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Economic Development and the Motherhood Wage Penalty

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Abstract

We investigate whether the motherhood wage penalty varies by level of economic development. Using data from 21 middle- and low-income countries that have a common questionnaire, we find that the penalty increases with economic development. To address differential selection into motherhood, we instrument for the number of children with infertility shocks and continue to find that motherhood wage penalty raises with economic development. We explore two possible explanations for this increase. First, while the penalty for young children is similar across levels of development, in low-income countries adolescent children generate a premium. This reflects the role that adolescent children, especially daughters, play as substitutes for their mother's time in household tasks in poorer countries. Second, as labor markets become more complex, employment type and occupational segregation account for more of the motherhood wage penalty. Labor market variables account for very little of the family penalty in low-income countries but they explain around one-third of the penalty in middle-income countries.

Keywords: Female earnings, family size, family penalty, fertility, economic development

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1. Introduction

This paper documents how women's wages are affected by motherhood at varying stages of economic development. There is an ample literature describing a sizeable motherhood wage penalty in advanced economies (e.g., Davies and Pierre, 2005; Waldfogel, 1998; Gangl and Ziefle, 2009; Budig et al, 2012; Kleven et al, 2019). However, there is less comparable evidence in developing countries where the tension between productive and reproductive roles is perhaps weaker and where social norms and policies could mitigate these tradeoffs at different stages of economic development.

Arguably, the lack of evidence on the size and causes of the motherhood wage penalty in developing countries can be attributed to the lack of standardized, and representative earnings data across a large number of countries at varying stages of development. We use nationally representative surveys from 21 developing countries (12 low-income nations and 9 middle-income countries) that applied a common questionnaire. These data allow us to construct comparable measures of daily earnings, occupations and number of children by age and gender for all the countries in our sample. To the best of our knowledge this is the most comprehensive investigation of the impact of children on women's earnings in developing nations.

We document that the family penalty *increases* with economic development.[1] In middle-income countries, we find that each additional child is associated with a 15% decrease in daily earnings, which falls to 4.5% after conditioning on location, education and marital status. An additional child in low-income countries, however, imposes a penalty of only 4.4% which falls to 1.2% after controlling for the above variables.

[1] Our empirical analysis focuses on the effect of an additional child, regardless of parity, on the earnings of their mothers and not just on the comparison of mothers vs. non-mothers, thus we use the terms motherhood and family penalty interchangeably.

The finding of a sizable family penalty in middle-income countries and a small one in low-income countries is robust to unobserved heterogeneity. Following Agüero and Marks (2008, 2011) we use infertility shocks as an instrument for family size and find no evidence that the differential family penalty by stage of development is a byproduct of selection into larger families.

What accounts for the differential family penalty by stage of economic development? Our data allow us to explore several mechanisms. First, we consider Becker's (1985) model of effort allocation within the household. Consistent with effort at home being a driver of the motherhood wage penalty, we find that the wage penalty decreases with the age of the child. This is observed in both, low- and middle-income countries. However, we find that in low-income countries adolescent children provide a wage *premium*. This suggests a substitution between these children and their mothers in household tasks. No such wage premium is found for middle-income countries, which partially accounts for the difference in family penalty by stage of economic development. This difference would suggest that childcare responsibilities may be lower in countries with lower levels of economic development and consistent with the evidence that parental time spent on childcare is a "luxury good" (Guryan et al, 2008).

Additionally, as countries develop, the nature of the labor market changes in ways that may increase the family penalty (Mammen and Paxson, 2000). Structural change, captured by the decline of the agricultural sector and the rise of manufacturing and service sectors, could affect the family penalty if non-agricultural jobs provide less flexibility and have to be conducted away from home. We show that the complexity of the labor market can account for part of the differential motherhood wage penalties by level of development. In particular, we find that self-employment, working from home, occupational segregation, and seasonal work account for very

little of the family penalty in low-income countries. However, these variables explain one-third of the family penalty for more developed countries where labor market are more complex.

Our paper complements previous work that has focused on the impact of motherhood on the labor force participation of women in developing countries (e.g., Aaronson, et al, 2018; Agüero and Marks, 2008, 2011; Cáceres-Delpiano, 2012; Cruces and Galiani, 2008; Heath, 2017; Berniell, et al, 2019). Taken together, these papers tend to find that for current or historical lower levels of economic development, children have little impact on the labor force participation of their mothers.

Obviously, we are not the first paper to study the motherhood penalty in developing countries.[2] However, the evidence that exists is mixed, is usually limited to a single country and in most cases, has not addressed the endogeneity of motherhood.[3] Our use of multiple countries at different stages of development helps understand previous mixed findings. This is further complemented with an understanding of the mechanisms behind the differential motherhood penalty by stage of economic development.

The rest of the paper is organized in three additional sections. Section two describes the data, the construction of the earnings variable as well as the sample construction and representativeness. This section finishes with a description of our methodology to estimate the motherhood penalty. Section three presents our results and mechanisms. Section four concludes.

[2] A related topic that has received much academic attention in developing countries is the gender wage gap (e.g., Appleton et al, 1999 and Ñopo, Daza and Ramos, 2011).

[3] For example, Adair et al. (2002) find a negative impact of childbearing on women's cash earnings in the Philippines. For the same country, Orbeta (2005) finds that additional children have a positive effect on women's earnings for the upper three income quintiles. Olarte and Peña (2010) find a wage gap of around nine percent in Colombia. Explaining the mechanism for this gap, they show that motherhood increases the probability of being employed in the informal market but only for those who have young children. Piras and Ripani (2005) consider urban women in a sample of women in Latin America. They find no relationship between children and log earnings overall. Yet, for Peru they find a negative relationship, while in Brazil, mothers appear to earn more than non-mothers.

2. Data and Econometric Model

A. Data and Construction of the Daily Earnings Measure

In this section we present the main issues related to the data construction and the measurement of daily earnings. Additional details are discussed in our data appendix: Appendix B. To document and understand the motherhood wage penalty as countries develop, we use cross-sectional data from the third round of the Demographic and Health Surveys (DHS). The DHS are standardized nationally representative household surveys in which women between the ages of 15 and 49 provide information about their demographic traits, birth history, socio-economic and marital status, as well as their employment status, and occupation.[4]

Relevant to our study, only the third phase of DHS contains a unique set of additional standardized questions in the employment module about women's earning and therefore, we restrict our analysis to surveys from this phase (see Appendix Table A.1 for the list of surveys and years). In these surveys, women were asked if they work or have worked in the past 12 months. Any respondent that answered in the affirmative was then asked if she was paid in cash for her employment.[5] Respondents were asked a follow-up question about their frequency of pay period (i.e., hourly, daily, weekly, bi-weekly, monthly or annually) and how much they usually earn for their work per pay period. Thus, we have information on earnings of respondents who

[4] We cannot use census data for earnings because fewer than eight developing countries include this information and all of them are middle-income countries. Also, the DHS questionnaires were designed to be highly consistent across countries, which provides a higher comparability relative to censuses who are independently designed and executed by each country's statistical bureau. Finally, DHS allow to use a biological event, infertility, as an instrument. To the best of our knowledge, no census in the world collects this information.

[5] The DHS data provide no satisfactory way to impute the monetary compensation for workers that are paid in-kind. In Appendix B we investigate if excluding in-kind compensation could be biasing our estimates of the motherhood wage penalty by stage of development and conclude that it does not.

were working for cash at the time of the survey as well as earnings of those who were *not currently* working but who had worked for cash within the last twelve months.[6]

Depending on the stated pay period, the DHS collects data on the intensity of work (e.g., days per week, months per year, and/or days in the last year). In Appendix B, we document how we use the information about intensity of work and pay period to calculate *daily* earnings for all women in the sample. Daily earnings are as narrow as we can define earnings.[7] However, we think that daily earnings are a more accurate reflection of the nature of pay in developing countries than hourly earnings. In our sample, being paid a daily wage is the most common form of payment. For example, 12,997 respondents report that they are paid a daily wage, while only 82 women report hourly payment.

We argue for the validity of our daily earnings variable in two ways. First, Young (2012) uses the same DHS earnings data in a paper that proposes alternative and more reliable measures of economic growth in Africa. As an indicator of the DHS quality, he finds that the estimated Mincerian returns to education using the DHS data are close to the ones observed from Labor Force Surveys for developing countries.

Second, we compare our daily earnings measure with an alternative estimate of women's earnings obtained from the Global Gender Gap Report (Hausmann et al, 2008) using data from the United Nations Development Programme's Human Development Report. The report records estimated annual earned income of women in PPP US dollars for all countries included in our

[6] Our results are robust to limiting the analysis to the subsample of women who are currently working as shown in Appendix Table B.2

[7] A possible concern with using daily earnings is that wages could differ due to changes in the number of hours worked per day. In Appendix B, we investigate whether mothers and non-mothers differ along a measure of the intensive margin (days worked per year). The results suggest that motherhood is associated with a larger decrease in work intensity in middle-income countries than in low-income countries (4 days vs. 1 days less per child); reinforcing our finding of larger family penalties in middle-income countries.

sample (with the exception of Central African Republic and Comoros). We construct daily earnings of women for these countries assuming 250 working days a year for a comparable measure of real daily earnings. We then compare the UNDP's earnings estimates to our DHS measure of real daily earnings for female wage earners. Figure 1 presents, for each country, the average daily earnings from the DHS and the UNDP data in the form of a scatter plot. The correlation coefficient is 0.82 (0.90 when Jordan is excluded).[8] The paper by Young (2012) and the strong positive correlation between the earnings data from the two distinct sources leads us to conclude that the earnings data in the DHS as well as our construction of the measure of real daily earnings are reliable for the purpose of our analysis.

