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Propensity to Contracept

Determinants of Contraceptive Use in Cambodia between 2000 and 2010

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A Minor Field Study in Phnom Penh, Cambodia

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Abstract

The number of Cambodian women using modern contraceptive methods has increased by almost 60 % between 2000 and 2010. We investigate the determinants that have driven this change through a framework considering the supply of, and demand for, contraceptives, as well as income and education. We modify a model of contraceptive use suggested by Easterlin and Crimmins (1985) and use it to analyze Demographic and Health Survey (DHS) data. The main finding is that the effect of contraceptive demand, measured through fertility preference, has increased from being insignificant to have a major impact upon the contraceptive decision. We also find that the effect of supply, which we proxy with contraceptive knowledge, is diminishing beyond a low level. Unlike previous research, we find no effect of education upon contraceptive use. The income effect is ambiguous due to insufficient data.

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1 Introduction

Between 2000 and 2010, the rate of contraceptive use in Cambodia increased by almost 60 % (National Institute of Statistics and MEASURE DHS, 2011), along with a drastic reduction in preferred family size. Our aim in this thesis has been to study this shift and its underlying determinants.

Why are the factors that determine contraceptive use, and how they are affected by preferences, important to study? The maternal health situation in Cambodia lags behind several other Southeast Asian countries, with a maternal mortality ratio reaching 472 deaths per 100,000 women in 2005. This is more than ten times higher than in neighboring Thailand and three times higher than in Vietnam. As much as 14–16 % of these deaths are related to unsafe abortions, easily prevented through safer abortion procedures—but ideally through contraceptive use to prevent unwanted pregnancy in the first place (McDougall et al., 2009). Samandari et al. (2010) point out how women who did not practice family planning experienced both lower social status and quality of life, and that their children were less likely to fulfill their basic education, when compared to women whose contraceptive usage was higher. That reproductive health is one of the cornerstones of development work, is further emphasized by the United Nations making universal access one of the Millenium Goals. The overlap between questions regarding women's power over their reproduction and other issues for developing countries is clear. For that reason, we argue that this is also a key question for Cambodia today.

It is surprising how little attention has been given the Cambodian case. Rich data is available through the multiple Demographic and Health Surveys (DHS) conducted since 1998, but only one peer reviewed article focuses entirely on Cambodian family planning (Samandari et al., 2010). Neither has much research that examines the time dimension of fertility and contraceptive use changes been performed; cross-sectional analysis comparing countries in one-period models is far more common. The purpose of this thesis is to find a model to fill this gap, through analysing what determines the decision making for contraceptive use and how it has changed over time. We will study supply- and demand factors as well as the impact of certain socioeconomic factors, such as education and income.

2 Previous Research

2.1 Fertility in Economic Analysis

Fertility was brought to the attention of economists in the sixties with the publication of "An Economic Analysis of Fertility" (Becker, 1960). Instead of considering demographic factors as *data* in economic analyses, Becker presents a framework for economic theory to understand such factors in themselves (Duesenberry, 1960). By treating children as a "durable good [...] which yields income, primarily psychic income, to parents", fertility becomes a subject one can analyse through assuming utility maximising agents facing economic constraints.

Easterlin and Crimmins (1985) present a framework to further deepen the economic analysis of fertility. They suggest that such a model should contain insights from not only economists but demographers, sociologists and "other scholars on human fertility" as well (Easterlin, 1975); and subsequently put forward a rich model whose components have been central for later research. One of the model's components treats contraceptive use as a function of the natural supply of children, individual demand for children and the costs for engaging in family planning. Through considering the criticism and modifications presented since the publication [see Schultz (1986) and Montgomery (1987)], we build upon this model to understand the Cambodian situation.

2.2 Supply and Demand

Looking at the present research in the wake of Becker and Easterlin, we find two seemingly conflicting hypotheses. The first is that the demand for contraceptives is the main determining factor; in contrast to the argument that the supply of contraceptives is the main component. Many efforts have been made to test these hypotheses. In one of the most ambitious experiments, the Matlab village, Bangladesh,[1] was randomly selected. All residents received free family planning and free contraceptives. This, "the only reasonably valid experiment [...] that deals with program effects on fertility preferences," (Freedman, 1997) showed an immediate increase in the number of women reporting that they currently

[1] The Bangladeshi geographical region of Matlab is not to be confused with the computing software with the same name.

use modern contraceptive methods (a measure in the literature referred to as the *Contraceptive Prevalence Rate*). The effect was shown to last for several years (DeGraff, 1991), and gives support to the view that an increased supply increases the contraceptive prevalence rate. Drawing upon data from Vietnam, Thang and Anh (2002) also show how accessibility in itself, proxied through required travelling distance to a contraceptive source, has a positive effect upon use.

The demand hypothesis instead put forward factors such as attitudes, perceptions of method efficiency and fertility preferences as more influential upon the decision. Economic reasoning supports the importance of preferences through the fact that contraceptive costs is a very small component in the total cost-benefit decision of the children decision.(Pritchett, 1994)[2] Further support to the claim that other factors are more important than supply is given when regarding the historic transition period in Western Europe. Here, most of the European countries went through a similar transition from high to low fertility, through drastically reducing the number of children per women—despite an almost negligent supply of contraceptives (Mauldin, 1982).

