: Results of regressions using the "Family Size" variable

Dependent Variable: Blood Pressure (systolic)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	110.7	23.429	109.764	20.415	110.690	20.188
Age	0.107	0.513	0.089	0.384	0.047	0.205
Age2	0.006	2.198	0.006	12.202	0.006	2.306
Sex	-3.532	-2.235	-3.487	-2.047	-3.001	-1.760
Family Size	0.458	1.220	0.535	1.333	0.495	1.234
Edu			-0.160	0.487	0.142	0.431
Agriculture					1.463	0.758
Retail					-3.839	-1.669
Finance					-1.817	-0.133
R^2	0.197		0.162		0.203	
Adjusted R^2	0.191		0.149		0.190	
F-statistic	34.567		13.085		15.909	
P(F-value)	0.000		0.000		0.000	
Nr. observations	570		509		509	

Note: These equations use Ordinary Least Squares and should be read vertically. The aim of the original equation is primarily to use the variables that we are interested in finding the coefficients and t-values of. The consequently added variables in the other equations control for other factors thought to affect blood pressure. The robustness of the results are checked by comparing the results in the models as well as by diagnostic testing

Appendix B: Results of regressions using the "Family Size" variable for Men

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	97.334	12.058	95.466	10.914	122.129	17.919
Age	0.351	0.901	0.386	0.951	-0.285	-1.074
Age2	0.005	1.179	0.005	1.047	0.0079	2.623
Family Size	0.805	1.420	0.957	1.614	0.064	0.122
Edu			0.072	0.146	-0.292	-0.066
Agriculture					3.038	1.260
Retail					-2.259	-0.705
Finance					-6.044	-0.348
R^2						
Adjusted R^2	0.266		0.263		0.144	
F-statistic	0.258		0.251		0.119	
P(F-value)	34.469		22.780		5.760	
Nr. observations	0.000		0.000		0.000	
	290		261		248	

Appendix C: Results of regressions using the "Family Size" variable for Women

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	97.334	(12.058)	95.466	(10.914)	96.641	10.878
Age	0.351	(0.901)	0.386	(0.951)	0.392	0.954
Age2	0.005	(1.179)	0.005	(1.047)	0.005	1.046
Family Size	0.805	(1.420)	0.957	(1.614)	1.024	1.719
Edu			0.072	(0.146)	0.051	0.104
Agriculture					-0.622	-0.209
Retail					-5.689	-1.750
Finance					5.919	0.295
R^2						
Adjusted R^2	0.266		0.263		0.273	
F-statistic	0.258		0.251		0.252	
P(F-value)	34.469		22.780		13.574	
Nr. observations	0.000		0.000		0.000	
	290		261		261	

Appendix D: Results of regressions using the "Large" variable for all

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	111.923	24.940	111.42	21.558	112.556	21.367
Age	0.103	0.472	0.0795	0.344	0.037	0.160
Age2	0.001	2.263	0.006	2.267	0.007	2.469
Sex	-3.478	-2.20	-3.404	-1.997	-2.933	-1.714
Large	1.652	0.906	1.613	0.819	1.186	0.601
Edu			0.15	0.464	0.130	0.395
Agriculture					1.48	0.727
Retail					-3.875	-1.683
Finance					2.402	-0.176
R^2	0.196		0.192		0.201	
Adjusted R^2	0.190		0.184		0.188	
F-statistic	34.359		23.95		15.727	
P(F-value)	0.000		0.000		0.000	
Nr. observations	570		509		509	

Appendix E: Results of regressions using the "Large" variable for Men

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	121.418	23.129	123.380	19.319	122.910	19.156
Age	-0.166	-0.674	-0.256	-0.963	-0.293	-1.066
Age2	0.006	2.296	0.007	2.492	0.008	2.612
Large	-0.062	-0.027	-0.560	-0.221	-0.723	-0.284
Edu			0.020	-0.045	-0.002	-0.005
Agriculture					3.075	1.339
Retail					-4.814	-1.181
Finance					-5.811	-0.336
R^2	0.129		0.131			
Adjusted R^2	0.120		0.117			
F-statistic	13.675		9.168			
P(F-value)	0.000		0.000			
Nr. observations	280		248			

