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Essays in Female Labor Supply and Marriage in Developing Countries

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ABSTRACT OF THE DISSERTATION

Essays in Female Labor Supply and Marriage in Developing Countries

by

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This dissertation presents three chapters on female labor supply and marital stability in developing countries. The first two chapters focus on female labor supply in India. In the first chapter, I study the relationship between husband's earning and female labor supply of married women in India. Despite economic growth, fertility reductions, and improvement in education, female labor force participation in India declined from 35% to 27% between 1999 and 2012. This chapter examines the degree to which the decline can be attributed to an increase in the earnings of married males. Using two datasets and three sources of variation in married male earnings, I find a robust and negative elasticity of married female labor supply with respect to married male earnings. Subgroup and robustness analyses indicate the presence of a household-level income effect. Back-of-the-envelope calculations suggest that this relationship can account for over 40% of the above decline in married female labor supply. Continuing with this investigation in the second chapter, I study the role of other spatial and individual characteristics behind the changes in female labor supply in India during the same period. Based on the decomposition analysis of changes in labor supply for paid versus unpaid work in rural areas, I find that geographical characteristics, such as the capital intensity of agriculture, are important drivers of changes in married female labor force participation in paid jobs but not in unpaid jobs. Individual-level variables, such as age, education, caste, and religion, are significant determinants of both paid and unpaid labor jobs of married women in rural India. In the third chapter, we study the effect of fertility challenges faced by couples on divorce in developing countries. Using the Demographic and Health Surveys from 66 countries over 23 years, we find that, infertility, the first-born child being a daughter, and death of the first-born child significantly increase the likelihood of divorce in a marriage. These findings lend support for the implications of theoretical analysis by Becker (1977), which says that unanticipated shocks increase marital instability by generating greater differences between the expected and actual utility from a union.

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CHAPTER 1

To Work or Not to Work? Male Earnings and Female Labor Force Participation in India [1]

1.1 Introduction

The period since the beginning of the twenty-first century in India has witnessed substantial declines in fertility and advancements in female education along with an overall positive economic growth of the economy.[2] These demographic changes are known to be associated with increases in female labor force participation in several other contexts.[3] However, despite these three economic phenomena moving in a direction that is associated with an increase in female labor supply, the past decade has witnessed a significant decline in female labor force participation rates in India. The married female labor force participation rate decreased by eight percentage points between 1999 and 2012 according to the National Sample Survey. As per the 2001 census, the labor force participation

[1] I am grateful to Mindy Marks, Joseph Cummins, Anil Deolalikar, Robert Kaestner, and Michael Bates for constant guidance and support throughout this project. This paper has benefited from discussions with seminar participants at the Applied Economics seminar at UC Riverside, PacDev annual conference, APPAM Regional student conference, PAA annual meeting, Eastern Economic Association annual meeting and the Ronald Coase Workshop. All errors are my own.

[2] The fertility rate decreased from 3.14 in 2000 to 2.5 in 2012, the primary education completion rate increased from 60% in 1999 to 99% in 2014, and the average growth rate of GDP per capita was 5.4% between 1999-2012 (Source: World Bank).

[3] For example: Angrist and Evans (1998), Cruces and Galiani (2007), Heath and Jayachandran (2017), Rosenzweig and Wolpin (1980), Tzannatos (1999)

rate for females aged 15-59 years was 40.02 percent. In the 2011 census, this rate fell to 37.4 percent.[4] According to the Demographic and Health survey, the percentage of women who reported to work for pay in the reference year declined by 4 percentage points in the last two rounds of the survey: in 2005-06, 28.6 percent of women were engaged in a paid labor market activity, while in 2015-16 only 24.6 percent reported to be doing so. This puzzle calls for a closer investigation of the factors that determine women's decisions to engage in the labor market.

At the same time, there has also been an increase in the real earnings of males, and this paper links those changes in married male earnings with the changes in married female labor force participation, to understand the overall decline in female labor force participation. Goldin (1994) and Mammen and Paxson (2000) show a U-shaped relationship between female labor force participation rates and GDP per capita at a cross-country level, where economic growth could lead to falling female labor supply if the income effect from higher household income dominates the substitution effect of increasing opportunities cost of time. Standard household decision making models offer a prediction that when the relative wage offers to men are higher than those to women, households could optimize total utility by increasing or maintaining male labor supply levels while the wealth effect from husband's increased income decreases female labor supply. Hence, as household income improves, female labor supply and labor force participation may decrease because the income effect from higher non-labor earnings of the household or husband's earnings may overpower the substitution effect from higher wages for women and men in the labor market.

If women's time spent within the household, engaged in home production or leisure, is perceived as valuable, then a wealth effect can potentially explain women opting-out of the labor force. Suggestive evidence for this hypothesis is shown in figures 1 and 2 below. Figure 1.1 shows the time-series of earnings of married males and the labor force participation of secondary workers including married females between the age of 18-55 years. Between 1999 and 2012, earnings of married males increased

[4] These numbers were calculated by the author using B series of the census economic tables. Note that this is overall and not married female labor supply as the available data is for all females and not for married females. Also, the measure of labor force participation is different in the Census as compared to other sample surveys.

by about fifty percent in India and the labor force participation of married females declined by eight percentage points.[5] In figure 1.2, I show a scatter plot of districts depicting changes in labor force participation of married females on the y-axis and changes in earnings of married males on the x-axis between 1999-2005, 2005-2012, and 1999-2012. The scatter plots illustrate a negative correlation between the two variables, which is especially pronounced between 2000-2005.

To examine the relationship between earnings of married males and labor force participation of married females in detail, I employ three different and complementary spatial-temporal comparisons - across district-year aggregate outcomes; within districts, across labor market-year aggregate outcomes; and within individual households over time. First, using the National Sample Survey (NSS), I build a panel of districts covering the years 1999-2012. I use the temporal variation in district-level married male earnings in a district fixed effects model and find a negative correlation between married female labor force participation and earnings of married males. A 10 percent increase in earnings of married males is associated with a 0.8 percentage points decline in married female labor force participation.

However, there could be several omitted variables at the district level, correlated with married female labor supply and married male earnings in the above across-district comparison that can bias the relation-ship. To rule out such omitted variables that are common for a district and time, I exploit dissimilarities between changes in the earnings of married males in different labor markets, defined by male education levels within each district. I observe that for a large proportion of the districts, different labor markets in the same district experience different growth in married male earnings. Exploiting this variation, which is different than the over time variation across districts, I compare changes in labor supply of married females between labor markets in a district over time. Evidence from within-district methodology reinforces the results found in the across-district comparison. From 1999 to 2012, a 10 percent increase in earnings of married males is associated

[5] Author's calculations using the National Sample Survey. The changes in married female labor force participation between 1999-2012 are similar for different demographic groups defined by education, age, or caste. Even though the levels of labor force participation differ between groups with women belonging to socio-economically disadvantaged groups being the most active in the market, there is a ubiquitous decline over time among all groups.

with a 0.7 percentage points decline in married female labor force participation. The resulting cross-income elasticity of married female labor force participation is -1.7.

After showing the aggregate-level relationship, I further extend the analysis using intertemporal variation at the household-level. Using the longitudinal data set from the Indian Human Development Survey, I estimate the relationship between changes in earnings of husbands over time and the labor supply of their wives between 2005 and 2012. The advantage of this data is that I can observe changes for the same household over time and use a household-level fixed effect panel model. Results from this analysis corroborate the findings of the district-level analysis. Between 2005 and 2012, a 10 percent increase in husband's earnings is associated with a 0.2 percentage points decline in the probability of wife engaging in labor market work. The elasticity estimated in the household-level analysis is -0.53. This is a third of what I find from the district-level analysis; and a part of the reason is that, it is estimated for a selected sample which is relatively better off with higher female education.

All the above empirical strategies rely on different sources of variation in married male earnings and have distinct strengths and caveats associated with them. A prime benefit of the district-level analysis is that I can conduct a falsification exercise by checking if a similar relationship exists for currently unmarried females of the same age group. I find no association between married male earnings and labor force participation of unmarried women. This suggests that women who face similar labor market changes as married women and belong to the same age group, but who do not experience a change in earnings from husbands, experience no negative effect through that channel.

There are potential threats to identification in the district-level analysis and some of them are ad-dressed in the intertemporal household-level exercise. Even though the within-district exercise at labor market level accounts for district-year unobservables flexibly, which are not captured by controls in the across district comparison over time, it leaves out unobserved variables at the labor market level that could bias the estimates. The third analysis, at the household level, captures a different source of variation in married males' earnings. It copes with both the aggregate-level unobservables in the across and within district analysis, and time-invariant household-level omitted variables. It is also closest to the responsiveness in female labor market behavior when her own husband's earnings change. However, it does not deal with time varying household-level unobserved variables that affect husband's earnings and wife's labor supply, which is not a concern for the previous two analyses. Hence, the sources of bias in each of the estimation methods are not the same. Altogether, the three pieces of this analysis allow me to leverage the strengths of different research designs and datasets, to find a compelling evidence for negative income effect from husband's earnings to wife's labor supply.

Several other empirical checks further support the findings above. I find that an increase in married male earnings is associated with a decrease in labor force participation for adolescents and the elderly, suggesting that a negative effect exists for other secondary workers in the household as well. Simultaneously, there is also a positive response in the school enrolment of adolescents. The substitution of market work of secondary workers with other activities that may be valuable to the household, combined with the absence of any responsiveness in labor supply of unmarried females with respect to earnings of married males, adds support for an income effect mechanism driving the relationship. To mitigate potential threats to identification posed by measurement error in the key variable of interest and omitted variables that are correlated with both married male earnings and female labor supply, I perform extensive robustness checks. For instance, I verify that changing fertility and marriage rates are not driving the results. The results are also robust to district time trends, different sample restrictions, and changes in male employment trends.

India accounts for 17 percent of the world population. According to IMF chief Christine Lagarde, 217 million women are missing from the Indian labor force and if women and men were equally represented in the labor force, it would boost India's economy by 27 percent. Considering these large-scale demographic changes, analysis of household decision making is important to understand the overall macroeconomic shifts in the labor force. A few studies have mentioned the potential role of an income effect in the context of declining female labor force participation of Indian women

(Klasen and Pieters, 2015, Neff et al., 2012). This paper adds to that debate by showing a robust empirical evidence at a more disaggregated level over a longer period, which is missing in the extant literature. Further, the paper contributes to the broader literature on the added-worker effect, on which there is limited empirical literature in developing countries. The results in this paper present new evidence of reallocation of secondary labor when the economic environment of the household changes in a low to middle-income scenario.

In summary, this work empirically shows a negative relationship between earnings of married males and the probability of married females participating in the labor market. Further, I provide suggestive evidence for the income effect as a mechanism behind this association. The results in this paper offer support for a quantitatively important channel behind the puzzling decline of female labor force participation in India, which may be useful in understanding the declines in female labor supply observed in other settings with similar socio-economic contexts.[6] The next section describes the related literature with a focus on India.

1.2 Related Literature

Several explanations have been explored to understand the phenomenon of declining female labor force participation rates in India. Using decomposition methods, Afridi et al. (2017) illustrate that rising education levels among married females is a significant determinant of female labor force participation rate. They argue that the productivity of women in household activities, such as child rearing, increases when they attain some education and the returns in the labor market have not increased relative to the returns in home production. Consequently, more women are choosing to opt out of the workforce.

Second, limited growth of jobs for females during structural transformation of the economy in the last decade is discussed as a demand-side reason for the lack of females joining the labor force.

[6] For instance, Bangladesh, which is also experiencing a decline in female labor supply, although from a much higher level (54% in 2000) as compared to India.

Chatterjee et al. (2015) regress female labor force participation on individual characteristics, local employment rates, and share of workers in agricultural and non-agricultural employment categories. They find significant associations between these local indicators and woman's labor force participation for 2004-05 and 2011-12. They interpret their results as a collapse of rural jobs between 2004-05 and 2011-12, which is responsible for the decline in female labor supply. Klasen and Pieters (2015) perform cross-sectional regression analysis in urban areas to identify various supply and demand side factors for stagnating urban female labor supply. They find that changes in the proportion of males employed in different sectors at the district-level is negatively associated with female labor supply. They also find that education of the head of household and male salaried employment status in the household have strong negative associations with female labor force participation in urban areas.

Neff et al. (2012) probe four potential reasons for changes in female labor supply: higher enrolment in education, income effect, lack of employment opportunities, and socio-cultural norms. They don't find evidence in support of the education or employment opportunities-based explanations. They do, however, find some descriptive evidence in support of the income effect hypothesis by analyzing the country-level changes in average male earnings and female labor supply between 2005 and 2012 for different income groups. Using probit analysis on pooled cross-section of women, **?** also note that rising real wages in rural areas have a strong negative income effect on female labor force participation.

While all the above studies present interesting insights into female labor supply and other factors, this paper builds on the largely cross-sectional and descriptive literature and attempts to establish a causal pathway from earnings of husbands to labor force participation of the wives, to understand the declining female labor force participation in India.

1.3 Conceptual Framework

Consider the case of a household as a single decision-making unit in one time-period.[7] Let one spouse be the primary earner and other the secondary worker in the household. Given the high level of division in home production activities and market labor between males and females in developing countries, I use the subscript m for primary worker (male primary earner) and subscript s for the other secondary workers which represents the wife. The household maximizes a single utility function composed of household-level consumption good (C), and the amount of leisure consumed by each individual(L_m, L_s):

$$U = U(C, L_m, L_s)$$

subject to the full income constraint:

$$PC + W_m L_m + W_s L_s = Y + W_m T_m + W_s T_s$$

where $T_i = L_i + H_i$ is the total amount of time available and H_i is the time spent in labor market activities for i=m, s. W_m, W_s and P are the prices of male labor, secondary labor, and consumption good respectively, and Y is non-labor income. $Y + W_m T_m + W_s T_s$ is the full income of the household.

Leisure can be both true leisure or time spent in household production activities performed by family members. The assumption here is that household utility increases when home production increases. Examples of activities that are included in the category of home production and are valuable to the household can be child care, attending to elderly household members, engaging in social and religious practices, and preparing nutritious meals. As argued earlier in the literature, some of these activities may not be completely delegable and require personal attention (Eswaran et al., 2013, Papanek, 1979).[8]

[7] This abstracts away from the bargaining aspect between different members. In the Indian scenario, however, households are likely to make decisions collectively and pool their incomes.

[8] In 2004-05, for married females who were not part of the labor force and were 'required' to engage in domestic duties, 19 percent said their absence from the labor force was because of social and religious reasons, 7 percent said they could not afford hired help, 55 percent said there was no member to carry domestic duties, and the rest said

An increase in male wages (W_m) has a substitution effect making leisure more expensive and will increase labor supply of the male member. As income earned for each hour increases, it will also have an income effect lowering his labor supply. The outcome for male labor supply will depend on the strengths of these two effects and is ambiguous a priori. A similar prediction exists for the female member when W_f increases.

When husband's wages (W_m) increase, all else constant, a direct income effect from his earnings will push the female member to substitute her market work with non-market time, assuming non-market time is a normal good.[9] Additionally, when husband's wages increase, it will also exert a cross-substitution effect. As his time becomes more valuable in the market, it can lead to substitution by wife for husband's time in home production activities. While the latter effect is relevant in other developed country scenarios, in the Indian case it is likely to be muted given that home production activities are mostly a function of only female time spent at home. Eswaran et al. (2013) show that Indian rural households engage in 'status' production (a household good), which is especially intensive in female's time spent at home but not in male's time. Other empirical evidence in the literature also suggests that household production activities are largely accomplished by female members (Choudhary et al., 2009, Jain, 2007, Sudarshan and Bhattacharya, 2009).[10] An empirically testable prediction that emerges out of this simple comparative static exercise is that, as husband's wages increase, wife's labor supply will decrease. Similar theoretical prediction exists for other secondary workers in the household including children and the elderly.

other reasons. Out of those who were "not required" to engage in domestic duties, 50 percent said they did so by preference, 15 percent said there was no work available, and the rest said other reasons. While these numbers are purely suggestive, they hint that both leisure and domestic production are important to households. The figures are the author's calculations using the NSS.

[9] At very high levels of wealth, home production can become an inferior good as households may be able to hire domestic help, in which case leisure will only represent true leisure.

[10] It is also possible that leisure of the husband and wife are complimentary in nature. In that case, as the husband's wages increase, and he works more (own substitution effect dominates own income effect), the wife's actual leisure will decrease, and her labor supply will increase through the cross-substitution effect channel. If the income effect from his own increased wages dominates, leading him to work less, then the wife's labor supply may reduce as her leisure increases. However, as I mention in the data section, male labor supply in the sample is stable across years, reducing the importance of the cross-substitution effect channel from the husband's earning on the wife's labor supply.

1.4 Empirical Framework

In the first method, which is referred to as the across-district specification, I estimate the relationship between married male earnings and the labor force participation of married women using a district fixed effects model. Districts are sub-national units with important administrative and political autonomy in India.[11] These are well-defined geographic areas that reflect local labor markets and many policy implementation decisions are made at the district-level (Duflo and Pande, 2007, Topalova, 2007). This method uses the differential changes in married male earnings experienced across districts over time as the source of variation in married male earnings. The specification of interest is the following:

$$FLFP_{dt} = \beta LogMarriedMaleEarnings_{dt} + \eta_d + \rho_t + \delta X_{dt} + \epsilon_{dt} \tag{1.1}$$

In equation (1), $FLFP_{dt}$ is the average female labor force participation rate of married females in district d for time t. $LogMarriedMaleEarning_{dt}$ is the log of average earnings of married males in district d at time t. η_d are the district fixed effect to control for any time-invariant unobservables at the district level. ρ_t is the survey year fixed effect to control for any time specific unobservable which is common across all districts. X_{dt} are time-varying demographic controls at the district level. These include age of females and males in a district, and education of married females. To control flexibly for the age composition of different districts, I use share of married males and married females in the following age-groups for each district: 18-25, 26-33, 34-40, 41-47, and 48-55 years old. For education, I control using the proportion of married females in the following groups: no education at all, below primary education, primary education, middle school education, secondary education, higher secondary education, and college education.[12] Standard errors are clustered at

[11] India is divided into 28 states, 7 union territories and 640 districts.

[12] 12 Individual education is reported as the following categories in NSS: not literate, literate without formal school, EGS/NFEC/AEC, TLC, below primary, primary, middle, secondary, higher secondary, diploma/certificate course, graduate, and postgraduate. I combine the first four categories to form the no education variable and the last three to form the college education variable.

the district level.

An obvious concern with this estimation strategy relates to unobserved omitted variables which might be correlated with changes in both male earnings and female labor force participation in a district. Any competing story that could bias the relationship of interest should simultaneously increase married male earnings and decrease labor supply of married females. This assumption cannot be tested completely in the current framework. However, most of the (unobserved) variables that lead to an increase in male earnings for a labor market will also, a priori, increase employment opportunities for females and other individuals in the secondary labor force. For example, if the economy improves or a factory opens and there are new labor market opportunities leading to higher wages, it will most likely increase employment opportunities for both males and females. Hence, to some degree, omitted variable bias is less of a concern in this scenario. Even so, a major weakness of the above approach is that the changes in earnings of married males are not exogenous. The empirical approach adopted above can result in biased estimates if the unobserved variables that increase the earnings of married males also somehow lead to lower labor force participation of married females. For example, districts may face changes in political scenarios (for example, lower female representativeness in village councils) that could lead to higher economic growth and lower female labor supply. In such cases, a negative relationship between rising male earnings and declining married female labor supply could be misinterpreted as a pure income effect at the household level. This is a potential problem. To account for these concerns, I complement the analysis by utilizing the within district variation in male earnings, which is the second source of variation in married male earnings.

In the second source of variation, I exploit changes in married male earnings between male labor markets in a district, where labor markets are defined based on the education of males. If a male has primary or less than primary education, then he belongs to the low educated labor market; if he has higher than a primary education, he belongs to the highly educated labor market. Because I cannot connect each married female to her spouse in the dataset, I use the household head's education to assign her to different groups. If the household head has primary or below primary education, I assume that secondary workers in the household belong to the group where males have low education; for all others, I assume they belong to the group where married males have high education.[13]

This method hinges on the variation in male earnings between labor markets in a district over time. In figure 1.3, I provide evidence for the presence of several districts where the two labor markets experience differential changes in married male earnings. This figure displays a scatter plot of changes in log married male earnings between 1999 and 2012 for high and low educated labor markets in every district. There are quite a few districts where one labor market had a large increase and the other experienced a decrease in married male earnings. For districts where both labor markets experienced an increase in married male earnings, the magnitude of the change also varies. Hence, there is potential variation left in married male earnings within a district between different labor markets that can be exploited. The within-district specification is the following:

$$FLFP_{edt} = \beta LogMarriedMaleEarnings_{edt} + \delta X_{edt} + \omega_{dt} + \pi_{et} + \gamma_{ed} + \epsilon_{edt} \tag{1.2}$$

where $FLFP_{edt}$ is the average female labor force participation rate for married females who belong to households where the head of the household belongs to education group e, in district d and time t. $LogMarriedMaleEarnings_{edt}$ is the log average earnings of married males in district d, education group e and time t. Recall that a labor market is defined by education group and district and is hence represented as ed. γ_{ed} is the labor market fixed effect. This variable captures all time invariant unobserved factors that affect labor force participation for all workers in a labor market. π_{et} is the education group by time fixed effect, to pick up factors that affect an education group in a time-period. These do not vary by district and hence they control for country-wide unobserved factors common to education groups in a given time-period.

[13] Median years of schooling for married males in the sample corresponds to primary level education.

A main advantage of using this methodology is that it allows me to control for district- and time-specific unobserved variables through fixed effect represented by ω_{dt}. These district by time fixed effect net out any common unobserved variables that influences the labor markets in both a district- and time-specific manner. Examples of such unobserved variables include shocks to weather or a new government in the district that affects both earnings of males and labor supply of secondary workers.

The demographic controls included here are represented by X_{edt}. As with the across-district model, these controls include the proportion of married males and married females in different age groups and the proportion of married females in different education categories in a labor market ed and time t. Standard errors are clustered at the labor market level. β is the coefficient of interest that captures the following question: how much does the relative difference in the female labor force participation rates between low and high educated labor markets change when the relative difference in the earnings of married males between the two labor market changes by a certain percent?

An implicit assumption made earlier pertains to assortative mating in the sample. For married females to be attached to the correct male labor market, the education levels of male and female family members should be sufficiently correlated. If married men are not being matched to their wives in these labor markets, it will lead to measurement error in measured earnings, creating attenuation bias. To be convinced that married males are being matched to their wives in the labor market, I check for assortative mating in India using the Indian Human Development Survey. Years of education of husbands and wives are strongly correlated with a correlation coefficient of 0.6 suggesting substantial assortative matching (table 1.14).

In addition to married females, I estimate equation 1 and 2 for three other groups- adolescents, the elderly, and unmarried females. Adolescents and the elderly are also secondary workers in the household, like married females. If there is reallocation of labor by wives when earnings of the primary male worker rise, the negative wealth effect is likely to be present for other secondary workers also. For adult unmarried females of the same age-group, however, the negative wealth effect is likely to be zero or low as they do not have spouses. It is possible that they may be affected, as some of them will be daughters of currently married fathers, or divorced women who receive alimony. If not perfectly absent, the household level wealth effect is likely to be much lower for this group as compared to married women. Other district-level and labor market level changes over time are expected to be similar for all women of the same age group regardless of their marital status. Essentially, this group will serve as the main falsification test. In the empirical analysis, women who report being never-married, widowed, divorced, and separated and are between the age of 18-55 years are included in the unmarried sample of women.

