If Children Suffer when Mothers Work, Do They Work Less?

Èric Roca Fernández*[1]

[1]IRES/IMMAQ, Université catholique de Louvain

Abstract

This paper studies a new determinant of female employment in the context of developing countries. Using data from sub-Saharan regions, it advances that maternal job-taking varies with the mortality risk premium it poses to children. Reductions in maternal employment are sizeable and reach 5.6 percentage points among affluent families in more developed areas. We do not find such evidence among poor households, suggesting financial constraints may impede trading off maternal income against children safety. The effect we document applies only to families with under-five infants. We introduce a theoretical model rationalising our findings. It also generates a U-shaped relationship between economic prosperity and female employment.

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1 Introduction

This paper is concerned with the determinants of maternal employment in developing countries. We focus on the sub-Saharan region, where women are frequently employed in diverse occupations. We consider all income-generating activities, paid in kind or in cash, even within informal sectors.[1] The paper advances that maternal job-taking varies with the mortality risk it poses to children. Such gradient represents a non-trivial trade-off between maternal income and child endangering. This neglected factor affects mostly well-off families where the need for additional income urges less and can afford a non-working wife. Overall reductions in mothers' job-taking are sizeable and reach 5.6 percentage points among affluent families in more developed areas.

Our paper in anchored by the medical literature we review later. Empirically, we propose an original methodology to estimate a child mortality gradient associated with the working status of mothers. The gradient is, in turn, employed to assess how maternal job-taking changes with it. A simple, theoretical model rationalizes our findings. It relates the child mortality gradient to economic prosperity and generates a U-shaped relationship between development and female labour-force participation.

Female labour-force participation and economic prosperity: The economic literature proposes several theories to explain the massive incorporation of women into the labour force, and empirically tests multiple determinants. Our paper advances that maternal job-taking dwindles as the child mortality gradient between working and non-working mothers widens. Our contribution complements and contrasts previous scholarly work on the topic. In particular, we propose that economic growth has a definitive component in explaining the reduction in maternal employment during the initial stages of development. More precisely, as income raises and as long as maternal employment endangers children, mothers participate less in market activities. Galor and Weil (1996) obtain a similar result, although it operates through increased fertility and female specialisation in child-rearing.

This paper presents a novel mechanism to relate maternal job-taking to development. It is based on child mortality, and we propose it increases with maternal employment. Among the possible causes, one possibility is the incompatibility between childcare and maternal employment, which may oblige families to resort to alternative caregivers. Attanasio et al. (2008), Thévenon

[1] Employment is highly informal in this context, especially in rural areas. We use DHS data, which encompasses urban and rural areas alike. It improves upon official statistics that consider only formal occupations and suffer from limited resources and governmental reach.

(2013), Chevalier and Viitanen (2002) and Posadas and Vidal-Fernández (2013) explore in detail how the cost of childcare and the availability of grandparents as caregivers affects mothers' job-taking. Incidentally, Galor and Weil (1996) also hint at the incompatibility between maternal housework and simultaneous childcare. Nevertheless, we refine the analysis evincing that maternal employment reductions vary with the mortality cost of relying on alternative caregivers. In that sense, we explain that, besides availability, the quality of childcare is a determinant of maternal employment. For instance, young infants left under the care of less experienced custodians —such as siblings— may be at a higher mortality risk. Finally, Albanesi and Olivetti (2016) share us the concern for health as a determinant of female employment, although the authors refer to post-partum health issues.

Related to the previous, the association we advance assumes that families are aware of the effect of maternal work on child mortality. Still, the gradual spread of information and learning about these outcomes can delay women's incorporation into the labour force, as in Fogli and Veldkamp (2011) and Fernández (2013). Our theory represents a nice complement to this literature, indicating that being informed is only a necessary condition. In detail, we highlight that financially-constrained individuals may be forced to follow sub-optimal decisions, despite having the right information readily available.

A recurrent explanation for variations in female labour-force participation considers the effects of fertility. Indirectly, these theories point towards the degree of compatibility between motherhood and maternal work. This paper introduces the notion of incompatibility, which manifests in the child mortality differential between working and non-working mothers. Nevertheless, several authors have explored the precise implications of maternity in terms of female labour force participation, distinguishing between developing and developed countries, see Agüero (2008) and Aaronson et al. (2017); and Bloom et al. (2009), Cristia (2008) and Hupkau and Leturcq (2017), respectively.

Finally, a growing strand of the literature analyses the effects of social norms on multiple outcomes, including feminine participation in the labour force. Fernández et al. (2004), Vendrik (2003), Fernández and Fogli (2009) and Alesina et al. (2013) explore this channel. Even though we do not incorporate cultural prescriptions, the child mortality differential can be loosely interpreted in those terms. In that case, working mothers would derive less utility from children as they deviate from the norm.

The literature above strives, in general, to rationalise the massive incorporation of women to the labour force. However, this ubiquitous rise is part of a broader picture that economic scholars recurrently document, which takes the form of a U-shaped relationship between economic development and female labour-force participation. This association emerges using different data vintages covering an increasing number of countries and under more demanding econometric specifications, see Mammen and Paxson (2000), Luci (2009), Tam (2011) and Olivetti (2013).[2] Our paper presents additional evidence confirming the U-shaped relationship between variables. Nevertheless, we depart from the tradition of using macroeconomic aggregates at the country level and employ individual-level data, while focusing on developing countries in sub-Saharan Africa. In that sense, our estimates of economic development are original and include husband's education, his wage, and night-light luminosity to proxy for regional development.