Appendix F: Results of regressions using the "Large" variable for Women

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	121.418	23.129	123.380	19.319	95.960	11.413
Age	-0.166	-0.674	-0.256	-0.963	0.364	0.885
Age2	0.006	2.296	0.007	2.492	0.005	1.069
Large	-0.062	-0.027	-0.560	-0.221	2.839	0.956
Edu			0.020	-0.045	0.172	0.344
Agriculture					3.427	1.235
Retail					8.188	2.215
Finance					8.206	0.395
R^2	0.263		0.258		0.272	
Adjusted R^2	0.255		0.246		0.252	
F-statistic	34.031		22.233		13.51	
P(F-value)	0.000		0.000		0.000	
Nr. observations	290		261		261	

Appendix G: Results of regressions using "home" and "away" for all

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	109.7871	23.039	108.841	20.124	109.751	19.891
Age	0.1111	0.510	0.092	0.340	0.051	0.222
Age2	0.06	2.189	0.006	2.175	0.006	2.378
Sex	-3.565	-2.258	-3.491	-2.0515	-3.019	-1.7663
Home	1.642	1.792	1.817	1.869	1.749	1.801
Away	0.256	0.638	0.295	0.680	0.262	0.604
Edu			0.151	0.428	0.123	0.374
Agriculture					1.493	0.774
Retail					-3.769	-1.640
Finance					-1.509	-0.111
R^2	0.199		0.197		0.206	
Adjusted R^2	0.192		0.188		0.192	
F-statistic	28.103		20.582		14.393	
P(F-value)	0.000		0.000		0.000	
Nr. observations	570		509		509	

Appendix H: Results of regressions using "home" and "away" for Men

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	120.264	21.847	121.845	18.378	122.071	17.698
Age	-0.141	-0.656	-0.246	-0.931	-0.284	-1.071
Age2	0.006	2.271	0.007	2.458	0.008	2.616
Home	0.322	0.267	0.226	0.175	0.137	0.106
Away	0.158	0.308	0.145	0.257	0.051	0.091
Edu			-0.005	-0.0116	-0.029	-0.068
Agriculture					3.040	2.258
Retail					-2.255	-0.702
Finance					-6.008	-0.345
R^2	0.130		0.131		0.144	
Adjusted R^2	0.117		0.113		0.115	
F-statistic	10.264		7.315		5.020	
P(F-value)	0.000		0.000		0.000	
Nr. observations	280		248		248	

Appendix I: Results of regressions using "Home" and "Away" for Women

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	96.077	11.867	93.945	10.719	95.138	10.683
Age	0.340	0.880	0.397	0.980	0.403	0.982
Age2	0.005	1.187	0.005	1.002	0.005	1.002
Home	2.65	1.982	3.078	2.189	3.082	2.192
Away	0.488	0.810	0.544	0.849	0.621	0.966
Edu			0.045	0.093	0.026	0.05
Agriculture					-0.630	-0.213
Retail					-5.574	-1.719
Finance					5.833	0.281
R^2	0.271		0.270		0.280	
Adjusted R^2	0.261		0.256		0.258	
F-statistic	26.551		18.902		12.230	
P(F-value)	0.000		0.000		0.000	
Nr. observations	290		261		261	

Appendix J: Results of regressions using "daughters" and "Sons" for all

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	110.402	23.355	109.587	20.486	110.646	20.194
Age	0.134	0.612	0.109	0.471	0.091	0.298
Age2	0.005	2.101	0.006	2.120	0.006	2.319
Sex	-3.421	-2.101	-3.366	-1.974	-2.873	-1.677
Daughters	0.891	1.804	0.972	1.823	0.959	1.799
Sons	-0.048	-0.091	0.024	0.043	-0.049	-0.084
Edu			0.132	0.400	0.111	0.336
Agriculture					1.252	0.647
Retail					-4.106	-1.779
Finance					-2.155	-0.158
R^2	0.199		0.197		0.206	
Adjusted R^2	0.192		0.180		0.191	
F-statistic	28.056		20.470		14.356	
P(F-value)	0.000		0.000		0.000	
Nr. observations	570		509		509	

