An Application of Game Theory in Strategic Decision of Family Planning

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2014

An Application of Game Theory in Strategic Decision of Family Planning

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Abstract

Family planning is determined by a set of strategies that provide a way to policy makers for scheming population growth. There are two way for reducing fertility rate; first is by making laws and secondly by self control. The democratic county like India, it is not possible to control it forcibly, so there is only second way to reduce fertility. The decisions related to family planning is taken by the two important player wife and husband, but their decisions influenced by the various factors such as; cost of nurturing children, income of husband and wife, family assets, educational level of husband and wife and marring age of couple. The expected utility theory is applied for knowing the expected returns from children. The study is based on the field Survey data of 150 sample newly married couple in western Delhi.

Key Worlds: *Family Planning, Strategic Decision and Expected Utility theory*

1. Introduction

Family planning is essential for reducing the presser of human force on natural resources and it can be possible through education of both male and female child. The country like India is facing the problem of higher growth of population and policy maker tried to reduce the birth rate and now the decline trend are seen between the two census surveys 2001 to 2011. But the rate of growth of population is also high as compare to other developing nations like china, etc. So there is need to know the family planning strategies of new educated couples in both urban and rural areas but due to lack of time I have chosen Delhi for survey because I have stay in Delhi in summer vacation. The result may be different when we study in rural educated couples due to cost of living and lack of information related to use of contraceptive. Education provides strategies for making decision of family planning. The economic condition, residence location, and demonstration effect are also seen in some cases of family planning. The number of children

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of a couple also affects the number of children of their friend, relative couple. It is clear that the new generation educated couple prefer fewer children than the low educated and their parents. The study finds that the contraceptive had made significant impact on reducing the risk of unnecessary child birth. The information related to use of contraceptive are made by the doctor, electronic, print media, radio and now internet source. But the access to information depends on the education of couples. For reducing the birth rate is necessary girl's education because it promotes the late marriage and transfer knowledge related to unnecessary birth control after marriage.

2. Review of Literature

Game theory application literature is available in different branches of science, such as medical science, mathematics, economics etc. The literature on women's status and fertility-related behavior analysis of Togolese women was conducted by Gage (1995) and found that control over the decision of whom to marry was related to higher spousal communication about family planning and ever use of a modern contraceptive method. In addition, she also found an important role for women's economic power in fertility behavior. Some studies on the relationship between women's autonomy and fertility-related behavior show a positive relationship between autonomy and contraceptive use (Morgan &Niraula 1995; Cleland et al. 1996; Visaria 1996; Gwako 1997; Schuler et al. 1997) and some others inverse relationship between autonomy and fertility (Balk 1994; Basu 1996; Gwako 1997) and However, another study found no significant relationship between women's autonomy and the desired number of children (Vlasoff 1996).

United Nations (1995) pointed out that increases in women's education have been linked to declines in the Total Fertility Rate (TFR), particularly among highly educated women. Further Riley (1997) illustrate that at the same time, increases in women's education and labor force participation can enhance women's status vis-à-vis men, by offering women opportunities to control their own resources as well as their power to make decisions about demographic outcomes such as fertility. Martín (1995) find that Women's education has also been shown to be related to higher levels of modern contraceptive use in many developing countries. Again Bledsoe et al. (1999) a review of the relationship between mass education and fertility points to some of the findings that counteract the idea that mass education results in fertility declines.

According to the above review, there is evidence that education and fertility are not inversely related in some countries, while in others, there is evidence of a positive relationship some countries; women with some education had higher completed fertility than illiterate women.

Mahmud & Johnston (1994) recognized the relationship between labor force participation and fertility, there is some empirical evidence for a negative association between women's employment and fertility, while other studies show no relationship between the two. Again Jejeebhoy (1995) identified the relationship between women's employment and fertility is even less clear. Women's employment may have a direct effect on lowering fertility, or may reflect increased education levels. Women's education is thought to increase women's employment opportunities and their ability to make decisions in the household which, in turn, may also lower fertility

Indeveloping countries still have male- dominated cultures due to lack of female education. For example, in Sub- Saharan Africa, ancestral customs give men rights over women's procreative power (Ezeh, 1991). In those societies where above situations found, we would expect that the husband's approval may often be a precondition for a woman to use family planning. Studies in other regions have shown that one reason women give for nonuse is husband's disapproval. Even in developed societies, studies have shown important effects of the husband's desires on a couple's fertility.