2.3 Other Factors Influencing Use

A number of researchers studying fertility and contraceptives address their work more peripherally towards the supply and demand framework and analyse the effect of isolated factors. The most important of these include education and income. The effect of education upon fertility has been studied closely by Bongaarts (1990), who finds a negative correlation between educational attainment and fertility throughout a country's entire fertility transition. The role of contraceptives in this study is considerable. Other authors have investigated the role of income on women's contraception choices. One study on low income groups in Indonesia was not able to find a large enough effect of income to conclude that it does affect the contraceptive decision (Schoemaker, 2005). Bollen et al. (2007), in contrast, find that income has a largely negative effect on fertility through developing alternative methods to measure wealth. They do not look at the relationship to contraceptive use. Though the income effect is debated,

[2]When browsing household survey data, Pritchett (1994) concludes that contraceptives accounts for around 1 % of total costs for a household in a developing economy. In contrast, the cost of a child is estimated to be 30–40 % of ditto income.

Harvey (1994) finds, through analysing a cross section of countries, that the relationship between price and use is—predictably—negative.

2.4 Changes Over Time

Feyisetan and Casterline (2000) perform a decomposition analysis of the weight of preference and its changes over time. When looking at 22 developing countries over ten years they find that change in the impact of fertility preferences is the main driving factor behind the increased contraceptive prevalence rates. By decomposing into stated preferences and the unobserved effect of these preferences, they conclude that change in actual preference never explains more than 25 % of the increased contraceptive prevalence rate—leaving the increase explained by the residual.

2.5 A Research Question

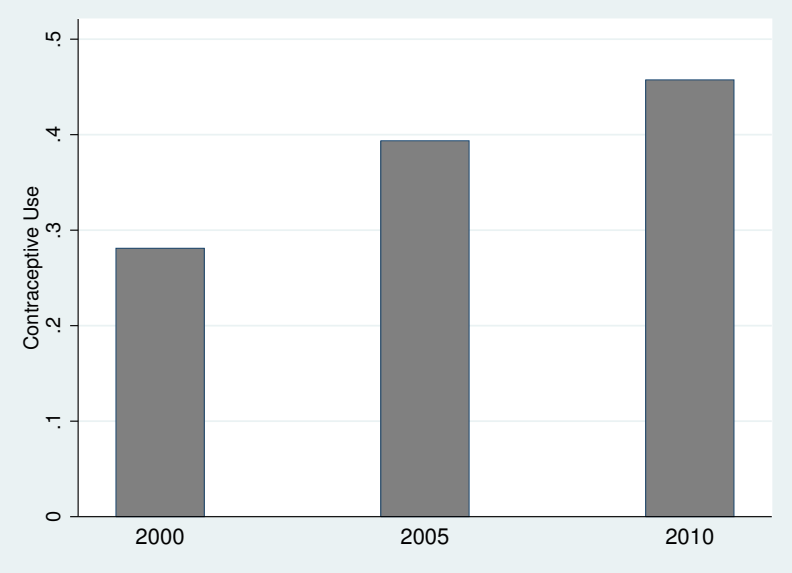


Figure 1: Contraceptive Use at Zero Child Preference, Cambodia 2000–2010 (DHS data)

Not only has the effect of demand versus supply upon contraceptive use been debated; but also how socioeconomics affect this choice—and how the ef-

fects change over time. We observe how the Cambodian contraceptive use has increased markedly during the period 2000–2010, and as notable is the increase in contraceptive use among women who do not desire additional children. Figure 1 shows an almost 70 % increase in use in this group—whose rate of use ideally should approach 100 %, in the case when there are no barriers to contraceptive use. This tells us to which degree the woman's own preference is provided: in essence her power over her own reproduction. Through including important socioeconomic factors we hope to enrich the supply-demand framework. These variables can affect the choice of using contraceptives both through affecting preference directly, and indirectly by changing the effects of the fertility preference. We hope to shed light upon the relative effect of these two.

We want to examine: *how the contraceptive use in Cambodia is determined by supply of, and demand for, contraceptives; what the effect of the socioeconomic education and income variables is; and if any changes can be seen in these factors between 2000–2010.*

3 Model and Methods

3.1 The Economics of Contraceptive Use

A model to predict contraceptive use is suggested by Easterlin and Crimmins (1985). Contraceptive prevalence rate (U) is assumed to be a function of a demand term, $\delta(S-D)$[3] and a cost for practicing birth control RC:

$$U = \beta_0 + \delta(S-D) + \gamma RC + \epsilon \tag{1}$$

The model has been criticised by Montgomery (1987) as emphasising too much the monetary part of the RC term. This gives that the non-monetary, psychic, costs are underestimated, subsequently underestimating the total costs facing the individual. We present a way of combining the model by Easterlin with a supply measure that more fully takes into account other, non-monetary, costs.[4] In addition, we investigate the role of socioeconomic factors.

[3]This is derived from an assumed fertility rate in absence of family planning, S, and an individual child preference, D. A high "natural" fertility rate therefore implies a higher probability of using contraceptives, whereas a higher child preference should reduce use.

[4]Easterlin's model partly reflects non-monetary costs although they are considered to be minor. We discuss these costs in the Cambodian case.