I extend my enquiry using the third source of variation from the Indian Human Development Survey (IHDS)- an individual-level panel dataset. Here, I estimate the effect of a change in the husband's earnings on the labor force participation of the wife between 2005 and 2012. Even though the data only spans seven years, there are two advantages of this analysis. First, in this data I can connect all females to their husbands. This reduces the measurement error in the key independent variable, as I can match couples perfectly. Another benefit of this analysis is that I can use household fixed effect, which allows me to control for all time-invariant unobserved dimensions at the household level that may influence both earnings of the husband and labor supply of the wife. The household-level specification is as follows:

$$WLFP_{ht} = \beta LogHusbandEarning_{ht} + \eta_h + \rho_t + \phi X_{ht} + \epsilon_{ht} \tag{1.3}$$

where $WLFP_{ht}$ is the measure of labor force participation for wife belonging to household h in time-period t. The primary variable of interest is $LogHusbandEarning_{ht}$, which is the log earning of the husband in household h in time t. η_h and ρ_t are the household and survey year fixed effects, respectively. A household consists of one couple. X_{ht} is a set of time-varying variables in household h. It is likely that households that become wealthier may increase their fertility as they are able to afford more children, and this may reduce the labor supply of the wife. To capture changes in fertility and household structure over time, I account for any changes in household size by including controls for the number of children below age 5, between the ages of 6 and 14 years, between 15-59 years, and above the age of 59 years. Standard errors are clustered at the primary sampling unit level, which is a cluster of 150-200 households in a district.

1.5 Data

1.5.1 District-Level Data

For district level analysis, I obtain data from the household-level repeated cross-sections of the Employment-Unemployment survey conducted by the National Sample Survey (NSS). These surveys are conducted every year, but every five years NSS conducts the large sample survey round administered all over India with a sample size of about 100,000-120,000 households. The four large sample survey rounds used in this paper are from years 1999-2000 (55th), 2004-05 (61st), 2009-10 (66th), and 2011-12 (68th). In the regression analysis, I pool the last two rounds together since they were conducted within a short interval and unlikely to show big changes in income and employment. I run my regressions without pooling the last rounds as well, and it doesn't change my results.[14]

I measure labor force participation using the official definition of labor force participation used by NSS. This definition is used by NSS for annual estimates of labor supply and in most of the research on labor in India. Labor force participation is the combination of the usual principal activity status and subsidiary economic activity status. The activity status in which the person spent the most time during the past 365 days preceding the survey is the usual principal activity status. After the principal activity status has been determined, the activity in which the person spent 30 days or more in last 365 days is the subsidiary activity status. I define an individual as part of the labor force if she is working according to at least one of the two criteria. To be considered as part of the labor force,

[14] NSS considers district sample size to be inadequate for reporting district-level estimates. However, as Duflo and Pande (2007)point out, it does not affect the analysis if we are not drawing inference about any specific district and report regression results for many districts.

the activity reported for the individual should be one of the following: own account worker, employer, helper in household enterprise (unpaid family labor), regular salaried/wage employee, casual wage laborer in public works, casual wage laborer in other types of work, or unemployed seeker of work. If a person reports one of these activities in either usual principal status or subsidiary status, she is part of the labor force.

Sample Description

Various districts were partitioned during the time under study. I adjust for district boundaries by returning all child districts to the parent districts in 1999-2000.[15] I retain a total of 514 districts for the four rounds pooled together after this matching exercise. Following the literature, I exclude the following small states from my analysis: Andaman and Nicobar Islands, Arunachal Pradesh, Goa, Lakshwadeep, Manipur, Meghalaya, Mizoram, Nagaland, Puducherry, Tripura, Dadra and Nagar Haveli, Daman and Diu. These states are small and have few observations in the dataset.[16] After dropping the above states, I retain 463 districts. The next level of sample restriction is on the age and marital status.

I restrict the sample to females aged 18-55 years old. The sample of males consists of those aged 18-57 years. The average difference between the age of married males and females is 2 years in the sample. Hence, I choose the upper bound for men to be 2 years greater than 55 years. The survey instrument reports the marital status of an individual as one of the following: never married, currently married, widowed, and divorced/separated. For the main results, I restrict to those who report their marital status as 'currently married'. To calculate average male earnings at the district level, I include married males who are qualified to answer the earning module in the NSS. Weekly earnings are collected for individuals who were engaged in an economic activity, except for those who were self-employed (own business, unpaid family worker) during the reference

[15] I referred to District boundary information from http://www.statoids.com/yin.html. I also thank Stephen O'Connell for generously sharing the matching of district boundaries which was a helpful resource in checking my matching.
[16] The results are robust to including these small states.

period of one week. This restriction ignores information on those who were engaged in economic work such as subsistence agriculture and did not get paid during the last week. If there was data on hours reported or the industry composition of those who were not interviewed on the earnings module, there was a possibility of imputing the earnings of those men. However, the present data does not allow me to impute earnings of these individuals.[17] I adjust earnings for inflation using the national consumer price index accessed from the World Bank website. I group the data by district and survey round using sample survey weights. While aggregating the data at the district level, there are some districts with too few observations to generate reliable averages, which may lead to measurement error causing attenuation bias. Hence, I keep districts with at least 15 males and at least 15 females to minimize this issue. Finally, I keep districts that are present in all three periods and run my results on a balanced panel of districts. All results hold when I use the unbalanced panel of districts.[18] [19] After the above two additional restrictions, the final number of districts used for this analysis is 446.

I show changes in the variables of interest in table 1.1. Column 1 in table 1.1 displays descriptive statistics for all districts. Columns 2 and 3 divide the districts based on whether they experienced a change in male earnings above or below the median change between 1999-2012. The decline in married female labor supply is higher for districts that experience a change in married male earnings above the median as compared to districts that experience a change below it. Districts with above median changes in married male earnings also gain 0.6 more years of female schooling than the remaining districts in column 3. Fertility and marriage rates may also respond to earnings of married males. Changes in fertility and marriage rates are similar across the two sets of districts

[17] Recognizing that in the current context there is a major proportion of the population engaged in economic activity and not reporting their earnings, I check for the robustness of my results after controlling for the proportion of married males working for pay in the results section.

[18] The results are robust to including districts with less than 15 married males or females and if I chose the cut-off as 20. Three additional districts–Shivpuri, Deogarh, and Uttar Kashi–were dropped due to small sample size for other demographic groups used in the robustness section. The main results for married females are robust to including these districts as well.

[19] For the within district specification, 34 districts were dropped for analysis in this section as they had less than 15 observations of either males or females (regardless of their marital status) in each cell. Additionally, I dropped Phulbani district from analysis in this section because the change in male earnings for the high educated labor market was more than 300 percent. The results are robust to keeping these districts.

in column 2 and 3. Male labor force participation rates are quite high in the sample, at 98 percent for both columns and there is no significant change over time in this variable. The proportion of married males working for pay shows very little change over time and across columns. A big change in this variable may have caused a misrepresentation in the changes in average earnings of married males. If many subsistence agricultural workers change to daily wage workers (unskilled) and start reporting earnings, this may reflect as a drop of earnings instead of a zero change. No change in this variable reassures that there are no big changes in the proportion of married males who report earnings in the data. Nevertheless, I will check for robustness of my results by including a control for this variable in my specifications.

Next, I show the top four industries for married males coded at the 1-digit level. In column 2, districts that experienced above median change for earnings of married males have a greater percentage of married males working in agricultural activities and a slightly lower share of males in mining, construction, and manufacturing in 1999-00. These districts also face a larger reduction in their agricultural male workforce and a lower reduction in manufacturing between 1999-2012. Hence, the type of districts that experience higher or lower change in married male earnings differ in their industrial composition.

1.5.2 Household-Level Data

Indian Human Development Survey (IHDS) is a nationally-representative survey collecting information on multiple topics including household characteristics, consumption, education, health, and employment of household members. IHDS was conducted in 2004-05 (henceforth 2005), and 2011-12 (henceforth 2012). It is a panel data set of 41,554 households.[20]

Here, the labor force participation indicator is constructed separately for various work categories. The work categories are the following: work on family farm, agriculture wage labor, non-agriculture

[20] 6,911 households were lost due to attrition between 2005 and 2012. The sample was refreshed by randomly selecting a household in the same neighborhood for urban blocks and rural north-eastern states, resulting in 2,134 new households being included in the second wave.

wage labor, salaried work, and family business work. IHDS-2 added work in National Rural Employment Guarantee Program (NREGA) wage labor and work in non NREGA wage labor as separate categories and these are counted as work for 2012. The survey creates a labor force participation variable for a specific category as 1 if the individual spent 240 or more hours in that activity in the past one year. I define my labor force participation measure as 1 if an individual worked in any of the above categories. This definition maintains comparability to the NSS definition of labor force participation of working at least 30 days in the reference year. Apart from work for wage, unpaid family farm work and work in household business is counted as work in both NSS and IHDS. I exclude animal work from the definition of work in IHDS, since it is not clear if it is included as work in NSS. Another discrepancy in the definition of LFP is that 'seeking work' is included as LFP in NSS but not in IHDS. Including 'livestock rearing' for IHDS or excluding 'seeking work' from the NSS does not change the main results.

Sample Description

I restrict the IHDS sample to make it as comparable to the NSS sample as possible. Since I exploit changes over time, I perform my analysis on a balanced panel of females who are 18-48 years old in the first time-period and married in both time periods. This gives me a sample of 30,856 women. There are 2,837 women who are married in period 1 but who are not married in period 2 or have missing spouse identifiers. I exclude these women from my sample. I also exclude another 154 women who have the same spouse identifiers in the same household. I do so because it is either a data coding error or these are polygamous households. In the latter case, it is hard to distinguish the share of each wife in the husband's earnings. This leaves me with 27,865 women.[21]

The main explanatory variable in the analysis is the husband's earning. In the survey data, annual earnings at the individual level are recorded for all members of the household. The deflator provided

[21] Not including women with no husbands in period 2 (widows/separated/spouse absent) will underestimate my results since absence of the spouse leads to an increase in labor force participation of women in the data over time. I run my analysis including these women as well, and it does not change my analysis. Also, results are consistent if I keep presumably polygamous households.

in the IHDS data has been used to deflate 2012 earnings. However, there is a large proportion of married males in the data with no recorded earnings at an individual level even when they work and have total household-level income reported. There is data for household income from all economic activities; such as, income from farm work and household businesses. However, I cannot be perfectly certain about the individual contribution of the husband to the household income pool, which is why I exclude wives with husbands who have no individual level earnings reported in any one period. Additionally, I drop 736 women who have husbands older than 57 years in the second period to keep the age band comparable to what was used in NSS. This generates a panel of 12,890 women who are married in both time periods and have earnings information available for their husbands in both time periods. This is the final working sample for this analysis. It must be kept in mind that these results are not representative since the sample is biased towards those who are more likely to work in the formal sector, report earnings and be economically better-off.

The descriptive statistics of the estimation sample can be found in 1.2. Column 1 shows the summary of all variables used in the analysis in 2005 (base period) and the change in those variables between 2012 and 2005 for the full sample. In columns 2 and 3, I split the sample depending on if the woman experienced an increase or decrease in the earning of her husband. First, the overall female labor force participation increased, and it increased more for females who face a decline in their husband's earnings in the sample. For other variables, the changes are similar across the three columns. The number of children between the age of 6-14 years declined by .03 for households where the husband's earnings decreased, and it rises by .08 where the husband's income rises. Importantly, the change in fertility for 0-5-year-old children between these two groups is comparable over this period. The number of children between the age of 0 to 5 years decreased by 0.2 in all columns. Household size between the age of 6-11 years increases for households where the husband's income rises and decreases for households where husband's income falls. There is no difference for changes in household size for the age group between 15-59 years. Husbands who experience an increase in income are more educated and more likely to reside in urban areas.

1.6 Results

1.6.1 Across and Within-District Results

Table 1.3 provides estimates from the across-district specification in equation 1 for the sample of married females. Column 1 includes district and survey fixed effects. Column 2 has a basic set of demographic controls (male and female age and female education) in addition to the district and time fixed effects. I find a significant negative relationship between married male earnings and married female labor force participation in a district. A 10 percent increase in earnings of married males is associated with a 0.7 percentage point decline in the average labor supply of married females at the district level. This corresponds to an approximate decline of 16 percent over the mean labor force participation rate.[22] There are likely to be several sources of bias in this analysis, such as selection into the marriage market, shifts in male employment, and changes in fertility levels. In what follows, I explain some of these concerns and check for the robustness of my results to such confounding factors.

First, I address the problem introduced by selection into marriage. Changing income levels of males are likely to affect marriage rates in a district. It is reasonable to expect that males with higher earnings are also more likely to get married because they become more attractive in the marriage market (Becker, 1973, Ginther and Zavodny, 2001, Nakosteen and Zimmer, 1997). For females, the decision regarding when and whom to marry may be determined together with her willingness to work. If overall wages in a district increase for both males and females, then women who have a higher willingness for work may delay marriage if marriage and working are not perfectly compatible. This will lead to a sample of married females with a lower taste for work and hence less attachment to the labor market. To account for the bias introduced by marriage selection, I control

[22] I also conduct analysis where I use year-specific population of the districts to weight each district in the regressions. I use population data obtained from the Census. The population at a district-level for each year was extrapolated by using the growth rate of population between the 2001 and 2011 censuses and then applying that growth rate for every year. All results in this paper hold when using these population weights.

for the proportion of males and females married in the age group 18-55 years at the district level. The estimated coefficient in column 3 of table 3 does not change after controlling for these variables, which helps to some degree to address concerns due to selection into marriage.

It was mentioned previously in section 5.1 that the earnings module of the questionnaire is not conducted for self-employed people and that may be a problem. Change in married male earnings, which is my main independent variable, could be confounded because of the changes in the proportion of males who report earnings. A perceived change in the average earnings of a district may be due to a fraction of married men moving from self-employed status to a wage-earner status or the other way around. Additionally, overall changes in male employment rates in the district can also bias the results as they may be correlated with the female labor market. Column 4 of table 1.3 confronts this issue by showing estimates after controlling for unemployment rates of males in the district and for the percentage of married males who work for pay in the district. I find that the point estimate is not sensitive to such male employment controls.

Another potential concern is the response in fertility due to changes in married male income. There is a bulk of evidence showing that fertility changes with economic growth (Black et al., 2013, Currie and Schwandt, 2014), and that female labor supply responds to changes in fertility (Angrist and Evans, 1998, Bailey, 2006, Cristia, 2008, Cruces and Galiani, 2007). The concern here is that with higher income, households can afford more children, and higher fertility levels would reduce female labor supply since females are the primary caregivers for children. To account for this, I control for fertility in column 5 by including three variables: average number of children in the household for age groups 0-2 years, 3-5 years, and 6-8 years since different aged children can affect work decisions in different ways (Blau and Kahn, 2007). Here too, I find that the estimated coefficients are robust to fertility controls and the magnitude of the coefficient is stable. These checks add further evidence that the estimated relationship is not representing a response in fertility, changes in male employment variables, or selection into marriage channel, but is rather consistent with an income effect hypothesis.

I also check for robustness of my results to the inclusion of district specific time trends in equation 1. The estimation of the coefficient after the inclusion of time trends depends on the variation in male earnings from a linear parametric trend and it is usually hard to retain much variation after including them. Despite this, in column 6, I find that the estimated coefficient is stable in magnitude and is significant at a 10 percent level.

In a similar way, table 1.4 shows results for the sample of married females using the within-district specification in equation 2. Column 1 includes all pair-wise fixed effects and column 2 includes basic demo-graphic controls. Examining the coefficient in column 2 reveals that a 10 percent increase over time in the difference between married male earnings between two labor markets is associated with a significant decline of 0.7 percentage points in the difference between the married female labor force participation of the two groups. This is a 17.5 percent decrease over the baseline FLFP rate of 40 percent. This estimate is almost equal to the one which utilized across-district variation.

I also check for the robustness of the coefficient to the inclusion of controls related to marriage market, male employment, and fertility in columns 3, 4, and 5, respectively. These controls are defined at the labor market level and not at the district level as before. I find that the results are not sensitive to the inclusion of the three sets of controls, corroborating the hypothesis of this paper. An additional concern in the within-district analysis pertains to the selection of married males being in a specific labor market. Some districts may experience a systematic increase in the share of highly educated married males that correlates with female labor force participation over time. In column 6 of table 1.4, I control for the share of highly educated married males in a district that changes over time. The point estimates are robust to including this variable.

I present results for other demographic groups with my preferred specification that includes marriage controls, fertility controls, and male employment controls separately for the across-district and within-district specification. Tables 1.5 and 1.6 show the coefficients for the sample of adolescents, the elderly, and unmarried women for the across-district and within-district comparison, respectively. Results show that married male earnings have no effect on the labor supply of unmarried females of age group 18-55 years old.[23] Women in this group belong to the same age-group and face the same labor market changes over time as the group of married females. However, they do not experience a change in the earnings of their husbands; therefore, no effect exists through that channel. So, the effect of married male earnings ought to be much lower for this sample, which is confirmed here in both across-district and within-district results. This serves as my falsification check.

Further, I find that an increase in the earnings of married males leads to a significant negative decline in the labor force participation of adolescents between the ages of 13-17 years. In the within-district results, a 10 percent increase in the earnings of married males is associated with a 0.35 percentage point decline in the average labor supply of adolescents.[24] This corresponds to a decline of 20.5 percent over the mean labor force participation rate. That the marginal estimates are lower for adolescents as compared to married adult females could be a result of low average labor force participation rates to begin with. I also find a positive effect of an increase in married male earnings on enrolment ratios in the district. This suggests that households are substituting adolescents labor market work with school in response to an increase in the earnings of prime age male workers, although the point estimate is not estimated precisely in the within-district specification (table 1.15). For the elderly population between the age of 60-75 years, the across-district specification shows a small negative coefficient, but the within-district specification finds no association.[25]

Using the estimated marginal effect of married male earnings from the above analysis, I can make some back-of-the-envelope calculations about the role of male earnings in explaining the declining female labor supply. In the NSS data, as shown in figure 1.1, I find that between 1999-2012, average married male earnings grew by 50 percent. Using the estimated coefficient of 0.7 percentage points, we can say that rising male earnings explain about 3.5 percentage points of the decline in female

[23] Results hold if I trim the sample to 21-55 year old unmarried women. Younger women are more likely to stay with their parents and could be more affected by their father's earnings. The results also hold if I only exclude divorced, separated and widows.

[24] It is illegal for children to work below the age of 14 years. Although this law is not perfectly enforced, the labor force participation rates are quite low for younger children and increase after 13 years of age in the sample, hence I restrict to the age group 13-17 years.

[25] Unlike other specifications, for the regression on elderly, I restrict elderly individuals who are not household heads population as they may not be secondary workers. The results do not change if I do not include this restriction.

labor supply–44 percent of the entire decline between 1999 and 2012.

1.6.2 Household-Level Fixed Effect Results

In column 1 of table 1.7, I show results from a regression with the two rounds pooled together without household fixed effects. The estimate on the pooled regression indicates a significant negative effect of husband's earnings on female labor force participation. However, this regression does not consider the within-person variation. The main individual-level results for married females presented in the last two columns of table 8 confirm a significant negative relationship between change in husband's earnings and a change in wife's labor force participation. Column 3 presents results after controlling for time-variant covariates. A 10 percent increase in earning of the spouse leads to a 0.2 percentage point decline in wife's labor supply, which is a 5.3 percent decrease over mean labor force participation, giving an elasticity of -0.53. The above elasticity is almost a third in magnitude of what I found in the previous analysis. Although the directional interpretation of the effect of male earnings on married female labor supply is the same in both the datasets, the magnitude of the estimates from this sample cannot be directly compared to the district-level results since the period of analysis, variation used in estimating the coefficient, and characteristics of the sample are different in these two empirical analyses. Additionally, the estimates from the household-level analysis are for a selected sample that is wealthier and better educated due to the nature of sample restrictions.[26]

The longitudinal nature of the IHDS data makes it hard to examine the effect of married male earnings on the labor force participation of adolescents as was done in the NSS. A seven-year difference between the two rounds does not allow me to follow the same adolescent in the age window of 13-17 years. Thus, I perform a slightly modified analysis at the household level. I calculate the fraction of total adolescents (13-17 years old) in the household who are engaged in the labor market. I regress this ratio on household characteristics and the earnings of the husband in the household.

[26] A separate analysis of the covariates of the two sample suggests that in the working sample from IHDS, women have higher education levels as compared to an average woman in the NSS sample and males have a higher probability of working in the formal sector.

To be included in this regression, a household needs to have at least one adolescent in both the periods. Table 1.8 presents the results of this regression. I do not find any significant effect on this sub-group as was found in the previous two sets of analyses. As in the previous section, I perform the analysis on the subsample of elderly between the age of 60-75 years. I find a significant negative effect of married male household earnings on labor supply of the proportion of old individuals in the household working. Results in table 1.8 show that a 10 percent increase in married male earnings is associated with a 0.7 percentage point decline in the labor supply of elderly individuals. Over the mean labor force participation of this sub-group, it is a change of 28 percent, which is much higher than what was found in the NSS results. One possibility for this observation could be that in the household analysis, the elderly must co-reside in the household to be in the sample. In the district level analysis, this did not have to hold. The income effect is likely to be stronger when secondary workers live in the same household. Overall, the results suggest that changes in the earnings of married males affect the labor supply of secondary workers in the household.

1.7 Robustness Checks and Other Concerns

District-Level Analysis

In the previous section, I described how changes in marriage rates can bias the estimates and provide results after controlling for the changes in the proportion of males and females married. As an additional check, I test for the effect of earnings of all males (not only married males) on married female labor supply. Since the arguably exogenous changes in earnings of males over time at the district level should affect adult married and unmarried males in the same way, I should find a similar effect of the district-level changes in all male earnings on the labor supply of married females. In tables 1.9 and 1.10, I show the effect of earnings of all males in the district on the labor supply of married females for the across district and within district strategies. Reassuringly, I find similar point estimates of the effect of all-male earnings on the labor supply of married females.

To alleviate the problem of measurement error in the independent variable arising from a certain fraction of males who do not report their earnings, I control for the changing share of married males who work for pay in the results section. To further check if the earnings variable used here is indeed a reasonable measure of the actual changes in earnings, I drop those districts which have a very low share of married males who worked for pay or a very high share of married males who report being engaged in self-employed jobs. Males in such districts are less likely to report earnings introducing measurement error in the average earnings variable. I exclude districts (or labor markets in the case of within district specification) where the share of married males working for pay is less than 30 percent. This is about 15 percent of the districts. Regression results obtained after this restriction are shown in tables 1.11 and 1.12 for the across district and within district specifications respectively. The results remain consistent to this additional check.

There is an additional concern related to migration of individuals between districts. If males are selectively migrating to better-off districts in response to more rewarding jobs, it could potentially bias the results in various ways. If females are migrating with men and finding work in other districts, then my results would be underestimated. If females are staying behind and taking over activities like farm work, then female labor supply would rise in districts with low economic growth, and my results would be overestimated. However, cross-district migration in India is very low. Using the Rural Economic Development Survey, Munshi and Rosenzweig (2009) find low rural spatial mobility despite increases in economic growth and inequality. Topalova (2007) reports that only 3.6 percent of the rural population in 1999-2000 changed districts. Pathania (2007) finds that a very small proportion of rural women migrate to districts different from their birth districts in the Indian census. Thus, migration is less concerning as a confounding factor.

It may also be argued that if the wife devotes her time to only household activities instead of working, it increases productivity of the husband and time spent in the labor market, leading to higher earnings (Benham, 1974). However, for the context at hand, it seems unlikely that this will be a cause for bias, as most of the household activities in India are primarily done by women (Choudhary et al., 2009, Jain, 2007, Sudarshan and Bhattacharya, 2009). Moreover, when a woman works, there is usually support from her family and relatives, such as the mother and/or father-in-law who co-reside and share the burden of household activities.