B. Sample Construction and Representativeness

Our sample contains all DHS surveys that meet the following three criteria: (1) the survey had to include information on earnings (2) the data had to be publicly available and (3) the survey had to include the questions that we use to identify infertile women for the instrumental variable approach. This leads to a total of 22 surveys representing 21 countries from Africa, Asia, Latin America and the Middle East.[9] Table 1 contains information about the 21 countries included in our sample by income level as defined by World Bank classification.[10] Our sample contains 12 low-income countries, 8 lower middle-income countries and 1 upper middle-income country. We

[8] All of our results are robust to the exclusion of Jordan from the sample.

[9] As a robustness check (see Table A.2) we exclude the countries where fewer than 15% of women participated in the paid labor market and where selection into the labor force may be particularly strong. The estimated impact of children on earnings is unchanged in low-income countries and increases to 5.2% for middle-income countries when we exclude these countries.

[10] The same classification of countries is obtained if instead of the World Bank's GNI per capita (Atlas method) we use the UN's Human Development Index or alternative measures such as infant mortality rates, life expectancy or literacy rates. The smallest pair-wise spearman correlation coefficient between GNI per capita and these other measures is around 0.79.

combine the one upper middle-income country (South Africa) with the lower middle-income countries in our analysis. We refer to these countries as "middle-income."

An important feature of our data is that the countries included in our analysis are representative of nations at varying stages of economics development increasing the external validity of our results. Table 1, Panel A, compares characteristics of our subsample of nine middle-income countries to data from external sources. For this income group, as show in column 1, the total fertility rate in the DHS is 3.8 and is close to the observed rate among all middle-income countries (3.1). Our sample matches very well with respect to labor supply indicators such as female labor force participation rates (51% in DHS vs. 53% for all middle-income countries, column 2) and the percentage of women working for a wage (88% vs. 87%, column 3). Our DHS sample has a slightly higher share of women with education above primary school. A similar pattern is observed in Panel B, when comparing our DHS sample of 12 lower-income countries with all countries in this income group. Note also that our data support the fertility transition that accompanies economic development as total fertility rate falls from 5.3 to 3.8 with rising levels of income.

Within this set of countries and to be consistent with the literature studying the family penalty, we restrict the sample to wage earning women between 20 and 44 years of age at the time of the survey and exclude mothers with all children over the age of 18 years from the sample. We also exclude women enrolled in school in the year of the survey. Our final estimation sample contains 55,552 working women. A breakdown by country is shown in Appendix Table A.1.

Summary statistics for our estimation sample are shown in Table 2. The average woman in our sample is 30 years old with two children, one of whom is under the age of six. The

average daily earnings for the women in our sample is $6.11 a day. In Table 2, columns (2) and (3) contain summary statistics for non-mothers and mothers, respectively. The average mother earns $5.70 while her childless counterpart earns $7.42 daily. However, non-mothers are much more educated, far more likely to be unmarried, more likely to work year-round and more likely to reside in urban areas. There is also a difference in the occupational distribution between mothers and non-mothers; mothers are over-represented in agricultural and sales work and under-represented in office work (professional, managerial and clerical positions) and services. Mothers are also more likely to be self-employed and to work from home[11].

Columns (3) and (4) compare all mothers to those with young children. The demographic characteristics between these groups are very similar; however, mothers with young children earn significantly less ($5.18 vs. $5.70) and are slightly more likely to work in agricultural jobs and less likely to have an office job. In addition, mothers with young children are less likely to work year-around.

In Columns (5) and (6) we split the sample by level of economic development. As previously shown, women in middle-income countries have fewer children than their counterparts in low-income countries. There are sizable differences in earnings and educational attainment. There are also notable differences in the nature of work by stage of economic development. Women in low-income countries are more likely to be currently working but less likely to work year around. Self-employment is much less common in middle-income countries. There are also differences in the occupation mix; women in low-income countries are more likely to be in "child friendly" occupations. Sales and agricultural work account for fully two-third of all work in the low-income countries whereas only a third of female wage earners work

[11] These patterns are also present if we compare mothers and non-mothers by stage of economic development as shown in Appendix Table A.3.

in these two occupational categories in the more developed countries. The decline of agriculture and the rise of the services documented in our data are consistent with the pattern observed for a broader set of countries (ILO 2010).

Preliminary evidence of a motherhood wage penalty is presented in Figure 2a. The solid line represents average daily earnings for women with children of any age. Earnings clearly fall with family size. The average woman with one child earns $6.27 whereas her counterpart with five children earns only $3.77 a day. For women with young children, represented by the dashed line, the effects are more pronounced. Additionally, the average woman with younger children earns less than her counterpart with older children regardless of the number of children.

In Figure 2b we split the sample into middle- and low-income countries. The figures suggest a stark difference in the family penalty by stage of economic development. The pattern for middle-income countries looks very similar to the aggregate (Figure 2a). Average earnings fall starkly as the number of children increases and the effect is more pronounced for children under the age of six. In stark contrast, for low-income countries we see little preliminary evidence of a family penalty. Average daily earnings hover around $3.00 over the entire family size distribution. Earnings do appear to be slightly lower for mothers with multiple young children at home.

C. Econometric Model

For the samples described above, our general specification is given by equation (1):

(1) $\text{Log}(\text{Earnings}_{ij}) = \beta K_{ij} + \Sigma_s \gamma_s \text{Age}_{ijs} + P_{ij}'\theta + \alpha_j + X_{ij}'\delta + e_{ij}$

where $Earnings_{ij}$ is daily earning for women i in country j as described above. Our main variable of interest, K_{ij}, indicates the number of children under the age of 19 living at home. Thus, β is the

parameter of interest. We include dummies for women's age in single years denoted by $s = \{20,...,44\}$ and survey fixed effects (α_j). The inclusion of survey fixed effects allows us to control for the possibility that unobserved country-level characteristics are jointly correlated with the number of children a woman has and her earnings, such as differences in attitudes toward women and motherhood across countries. Furthermore, while all surveys employ a standardized questionnaire, minor changes in the survey design could also affect our results. Survey fixed effects permit us to control for this possibility as well. Similarly, the model includes indicators for reported pay period (daily, weekly, monthly etc.) to subsume measurement error in the construction of the daily wage variable (vector P_{ij}). This is our Model 1.

In Model 2 we expand the set of variables to include those commonly present in the literature studying the family penalty (vector X_{ij}). We include six indicators for educational attainment (i.e., none, as the omitted category, incomplete primary, complete primary, incomplete secondary, complete secondary, and higher), six indicators for current marital status (i.e., never married as the omitted category, married, living together, widowed, divorced, and not living together), and four indicators for the size of the current place of residence (large city, small city, town and countryside). All results include robust standard errors clustered using the 189 sub-national sampling clusters (for example, departments, provinces, or districts) and all estimates include sample weights**.** In section 3.B this model is extended to include the possibility of selection into motherhood using an instrumental variable approach as in Agüero and Marks (2008, 2011).

3. Results

A. Documenting the Family Penalty

Table 3 presents the results of estimating Models 1 and 2. We start by discussing the results for all countries in our sample as shown in column (1). Each additional child is associated with a decrease in daily earnings of 10% on average (Panel A). When controls for education, marital status and size of current location are added (Panel B), these variables account for a substantial share of the motherhood penalty. Nonetheless, there is still a sizable negative relationship between children and their mothers' daily earnings.

There are differences in labor markets, gender norms, and in institutions between low- and middle-income countries that affect labor market outcomes of women.[12] In this paper, we argue that the observed family penalty for developing countries hides patterns that vary by the country's level of economic development. For instance, economic development is accompanied by a shift away from self-employment and agriculture and towards service and office jobs, which implies that the new labor opportunities for women are less "mother-friendly" as these new jobs require working away from home and tend to be less flexible (Goldin, 1994; Mammen and Paxson, 2000 and Gaddis and Klasen, 2014). Additionally, policies regarding school attendance imply that children are more likely to be in school in more advanced economies and this reduces their ability to substitute for their mothers in household tasks and rearing of their younger siblings. [13]

Columns (2) and (3) of Table 3 split the sample by level of economic development according to the World Bank classification. The family gap is over three times larger in middle-

[12] Differences is gender norms, labor markets and social policies also impact the magnitude of the family penalty in more developed counties (see Budig et al, 2012 and Kleven et al, 2017).

[13] An additional explanation is that multigenerational households could potentially lessening the childcare burden on working mothers (Duflo, 2003 and Hamoudi and Thomas, 2014). The data presented in Figure 3 suggests that for our sample other relatives are more likely to be the caregivers of young children in middle-income countries than in low-income countries. This suggests that multigenerational households cannot explain the smaller family penalty in low-income nations.

income countries than in low-income countries. In the model with a limited set of controls (Panel A), each child is associated with a 14.7% reduction in earnings in middle-income countries but only with a 4.4% reduction in low-income countries. These differences by stage of development are statistically significant (at the 1% level) as shown by the p-value for the null hypothesis of equality. The results in Panel B suggest that education, marital status and location account for over two-thirds of the family gap in both low and middle-income countries. Once we condition on a standard set of controls, there remains a small family gap of 1.2 percent per child in the low-income countries and a family penalty of 4.5 percent per child in the middle-income countries.[14] Again, these difference by level of development are statistically significant at 1% level.

