A comparative analysis of contraceptive use and intent in Guatemala

1 Introduction

Much of Latin America has recently experienced a rapid decline in fertility accelerated by an increase in contraceptive use (PRB 2007). An increasing number of countries in both Central and South America are characterized by below replacement total fertility rates (TFR) and contraceptive prevalence rates (CPR) matching those of more developed countries (PRB 2007, De Broe & Hinde 2006, Rosero-Bixby, Martin & Martin-Garcia 2008). However, a closer look at country and regional family planning behavior in Latin America reveals exceptional subgroups with unusually high TFR and correspondingly low CPR. Once a leader in family planning, Guatemala, as shown in Table 3.1, now has the highest TFR in Latin America and one of the lowest CPRs in the Western Hemisphere (Santiso-Galvez & Bertrand 2004). In a context where maternal and infant mortality rates are high, poverty is rampant, and malnutrition is common, empowering women with the knowledge and resources to plan their own families is vital. However, Guatemala's low CPR and high TFR suggest that the ability of women to freely determine the timing and number of births may be limited.

The low CPR is theorized as an important determinant of high fertility levels (Bongaarts 1978) and a thorough understanding of contraceptive use and intention correlates is therefore necessary for a thorough understanding of fertility. The goals of this research therefore are twofold: 1) to update previously established models of contraceptive use in Guatemala with models using the most recent data, and 2) to compare current (using 2002 data) trends in contraceptive use and intention to past (using 1987 data) trends. The results of the analysis aim to provide information helpful to monitoring components of Guatemala's fertility transition and examining the population's evolving unmet contraceptive need. Differing from related research, these models use flexible modeling techniques, the most current data, and incorporate an alternative approach to ethnic classification contributing to a general understanding of

acculturation among Guatemala's Indigenous population.

2 Theories of Contraceptive Use

Coale (1973) and Bongaarts (1978) developed broadly generalizable frameworks which have become key theoretical components in virtually all fertility analyses. Coale (1973) theorizes that fertility declines when the following three conditions are met: 1) fertility is perceived as controllable, 2) lower levels of fertility have positive implications, and 3) individuals are aware of family planning technologies, how to obtain them and are willing to use them. These preconditions have framed most modern fertility analyses. Population scientists have explored fertility within Coale's theory, developing and interpreting models based on how micro- and macro-level characteristics correspond to the three conditions. Coale's theory of decline motivates the development of a model exploring an individual's desire to use contraception to determine the individual and household correlates of family planning behavior.

Contraceptive use has also been identified as one of Bongaarts' three direct determinants (or proximate determinant using Bongaarts' terminology) of fertility; any change in fertility results directly from a change in one of the direct determinants. Micro-fertility analyses generally explore the indirect determinants of fertility – the demographic, economic, social, and cultural factors that are hypothesized to act on the direct determinants and therefore cause a change in fertility (Davis & Blake 1956, Bongaarts 1978). These theories have supported and motivated modern fertility research and the significance of contraceptive use and desire in these fundamental and largely applied theories underscores the importance of examining patterns of contraceptive use as a response variable on its own. The following subsections introduce contraceptive use theories and the link between contraception and fertility.

2.1 Types of Contraceptive Use: Spacing and Stopping

Contraceptive technology and its use are necessary components of fertility decline. Based on evidence from the European transition from high to low fertility, decreases are typically

accompanied by a reduction in births of higher order. Therefore an evaluation of fertility change over time in a population that was transitioning to lower fertility would show relatively stable rates of transition from no children to parity one and parity one to parity two (and perhaps to higher parities depending on the population's location in the transitional curve) and declining rates of transition to higher parities (Van Bavel 2004). The customary decline in higher order births is attributed, almost exclusively, to an increased use of birth control techniques. A change in age at first or second (or beyond) birth is generally expected to occur, perhaps simultaneously to a decline in higher order births. An increase in mean age at first birth generally coincides with a declining fertility rate and increased contraceptive use serves as a factor that motivates this change (timing of entry into motherhood). Increasing spacing, the difference in months/years between births, should also theoretically lead to a decline in fertility as it limits the amount of exposure time women ultimately have to enter into higher parities. An increase in women deliberately spacing their births, similar to increasing the age at first birth, is also a result of increased use of some from of contraception. Contraceptive use, therefore impacts fertility rates in different ways enables the permanent cessation of births, enables a delay of entrance into motherhood, permits the woman to space and time her births which can ultimately lead to a limitation in the progression to higher parities.

2.2 Unmet Need

The actual decline from high to low fertility has been suggested to follow the "gradual development of a new value — wanting fewer births" (Freedman & Coombs 1974, Bongaarts 1991). The reasons for this ideational change may reflect changes in the perceived cost/benefit of children or come as a result of the diffusion of information relating to family size or gender values or contraceptive technology (Raftery, Lewis & Aghajanian 1995, Caldwell 1982, Cleland & Wilson 1987). This ideational change is also identified by Coale as a precondition, suggesting that in addition to wanting fewer births a willingness to control fertility and ability to access and use contraception must also exist for a change in fertility to occur. In the life of an in-

dividual woman, a change in optimal family size, does not, however, result in a simultaneous "adoption of birth control". Instead, there is a subset of the reproductive population that may want fewer children but have inadequate resources, or lack access to resources, to achieve this goal. This portion of the population is therefore said to have "unmet need".

The Knowledge, Attitudes and Practices (KAP) surveys of the 1960s and 1970s (Andro, Hetrich & Robertson 2002, Bongaarts 1991) serve as the origin of "unmet need". These KAP surveys, where the data collected was specific to the family planning and contraception characteristics of women, allowed for the construction of a statistic representing the proportion of (married) women who "do not want a birth in the future but are not practicing contraception [currently]" (Bongaarts 1991, Becker 1999). The proportion of women with unmet need is commonly referred to as the KAP-gap and the concept is virtually identical to the concept of unmet need (see Bongaarts 1991 for additional discussion on KAP-gap and unmet need).

Currently, Demographic and Health Survey (DHS) data includes the rate of unmet need in their country specific reports. DHS defines a married woman as having unmet need if she is "not a current user of contraceptives; not currently pregnant or amenorrheic (where the pregnancy was reported as intentional); not infecund; and not a fecund woman who wants a child in less than two years" (Becker 1999, Bankole & Westoff 1998).

Research has shown that even a small gap can result in a relatively large percentage of unwanted births. For illustration, using a slightly different definition of unmet need, Bongaarts shows that with an instantaneous KAP-gap of about 3%, 20% of all births for the corresponding time period are unwanted (Bongaarts 1991). A 2003 report of unmet need in the developing world (based on DHS data) showed a low unmet need of 6% for Columbia (DHS 2000) with a high of 40% for Haiti (Guatemala had an unmet need of 28% - second only to Haiti in the Latin American/Caribbean region). On a global scale, the estimated number of women with unmet need hovers near 100 million (Becker 1999, Robey, Ross & Bhushan 1996). Since a woman's desire to use contraception may be influenced by partner, couple or community characteristics determining individual unmet need is complex. There is ongoing debate over the role of the woman, the husband and the couple in determining unmet need (Becker 1999). Research has

revealed the importance of the husband's role in a couple's (or woman's) use of contraception and couple cohesion on adoption of family planning. As the impact of couple's or partner's need on the woman's need is not fully understood, the accuracy of the current method for evaluating unmet need remains unresolved.