Household-Level Analysis

One of the time-varying household-level variables that correlates with wife's labor supply and husband's income is husband's health. The husband's health can affect both his earnings and the labor supply of the wife. It may increase if she is compensating for the loss in income by working more. It may decrease if she is spending more time taking care of him by substituting from market work. In column 1 of table 1.13, an indicator for husband's health is included to check if results are robust after including this husband's morbidity as control.[27] The point estimate remains unchanged after inclusion of the morbidity variable, which helps eliminate the alternative channel of health.

1.8 Comparison with Previous Studies

A useful comparison is to contrast the elasticity estimated in other countries with those found in this paper. For developed countries, the evidence on added worker effect suggests small effects. For the United States, a general trend has been a decline in the responsiveness of married women's labor supply to their husband's income. Estimates of cross-income elasticities for married women in the United States range from -0.09 to -0.4 (Blau and Kahn, 2007, Bradbury and Katz, 2008, Devereux, 2004, Juhn and Murphy, 1997). The estimated cross-income elasticity in this paper was -1.7 in the district-level specification and -0.53 in the household-level specification, both of which are greater than what has been estimated in the United States.

In the developing country context, Bhalotra and Umana-Aponte (2010) merge Demographic and Health Surveys with a country by year panel of GDP to estimate responsiveness of female

[27] A dummy variable for long term morbidity equals 1 if husband suffers from any of the following: cataract, tuberculosis, high BP, heart disease, diabetes, leprosy, cancer, asthma, polio, paralysis, epilepsy, mental illness, STD/ AIDS, or other long term illness.

labor supply to country-level GDP. Overall, the authors find an elasticity of -1.5.[28] Cerrutti (2000) studies the relationship between employment instability of the household head and female labor supply using panel data in Argentina. The author finds that females, in households where the head changed employment status, were twice as likely to enter the labor force as compared to those who had a household head always employed. For urban Mexico, Parker and Skoufias (2004) finds that when a household head becomes unemployed, adult females are 16 percent more likely to obtain employment relative to households where males did not experience unemployment.

The findings also resonate with some previous observations for the case of India in the literature. Rosenzweig (1980) estimates the responsiveness of married female labor supply with respect to the husband's earnings to lie between -1.4 and -2. Heyer (2010) studies the Dalit community in the Tiruppur region in south India from 1980 to 2009. The author finds a similar phenomenon of women retreating from the labor force to become housewives as the community overcomes extreme poverty and the well-paid employment opportunities for women remain limited. Srivastava and Srivastava (2010) argue that female labor supply is more of an insurance mechanism in India based on the analysis of average labor force participation of different demographic groups across income deciles. The estimated elasticities in this paper are comparable in magnitude with findings of previous researchers for India and developing countries.

Comparison of developed and developing countries shows that the responsiveness in labor supply of married females seems to be higher in developing than in developed countries. This has also been previously noted in the literature. In low-income settings, a large fraction of the population is dependent on agriculture and other informal employment, making households prone to income shocks. Moreover, credit constraints are common and formal safety nets are rare, factors which limit a household's ability to smooth consumption over time. Combined with a higher division of labor in the household, this would lead to a higher responsiveness of female labor supply as compared to other developed countries with relatively fewer income shocks and unemployment insurance in

[28] See table 3 of the paper.

place. For the case of India, status concerns may lead to an even higher elasticity of women's labor supply with respect to the husband's wage rate.

1.9 Conclusion

Historically, females in India have exhibited low labor force participation rates as compared to other developing nations. Higher income, higher education, and higher caste are associated with relatively lower female labor force participation rates. The low female labor force participation has declined even further during the last decade. This is observed among all demographic groups defined by class, caste, education, and age. In light of falling fertility and rising female education levels, the steep decline in female labor force participation has presented a puzzle to economists and policy-makers.

This paper addresses this issue by linking females' labor force participation decisions to their husband's earnings. The empirical investigation in this paper reveals a negative relationship between husband's earnings and wife's labor supply between 1999 and 2012. This finding remains consistent across specifications using different sources of variation in earnings of married males. I perform several robustness checks to mitigate potential threats to identification posed by omitted variables and measurement error in the key independent variable. Furthermore, I find that earnings of married males do not impact the labor supply of adult unmarried females, but a negative relationship is observed for the labor force participation of other secondary workers in the household, specifically for adolescents and the elderly. This is in line with standard predictions of labor reallocation of secondary workers when earnings increase for primary workers. These results suggest that a household level income effect drives this relationship.

The welfare effects of these changes remain less clear. There is plenty of evidence that women's market work is associated with improved socio-economic outcomes for women and their children (Afridi et al., 2016, Antman, 2014, Blau and Grossberg, 1992, Jensen, 2012). At the same time, higher household incomes can buy more leisure for females and relieve them of working in poor conditions.

Research also shows that increased time spent at home by married females adds positively to the human capital of children in India (Shah and Steinberg, 2017). This may contribute to growth of the economy and higher equality of income in the long term. There may be resulting implications for decisions on fertility and investment in children that require further empirical investigation.

Tables and Figures

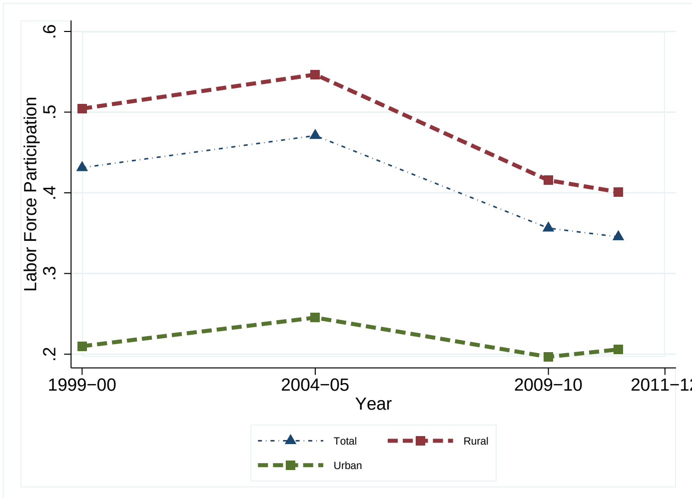

Figure 1.1: Changes in Labor Force Participation and Married Male Earnings Over Time

Note: Data Source: National Sample Survey.

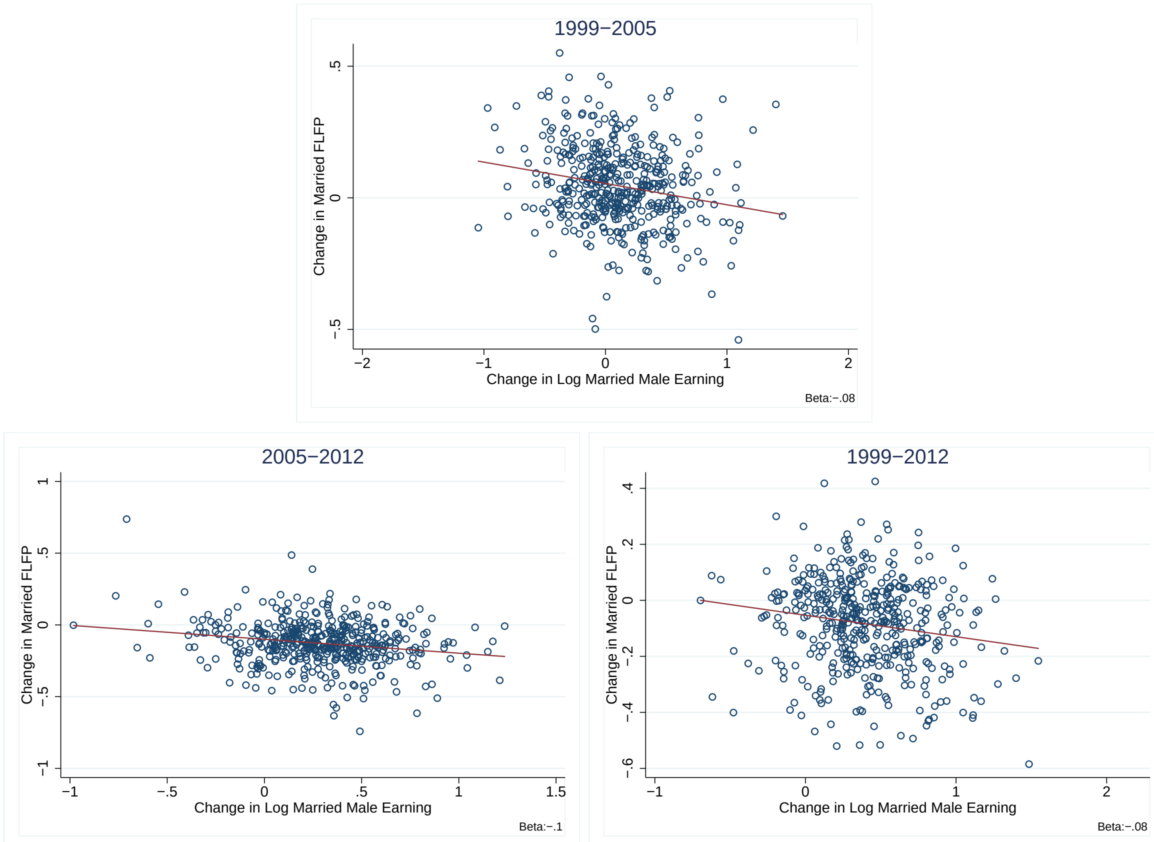

Figure 1.2: Changes in Married Female Labor Force Participation and Married Male Earnings at District Level

Note: Data Source: National Sample Survey.

Figure 1.3: Change in District-Level Married Male Earnings for High and Low Educated Labor Markets

Note: Data Source: National Sample Survey.

Table 1.1: Summary Statistics at the District Level

Variables	Full Sample (1) mean/sd	Change in Male Earnings above median change (2) mean/sd	Change in male Earnings below median change (3) mean/sd
Change in log married male earnings	0.399 (0.35)	0.668 (0.23)	0.121 (0.20)
Log married male earning in 99-00	6.812 (0.47)	6.614 (0.48)	7.018 (0.37)
Change in married FLFP(18-55 years)	-0.083 (0.16)	-0.101 (0.17)	-0.063 (0.16)
Married FLFP in 99-00(18-55 years)	0.450 (0.23)	0.469 (0.23)	0.431 (0.23)
Change in married female years of school	1.579 (0.94)	1.873 (0.84)	1.274 (0.94)
Married female years of school in 99-00	2.774 (1.62)	2.663 (1.79)	2.889 (1.43)
Change in female marriage rate*	-0.017 (0.06)	-0.017 (0.05)	-0.016 (0.06)
Female marriage rate in 99-00	0.843 (0.07)	0.844 (0.07)	0.843 (0.06)
Change in children(0-2yrs)	-0.094 (0.07)	-0.093 (0.07)	-0.095 (0.07)
Children(0-2yrs) in 99-00	0.305 (0.10)	0.298 (0.10)	0.312 (0.10)
Change in children(3-5 yrs)	-0.108 (0.08)	-0.107 (0.08)	-0.109 (0.08)
Children(3-5 yrs) in 99-00	0.396 (0.13)	0.385 (0.13)	0.407 (0.13)
Change in male LFP (18-57 years)	0.004 (0.02)	0.003 (0.02)	0.005 (0.02)
Male LFP in 99-00	0.980 (0.02)	0.981 (0.02)	0.980 (0.02)
Change in percent married male working for pay	-0.005 (0.12)	0.008 (0.12)	-0.019 (0.12)
Percent male working for pay in 99-00	0.547 (0.13)	0.528 (0.13)	0.567 (0.13)
Change in percent males married*	-0.015 (0.07)	-0.017 (0.07)	-0.014 (0.07)
Percent males married in 99-00	0.741 (0.08)	0.743 (0.08)	0.739 (0.08)
Change in percent married male in agriculture	-0.290 (0.20)	-0.345 (0.21)	-0.232 (0.17)
Percent married males in agriculture in 99-00	0.472 (0.25)	0.526 (0.27)	0.416 (0.21)
Change in percent married male in mining	-0.006 (0.04)	-0.006 (0.03)	-0.007 (0.05)
Percent married males in mining in 99-00	0.015 (0.04)	0.014 (0.04)	0.016 (0.05)
Change in percent married male in construction	0.013 (0.12)	0.013 (0.12)	0.014 (0.11)

Percent married males in construction in 99-00	0.096 (0.11)	0.094 (0.11)	0.098 (0.11)
Change in percent married male in manufacturing	-0.046 (0.09)	-0.043 (0.09)	-0.050 (0.09)
Percent married males in manufacturing in 99-00	0.094 (0.11)	0.091 (0.11)	0.097 (0.11)
Observations	446	227	219

Note: * indicates that the variable was constructed on the whole sample within the age group 18-55 years instead of the married sample as used for other variables. Data Source: National Sample Survey.

Table 1.2: Summary Statistics for the IHDS Sample

	Full Sample	Husband's income rises	Husband's income falls
Change in log male earnings	0.256	0.739	-0.723
	(0.94)	(0.58)	(0.73)
Log male earning in 2005	10.226	10.123	10.437
	(1.01)	(1.05)	(0.91)
Change in percent females working	0.065	0.053	0.091
	(0.55)	(0.55)	(0.55)
Female Labor Force Participation in 2005	0.434	0.420	0.461
	(0.50)	(0.49)	(0.50)
Change in number of children 0-5 years	-0.198	-0.199	-0.195
	(1.30)	(1.30)	(1.29)
Number of children 0-5 years in 2005	0.866	0.874	0.851
	(1.01)	(1.02)	(0.98)
Change in children 6-14 years	0.046	0.086	-0.035
	(1.67)	(1.67)	(1.65)
Number of children 6-14 years in 2005	1.331	1.297	1.400
	(1.27)	(1.25)	(1.30)
Change in number of persons 15-59 years	0.517	0.504	0.545
	(1.36)	(1.37)	(1.34)
Number of person 15-59 years in 2005	3.318	3.344	3.265
	(1.66)	(1.68)	(1.62)
Female age in 2005	30.728	30.455	31.280
	(7.29)	(7.27)	(7.32)
Husband's age in 2005	35.570	35.359	35.996
	(7.83)	(7.82)	(7.85)
Husband's education in 2005	5.579	5.761	5.211
	(4.76)	(4.81)	(4.65)
Percent high caste households	0.138	0.137	0.139
	(0.34)	(0.34)	(0.35)
Percent urban households	0.257	0.268	0.235
	(0.44)	(0.44)	(0.42)
Observations	12890	8682	4208

Data Source: Indian Human Development Survey.

Table 1.3: Across-District Regression with Full Controls
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)	(6)
Log married male earnings	-0.075***	-0.073***	-0.076***	-0.082***	-0.081***	-0.083*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
Percent females married			-0.167	-0.198	-0.187	-0.186
			(0.13)	(0.13)	(0.13)	(0.23)
Percent males married			0.276***	0.265**	0.277***	0.170
			(0.11)	(0.11)	(0.10)	(0.19)
Male unemployment rate				-0.155	-0.113	0.065
				(0.32)	(0.32)	(0.56)
Percent males working for pay				0.101*	0.101*	0.133
				(0.06)	(0.06)	(0.12)
Fertility (0-2)					0.262**	0.229
					(0.13)	(0.22)
Fertility (3-5)					-0.123	-0.160
					(0.10)	(0.20)
Fertility (6-8)					-0.048	0.103
					(0.10)	(0.18)
District Fixed Effect	Y	Y	Y	Y	Y	Y
Time Fixed Effect	Y	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y	Y
District Time Trend	N	N	N	N	N	Y
N	1338	1338	1338	1338	1338	1338
R^2	0.84	0.85	0.85	0.85	0.85	0.93
Y-mean	0.44	0.44	0.44	0.44	0.44	0.44
Number of districts	446	446	446	446	446	446

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Data Source: National Sample Survey.

Table 1.4: Within-District Regression with Full Controls
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)	(6)
Log married male earnings	-0.073***	-0.069***	-0.069***	-0.070***	-0.070***	-0.070***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Percent females married			0.053	0.053	0.066	0.066
			(0.08)	(0.08)	(0.08)	(0.08)
Pct males married			-0.016	-0.013	-0.012	-0.012
			(0.06)	(0.06)	(0.07)	(0.07)
Male unemployment rate				-0.091	-0.090	-0.090
				(0.18)	(0.18)	(0.18)
Percent males working for pay				0.038	0.042	0.042
				(0.05)	(0.05)	(0.05)
Fertility (0-2)					-0.042	-0.042
					(0.06)	(0.06)
Fertility (3-5)					-0.043	-0.043
					(0.06)	(0.06)
Fertility (6-8)					-0.007	-0.007
					(0.06)	(0.06)
Share of high educated males						-0.061
						(1.40)
EducationxTime FE	Y	Y	Y	Y	Y	Y
DistrictxTime FE	Y	Y	Y	Y	Y	Y
DistrictxEducation FE	Y	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y	Y
N	2472	2472	2472	2472	2472	2472
R^2	0.96	0.96	0.96	0.96	0.96	0.96
Y-mean	0.40	0.40	0.40	0.40	0.40	0.40
Number of Labor Markets	824	824	824	824	824	824

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. FE stands for Fixed Effects. DistrictXEducation Fixed Effect are also called Labor Market Fixed Effect in the paper. Data Source: National Sample Survey.

Table 1.5: Across-District Regression with Full Controls
Dependent Variable: Labor Force Participation of Other Workers

	Adolescents	Elderly	Unmarried Females (Placebo Group)
Log married male earnings	-0.035* (0.02)	-0.026 (0.03)	0.004 (0.02)
District Fixed Effect	Y	Y	Y
Time Fixed Effect	Y	Y	Y
Demographic Controls	Y	Y	Y
Marriage Controls	Y	Y	Y
Male Employment Controls	Y	Y	Y
Fertility	Y	Y	Y
N	1338	1338	1338
R^2	0.72	0.58	0.72
Y-mean	0.20	0.20	0.44
Number of districts	446	446	446

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. Adolescents, the elderly, and unmarried females belong to the age-group 13-17 years, 60-75 years, and 18-55 years respectively. Data Source: National Sample Survey.

Table 1.6: Within-District Regression with Full Controls
Dependent Variable: Labor Force Participation of Other Workers

	Adolescents	Elderly	Unmarried Females (Placebo Group)
Log married male earnings	-0.036* (0.02)	0.005 (0.03)	0.009 (0.03)
EducationxTime Fixed Effect	Y	Y	Y
DistrictxTime Fixed Effect	Y	Y	Y
Labor Market(DistrictxEducation) Fixed Effect	Y	Y	Y
Demographic Controls	Y	Y	Y
Marriage Controls	Y	Y	Y
Male Employment Controls	Y	Y	Y
Fertility	Y	Y	Y
N	2472	2472	2472
R^2	0.90	0.82	0.89
Y-mean	0.17	0.20	0.40
Number of Labor Markets	824	824	824

Clustered standard errors statistics in parentheses.*** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. Adolescents, the elderly, and unmarried females belong to the age-group 13-17 years, 60-75 years, and 18-55 years respectively. Data Source: National Sample Survey.

Table 1.7: Household-Level Regression
Dependent Variable: Wife's Labor Force Participation

	(1)	(2)	(3)
Log husband earning	-0.128***	-0.021*	-0.023**
	(0.01)	(0.01)	(0.01)
N	25,780	25,780	25,780
R^2	0.13	0.02	0.02
Y-mean	.43	.43	.43
Household Fixed Effect	N	Y	Y
Controls	Y	N	Y

Clustered SE statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include number of household members in the following age groups: 0-5 years, 6-14 years, 15-59 years, and above 59 years old. Data Source: Indian Human Development Survey.

Table 1.8: Household-Level Regression
Dependent Variable: Labor Force Participation of Other Secondary Workers

	Adolescents		Elderly	
	(1)	(2)	(3)	(4)
Log husband earning	-0.010	-0.006	-0.083**	-0.068**
	(0.01)	(0.01)	(0.04)	(0.03)
N	6,413	6,413	1,672	1,672
R^2	0.01	0.04	0.04	0.15
Y-mean	.14	.14	.25	.25
Controls	N	Y	N	Y

Clustered SE statistics in parentheses.*** p<0.01, ** p<0.05, * p<0.1. Controls include number of household members in the following age groups: 0-5 years, 6-14 years, 15-59 years, and above 59 years old. Column 2 includes the age of adolescent and column 3 includes age of the elderly as additional controls. Outcome variable is the proportion of household members between ages 60-75 years (or 13-17 years for teenagers) working. Sample consists the subsample of households used in regressions for wives with atleast one elderly between ages 60-75 years (or 13-17 years for teenagers). Fixed effect at household level included in all columns. Data Source: Indian Human Development Survey.

Table 1.9: Across-District Regression using *all* Male Earnings and with Full Controls (Robustness Test)
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)	(6)
Log all male earnings	-0.079***	-0.076***	-0.083***	-0.088***	-0.088***	-0.083*
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.05)
District Fixed Effect	Y	Y	Y	Y	Y	Y
Time Fixed Effect	Y	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y	Y
Marriage Controls	N	N	Y	Y	Y	Y
Male Employment Controls	N	N	N	Y	Y	Y
Fertility	N	N	N	N	Y	Y
District Time Trend	N	N	N	N	N	Y
N	1338	1338	1338	1338	1338	1338
R^2	0.84	0.85	0.85	0.85	0.85	0.93
Y-mean	0.44	0.44	0.44	0.44	0.44	0.44
Number of districts	446	446	446	446	446	446

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. Data Source: National Sample Survey.

Table 1.10: Within-District Regression using *all* Male Earnings and with Full Controls (Robustness Test)
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)
Log all male earnings	-0.073***	-0.068***	-0.068***	-0.068***	-0.068***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
EducationxTime Fixed Effect	Y	Y	Y	Y	Y
DistrictxTime Fixed Effect	Y	Y	Y	Y	Y
DistrictxEducation Fixed Effect	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y
Marriage Controls	N	N	Y	Y	Y
Male Employment Controls	N	N	N	Y	Y
Fertility	N	N	N	N	Y
N	2472	2472	2472	2472	2472
R^2	0.96	0.96	0.96	0.96	0.96
Y-mean	0.40	0.40	0.40	0.40	0.40
Number of Labor Markets	824	824	824	824	824

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. DistrictXEducation Fixed Effect are also called Labor Market Fixed Effect in the paper. Data Source: National Sample Survey.

Table 1.11: Across-District Regression with Full Controls using Limited Districts (Robustness Test)
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)	(6)
Log married male earnings	-0.082***	-0.088***	-0.089***	-0.092***	-0.093***	-0.122**
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.06)
District Fixed Effect	Y	Y	Y	Y	Y	Y
Time Fixed Effect	Y	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y	Y
Marriage Controls	N	N	Y	Y	Y	Y
Male Employment Controls	N	N	N	Y	Y	Y
Fertility	N	N	N	N	Y	Y
District Time Trend	N	N	N	N	N	Y
N	1120	1120	1120	1120	1120	1120
R^2	0.87	0.87	0.87	0.88	0.88	0.96
Y-mean	0.44	0.44	0.44	0.44	0.44	0.44
Number of districts	427	427	427	427	427	427

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Districts with share of married males working for pay < 30 percent excluded. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. Data Source: National Sample Survey.

Table 1.12: Within-District Regression with Full Controls using Limited Districts (Robustness Test)
Dependent Variable: Married Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)
Log married male earnings	-0.074***	-0.070***	-0.070***	-0.068***	-0.073***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
EducationxTime Fixed Effect	Y	Y	Y	Y	Y
DistrictxTime Fixed Effect	Y	Y	Y	Y	Y
DistrictxEducation Fixed Effect	Y	Y	Y	Y	Y
Demographic Controls	N	Y	Y	Y	Y
Marriage Controls	N	N	Y	Y	Y
Male Employment Controls	N	N	N	Y	Y
Fertility	N	N	N	N	Y
N	2011	2011	2011	2011	2011
R^2	0.97	0.97	0.97	0.97	0.97
Y-mean	0.42	0.42	0.42	0.42	0.42
Number of Labor Markets	776	776	776	776	776

Clustered standard errors statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Labor markets with share of married males working for pay < 30 percent excluded. Marriage controls include percent of males and females in age-group 18-55 who are married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. DistrictXEducation Fixed Effect are also called Labor Market Fixed Effect in the paper. Data Source: National Sample Survey.