B. Selection into Motherhood

It is possible that the difference in the size of the family penalty by stage of economic development reflects different patterns of selection into motherhood and/or parity. To address the endogeneity of family size, we adopt the infertility instrument first proposed in Agüero and Marks (2008) and later used by Agüero and Marks (2011), Jensen (2012), Rondinelli and Zizza (2011), Schott (2012), Lundborg et al (2017), and Bago and Dessy (2019). The key idea is that infertility creates a "natural experiment" in which some women are biologically limited in the number of children they can have (either no children at all or no further children after parity *n*). The third wave of the DHS datasets allow us to identify self-reported infertility in two ways. The

[14] The estimate for middle-income countries is in the range of findings from developed countries. For instance, using a sample of seven industrialized countries, a similar set of controls and time period, Harkness and Waldfogel (2003) estimate the family penalties for a mother of two children that range between 2-24%. Davies and Pierre (2005) using data from the late 1990s find two-child wage penalties that range from very small (and statistically insignificant) to 9% in the Netherlands and around 22% in Germany and the UK. Within more developed countries there is an active debate regarding mother's earnings and the size of the family penalty. England et al (2016) find that in the US the wage penalty increases with the skills and earnings of the mother, in contrast Glauber (2018) suggests that the family penalty is larger for low-earning women.

first way is when the subset of women, who are not using any form of contraceptives (including traditional methods) at the time of the survey, mentioned sub-fertility or infertility as their reason for not currently using contraceptives. The second way is when non-sterilized women responded as being unable to have more children when asked about their desire for future children. The infertility indicator is the union of these two measures. We will use infertility to instrument for K_{ij} in equation (1) to address the potential selection concern.[15]

The results of using infertility as an instrument for family size are shown in Table 4. For column (1) we re-estimate Equation (1), using Model 2, for the subsample of women for whom we can measure infertility. The OLS estimates again suggest that each additional child decreases daily earnings by 1.2% for women in the least developed countries and 4.5% for women in middle-income countries. Column (2) reports the estimates that use infertility as an instrument for family size. We have very strong first stage estimates; on average, infertility reduces family size by 1.1 children in middle-income countries and 1.2 children in low-income countries. Also, for both samples the F-statistic is very high. The 2SLS result suggests that the effect of children on earnings, using the variation in the number of children that comes through the infertility channel, is indeed causal.[16] For both subsamples, the 2SLS estimate is larger in absolute value than the corresponding OLS, but one cannot reject the hypothesis that the two point estimates are the same (the reported Hausman tests have a p-value of 0.287 and 0.347 respectively). Thus,

[15] See Agüero and Marks (2011) for more details about the instrument. They show that infertility appears to be independent of the background characteristics and thus it serves as a valid instrument. We replicate theirs and Jensen's (2012) analysis for the set of countries used in our paper and the subsample of women who work for pay split by stage of development. In Appendix C, in both low- and middle-income countries, we show that after conditioning on age, infertile women do not differ from their fertile counterparts along a wide set of characteristics such as being born in a rural location, month of birth, number of siblings, and birth order. These results are consistent with previous papers cited above.

[16] For the entire sample, the corresponding 2SLS estimated penalty is 5.2% ($p<0.05$) per child.

there is no evidence of a downward bias in the OLS parameter.[17] We conclude that differential selection into childbirth cannot account for the family penalty and the 2SLS estimates support the fact that the family penalty grows as countries develop.

Having established a causal link between children and their mother's earning and confirmed that the family penalty increases as a country develops; the remainder of the paper explores the nuances of the observed family gap. To do so, we will first explore how the age and gender of children matter and, therefore, no longer use the 2SLS.

C. Understanding the Motherhood Wage Penalty: The Effort Hypothesis

Based on Becker's (1985) model of effort (and time) allocation within the household, the literature has hypothesized that at-home responsibilities play a key role in explaining the motherhood wage penalty. According to this theory, motherhood adds an "effort requirement" that is absent for non-mothers: namely childcare. Thus, even if both mothers and childless women spent the same amount of *time* working, it is predicted that mothers would allocate less *effort* toward market work than childless women. As a result, mothers will have lower productivities and lower earnings than non-mothers with similar characteristics.

This theory could help us understand why there is a higher family penalty observed in middle-income countries vis-à-vis poorer economies. There is strong evidence that time spent on childcare is a "luxury good".[18] For instance, Sun et al (2016) use data from 28 low- and middle-

[17] The persistence of a motherhood wage penalty when unobserved heterogeneity is accounted for is consistent with the results from fixed effect models over long time horizons (Budig and England 2001; Waldfolgel 1997; Lundberg and Rose 2000; Kleven et al 2019). There are limited studies in the developing world that address the endogeneity of family size. Orbeta (2005) uses variation in caused by twinning and concludes that children are exogenous. While, Adair et al. (2002) use mother's fixed effects to account for selection and find a high level of endogeneity of childbearing on women's earnings.

[18] Due to data limitation, we are agnostic about whether the variation in childcare efforts relates to norms about childhood, differentials returns to investment in children, or institutional (e.g., education policies).

income countries and find that maternal caregiving for young children increases with a country's economic development. This is reinforced by evidence within countries. Campaña et al (2017) and Torres and Agüero (2017) show that time spent with children increases with parents' levels of education in developing countries. Thus, we should expect childcare responsibilities to be lower (demanding less time and effort) at lower stages of economic development. We test for this hypothesis by examining how the family penalty varies by age and gender of the child across different levels of economic development.

We start by exploring whether the family penalty is largest for younger children as they demand more childcare and whether the age-specific penalty varies by levels of development. For this exercise, we modify equation (1) as follows:

$$(2)\ \text{Log}(\text{Earnings}_{ij}) = + \Sigma_a \beta_a K_{ija} + \Sigma_s \gamma_s \text{Age}_{ijs} + X_{ij}'\delta + \alpha_j + e_{ij}$$

where now K_{ija} is number of children for women i in country j by age group, indexed by a. Following Anderson et al. (2003), we grouped children into developmental and schooling stages and formed the following age groups: under 3, 3 to 5, 6 to 10, 11 to 13 and 14 to 18. We restrict our focus to Model 2, which includes controls for education, marital status, and current location in addition to controls for age, survey and pay period.

Table 5 shows the estimation of Equation (2) by stage of economic development and reveals interesting heterogeneity by child age. Column 1 presents the results for middle-income countries. The results are consistent with the effort hypothesis. The family penalty is largest for the youngest children and declines with child age. For example, each additional child under the age of five is associated with a daily earnings penalty of seven percent. However, an additional child aged 11 to 13 is linked to a decline of only three percent. This pattern of a declining penalty

by child age is consistent with older children required less effort and is also observed in developed countries (e.g., Anderson et al., 2003 and Jacobsen et al., 1999).

For low-income countries the patterns are different, especially for older children. In Column 2, we show that the largest penalty is found, once again, for the youngest children. Thus, regardless of the stage of development, caring for very young children is very time demanding and a similar sized wage penalty is found across both groups of countries. However, the penalty for an additional child between 3-5 shrinks to two percent in low-income counties compared to the seven percent found for middle-income nations. In poorer countries, the earnings penalty disappears for children of primary-school age consistent with less time spent raising children. Furthermore, in low-income countries we find a *premium* for adolescent children. Having an additional child between 14-18 *increases* his/her mother's daily earnings by almost four percent. The premium is also observed, although less precisely estimated, for children between 11-13 years of age. This is consistent with the fact that, unlike their middle-income counterparts, many adolescent children in low-income countries are not in school and could substitute for their mothers' effort at home. Thus, averaging across a children ages --and ignoring the differential role that older children have on their mother's earnings-- to generate a single estimate of the motherhood wage penalty lowers the penalty in low-income countries.

To provide additional evidence that adolescent child may be substituting for their mother's time in the household, we investigate if the impact of children on earnings varies with the gender of the child. A large body of literature in developing countries documents that the difference in gender roles becomes more pronounced as children age, with daughters (but not sons) contributing to childrearing and household tasks as they enter adolescence (e.g., Zapata, Contreras and Krueger, 2011; Jakiela et al, 2019.)

We provide additional evidence of the role of adolescent children in household responsibilities by stage of development in Figure 3. The DHS ask women with at least one child under the age of six about who "minds" that child. We then further restrict the sample to those wage-earning women with children over the age of 10 so that the options "Female/Male Child" are possible responses. Consistent with the findings in Table 5, the probability that an adolescent child provides care for his/her younger sibling is larger in low-income countries compared to more advanced economies. Furthermore, Figure 3, presents evidence that adolescent girls assume a disproportional child-caring role for their younger siblings (relative to boys). As shown, older daughters are the second most likely person to care for younger children (slightly less than the respondent herself). This is observed in both low- and middle-income countries, but more so in low-income countries.

Based on these findings, we explore differences in the family penalty by age and gender of the child. If the effort hypothesis is responsible for a portion of the family penalty, then we should see larger penalties for sons than daughters. Equation (2) is modified by replacing $\Sigma_a \beta_a K_{ija}$ with $\Sigma_a \pi_a S_{ija} + \Sigma_a \theta_a D_{ija}$, where S_{ija} and D_{ija} refer to the number of sons and daughters in age group a, respectively. Panel A of Table 6 shows the estimates of this modified equation for middle-income countries. Column (1) presents the coefficient estimates for the variables that capture the number of sons (π_a) while the estimates for daughters (θ_a) are shown in column (2). There are no differences in the effect of a child by gender when they are young (under 10 years). We formally test whether all parameters for boys and girls under 10 years are jointly similar and cannot reject the null hypothesis (p-value=0.185). However, an older son continues to be negatively associated with his mothers' earnings while an older daughter has no effect on earnings. For low-income countries, Panel B of Table 6 shows a similar pattern for children

under the age of 10. We do not observe a difference by gender. However, while having an older son has no effect on earnings in low-income countries, older daughters are associated with an earning *premium* of around five percent. We reject the hypothesis of equal parameters by gender for children older than 10 with a p-value of 0.066. The differential impact on mother's earning by gender of the child likely reflects strong gender norms in developing countries, whereas adolescent girls (but not adolescent boys) are responsible for time-intensive households and child rearing tasks. The finding of differences by gender of the child reinforces the fact that time use in the household is an important determinate of the motherhood wage penalty.