3 Contraceptive Use in Guatemala

Concern about the reproductive health of poor Guatemalan women inspired the 1964 development of the Asociacion ProBienstar de la Familiar (the Association of Family Well-being [APROFAM]) (Santiso-Galvez & Bertrand 2004). Supported by the International Planned Parenthood Association, APROFAM began building reproductive health clinics the following year. Shortly after the first clinic was established Guatemala was identified as one of only a handful of forward-thinking Latin American countries (Santiso-Galvez & Bertrand 2004, Hall 1973). However, the combined impact of the war with other socio-demographic factors caused significant stagnation in the country-wide adoption of family planning. Guatemala's unstable and, at times, violent social and political climate are theorized to be the root causes of the "delayed contraceptive revolution" and have resulted in a limited supply and demand of contraception (Santiso-Galvez & Bertrand 2004). According to the most recent reports, Guatemala ranks the lowest in overall contraceptive use among the neighboring Central American countries of El Salvador, Honduras and Nicaragua. The 2002 ENSMI[1] reports a use rate of 43.3% among married women almost 20% lower than Honduras, the second lowest recorded rate. With a high value of 60% the Metropolitan use rate perhaps reflects the impact of economics and access on contraceptive use while the low value of 27% for the Northwest region suggests that either the region has not adopted Western ideas of family size or has significant unmet need. When characterized by age only 23% of married women aged 15-19 and 35% of women

[1]Encuesta Nacional de Salud Materno Infantile or, in English, the National Survey of Maternal/Child Health, is a national Reproductive Health Survey (RHS) collected with the support of the Centers for Disease Control. While not identical to the Demographic and Health Surveys (DHS) collected in 1987, 1995 and 1998/99, the 2002 ENSMI contains similar socio-demographic and health information of the woman and the household and is collected from a nationally representative sample.

aged 20-24 report use of contraception. These are the lowest age-specific use rates among the four countries more than 30% lower than Nicaragua's comparative rates and about 20% lower than those of Honduras. Rates of use are particularly low among the Indigenous population (Bertrand, Seiber & Escudero 2001). Indigenous women traditionally have limited access to Spanish, the dominant language, and have higher ideal family sizes — factors which may inhibit fertility regulaton (De Broe & Hinde 2006, Pebley, Goldman & Robles 2005, Pebley, Delgado & Brineman 1979, Bertrand et al. 2001).

Guatemala also has some of the highest total fertility rates of the Central American region a country-wide TFR of 4.4 births, certain sub-populations have completed birth cohort values that exceed 7 and 8 births (Carr 2006). While it is generally assumed that the high fertility countries are experiencing decline, the relatively stagnant, and in some case increasing fertility rates of some regions may reflect a rejection of family planning (limited demand) or limited access to family planning (supply).

4 Data

Data from the 1987 and 2002 ENSMI will be used to conduct the analysis (MSPAS (1989, 2002)). The 1987 data was collected as a Demographic and Health Survey (DHS) with the assistance of Macro/Measure and the 2002 data was gathered with the technical assistance of the Centers for Disease Control and Prevention (CDC) as part of the Reproductive Health Surveys (RHS) program of the CDC. The 1987 data was collected as an equally weighted sample. The 2002 data were randomly collected based on a stratified sampling scheme and each individual is assigned a weight. The weights were calculated based on a probabilistic sampling design of randomly selected households within random selected areas (like census tracts) and are adjusted to account for multiple eligible women within a household. The ENSMI report contains detailed information on the sampling strategy and on the departmental and regional weights.

The surveys contains data from up to 9,155 Guatemalan women between the ages of 15 and

49 (15-40 for the DHS). To incorporate the 2002 survey weights into the analysis, observations were replicated proportional to the weight such that the smallest fractional weight was equal to a single observation. This resulted in a self-weighting data set with 150,000 records. That data was then sampled to yield 10,000 records so as to not overstate the precision of the resulting estimates. Table 3.2 compares the original weighted CDC data to the equally weighted sample of 10,000. Differences between the two datasets are minimal. While there are some minor differences between the two data sets, there is no indication that there is any significant difference between the original weighted sample or the constructed self-weighted sample.

5 Methods

Beyond the use of the most current data, this analysis differs from related analyses of Guatemala's contraceptive dynamics through the use of classification modeling techniques. Classification trees are a non-parametric technique designed to sort data in terms of the dependent variable into mutually exclusive categories based on the effective categorization of the independent variables. Trees have been used in public health research to identify at-risk populations and are valued for their ability to capture conditional relationships ("describe associations in the data" (Lemon, Roy, Clark, Friedman & Rakowski 2003)) rather than test the significance of variables on the response (see Lemon et al. 2003 for a detailed list of instances where trees have been used). Despite extensive analyses of family planning correlates, however, trees have not been applied in contraceptive use analyses and the utility of these models in family planning research is unexplored. In reference to Guatemala, where there is a long history of family planning research and yet a persistently low rate of contraceptive use, tree models may identify at-risk populations not captured by traditional regression techniques. Reflecting the research aims listed in the introduction for each time period models of use versus non-use and intention versus no-intention for both the rural only and the entire population will be constructed.

The model is constructed as the tree splits the data into the two groups of the response using each variable. The variable that causes the most effective split, as measured by an entropy

(measure of similarity) calculation (in this case the Gini Index[2] is used), initiates the tree. The optimal split maintains the highest possible level of homogeneity in the daughter nodes that contain the split data (Ambalavanan, Baibergenova, Carlo, Saigal, Schmidt & Thorpe 2006). The splitting and entropy calculation process then continues at each node of the tree using each of the independent variables (Nelson, Bloch, Longsteth & Shi 1998, Ambalavanan et al. 2006). The tree finally stops growing once perfect homogeneity is obtained or stopping rules are met (Ambalavanan et al. 2006, Lemon et al. 2003). At this point the analyst then selects the ideal tree based on parsimony and efficiency in categorization. Similar to an overparameterized regression, a "perfect" tree can be fit but it would be too cumbersome and unstable to be of any value. Model specification testing to achieve parsimony employs cross-validation. The validation data set is an *a priori* randomly selected portion of the data set. The cross-validation measure is calculated at each split and is adjusted to reflect the added complication brought in by additional variables (similar to adjusting the R-square in a regression). I used a combination of the cross-validation error and the number of factors in the tree to select the best tree among the universe of trees. The final tree was selected among the set of trees that was small enough to be interpretable but large enough to successfully categorize the sample[3]. Terminal nodes in these pruned trees can therefore be interpreted as representing one level of the two-level response variable[4]. The final terminal nodes represent categorization that is as near perfect homogeneity as possible within the confines of the *a priori* stopping rules. In the results presented here, gray shading is used to distinguish the terminal nodes from the daughter nodes.

Classification trees are able to incorporate a large number of independent variables and to identify complex interactions among variables. These are not characteristics of logistic regres-

[2]The Gini Index is a measure of similarity. The calculation is straightforward: Gini = 1-$\sum_i p_i^2$ where p is the observed proportion of each type i. When comparing ethnicity, for example, if 75% of a population is Indigenous the Gini value is lower than when half the population is Indigenous.

[3]Almost identical trees were created with the use of the standard deviation technique. This technique selects the smallest tree with a misclassification error within one standard deviation of the tree with the smallest misclassification error (see Lemon et al. (2003) for more details).

[4]Similar to logistic regression where a cut-off percentage is established that groups continuous response values into one of two categories. This is the standard method used in regression to determine the predicted categorical outcome of an individual observation.

sion and are among the primary reasons for using classification analysis instead of regression modeling. Frequently logistic regression models tend to be fitted with only marginal effects with the occasional addition of specific two-way effects. Higher order interactions tend to be omitted because they are difficult to interpret and present, even for experienced analysts. These issues are irrelevant in tree building as higher order interactions between variables are easy to identify and interpret. These benefits enable the analyst to explore varied factors that may have a potential effect on the outcome with virtually no limitations on the structure of the independent variables. The tree analysis scheme creates cut-off values for continuous independent variables and has the potential to group the different levels of categorical variables for the purpose of creating an effective splitting node (Nelson et al. 1998).

In terms of accessibility, trees are an improvement on regression models The usefulness of the regression model is restricted by the relatively small population of scientists and researchers with the training to interpret them. The classification tree's natural flow-chart style enables quick and easy model interpretability by a broad group of interested individuals (Faraway 2006, Martin, Meyricke, O'Neill & Roberts 2006). The inferential framework of logistic regression, on the other hand, emphasizes assessment and interpretation from estimated parameters, concepts which are unfamiliar to policy and health professionals.

Despite the flexibility of trees, and as with all quantitative analyses, it is still necessary to ground the selected independent variables in theory and to hypothesize about their relationship with the response variable. The following sub-section introduces the variables and the theories supporting their use.