We further suggest excluding the "natural fertility" component from the $\delta(S - D)$-term, and instead include perceived preference for children as concluded by Bongaarts (1990). This is in line with Schultz (1986) who argues that the natural fertility component suffers from endogeneity problems, in that it is difficult to disentangle direct from indirect factors to find an exogenously given natural rate of fertility.[5] To overcome these problems, we present a simplified model that explores the impact of the more direct preference factor.

3.2 Regression Equation

Through the model, we focus the impact of demand for contraceptives as well as the impact of contraceptive supply. We also see changes in these variables' effects over time. A regression equation is developed below. We perform OLS regressions using data from three different years (2000, 2005 and 2010), to see if the coefficients change over time in Equation 3. We also perform a pooled OLS regression using observations from all years in Equation 2. The models will be run both with and without the control variables education, marital status and income, to discern the robustness of the supply and demand regressors. In all regressions we control for region and urban/rural residence.

$$U = \alpha + \beta_1 P + \beta_2 S + \beta_3 S^2 + \sum_{i=3}^{n} \beta_i X_i + \delta_t T + \epsilon \tag{2}$$

$$U_t = \alpha_t + \beta_{1t} P_t + \beta_{2t} S_t + \beta_{3t} S_t^2 + \sum_{i=3}^{n} \beta_i X_i + \epsilon_t,\ t = 1, 2, 3 \tag{3}$$

where U is a dummy for contraceptive use, P is a fertility preference measure, S is a contraceptive supply and X_i is a vector of n socioeconomic control variables, α is the intercept and ϵ is a random error term. In the pooled model, T is a year dummy, whereas the second regression equation is run once for every year.

[5] An example of this is the presence of breastfeeding, included in the natural fertility variable. It is not clear whether to treat it as an exogenous factor affecting fertility—but not contraceptive use; or whether it is in certain cases is consciously used as a contraceptive method. The latter would introduce an endogeneity problem.

3.2.1 Dependent Variable: Current Contraceptive Use

Use of modern contraceptives is measured as a binary variable that takes the value of 1, if the respondent is currently using any of a set of modern methods. The respondents have had the possibility to report use of the methods "withdrawal" and "periodic abstinence" which are not included among the modern methods, and thus treated as non-use. There are two reasons for this. The first is that it is the accepted procedure in the literature which we follow to facilitate comparisons. The second is that the excluded methods simply are not very effective (Steiner et al., 2003). Please see Table 6 in the appendix for a complete list of methods and their classifications.

The interpretation of the independent variables' effect upon the dependent variable, is the effect on the probability of using contraceptives. The β_i shows, ceteris paribus, the change in probability of outcome $U = 1$ for an incremental change in variable i.

3.2.2 Demand: Fertility Preference

Ideally, a fertility preference measure would be based on observed values. This is not possible for the analysis we perform, since using observed values would require the researcher to work with women past childbearing age; a method that would introduce a certain time lag. Researching fertility preferences is for that reason rather different from observing people in the grocery store, where the till reveals true demand. As many economists show scepticism towards the validity of perceived variables, McClelland (1983) shows that when comparing different variables based on queried preferences, fertility is in fact one of the measures that closest matches the actual outcome. This implies that when no barriers to fertility control exists, most people have a good idea about their own child preference—something that enables us to use the interview data and believe they are consistent with the true outcome.

There are, however, a number of different ways to measure a woman's fertility preference. Bongaarts (1990) investigates the validity of the three measures most commonly used. The first method is to ask whether the respondent's last or current pregnancy was wanted or not, where a positive answer indicates a positive demand and vice versa. The second uses information on the respondents preferred family size, or alternatively the difference between the actual and

ideal number of children, potentially adding a dimension of preference depth. The third method is constructed through asking whether the respondent desires another child or not. Bongaarts (1990) further concludes that certain biases are found in all measures, both *ex ante* (through time inconsistent discounting and incorrect cost-benefit analysis) and *ex post* (through post-rationalisation).

The first of the above methods is backward-looking and clearly subject to a post-rationalisation bias. Even though a child was unwanted at birth, it is possible (and perhaps likely) that the mother changes her mind and later reports that it was wanted. It would also exclude a large part of our sample, since many have not conceived any children. The second of these methods, the gap measure, has more bearing in the long term: it might well be that a woman wants more children but uses contraceptives due to her present situation. Thus it is shown that the gap measure better captures long term fertility preference than present contraceptive use (McClelland, 1983). As it is the current use of contraceptives we analyse, we are more interested in a measure that captures the short to medium term contraceptive decision. This binary desire for continued childbearing is also concluded by Bongaarts (1990) to be the least biased of the discussed measures, and will be primarily used in our model.[6] Unlike some other authors using this measure we also include women with a desire for more children but wishing to space the next birth for at least two years.

3.2.3 Supply: Knowledge of Methods

Supply is determined by multiple factors, involving price level, proximity to sources and knowledge. Previous research has tried to use proxy variables in form of distance to the nearest distributor (Thang and Anh, 2002) or the self-perceived price for contraceptives (Schoemaker, 2005) to capture the effect of the actual supply. do Valle Silva et al. (1990) use the number of contraceptive methods known to the individual for proxying the *RC* (contraceptive costs) variable, when they test the Easterlin model. We develop why knowledge of methods is also a feasible proxy for contraceptive supply.