3. Decisions of Family Planning

In Real world, decisions related to birth of first child, time gap between two children and numbers of children in whole reproductive period are usually taken by the both husband and wife with the cooperation of each other. But some time due to lack of information related to contraceptive, miss happening and unwanted child creates problems for family due to limited recourses and income, because the expenditure on mother's and additional new born child's increased which creates problems in nurturing of existing children's and any additional child gives demising returns to family, therefore the budget of family not sufficient for proper nurturing children. So there is need that husband and wife take right decision related to number of children's and time gap between children's according to their budget constantans which depends on their pervious saving, current income and family assets. The decision related to

number of children's depends on expected utility attains in future by the parent. The present investments on children's are determined their future returns which provide parents satisfaction.

The famous economist Malthus assumes that fertility is determined primarily by two primitive variables, age of female at married and the frequency of coition during marriage. With development and spreads of knowledge about use of contraceptives during the last century was really played an important role in family size decision-making. The demographic researchers have been given greater attention to decision-making than either Malthus or the forecasters did. Psychologists have tried to put these decisions within a certain framework known as psychological theory and other hand sociologists have tried to suggest through sociological theory, but most persons would admit that none of framework has been particularly successful in providing the information related to fertility decision (Backer, 1960).

Two thought encouraged me to analyze family planning decisions within an economic framework. One is that Malthus' famous discussion that was based on an economic framework but the aim of this research is viewed and endorses the Malthus thoughts. Second was Baker's work on An Economic Analysis of Fertility, although in family planning decision all social, cultural, religious, climatic and economic variables explained more than a small fraction of the variation in fertility but economic variables did better than others.

4. Methodology and Data Sources

For the purpose of study, survey has been conducted from 150 newly married couple in the year 2012 and 2013, in city of Western Delhi (Vidhnu Garden, Tilak Nagar, Jankapuri, Khayala and PaschimVihar). For the purpose knowing the information the newly married couples used snow ball sampling method. All the newly married educated couples are cooperating with interview and share information for their future planning strategies related first child and number of children with gap between two children. The couples are classified into three income slabs and mostly are job holder either in Private or govt. During the field survey researcher finds that the higher educated couple cooperates and discussed openly related to use of contraceptive and other family planning methods but the less educated couple hesitate in answering these questions.

Game theory is applied for the fertility related decisions and these decisions determined by present income of couple and expected returns of child. Expected returns calculated with the help of expected utility get by couple's in future by additional child which depends on present

income and investment desire of the couple. The subjective desire of a particular choice is determined by its expected utility function. The study applied Expected Utility Theory (EUT) *DanielBernoulli (1738)* and he tried to solve a problem that how much a rational individual is prepared to play family planning game, it is also called as Bayesian Decision Theory. Preferences over prospects can be represented by function *U(x*),* which gives a real-valued index to each prospect. *U(x*)* Function operates between prospects so that $U(x) \geq U(r) \leftrightarrow x \geq r$. A couple will choose prospect *x* over prospect *r* if and only if a value of the index *x* is no less than a value of the index *r*. It is also assume that couple maximizes the function index. Moreover, the expected utility theory to choices of children is based on the following three canons;

Expectation: If all three axioms ordering, continuity and independence are hold, preferences to prospect *x* can be represented by the following utility function;

$$U(x) = \sum_i p_i . u(x_i) = p_1 . u(x_1) + \ldots + p_n . u(x_n) \ldots\ldots\ldots\ldots\ldots (1)$$

Where; *U(x*)* is a utility function and i = 1, 2, 3…..n. We assume that the utility function is continuous, monotonous and at least twice differentiable. Thus, *U (x)* is the expected utility of prospect *x*.