D. Other Mechanisms: Employment Type and Occupational Segregation

In this section, we add to the model potential mechanisms that that have been shown to account for a portion of the family penalty in other settings. It is possible that mothers earn less than non-mothers because they sort into types of work that are more compatible with child rearing but are less remunerative. In particular we investigate if the explanatory power of differences between mothers and nonmothers with regard to type of work, occupation, and work intensity –broadly defined– varies by the stage of economic development. We suspect that as labor markets become more complex with economic advancement, these factors will play a more prominent role in determining wages and the size of the family penalty for women.

Economic development is associated with a decline in agricultural employment and an increase of manufacturing and services. These later occupations are more lucrative and less compatible with motherhood and thus the wider presence of these occupations may account for some of the motherhood wage penalty. Similarly, economic development is associated with a decline in the informal self-employment (La Porta and Shleifer, 2014). Due in part to

compatibility with family responsibilities women are overrepresented in this sector (Maloney, 2004). In contrast, work in the formal sector offers greater stability, and higher earnings, but generally longer hours and a work location typically away from home (e.g, Anker and Hein, 1986 and López Boó et al, 2010). To investigate the role that employment type and occupational segregation play in the motherhood wage penalty, we include a series of control variables in Equation (2) that capture these features to see if they mediate the relationship between children and earnings.

Starting with middle-income countries, in Panel A of Table 7, column (1) replicates the results from Panel A of Table 3 for ease of comparison. Column (2) of Table 7 investigates the role of the *type of work* in explaining the family penalty. Specifically, we add to Equation (2) two variables: an indicator for self-employment and another that indicates that the woman reports working from home to approximate less-formal types of work. While there are large penalties attached to both self-employment and working at home, the comparisons of columns (1) and (2) indicate that differences in the type of work between mothers and non-mothers account for little of the family penalty in more developed countries.

Mothers may also sort into "parent-friendly" occupations. The theory of compensating wage differentials predicts that the features of these occupations that make them easier to combine with motherhood will in turn result in lower earnings (Anderson et al, 2003; Budig and England, 2001). For example, mothers may choose occupations that have flexible hours, the ability to have your child at the work site and/or fewer demands for commuting. Column (3) of Table 7 adds 275 detailed occupational controls to Equation (2). Occupational sorting accounts for a significant portion of the family penalty in middle-income countries. The inclusion of detailed occupational controls (comparing column 3 to column 1 in Panel A) explains close to 20

percent of the family penalty. Furthermore, occupational sorting accounts for one-third of the penalty for mothers with adolescent children and almost two thirds of family penalty for mothers with teenage children in middle-income countries.

Column (4) adds the only measures of work intensity available for all women in our sample. The survey asks respondents if they work year-round, seasonally, or occasionally. Additionally, we can determine if the respondent is currently working as opposed to having worked sometime in the past 12 months. In middle-income countries, 9% of mothers report that they work occasionally. The corresponding figure for non-mothers is 5.5%. On the other hand, mothers are slightly less likely to have worked in the prior year as opposed to the current year. In middle-income countries, differences in labor force attachment account for a portion of the family penalty. The estimated coefficients in column (4) are 5-15% smaller than those in column (1). The final column in Table 7, Panel A, includes all of the above controls. After we condition on type of work, detailed occupation categories and labor force attachment we can explain over 30 percent of the family penalty for women in middle-income countries.[19]

In Panel B of Table 7, we repeat this exercise for working women in low-income countries. In these countries, labor markets are less sophisticated, potentially decreasing the role of job type, occupation and intensity in explaining wages differences across groups. We first investigate the role of working from home and self-employment on the family penalty. As was shown in Table 2, in low-income countries the vast majority of women are self-employed. In Table 7, comparing columns (1) and (2) in Panel B, we find negligible changes in the point

[19] We suspect that 30% is a lower bound on the role that labor market variables play in accounting for the motherhood wage penalty as we lack data on experience and tenure with the firm. These two variables often play a large explanatory role. For instance, Gangl and Ziefle (2009) find the wage penalties in the US and Great Britain can be entirely explained by rich labor market controls.

estimates, indicating that differences in the type of work between mothers and non-mothers do not account the family penalty in less developed countries.

Unlike middle income countries, work in low-income nations is dominated by two occupational categories: agriculture and sales. They account for two-thirds of female employment, compared to just one-third in middle-income countries. As such, occupational segregation may have less of an explanatory role in explaining wages and wage gaps in poorer economies. This is borne out in Panel B. The point estimates in column (3) which include detailed occupational controls are almost identical to the estimates in baseline column (1), when these occupation controls were not included. The lower role that occupational sorting plays in explaining the family penalty for women in less-developed countries relative to their counterparts in more advanced economies is consistent with the heterogeneity in the nature of work that occurs as countries develop. This creates a tradeoff between jobs that are more family friendly (such as agriculture and sales) with lower pay and those that are less family friendly (such as clerical, manufacturing and professional positions) but pay more.[20]

Column (4) includes our measures of work intensity. Incorporating these features of labor force attachment (if the respondent reported working year-round, seasonally or occasionally and an indicator for currently working) account for little of the remaining family penalty in low-income nations.[21] Again, this contrasts with our findings for middle-income countries described above, where these features play a much more important role.

The final column in Table 7, Panel B, includes all of the above controls. Despite the inclusion of numerous channels through which the motherhood wage penalty may operate, we

[20] Almost half of the women with children under the age of 6 who work in sales and agriculture report that they are the primary care giver for young children compared to 30% of mothers in other occupations.

[21] While mothers are overrepresented in seasonal employment (see Table A.3), the wage regressions suggest there is no daily wage penalty to seasonal employment in low-income countries.

are able to explain only 10 percent of the family penalty for women with children under the age of three and none of the family penalty for women with toddlers or school-aged children in low-income countries.

As a summary, we re-estimate Table 7 considering the total number of children instead of disaggregating by age of the child. This is shown in Appendix Table A.4. After conditioning on labor market variables, in middle-income countries the per child penalty falls from 4.5% to 3.1%. In low-income countries the per child penalty is unchanged by the inclusion of controls at 1.2% per child.

4. Conclusion

This paper provides an assessment of the motherhood wage penalty by stage of economic development. We compile a unique set of household surveys that collect standardized information on family size and female earnings from twelve low-income and nine middle-income countries. This allows us to establish a previously unknown stylized fact: the motherhood wage penalty *increases* with the level of economic development.

For low-income countries, the unconditional penalty indicates that mothers earn 4.5% less per day for each additional child compared to their childless counterparts. The penalty reduces to one percent per child when conditioning on age, education, marital status, and size of the current location. For women in middle-income countries the unconditional per child penalty is 15% and drops to five percent in a model with limited demographic controls.

We provide evidence to support two explanations for the increase in the motherhood wage penalty with more economic development. First, in low-income countries women can combine work and family responsibilities relatively easily because most work is conducted from

or near home and most women work in two broad occupational categories: sales and agriculture. The widespread employment of women in these two sectors implies that in poorer nations, labor marker factors do not play a major role explaining the family penalty. This contrasts with labor market features in middle-income countries. We find that almost one-third of the family penalty in middle-income countries is driven by mothers being overrepresented in low-paying occupations and working at a lower intensity than their childless counterparts. The larger penalty is explained, in part, by the segmentation in the labor market for mothers as countries develop.

Second, we find that throughout the developing world the family penalty is larger for younger children and is especially large for women with children under three years of age. However, in low-income countries we find that older children, especially adolescent daughters, provide a wage *premium*. This is consistent with adolescent daughters substituting for their mothers in household tasks. We find no such wage premium for middle-income countries, which also accounts for some of the difference in family penalty by stage of economic development. The substitution between mothers' and adolescent children's' responsibilities in the household has important implications for policies that alter child time use as countries develop. In particular the expansion of schooling for older children that accompanies economic development (UNESCO 2019) may have the unintended consequence of reducing wages for working mothers.

Our results suggest that policies and institutions such as preschool, on-site childcare, school buses, and labor-saving household technologies, which facilitate the balance of work and family will become increasingly important as economies develop. Future scholarship should investigate the effectiveness of policies that support working mothers as labor markets increase in complexity.