Table 1.13: Household-Level Regression
Robustness Test

Log husband earning	-0.023**
	(0.01)
N	25,780
R^2	0.02
Y-mean	.43
Controls	Y
Husband's Health	Y

SE statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at PSU level. Controls include number of children aged 0-5 years, number of children 6-14 years, number of household between 15-59 years, number of household members above 59 years old, and highest adult education. Husband's health is a dummy variable for long term morbidity that takes value 1 if husband suffers from any of the following: cataract, tuberculosis, high BP, heart disease, diabetes, leprosy, cancer, asthma, polio, paralysis, epilepsy, mental illness, STD/ AIDS, or other long term illness. Fixed effect at household level included. Data Source: Indian Human Development Survey.

Table 1.14: Correlation between Male and Female Years of Schooling

	Wife's education
Husband's education	0.591***
	(0.01)
N	55,514
R^2	0.39

Clustered standard errors statistics in parentheses. *0.10 **0.05 ***0.01. Data Source: Indian Human Development Survey.

Table 1.15: Effect of Married Male Earnings on Enrollment of Adolescents

	Across-District	Within-District
Log married male earning	0.054***	0.038
	(0.02)	(0.02)
Demographic Controls	Y	Y
Marriage Controls	Y	Y
Male Employment Controls	Y	Y
Fertility	Y	Y
N	1338	2472
R-square	0.83	0.92
Y-Mean	0.68	0.73
Number of Districts/ Labor Markets	446	824

Clustered standard errors statistics in parentheses.*** p<0.01, ** p<0.05, * p<0.1. Column 1 has district fixed effects and time fixed effect. Column 2 has labor market fixed effect, education by time fixed effect, and district by time fixed effect. Demographic controls include proportion of married males and females in different age-groups and proportion of married females in different education categories. Marriage controls include percent of males and females in age-group 18-55 married. Male employment controls include percent of males who report working for pay and male unemployment rate. Fertility controls includes average number of children in age group 0-2, 3-5, and 6-8 years. Data Source: National Sample Survey.

CHAPTER 2

A Decomposition Analysis of Changes in Married Female Labor Supply in India[1]

2.1 Introduction

Between 1999 and 2012, married female labor force participation rate in India declined from 35 percent to 27 percent. However, the decline in female labor force participation between 1999 and 2012 has not been uniform. Between 1999 and 2005, female labor force participation increased by about 4 percentage points, but between 2005 and 2012 female labor force participation decreased by 12 percentage points. At the same time, India witnessed a series of rather significant social and economic changes. Throughout the period of 1999 to 2012, economic growth was consistently positive; fertility declined precipitously; there was a rapid increase in female education; and major government development schemes were implemented, such as the road construction program, National Employment Guarantee Public Works Program, and the primary school construction program.

Given the generally improving economic and socioeconomic conditions in India throughout the period, the distinct time-specific changes in married female labor force participation is surprising.[2]

[1] I am grateful to Robert Kaestner for guiding me through this paper. All errors are my own.

[2] The GDP per capita growth rate was 2% in 2000, 7.5% in 2005, 2.3% in 2008, and 4% in 2012 (World Bank). The declining trend in fertility and increasing trend in female education was consistent between 1999 and 2012.

Intuition suggests that changes in female labor force participation should coincide with changes in social and economic conditions in a similar way across periods. This was not the case. Moreover, explanations for changing female labor force participation offered in previous studies, such as rising education of females (Afridi et al., 2017), structural changes in the economy (Klasen and Pieters, 2015, Mehrotra and Parida, 2017), and negative wealth effect (Klasen and Pieters, 2015, Neff et al., 2012)) also seem to be unable to explain the period-specific changes in female labor force participation. Abraham (2009) argues that the increase in employment in 2005 was the result of falling agricultural productivity between 2000 and 2005. However, there still exists a gap in understanding why the trend in female labor supply was strongly reversed after 2005.

In this article, I assess how much of the period-specific changes in female labor force participation is due to change in individual and area-specific factors and to changes in the association between these factors and labor force participation. Using a simple decomposition analysis, this paper attempts to complement the literature by studying the role of both spatial and individual factors together in one analysis. Additionally, unlike any other study, I also attempt to segregate the changes in labor force participation into changes in work-for-pay and unpaid work shedding new light on changes in female labor supply. To my knowledge, there is no study that combines these elements together in a single analysis.

To accomplish the goals of the study, I use household-level data from the National Sample Survey spanning the period between 1999 and 2012 combined with the data on indicators of regional economy at the state-level. I conduct Oaxaca decomposition analyses to distinguish the contribution of various person-specific and location-specific factors that explain the changes in female labor force participation. Besides individual variables in the model like age, education, religion, etc., the state-level factors included in the analysis are measures of road density, employment intensity in rice and wheat, and mechanization of agriculture.

Overall, changes in the means of individual-level variables account for about 20%-25% of the total change in the married female labor force participation rate and the rest is captured by changes in the returns to the individual-level and state-level variables. The breakdown of total labor force participation rate reveals that most of the fluctuation in female labor force participation is driven by the movement of females in and out of unpaid economic activities in rural areas, which is working in household businesses without pay. Between 1999 and 2005, the individual-level factors explained the changes in labor force participation, while both individual and state level factors were important between 2005 and 2012. Female education is negatively associated with labor force participation in rural areas. However, in urban areas, education has a positive effect on participation in paid activities. The next insight is that the location, or the state where a female resides, plays a significant role in determining her labor supply decisions. Upon analyzing these state-level factors more closely, I find that the changes in the coefficients of state-level variables, or the "returns" of state-level factors, are important for labor market participation in paid activities, but not for unpaid activities. Furthermore, the state-level characteristics are much more influential for the period between 2005 and 2012 as compared to between 1999 and 2005. Among the state-level characteristics, changes in the returns of road density increases while agricultural mechanization decreases female labor force participation in paid activities. These findings, while only suggestive, present useful distinctions by the type of work and place of residence and the importance of different individual and state-level factors for these distinct work types.

2.2 Correlates of Female Labor Supply in India

2.2.1 Some Conceptual Considerations

Economic theory suggests that married female labor force participation will depend on individual level characteristics, such as wage rates, unearned income, education, and number of children. Labor force participation increases when wages for women increase in the labor market as leisure becomes more expensive (substitution effect). Labor supply can also respond negatively due to an offsetting income effect, i.e., as the earnings for a given number of hours increase, individuals can spend less time working and more time on leisure. On the other hand, a change in the unearned income, such as inheritance, is only expected to have a negative income effect. Hence, the effect of changes in changes in wage rates is ambiguous and positive unearned incomes decrease labor supply.

Higher education increases the potential wage in the labor market and can increase the labor supply for females, especially into higher paying jobs. Increased education may also lead to matches with highly educated husbands in the marriage market. This could lead to a reduction in the propensity to work due to higher unearned income from earnings of the husband. Hence, the final effect of education on female labor supply is ambiguous. Identification of the causal relationship between education and labor supply is complicated since education and taste for work may be determined simultaneously. Overall empirical evidence that deals with these identification concerns indicates that for a majority of the developed and developing world, increased education leads to higher labor supply among females.[3] In the Indian case, raw data indicates that increased education is associated with lower female labor force participation rates, except for women with college education. For 2004-05, the labor force participation rates of women with below primary education, with primary education, with higher secondary education, and with college education was 55 percent, 40 percent, 30 percent, and close to 37 percent respectively.

Next, motherhood also affects women's labor supply as time invested in childcare competes with labor market time. Since women face a disproportionate burden of domestic activities and childcare, their labor supply is much more elastic to these family cycle events. Exogenous variations in fertility have been used in both developed and developing world to study the effect of children on female labor supply. Majority of the evidence indicates that increase in fertility leads to a decline in female labor supply (Angrist and Evans, 1998, Cáceres-Delpiano, 2012, Cruces and Galiani, 2007, Xia, 2010). Even though child care responsibilities are often shared between female members in joint families in India, which can mitigate the cost of childcare, fertility could be an important individual factor for female labor supply.

[3] See Heath and Jayachandran (2017) for review

State level factors will also affect married women's employment by influencing both supply and demand-side factors in a region. We can expect these geographical factors to affect women's work in different ways. One such area-specific factor is road density. Road density proxies for the mobility in a region and may facilitate labor force participation by generating new economic opportunities, making movement from one place to another much more feasible, and attracting other employers in the region. Given that a large share of women in India are engaged in the agricultural sector, the type of agriculture is another important factor that can affect female labor supply. Rice and wheat are the two most important crops grown in India. It is known that rice is more intensive in female labor than male labor (Mbiti, 2007). Hence, regions that grow different crops could experience differential gender-specific changes in employment over time. A similar economic change could play out differently because of the differences in the labor demand for the two groups. In the empirical analysis, measures of rice intensity and wheat intensity will be incorporated to study the role of rice and wheat agricultural intensity in changing married female labor supply. Lastly, agricultural mechanization may have implications for agricultural labor and in particular for female labor. Not only does agricultural mechanization act as a substitute for jobs that were earlier performed by women, such as weeding, but it could also mean that increased productivity and household incomes can cause reallocation of labor in the household. Hence, it is useful to study the relationship between agricultural mechanization and responses in labor supply of females in a region. To measure the state of mechanization of agriculture, I use number of tractors used in the state and the proportion of land under high-yield variety seeds.

2.2.2 A Brief Review of the Literature

Female labor force participation rates in India have remained low as compared to other developing nations.[4] Distinct changes in female labor supply in the recent years have resulted in a growing literature which studies the relationship between female labor supply in India and several individual

[4] For instance, in 2017, the female labor force participation rate was 33 percent in Bangladesh, 51 percent in Indonesia, 61 percent in China, 53 percent in Brazil, and 25 percent in Pakistan (World Bank).

and local factors mentioned above.

The negative relationship between higher education and lower female labor supply has been noted in Afridi et al. (2017). The authors conduct a parametric and semi-parametric decomposition of married female labor supply between 1987-1999 and 1999-2009. For the period 1999-2009, they find that individual and household characteristics account for half the decline in female labor force participation. The most important determinant in their analysis is the woman's education, which negatively influences labor force participation. They conjecture that this finding is because rising education increases the productivity of females in home production activities and the returns in the labor market have not increased at the same pace.

Using a cross-sectional regression framework, Chatterjee et al. (2015) obtain associations between female labor force participation and individual characteristics, local employment rates, and share of workers in agricultural and non-agricultural employment categories for 2004-05 and 2011-12 separately. They find significant associations between the above local indicators and woman's labor force participation. They interpret their results as the collapse of rural jobs between 2004-05 and 2011-12, which is responsible for the decline in female labor supply. Klasen and Pieters (2015) conducted similar analysis using women in urban areas to identify various supply and demand side factors for stagnating urban female labor supply. They find that changes in the proportion of males employed in different sectors at the district-level is negatively associated with female labor supply. They also find that education of the head of household and male salaried employment status in the household have strong negative associations with female labor force participation in urban areas.

Mehrotra and Parida (2017) explore the role of macro- and micro-level factors in explaining the declining female labor force participation in India from 1983 to 2012 in a pooled cross-sectional analysis. They estimate two separate probit models: one at the individual level to look at person-specific factors and then another model at the state-level with state-specific covariates predicting state-level female labor force participation rate. Among individual-level factors, they find that higher education and higher real wages in rural areas are negatively related with female labor supply. Among the state-level factors, they find negative association between female labor supply and indicators of agricultural mechanization. A limitation of this analysis is that regressions include contemporaneous values of the state-level variables, such as average wages in the state, state domestic product, and gross fixed capital formation in agriculture, which could themselves be affected by the state-level female labor supply.[5]

Social forces have also shown to be influential for female labor supply decisions. Using data from a primary survey in the Indian case, Bernhardt et al. (2018) find that husbands are more likely than wives to oppose women working and such opinions are strongly correlated with female labor supply. Men are more likely than women to place value on community respect than financial stability and to perceive violation of community norms as costly. Women, on the other hand, value obedience to husbands for maintaining household harmony more. Hence, interaction of these cultural norms is significant in understanding the variations in female labor supply in the Indian case.

2.2.3 Summary and Contributions

As we can see, a majority of the existing literature (Chatterjee et al., 2015, Klasen and Pieters, 2015, Mehrotra and Parida, 2017) relies on cross-sectional regression analysis and at best examine the relationship between state-level indicators and state-level female employment to examine the role of macro factors. More importantly, none of these papers clarify how changes in the characteristics examined, or changes in the associations obtained can explain the changes in female labor force participation that have not been consistent over time and place (e.g., urban-rural). In this article, I provide a systematic assessment of these issues. I include both individual and regional factors in the same model while performing the decomposition analysis over time, so we can examine the relative importance of micro and macro factors. The potential issue of endogeneity due to inclusion of state-level economic variables is not a concern in the current analysis, a concern which is present

[5] The full list of state-level variables in their model includes average household size, log of average wages in the state, net state domestic product, enrolment rates in education, growth of gross fixed capital formation in agriculture, tractors and power tillers sold, and average years of schooling.

in the existing literature. I include some novel variables to measure mechanization and the state of agriculture and infrastructure in the state to study its relationship with individual-level labor force participation decisions. The analysis is focused on not just total labor force participation, but also on separate indicators of paid and unpaid labor force participation. This generates insights by determining which kinds of work are responsive to particular individual and geographic factors. It could also have implications for welfare concerns due to changes in female labor force participation as one kind of work might be welfare improving than other work.

2.3 Data, Sample, Methods

2.3.1 Data Sources

Data for this analysis comes from the Employment-Unemployment Surveys from the National Sample Survey (NSS)- a household-level repeated cross-section survey conducted by the National Sample Survey Organization (NSSO). NSSO is the primary source of information on various indicators of labor and employment in the country. The respondent in NSS is the household head and information is collected on education, employment, income, and household characteristics of all household members. These surveys are conducted every year, but every five years NSSO conducts the large sample survey round administered all over India with a sample size of about 100,000-120,000 households. The three large sample survey rounds used in this paper are 1999-2000 (55th), 2004-05 (61st), and 2011-12 (68th).

Labor force participation is measured using the official definition of labor force participation by the NSSO. This definition is used in most of the research papers on labor force participation in India, which is the union of the Usual Principal Activity Status and Subsidiary Economic Activity Status (UPSS). The activity status in which the person spent a relatively longer time in the 365 days preceding the survey is the usual principal activity status. After the principal activity status has been decided, the activity in which the person spent 30 days or more in the last 365 days is the subsidiary activity status. I define an individual as part of the labor force if she is working in accordance with at least one of the two time criteria. To be counted as working in any category, one of the following codes should have been recorded for the individual: own account worker, employer, worked as a helper in household enterprise (unpaid family labor), worked as regular salaried/wage employee, worked as casual wage labor in public works, worked as casual wage labor in other types of work, and did not work but was seeking work. I differentiate between unpaid and paid work in the analysis below. I define *unpaid work* as women who report 'worked as helper in household enterprise (unpaid family labor)' as their primary or subsidiary activity. The remaining categories of work are counted as *work for pay*, which includes own account worker, employer, worked as regular salaried/wage employee, and worked as casual wage labor.

Information on state-level factors was collected from the meso-level database maintained by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). This data set provides state and district level information on the structure of the regional economy, such as land use, irrigation, fertilizer consumption, agro-climatic data, crop area and production. I use the data at the state-level, as the district level data is available only according to 1966 district boundaries and several new districts have been carved since 1966. This implies that for a large proportion of current districts, I will not be able to match them to their district-level values from the ICRISAT data, leading to exclusion of several districts.

The state-level variables included in the analysis are the following: length of roads in kilometer per hectare, land under rice cultivation in hectares per 100,000 residents, land under wheat cultivation in hectares per 100,000 residents, number of tractors per hectare of net cropped area, and area under High Yielding Variety seeds (HYV) per 100,000 residents. Square terms for the proportion of area under rice, wheat, and HYV are also included in the model and the corresponding estimates are combined with their linear counterparts under the common heading of rice-intensity, wheat-intensity, and HYV-intensity, respectively, in regression tables.

2.3.2 Sample Construction

The working sample consists of 18-55-year-old females who report to be currently married in each round. This is the prime working-age population. In line with the literature, thirteen small states are dropped from the analysis.[6]

Summary Statistics of the sample are presented in table 2.1 for each round. We can see that unpaid work is much more volatile as compared to paid work. Even though the sample has been restricted to 18-55 years in each year, the average age of married females in the estimation sample increased by 1.4 years. This is evidence of the rising age-at-marriage over this period and representative of the social changes occurring in India. Education levels of women in the sample are increasing, as the percentage of the sample above primary schooling and beyond school increases over this period by 11 and 4.5 percentage points respectively. Household size declines by 0.8 and the total number of children in the house below 5-years old declines by 0.2. Changes in the composition of the sample consisting of “other backward class” and “others” is surprising. The proportion of “other backward class” in the sample increases by 8 percentage points and proportion of “others” declined by the same proportion.

2.3.3 Methodology- Oaxaca-Blinder Decomposition

To analyze the drivers of differences in labor supply across time, I estimate the following model for each period, i.e., 1999-2000, 2004-05, and 2010-12:

$$FLFP_{ihst} = \alpha + \beta X_{ihst} + \gamma Z_{hst} + \omega A_{st} + \epsilon_{ihst} \tag{2.1}$$

[6] These states include Andaman and Nicobar Islands, Arunachal Pradesh, Goa, Lakshadweep, Manipur, Meghalaya, Mizoram, Nagaland, Puducherry, Tripura, Dadra and Nagar haveli, Daman and Diu. Additionally, Assam, Sikkim, Delhi, Jammu and Kashmir, and Chandigarh were dropped because no state-level data was found for these states for the relevant years.

$FLFP_{ihst}$ is a binary variable denoting whether the woman i in household h in state s and time t participated in the labor force or not. X_{ihst} indicates the vector of individual characteristics for person i in household h for time t. The individual characteristics include dummies for age, dummies for education level, dummies for religion, and dummies for caste. Household characteristics represented by Z_{hst} include household size, dummies for household head's education, and number of married women in the household. A_{st} represents the state-level variables. The state-level variables included in the analysis were described in detail above. These include measures of road density, rice intensity, wheat intensity, and agricultural mechanization. ϵ_{ihst} is an error term, assumed to follow a normal distribution with zero mean and variance σ.

Using the Oaxaca-Blinder decomposition, the difference in sample means of the outcome variable between two periods can be written as:

$$\overline{FLFP_1} - \overline{FLFP_0} = \hat{\beta}_1\overline{X_1} + \hat{\gamma}_1\overline{Z_1} + \hat{\omega}_1\overline{S_1} - (\hat{\beta}_0\overline{X_0} + \hat{\gamma}_0\overline{Z_0} + \hat{\omega}_0\overline{S_0}) \tag{2.2}$$

This can be re-written as:

$$\begin{aligned} \overline{FLFP_1} - \overline{FLFP_0} = {} & [\hat{\beta}_0(\overline{X_1} - \overline{X_0}) + \hat{\gamma}_0(\overline{Z_1} - \overline{Z_0}) + \hat{\omega}_0(\overline{S_1} - \overline{S_0})] + \\ & [(\hat{\beta}_1 - \hat{\beta}_0)\overline{X_1} + (\hat{\gamma}_1 - \hat{\gamma}_0)\overline{Z_1} + (\hat{\omega}_1 - \hat{\omega}_0)\overline{S_1}] \end{aligned} \tag{2.3}$$

$$\overline{FLFP_1} - \overline{FLFP_0} = [Explained] + [Unexplained] \tag{2.4}$$

The first element on the right-hand side, commonly denoted as the 'Explained' term in the literature, is the change in female labor force participation due to changes in the components of X, A, and Z. The 'Unexplained' term is the change in female labor force participation due to changes in the estimated coefficients of the components of X, A, and Z, which I refer to as the change in the *returns* of these characteristics.[7] I keep the "pooled" model as the reference category in the empirical analysis and the results are similar if I choose a specific year as the base category.[8]

In the analysis below, after including all individual and household-level covariates in the analysis, I incorporate state-level variables. I only include these state-level variables measured in the base period. As a result, the explained part of the difference in outcomes will be zero ($\overline{S_1} - \overline{S_1} = 0$) for state-level variables because there is no change over time in their means. However, there can still be unexplained component of those state-level variables because of time-varying returns. The baseline year is the first chronological year of the period over which the analysis is conducted.[9]

2.4 Results

Even though majority of the public debate and academic research has been focused on the declining trend in female labor supply, female labor force participation increased between 1999 and 2005 before declining drastically after 2005. Accordingly, I conducted the decomposition exercise for two separate time intervals: 1999-2005 and 2005-2012. The total work participation rate of married females in the sample declined by 5.3 percentage points between 1999 and 2012, and virtually all of it is accounted for by changes among women in rural areas. In addition, separate analyses of paid and unpaid work reveal that the decline in unpaid work activities accounts for most of the change in employment (Figure 2.1). Hence, the results are presented separately for paid/unpaid activities and by rural/urban areas. The discussion is primarily focused on women in rural areas except for notable results for women in urban areas.

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[7] As pointed out previously, the choice of omitted category for categorical variables can alter the results for the unexplained component of the decomposition (Gardeazabal and Ugidos, 2004, Yun, 2005). Hence, as outlined in Jann et al. (2008), I use the normalization approach in the analysis for categorical variables that averages the results over all permutations using different omitted group.

[8] Pooled model refers to the model with data for both time periods included in one regression.

[9] For analysis between 2005 and 2012, 2005 is the baseline year, and for analysis between 1999 and 2005, 1999 is the base year.

2.4.1 Between 1999-00 and 2004-05

Between 1999 and 2005, the overall female labor force participation rate increased by approximately 4.5 percentage points with the change in unpaid work accounting for most of this. Estimates in column 1 of table 2.2 indicate that the changes in labor force participation between 1999 and 2005 are mostly due to changes in the association between characteristics and labor force participation, which I will refer to as the "returns" to characteristics, and not because of changes in the average individual characteristics. The factor with the largest changes in returns is education.

Column 2 of table 2.2 shows estimates when state dummy variables are added to the model. Here too, changes in labor force participation between 1999 and 2005 are mostly due to changes in the "returns" to characteristics. In this case, culture and education are influential among individual characteristics. Changes in the return to cultural characteristics (caste and religion) and education each explain approximately 46% and 35% of the total change in labor force participation between 1999 and 2005.

While changes in the return to factors explain most of the overall change, there were changes in the mean of characteristics that had some explanatory power. Among rural women, changes in the relative population of states contributed towards an increase in the labor supply by 15%. Rise in the mean education of women and mean education of head of the household each accounted for approximately 18% of the decline in labor force participation between 1999 and 2005 for rural women.

The state dummies could be capturing the total effect of many factors, like changes in the returns to the state of agriculture, institutional set up of the state, or state-level economic policies. In column 3 of every table, I replace the state dummies with some state-level variables in the baseline to capture changes in the coefficients or the returns to those state-level variables over time. To minimize the concerns of endogeneity, baseline values instead of the contemporaneous values of the state-level variables have been used. For instance, it is likely that the investment in agricultural technology that may be related to changes in female labor force participation over time is influenced by the existing labor quality or composition of labor in a state. As a result, exercises in column 3 of every subsequent table only study the changes in the returns to state-level variables. Column 3 in table 2.2 shows that mechanization as measured by the number of tractors per unit of net cropped area significantly increase the labor force participation of females between 1999 and 2005. However, it is not clear in what kind of work (paid or unpaid) it is concentrated.