5.1 Modeling Contraceptive Use and Intent

Large differences in contraceptive use exist between the rural Indigenous and their urban counterparts and the population of women with secondary education and those without. Analyses of contraceptive dynamics in Guatemala examine these differences and have shown the statistical importance of ethnicity, education and, in some cases, access to clinics (specifically for

the Indigenous population) (Bertrand et al. 2001, Seiber & Bertrand 2002, De Broe, Hinde, Matthews & Padmadas 2005, De Broe & Hinde 2006).

The independent variables used to model contraceptive use and desire in Guatemala have been selected based on the significance of related variables in similar research. The independent variables have been grouped into three categories: 1) Woman's characteristics, 2) Housing characteristics, and 3) Family/Relationship characteristics.

Woman's characteristics: This group of variables contains factors specific to each woman in the sample. Age and educational attainment are standard control variables in family planning analyses and are therefore implemented here. Older women have been exposed to childbearing longer than younger women and it is therefore necessary to adjust for the lengthened period of childbearing. I categorized age into seven groups, consistent with the standard five-year groupings, noting that the use of age as a categorical variable would facilitate the comparison of cohort behavior. Older women may be more interested in controlling their fertility because they are nearing childbearing goals (Anderson, Morris & et al. 1980, Beckman, Aizenberg, Forsythe & Day 1983, Bertrand et al. 2001, Zaky 2004). Because of recent expansions in health education outreach programs and changing family size ideals younger women may be more interested in delaying births. Older women, however, may be more likely to use stopping techniques as they may have attained their ideal family size (Bertrand et al. 2001) . The woman's educational attainment has also been a significant variable in related research. Education can serve to delay entrance into motherhood (limiting exposure), increase contraceptive knowledge and decrease family size goals (Anderson 1983, Johnston & Reid 1989, Rutstein 1998, Bertrand et al. 2001, Zaky 2004, Carr, Pan & Bilsborrow 2006).

In Guatemala, both education and age have been positively linked with increased contraceptive use and are expected to have the same relationship here (Bertrand et al. 2001, De Broe et al. 2005, Lindstrom & Hernández 2006, De Broe & Hinde 2006). In this case, three levels of education have been created, none, primary (including literate), and secondary or beyond.

In addition to the use of the control variables, two variables, a Catholic identifier and an ethnicity variable, have also been constructed to capture individual differences. Catholicism

has had a negative impact on contraceptive use expansion and family size goals throughout the world (Cutright, Hout & Johnson 1976, Herold, Westoff, Warren & Seltzer 1989, Martine 1996, McQuillan 2004) and may have had a negative impact on contraceptive use in Guatemala (Terborgh, Rosen, Santiso-Gálvez, Terceros, Bertrand & Bull 1995, Santiso-Galvez & Bertrand 2004). Each woman is therefore categorized as Catholic or non-Catholic with the expectation that women who are Catholic will be less likely to use or intend to use birth control.

Related research has indicated a link between fertility behavior, contraceptive use and ethnicity (Anderson et al. 1980, Terborgh et al. 1995, Shah, Shah & Radovanovic 1998). The role of ethnicity on contraceptive use and family planning may be linked specifically to access (Seiber & Bertrand 2002, Santiso-Galvez & Bertrand 2004, De Broe et al. 2005) to gender equity (Carter 2002, 2004) or even to ideas of Indigenous acculturation (Sexton 1979, Adams 1994). Santiso-Galvez & Bertrand (2004), Bertrand et al. (2001), Glei & Goldman (2000) and others have shown that Indigenous women in Guatemala, reflecting the impact of cultural and linguistic barriers, have different patterns of contraceptive and reproductive health care use (Anderson et al. 1980, Bertrand, de Salazar, Mazariegos, Salanic, Rice & Sow 1999, Singh, Prada & Kestler 2006).

The strong role of ethnicity in reproductive health outcomes requires the use of an ethnicity explanatory variable. Despite the presence of more than 20 distinct Guatemalan Indigenous groups Bertrand et al. (2001) determined that distinct Indigenous groups make similar family planning decisions and that the creation of a Ladino/Indigenous two-level categorical variable can adequately capture ethnic variation. I adopted this assumption of homogeneity among the Indigenous population and did not disaggregate the Indigenous population according to language or culture. I did, however, explore the idea that there is a process of acculturation or *ladinization* (adoption by the Indigenous population of Spanish language and western-style clothing (Adams 1994, Wilson 1999)) that can occur over time and that Spanish speaking Indigenous women may have different access to family planning than their non-Spanish speaking counterparts (Bertrand et al. 1999, Glei & Goldman 2000, Bertrand et al. 2001).

Historically Indigenous women are distinguished from Ladino women by their traditional

clothing and Mayan-based language (contrasted with Ladino women who dress in western clothing and speak Spanish). In an analysis of delivery care, Glei & Goldman (2000) created four distinct categories of Guatemalan women, primarily disaggregating the Indigenous population according to clothing and language. The results of the study highlight the significant variation in prenatal care that can be attributed to different degrees of Indigeneity. Self-identification of ethnicity, facilitated through qualitative analysis, was applied by De Broe et al. (2005) to evaluate contraceptive use in a small Guatemalan community. The authors determined that traditional DHS indicators of ethnicity are likely inadequate and may be misrepresenting actual contraceptive use patterns. Here, because of differences in the type of data available and a desire to incorporate characteristics from the woman's childhood a different technique was used to construct an ethnicity variable. Three factors were used to create an *Indigenous generation* variable; ethnic identification, maternal language, and language of the interview. Women who identified as Indigenous[5], whose interview was conducted in an Indigenous language and whose maternal language was not Spanish were given a score of zero and are considered Indigenous. Any change in one of these variables indicates a certain degree of assimilation (acculturation) by the Indigenous woman of components of the dominant Ladino culture and the score is therefore increased by a point. A woman who identifies as Ladino, whose maternal language was Spanish (indicating that her family of origin was Spanish dominant) and who was interviewed in Spanish is considered Ladino and receives a score of two. For the purposes of this analysis, women who are not classified as either *fully* (for lack of a better term) Indigenous or *fully* Ladino are referred to as *bicultural* women as they have traits from both ethnicities. Including this variable allows for the possibility that a woman could identify as Ladino but could have an Indigenous upbringing as well as for the possibility that a woman could identify as Indigenous but, with use of the dominant language, may have increased access to social and health services (Seiber & Bertrand 2002, De Broe et al. 2005, Singh et al. 2006). I anticipate this variable to be positively correlated with both use and intention to use.

[5]Because of different interviewers women may have been asked directly to self-identify their ethnic group or the interviewer may have categorized the women based on language or dress. This is a limitation of survey data in an ethnically divided population.

Housing Characteristics: This set of variables is used primarily to represent the household socio-economic level and the relative availability and accessibility of health and social services. Socioeconomic status has historically been an important component of theoretical models of fertility decline (New Home Economics model (Becker 1981)) and in some applications, the cost of educating children and an increasing focus on material gain have accompanied increases in family size limitation (contraceptive use) (van de Kaa 1996, Rutstein 1998, Bertrand et al. 2001). Type of floor material is therefore brought into the model as a measure of household wealth and is divided into two categories, dirt and improved (De Broe et al. 2005). Building on the socioeconomic theories, families with developed flooring are expected to have an interest in household economic status and may have fewer children than those with more rustic flooring.

Television ownership is also incorporated into the model as both a measure of household wealth and a potential means of increasing the woman's demand for contraception directly, through family planning information messages, or indirectly through the introduction to Western or more urban family size norms and ideals (Sexton 1979, Rutstein 1998, Bertrand et al. 1999, Bertrand et al. 2001, Carr 2002). Rates of contraceptive use in Guatemala are higher for women in urban centers and the urban/rural differential is linked to several theories of contraceptive use and fertility decline. Urbanization, a component of economic models of fertility decline, facilitates female labor participation and education (Becker 1981, Rosero-Bixby et al. 2008). Furthermore, urban living may enable the development of influential social-networks useful for passing contraceptive and family planning information (Entwisle, Rindfuss, Guilkey, Chamratrithirong, Curran & Sawangdee 1996, Kohler, Behrman & Watkins 2001, Lindstrom & Munoz-Franco 2005, Lindstrom & Hernández 2006, Singh et al. 2006). Urban residence will therefore be included as an independent variable in the models.