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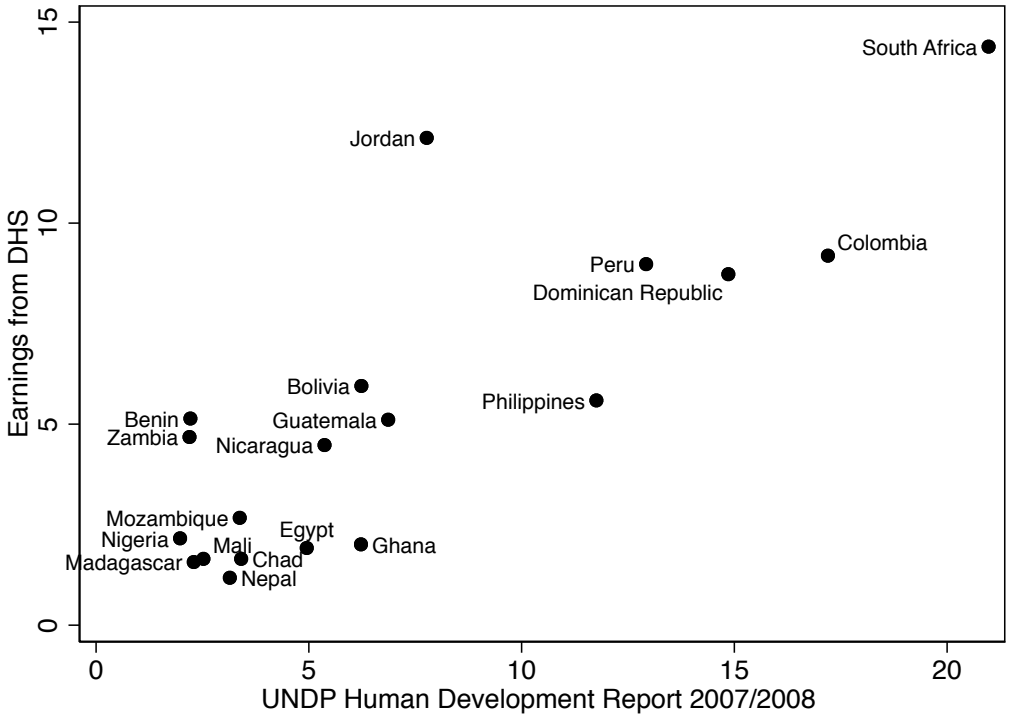
Figure 1. Validity of the earnings data



Note: Daily earnings from UNDP Human Development Report 2007/2008 are expressed in 2007 PPP US$. These are imputed from the estimated annual earnings of women by assuming 250 working days. Average daily earnings from the DHS are expressed in 2006 US$.

Figure 2a. Average daily earnings by number of children

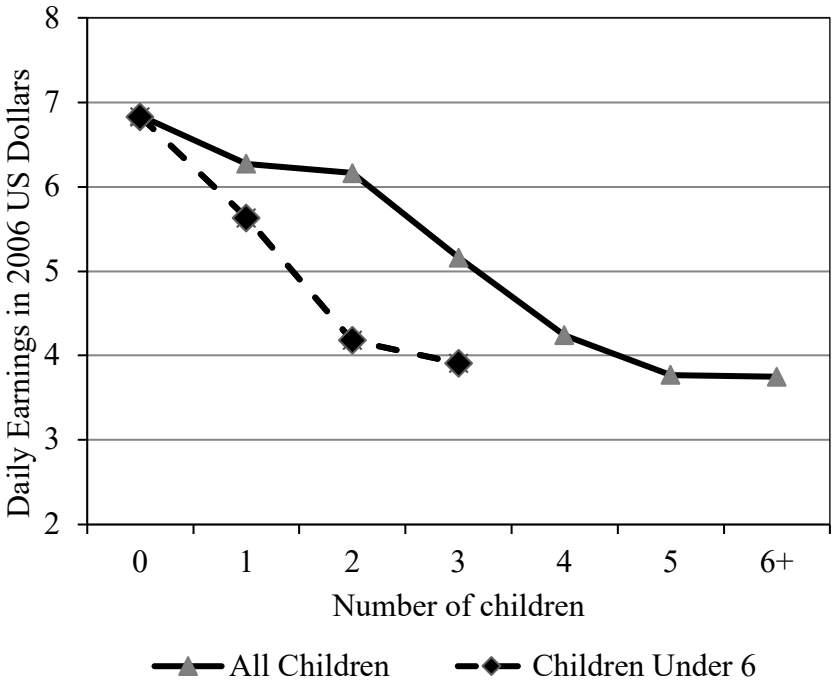
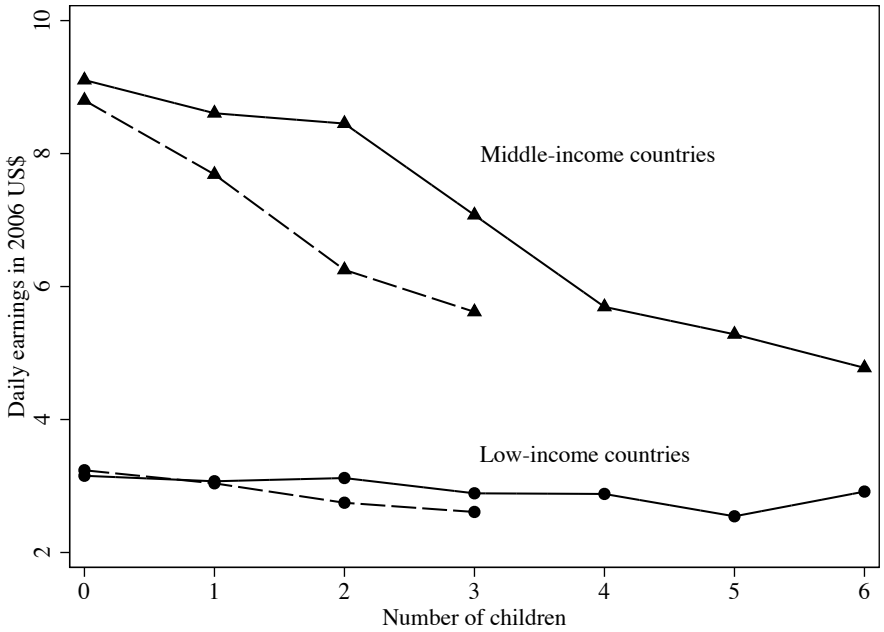
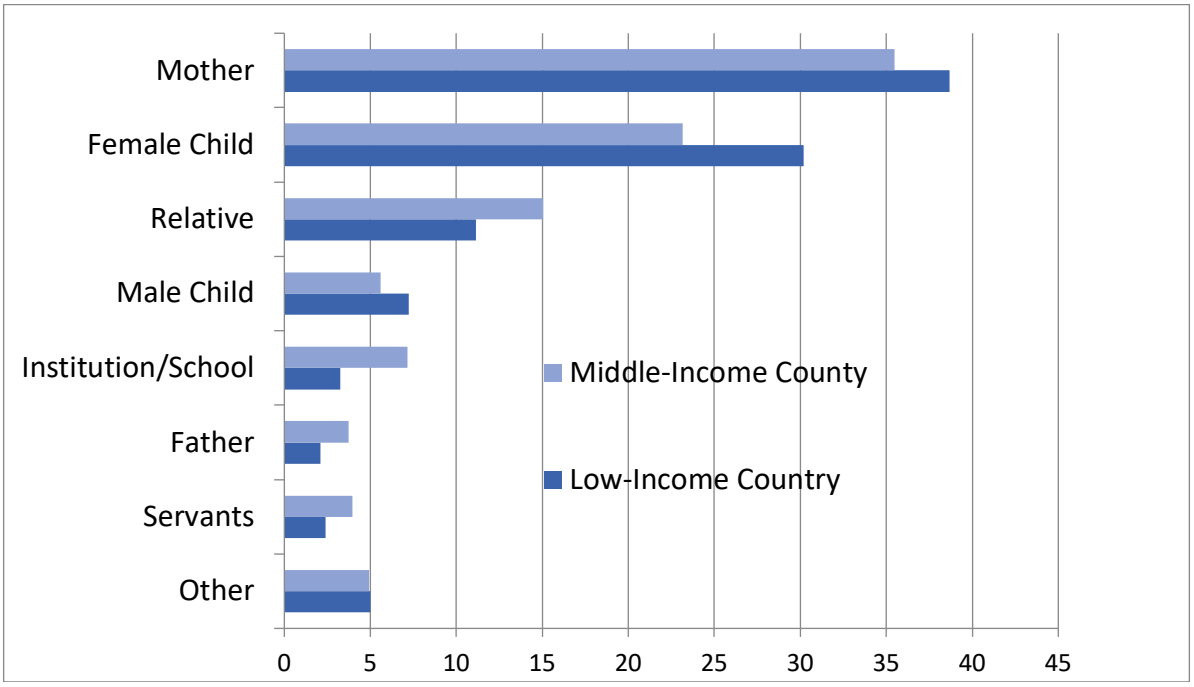


Figure 2b. Average daily earnings by number of children and level of development



Note: Each point corresponds to the average daily earnings of women with the given number of children. The solid lines are for all children regardless of age. Women with 6 or more children were combined for the last data point. The dashed lines are for women with varying numbers of children under the age of six years. Women with more than three children under the age of 6 were combined in the final data point.

Figure 3. Primary source of childcare by stage of development



Note: The question on who minds the child is only asked to women with a child under the age of 6. We further restrict the sample to those women with an additional child over the age of 10 so that Female/Male Child are possible responses. This leaves us with a sample of 6,864 observations for low-income countries and 5,507 observations for middle-income countries.

Table 1. Representativeness of DHS countries and selected indicators, by income level

Country	Total Fertility Rate[a]	Share in the labor force[b]	Share working for wage[c]	Above primary education (share)[d]
	(1)	(2)	(3)	(4)
Panel A: Middle-income countries				
DHS countries	3.8	0.51	0.88	0.56
All countries[e]	3.1	0.53	0.87	0.49
Panel B: Low-income countries				
DHS countries	5.3	0.67	0.65	0.20
All countries	5.1	0.69	0.68	0.28

[a] For *All countries*, the average was computed using data from all countries included in the World Bank's 1997 World Development Indicators.

[b] For DHS countries, this represents women currently working or reported working in the last 12 months. The aggregate data comes from the Hausmann et al (2008).