Table 2.3 shows a similar decomposition exercise for paid labor activities. Paid labor force participation increased by 2 percentage points with over 100% of this change driven by the unexplained component. Changes in the mean of education and head's education each account for a 20% and 30% decrease for the total change in paid work. The returns to culture explain 85% of the total change in paid labor supply and state fixed effects also have some explanatory power but none of the state-level variables included in this analysis are important in determining changes in paid labor supply.

Now I describe results for unpaid work in rural areas where majority of the changes in labor supply occurred. Estimates in table 2.4 show that returns to characteristics are much more important than changes in those characteristics. Once again, changes in the mean of education and education of head of the household influence participation in unpaid work negatively. While a woman's own education accounts for an 8% decrease in participation, head's education explains 5% of the total decrease in participation. Incorporating state dummies in column 2 of table 2.4 indicates that almost 3% of the change in unpaid work can be accounted for by the changes in the population of females across these states and returns to these state dummies do not have explanatory power for changes in unpaid rural work between 1999 and 2005.

For urban areas, in contrast to the results of rural areas, changes in the mean of female education and education of head of the household increase participation in paid activities while there is no effect of these variables on unpaid activities in urban areas. Changes in the returns to female education, however, still exerts a negative effect on paid activities and has no effect on changes in unpaid activities. These findings highlight that education in urban areas is instrumental for finding paid employment in urban areas, but is otherwise negatively associated with labor force participation.

2.4.2 Between 2004-05 and 2009-12

The period between 2004 and 2012 experienced a massive decline of 14 percentage points in total married female labor force participation for the estimation sample with a highly prominent decrease for unpaid work (13 percentage points) and a relatively small decrease in paid work (3 percentage points). Essentially all the difference in labor force participation during this period is accounted for by the unexplained component or the change in the returns to characteristics (table 2.8).

For paid labor supply in rural areas, the decomposition results are presented in table 2.9. Estimates from column 2 show that two important variables in the explained component are changes in the mean of woman's education and household head's education, explaining about 18% and 15% of the total decrease in paid labor force participation respectively. Changes in the mean of age dummies and number of married women in the household each increases the paid labor force participation by 12%. However, most of the change in paid work is concentrated in the unexplained part. I find that the variables with the largest change in returns are the number of married women in the household. Returns to the number of married women account for a 73% increase in paid work. This could indicate that division of domestic activities is a relevant determinant for paid work as many paid jobs, unlike unpaid jobs, require traveling out of the household. Sharing of home production activities can significantly affect participation in these activties.

Analyses in tables 2.9 and 2.10 indicate that the returns to state-level factors matter mostly for work-for-pay and not as much for unpaid work in rural areas. Even though the overall change in paid labor force participation rate is relatively small over this time-period, I discuss the results for paid work because of the strong impact of state-level variables on participation in paid work. After including state-level variables in column 3 of table 2.9, I find that the returns to rice intensity and number of tractors per hectare of cropped area each account for approximately 120% of the decline in paid work and returns to road density in the baseline explain an increase in paid work by 150%. Hence, mechanization of agriculture, once again, shows a negative association and road connectivity shows a positive association with participation in paid activities for women. As expected, mechanization of agriculture can substitute jobs that were earlier performed by women and road connectivity is crucial for mobility and can spur economic development leading to new job opportunities.

When looking at changes in unpaid work in rural areas in table 2.10, which is more remarkable than changes in paid labor supply, I find that about 88% of the change is accounted for by the unexplained component. Here too, changes in the mean and returns to female education and education of head of the household are negatively associated with participation in unpaid activities. Returns to education of the woman and household head are associated with 15% and 4% of the decline in participation in unpaid work respectively. Changing means of education have some explanatory power among individual characteristics explaining about 9% of the total change in unpaid work activities. Among state-level variables, the largest contribution is by intensity of land under HYV seeds which explains 54% of the total decline in unpaid work between 2005-2012. This hints to the fact that changes in agricultural technology have implications for labor force participation.

Tables 2.12 and 2.13 show the results for paid and unpaid activities for urban areas. Similar to the analysis of 1999-2005, changes in the mean of female education are associated with an increase in participation in paid jobs and decrease in unpaid jobs in urban areas, reinforcing the positive effect of education on paid employment in urban areas for both time periods.

2.5 Conclusion

This paper explores the determinants of female labor force participation in India between 1999 and 2012. Using individual-level data combined with information on the indicators of local economy, I perform Oaxaca-Blinder decomposition of total female labor force participation and labor market participation in paid and unpaid activities separately. The findings of this paper indicate that while individual-level factors are important for changes in labor force participation between 1999 and 2005, both individual and location-specific factors play important role in determining female labor force participation rate between 2005 and 2012. Results suggest that among individual characteristics, education of the woman and the head of the household have significant negative influence on female labor force participation on both paid and unpaid activities in rural areas. On the other hand, increase in female education is associated with increase in paid activities in urban areas. Presence of other married women in the household increases participation in paid activities. This could signal that if household activities can be shared between married women, it can release some time to engage in paid jobs which are more likely to be outside the house. Among state-level factors, returns to access to roads is associated with increased participation in paid activities and returns to capital intensity in agriculture decreases female participation in paid activities between 2005 and 2012. Returns to such local factors have little influence on the participation in unpaid activities which accounted for majority of the change in female labor force participation. Besides, studying the individual-level factors, this paper is a preliminary exercise in exploring the connections between locational factors and female labor force participation. The role of location-level economic factors and its connection with individual labor market decisions needs further analysis and is a potential research arena for the future.

Tables and Figures

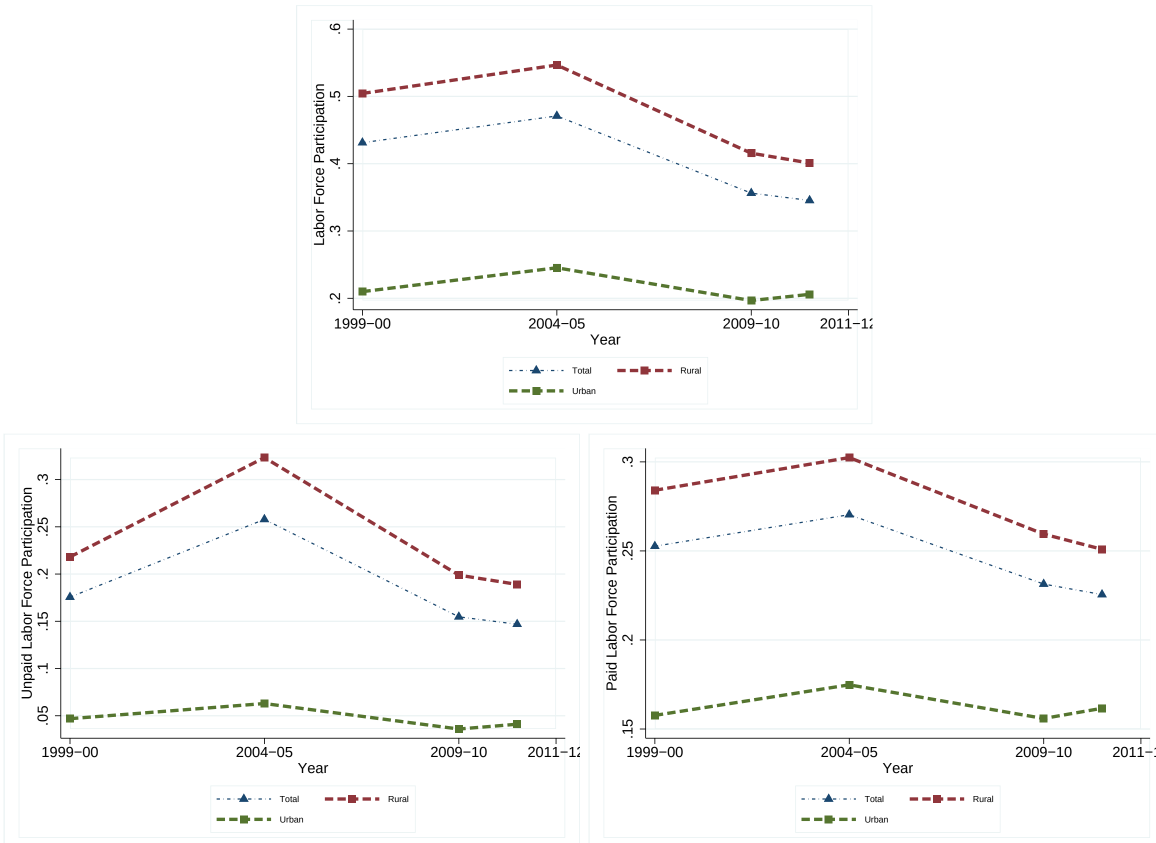

Figure 2.1: Total, Paid, and Unpaid Married Female Labor Force Participation by Rural-Urban

Table 2.1: Summary Statistics

	1999-2000 mean/sd	2004-05 mean/sd	2011-2012 mean/sd
Work=1	38.779	44.654	32.727
	(48.72)	(49.71)	(46.92)
Paid Work=1	21.628	24.429	21.111
	(41.17)	(42.97)	(40.81)
Unpaid Work=1	16.728	23.764	13.340
	(37.32)	(42.56)	(34.00)
Age	33.986	34.322	35.320
	(9.87)	(9.84)	(9.71)
Below Primary education	59.237	54.430	41.926
	(49.14)	(49.80)	(49.34)
Primary education	10.719	12.670	12.207
	(30.94)	(33.26)	(32.74)
Above primary schooling	24.996	26.806	36.234
	(43.30)	(44.30)	(48.07)
Beyond school/college/diploma	5.047	6.094	9.633
	(21.89)	(23.92)	(29.50)
Hindu	82.089	82.189	82.158
	(38.34)	(38.26)	(38.29)
Muslim	11.691	11.336	12.408
	(32.13)	(31.70)	(32.97)
Christian	2.036	2.076	2.006
	(14.12)	(14.26)	(14.02)
Sikh/Jain/Buddhism/Other	4.183	4.399	3.428
	(20.02)	(20.51)	(18.19)
ST	7.341	6.988	6.963
	(26.08)	(25.50)	(25.45)
SC	16.914	17.493	16.904
	(37.49)	(37.99)	(37.48)
OBC	36.327	42.296	44.785
	(48.09)	(49.40)	(49.73)
General caste	39.418	33.222	31.348
	(48.87)	(47.10)	(46.39)
No. children below 5 yrs	0.744	0.718	0.538
	(0.98)	(0.96)	(0.83)
No. married women in household	1.389	1.390	1.329
	(0.76)	(0.74)	(0.68)
Household Size	6.222	6.039	5.468
	(3.29)	(3.12)	(2.72)
Head education-below primary	49.218	44.885	36.138
	(49.99)	(49.74)	(48.04)
Head education-primary	12.131	14.542	12.763
	(32.65)	(35.25)	(33.37)
Head education-above primary schooling	30.602	30.994	37.892
	(46.08)	(46.25)	(48.51)
Head education-Beyond school	8.049	9.579	13.207
	(27.21)	(29.43)	(33.86)
Percent Rural	63.105	66.847	62.615
	(48.25)	(47.08)	(48.38)
Observations	102844	103184	79698

Table 2.2: Decomposition of Total Female Labor Force Participation Between 1999-2005 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.538***	0.538***	0.538***
	(0.01)	(0.01)	(0.01)
FLFP 1999	0.493***	0.493***	0.493***
	(0.01)	(0.01)	(0.01)
difference	0.045***	0.045***	0.045***
	(0.01)	(0.01)	(0.01)
explained	-0.011***	-0.006	-0.011***
	(0.00)	(0.00)	(0.00)
unexplained	0.055***	0.050***	0.056***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.005***	-0.008***	-0.007***
	(0.00)	(0.00)	(0.00)
Age	0.004***	0.003***	0.004***
	(0.00)	(0.00)	(0.00)
Head_education	-0.009***	-0.008***	-0.009***
	(0.00)	(0.00)	(0.00)
Culture	-0.000	-0.000	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in household	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)
State_Dummies		0.007**	
		(0.00)	
Road length/Tot.area			0.002
			(0.00)
Rice-intensity			-0.002
			(0.00)
Wheat-intensity			0.016**
			(0.01)
Tractors/NCroppedarea			-0.002
			(0.00)
HYVarea-intensity			-0.012*
			(0.01)
unexplained			
Education	-0.017**	-0.016**	-0.017**
	(0.01)	(0.01)	(0.01)
Age	0.002	0.001	0.001
	(0.00)	(0.00)	(0.00)
Head_education	-0.002	0.002	0.000
	(0.00)	(0.00)	(0.00)
Culture	-0.003	-0.021*	-0.017
	(0.01)	(0.01)	(0.01)
No. married women in household	0.005 (0.01)	-0.003 (0.01)	0.001 (0.01)
State_Dummies		0.007	
		(0.01)	
Road length/Tot.area			0.001
			(0.02)
Rice-intensity			-0.017
			(0.02)
Wheat-intensity			-0.019
			(0.02)
Tractors/NCroppedarea			0.027***
			(0.01)
HYVarea-intensity			-0.002
			(0.02)
Constant	0.071***	0.080***	0.096**
	(0.02)	(0.02)	(0.05)
N	133,875	133,875	133,875

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.3: Decomposition of Paid Female Labor Force Participation Between 1999-2005 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.274***	0.274***	0.274***
	(0.01)	(0.01)	(0.01)
FLFP 1999	0.254***	0.254***	0.254***
	(0.01)	(0.01)	(0.01)
difference	0.020***	0.020***	0.020***
	(0.01)	(0.01)	(0.01)
explained	-0.003*	-0.004	-0.006***
	(0.00)	(0.00)	(0.00)
unexplained	0.023***	0.023***	0.026***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.001	-0.004***	-0.003***
	(0.00)	(0.00)	(0.00)
Age	0.003***	0.002***	0.003***
	(0.00)	(0.00)	(0.00)
Head_education	-0.007***	-0.006***	-0.006***
	(0.00)	(0.00)	(0.00)
Culture	0.000	-0.000	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in household	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)
State_Dummies		0.004**	
		(0.00)	
Road length/Tot.area			0.001
			(0.00)
Rice-intensity			-0.002*
			(0.00)
Wheat-intensity			0.008**
			(0.00)
Tractors/NCroppedarea			-0.001
			(0.00)
HYVarea-intensity			-0.007**
			(0.00)
unexplained			
Education	-0.008	-0.008	-0.009
	(0.01)	(0.01)	(0.01)
Age	-0.001	-0.001	-0.002
	(0.00)	(0.00)	(0.00)
Head_education	-0.004	-0.001	-0.002
	(0.00)	(0.00)	(0.00)
Culture	-0.010	-0.017*	-0.012
	(0.01)	(0.01)	(0.01)
No. married women in household	-0.008	-0.009*	-0.008
	(0.01)	(0.01)	(0.01)
State_Dummies		-0.010**	
		(0.00)	
Road length/Tot.area			0.028
			(0.02)
Rice-intensity			0.003
			(0.02)
Wheat-intensity			0.010
			(0.03)
Tractors/NCroppedarea			0.006
			(0.01)
HYVarea-intensity			0.010
			(0.02)
Constant	0.055***	0.070***	0.001
	(0.01)	(0.01)	(0.04)
N	133,875	133,875	133,875

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.4: Decomposition of Unpaid Female Labor Force Participation Between 1999-2005 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.322***	0.322***	0.322***
	(0.01)	(0.01)	(0.01)
FLFP 1999	0.237***	0.237***	0.237***
	(0.01)	(0.01)	(0.01)
difference	0.085***	0.085***	0.085***
	(0.01)	(0.01)	(0.01)
explained	-0.012***	-0.006**	-0.009***
	(0.00)	(0.00)	(0.00)
unexplained	0.098***	0.091***	0.095***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.008***	-0.007***	-0.007***
	(0.00)	(0.00)	(0.00)
Age	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)
Head_education	-0.004***	-0.004***	-0.004***
	(0.00)	(0.00)	(0.00)
Culture	-0.001	0.000	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in	-0.000	-0.000	-0.000
household	(0.00)	(0.00)	(0.00)
State_Dummies		0.003*	
		(0.00)	
Road length/Tot.area			0.001
			(0.00)
Rice-intensity			-0.002
			(0.00)
Wheat-intensity			0.007
			(0.00)
Tractors/NCroppedarea			-0.001
			(0.00)
HYVarea-intensity			-0.004
			(0.00)
unexplained			
Education	0.008	0.005	0.005
	(0.01)	(0.00)	(0.01)
Age	0.003	0.001	0.001
	(0.00)	(0.00)	(0.00)
Head_education	0.012***	0.015***	0.013***
	(0.00)	(0.00)	(0.00)
Culture	0.017	-0.014	-0.012
	(0.01)	(0.01)	(0.01)
No. married women in	-0.004	-0.011	-0.006
household	(0.01)	(0.01)	(0.01)
State_Dummies		0.006	
		(0.01)	
Road length/Tot.area			0.005
			(0.02)
Rice-intensity			0.028
			(0.02)
Wheat-intensity			0.007
			(0.02)
Tractors/NCroppedarea			0.003
			(0.01)
HYVarea-intensity			0.018
			(0.02)
Constant	0.062***	0.088***	0.033
	(0.01)	(0.01)	(0.04)
N	133,875	133,875	133,875

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.5: Decomposition of Total Labor Force Participation Between 1999-2005 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.262***	0.262***	0.262***
	(0.01)	(0.01)	(0.01)
FLFP 1999	0.207***	0.207***	0.207***
	(0.01)	(0.01)	(0.01)
difference	0.055***	0.055***	0.055***
	(0.01)	(0.01)	(0.01)
explained	0.013***	0.008***	0.010***
	(0.00)	(0.00)	(0.00)
unexplained	0.042***	0.047***	0.045***
	(0.01)	(0.01)	(0.01)
explained			
Education	0.002***	0.002***	0.002***
	(0.00)	(0.00)	(0.00)
Age	0.001**	0.001	0.001
	(0.00)	(0.00)	(0.00)
Head_education	0.002**	0.002**	0.002**
	(0.00)	(0.00)	(0.00)
Culture	0.008***	0.006***	0.006***
	(0.00)	(0.00)	(0.00)
No. married women in	-0.000	-0.000	-0.000
household	(0.00)	(0.00)	(0.00)
State_Dummies		-0.003	
		(0.00)	
Road length/Tot.area			0.000
			(0.00)
Rice-intensity			-0.001
			(0.00)
Wheat-intensity			0.007*
			(0.00)
Tractors/NCroppedarea			-0.000
			(0.00)
HYVarea-intensity			-0.007*
			(0.00)
unexplained			
Education	-0.007***	-0.006**	-0.007***
	(0.00)	(0.00)	(0.00)
Age	0.004*	0.006**	0.005**
	(0.00)	(0.00)	(0.00)
Head_education	0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)
Culture	-0.000	-0.002	0.000
	(0.01)	(0.01)	(0.01)
No. married women in	-0.003	0.001	-0.000
household	(0.01)	(0.01)	(0.01)
State_Dummies		-0.009	
		(0.01)	
Road length/Tot.area			0.009
			(0.02)
Rice-intensity			-0.014
			(0.02)
Wheat-intensity			0.025
			(0.02)
Tractors/NCroppedarea			-0.006
			(0.01)
HYVarea-intensity			-0.031*
			(0.02)
Constant	0.049***	0.056***	0.065
	(0.02)	(0.02)	(0.04)
N	72,153	72,153	72,153

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.6: Decomposition of Paid Female Labor Force Participation Between 1999-2005 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.185***	0.185***	0.185***
	(0.01)	(0.01)	(0.01)
FLFP 1999	0.152***	0.152***	0.152***
	(0.00)	(0.00)	(0.00)
difference	0.033***	0.033***	0.033***
	(0.01)	(0.00)	(0.01)
explained	0.010***	0.006***	0.007***
	(0.00)	(0.00)	(0.00)
unexplained	0.024***	0.027***	0.026***
	(0.00)	(0.00)	(0.00)
explained			
Education	0.002***	0.002***	0.002***
	(0.00)	(0.00)	(0.00)
Age	0.001**	0.001	0.001*
	(0.00)	(0.00)	(0.00)
Head_education	0.002**	0.001**	0.002**
	(0.00)	(0.00)	(0.00)
Culture	0.005***	0.004***	0.004***
	(0.00)	(0.00)	(0.00)
No. married women in household	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)
State_Dummies		-0.002	
		(0.00)	
Road length/Tot.area			0.000
			(0.00)
Rice-intensity			-0.002**
			(0.00)
Wheat-intensity			0.003
			(0.00)
Tractors/NCroppedarea			-0.000
			(0.00)
HYVarea-intensity			-0.002
			(0.00)
unexplained			
Education	-0.005**	-0.004*	-0.004**
	(0.00)	(0.00)	(0.00)
Age	0.005**	0.005***	0.005**
	(0.00)	(0.00)	(0.00)
Head_education	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
Culture	0.001	-0.003	-0.001
	(0.01)	(0.01)	(0.01)
No. married women in household	-0.006	-0.001	-0.002
	(0.01)	(0.01)	(0.01)
State_Dummies		-0.002	
		(0.00)	
Road length/Tot.area			0.020
			(0.02)
Rice-intensity			0.020
			(0.01)
Wheat-intensity			0.014
			(0.02)
Tractors/NCroppedarea			-0.008
			(0.01)
HYVarea-intensity			-0.000
			(0.01)
Constant	0.030**	0.032***	-0.017
	(0.01)	(0.01)	(0.03)
N	72,153	72,153	72,153

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2.7: Decomposition of Unpaid Female Labor Force Participation Between 1999-2005 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2005	0.068***	0.068***	0.068***
	(0.00)	(0.00)	(0.00)
FLFP 1999	0.049***	0.049***	0.049***
	(0.00)	(0.00)	(0.00)
difference	0.019***	0.019***	0.019***
	(0.00)	(0.00)	(0.00)
explained	0.003***	0.001	0.002**
	(0.00)	(0.00)	(0.00)
unexplained	0.016***	0.018***	0.017***
	(0.00)	(0.00)	(0.00)
explained			
Education	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)
Age	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)
Head_education	0.001*	0.001*	0.001**
	(0.00)	(0.00)	(0.00)
Culture	0.002***	0.002***	0.002***
	(0.00)	(0.00)	(0.00)
No. married women in household	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)
State_Dummies		-0.001**	
		(0.00)	
Road length/Tot.area			0.000
			(0.00)
Rice-intensity			-0.000
			(0.00)
Wheat-intensity			0.003
			(0.00)
Tractors/NCroppedarea			-0.001*
			(0.00)
HYVarea-intensity			-0.003
			(0.00)
unexplained			
Education	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)
Age	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
Head_education	0.000	0.001	0.000
	(0.00)	(0.00)	(0.00)
Culture	-0.002	-0.005	-0.005
	(0.01)	(0.01)	(0.01)
No. married women in household	0.002 (0.01)	0.003 (0.01)	0.003 (0.01)
State_Dummies		-0.003	
		(0.00)	
Road length/Tot.area			0.017*
			(0.01)
Rice-intensity			0.003
			(0.01)
Wheat-intensity			0.035***
			(0.01)
Tractors/NCroppedarea			-0.009**
			(0.00)
HYVarea-intensity			-0.008
			(0.01)
Constant	0.015*	0.022**	-0.020
	(0.01)	(0.01)	(0.02)
N	72,153	72,153	72,153