Because of variation in fertility, contraceptive use rates, and degree of overall development across Guatemala's eight regions, the woman's region of residence may be an important component in her contraceptive use (MSPAS 2002). Moreover, several micro-level studies have evaluated behavior within smaller communities and have revealed significant geographic variation in barriers to contraception (Bertrand et al. 2001, De Broe et al. 2005, De Broe & Hinde 2006).

Beyond regional variations in behavior, policies impacting health and development are commonly implemented and monitored by the Guatemalan government at the regional level. The Guatemalan government's planning commission (SEGEPLAN[6]) is responsible for a broad range of programs and services. The commission works at a regional level where regional directors and teams work to meet the specific needs of each regional sub-population. This regional approach to service provision and policy implementation further supports the incorporation of region of residence into models of contraceptive behavior.

Family/Relationship Characteristics: Among the variables representing different aspects of a woman's family and relationship with her partner, the variable, union status, is used as a control variable and will be used in the contraceptive use model. Contraceptive demand may be different among women who are married (formally or informally) than their single counterparts.

Number of children ever born and number of children who have died are used to represent the supply of children in a woman's life. Larger families have been hypothesized to act as a catalyst to increase the demand for contraception (Bertrand et al. 1999, Zaky 2004). However, if the death of a child has occurred, women may be more reluctant to regulate their fertility and are therefore expected to not use contraception or not have a desire to use contraception if an infant/child mortality experience has occurred (Pebley et al. 1979). The impact of these factors on national-level contraceptive patterns over time has not been directly explored in Guatemala (Bertrand et al. 2001).

The final variables in this category were selected to measure the effect of the partner on a woman's desire to use contraception[7]. One of Coale's preconditions of fertility decline states that reduced family size must be seen as beneficial (Coale 1973). However, couples shared family size aspirations and contraceptive values are not always present and frequently disagreements result in men making more decisions (Blanc 2001). Women may experience the cost of childbearing to a greater extent than their partners, particularly in gender unequal households, and therefore have increased contraceptive desire but are not always able to act on their desires (Fapohunda

[6]La Secretaría de Planificación y Programación de la Presidencia

[7]Gender equity and partner characteristics are only explored in the intent to use model as this is the only analysis restricted to married women.

& Todaro 1988, Dodoo & Seal 1994, Boserup 1981, Dodoo 2001, Carter 2002, Carter 2004). To evaluate household gender power dynamics the number of additional years of education obtained by the partner will be included (Blanc 2001). Where the partner has nearly the same or less education (as indicated by a relatively low value or a value of zero), I anticipate a more equitable partnership and different contraceptive desire characteristics. To incorporate the concept of couple's unmet need (Becker 1999) and to evaluate the role of communication and shared values, the variables evaluating contraceptive use agreement in the partnership, partner's acceptance of family planning, and partner's desire for more children are also included in the desire to use model.

6 Results

The following section presents the results of the analysis. As this analysis involves data from two time periods, results relevant to each time period will be discussed and compared in each sub-section.

6.1 Descriptive Analysis

The rates, means and standard errors of each of the independent variables are presented in terms of the Indigenous generation variable (Table 3.3). Of the 7,851 women who are included in the analysis in the 2002 period (infecund (menopausal or sterile) and those who are pregnant are excluded from the analysis), the majority (67%) are Ladino. The Indigenous generation variable generally partitions the women identified as Indigenous based on their language skills. Sixty-seven women who are identified as Ladino did not interview in Spanish and their maternal language was not Spanish. The majority of the bicultural women were identified as Indigenous (and would normally be classified as Indigenous in DHS-type reports) with Ladino language characteristics. Average age was fairly consistent across the population (roughly 27-29 years). Education levels, however are quite different. As compared to the Ladino women, the Indigenous women had much lower levels of secondary education. Approximately 5% of Indigenous women

reported that they received a secondary or beyond secondary education as compared to 43% of the Ladino women. Increasing rates of primary and secondary education occur as we move away from the fully Indigenous women to the fully Ladino women[8]. The country, as well as the different levels of ethnicity, were very nearly evenly divided into Catholic and non-Catholic religious groupings.

The majority of women who live in the Metropolitan, Northeast, Southeast, Central, and Petén, regions were Ladino. Of the non-Ladino women in the Metropolitan region, the majority have some Spanish language skills. The Northern, Northwest, and Southwest regions were largely Indigenous or not fully Ladino. Among the women grouped into non-Ladino, the majority lived in rural areas with the largest differential in urban/rural dwelling among the fully Indigenous women. The fully Ladino women living in rural areas was almost equal to those living in urban areas. Enhanced or developed flooring and television ownership were characteristic of Ladino women more than Indigenous women and as Indigenous women moved through the *ladinization* process the ratio began to increase.

The mean number of children ever born is highest and lowest in comparing both ends of the ethnicity variable and the mean number of children who have died decreases as we move from left to right across the table. Roughly half the women in the left-most column do not know where to access contraception. More women were in union than not, with the large portion of Indigenous women in union.

In terms of couple/partner contraceptive characteristics, the majority of Ladino women were in couples where the couple agreed on methods, partner supports family planning, and the couple had shared family size goals. Moving left towards fully Indigenous, there was an decrease in the ratio of yes (or positive) responses to 'don't know'/'no opinion' responses (these are distinguished from missing values). Difference in education level between the woman and her partner are nearly equal across ethnic categories (about 1 year).

[8]Based on 2002 population census levels, it is likely that rates of non-educated Indigenous women are much higher than those indicated by the 2002 RHS. Approximately two thirds of the Indigenous population did not record a level of education and may explain the apparently large increase in Indigenous women attaining at least some education.

The final rows of the table provide the descriptive information of the response variables. Modern method use was increasingly common among the Ladino women with very low rates of use among the Indigenous population. Among women who do not use contraception, intent to use remains fairly constant across all three ethnic groups. However, the majority of non-users, across all three ethnic levels, has no desire to use contraception.

The rates based on the sample of 4592 collected in 1987 show ethnic divisions similar to those of 2002 with approximately two-thirds of the population classified as Ladino. There were about 6% more Indigenous women reporting Spanish as the maternal language in 1987 than 2002. Mean age was slightly younger in 1987 but still within one standard deviation of the 2002 levels. Religion and partner/couple characteristics, with the exception of years of educational difference, was not available for the 1987 period.

In both time periods Indigenous women reported less education than bicultural or Ladino women and Ladino women had higher rates of education than bicultural women. Education rates within ethnic groups were strikingly different in the two time periods. According to these trends, enormous progress has been made in advancing education across all ethnicities. Rates of non educated Indigenous women have plummeted nearly 80% since 1987 (a yearly decrease of about 5%) and there has been nearly a doubling of Ladino women with secondary or higher education during the 15 years between surveys.

The majority of the population in both 2002 and 1987 were rural dwellers. Rates of Ladinos living in urban areas has remained fairly consisted when comparing the two time periods while Indigenous women and bicultural women have increased their presence in urban areas.

Mean number of births has not changed dramatically in the 15 years between surveys but child mortality experiences are showing signs of decline for all ethnic groups. Rates of union have remained fairly consistent across time with Indigenous women more often married than bicultural or Ladino women. Unfortunately, information on partner or couple fertility and family planning characteristics were not available in the 1987 data set. The only indicator of gender equity, education difference, shows a decrease in Ladino and bicultural educational differences but an increase in Indigenous educational differences.

6.2 Trees

Trees were constructed to determine populations at most need for contraception and family planning services. The two dependent variables, use versus non use[9] and intent versus no-intent were used to build trees for the entire Guatemala population.