[c] In the DHS, this is the percentage of women working who report being paid in cash. For the aggregate, data come from Women's Indicators and Statistics Database (version 4, WISTAT 4). We compute the *share working for wage* as [number of female employees + employers and own-account workers + unclassifiable by status]/[number of female employees + employers and own-account workers + unpaid family workers + unclassifiable by status].

[d] Data for *all countries* comes from Barro and Lee (2013) for the year of 1995.

[e] We restrict the countries to lower middle-income to match our DHS sample.

Notes: *DHS countries* include all the surveys in our analysis. We include all women aged 20-44 not enrolled in school, (working or not) and using sample weights.

Table 2: Descriptive statistics

Variable	Full Sample	Non-mothers	Mothers	Mothers with kids under 6	Mid-income countries	Low-income countries
	(1)	(2)	(3)	(4)	(5)	(6)
Number of children	1.98	-	2.59	2.72	1.80	2.22
	(1.70)		(1.48)	(1.57)	(1.63)	(1.76)
Number of kids <6	0.85	-	1.11	1.51	0.70	1.05
	(0.90)		(0.87)	(0.66)	(0.84)	(0.93)
Working at time of survey	0.91	0.89	0.91	0.90	0.87	0.95
	(0.29)	(0.31)	(0.29)	(0.30)	(0.33)	(0.21)
Office Work[a]	0.21	0.28	0.18	0.17	0.29	0.10
	(0.41)	(0.45)	(0.39)	(0.37)	(0.29)	(0.30)
Services[a]	0.10	0.13	0.09	0.08	0.14	0.04
	(.30)	(.34)	(.28)	(.27)	(.35)	(.19)
Sales[a]	0.33	0.26	0.35	0.36	0.27	0.40
	(0.47)	(0.44)	(0.48)	(0.48)	(0.44)	(0.49)
Agricultural[a]	0.15	0.09	0.17	0.19	0.06	0.26
	(0.36)	(0.29)	(0.37)	(0.39)	(0.24)	(0.44)
Works at home[b]	0.25	0.22	0.26	0.27	0.24	0.27
	(0.44)	(0.41)	(0.44)	(0.44)	(0.43)	(0.44)
Self employed[b]	0.54	0.45	0.56	0.59	0.40	0.73
	(0.50)	(0.50)	(0.50)	(0.49)	(0.49)	(0.45)
Worked year-round	0.73	0.77	0.72	0.70	0.77	0.68
	(0.44)	(0.42)	(0.45)	(0.46)	0.42	0.47
Daily earnings	6.11	7.42	5.70	5.18	8.31	3.12
	(8.00)	(8.96)	(7.63)	(7.14)	(9.14)	(4.70)
Age	30.47	27.98	31.24	29.73	30.87	29.93
	(6.38)	(6.54)	(6.24)	(5.86)	(6.40)	(6.31)
Above primary	0.51	0.65	0.47	0.45	0.68	0.29
	(0.50)	(0.48)	(0.50)	(0.50)	(0.47)	(0.45)
Currently married[c]	0.79	0.41	0.91	0.93	0.74	0.87
	(0.40)	(0.49)	(0.28)	(0.26)	(0.44)	(0.34)
Urban	0.62	0.72	0.59	0.55	0.76	0.43
	(0.49)	(0.45)	(0.50)	(0.50)	(0.43)	(0.50)
Observations	55,522	12,446	43,076	31,867	31,051	24,471

Note: Sample weights are used. Standard deviations are in parenthesis.
a. Office work includes professional, technical, managerial and clerical positions. Agricultural work includes both self-employed and contractual agricultural work. The omitted occupation group is manual labor.
b. Missing for 2,604 respondents.
c. Egypt, Jordan, and Nepal restrict the sample to currently married women.

Table 3: Documenting the family penalty

Dependent variable: Log daily earnings	All (1)	Middle-income countries (2)		Low-income countries (3)
Panel A: Model 1				
Number of children	-0.100***	-0.147***		-0.044***
	[0.017]	[0.028]		[0.007]
Observations	55,552	31,051		24,471
R-squared	0.405	0.176		0.387
P-value			0.000	
Panel B: Model 2				
Number of children	-0.028***	-0.045***		-0.012**
	[0.006]	[0.011]		[0.005]
Observations	55,552	31,051		24,471
R-squared	0.522	0.382		0.451
P-value			0.006	

Note: Robust standard errors (in brackets) are clustered at the sub-national level.
* denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent. All regressions include women's age and survey fixed effects, indicators for pay period, Model 2 adds to Model 1 indicators for education, marital status, and the size of current location. P-value refers to the null hypothesis for the equality of coefficients between middle and low-income countries (columns 2 vs. 3). All models include sample weights.

Table 4. Number of children and daily earnings of women

Dependent variable:	OLS	2SLS
Log daily earnings	(1)	(2)
Panel A. Middle-income countries		
Number of children	-0.045***	-0.073**
	[0.011]	[0.032]
Observations[a]	30,916	30,916
R-squared	0.380	0.379
First stage		-1.108***
		[0.052]
F-statistic (1st stage)		452.9
Hausman (p-value)		0.347
Panel B. Low-income countries		
Number of children	-0.012**	-0.041
	[0.005]	[0.027]
Observations[a]	24,435	24,435
R-squared	0.451	0.450
First stage		-1.211***
		[0.085]
F-statistic (1st stage)		205.0
Hausman (p-value)		0.287

Note: Robust standard errors (in brackets) are clustered at the sub-national level. * denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent. The 2SLS instrument for the number of children uses the union of the infertility measures. All models include the control variables listed in Table 3. The F-statistic refers to the first stage results. The Hausman p-value refers to the test where the null hypothesis equals the efficient and the consistent estimators. a. We can only identify infertility for non-sterilized women. Thus, sterilized women are excluded from the sample. All models include sample weights.

Table 5. Family penalty by age of child and stage of development

Age of child	Middle-income (1)	Low-income (2)
Under 3	-0.069***	-0.082***
	[0.018]	[0.011]
3 to 5	-0.070***	-0.020*
	[0.019]	[0.010]
6 to 10	-0.042***	-0.009
	[0.011]	[0.010]
11 to 13	-0.027*	0.021
	[0.014]	[0.013]
14 to 18	-0.023*	0.038***
	[0.013]	[0.015]
Observations	31,051	24,471
R-squared	0.38	0.45

Note: Robust standard errors (in brackets) are clustered at the sub-national level. Significance at 10 percent denoted by *, ** significant at 5 percent and *** significant at 1 percent. All regressions include women's age, survey fixed effects, and indictors for education, marital status, the size of current location, and pay period. All models include sample weights.

Table 6. Family penalty by age and gender of the child and stage of development

	By gender	
	Sons	Daughters
Age of the child	(1)	(2)
Panel A: Middle-income countries		
Under 3	-0.073***	-0.064***
	[0.022]	[0.020]
3 to 5	-0.073***	-0.067**
	[0.018]	[0.025]
6 to 10	-0.030***	-0.054***
	[0.011]	[0.016]
11 to 13	-0.040*	-0.013
	[0.021]	[0.018]
14 to 18	-0.042***	-0.004
	[0.016]	[0.022]
P-value: $Boys_{0-10}=Girls_{0-10}$	0.185	
P-value: $Boys_{11-18}=Girls_{11-18}$	0.169	
Observations	31,051	
R-squared	0.38	
Panel B: Low-income countries		
Under 3	-0.092***	-0.073***
	[0.013]	[0.014]
3 to 5	-0.034***	-0.007
	[0.013]	[0.014]
6 to 10	-0.006	-0.012
	[0.013]	[0.012]
11 to 13	-0.004	0.046***
	[0.017]	[0.016]
14 to 18	0.031	0.047**
	[0.022]	[0.019]
H_0: $Boys_{0-10}=Girls_{0-10}$	0.352	
H_0: $Boys_{11-18}=Girls_{11-18}$	0.066	
Observations	24,471	
R-squared	0.45	

Note: The model controls for sons and daughters simultaneously. Robust standard errors (in brackets) are clustered at the sub-national level. Significance at 10 percent denoted by *, ** significant at 5 percent and *** significant at 1 percent. The p-value corresponds to an F-test for the equality of parameters across gender by age group. All regressions include women's age, survey fixed effects, and indictors for education, marital status, the size of current location, pay period. All models include sample weights.