First, a large part of Cambodia's population live in remote areas that lack

[6] Using a dummy as a dependent variable in an OLS regression is potentially problematic as there is a risk obtaining coefficients that predict unrealistic values—outside the interval between 1 and 0—why we confirm our results through a logistic marginal effects regression, its results shown in Table 5 in the appendix.

well-functioning public infrastructure. The family planning programs in place works both through increasing contraceptive awareness and through increasing physical supply.[7] Thus we assume them to be correlated. It follows that if an individual has high knowledge about methods, she is also more likely to face a high material supply.

The second argument regards the price components of a good. The most obvious is, of course, the monetary cost. Due to subsidies that keep prices artificially low,[8] the monetary cost should play almost no role in Cambodia. Instead, the other perceived price components, which include search costs, make up a larger fraction of the total price. The search costs relate to the time and effort spent on gathering information about why and how to use contraceptives, as well as what methods to consider (Pritchett, 1994) and we argue that they are inversely related to the knowledge one has about contraceptives. That is, the more methods one knows of, the easier it is to procure them, and the lower is the psychological threshold for usage. As knowledge increases, the price of contraceptives becomes "cheaper" and the supply faced by the individual increases.

The Matlab experiment saw the results of a massively increased supply. However, Pritchett (1994) points out that an equally valid explanation was the region's unusually low level of initial supply. He argues that an increase in contraceptive supply is likely to have a bigger impact at low levels. Further supply increases are potentially less fruitful, explaining the high costs of the experiment. For that reason, we also include the squared functional form of knowledge in order to test for decreasing marginal effects.

Last, there is a possibility that the socioeconomic variables included in the second stage of the regressions have their effect on the propensity through either the knowledge or the preference variable. For that reason we compare the coefficients in an regression with knowledge and preference excluded.

3.2.4 Socioeconomic Variables

Education Bongaarts (2003) finds that education has a negative effect upon fertility. He explores the effect that goes through a reduced child preference.

[7] Interview with Alysha Beyer, Senior Technical Advisor PSI Cambodia. Phnom Penh, February 17, 2012.

[8] Interview with Dianna Long, Research Director at PSI Cambodia. Phnom Penh, February 20, 2012.

However, in our framework the education effect could possibly go through both contraceptive use propensity (an increased usage given the same demand), as well as through reduced fertility demand in itself—that we can see through excluding the demand variable. We will test both of these statements. The data provides education in number of years.

Marital Status The majority of our sample report that they are currently married. The effect upon contraceptive use propensity is not entirely clear from outset. We could see an increased interest in family planning given the same fertility preference. In contrast, reduced costs associated with receiving an unwanted child within marriage, as compared to an out of wedlock birth, could potentially reduce propensity to use contraceptives. The expected signs therefore go in both directions. However, by controlling for marriage we are also likely to pick up other omitted factors: being part of the small non-married minority could have effects of its own.

Income Whether increased income should have a negative impact upon fertility (Bollen et al., 2007) or no discernible impact upon contraceptive use (Schoemaker, 2005) is not clear. We test both these statements. Regarding the measuring difficulties encountered when tracking income in developing country, please see the Data section.

Other Controls Throughout all versions of the regression we include 19 region dummies,[9] which will have the same effect as using a region fixed effects model for the pooled OLS. This will reduce the effect of differences in initial levels of contraceptive use. We also control for urban/rural residence and exposure to family planning messages, where the latter is measured in the number of media sources exposed to.

3.2.5 Interviews

This thesis was written in Phnom Penh, Cambodia, where we conducted a number of qualitative interviews with professionals working in the fields of family planning and reproductive health. Many of the interviews were arranged with

[9] In fact, there are 24 Cambodian provinces but due to the limited sample sizes from the smallest of these, some have been merged with neighboring regions.

the intention to increase our understanding of the specifics of the Cambodian situation, and will not be quoted. The interviews had an open approach from our side and to every interview we brought a number of topics of our interest. From there, we also allowed the subjects to develop their own view of the family planning and contraceptive situation.

4 Data

4.1 The Cambodian Demographics and Health Survey

The Demographics and Health Surveys (DHS) is a global project primarily funded by the United States Agency for International Development (USAID). The project's purpose is to conduct extensive data gathering in order to prepare a decision basis for policy makers and program managers. The project has been implemented in several developing countries during the last few decades in cooperation with the local authorities. In Cambodia the project was initiated in small scale in 1998 and has been expanded in the succeeding surveys (2000, 2005 and 2010).

The Cambodian DHS data sets consist of large, nationally representative, samples. The sample size in 2000 was 15,351 women, 16,823 in 2005 and 18,754 women in 2010. All respondents are between 15–49 years. The rate of response is 98 % in the first survey and 97.5 % in the two following.[10]

4.1.1 A Note on the Wealth Index

Accurate measures of income are difficult to find in developing economies as income reporting is often absent and tax systems regularly wanting. Further, many developing economies are cash based, with a large fraction of the population relying upon non monetary income. There is also a risk for biases when survey data is found, such as underreporting of income by wealthy individuals, for tax evation reasons. One way to handle this problem is to observe consumption which is, potentially, easier. Here, DHS has developed the *Wealth Index*. It is computed from data on material properties in the respondent's residence.