In the tree presentations used here the dependent variable's prevalence in the sample is listed at the top of the figure. The variable most effective at splitting the data (the variable with the lowest Gini coefficient) is then listed, followed by the next variable, and so on. At each terminal node, representing a homogenous sub-population such that no additional splitting is necessary, a box with the response variable and the corresponding prevalence in the sub-population is listed. Keep in mind that trees do not indicate a variable hierarchy and that each terminal node represents an at-risk (or at-need) group of the overall population. The thickness of the lines linking each node represents the size of the population that is characterized by the variable values. Regions[10] are referred to in the tree by letter. In the case where a tree splits on the region variable the resulting subset of regions underscores the variability in regional contraceptive/family planning needs. Moreover, as each region contains a government-sponsored family planning agency, results disaggregated by region are particularly relevant. The appendix provides a Guatemala map with the region names and the codes used in the tree building.

The 1987 tree, Figure 1, evaluating modern use versus non use highlights the importance of number of children, television ownership, ethnicity, marital status, education and age. Number of children[11] and ethnicity are important splitting variables early in the tree and number of children provides the first, most efficient (as measured by Gini coefficient) split. Modern contraceptive use, a rate of 3.1%, is rare among women with few children. Television owning

[9]Use is restricted to women using modern methods. Too few women were traditional contraceptive users as compared to modern users and non-users. Multinomial and tree models using a three pronged usage variable showed no difference in variable selection as compared to the two pronged variable used here.

[10]The division of Guatemala into eight policy and statistical regions is well established among governmental agencies. Regions serve as the largest geographic level of policy implementation and statistical data collection and analysis.

[11]Because of small sample sizes in high parity groups, women with 10 or more children are grouped together here and in the subsequent trees.

Indigenous and bicultural women have a higher rate of use than the full sample (22.1%) but much lower than Ladino women in any of the remaining sub-groups.

In 1987 22.0% of the women in the sample not using contraception report intent to use family planning (see Figure 2). Ethnicity is the first splitting variable and reveals a comparatively low rate of intention to use among the non-Ladino women (11.2%). Among Ladino women between 20-35 years of age intention to use contraception is impacted by television ownership (31.4% of non-owners report intent to use) and region of residence. Education, urban residence, and number of children further group the population. The sub-population with the highest rates of intent to use are Ladino women between 20-34 years old who own a television and already have several children (78.3%).

The 2002 modern use tree, Figure 3, highlights the importance of the number of children, economic status (flooring), marital status, region of residence, ethnicity and age. The 4.7% use rate among women with none or high numbers of children is significantly lower than the population use rate of 31.2%. It is notable that while number of children was also significant in 1987, the fertility level associated with use is lower in 2002 than in 1987. Economic status, ethnicity, and marital status further group the data. Wealthier women who are not-married, regardless of ethnicity have a use rate of 32.4%. Wealthier, married, Indigenous or bicultural women have a lower use rate (18.1%) than the evaluated population. The highest use rate, 82.4%, is among married, Ladino women with more than .5 children, higher socio-economic status and who live in specific regions. Women of low socioeconomic status report higher use rates if they are Ladino, have at least 6.5 children and are married.

The 2002 country-wide intent tree, Figure 4, splits first on couple's agreement on contraceptive methods followed by age group, region of residence, number of children and finally by the couple's attitude towards more children. Because partner/couple characteristics were excluded from the 1987 data, a comparable 2002 tree was constructed, Figure 5. Among married women 41.6% intend to use contraception, however, women older than 40 have much lower rates (13.6%). At 46.1%, younger Indigenous and bicultural women have a slightly higher rate of intention than the population as compared to 62.7% of their Ladino counterparts. The highest

rate of intent is found among young women who already have children and who live in more remote, high fertility regions.

The differences between trees, the interpretations of the variables and conditional relationships and the subsequent identification of at-risk populations (populations with unmet need) will be further discussed in the next section.

7 Discussion

The direct determinants framework of Davis & Blake (1956) and Bongaarts (1978) lists contraception as one of three proximate determinants – an increased use of contraception results in a decrease in fertility (given no change in the other two factors). One of Coale's (1973) three preconditions of fertility directly relates to knowledge, access, and use of contraception while the other two preconditions address ideational aspects of family planning. These two widely applied theories have guided contemporary fertility research and interpretation and have therefore brought contraceptive dynamics to the forefront of demographic science. Given the dominant presence of contraception in evaluating fertility and fertility transitions studies of contraceptive use dynamics are an important component of fertility research. This research explored contraceptive dynamics in 1987 and 2002. The use of classification modeling techniques elucidated complex variable interactions and highlighted populations that are at particular need for services.

The results of the analysis reveal that contraceptive use and intention are related to family and socio-economic characteristics, region/area of residence and reveal sub-populations who are likely neglected by current family planning programs. Moreover, through the comparison of two time periods, the results begin to hint at causal relationships between use and intention to use and an increase in socio-economic status.

7.1 Contraceptive dynamics over time

Contraceptive use: The primary objectives of this research were 1) to develop the most current models of contraceptive use and intention and 2) to compare 2002 patterns to 1987 patterns of use. The 2002 model of modern contraceptive use, which includes socio-economic status as a splitting variable, suggests that fewer poor women use contraception as compared to wealthier women. In combination with ethnicity, poor Indigenous and bicultural women stand out with particularly low use rates. Since Spanish speaking Indigenous women are grouped (by the classification approach) with non-Spanish speaking Indigenous women (in all cases but one) we cannot conclude that language serves as a barrier to contraceptive use (Terborgh et al. 1995, Santiso-Galvez & Bertrand 2004, De Broe et al. 2005, De Broe & Hinde 2006). Instead, in combination with low socio-economic status, the model either indicates that women of low-socioeconomic status have reduced interest in planning their families or that socio-economic status serves as a barrier to family planning access and use (Becker 1981, Monteith, Anderson, Pineda, Santiso-Galvez & Oberle 1985, Terborgh et al. 1995, Bertrand et al. 2001). However, among Ladino women socio-economic status does not appear to serve as the barrier to contraceptive use that it does for Indigenous women. Young women and women nearing the end of their reproductive years or women with large numbers of children show increasing use of modern contraception despite their comparatively limited financial means.

In 1987, among the factors impacting use, socio-economic status (in this case measured by television) and ethnicity, separate the population early in the tree - as they did in the 2002 tree. When comparing the results from the two time periods low socio-economic status served as a more definitive predictor of use in 1987 than in 2002. This suggests that an ideational shift across the entire population may have occurred or that strategies to access the poorest segments of the population have been effective.

Intent to use: In terms of women who are not using contraception but intend to at some point, the presence of ethnicity in the 2002 and the 1987 tree indicate that there are significant geographical, institutional, or economic barriers to use impacting Indigenous and bicultural

women. The significance of socio-economic status and informal education (as measured by television ownership) in 1987 further support the hypothesis that women who were not using contraception were doing so because of outside factors and not because of limited desire to control their fertility and plan their families. In 2002 the role of socio-economic status is diminished but ethnicity remains an important component of intent to use as does region of residence. Continued commitment to expanding family planning to all segments of the society in all regions regardless of ethnicity may help expand contraceptive use. Also, as highlighted in the tree, using partner/couple characteristics, the role of the partner is important in determining contraceptive intent (Carter 2002, Carter 2004). This may indicate lack of equal-power domestic relationships or it may indicate couple-based decision-making as a component of family planning use. Whatever the reason, the expansion of services to include men and couples may positively impact future contraceptive use.

The role of ethnicity: Ethnicity, an underlying component of this analysis and most related Guatemalan focused fertility and family planning analyses is an important sub-current of this analysis (Monteith et al. 1985, Terborgh et al. 1995, Glei & Goldman 2000, Bertrand et al. 1999, Singh et al. 2006). Ethnicity has been hypothesized to serve as a cultural, linguistic and social barrier to contraceptive use and family planning. In this analysis ethnicity was a significant splitting variable in all trees with Indigenous women and bicultural women fairing less well in terms of use and intent to use. Based on the descriptive results from the analysis it is clear that socio-economic status and educational attainment, important determinants of fertility, have increased in the 15 years between surveys despite no significant changes in ethnic identification. Indigenous women and bicultural women still lag behind their Ladino counterparts in terms of education but are undoubtedly making positive strides. Contraceptive use and intent has also increased for Indigenous women while adoption of the dominant language has not and suggests that economic and educational changes, or perhaps unmeasured changes in service provision, have facilitated ideational changes and access to services. However, ethnicity still plays a significant role in contraceptive use and intent and a closer look at the quality of services available to Indigenous and bicultural women may provide insight into their comparatively low

rates (Seiber & Bertrand 2002, Singh et al. 2006).