Table 7: Employment type, occupational segregation and the family penalty

	(1)	(2)	(3)	(4)	(5)
Panel A. Middle income countries (N=31,051)					
Under 3	-0.069***	-0.067***	-0.061***	-0.059***	-0.050***
	[0.018]	[0.016]	[0.014]	[0.017]	[0.012]
3 to 5	-0.070***	-0.068***	-0.060***	-0.064***	-0.054***
	[0.019]	[0.018]	[0.016]	[0.018]	[0.015]
6 to 10	-0.042***	-0.044***	-0.032***	-0.038***	-0.030***
	[0.011]	[0.010]	[0.010]	[0.011]	[0.009]
11 to 13	-0.027**	-0.030**	-0.018	-0.023	-0.019
	[0.014]	[0.013]	[0.013]	[0.014]	[0.013]
14 to 18	-0.023*	-0.019	-0.008	-0.022*	-0.007
	[0.013]	[0.014]	[0.010]	[0.013]	[0.011]
Self Employed[a]		-0.193**			-0.098
		[0.090]			[.065]
Works from home[a]		-0.301***			-0.279***
		[0.024]			[0.024]
Occupation[b]			X		X
Seasonal[c]				X	X
Currently working				-0.060**	0.003
				[0.030]	[0.020]
R-squared	0.383	0.404	0.460	0.400	0.481
Panel B. Low income countries (N=24,471)					
Under 3	-0.082***	-0.078***	-0.082***	-0.079***	-0.074***
	[0.011]	[0.011]	[0.010]	[0.011]	[0.011]
3 to 5	-0.020**	-0.022**	-0.021**	-0.022**	-0.022**
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]
6 to 10	-0.009	-0.009	-0.011	-0.009	-0.010
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]
11 to 13	0.021	0.020	0.019	0.023*	0.022*
	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]
14 to 18	0.038**	0.039**	0.037**	0.037**	0.035**
	[0.015]	[0.015]	[0.015]	[0.014]	[0.015]
Self Employed[a]		0.003			0.011
		[0.046]			[0.044]
Works from home[a]		-0.243***			-0.254***
		[-0.037]			[0.035]
Occupation[b]			X		X
Seasonal[c]				X	X
Currently working				0.067*	0.084*
				[0.034]	[0.035]
R-squared	0.453	0.459	0.477	0.456	0.487

Note: Robust standard errors (in brackets) are clustered at the sub-national level. * denotes significance at 10%; ** at 5% and *** significance at 1%. All regressions include women's age and survey fixed effects, indicators for pay period, education, marital status, and the size of current location. All models include sample weights.
a. 2,604 respondents did not report and are coded as missing.
b. Occupation denotes 275 detailed occupational categories. Note that 146 respondents did not list an occupation and are coded as missing.
c. Seasonal refers to indicators if employment is all year, seasonal or occasional.

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Appendix A. Additional figures and tables

Table A.1 Sample summary statistics by survey/country

Country (Abbreviation)	Survey year	Number of children	Above primary (share)	Daily Earning (US$)	Sample size
Middle-income countries					
Bolivia (BO)	1994	2.18	0.56	5.25	2,434
Bolivia (BO)	1998	2.01	0.64	7.10	3,093
Colombia (CO)	1995	1.55	0.65	9.54	3,834
Dom. Republic (DR)	1996	1.55	0.54	9.56	2,246
Egypt (EG)	1996	2.40	0.74	1.89	1,822
Guatemala (GU)	1999	2.24	0.33	5.48	1,094
Jordan (JO)	1997	3.06	0.93	12.16	557
Peru (PE)	1996	1.72	0.74	9.46	8,740
Philippines (PH)	1998	1.70	0.77	5.81	4,549
South Africa (ZA)	1998	1.34	0.73	15.13	2,682
Low-income countries					
Benin (BJ)	1996	2.34	0.08	5.38	3,108
Cen. Afr. Rep. (CF)	1995	2.04	0.11	2.74	2,804
Chad (TD)	1997	2.63	0.05	1.47	1,763
Comoros (KM)	1996	2.29	0.21	4.23	542
Ghana (GH)	1999	1.89	0.52	2.05	2,364
Madagascar (MD)	1997	2.12	0.34	1.45	2,360
Mali (ML)	1996	2.57	0.09	1.73	2,589
Mozambique (MZ)	1997	1.96	0.27	2.63	649
Nepal (NP)	1997	2.53	0.16	1.12	607
Nicaragua (NC)	1998	2.07	0.56	4.78	3,170
Nigeria (NG)	1999	2.31	0.43	2.14	2,323
Zambia (ZM)	1997	2.22	0.36	4.97	2,192

Notes: Author's calculations based on DHS data. See text for details. Sample weights are used.

Table A.2: The family penalty, excluding countries with low female participation in paid work

Dependent variable: Log daily earnings	Middle-income countries (1)		Low-income countries (2)
Panel A: Model 1			
Number of children	-0.158***		-0.046***
	[0.029]		[0.007]
Observations	28,672		23,215
R-squared	0.128		0.391
P-value		0.000	
Panel B: Model 2			
Number of children	-0.052***		-0.014**
	[0.011]		[0.005]
Observations	28,672		23,215
R-squared	0.350		0.454
P-value		0.002	

Note: Robust standard errors (in brackets) are clustered at the sub-national level. Sample excluded the following countries with low levels of female participation in the paid work (less than 15%): Mozambique, Nepal, Egypt and Jordan. All regressions include women's age and survey fixed effects, indicators for pay period, Model 2 adds to Model 1 indicators for education, marital status, and the size of current location. P-value refers to the null hypothesis for the equality of coefficients between middle and low-income countries (columns 1 vs. 2). All models include sample weights. * denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent.

Table A.3: Descriptive statistics by stage of economic development

	Mid-income countries		Low-income countries	
Variable	Non-mothers	Mothers	Non-mothers	Mothers
	(1)	(2)	(3)	(4)
Number of children	-	2.46	-	2.75
		(1.41)		(1.55)
Number of kids under 6	-	0.95	-	0.70
		(0.85)		(0.84)
Working at time of survey	0.87	0.87	0.95	0.95
	(0.34)	(0.33)	(0.23)	(0.21)
Office Work[a]	0.36	0.26	0.14	0.09
	(0.48)	(0.44)	(0.34)	(0.28)
Services[a]	0.17	0.13	0.06	0.03
	(0.38)	(0.34)	(0.23)	(0.18)
Sales[a]	0.20	0.30	0.36	0.41
	(0.40)	(0.46)	(0.48)	(0.49)
Agricultural[a]	0.02	0.08	0.22	0.28
	(0.16)	(0.27)	(0.41)	(0.45)
Works at home[b]	0.21	0.26	0.24	0.26
	(0.41)	(0.44)	(0.43)	(0.44)
Self employed[b]	0.35	0.42	0.66	0.74
	(0.48)	(0.49)	(0.47)	(0.44)
Worked year-round	0.80	0.76	0.72	0.67
	(0.40)	(0.43)	(0.45)	0.47
Daily earnings	9.56	7.85	3.35	3.07
	(9.80)	(8.83)	(5.03)	(4.62)
Age	27.89	31.97	28.14	30.35
	(6.43)	(6.03)	(6.72)	(6.40)
Above primary	0.79	0.64	0.38	0.27
	(0.41)	(0.48)	(0.49)	(0.44)
Currently married[c]	0.30	0.90	0.61	0.93
	(0.46)	(0.30)	(0.49)	(0.26)
Urban	0.83	0.74	0.51	0.42
	(0.38)	(0.44)	(0.50)	(0.49)
Observations	4,718	19,753	7,728	23,323

Note: Sample weights are used. Standard deviations are in parenthesis.
a. Office work includes professional, technical, managerial and clerical positions. Agricultural work includes both self-employed and contractual agricultural work. The omitted occupation group is manual labor.
b. Missing for 2,604 respondents.
c. Egypt, Jordan, and Nepal restrict the sample to currently married women.

Table A.4. Employment type, occupational segregation and the family penalty

	(1)	(2)	(3)	(4)	(5)
Panel A. Middle income countries (N=31,051)					
Number of children	-0.045***	-0.045***	-0.035***	-0.040***	-0.031***
	[0.010]	[0.010]	[0.008]	[0.010]	[0.008]
Self Employed[a]		-0.193**			-0.098
		[0.092]			[0.066]
Work from home[a]		-0.301***			-0.281***
		[0.024]			[0.024]
Occupation[b]			X		X
Seasonal[c]				X	X
Currently Working				-0.059**	0.004
				[0.029]	[0.020]
R-squared	0.387	0.404	0.461	0.396	0.481
Panel B. Low income countries (N=24,471)					
Number of children	-0.012**	-0.012**	-0.014**	-0.012**	-0.012**
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Self Employed[a]		0.002			0.011
		[0.046]			[0.044]
Work from home[a]		-0.245***			-0.256***
		[-0.037]			[0.035]
Occupation[b]			X		X
Seasonal[c]				X	X
Currently Working				0.069**	0.087**
				[0.034]	[0.035]
R-squared	0.451	0.458	0.476	0.454	0.486

Note: Robust standard errors (in brackets) are clustered at the sub-national level. * denotes significance at 10%; ** at 5% and *** significance at 1%.

All regressions include women's age and survey fixed effects, indicators for pay period, education, marital status, and the size of current location.

a. 2,604 respondents did not report and are coded as missing.

b. Occupation denotes 275 detailed occupational categories. Note that 146 respondents did not list an occupation and are coded as missing.

c. Seasonal refers to indicators if the respondent has worked all year, seasonally or occasionally.

Appendix B. Data issues: sample and earnings measurement

This appendix covers a few additional issues regarding the sample restrictions and the measurement of earnings using the Demographic and Health Surveys (DHS) discussed in the main text.

Observations dropped and additional assumptions for computing daily earnings
For our main analysis, we restrict the sample to observations that provide sufficient information about earnings and the intensity of work. Specifically, we exclude 173 observations with missing earnings information, 322 women who reported cash earnings and a pay period above daily but provided no information about the intensity of work, and 28 women with a pay period above weekly and no information about the number of days or months worked per year. To compute daily earnings, we assumed workers who reported hourly pay worked 8 hours a day and that those who reported monthly pay worked 4.2 (=30/7) weeks a month. When not reported, we assumed workers that reported weekly pay worked 5.6 days a week (the sample average) and those that reported annual pay worked 250 days a year (the sample median). Daily earnings are expressed in constant 2006 US dollars using the nominal exchange rates available from the International Financial Statistics of the International Monetary Fund, and then brought to 2006 prices using the US Consumer Price Index (from the Financial Statistics of the Federal Reserve Board).[22] To minimize measurement error, for each survey, we drop outliers whose real daily earnings belong to the lowest or highest percentile of the distribution. Finally, we omit Zimbabwe from our sample because of implausibly high real daily earnings.