[10] National Institute of Statistics and MEASURE DHS (2001), National Institute of Statistics and MEASURE DHS (2006) & National Institute of Statistics and MEASURE DHS (2011)

These include type of water source, type of flooring, access to electricity, type of vehicle, and so on (Rutstein and Johnson, 2004). Possession of many of these durable items is related to long-run per capita household consumption, and thus also to the long-run income level (Bollen et al., 2007).

The Wealth Index is for the reasons described above a feasible measure of income, with a few reservations. First, consumption is only possible to measure on a household level. Very few live in a single person household, for which reason DHS is obliged to disentangle private from common household goods. This makes our result dependent upon the accuracy of the DHS computations. Second, DHS uses a method to standardise the measure for every year for easier comparison. This does, however, not allow us to compare the values between the years and we therefore use Wealth Index quintiles. Thus we see the relative effect of moving between quintiles and whether this changes over time—but not how the changes in absolute level of wealth affects use.

4.2 Data Subselection

In our analysis, we have only included individuals with a need, met or unmet, for family planning. Family planning methods are relevant only for women with a desire to limit or space births, why we drop observations for all infecund women. This includes women who declare their infecundity themselves, as well as those declared infecund by the DHS analyst team by following a set of conditions—including menopause, hysterectomy, etc. In addition, married women not using contraceptives who have not had a pregnancy in the last five years, are considered infecund. Infecundity is also classified for women who are neither pregnant nor postpartum amenorrheic, and for those who have not menstruated in the last six months (Rutstein and Rojas, 2006). Women who have not yet initiated sex are also excluded from the analysis. Some researchers on contraceptive use have found it necessary to exclude all non-married women from their sample Feyisetan and Casterline (2000). We refrain from this exclusion, since preventing unwanted pregnancies is an issue for all sexually active and fecund women.

In line with most other authors in this field such as Vaessen (1981), Thang and Anh (2002) and Schoemaker (2005), we have chosen not to use sampling weights when reporting our regression results. According to Rutstein and Rojas (2006) at DHS, sampling weights are inappropriate for estimating relationships

such as regression coefficients. They are, however, applied when we report summary statistics.

5 Results

5.1 Summary Statistics

As seen in Table 1,[11] the ten year period have brought significant changes in many of the variables we investigate. The use of modern contraceptives has increased by almost 60 %, from 26.65 % to 41.59 %. This is accompanied by an increase in the average number of methods known to the respondents. Today, the average number is 7.77 (out of 13), which is an increase of about 25 % from 2000. Both the fertility rate and the fertility preference are substantially lower when compared to one decade earlier. The percentage of women responding that they do not want an additional child within two years, is now 76.88 %, an increase by 65 % from 2000. The average number of living children per woman is 2.65 compared to 3.18 in year 2000 which indicates a lower total fertility rate.[12]

Table 4 presents cross-correlation values for all investigated variables in the pooled data except for regional residence. The highest correlation is between *Urban* and *Wealth* at .460. We conclude that no risk for multicollinearity exists.

[11] Sampling weights have been applied.

[12] This does not take into account changes in child mortality and other factors that also affect the fertility rate. However, it is more likely that these factors also have improved than not, which makes this a conservative estimate.

Table 1: Sample-Weighted Summary Statistics for Selected Subsample

	2000			2005			2010			All Years		
	Avg./%	Min.	Max.	Avg./%	Min.	Max	Avg./%	Min.	Max	Avg./%	Min.	Max
Uses Modern Contraceptives[a]	26.65	0	1	34.01	0	1	41.59	0	1	35.2	0	1
Fertility Preference[b]	46.49	0	1	75.57	0	1	76.88	0	1	68.7	0	1
Contraceptive Knowledge[c]	6.23	0	13	7.29	0	13	7.77	0	13	7.21	0	13
Married[d]	90.7	0	1	89.84	0	1	92.42	0	1	91.13	0	1
Education[e]	3.34	0	16	3.79	0	17	4.58	0	20	4.00	0	20
Number of Children[f]	3.18	0	12	2.99	0	2	2.65	0	11	2.90	0	12
Urban[g]	18.75	0	1	17.87	0	1	19.65	0	1	18.82	0	1
Exposure to Family Planning Messages[h]	1.87	0	3	1.39	0	1	1.38	0	3	1.51	0	3
N	5,051			6,574			7,814			19,439		

Notes:
[a]Percentage that currently use a modern contraceptive method.
[b]Percentage with no desire for an additional child within two years.
[c]Number of modern contraceptive methods known (out of 13 possible).
[d]Percentage of women currently married.
[e]Expressed in number of years.
[f]Includes only living children.
[g]Percentage living in urban areas.
[h]Number of sources from where family planning messages have been received (TV, radio and newspaper)

5.2 Basic Model

Results from the basic regression are shown in Table 2. We control for urban dwelling and family planning exposure and find that none is significant. The pooled regressions use a fixed effects model on regional level and year dummies. In the year-specific regressions we also control for region. The preference and knowledge coefficients are all significant on a 5 % level in the first stage before controlling for socioeconomics. Throughout the three years, the effect increases for preference.[13]