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2.8: Decomposition of Total Female Labor Force Participation Between 2005-2012 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.399***	0.399***	0.399***
	(0.01)	(0.01)	(0.01)
FLFP 2005	0.538***	0.538***	0.538***
	(0.01)	(0.01)	(0.01)
difference	-0.139***	-0.139***	-0.139***
	(0.01)	(0.01)	(0.01)
explained	-0.009***	-0.010***	-0.013***
	(0.00)	(0.00)	(0.00)
unexplained	-0.131***	-0.129***	-0.127***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.006***	-0.010***	-0.013***
	(0.00)	(0.00)	(0.00)
Age	0.007***	0.006***	0.006***
	(0.00)	(0.00)	(0.00)
Head_education	-0.010***	-0.009***	-0.009***
	(0.00)	(0.00)	(0.00)
Culture	-0.002	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in	0.002***	0.002***	0.002***
household	(0.00)	(0.00)	(0.00)
State_Dummies		0.002	
		(0.00)	
Road length/Tot.area			0.002**
			(0.00)
Rice-intensity			0.002*
			(0.00)
Wheat-intensity			-0.038**
			(0.02)
Tractors/NCroppedarea			0.002
			(0.00)
HYVarea-intensity			0.036**
			(0.02)
unexplained			
Education	-0.005	-0.001	0.001
	(0.00)	(0.00)	(0.00)
Age	-0.008***	-0.004*	-0.004*
	(0.00)	(0.00)	(0.00)
Head_education	-0.002	-0.004*	-0.004*
	(0.00)	(0.00)	(0.00)
Culture	-0.009	-0.003	-0.004
	(0.01)	(0.01)	(0.01)
No. married women in	0.013	0.014	0.013
household	(0.01)	(0.01)	(0.01)
State_Dummies		-0.001	
		(0.01)	
Road length/Tot.area			0.023
			(0.02)
Rice-intensity			-0.003
			(0.02)
Wheat-intensity			0.031
			(0.03)
Tractors/NCroppedarea			-0.041*
			(0.02)
HYVarea-intensity			-0.055
			(0.04)
Constant	-0.120***	-0.129***	-0.084
	(0.02)	(0.02)	(0.05)
N	118,878	118,878	118,878

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.9: Decomposition of Paid Female Labor Force Participation Between 2005-2012 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.241***	0.241***	0.241***
	(0.01)	(0.01)	(0.01)
FLFP 2005	0.274***	0.274***	0.274***
	(0.01)	(0.01)	(0.01)
difference	-0.033***	-0.033***	-0.033***
	(0.01)	(0.01)	(0.01)
explained	0.001	-0.002	-0.003
	(0.00)	(0.00)	(0.00)
unexplained	-0.034***	-0.031***	-0.030***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.001	-0.006***	-0.007***
	(0.00)	(0.00)	(0.00)
Age	0.005***	0.004***	0.004***
	(0.00)	(0.00)	(0.00)
Head_education	-0.007***	-0.005***	-0.006***
	(0.00)	(0.00)	(0.00)
Culture	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in household	0.005*** (0.00)	0.004*** (0.00)	0.004*** (0.00)
State_Dummies		0.002**	
		(0.00)	
Road length/Tot.area			0.001**
			(0.00)
Rice-intensity			0.002***
			(0.00)
Wheat-intensity			-0.030**
			(0.01)
Tractors/NCroppedarea			0.001
			(0.00)
HYVarea-intensity			0.028**
			(0.01)
unexplained			
Education	0.005	0.006	0.008**
	(0.00)	(0.00)	(0.00)
Age	-0.004**	-0.003	-0.003
	(0.00)	(0.00)	(0.00)
Head_education	-0.001	-0.003	-0.002
	(0.00)	(0.00)	(0.00)
Culture	0.011	0.010	0.011
	(0.01)	(0.01)	(0.01)
No. married women in household	0.027*** (0.01)	0.024*** (0.01)	0.022*** (0.01)
State_Dummies		-0.003	
		(0.01)	
Road length/Tot.area			0.049***
			(0.02)
Rice-intensity			-0.039**
			(0.02)
Wheat-intensity			0.030
			(0.02)
Tractors/NCroppedarea			-0.038**
			(0.02)
HYVarea-intensity			0.020
			(0.04)
Constant	-0.072***	-0.063***	-0.089**
	(0.02)	(0.02)	(0.04)
N	118,878	118,878	118,878

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.10: Decomposition of Unpaid Female Labor Force Participation Between 2005-2012 (Rural)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.188***	0.188***	0.188***
	(0.01)	(0.01)	(0.01)
FLFP 2005	0.322***	0.322***	0.322***
	(0.01)	(0.01)	(0.01)
difference	-0.134***	-0.134***	-0.134***
	(0.01)	(0.01)	(0.01)
explained	-0.016***	-0.013***	-0.016***
	(0.00)	(0.00)	(0.00)
unexplained	-0.118***	-0.122***	-0.118***
	(0.01)	(0.01)	(0.01)
explained			
Education	-0.011***	-0.008***	-0.012***
	(0.00)	(0.00)	(0.00)
Age	0.003***	0.003***	0.002***
	(0.00)	(0.00)	(0.00)
Head_education	-0.005***	-0.006***	-0.005***
	(0.00)	(0.00)	(0.00)
Culture	-0.000	-0.000	-0.001
	(0.00)	(0.00)	(0.00)
No. married women in household	-0.002***	-0.002***	-0.002***
	(0.00)	(0.00)	(0.00)
State_Dummies		0.000	
		(0.00)	
Road length/Tot.area			0.001
			(0.00)
Rice-intensity			0.001
			(0.00)
Wheat-intensity			-0.011
			(0.01)
Tractors/NCroppedarea			0.001
			(0.00)
HYVarea-intensity			0.009
			(0.01)
unexplained			
Education	-0.023***	-0.019***	-0.020***
	(0.00)	(0.00)	(0.00)
Age	-0.003	-0.002	-0.002
	(0.00)	(0.00)	(0.00)
Head_education	-0.003	-0.005***	-0.005**
	(0.00)	(0.00)	(0.00)
Culture	-0.028***	-0.010	-0.014
	(0.01)	(0.01)	(0.01)
No. married women in household	0.005	0.009	0.009
	(0.01)	(0.01)	(0.01)
State_Dummies		0.001	
		(0.01)	
Road length/Tot.area			-0.016
			(0.02)
Rice-intensity			0.010
			(0.02)
Wheat-intensity			-0.016
			(0.02)
Tractors/NCroppedarea			0.010
			(0.02)
HYVarea-intensity			-0.069**
			(0.03)
Constant	-0.066***	-0.096***	-0.006
	(0.01)	(0.01)	(0.04)
N	118,878	118,878	118,878

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.11: Decomposition of Total Labor Force Participation Between 2005-2012 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.208***	0.208***	0.208***
	(0.01)	(0.01)	(0.01)
FLFP 2005	0.262***	0.262***	0.262***
	(0.01)	(0.01)	(0.01)
difference	-0.055***	-0.055***	-0.055***
	(0.01)	(0.01)	(0.01)
explained	-0.001	-0.006***	-0.006***
	(0.00)	(0.00)	(0.00)
unexplained	-0.054***	-0.049***	-0.048***
	(0.01)	(0.01)	(0.01)
explained			
Education	0.004***	0.001	0.001
	(0.00)	(0.00)	(0.00)
Age	0.004***	0.003***	0.003***
	(0.00)	(0.00)	(0.00)
Head_education	-0.012***	-0.011***	-0.011***
	(0.00)	(0.00)	(0.00)
Culture	0.002**	0.001	0.001
	(0.00)	(0.00)	(0.00)
No. married women in	0.001***	0.001***	0.001***
household	(0.00)	(0.00)	(0.00)
State_Dummies		-0.001	
		(0.00)	
Road length/Tot.area			0.000
			(0.00)
Rice-intensity			-0.000
			(0.00)
Wheat-intensity			-0.022
			(0.01)
Tractors/NCroppedarea			-0.001
			(0.00)
HYVarea-intensity			0.022
			(0.01)
unexplained			
Education	0.003	0.001	0.002
	(0.00)	(0.00)	(0.00)
Age	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
Head_education	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)
Culture	-0.002	-0.002	0.000
	(0.01)	(0.01)	(0.01)
No. married women in	0.007	0.005	0.006
household	(0.01)	(0.01)	(0.01)
State_Dummies		0.001	
		(0.01)	
Road length/Tot.area			0.024
			(0.02)
Rice-intensity			0.026*
			(0.02)
Wheat-intensity			-0.055
			(0.03)
Tractors/NCroppedarea			-0.002
			(0.01)
HYVarea-intensity			0.055
			(0.04)
Constant	-0.062***	-0.054***	-0.104***
	(0.01)	(0.01)	(0.04)
N	64,004	64,004	64,004

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.12: Decomposition of Paid Female Labor Force Participation Between 2005-2012 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.162***	0.162***	0.162***
	(0.00)	(0.00)	(0.01)
FLFP 2005	0.185***	0.185***	0.185***
	(0.01)	(0.01)	(0.01)
difference	-0.024***	-0.024***	-0.024***
	(0.00)	(0.00)	(0.00)
explained	0.002*	-0.002	-0.002
	(0.00)	(0.00)	(0.00)
unexplained	-0.026***	-0.022***	-0.021***
	(0.00)	(0.00)	(0.00)
explained			
Education	0.004***	0.002**	0.002**
	(0.00)	(0.00)	(0.00)
Age	0.004***	0.003***	0.003***
	(0.00)	(0.00)	(0.00)
Head_education	-0.008***	-0.007***	-0.008***
	(0.00)	(0.00)	(0.00)
Culture	0.001	0.000	-0.000
	(0.00)	(0.00)	(0.00)
No. married women in household	0.002*** (0.00)	0.002*** (0.00)	0.002*** (0.00)
State_Dummies		-0.001	
		(0.00)	
Road length/Tot.area			-0.000
			(0.00)
Rice-intensity			0.001
			(0.00)
Wheat-intensity			-0.013
			(0.01)
Tractors/NCroppedarea			-0.001
			(0.00)
HYVarea-intensity			0.012
			(0.01)
unexplained			
Education	0.002	0.001	0.001
	(0.00)	(0.00)	(0.00)
Age	-0.001	0.000	0.000
	(0.00)	(0.00)	(0.00)
Head_education	0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)
Culture	0.001	0.003	0.004
	(0.01)	(0.01)	(0.01)
No. married women in household	0.010 (0.01)	0.008 (0.01)	0.008 (0.01)
State_Dummies		-0.002	
		(0.00)	
Road length/Tot.area			0.002
			(0.01)
Rice-intensity			-0.007
			(0.01)
Wheat-intensity			-0.029
			(0.02)
Tractors/NCroppedarea			0.017
			(0.01)
HYVarea-intensity			-0.006
			(0.03)
Constant	-0.039***	-0.033***	-0.011
	(0.01)	(0.01)	(0.03)
N	64,004	64,004	64,004

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2.13: Decomposition of Unpaid Female Labor Force Participation Between 2005-2012 (Urban)

	Individual-level variables (1)	With State Fixed Effect (2)	With State-level Variables (3)
overall			
FLFP 2012	0.043***	0.043***	0.043***
	(0.00)	(0.00)	(0.00)
FLFP 2005	0.068***	0.068***	0.068***
	(0.00)	(0.00)	(0.00)
difference	-0.025***	-0.025***	-0.025***
	(0.00)	(0.00)	(0.00)
explained	-0.005***	-0.005***	-0.006***
	(0.00)	(0.00)	(0.00)
unexplained	-0.020***	-0.020***	-0.019***
	(0.00)	(0.00)	(0.00)
explained			
Education	-0.004***	-0.003***	-0.004***
	(0.00)	(0.00)	(0.00)
Age	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)
Head_education	-0.003***	-0.003***	-0.003***
	(0.00)	(0.00)	(0.00)
Culture	0.001***	0.001**	0.001**
	(0.00)	(0.00)	(0.00)
No. married women in household	-0.000*	-0.000**	-0.000*
	(0.00)	(0.00)	(0.00)
State_Dummies		0.000	
		(0.00)	
Road length/Tot.area			-0.000
			(0.00)
Rice-intensity			-0.000
			(0.00)
Wheat-intensity			-0.000
			(0.00)
Tractors/NCroppedarea			-0.000
			(0.00)
HYVarea-intensity			0.001
			(0.00)
unexplained			
Education	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)
Age	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)
Head_education	0.000	0.001	0.000
	(0.00)	(0.00)	(0.00)
Culture	-0.001	0.001	0.002
	(0.01)	(0.01)	(0.01)
No. married women in household	-0.007	-0.008	-0.007
	(0.01)	(0.01)	(0.01)
State_Dummies		-0.000	
		(0.00)	
Road length/Tot.area			0.000
			(0.01)
Rice-intensity			-0.007
			(0.01)
Wheat-intensity			0.014
			(0.02)
Tractors/NCroppedarea			0.000
			(0.01)
HYVarea-intensity			-0.036*
			(0.02)
Constant	-0.011	-0.014	0.014
	(0.01)	(0.01)	(0.02)
N	64,004	64,004	64,004

Note: Education heading subsumes dummies for education levels. Age includes dummies of all ages. Culture includes dummies for religion and caste. Rice-intensity includes linear and square terms of land under rice cultivation in hectares per 100,000 residents. Wheat-intensity includes linear and square terms of land under wheat cultivation in hectares per 100,000 residents. HYVarea-intensity includes linear and square terms of land underarea under high yielding variety seeds per 100,000 residents. Tractors/Ncroppedarea is number of tractors per hectare of net cropped area. Clustered standard errors at the district level in parentheses.*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

CHAPTER 3

Fertility Challenges and Marital Dissolution

3.1 Introduction

Marriage is a nearly ubiquitous socio-economic phenomenon, especially in the developing world. In the 2000s, out of 159 countries, 143 countries reported at least 80 percent of women between the ages of 45-49 who had ever married.[1] A common aspect among married couples is the desire to parent children. Previous research finds that children affects well-being and even more so for men (Conzo et al., 2017, Kohler et al., 2005, Margolis and Myrskylä, 2011). In Demographic and Health Surveys from 66 countries, for the sample of women between 18-49-year old, 93 percent of women want at least one child.[2] In such a scenario, it is likely that if the desire for children is not fulfilled, it may lead to distress and diminish the utility in a marriage. Becker et al. (1977) was the first study to conceptualize the idea of unanticipated shocks causing decrease in the gains from marriage and resulting in marital dissolution. In essence, couples marry because the expected utility of marriage is greater than that of remaining single. There is some initial match quality that predicts the stability of a marriage. However, the actual value of marriage is uncertain and can change with some unexpected shocks. Such surprises about the partner or themselves, which can be positive or

[1] Source: UN Population Facts.
[2] Based on author's calculations.

negative in nature, will have a destabilizing effect on the union.

In this paper, we study the effect of fertility challenges that couples face on marital stability using a large sample of ever-married women. The first analysis investigates the relationship between infertility and divorce rates. The inability to conceive a child serves as an unanticipated biological event that reduces the benefits from a marriage and may result in its failure if couples desire to have children. Tilson and Larsen (2000) study the determinants of divorce in Ethiopia and find that having a child in the first marriage is inversely related to divorce. Using the Demographic and Health Surveys for 66 countries, we estimate the effect of self-reported infertility on divorce and separation. Our main finding here is that infertility increases the likelihood of divorce by 85% and divorce or separation by 46% percentage points. We include a rich set of controls related to the match-quality, background characteristics, and health of the female to deal with potential omitted variable bias issues. Additional heterogeneity and robustness analyses further reinforce the interpretation of the main result. In particular, we find that the effect of infertility on divorce is stronger for women who are childless (full-infertility) as compared to those who have at least one child (subfecundity). Another supporting evidence is obtained by segregating the countries with low and high polygamy rates. Since societies that are more polygamous in nature are more likely to provide the opportunity to be with additional wives without separating from the previous wife, it should decrease the effect of infertility on divorce rates. In line with this prediction, we find that the estimate measuring the effect of infertility on divorce is greater for countries that are less likely to practice polygamy.

Next, we examine the relationship between divorce and two additional fertility shocks: death of the first-born child and gender of the first-born child. Death of a child can cause significant emotional stress and lead to marital disruptions (Rogers et al., 2008). Another feature of fertility preference which has been documented in the literature for both developing and developed countries is that parents, especially fathers, prefer sons over daughters (Dahl and Moretti, 2008, Kohler et al., 2005, Mason and Taj, 1987). We use these two events as independent variables to estimate their effect on divorce and separation. Results indicate that death of the first child increases the likelihood of divorce by 10% percentage points. This is greater than the effect of first-born being daughter, which increases the likelihood of divorce by 3%. The above three separate pieces of analyses are not causal by themselves. However, taken together, along with the sub-sample analysis, support the hypothesis that deviations from the desired fertility size and composition have a negative effect on marital stability. In addition, as we can expect infertility to be a more intense negative event than death of the first-born and gender of the first-born, the magnitude of the estimate increases with the severity of the fertility shock.

This paper makes the following contributions. First, we use a previously unexplored shock to test the role of unanticipated events on marital stability for a large sample of women across countries with a substantial degree of variation in divorce rates[3] Most of the empirical literature testing the theory proposed by Becker et al. (1977) uses pecuniary shocks to estimate the effects on marital stability. Unlike deviations in earnings, shocks to fertility are likely to be more permanent in nature and may have potentially larger consequences for marriage. Second, this paper contributes to literature on divorce in developing countries, which is limited despite divorce having important socio-economic implications on the welfare of the family. Previous literature finds that parental divorce has negative effects on children's schooling, poverty, and employment (Amato and Cheadle, 2005, Amato and Keith, 1991, Chae, 2016). In that sense, there are still several gaps in the literature on divorce in developing countries despite the increasing relevance of this phenomenon.

We begin by presenting a brief description of the literature on unexpected events and divorce in section 3.2. Section 3.3 presents information on the data source and the estimation sample. Section 3.4 discusses the empirical strategy followed by results in section 3.5 and robustness checks in section 3.6. Finally, the conclusion is presented in section 3.7.

[3] Many countries in the developing world have divorce rates comparable to the United States. Summarizing the crude divorce rates in 2008 for developing countries, Anukriti and Dasgupta (2017) note that the crude divorce rate ranges from 2.4 in Ethiopia for 1999 to 6.9 in Botswana for 2001. To compare it with the divorce trends in the developed world, United States shows a crude divorce rate of 3.5 in 2006, while it is 2.4 in United Kingdom for 2006.

3.2 Shocks and Marital Instability: A Brief Review of the Literature

A majority of the literature examining the relationship between unanticipated shocks and marital instability uses changes to employment or income. Some of the early empirical work in this area is by Becker et al. (1977) and Weiss and Willis (1997). In a cross-sectional setting, Becker et al. (1977) studied the role of age at marriage, education, and earnings on marital stability. They find that a permanent increase in income is associated with a decrease in the probability of divorce while higher deviations between actual and predicted earnings are positively related with divorce. Weiss and Willis (1997) use longitudinal data to examine this difference between predicted and actual earnings while controlling for the match quality of the couples. They find that a positive shock to the earnings of the husband decreases the probability of divorce, while a positive shock to earnings of the wife raises the probability of divorce. Both these studies are in the U.S. context.

Unlike the above two studies, Charles and Stephens (2004) use an explicit measure of earnings shock to study the relationship between divorce rates and income changes. Using the Panel Study for Income Dynamics, they study the effect of job loss and disability on divorce rates. They find that job loss increases the divorce hazard, but disability does not. They interpret these results as casting doubt on the purely pecuniary reasons for divorce after an earnings shock. Additionally, the increase in divorce rates is only found for layoffs and not for plant closings. Nunley and Seals (2010) study the effect of household income shock on divorce rates for the 1979 cohort of National Longitudinal Survey of Youth. They construct transitory shocks by using the residuals of two time periods from the regression of family incomes on observed characteristics and residuals of four time periods for permanent shocks. They find that negative temporary income shocks increase the probability of divorce while permanent income changes do not affect divorce rates. Using the Survey of Income and Program Participation matched with longitudinal income data, Singleton (2012) finds that workpreventing (and not work-limiting) disability of males is associated with lower earnings and higher probability of divorce. In the U.S. case again, Hankins and Hoekstra (2011) exploit the random variation in the amount of cash prize in the Florida lottery and find that large cash transfers do not have an impact on divorce. Their results reinforce the observation in the literature that shocks conveying information about the individual characteristics are more likely to affect divorce rates than one-time changes. Doiron and Mendolia (2012) also find results supporting this interpretation. They study the effect of job loss on the divorce rates using the Britain Household Panel Survey. They distinguish between involuntary job displacement, which are short-term shocks, versus person-specific dismissal, which convey information about future earnings. They find a positive relationship between job loss and divorce rates. They also show that job dismissals due to person-specific reasons have larger positive effects than other involuntary and exogenous reasons for displacements. Overall, shocks to earnings that cast doubt on the earning ability of the spouse are found to precipitate divorce at a higher rate than other economic changes.

Moving away from pecuniary shocks, Dahl and Moretti (2008) study the role of son preference on divorce and marriage in the U.S. They find that couples with girls are more likely to get a divorce across groups defined by region, race, and education by 1-7 percentage points, and divorced fathers are more likely to get custody of their sons. Furthermore, when the sex of the child is known, women with sons are more likely to get married than couples with unborn girls. They also find that in families with at least two children, the probability of having another child is higher in all-girls family as compared to all-boys families. Using several such pieces of evidence, they document the presence of a subtle son preference in the U.S. and compare their effects with five developing countries. The gender bias in the U.S. is found to be smaller than in Mexico, Columbia, and Kenya, and only slightly smaller than in China and Vietnam. Turning to the stated preference data, they document that more Americans prefer sons over daughters and this is preference is driven by men in the population.

Studies on marriage and divorce which focus solely on developing countries are far fewer in number. One exception to this is Bobonis (2011). Using the variation in conditional cash transfers received through Progresa in Mexico, the author finds an increase in the marital turnover among women who received transfers even though the overall share of married women did not change. The author also finds a positive response in the formation of new unions among divorced and separated women due to positive cash transfers.[4]

Thus, existing evidence suggests that negative monetary shocks and son preference significantly increases the probability of divorce. Although, as we can see, there is limited evidence on the effect of other non-pecuniary shocks on family dissolutions and majority of the research is limited to the U.S. and other developed countries. This paper seeks to fill this gap in the literature by studying the effect of infertility, a previously unexplored shock. We use three different fertility events, namely infertility, gender of the first-born child and death of the first-born child, to study their effects on marital outcomes for a large set of developing countries.

3.3 Data and Sample

We use the individual-level data from 158 Demographic and Health Surveys (DHS) conducted between 1992 and 2015 covering 66 countries. DHS are nationally-representative household surveys that provide information on a wide-range of indicators related to health, nutrition, fertility, women's empowerment, and other demographic information for women, children, and in some cases for men. The survey is usually conducted every five years in a country and the sample-size in each survey is between 5,000 to 30,000 households. It follows a two-stage cluster design where the enumeration areas are drawn from census files and then a sample of households is drawn from enumeration areas.

[4] There are other studies for developing countries on marital dissolution which are not directly examining the effect of an unanticipated event on marital outcome. Chong and Ferrara (2009) study the effect of rollout of television signal on divorce rates in Brazil and find a positive relationship. Soap operas show themes related to criticism of traditional values and women's empowerment and divorce are a consequence of these attitudes. Clark and Brauner-Otto (2015) document the geographic distribution of divorce for sub-Saharan Africa and country-level variables correlated with divorce. They find that the variation in divorce rates is quite high in sub-Saharan Africa and is comparable to Europe. They find urbanization and women's employment is positively related to higher levels of divorce and higher female education and higher age at marriage is correlated with lower levels of divorce. In another study, the one-child policy in China has been shown to have a positive relationship with divorce rates Zhang (2017).

The questionnaires are generally comparable across countries and over time and respondents are women in the ages of 15-49 years.