In-kind compensation
One feature of the labor market in developing countries is the relatively larger share of workers receiving in-kind compensation for their labor. In our set of countries, 24% of the working women were paid in-kind and are excluded from our analysis. This aspect of the labor market varies by the stage of development. Only 12% of working women in middle-income countries are paid in-kind, whereas the corresponding figure for low-income countries is 35%, as such, we explore whether selection into paid work could be driving our findings.

The DHS data provide no satisfactory way to impute the monetary compensation for workers who are paid in-kind. To investigate if excluding in-kind compensation could be biasing our estimates of the motherhood penalty, we estimated models to determine if women with children are overrepresented among workers who are paid in-kind. Panel A of Table B.2, which includes our standard set of controls, suggests that mothers are slightly overrepresented among paid in-kind workers. Each additional child is associated with an increase in the likelihood of in-kind work between 0.05 (low-income) and 1% (middle-income). If in-kind work is less remunerative then our estimates of the motherhood wage penalty are lower bounds. Panel B adds to the set of control variables information on type of work, detailed occupation categories and labor force attachment as discussed in the Section 3.D of the main text. Once these variables are included in the model there is no residual relationship between family size and in-kind payments. This suggests that the difference in the motherhood wage penalty by stage of development is not an

[22] The cross-sectional nature of our survey implies that including survey fixed effect variables in the regressions would control for PPP transformation since all earnings from the same country will be scaled up or down with PPP.

artifact of selection into in-kind compensation and rather, it could be explained by job sorting as we discuss in the main text.

Table B.1: Motherhood and in-kind compensation (OLS)

Dependent variable: Paid In-kind	Middle-income countries (1)	Low-income countries (2)
Panel A: Model 1		
Number of children	0.009***	0.005**
	[0.002]	[0.002]
Observations	36,426	36,884
R-squared	0.237	0.471
Panel B: Model 2		
Number of children	0.001	0.002
	[0.001]	[0.002]
Observations	36,426	36,884
R-squared	0.442	0.600

Note: Robust standard errors (in brackets) are clustered at the sub-national level.
The sample includes all women who worked in the past 12 months regardless of if they were paid in cash or in kind
* denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent. All regressions include women's age and survey fixed effects, indicators for education, marital status, pay period and the size of current location Model 2 adds to Model 1 indicators for currently working, self-employed and worked from home, detailed occupation categories and indicators for if the respondent has worked all year, seasonally or occasionally.
All models include sample weights.

Timing of reported wages

Nine percent of the women in our estimation sample were not working at the time of the surveys but reported having worked sometime in the twelve months prior to the interview date. For these women the daily wage information reflects the earnings in the previous year. As such, there is the potential for measurement error in our variable of interest, the number of children currently living at home, as this information is measured at the time of the survey. As a robustness check, we estimated all models from Table 3 in the main text, where we only assign positive earnings to women "currently working," at the time of the survey. These estimates (see Table B.2, below) mirror the findings of our main analysis. For instance, we find that each additional child in a low-income country is associated with a reduction in earnings by 1.2%, which is identical to our estimate in the main analysis. For middle-income countries, we find that each additional child reduces earnings by 4.3% whereas the main analysis suggests that each child reduces earnings by 4.5%. In section 3.D of the main text, we also try an alternative specification that includes a

control for currently working in Equation 2 to see if differences in the timing of work explains any of the family gap and it does not.

Table B.2: The family penalty, for women currently working (OLS)

Dependent variable: Log daily earnings	Middle-income countries (1)	Low-income countries (2)
Panel A: Model 1		
Number of children	-0.144***	-0.043***
	[0.028]	[0.007]
Observations	27108	23379
R-squared	0.187	0.387
Panel B: Model 2		
Number of children	-0.043***	-0.012**
	[0.010]	[0.005]
Observations	27108	23379
R-squared	0.394	0.451

Note: Robust standard errors (in brackets) are clustered at the sub-national level. Sample is restricted only to women currently working. All regressions include women's age and survey fixed effects, indicators for pay period, Model 2 adds to Model 1 indicators for education, marital status, and the size of current location. All models include sample weights. * denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent.

Work intensity

A possible concern with our daily earnings is that wages could differ due to changes in the number of hours worked per day. Information on hours worked per day is not available in the survey but 95% of working women provide data on the number of days worked per year. In Table B.3 below, we investigate if there is a relationship between family size and the number of days worked per year in a model that includes our usual controls. In both sets of countries, there is a small (relative to the mean) but statistically significant relationship between motherhood and this related measure of work intensity. Importantly, the magnitude is larger in middle-income countries. Thus, if we were to use an outcome variable that included work intensity, we would continue to find that the family penalty is larger in middle-income countries.

Table B.3 Motherhood and work intensity (OLS)

Dependent variable: Days worked per year	Middle-income countries	Low-income countries
	(1)	(2)
Number of children	-4.090***	-1.704***
	[0.720]	[0.486]
N	28408	24365
R^2	0.069	0.134
Y-mean	238.5	228.4

Note: Robust standard errors (in brackets) are clustered at the sub-national level. All regressions include women's age and survey fixed effects, indicators for pay period, a s well as indicators for education, marital status, and the size of current location. All regressions include sample weights. * denotes significance at 10 percent; ** at 5 percent and *** significance at 1 percent.

Appendix C. The infertility instrument

Table C.1. Correlates of Infertility (Sample: Working women low-income)
Panel A: Middle-income countries

Women's Characteristics	Infertile θ_1 q1	Fertile θ_2 q2	Test q1-q2=0	N	Countries excluded due to lack of data
Age at first intercourse[a]	16.301	16.567	-0.266*	24,277	EG, JO
	(0.239)	(0.126)	[-1.83]		
Month of birth	6.565	6.563	0.001	30,916	
	(0.183)	(0.183)	[0.01]		
Birth order	2.654	2.712	-0.057	18,587	BO, CO, DR, EG, GH,
	(0.154)	(0.153)	[0.15]		GU, KM, NC
Number of siblings	5.624	5.381	0.243	18,934	BO, CO, DR, EG, GH,
	(0.201)	(0.220)	[1.25]		GU, KM, NC
Rural childhood	0.228	0.220	0.008	30,916	
	(0.052)	(0.046)	[0.43]		
Son preference[b]	0.134	0.139	-0.004	27,328	KM, ZA
	(0.022)	(0.012)	[-0.29]		
Total number of children desired[c]	2.430	2.430	0.046	30,056	
	(0.084)	(0.083)	[0.78]		
Current location is urban	0.769	0.758	0.011	30,916	
	(0.046)	(.047)	[0.69]		
Currently married	0.466	0.383	0.082	28,657	EG, JO, NP
	(0.048)	(0.042)	[4.42]***		
Above primary education	0.630	0.665	-0.035	30,916	
	(0.055)	(0.040)	[-1.58]		
Age at first marriage[d]	17.017	17.053	-.036	24,367	
	(0.284)	(0.112)	[-0.17]		
Health visit in last 12 months	0.402	0.430	-0.028	30,806	GH
	(0.042)	(0.033)	[-1.24]		
Ever miscarried	0.105	0.072	0.033	27,810	BJ, BO, KM, MZ, TD
	(0.020)	(0.018)	[1.84]*		

Panel B: Low-income countries

Women's Characteristics	Infertile θ_1 q1	Fertile θ_2 q2	Test q1-q2=0	N	Countries excluded due to lack of data
Age at first intercourse[a]	15.007	15.706	-0.700***	22,912	EG, JO
	(0.168)	(0.085)	[-4.77]		
Month of birth	6.275	6.225	0.050	24,435	
	(0.178)	(0.126)	[0.44]		
Birth order	2.808	2.722	0.086	17,718	BO, CO, DR, EG, GH,
	(0.122)	(0.098)	[0.95]		GU, KM, NC
Number of siblings	5.974	5.926	0.048	18,354	BO, CO, DR, EG, GH,
	(0.223)	(0.133)	[0.31]		GU, KM, NC
Rural childhood	0.484	0.506	-0.022	24,435	
	(0.041)	(0.042)	[-0.97]		
Son preference[b]	0.205	0.205	-0.013	21,771	KM, ZA
	(0.017)	(0.017)	[-0.83]		
Total number of children desired[c]	5.089	5.008	0.080	22,499	
	(0.262)	(0.223)	[0.61]		
Current location is urban	0.393	0.373	0.021	24,435	
	(0.049)	(.040)	[0.74]		
Currently married	0.702	0.732	-0.030	23,847	EG, JO, NP
	(0.028)	(0.026)	[-1.85]*		
Above primary education	0.193	0.209	-0.016	24,435	
	(0.037)	(0.030)	[-0.76]		
Age at first marriage[d]	15.737	16.022	-.285	22,345	
	(0.244)	(0.102)	[-1.07]		
Health visit in last 12 months	0.382	0.456	-0.073	22,054	GH
	(0.033)	(0.024)	[-2.81]**		
Ever miscarried	0.113	0.137	-0.023	16,171	BJ, BO, KM, MZ, TD
	(0.016)	(0.015)	[-0.84]		

Note: Robust standard errors in parenthesis and t-statistics in brackets. Significance at 10 percent denoted by *, ** significant at 5 percent and *** significant at 1 percent. Sample weights included.

The parameters θ_1 and θ_2 are estimated from regressions for each of the women's characteristics against an indicator of infertility (and 1-infertility) after controlling for dummies for age by single years and without an intercept. All estimates are for the subsample that answered questions regarding infertility.

a. Excludes inconsistent and don't know.

b. An indicator that takes a one if the women's stated ideal number of daughters is greater that the ideal number of sons. Non-numeric answers are excluded.

c. Excluded don't know and up to god

d. Married or living together.