Asset Integration: If *y* is present income of couple at the time of family planning, then couple will choose number of children and their expected utility (*x*);

$$U(x) = U(y + x) > u(y) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

In other words, a prospect is acceptable if the utility resulting from the prospect including the initial income exceeds the utility of initial income with single child. Thus, EUT considers risky decisions from a perspective of number of children if the couples have less investment capability on Childs, they should desire less number children. Education of wife, job of male or female are influence the decisions related to time of fertility and number of children. Each couple wants to maximize their expected utility by producing number of children.

Table1: Expected Utility of an Additional Child to the family (1$=60 Rs)

Expected Utility	*Family Planning*		*Respondent Couple*
	No of Child	*MUc*	

150$	1	-	15
250$	2	100$	60
300$	3	50$	55
320$	4	20$	30

Source: Field Survey 2013

The marginal utility theory explains as soon as the number goods increases the marginal utility demising with additional unit this rule can also applied in case of getting child. The children's are treated like a private good and assume that additional child gives lesser utility than previous one. The expected utility earn by number of children's is calculated on the basis of parent's income and their expenditure on child. We assume that every additional child gives 0 .25 less utility than previous child because the expenditure divided into each additional child's with less increment aggregate expenditure because income remains constant. Table 1 shows that the expected utility which received by first child is more than remaining because the probability and expected utile is more from first child to parents than others and expected utility decreases due to increase number of children.

5. Application of Game Theory in Family Planning

Family planning is a set of strategies that determine the expected utility of forthcoming children's in the family. Figure 1(a) shows that the cooperation of both players is necessary in the decision of number of children. The majority of new generation couple wants two children one female and one male child. Figure 1(b) illustrate the expected utility payoff receive from number of children's, by the husband and wife. When both player plays maxi-mini strategy and fallow optimize their utility at least two child. But the sometimes cooperation is not occurs due to different ideology of the spouses the number of children's are more than two, it is good sign that the present generation couples not have faith in discrimination between girl and boy child.

		Husband	
		No	Yes
Wife	No	*4, 4*	*2 , 1*
	Yes	*1, 2*	*2, 2*

		Husband	
		Disagree	Agree
Wife	Disagree	$U_{W\,less}$, $U_{H\,less}$	$U_{W\,Max}$, $U_{H\,min}$
	Agree	$U_{W\,min}$, $U_{H\,max}$	$U_{W\,opt}$, $U_{H\,opt}$

Figure 1 (a) No. of children's matrix   **Figure 1 (b)** Expected utility payoff matrix of couple

6. Results and Finding of the Field Survey

The respondent are very much concuss on future family planning, the educated females are rigid related to time of first child of marriage. The new generation youth are interested in the enjoying marring life two to five year without children. The sample couple, most of them are employed in private companies, some are involve in business and rest of them at least husband or wife in government job. So it is clear that the young educated couples think differently from the traditional couple and they are aware related to use of different type contraceptives for reducing the risk of child and they want child after two to five year passing marriage. Table 2 shows that as soon income of the family increase the desire of number of children decreases, because the high income groups wants less but high quality children. The lower income groups of couples want more children as shows in table that below 500$ income couple wants two to four children (50 percent of couple).The middle income group couples want two to three children (26 percent of couple). But the higher income group couple plans only one or two children (24 percent of couple) they are also higher educated.

Table2. Planning for Future no of Children by Respondent

Planning no of Children	Families Monthly Income Slabs						
	500 $ <	Percent	500-1000 $	Percent	1000 $ >	Percent	Total
1	0	0.00	0	0.00	15	41.67	15
2	12	16.00	29	74.36	21	58.33	60
3	33	44.00	12	25.64	0	0.00	45
4	30	40.00	0	0.00	0	0.00	30
Total	75	100	39	100	36	100	150

Source: Field Survey 2013

The out of total sample there is only 10 percent couple that wants only single child and they all belong to higher income group. The 40 percent couple plans only two children that means in that the half of the sample population is target to replacement rate but another low income and some middle income groups are planning three two to four children that is 50 percent of total sample.

Table 3 Use of Contraceptive for the Family Planning by the Respondent

Planning no of Children	Use Contraceptive by Couple				
	Always	Percent	Sometime	Percent	Total

1	15	100.00	0	0.00	15
2	57	95.00	3	5.00	60
3	39	86.67	6	13.33	45
4	18	60.00	12	40.00	30
Total	129	86.00	21	14.00	150

Source: Field Survey 2013

Note: Contraceptive includes; Condom, Pills, Caper T, Ejections etc.