Appendix K: Results of regressions using "daughters" and "Sons" for Men

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	199.900	22.133	121.577	18.597	122.255	17.985
Age	-0.123	-0.499	-0.198	-0.745	-0.239	-0.897
Age2	0.006	2.128	0.007	2.291	0.007	2.464
Daughters	0.636	1.065	0.912	-1.224	0.689	1.034
Sons	-0.517	-0.619	-0.682	-0.921	-0.759	-1.006
Edu			-0.076	-0.178	-0.101	-0.236
Agriculture					2.476	1.019
Retail					-2.922	-0.906
Finance					-5.693	-0.329
R^2	0.135		0.140		0.152	
Adjusted R^2	0.1222		0.123		0.124	
F-statistic	10.712		7.90		5.356	
P(F-value)	0.000		0.000		0.000	
Nr. observations	280		248		248	

Appendix L: Results of regressions using "daughters" and "Sons" for Women

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	97.366	12.05	95.488	10.895	96.698	10.858
Age	0.253	0.910	0.387	0.950	0.392	0.951
Age2	0.006	1.171	0.005	1.044	0.005	1.045
Daughters	1.095	1.396	1.041	1.266	1.144	1.390
Sons	0.497	0.615	0865	1.090	0.892	1.035
Edu			0.070	0.142	0.049	0.099
Agriculture					-0.625	-0.210
Retail					-5.718	-1.754
Finance					5.639	0.270
R^2	0.266		0.263		0.273	
Adjusted R^2	0.256		0.248		0.250	
F-statistic	25.860		18.156		11.838	
P(F-value)	0.000		0.000		0.000	
Nr. observations	290		261		261	

Appendix M: Results of regressions using "daughters" and "Sons" when they are either living at "home" or "away" for Women

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	95.859	11.743	93.442	10.598	94.746	10.578
Age	0.348	0.897	0.409	1.007	0.418	1.015
Age2	0.005	1.155	0.005	0.962	0.005	0.955
DaughtersHome	3.358	1.899	4.006	2.175	4.010	2.160
DaughtersAway	0.808	0.948	0.504	0.564	0.626	0.698
SonsHome	2.200	1.418	2.367	1.418	2.326	1.421
SonsAway	0.126	0.133	0.677	0.658	0.596	0.672
Edu			0.036	0.073	0.019	0.037
Agriculture					-0.935	-0.311
Retail					-5.679	-1.745
Finance					5.167	0.247
R^2	0.273		0.272		0.282	
Adjusted R^2	0.258		0.252		0.253	
F-statistic	17.710		13.522		9.830	
P(F-value)	0.000		0.000		0.000	
Nr. observations	290		261		261	

Appendix N: Results of regressions using "daughters" and "Sons" when they are either living at "home" or "away" for Men

Dependent Variable: Blood Pressure (systolic) mm Hg (millimeters of Mercury)

	Equation 1		**Equation 2**		**Equation 3**	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	119.781	21.557	121.532	18.227	122.135	17.647
Age	-0.120	-0.486	-0.195	-0.933	-0.236	-0.885
Age2	0.006	2.115	0.007	2.276	0.007	2.448
DaughtersHome	0.605	0.356	0.834	0.462	0.812	0.450
DaughtersAway	0.647	1.019	0.812	1.141	0.674	0.941
SonsHome	0.028	0.021	-0.357	-0.245	-0.484	-0.334
SonsAway	-0.595	-0.757	-0.804	-0.934	-0.846	-0.971
Edu			-0.091	-0.211	-0.110	-0.255
Agriculture					2.477	1.014
Retail					-2.909	-0.898
Finance					-5.446	-0.312
R^2	0.135		0.141		0.152	
Adjusted R^2	0.116		0.115		0.116	
F-statistic	7.180		5.607		4.25	
P(F-value)	0.000		0.000		0.000	
Nr. observations	280		248		248	