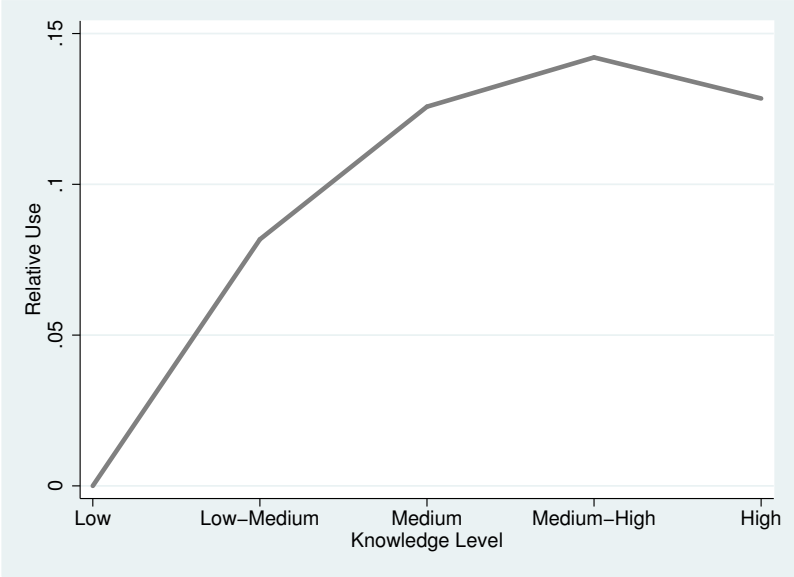


Figure 2: Effect of Contraceptive Knowledge, Compared to Low Level (pooled DHS data)

We conclude that the knowledge variable follows a parable with the same maximum in all three years, plotted in figure 5.2. Beyond a medium knowledge level, equalling knowing 6–8 methods, the marginal effect is diminishing, peaking at medium-high level. This equals knowledge of 9–11 methods and is identical

[13]We perform a Student's t-test to test for difference in the coefficients between 2005–2000, 2010–2005 and 2010–2000, where $t = (\beta_{t=i} - \beta_{t=j})/(se^2_{t=i} + se^2_{t=j})^{0.5}$. The difference in the coefficient to fertility preference is statistically different from zero between 2010–2000 and 2005–2000 but not between 2010–2005. Refer to Table 3 for t-statistics for all coefficient differences.

to the parable form of the supply variable in the basic model. The maximum point is the same in the three years at a knowledge level of 10 methods.

5.3 Socioeconomic Controls

The coefficients of preference and knowledge decrease slightly when we add education level and wealth to the regression. The significances to the coefficients do not change below a 5 % level. Education level is insignificant throughout all years, an effect that remains when excluding child preference and the two knowledge variables. The effect of wealth is significant in the first and last year and its effect turns from positive to negative—an effect that is identical when excluding preference and knowledge from the regression. Family planning exposure turns from insignificant to significant when excluding preference and knowledge, indicating that it has an indirect effect upon contraceptive use through either of these two variables.

Table 2: Basic Model, Controls

	(1) All Years	(2) 2000	(3) 2005	(4) 2010	(5) All Years	(6) 2000	(7) 2005	(8) 2010	(9) W/O[1]
Contraceptive Knowledge	0.0403***	0.0368***	0.0530***	0.0540***	0.0387***	0.0314***	0.0513***	0.0504**	
	(8.19)	(4.88)	(5.03)	(3.47)	(7.89)	(4.17)	(4.89)	(3.28)	
Squared Knowledge	-0.00192***	-0.00173*	-0.00275**	-0.00276**	-0.00190***	-0.00166*	-0.00291***	-0.00253*	
	(-4.63)	(-2.22)	(-3.23)	(-2.59)	(-4.61)	(-2.15)	(-3.44)	(-2.41)	
Fertility Preference	0.127***	0.0367**	0.164***	0.168***	0.0978***	0.0332**	0.123***	0.130***	
	(17.54)	(2.88)	(13.03)	(13.57)	(13.55)	(2.62)	(9.63)	(10.48)	
Family Planning Exposure	0.00563				0.00427	0.0126*	-0.00578	0.00200	0.0117**
	(1.55)				(1.15)	(2.01)	(-0.80)	(0.32)	(3.29)
Year 2	0.0366***				0.0468***				0.0963***
	(4.04)				(5.22)				(11.30)
Year 3	0.0907***				0.0963***				0.156***
	(9.62)				(10.22)				(18.34)
Years of Education					0.000419	-0.00227	0.00512*	0.000117	0.000595
					(0.35)	(-0.95)	(2.38)	(0.07)	(0.50)
Wealth in Quintiles					-0.000832	0.0179***	0.00770	-0.0228***	0.00134
					(-0.28)	(3.30)	(1.47)	(-4.45)	(0.45)
Married					0.287***	0.224***	0.278***	0.322***	0.315***
					(40.07)	(19.91)	(23.48)	(24.16)	(45.69)
Constant	0.0295*	0.0369*	0.0365	0.0577	-0.209***	-0.191***	-0.201***	-0.142*	-0.0931***
	(1.99)	(1.98)	(1.38)	(1.02)	(-12.72)	(-8.45)	(-7.03)	(-2.52)	(-5.82)
Observations	19439	5051	6574	7814	19439	5051	6574	7814	19439
R^2	0.051	0.050	0.043	0.040	0.079	0.075	0.073	0.072	0.066

t statistics in parentheses

[1] W/O is All Years with all controls but exluding knowledge and fertility preference

All regressions include controls for region & urban dwelling.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Discussion

6.1 Increased Effect of Demand and Marginal Effect of Supply

We will discuss our findings through the demand- and supply framework, followed by a discussion of the socioeconomic variables. Last, we point to potential explanations for the main changes.