From table 3 it is clear that the 86 percent youth use contraceptive and reduces the risk of unwanted child. So it is clear that the awareness related to use of contraceptive have most of the couple in Delhi. There is 21 percent couple, those uses contraceptive some time but they take another precautionary method for unwanted child. The use of contraceptive is essential and necessary strategy for controlling the number of children in newly family. The preventing unwanted child is not meant that they will distinguish between male and female child. The crucial task is that the educated couple told us that they will not made any discrimination between their male and female children

Table 4: Education of Wives and Decision Power in Family Planning

Planning no Children	Education of Wife						
	School	Percent	Collage	Percent	University	Percent	Total
1	0	0.00	0	0.00	15	23.82	15
2	3	5.77	27	75.00	30	47.62	60
3	18	34.62	9	25.00	18	28.56	45
4	30	59.61	0	0.00	0	0.00	30
Total	52	100	36	100	63	100	150

Source: Field Survey 2013

Table 4 lustrates the role of spouse education in decision of future family planning. It is clear that those are received higher education married latter and their age of marriage ranges between 20 to 30 years in sample area, so the late marriage and education increase their knowledge related to family planning strategies that how to prevent unwanted child. The only 18 (28.56 percent) women plans for 3 child that have university level education out of 63 women, other 45 (71.44 percent) prefer one or two children but on the other hand those are get only school level education they are planning 3 to 4 children, because they think that higher number of Childers

provide them higher income and security in future. So it is clear that women education can prevent the higher growth of population in India.

Table 5: Education of Husband and Decision Power in Family Planning

Planning no of Children	School	Percent	College	Percent	University	Percent	Total
1	3	33.33	3	6.67	24	25.00	30
2	3	33.33	9	20.00	48	50.00	60
3	3	33.33	24	53.33	18	18.75	45
4	0	0.00	9	20.00	6	6.25	15
Total	9	100	45	100	96	100	150

Source: Field Survey 2013

Table 5 illustrates that education is important tools to reducing birth rate and reaching into replacement rate. The education of both male and female are playing important role in the decision of number of children and the time gap between two children along with family asset and couples income. The male education is equally important in the decision of family planning. Because if male is not educated he will not accept the plans of his wife that she suggested for controlling the unwanted child birth and the unnecessary burden on family. It is clear that the male education dose not influence much in future family planning, 24 (25 percent) male are planning 3 to 4 children (out of 96) that had received university level education. So the education of male and female are equally important for preventing the higher population growth rate in India.

Table6: Planning Number of Children and Family Assets (Monitory Value in $)

| Planning no of Children | Family Assets | | | | | | Total |
	less than 2000 $	Percent	2000-10000 $	Percent	More than10000 $	Percent	
1	0	0.00	5	8.33	15	25.00	20
2	3	10.00	12	20.00	45	75.00	60
3	18	60.00	27	45.00	0	0.00	45
4	9	30.00	16	26.67	0	0.00	25
Total	30	100	60	100	60	100	150

Source: Field Survey 2013

Table 6 presents the role of family assets in the planning of number of children; it is clear that as soon as the assets increases, initially the demand of number of children are increases then starts to fall and at the higher level of assets family plans less number of children. All the respondent higher assets range are planning 1 or 2 children but the middle income groups out of 60 respondent 71.67 percent (43) are planning 3 to 4 children. So the assets also play important role in family planning but not influence as much as education.

7. Conclusion

The new generation couples accepted that the cost of nurturing is increasing many folds in cities like Delhi due hyper increases prices and cost of living standard. So if the number of children is more than two it creates an additional burden on parents, because the parent income is not enough to provide, better livelihood of more than two children. They plan at least two or three children in their future family planning after the enjoying two to five year gap after marriage. The important finding is that most of couples' average age of marriage is 25 year, female are 23 and male are 27 year. The expected utility of additional child is lower than previous one when they are treated as private goods. The law of demising marginal utility is applicable in case of getting utility from additional child. So the finding is that the newly educated couples are appreciating population control.

Acknowledgement

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