We restrict the age of our estimation sample to 15-44-year-old women. We also exclude women who have never been married.[5] The marital status of the female is reported under the following categories: a) never-married, b) married, c) living together, d) widowed, e) divorced, and f) not living together. We construct two outcome variables: divorced and divorced or not living together. To measure infertility, we use information on the self-reported desire of future children in the survey. All women except those who never engaged in sexual intercourse were questioned about their desire for future children. Their response could be categorized into the following categories: a) wants children within 2 years, b) wants children after 2+ years, c) wants children but is unsure of timing, d) undecided, e) wants no more children, f) is sterilized, and g) is declared infecund. Those who report being infecund were coded as infertile[6]. Only countries where information on desire for children was collected for women of all marital status were included in the survey.[7] Figure 3.1 shows that for every age, infertile women have fewer children than fertile women based on the above measure showing that the current measure of fertility captures the actual infertility to some degree.

A potential issue is that the infertility is self-reported which could introduce measurement error in the analysis. We cannot compare the self-reported measures with medically tested measures of infertility in the DHS. However, we do not expect this to be a concern in the analysis as self-reported measures of infertility are highly correlated with biological measures. Cates et al. (1985) study 25 countries and show that the proportion of couples who self-reported to be infertile and became pregnant in the future is small. It ranges from 16 percent in Asia, 13 percent in Latin America, 15 percent in Africa, and 12 percent in Europe and Australia.

Summary information of the working sample on individual characteristics and other covariates used in the analysis are presented in table 3.1. The sample is divided by self-reported fertility

[5] Older women may be experiencing menopause instead of infertility.
[6] Observations with missing information on the desire for future children were dropped from the analysis.
[7] For instance, Egypt and Bangladesh did not collect information on desire for more children from divorced women.

status in columns 2 and 3. Infertile women are 2.4 percentage points more likely to be divorced and 4 percentage points more likely to be divorced or separated. Based on our measure of infertility, about 2 percent of the sample reports being infertile. Of these infertile women, approximately 18 percent are fully infertile (i.e., they have zero children), while 82 percent are sub-fecund, (i.e., they have at least one child). On average, infertile women are 2.4 percentage points more likely to be divorced than fertile women and 4 percentage points more likely to be divorced or separated. Age of first intercourse and age at first birth is similar between the infertile and fertile women. Age at first marriage, which captures the time available for divorce since first marriage for similar age women, is similar for fertile and infertile women. Infertile women are more likely to be older. On average, infertile women are about 7 years older than the fertile sample. This has been documented in medical literature that shows infertility increases with women's age. This will be an important covariate in our analysis; we will adjust our analysis to incorporate this. They are more likely to have lived in rural areas during childhood but are also less likely to be residing in rural areas during the time of the survey. Turning to health-related variables, which may be correlated with infertility, we find that on average infertile women are shorter by 0.2 centimeters, less likely to have visited the health center in last 12 months by 14.5 percentage points and perform poorly on body mass index as compared to fertile women. The incidence of sexually transmitted diseases does not differ by the infertility status.

Table 3.2 presents some descriptive statistics for the sub-sample of our main analysis sample who have given at least one birth regardless of the birth outcome. This estimation sample will be used for the analysis on the other two independent variables: gender of the first-born child and death of the first-born child. For this sample, about 12 percent of women experience death of their first-born child and infertile women are 5 percentage points more likely to have experienced this as compared to fertile women. There is a significant difference of 12 months in the age at death of the first-born between infertile and fertile women. It could be a result of the fact that fertile women are almost 7 years younger to begin with and hence are less likely to have children who would have survived till a higher age limit. In other words, they could have had children who would have survived till a higher age, but such cases are not captured in the current sample.

3.4 Empirical Strategy

We examine the relationship between fertility shocks and divorce using the specification below:

$$Y_{ict} = \alpha + \beta FertilityEvent_{ict} + \mu_{cy} + \delta D_{ict} + \gamma X_{ict} + \epsilon_{ict} \tag{3.1}$$

where i, c, and t index the woman, country, and year respectively. Y_{ict} is a dummy which equals 1 if the woman is currently divorced. The second outcome variable equals 1 if the woman is currently divorced or separated. $FertilityEvent_{ict}$ is a dummy variable which equals 1 if the woman reports being infertile and 0 otherwise. We further divide fertility into full-infertility (infertile women with 0 children) and subfecundity (infertile women who have at least one child). In addition to studying the effect of infertility on marital stability, we also study the effect of two other fertility-related variables separately: death of first child and gender of the first child. μ_{ct} are the survey fixed effects which control for any unobserved variables for a certain survey which is correlated with divorce and infertility. Additionally, since coupled who have been married for longer have had longer time to divorce, we also include the duration since first marriage in all regression models represented by D_{ict}. Duration since first marriage is calculated as the difference of current age and age at first marriage.

X_{ict} represents the set of controls for woman i. We begin by including controls related to the match quality of the union which predict divorce. These include dummies for age at first marriage, indicator for women having no pre-marital sex, dummies for education level of the husband, indicator for husband having greater education than the woman, and indicator for woman having greater education than the partner.[8] To further control for individual-level background characteristics, we

[8] Omitted category is husband having equal education as the woman.

include dummies for education level of the woman, dummies for age at first intercourse, number of siblings of the woman to proxy for childhood poverty. We also include an indicator for whether the current place of residence is rural and an indicator for whether the childhood place of residence is rural, which capture information about access to medical technology and other cultural preferences and norms. β is our parameter of interest which is the effect of a fertility event on divorce. Standard errors are clustered at the country-year level.

Identification of β in the above equation relies on the assumption that no other omitted variables exist that are correlated with both infertility and divorce. In other words, infertility should serve as a random unanticipated event after the couple is married and should not be related with other variables that may predict divorce. One possible concern is that infertility could be capturing poor health of the woman which may be correlated with both fertility and marital stability. Some evidence suggests correlation between sexually transmitted diseases, smoking, drinking, and miscarriages and infertility (Augood et al., 1998, Gesink Law et al., 2006, Grodstein et al., 1994, Hassan and Killick, 2005). However, most of such evidence relies on sample of couples recruited for fertility study and such study designs have been proven to have spurious associations (Negro-Vilar, 1993). Fertility has been found to be unrelated to education, race, occupation, father's social class, parity (Joffe and Barnes, 2000, Wilcox and Marks, 1994, Wilcox and Mosher, 1993). Buck et al. (1997) summarize the epidemiological literature and conclude that there is no clear evidence on the effect of life-style factors like smoking, alcohol and caffeine consumption, BMI, and drug use on secondary infertility. Even so, to deal with such concerns in our analysis, we show results by including controls for indicators of current health (had any sexually transmitted disease in past 12 months, had genital ulcer in past 12 months, body mass index, and recent visit to a health facility in past 12 months) and a measure of cumulative health status (respondent's height) for the subsample which was interviewed on anthropometric questions.

3.5 Results

3.5.1 Infertility

Tables 3.3 and 3.4 present results for the effect of infertility on divorce and divorce/separation, respectively. Column 1 in table 3 suggests that, adjusted for the duration since first marriage and country-year fixed effects, infertility increases the probability of divorce by 2.3 percentage points. In column 2, we add covariates related to the quality of the match, which may predict divorce. If these controls are uncorrelated to infertility, our estimate should not change, and this would be confirmed in column 2. Furthermore, signs on the coefficients of match quality controls are consistent with previous findings in the literature. Duration since first marriage and females having more education than the husband increases the probability of divorce while not having pre-marital sex decreases the probability of divorce. Moving forward in column 3, we add individual-level controls. We find the estimate to be consistent after including flexible controls for age at first intercourse, level of education, number of siblings, and place of residence in childhood and present.[9] This is our most preferred specification, which indicates that female infertility increases the probability of divorce by 2.13 percentage points, an 85 percent increase over the mean divorce rate. The estimates remain remarkably consistent as we move from column 1 to 3 suggesting that our measure of infertility is not correlated with the control variables.

An additional concern is related to the health of the individual. As discussed above, it is possible that infertility is proxying for inferior health, which could be correlated with marital instability. To deal with this issue we include health controls in column 5. In some countries, health information was collected for women who had given birth in the past 3 to 5 years. Hence, to estimate the model with health controls, we exclude surveys where more than 90 percent of childless women had missing health information. For the subsample of countries that report information on anthropometric

[9] Note that since we have control for duration since first marriage and age at first marriage, age is not included in the controls.

indicators, we estimate the model with and without controls for woman's health in columns 4 and 5 respectively. In column 5, we find that the effect of infertility on divorce persists after controlling for health controls.

In table 3.4, we show a similar analysis when the outcome variable is divorce or separated.[10] Column 3 shows the effect of infertility on divorce or separation after controlling for the duration since first marriage, country-year fixed effects, match quality and individual control variables. Infertility leads to an increase in the probability of divorce or separation by 3.2 percentage points. Here too, we find that the estimate is robust to controlling for health indicators in column 5.

3.5.2 Difference by Full and Partial Infertility

If desire for children among couples is responsible for dissolution of marriages, we should expect the effect of infertility to increase with the severity of the infertility shock. We divide infertility into sub-fecundity and full-infertility in tables 3.5 and 3.6 to examine if the effect is greater for women who have zero children as compared to women with a non-zero number of children. Subfecund women report being infertile but have at least one alive child whereas full-infertility means that the woman has zero living children. Table 3.5 shows results when infertility is replaced with subfecundity and full-infertility as independent variables. Comparing estimates on the two independent variables in column 3, we find that the effect is greater for women who are fully infertile than who are partially infertile or sub-fecund. Subfecundity increases the probability of divorce by 1.4 percentage points, whereas full-infertility increases this by 5.3 percentage points. Similarly, comparing column 3 in table 3.6, we again find that subfecundity increases the probability of divorce or separation by 2.8 percentage points, whereas full infertility increases it by 9 percentage points, reaffirming that more severe infertility shocks induce larger effects. This adds support to the interpretation of the main results, that failure to achieve the desired fertility levels leads to an increase in the probability of divorce and separation.

[10] If the marital status is reported as not living together, we refer to it separated.

3.5.3 Difference by Incidence of Polygamy

A useful distinction to exploit is by separating countries with different polygamy rates. Since societies where polygamy is accepted are more likely to provide men the option to have another wife to fulfill their desired fertility levels without separating from the current wife, infertility decreases the cost of remaining in the current marriage when the woman is infertile. This distinction may mute the effect of infertility on divorce in highly polygamous societies. We check this by splitting countries into high and low polygamy countries in the following way. For countries that collected information on polygamous unions, the median polygamy rate in the sample is 21 percent for all countries and years, i.e., 21 percent of women report being in a polygamous marriage.[11] Note that the country-level average polygamy rate is similar between infertile and fertile sample in table 3.1. So, if polygamous societies have a higher prevalence of sexually transmitted diseases which causes infertility, we expect to observe higher polygamy rates for the infertile population. We divide our surveys by the median polygamy rate into low and high polygamy country-years in table 3.7. Comparison of columns 1 and 3 shows that the effect of infertility on divorce is greater for low-polygamy societies by about 1.5 percentage points as compared to high-polygamy societies. Similarly, comparison of columns 2 and 4 indicates that in highly polygamous societies, the effect of infertility on divorce or separation is lower as compared to low-polygamy societies. Estimates show that in low-polygamy countries, infertility increases the probability of divorce or separation by 6 percentage points whereas in high-polygamy societies, this estimate is 4.3 percentage points. This further reinforces the hypothesis that the infertility acts as a negative shock that decreases the gains from a marriage and increases the probability of divorce.

[11] The survey question in the DHS used to measure is: Whether the respondent is in a polygamous union and the number of other wives the respondent's partner has. This question is asked to women who are currently married or in union.

3.5.4 Other Fertility Challenges

Gender of the First-born Child

It has been documented in the earlier literature that parents have preference for sons over daughters (Dahl and Moretti, 2008, Kohler et al., 2005). More than 100 million women are missing in South and West Asia, China, and North Africa (Sen, 1990). Over 65 million women are missing in India alone and sex-selective abortion has been illegal since 1996.[12] Given that son preference is even stronger in developing countries, we can expect to find such associations in the current case as well. To explore this, we test for the relationship between having the first-born as daughter on the likelihood of divorce.[13] This analysis is restricted to women who have had at least one birth. Table 3.8 shows the results for the effect of a first-born girl on divorce and divorce or separated.[14] Having a first-born daughter is associated with a .07 percentage point increase in the probability of divorce and .08 percentage point increase in the probability of divorce or separation. Once again, the estimates remain consistent in magnitude and statistical significance as we move from column 1 to column 3 and from column 4 to column 6 suggesting that gender of the first-born child is uncorrelated with the individual-level and match quality control variables.

Death of the First-born Child

The next fertility-related event we study is death of the first-born child. Death of the first-born child can cause emotional stress and anxiety leading to poorer well-being and marital disruptions (Rogers et al., 2008). To explore association between death of the first-born and marital outcome we segregate death of the first-born into death within a year and death after one year to ensure that we are not capturing the associations between infertility and early child deaths in the sample. Column 3 of table 3.9 shows that death of the first child increases the probability of divorce by .24 percentage

[12] http://www.nybooks.com/articles/1990/12/20/more-than-100-million-women-are-missing/

[13] We only use gender of the first-born as gender of the second-born is likely to be more endogenous than for the first-born.

[14] This has been noted previously in Dahl and Moretti (2008) while analyzing the effect of child's gender on marital outcomes.

points and it doesn't differ based on whether the child died in less than or more than 12 months. This is a 10 percent increase in the likelihood of divorce. For divorce or separation, we find that the estimate doubles. Death of first-born child is associated with .46 percentage points increase in the probability of divorce or separation. These estimates are larger as compared to the effect of gender of the first child and smaller than the effect of infertility on marital disruption.[15] The coefficients in table 3.9 change when we include individual-level and match-quality covariates in columns 2 and 3 suggesting that death of the first-born child is correlated with the control variables. It is also likely to be correlated with other unobserved variables such as poverty and is not as exogenous as the previously examined fertility challenges.

3.6 Robustness Tests

It is likely that for younger women infertility is a more severe negative event as younger women are less likely to have completed their desired fertility. So, infertility should stimulate a larger effect for younger women as compared to older women. Additionally, a limitation of the data is that we cannot infer the timing of the divorce. Since younger women are less likely to have experienced divorce and remarriage, we could expect a higher effect for younger women who have not had the same amount of time. Another possible way in which the results could be confounded by older women is that, with rising age, the probability of experiencing menopause increases and because older women are more likely to be experiencing menopause related infertility, we may be picking up the effect of menopause and not infertility among older women. To check for this, we repeat the main analysis for the sample of women in the age groups 15-35-year in table 3.12. The estimates for subfecundity increase in magnitude while those for full-infertility remain the same as compared to the 15-44-year old sample. This highlights that subfecundity at a younger age has a larger negative effect as younger couples are less likely to have completed their desired fertility size. On the other

[15] These estimates remain unchanged after controlling for infertility suggesting that this is indeed a different kind of a fertility challenge.

hand, the estimates on full-infertility are same as compared to the results for the main analysis sample suggesting that for women with no children, the effect is similar regardless of the age. Table 3.13 shows results when the outcome variable is divorce or separated for age group 15-35-year. Here too, the findings are similar.[16]

Another concern relates to the use of contraceptive use. Contraceptive use could indicate a higher probability of divorce rates because it may be the case that women who use contraceptives are likely to have more bargaining power in the marriage leading to a higher probability of divorce. It is also possible that contraceptive use reduces the probability of divorce as couples are more likely to control their desired fertility size. Contraceptive use may also be related to the knowledge of infertility for the women. Infertile women may be less likely to use contraceptive. In table 3.14, we address this concern by including a control for the respondent ever having used a contraceptive. The four categories for the variable of contraceptive use are: a) never used any, b) used only folkloric methods, c) used only traditional methods, and d) used modern methods. The estimates remain consistent to this additional control. Moreover, the negative sign on contraceptive use categories indicates that contraceptives use decreases the probability of divorce.

3.7 Conclusion

Marital instability has been linked to lower economic welfare of women and children in several contexts. While there is a large amount of literature on divorce in developed world, the literature on marital stability in developing countries is limited despite the rising importance of this phenomenon in the developing world. This paper addresses this gap by studying negative life events related to fertility. In particular, we investigate the relationship between fertility challenges faced by couples and marital dissolution using data for 1.3 million women from 66 developing countries. We explore three kinds of negative infertility events: infertility (further segregated into partial and full infer-

[16] Tables3.10 and 3.11 show similar analysis for the sample with age group 15-40-year old.

tility), gender of the first-born child, and death of the first-born child. Overall, the results provide supporting evidence for the theory proposed by Becker et al. (1977), that unanticipated events are associated with an increase in the likelihood of a divorce. Unlike previous literature, we exploit a shock which is non-pecuniary and more permanent in nature, which may lead to potentially larger effects than other negative shocks exploited in the literature. Specifically, we find that being infertile, having a first-born daughter, and experiencing the death of a first-born child significantly increases the probability of divorce and separation. These findings are robust to controlling for several match quality, individual-level, and health covariates of the women. Our findings provide the first set of evidence to support the hypothesis that negative fertility shocks can increase marital instability.

Tables and Figures

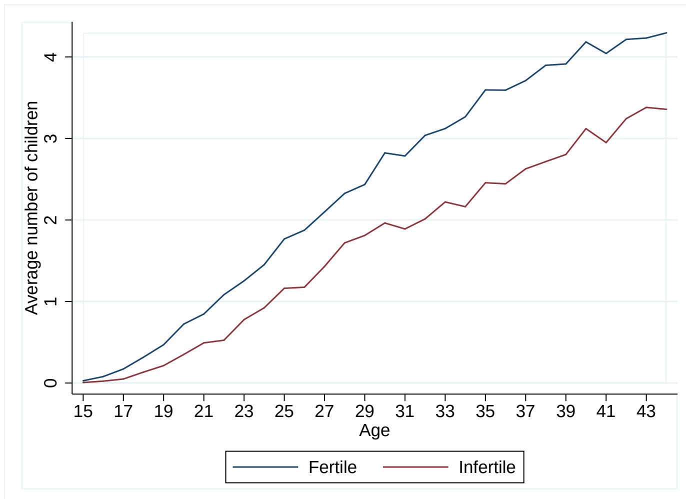

Figure 3.1: Average number of children by Infertility Status

Table 3.1: Summary Statistics I

	All	Infertile(1)	Fertile(2)	Test(2-1=0)
Panel A (Individual and Match Quality Variables):				
Divorced	2.50	4.89	2.46	
	(15.63)	(21.56)	(15.48)	
				-2.43***
Divorced+Separated	8.69	12.67	8.61	
	(28.17)	(33.27)	(28.05)	
				-4.06***
Infertility	1.92	100.00	0.00	
	(13.74)	(0.00)	(0.00)	
				-100.00
Full Infertility	0.35	18.23	0.00	
(Children=0)	(5.91)	(38.61)	(0.00)	
				-18.23***
Subfecundity	1.57	81.77	0.00	
	(12.45)	(38.61)	(0.00)	
				-81.77***
Age at first	17.44	17.51	17.43	
intercourse	(3.56)	(4.12)	(3.55)	
				-0.08***
Age at first	18.50	18.66	18.50	
marriage	(4.16)	(4.93)	(4.14)	
				-0.16***
Age at first birth	20.22	20.23	20.21	
	(3.88)	(4.36)	(3.87)	
				-0.02
Current age	30.39	36.88	30.26	
	(7.50)	(6.48)	(7.46)	
				-6.62***
Respondent- more	0.37	0.32	0.37	
than primary	(0.48)	(0.47)	(0.48)	
education				0.04***
Husband- more than	0.44	0.41	0.44	
primary education	(0.50)	(0.49)	(0.50)	
				0.03***
Wife has more	0.10	0.09	0.10	
education	(0.31)	(0.28)	(0.31)	
				0.02***
Husband has more	0.25	0.26	0.25	
education	(0.43)	(0.44)	(0.43)	
				-0.01*
No premarital sex	0.67	0.71	0.67	
	(0.47)	(0.45)	(0.47)	
				-0.04***
Childhood place of	0.56	0.59	0.55	
residence-rural	(0.50)	(0.49)	(0.50)	
				-0.03***
Current place of	0.59	0.58	0.59	
residence-rural	(0.49)	(0.49)	(0.49)	
				0.01**
Desired number of	4.12	4.34	4.12	
children	(2.53)	(2.72)	(2.53)	
				-0.22***
No. of siblings	5.64	5.43	5.64	
	(2.28)	(2.31)	(2.28)	
				0.22***
Country average	0.21	0.20	0.21	
polygamy rate	(0.14)	(0.14)	(0.14)	
				0.01***
Panel B (Health Variables):				
Respondent's height	156.02	155.77	156.03	
	(6.91)	(7.07)	(6.91)	

				0.25***
Visited health	53.75	39.49	54.02	
facility last 12	(49.86)	(48.88)	(49.84)	
months				14.53***
BMI-underweight	0.13	0.15	0.13	
	(0.33)	(0.36)	(0.33)	
				-0.03***
BMI-normal	0.56	0.50	0.56	
	(0.50)	(0.50)	(0.50)	
				0.06***
BMI-overweight	0.22	0.22	0.22	
	(0.41)	(0.41)	(0.41)	
				-0.00
BMI-obese	0.10	0.13	0.10	
	(0.30)	(0.33)	(0.29)	
				-0.03***
STD in last 12mo.	0.030	0.030	0.030	
	(0.17)	(0.17)	(0.17)	
				0.00
Genital sore/ulcer	0.044	0.044	0.044	
	(0.21)	(0.21)	(0.21)	
				0.01***
Observations	1311729	25248	1286481	1311729

Note: Sample of ever-married women between ages of 15-44 years. Age at first intercourse missing for 6 percent of the sample. Age at first birth calculated as current age minus age of first child. Summary for the following variables calculated on the sub-sample with non-missing information:Current place of residence-rural, Childhood place of residence-rural, Education in single years, partner's education in single years, number of siblings, desired number of children, respondent's height, visited health facility in 12 months, and BMI for four categories. The health variables were collected for a smaller sample than the total sample of 1311729.

Table 3.2: Summary Statistics II

	All	Infertile(1)	Fertile(2)	Test(2-1=0)
First born died	11.93	16.55	11.85	
	(32.42)	(37.17)	(32.32)	
				-4.70***
First born died in 12 mo.	8.09	10.29	8.05	
	(27.27)	(30.38)	(27.21)	
				-2.24***
First born died after 12 mo.	3.84	6.26	3.80	
	(19.22)	(24.23)	(19.12)	
				-2.46***
Age at death of first born in months	20.75	32.49	20.46	
	(42.50)	(62.15)	(41.84)	
				-12.04***
First born daughter	48.73	47.89	48.74	
	(49.98)	(49.96)	(49.98)	
				0.85*
Observations	1199800	21188	1178612	1199800

Sample of ever-married women between ages of 15-44 years who have given at least one birth.

Table 3.3: Effect of Infertility on Divorce

	Outcome=Divorced				
	(1)	(2)	(3)	(4)	(5)
Infertility	0.0229***	0.0215***	0.0213***	0.0231***	0.0226***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Duration since first marriage	0.0003***	0.0004***	0.0004***	0.0004***	0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wife has more education		0.0132***	0.0067***	0.0063***	0.0065***
		(0.002)	(0.001)	(0.002)	(0.002)
Husband has more education		0.0004	0.0069***	0.0045***	0.0045***
		(0.001)	(0.002)	(0.002)	(0.002)
No premarital sex=1		-0.0036***	-0.0024***	-0.0023***	-0.0024***
		(0.001)	(0.001)	(0.001)	(0.001)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1311729	1311729	1311729	586059	586059
R^2	0.04	0.05	0.05	0.03	0.03
Y-Mean	0.025	0.025	0.025	0.023	0.023

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.4: Effect of Infertility on Divorce or Separation

	Outcome=Divorced or Separated				
	(1)	(2)	(3)	(4)	(5)
Infertility	0.0456***	0.0418***	0.0398***	0.0334***	0.0317***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Duration since first marriage	0.0001	0.0005***	0.0005**	0.0007**	0.0010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wife has more education		0.0363***	0.0082***	0.0091**	0.0098**
		(0.002)	(0.003)	(0.004)	(0.004)
Husband has more education		0.0002	0.0268***	0.0251***	0.0252***
		(0.002)	(0.003)	(0.003)	(0.003)
No premarital sex=1		-0.0193***	-0.0128***	-0.0126***	-0.0129***
		(0.001)	(0.001)	(0.002)	(0.002)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1311729	1311729	1311729	586059	586059
R^2	0.04	0.05	0.06	0.05	0.05
Y-Mean	0.087	0.087	0.087	0.095	0.095

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.5: Effect of Subfecundity and Full Infertility on Divorce

	Outcome=Divorced				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.0560***	0.0539***	0.0534***	0.0572***	0.0562***
	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)
Subfecundity	0.0154***	0.0142***	0.0140***	0.0164***	0.0159***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1311729	1311729	1311729	586059	586059
R^2	0.04	0.05	0.05	0.03	0.03
Y-Mean	0.025	0.025	0.025	0.023	0.023

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse. Subfecundity is 1 for women who are infertile and have at least 1 child. Full infertility is 1 for women who are infertile and have zero children.