Place: Region of residence: Reflecting the Guatemalan government's use of eight policy and statistical regions, region of residence was included in the analysis as an independent variable. The significance of region of residence underscores the importance of "place" in family planning. For example, in the 2002 tree of contraceptive use (Figure 3) the model splits on region of residence after several splits on soci-demographic variables. A large portion of the population of married women, as indicated by the thickness of the branch through the nodes, have different patterns of use simply because of their home region. The post-region splits suggest that factors like ethnicity, age, and informal education (represented by television ownership) are significant only for women in specific regions of the country. Attention to any of these factors calls for regionally-designed family planning services and, in the case of Figure 3, those services specifically catering to non-Spanish speaking women or younger women. The role of region of residence therefore encourages policy-professionals and health workers to address the specific needs of regional sub-populations that are at most need.

8 Conclusion

Through the identification of sub-populations with low prevalence of contraceptive use and intent it is possible to identify important social and cultural factors. Building on a rich background of related analyses, this project identified conditional relationships between factors which may be helpful to future research projects or to policy planners and public health professionals. Trees provide an alternative perspective enhancing the general understanding of contraceptive dynamics and contribute to the development of a complete picture of family planning in Guatemala.

Table 1: Recent Central American Fertility and Contraceptive Use Rates

	Total Fertility Rate	Contraceptive Prevalence Rate*
Guatemala		
1998/99	5.0	38.2
2002	4.4	43.3
Honduras		
1996	4.9	50.0
2001	4.4	61.8
El Salvador		
1998	3.6	59.7
2002/3	3.0	67.3

Note: Rates are presented in the 2005 CDC report;
*Among married (formal and informal) women

Table 2: Confirming Correspondence between 2002 RHS Data and Sample Constructed with Weights and Sampling

	2002 Reproductive Health Survey	Equally Weighted Sample
Urban		
Education		
None	1.35%	1.34%
Primary	43.12%	36.52%
Secondary (and beyond)	55.53%	56.06%
Mean Age (sd)	29.12 (10.17)	29.45 (10.14)
Sample Size	3892	4152
Rural		
Education		
None	2.75%	2.72%
Primary	72.38%	73.01%
Secondary (and beyond)	24.87%	24.27%
Mean Age (sd)	28.27 (10.03)	28.05 (9.98)
Sample Size	5263	5848
Total		
Education		
None	2.08%	2.08%
Primary	58.40%	58.97%
Secondary (and beyond)	39.51%	38.94%
Mean Age (sd)	28.64 (10.09)	28.63 (10.07)
Sample Size	9155	10000

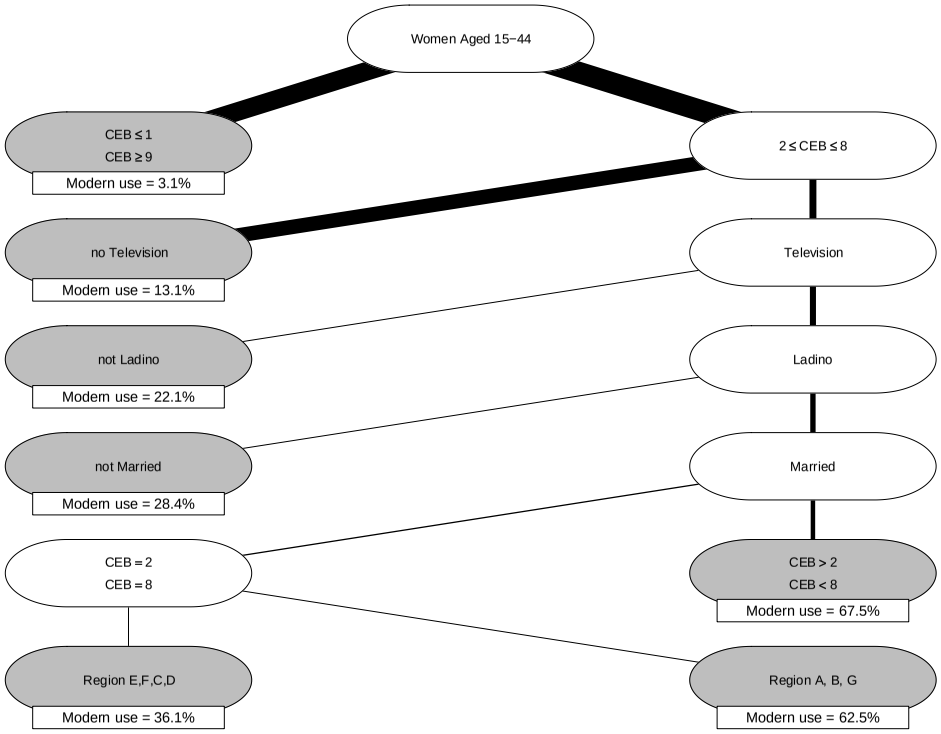
Note: Author's calculations based on 2002 RHS data and self-weighted, sampled data (designed to create equally weighted sample). Similar values in each data set across all variables supports the use of the equally weighted sample in place of the RHS data. 2002 RHS sample size values are rounded to the nearest whole number.

Table 3: Descriptive Statistics for Variables Included in the Analysis, 1987 and 2002

	2002			1987		
	Indigenous	Bicultural	Ladino	Indigenous	Bicultural	Ladino
Count	1004	1593	5254	442	1160	2990
Percent of Country Total	12.8%	20.3%	66.9%	9.6%	25.3%	65.1%
Interview language (Spanish)	0.0%	99.5%	100.0%	0.0%	99.6%	100.0%
Maternal language (Spanish)	0.0%	25.1%	100.0%	0.0%	31.5%	100.0%
Ethnic Identification (Ladino)	0.0%	4.6%	100.0%	0.0%	1.9%	100.0%
Mean Age (standard deviation)	28.57(9.6)	27.64(9.8)	28.98(10.0)	27.65(8.7)	27.31(8.0)	27.15(8.3)
Level of Education						
None	4.7%	3.5%	1.9%	83.5%	58.2%	21.8%
Primary	89.9%	76.1%	54.7%	16.5%	38.4%	55.8%
Secondary plus	5.4%	20.4%	43.4%	0.0%	3.4%	22.4%
Religion						
Catholic	54.3%	49.0%	49.7%	.	.	.
Non-Catholic	45.7%	51.0%	50.3%	.	.	.
Housing Characteristics						
Region						
Metropolitan	1.3%	26.4%	43.5%	0.0%	13.6%	36.0%
North	36.8%	8.5%	1.6%	27.8%	9.9%	1.6%
Northwest	6.4%	1.8%	9.7%	30.8%	28.2%	2.7%
Southwest	0.0%	0.8%	12.8%	36.7%	31.2%	16.2%
Central	2.2%	12.4%	11.2%	4.8%	15.2%	11.2%
Northeast	22.8%	30.0%	13.7%	0.0%	1.3%	16.2%
Southeast	25.9%	18.3%	4.4%	0.0%	0.6%	16.1%
Petén (reference)	4.7%	1.9%	3.0%	.	.	.
Area						
Urban	8.0%	40.4%	47.0%	0.9%	31.8%	46.8%
Rural	92.0%	59.6%	53.0%	99.1%	68.2%	53.2%
Type of floor material						
Rustic	84.3%	53.1%	27.1%	93.4%	71.5%	37.3%
Developed	15.7%	46.9%	72.9%	6.6%	28.5%	62.7%
Own Television						
Yes	17.1%	55.9%	79.4%	0.5%	18.5%	50.0%
No	82.9%	44.1%	20.6%	99.5%	81.5%	50.0%
Family/Relationship Characteristics						
Mean Number of Children Ever Born (sd)	3.97(3.5)	3.02(3.3)	2.43(2.5)	3.44(2.9)	3.13(3.0)	2.59(2.7)
Mean Number of Children Who have died (sd)	0.45(1.0)	0.15(.5)	0.15(.5)	0.60(1.1)	0.46(1.0)	0.30(.7)
Partner Variables - Used only in desire analysis						
In Union						
Yes	72.9%	61.4%	60.3%	74.9%	63.3%	59.2%
No	27.1%	38.6%	39.7%	25.1%	36.7%	40.8%
Agreement about methods						
Yes	50.8%	57.1%	84.4%	.	.	.
No	23.8%	21.5%	9.5%	.	.	.
No opinion	25.4%	21.5%	6.2%	.	.	.
Partner supports family planning						
Yes	41.8%	52.2%	79.7%	.	.	.
No	27.8%	22.2%	12.1%	.	.	.
Don't know	30.4%	25.6%	8.2%	.	.	.
Women/Partner Child Preference						
Same number	57.4%	48.0%	71.4%	.	.	.
More children	12.6%	10.1%	11.9%	.	.	.
Fewer children	5.5%	7.1%	8.6%	.	.	.
Don't know	24.5%	34.8%	8.2%	.	.	.
Mean Woman/Partner Years of Ed. Diff. (sd) *	1.21(1.5)	1.17(1.5)	1.02(1.5)	0.76(1.3)	1.47(2.3)	2.66(3.4)
Response Variables						
Desire/Intent to Use (no)	71.1%	74.9%	70.3%	92.2%	87.3%	70.6%
(yes)	28.9%	25.1%	29.7%	7.8%	12.7%	29.4%
Modern Method Use (no)	90.9%	81.9%	60.4%	98.9%	95.0%	79.0%
(yes)	9.1%	18.1%	39.6%	1.1%	5.0%	21.0%