The most evident finding is the increase in the coefficient of preference. This means that the effect of the woman's fertility preference is much more significant: it has gone from having no discernible effect upon the decision, to being one of the most important factors. It certainly hints at the importance of demand factors, but also that their importance might vary with time. Bongaarts (2003) discusses the concept of fertility transition, which is where a developing country goes through a period of a drastically reduced number of children per woman. This is something we see in Cambodia: at the end of the period the fertility is much lower. Our result points to that the effect of demand might not be static through this process, but instead have a more pronounced role in certain stages. However, this claim would require further research into the specifics of the link between Cambodia's current development and its general transition from high- to low fertility country. Feyisetan and Casterline (2000) see how the demand factors are important in early stages of the transition period when they look at a sample of sub-Saharan African countries, a hypothesis that would be fruitful to test using a longer time series from Cambodia.

When looking at the supply component of the framework, its proxied inclusion in the model serves three purposes. The first is to reduce the bias in the child preference variable. The second is because of interest in the knowledge effect itself, and the the third is to see whether any conclusions can be drawn from studying the actual supply.

Regarding the first purpose, we assume that the change in supply over these years could introduce an upward bias in the child preference coefficient. Including the knowledge proxy will allow us to control for parts of that effect. When introducing the control in Table 2 we see that the child preference coefficient is reduced slightly in the expected direction, but that it is rather robust. The effect is of the same magnitude in all three years, and indicates that the bias from omitting supply is low.

The most evident result regarding knowledge is the diminishing returns of the proxy itself, i.e. the knowledge of methods. In all years, we see the same parable where a maximum is reached at around ten known methods, but that the marginal effect of further knowledge is small beyond a few known methods. We further find that the factors influencing knowledge is education, wealth and family planning information. This could well be correlations rather than causal relationships, but hints that family planning information beyond a certain knowledge level is not likely to have much effect upon the use propensity.

What conclusions can we draw from the proxied actual supply? Authors with the aim to compare the importance of supply with that of individual preference for children, have used other proxies and have obtained different results. Thang and Anh (2002) examine family planning in Vietnam and provide support to the supply view when they find that accessibility (as measured in kilometres from the nearest source) had a substantial positive effect on use. Schoemaker (2005), on the other hand, performs a similar analysis in Indonesia and concludes that attitudes toward family planning (interpreted as a demand-side factor) have more explanatory power than supply factors, such as wealth. Providing that our assumptions regarding the proxy hold, the demand factor dominates supply in the two later years. It also hints that supply has an important role to play at a low level—but that its effect, unlike the effect of fertility preferences, could diminish above a certain level.

6.1.1 Socioeconomics

Among the indirect components it is notable, and perhaps surprising, that the education coefficient does not show up positive and significant. Bongaarts (2003) shows that increased education is generally followed by reduced fertility. Within our framework, such a reduced fertility through increased contraceptive can occur in two ways. The first is through an increased propensity to use contraceptives at a given fertility preference. No such effect can be found in Cambodia: the contraceptive use propensity for a given fertility preference is robust to changes in education level. Second, the effect can go through the child preference; something we would see in an increased education coefficient, when removing the preference and knowledge variables from the regression equation. As the coefficient is not changed, this hints that the woman's education has not been an important factor in the increased contraceptive use.

Bollen et al. (2007) points to the importance of income as a determinant for fertility—and thus contraceptive use; but also raises the difficulties encountered when measuring income in developing countries. This applies to the Cambodian situation, where the measures are standardised for each year and therefore not comparable between years. We find it difficult to explain the changed signs between the years, and to see why contraceptive use has gone from being positively to negatively related to income. This holds both when controlling for fertility preference and when excluding that variable, and is not consistent with previous research on income and contraceptive use. We believe that it is equally likely that the regression shows some bias, such as an omitted variable changing over, as it is that we observe some change in behaviour due to threshold effects. For that reason, we can not draw any clear conclusions on the wealth effect upon contraceptive use in Cambodia, and suggest finding alternate income measures in the manner of Bollen et al. (2007).

6.2 Explaining the Changes

An important factor determining female contraceptive use, given a certain preference, is interspousal communication. Where this component is lacking, the result is generally non- or covert use of contraceptives. As it is more common that it is the woman who wants to limit fertility, incurring the largest costs of childbearing (Mauldin, 1982), it is likely that an unequal gender situation is a barrier limiting contraceptive use as pointed out by Biddlecom and Fapohunda (1998).

A number of indicators on the Cambodian gender situation show some progress during the last decade, in that it is both easier to talk about sexual matters and that the general awareness of gender issues has improved.[14] If such a development would increase interspousal communication as well as women's negotiation positions regarding contraceptives, as suggested by the interviews conducted, we posit this as a potential explanation to why the direct preference component of the contraceptive choice has increased.

[14]Interview with Ros Sopheap, Executive Director Gender and Development Cambodia. Phnom Penh, March 16, 2012.