Table 3.6: Effect of Subfecundity and Full Infertility on Divorce or Separation

	Outcome=Divorced or Separated				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.0970***	0.0917***	0.0904***	0.0784***	0.0755***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Subfecundity	0.0340***	0.0305***	0.0284***	0.0244***	0.0230***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1311729	1311729	1311729	586059	586059
R^2	0.04	0.06	0.06	0.05	0.05
Y-Mean	0.087	0.087	0.087	0.095	0.095

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse. Subfecundity is 1 for women who are infertile and have at least 1 child. Full infertility is 1 for women who are infertile and have zero children.

Table 3.7: Effect of Infertility on Marital Stability by Average Country Polygamy Rate

	Low Polygamy		High Polygamy	
	(1)	(2)	(3)	(4)
	Divorced	Divorced+Separated	Divorced	Divorced+Separated
Infertility	0.0344***	0.0614***	0.0196***	0.0429***
	(0.010)	(0.009)	(0.003)	(0.005)
Match quality Controls	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
N	414949	414949	422049	422049
R^2	0.03	0.05	0.02	0.05
Y-Mean	0.03	0.08	0.02	0.06
Comparison	-	-	1=3	2=4
Chi2	-	-	2.07	3.05
Pval	-	-	.15	.08

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years who had at least one child born. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse. Median of country polygamy rate is 20% which was used to divide the sample of countries. Countries where polygamy question is missing for all women were excluded from this estimation sample.

Table 3.8: Effect of First Daughter on Marital Instability

	Outcome=Divorced			Outcome=Divorced or Separated		
	(1)	(2)	(3)	(4)	(5)	(6)
First born daughter	0.0007**	0.0007**	0.0007**	0.0008	0.0008*	0.0008*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Match quality Controls	N	Y	Y	N	Y	Y
Individual Controls	N	N	Y	N	N	Y
N	1199800	1199800	1199800	1199800	1199800	1199800
R^2	0.04	0.05	0.05	0.04	0.06	0.06
Y-Mean	0.024	0.024	0.024	0.085	0.085	0.085

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years who had at least one child born. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.9: Effect of Death of First Child on Marital Instability

	Outcome=Divorced			Outcome=Divorced or Separated		
	(1)	(2)	(3)	(4)	(5)	(6)
First born died in 12 mo.	0.0011*	0.0019***	0.0024***	0.0004	0.0025**	0.0046***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
First born died after 12 mo.	0.0014	0.0019**	0.0025***	0.0006	0.0022	0.0046***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Match quality Controls	N	Y	Y	N	Y	Y
Individual Controls	N	N	Y	N	N	Y
N	1199800	1199800	1199800	1199800	1199800	1199800
R^2	0.04	0.05	0.05	0.04	0.06	0.06
Y-Mean	0.024	0.024	0.024	0.085	0.085	0.085

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years who had at least one child born. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.10: Robustness: Effect of Infertility on Divorce (15-40-years)

	Outcome=Divorced				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.0592***	0.0576***	0.0572***	0.0567***	0.0557***
	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)
Subfecundity	0.0176***	0.0165***	0.0163***	0.0170***	0.0165***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1168458	1168458	1168458	521310	521310
R^2	0.05	0.05	0.05	0.03	0.03
Y-Mean	0.024	0.024	0.024	0.022	0.022

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.11: Robustness: Effect of Infertility on Divorce or Separation (15-40-years)

	Outcome=Divorced or Separated				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.0965***	0.0928***	0.0916***	0.0705***	0.0676***
	(0.017)	(0.017)	(0.017)	(0.016)	(0.015)
Subfecundity	0.0431***	0.0397***	0.0379***	0.0323***	0.0308***
	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	1168458	1168458	1168458	521310	521310
R^2	0.04	0.05	0.06	0.05	0.05
Y-Mean	0.085	0.085	0.085	0.092	0.092

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.12: Robustness: Effect of Infertility on Divorce (15-35-years)

	Outcome=Divorced				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.0599***	0.0587***	0.0581***	0.0593***	0.0583***
	(0.010)	(0.010)	(0.009)	(0.014)	(0.014)
Subfecundity	0.0230***	0.0221***	0.0217***	0.0237***	0.0232***
	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	936640	936640	936640	418167	418167
R^2	0.05	0.05	0.05	0.03	0.03
Y-Mean	0.024	0.024	0.024	0.022	0.022

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.13: Robustness: Effect of Infertility on Divorce or Separation (15-35-years)

	Outcome=Divorced or Separated				
	(1)	(2)	(3)	(4)	(5)
Full Infertility (Children=0)	0.1016***	0.0991***	0.0975***	0.0745***	0.0716***
	(0.020)	(0.019)	(0.019)	(0.018)	(0.017)
Subfecundity	0.0572***	0.0536***	0.0522***	0.0446***	0.0433***
	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)
Match quality Controls	N	Y	Y	Y	Y
Individual Controls	N	N	Y	Y	Y
Health Controls	N	N	N	N	Y
N	936640	936640	936640	418167	418167
R^2	0.04	0.05	0.06	0.05	0.05
Y-Mean	0.083	0.083	0.083	0.090	0.090

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse.

Table 3.14: Robustness: Control for Contraceptive Use

	Outcome=Divorced			Outcome=Divorced or Separated		
	(1)	(2)	(3)	(4)	(5)	(6)
Infertility	0.0229***	0.0215***	0.0197***	0.0456***	0.0418***	0.0348***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
used only folkloric			-0.0071***			-0.0196***
			(0.002)			(0.004)
used only trad. meth			-0.0110***			-0.0328***
			(0.002)			(0.003)
used modern method			-0.0094***			-0.0304***
			(0.001)			(0.004)
Match quality Controls	N	Y	Y	N	Y	Y
Individual Controls	N	N	Y	N	N	Y
N	1311729	1311729	1311729	1311729	1311729	1311729
R^2	0.04	0.05	0.05	0.04	0.05	0.06
Y-Mean	0.025	0.025	0.025	0.087	0.087	0.087

Standard error clustered at country-year level. *** p<0.01, ** p<0.05, * p<0.1. Sample includes ever married women between the ages of 15-44 years. All regressions have country-year fixed effect and duration since first marriage. Match quality controls include dummies for age at first marriage, indicator for woman having intercourse before marriage, dummies for husband's education, dummy for woman having more education than the partner, and dummy for partner having more education than woman. Individual-level controls include dummies for age at first intercourse, number of siblings, dummies for education, indicator variable for current place of residence being rural, and indicator for childhood place of residence being rural. Health controls include respondent's height, dummy for having visited the health facility in past 12 months, STD in past 12 months, genital ulcer in past 12 months, and four BMI categories: underweight, normal, overweight, and obese. Since health data was not collected for all women in all countries, we exclude countries where more than 90 percent of women with zero children have missing health information for analysis in columns 4 and 8. Observations with missing information on the following controls were included back in the sample with an indicator for the missing value: education of woman, partner's education, childhood place of residence, number of siblings, and age at first intercourse. Omitted category for ever used contraceptive is never used.

CHAPTER 4

Conclusion

This research has focused on the following two aspects of family economics in developing countries: women's work and marital instability. The first two chapters of this dissertation are motivated by the puzzling changes in married female labor force participation in India, which occurred despite consistent economic growth, falling fertility, and rising female education. In these two chapters, I investigate the role of individual, household, and state-level factors behind this phenomenon. The third chapter delves into the relationship between fertility challenges faced by couples and marital stability in the developing world.

In the first chapter, I argue that one of the factors that can help understand the puzzling decline in married female labor force participation in India between 1999 and 2012 is the rising earnings of husbands. Increase in the earnings of husbands can exert a negative income effect on the labor supply of wives. Empirical investigation using two datasets and alternative sources of variation in the earnings of married males indicates a robust and negative relationship between labor market participation for married women and earnings of married males. I also presented evidence that suggests that this relationship is indeed because of a negative income effect and not due to other mechanisms, such as responses in fertility and selection into marriage. While the income effect mechanism has been mentioned in the debate on falling female labor supply in India, little empirical work has been done to clarify this relationship. This work fills that gap by demonstrating robust empirical evidence for the relationship between married female labor supply and earnings of married males by using three complementary methods.

The second chapter is an extension of my investigation in the first chapter. Here, I focus on the relative role of state-level and individual-level factors in explaining the small rise in female labor force participation between 1999 and 2005 and the subsequent large decline between 2005 and 2012. I document that these fluctuations in labor supply were due to the movement of rural married women in and out of unpaid jobs, such as those in household businesses. The findings of the decomposition analysis indicate that among individual-level variables, education of the female and education of the head of the household have a significant negative pull on participation of married females in both paid and unpaid labor activities. Addition of the state-level variables shows that these factors are related to participation in paid jobs, but not in unpaid jobs. Road density is found to have a positive relationship and agricultural mechanization is found to have a negative relationship with paid labor force participation of married females. Overall, the state-level factors appear to influence the participation of women in jobs for pay, which are likely to be outside of their households. Further research is needed to understand the causal channels between these infrastructure-related factors and different measures of women's work in India.

The third chapter examines how fertility challenges among couples are related to marital outcomes. Using the 158 Demographic and Health Surveys from 66 developing countries, we show that self-reported infertility, death of the first-born child, and the first-born child being daughter increase the likelihood of divorce and separation. Additional sub-group analysis indicates that the negative relationship between infertility and divorce is higher among couples with no children as compared to those with at least one child and for societies that are less likely to practice polygamy. Overall, the findings of this paper highlight the role of negative fertility-related life events on marital stability and agree with the theoretical analysis in Becker (1977).

Women's work and marital stability are important aspects of household welfare. The overall purpose of this research was to generate a better understanding of these issues for developing countries. These findings can help both economists and policymakers conceptualize policies that improve the well-being of women, and households in general, for these developing countries.

Bibliography

Abraham, V. (2009). Employment growth in rural india: Distress-driven? *Economic and Political Weekly*, Vol. 44(Issue No. 16).

Afridi, F., Dinkelman, T., and Mahajan, K. (2017). Why are fewer married women joining the work force in rural india? a decomposition analysis over two decades. *Journal of Population Economics*, pages 1–36.

Afridi, F., Mukhopadhyay, A., and Sahoo, S. (2016). Female labor force participation and child education in india: evidence from the national rural employment guarantee scheme. *IZA Journal of Labor & Development*, 5(1):7.

Amato, P. R. and Cheadle, J. (2005). The long reach of divorce: Divorce and child well-being across three generations. *Journal of marriage and family*, 67(1):191–206.

Amato, P. R. and Keith, B. (1991). Parental divorce and the well-being of children: a meta-analysis. *Psychological bulletin*, 110(1):26.

Angrist, J. D. and Evans, W. N. (1998). Children and their parentsŠ labor supply: Evidence from exogenous variation in family size. *American Economic Review*, 88(3):450–477.

Antman, F. (2014). Spousal employment and intra-household bargaining power. *Applied Economics Letters*, 21(8):560–563.

Anukriti, S. and Dasgupta, S. (2017). Marriage markets in developing countries. *Oxford Handbooks Online*.

Augood, C., Duckitt, K., and Templeton, A. (1998). Smoking and female infertility: a systematic review and meta-analysis. *Human Reproduction (Oxford, England)*, 13(6):1532–1539.

Bailey, M. J. (2006). More power to the pill: the impact of contraceptive freedom on women's life cycle labor supply. *The Quarterly Journal of Economics*, 121(1):289–320.

Becker, G. S. (1973). A theory of marriage: Part i. *Journal of Political Economy*, 81(4):813–846.

Becker, G. S., Landes, E. M., and Michael, R. T. (1977). An economic analysis of marital instability. *Journal of political Economy*, 85(6):1141–1187.

Benham, L. (1974). Benefits of women's education within marriage. *Journal of Political Economy*, 82(2, Part 2):S57–S71.

Bernhardt, A., Field, E., Pande, R., Rigol, N., Schaner, S., and Troyer-Moore, C. (2018). Male social status and women's work. *AEA Papers and Proceedings*, 108:363–67.

Bhalotra, S. R. and Umana-Aponte, M. (2010). The dynamics of women's labour supply in developing countries.

Black, D. A., Kolesnikova, N., Sanders, S. G., and Taylor, L. J. (2013). Are children "normal"? *The Review of Economics and Statistics*, 95(1):21–33.

Blau, F. D. and Grossberg, A. J. (1992). Maternal labor supply and children's cognitive development. *The Review of Economics and Statistics*, pages 474–481.

Blau, F. D. and Kahn, L. M. (2007). Changes in the labor supply behavior of married women: 1980–2000. *Journal of Labor Economics*, 25(3):393–438.

Bobonis, G. J. (2011). The impact of conditional cash transfers on marriage and divorce. *Economic Development and cultural change*, 59(2):281–312.

Bradbury, K. and Katz, J. (2008). The responsiveness of married women's labor force participation to income and wages: Recent changes and possible explanations.

Buck, G. M., Sever, L. E., Batt, R. E., and Mendola, P. (1997). Life-style factors and female infertility. *Epidemiology*, pages 435–441.

Cáceres-Delpiano, J. (2012). Can we still learn something from the relationship between fertility and motherŠs employment? evidence from developing countries. *Demography*, 49(1):151–174.

Cates, W., Farley, T. M., and Rowe, P. J. (1985). Worldwide patterns of infertility: is africa different? *The Lancet*, 326(8455):596–598.

Cerrutti, M. (2000). Economic reform, structural adjustment and female labor force participation in buenos aires, argentina. *World Development*, 28(5):879–891.

Chae, S. (2016). Parental divorce and children's schooling in rural malawi. *Demography*, 53(6):1743–1770.

Charles, K. K. and Stephens, Jr, M. (2004). Job displacement, disability, and divorce. *Journal of Labor Economics*, 22(2):489–522.

Chatterjee, U., Murgai, R., and Rama, M. G. (2015). Job opportunities along the rural-urban gradation and female labor force participation in India. Policy Research Working Paper Series 7412, The World Bank.

Chong, A. and Ferrara, E. L. (2009). Television and divorce: Evidence from brazilian novelas. *Journal of the European Economic Association*, 7(2-3):458–468.

Choudhary, N., Tripathy, A., and George, B. (2009). Women's economic contribution through their unpaid household work: The case of india.

Clark, S. and Brauner-Otto, S. (2015). Divorce in sub-saharan africa: Are unions becoming less stable? *Population and Development Review*, 41(4):583–605.

Conzo, P., Fuochi, G., and Mencarini, L. (2017). Fertility and life satisfaction in rural ethiopia. *Demography*, 54(4):1331–1351.

Cristia, J. P. (2008). The effect of a first child on female labor supply evidence from women seeking fertility services. *Journal of Human Resources*, 43(3):487–510.

Cruces, G. and Galiani, S. (2007). Fertility and female labor supply in latin america: New causal evidence. *Labour Economics*, 14(3):565–573.

Currie, J. and Schwandt, H. (2014). Short-and long-term effects of unemployment on fertility. *Proceedings of the National Academy of Sciences*, 111(41):14734–14739.

Dahl, G. B. and Moretti, E. (2008). The demand for sons. *The Review of Economic Studies*, 75(4):1085–1120.

Devereux, P. J. (2004). Changes in relative wages and family labor supply. *Journal of Human Resources*, 39(3):698–722.

Doiron, D. and Mendolia, S. (2012). The impact of job loss on family dissolution. *Journal of Population Economics*, 25(1):367–398.

Duflo, E. and Pande, R. (2007). Dams. *Quarterly Journal of Economics*.

Eswaran, M., Ramaswami, B., and Wadhwa, W. (2013). Status, Caste, and the Time Allocation of Women in Rural India. *Economic Development and Cultural Change*, 61(2):311 – 333.

Gardeazabal, J. and Ugidos, A. (2004). More on identification in detailed wage decompositions. *Review of Economics and Statistics*, 86(4):1034–1036.

Gesink Law, D., Maclehose, R. F., and Longnecker, M. P. (2006). Obesity and time to pregnancy. *Human Reproduction*, 22(2):414–420.

Ginther, D. K. and Zavodny, M. (2001). Is the male marriage premium due to selection? the effect of shotgun weddings on the return to marriage. *Journal of Population Economics*, 14(2):313–328.

Goldin, C. (1994). The U-Shaped Female Labor Force Function in Economic Development and Economic History. NBER Working Paper 4707, National Bureau of Economic Research, Inc.

Grodstein, F., Goldman, M. B., and Cramer, D. W. (1994). Body mass index and ovulatory infertility. *Epidemiology*, pages 247–250.

Hankins, S. and Hoekstra, M. (2011). Lucky in life, unlucky in love? the effect of random income shocks on marriage and divorce. *Journal of Human Resources*, 46(2):403–426.

Hassan, M. and Killick, S. (2005). Is previous aberrant reproductive outcome predictive of subsequently reduced fecundity? *Human reproduction*, 20(3):657–664.

Heath, R. and Jayachandran, S. (2017). The causes and consequences of increased female education and labor force participation in developing countries. In *The Oxford Handbook of Women and the Economy*.

Heyer, J. (2010). Dalit women becoming'housewives: lessons from the tiruppur region, 1981/2 to 2008/9.

Jain, D. (2007). The value of time use studies in gendering policy and programme. In *International Seminar on Mainstreaming Time Use Survey in the National Statistical System in India*, pages 25–27.

Jann, B. et al. (2008). A stata implementation of the blinder-oaxaca decomposition. *Stata journal*, 8(4):453–479.

Jensen, R. (2012). Do Labor Market Opportunities Affect Young Women's Work and Family Decisions? Experimental Evidence from India. *The Quarterly Journal of Economics*, 127(2):753–792.

Joffe, M. and Barnes, I. (2000). Do parental factors affect male and female fertility? *Epidemiology*, 11(6):700–705.

Juhn, C. and Murphy, K. M. (1997). Wage inequality and family labor supply. *Journal of Labor Economics*, 15(1, Part 1):72–97.

Klasen, S. and Pieters, J. (2015). What explains the stagnation of female labor force participation in urban india? *The World Bank Economic Review*, 29(3):449–478.

Kohler, H.-P., Behrman, J. R., and Skytthe, A. (2005). Partner+ children= happiness? the effects of partnerships and fertility on well-being. *Population and development review*, 31(3):407–445.

Mammen, K. and Paxson, C. (2000). Women's Work and Economic Development. *Journal of Economic Perspectives*, 14(4):141–164.

Margolis, R. and Myrskylä, M. (2011). A global perspective on happiness and fertility. *Population and development review*, 37(1):29–56.

Mason, K. O. and Taj, A. M. (1987). Differences between women's and men's reproductive goals in developing countries. *Population and Development Review*, pages 611–638.

Mbiti, I. M. (2007). Moving women: Household composition, labor demand and crop choice. *Unpublished paper, Department of Economics, Southern Methodist University, Dallas, TX, USA*.

Mehrotra, S. and Parida, J. K. (2017). Why is the labour force participation of women declining in india? *World Development*, 98:360–380.

Munshi, K. and Rosenzweig, M. (2009). Why is Mobility in India so Low? Social Insurance, Inequality, and Growth. NBER Working Paper 14850, National Bureau of Economic Research, Inc.

Nakosteen, R. A. and Zimmer, M. A. (1997). Men, money, and marriage: Are high earners more prone than low earners to marry? *Social Science Quarterly*, 78(1):66–82.

Neff, D. F., Sen, K., and Kling, V. (2012). The Puzzling Decline in Rural WomenŠs Labor Force Participation in India: A Reexamination. SSRN Scholarly Paper ID 2066585, Social Science Research Network, Rochester, NY.

Negro-Vilar, A. (1993). Stress and other environmental factors affecting fertility in men and women: overview. *Environmental Health Perspectives*, 101(Suppl 2):59.

Nunley, J. M. and Seals, A. (2010). The effects of household income volatility on divorce. *American Journal of Economics and Sociology*, 69(3):983–1010.

Papanek, H. (1979). Family status production: The "work" and "non-work" of women. *Signs: Journal of Women in Culture and Society*, 4(4):775–781.

Parker, S. W. and Skoufias, E. (2004). The added worker effect over the business cycle: evidence from urban mexico. *Applied Economics Letters*, 11(10):625–630.

Pathania, V. (2007). The long run impact of drought at birth on height of women in rural india. *Working Paper, UC Berkeley.*

Rogers, C. H., Floyd, F. J., Seltzer, M. M., Greenberg, J., and Hong, J. (2008). Long-term effects of the death of a child on parents' adjustment in midlife. *Journal of family psychology*, 22(2):203.

Rosenzweig, M. R. (1980). Neoclassical theory and the optimizing peasant: An econometric analysis of market family labor supply in a developing country. *The Quarterly Journal of Economics*, 94(1):31–55.

Rosenzweig, M. R. and Wolpin, K. I. (1980). Life-cycle labor supply and fertility: Causal inferences from household models. *Journal of Political Economy*, pages 328–348.

Shah, M. and Steinberg, B. M. (2017). Drought of opportunities: Contemporaneous and long-term impacts of rainfall shocks on human capital. *Journal of Political Economy*, 125(2):527–561.

Singleton, P. (2012). Insult to injury disability, earnings, and divorce. *Journal of Human Resources*, 47(4):972–990.

Srivastava, N. and Srivastava, R. (2010). Women, work, and employment outcomes in rural india. *Economic and political weekly*, pages 49–63.

Sudarshan, R. M. and Bhattacharya, S. (2009). Through the magnifying glass: Women's work and labour force participation in urban delhi. *Economic and Political Weekly*, pages 59–66.

Tilson, D. and Larsen, U. (2000). Divorce in ethiopia: The impact of early marriage and childlessness. *Journal of biosocial science*, 32(3):355–372.

Topalova, P. (2007). Trade liberalization, poverty and inequality: Evidence from indian districts. In *Globalization and Poverty*, pages 291–336. University of Chicago Press.

Tzannatos, Z. (1999). Women and labor market changes in the global economy: Growth helps, inequalities hurt and public policy matters. *World development*, 27(3):551–569.

Weiss, Y. and Willis, R. J. (1997). Match quality, new information, and marital dissolution. *Journal of Labor Economics*, 15(1, Part 2):S293–S329.

Wilcox, L. S. and Marks, J. S. (1994). From data to action; cdc's public health surveillance for women, infants, and children.

Wilcox, L. S. and Mosher, W. D. (1993). Use of infertility services in the united states. *Obstetrics and Gynecology*, 82(1):122–127.

Xia, L. (2010). How children affect mother's labor market outcomes: Evidence based on pregnancy failures. Technical report, Mimeo.

Yun, M.-S. (2005). A simple solution to the identification problem in detailed wage decompositions. *Economic inquiry*, 43(4):766–772.

Zhang, J. (2017). The evolution of china's one-child policy and its effects on family outcomes. *Journal of Economic Perspectives*, 31(1):141–60.