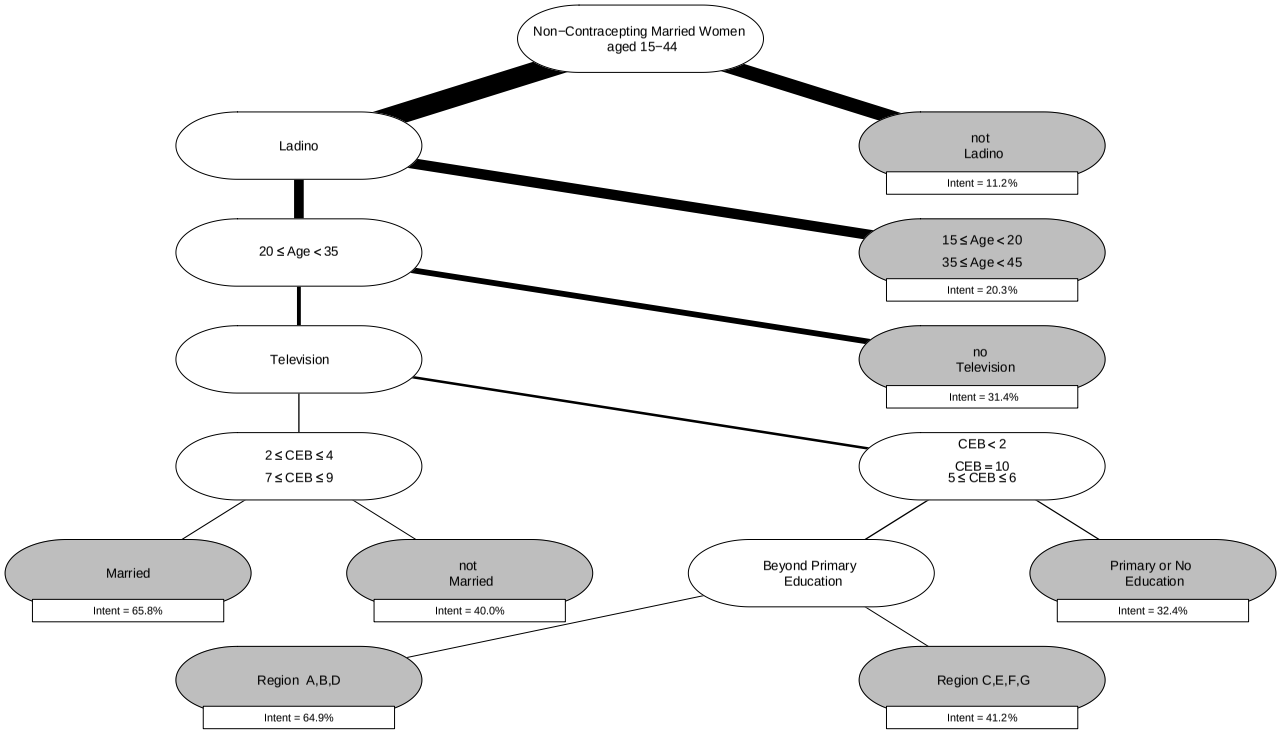
Note: Author's calculations based on data from 2002 RHS data and 1987 DHS data. The first five rows of the table present the ethnicity variable and highlight the breakdown within each level of ethnicity by language and ethnic identification. The remainder of the table presents means (with standard deviation) and percentages for each variable *within* each level of ethnicity.
*This information was only available for 3327 couples

Figure 1: Tree of Contraceptive Use versus Non-use among Guatemalan Women in 1987



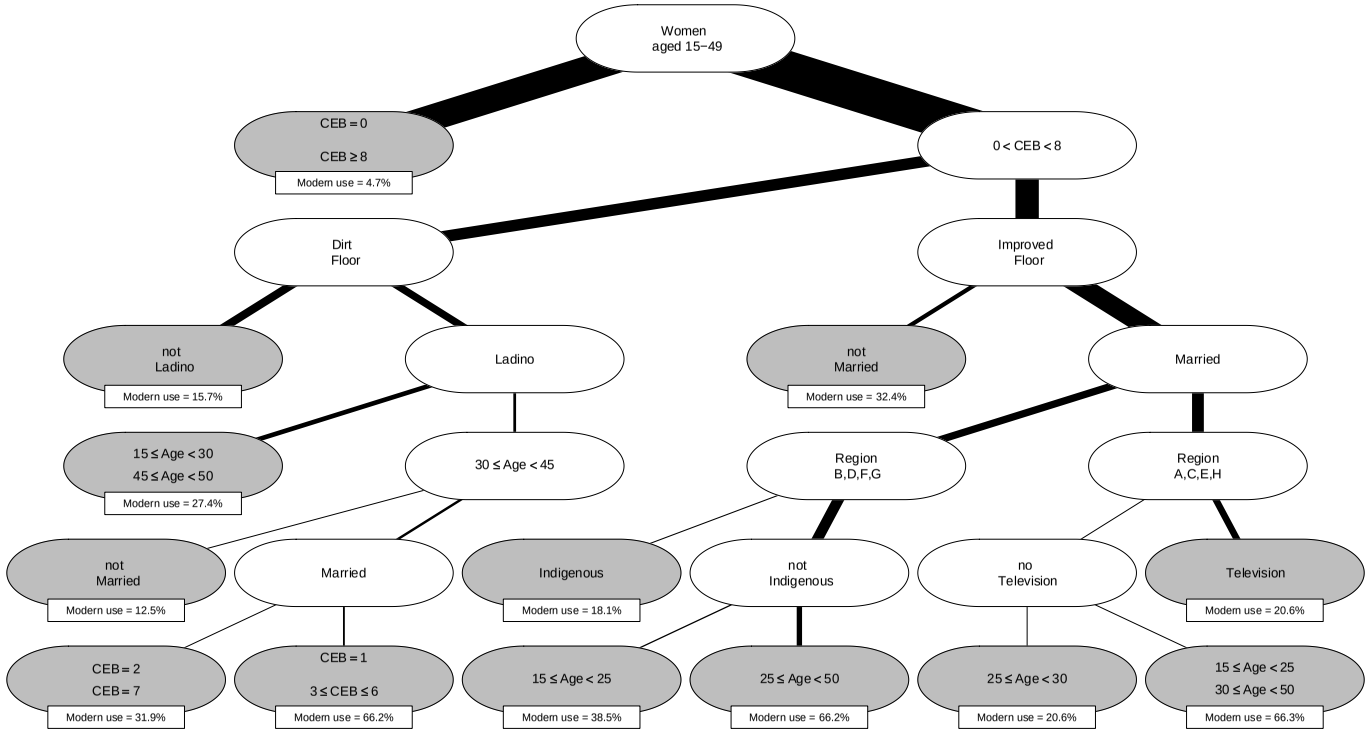
Note: Author's calculations based on the 1987 DHS data. The rate of contraceptive use in the population before any splits is 15.5%. Width of the lines represents the proportion of the population meeting the nodal characteristic. Thicker lines indicate that a larger portion of the population was classified by the specific variable category. The shaded ovals represent terminal nodes beyond which the population cannot be efficiently split. The boxes below the terminal nodes present the proportion of contraceptive users in the specific sub-population. Region codes are available in the appendix.