7 Conclusions

The share of women using modern contraceptives at a zero preference for additional children has increased. When constructing an OLS regression equation where contraceptive use is dependent variable, we see that the coefficient of child preference has increased both in effect and significance between 2000–2010. This implies that the woman's own preference has become more important in the contraceptive use decision. We discuss how this could be an effect of increased sexual liberalisation—and also point to the need for further research where the change is included in a more general framework regarding fertility transitions in developing countries.

We also show how the woman's knowledge about contraceptives has a clear diminishing effect on the probability that she will use contraceptives. Beyond the knowledge of a few methods, the effect of knowing further methods is marginally diminishing. If knowledge is also a valid proxy for supply, we reason how this result can be included in the supply-demand framework of contraceptive use. Whereas we see the effect of demand is increasing along with an increase of contraceptive use during this time period, the effect of supply seems to be important in the early stages. However, when the supply is increased beyond a beyond a basic level, the effect is rapidly diminishing. This level of individual supply has, on average, been reached in Cambodia in 2010.

Regarding the socioeconomic variables education and wealth, we test two hypotheses. The first is that socioeconomics affect the marginal propensity to use contraceptives at a given child preference. Here, education has no effect, whereas the effect of wealth is more ambiguous. Due to measuring difficulties and that we can not compare the three years, we are not able to draw any clear conclusions. Second, we test whether the socioeconomic variables have an indirect effect that is captured by the supply and preference variables. Unlike previous research, we find no such effect of education—and the effect of wealth is again not clear. However, in all cases the socioeconomic effects are of much lower magnitude than the effect of fertility preference in the two later years.

8 Appendix

Table 3: T-statistics for Coefficient Differences

	$\Delta 2005 - 2000$	$\Delta 2010 - 2005$	$\Delta 2010 - 2000$
Contraceptive Knowledge	1.54	-0.05	1.11
Squared Knowledge	-1.09	0.28	-0.67
Fertility Preference	5.01	0.38	5.47
Family Planning Exposure	-1.92	0.81	-1.19
Years of Education	2.30	-1.79	0.80
Wealth in Quintiles	-1.36	-4.17	-5.46
Married	3.36	2.46	5.66
Urban	-1.34	0.01	-1.35

Table 4: Cross-Correlation Table – Pooled Data

Variables	Modern Method	Contraceptive Knowledge	Squared Knowledge	Fertility Preference	Years of Education	Wealth in Quintiles	Married	Urban	Family Planning Exposure
Using Modern Method	1.000								
Contraceptive Knowledge	0.129	1.000							
Squared Knowledge	0.117	0.963	1.000						
Fertility Preference	0.150	0.139	0.130	1.000					
Years of Education	0.042	0.287	0.281	0.010	1.000				
Wealth in Quintiles	0.028	0.276	0.264	-0.009	0.475	1.000			
Married	0.192	0.046	0.044	0.158	0.042	0.026	1.000		
Urban	0.011	0.170	0.175	0.004	0.306	0.460	-0.016	1.000	
Family Planning Exposure	0.019	0.330	0.318	-0.062	0.311	0.339	0.012	0.172	1.000

8.1 Logistic Regression

In Table 5 we present results from a marginal effect logistic regression. The variables included are equivalent to those included in the regression in Table 2, but the coefficients now measure the marginal change in probability of using contraceptives per unit change in the explanatory variable. An advantage with this representation is that the coefficients are easily compared to those from the OLS estimations. The fundamental results from the OLS regressions hold when using a logistic form.

Table 5: Logit Regression – Marginal Effects

	(1) All years	(2) 2000	(3) 2005	(4) 2010
Contraceptive Knowledge	0.0582***	0.0449***	0.0659***	0.0604**
	(7.83)	(4.55)	(4.63)	(2.95)
Squared Knowledge	-0.00317***	-0.00272**	-0.00388***	-0.00311*
	(-5.71)	(-3.12)	(-3.64)	(-2.30)
Fertility Preference	0.101***	0.0298*	0.129***	0.139***
	(13.35)	(2.41)	(9.72)	(10.65)
Years of Education	0.000437	-0.00220	0.00525*	0.000133
	(0.36)	(-0.99)	(2.40)	(0.07)
Wealth in Quintiles	-0.000825	0.0183***	0.00766	-0.0241***
	(-0.26)	(3.48)	(1.44)	(-4.45)
Married	0.309***	0.230***	0.310***	0.351***
	(43.59)	(21.67)	(25.48)	(25.94)
Family Planning Exposure	0.00441	0.0137*	-0.00578	0.00180
	(1.13)	(2.21)	(-0.79)	(0.27)
Year 2	0.0525***			
	(5.07)			
Year 3	0.101***			
	(9.74)			
Observations	19439	5051	6574	7814

Marginal effects; t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Method Frequencies

Method	**N**	**Percent**
Not using	9,579	49.23
Modern		
Pill	3,246	16.68
Injections	1,446	7.43
Condom	624	3.21
IUD	559	2.87
Female sterilization	436	2.24
Monthly pill/Chinese pill	440	2.26
Male sterilization	33	0.17
Norplant	71	0.36
Lactational amenorrhea	8	0.04
Female condom	3	0.02
Traditional/Folkloric		
Withdrawal	1,970	10.12
Periodic abstinence	1,022	5.25
Other	20	0.10
Total	19,458	100.00

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