Figure 2: Tree of Intent to Use Contraception versus No-intent among Guatemalan Women in 1987



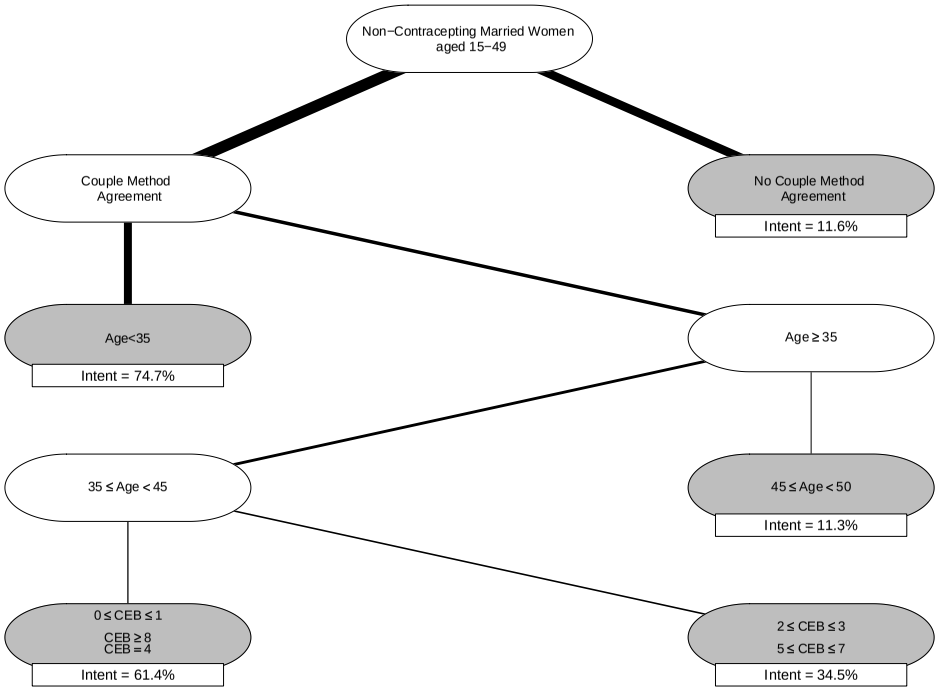
Note: Author's calculations based on 1987 DHS data. The rate of intent to use in the population before any splits is 22.0%. Width of the lines represents the proportion of the population meeting the nodal characteristic. Thicker lines indicate that a larger portion of the population was classified by the specific variable category. The shaded ovals represent terminal nodes beyond which the population cannot be efficiently split. The boxes below the terminal nodes present the proportion of women with intent to use in the specific sub-population. Region codes are available in the appendix.

Figure 3: Tree of Contraceptive Use versus Non-use among Guatemalan Women in 2002



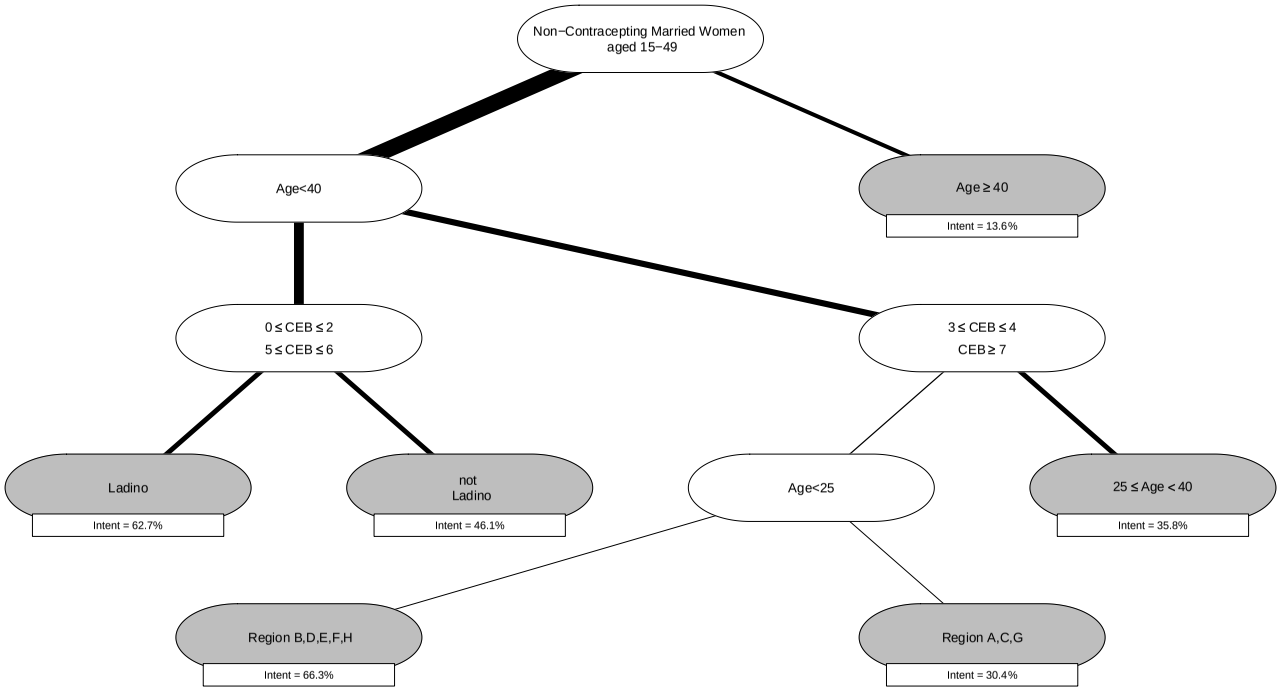
Note: Author's calculations based on equally weighted sample from 2002 RHS data. The rate of contraceptive use in the population before any splits is 31.2%. Width of the lines represents the proportion of the population meeting the nodal characteristic. Thicker lines indicate that a larger portion of the population was classified by the specific variable category. The shaded ovals represent terminal nodes beyond which the population cannot be efficiently split. The boxes below the terminal nodes present the proportion of contraceptive users in the specific sub-population. Region codes are available in the appendix.

Figure 4: Tree of Intent to Use Contraception versus No-intent to Use among Guatemalan Women in 2002



Note: Author's calculations based on equally weighted sample from 2002 RHS data. The rate of intent to use in the population before any splits is 41.6%. Width of the lines represents the proportion of the population meeting the nodal characteristic. Thicker lines indicate that a larger portion of the population was classified by the specific variable category. The shaded ovals represent terminal nodes beyond which the population cannot be efficiently split. The boxes below the terminal nodes present the proportion of women with intent to use in the specific sub-population. Region codes are available in the appendix.

Figure 5: Alternative Tree of Intent to Use Contraception versus No-intent among Guatemalan Women in 2002 (without partner variables)



Note: Author's calculations based on equally weighted sample from 2002 RHS data. The rate of intent to use in the population before any splits is 41.6%. Width of the lines represents the proportion of the population meeting the nodal characteristic. Thicker lines indicate that a larger portion of the population was classified by the specific variable category. The shaded ovals represent terminal nodes beyond which the population cannot be efficiently split. The boxes below the terminal nodes present the proportion of women with intent to use in the specific sub-population. Region codes are available in the appendix.

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Figure 6: Appendix: Guatemala map with region names and codes