Complementing the previous, we propose a simple theoretical model to rationalise our findings. It is apt at generating a U-shaped relationship between economic development and maternal employment, improving upon the literature which has traditionally focused only on its rising part.[3]

Feminine employment and child mortality: Woodbury (1926) provides early evidence of the risk maternal employment poses to children. A revision by Thomas (2015) summarises the findings as "[t]he mortality among infants of mothers employed outside the home was highest, of those gainfully employed in the home next highest, and of those not gainfully employed lowest. [...] [The] excess[ive mortality was] 'due probably to lack of the care which only the mothers who remained at home could give.' (p. 146)"

Caldwell and McDonald (1982) routinely found child mortality to be lower for the offspring of non-occupied mothers in ten surveyed countries. The authors ascribe the excess mortality to reduced childcare, dismissing income differentials. Similarly, Hobcraft et al. (1984) correlate maternal employment to child mortality using data from the World Fertility Survey from 28 countries. Similar results hold in 10 out of 14 countries surveyed by the UN during 1984, see Mensch et al. (1985).

Results from single-country analysis evidence the same mortality gradient. It surfaces in Farah and Preston (1982), using the 1973 Sudanese census.[4] Relying on more demanding econometric

[2] Çağatay and Özler (1995) misinterpret a coefficient and erroneously claim a U-shaped relationship as well. Actually, the authors find an opposite figure.

[3] The exception is Galor and Weil (1996), whose main model is devoted to the rising portion but develop two extensions to cover the decreasing part as well.

[4] The authors dismiss decreased maternal care from working mothers and reverse causality as a cause.

techniques and using more up-to-date data, several studies corroborate the result in multiple countries, including Indonesia (Titaley et al. (2008)), Pakistan (Nisar and Dibley (2014b))[5] and Bangladesh (Abir et al. (2015)). The effect goes beyond socio-economic background, delivery practices and community-level factors. In the latter case, the authors ascribe the result to non-traditional roles of Bengali working mothers. In historical terms, Reid (2001) analyses the causes of infant mortality in Derbyshire, England, at the turn of the twentieth century. Neonatal mortality rates were 1.58 times larger for mothers who worked while pregnant.

The Indian case is frequently scrutinised, and the evidence consistently indicates the existence of a mortality gradient. This is case in Kishor and Parasuraman (1998), Maitra and Rammohan (2011) and Singh and Tripathi (2013) that use different instalments of the Indian National Family Health Survey.[6] Related to child mortality, Sivakami (1997) indicates that the offspring of working mothers are more prone to suffer an illness. Moreover, they devote less time to childcare, to play with children and to nourish them. These side-effects of maternal employment may lead to higher child mortality.

In general, the medical literature documents increased child mortality rates for working mothers in developing countries. This mortality gradient goes beyond income differentials and is attributed to reduced childcare and decreased feeding time. Basu and Basu (1991) present a literature review exploring potential causes for the mortality gradient over maternal employment.

The remaining of the paper is organised as follows: Section 2 presents the theoretical model. Section 3 introduces the data, and documents the mortality gradient and the U-shaped pattern between economic prosperity and female labour-force participation. The core of this paper consists in determining how child mortality changes with maternal employment, and the effect of this gradient on maternal employment. Section 4 is devoted to the former while Section 5 establishes the negative relationship between variables. Section 6 concludes.

[5]In a follow-up, Nisar and Dibley (2014a) control for fewer variables and find that working mothers were not different from those occupied when considering unadjusted odd-ratios. Maternal occupation status is never included when odd-ratios are adjusted.

[6]Maitra and Rammohan (2011), analyse nutrition practices and record a small mortality gradient. Singh and Tripathi (2013) focus on under-five mortality in rural India. The gradient surfaces for birth orders one and two.

2 A Theoretical Model

Consider an economy populated by individuals of two genders, men and women, who live for two periods of time. During the first period, agents are young and do not make decisions. When old, all agents get married. We do not attempt to formalize the marriage market, and we simply posit that each household i, consisting of a man and a woman, is characterised by its level of human capital, $h_i \geq 0$. Adult agents are endowed with one unit of time that can be supplied as labour at the wage rate of w per unit of human capital. Men supply theirs inelastically. Women's labour decisions are taken at the family level.[7] Household utility is given by:

$$\mathcal{U}_i = \log\left(c_i - \delta\right) + \gamma \log\left(\psi_i(h_i, l_i)\, n_i\right), \tag{1}$$

$$\text{s.t.} \quad w_i h_i \left(1 + \frac{l_i}{\eta}\right)(1 - \phi n_i) = c_i \tag{2}$$

where $c_i - \delta > 0$ is consumption above subsistence —which generates the push factor Klasen and Pieters (2012) identify—, $\psi_i(h_i, l_i)$ is the conditional probability that children survive, which depends on mother's working hours, $\eta > 1$ captures the gender wage-gap and n_i is the total number of children ever born.[8]

Raising children to adulthood has a time cost of $\phi w h_i\left(1 + l_i/\eta\right)$ per child. It is incurred regardless of children actually reaching adulthood. Despite generating income, a working wife exposes children to a higher mortality, and families optimally trade off these two opposed effects. The probability that a child lives until the second period and becomes an adult depends on human capital and on the working status of her mother. This is captured by the term $\psi_i(h_i, l_i)$. In order to have a tractable model, we assume child survival probability to be a constant, human capital dependent, probability per unit of time. Therefore, if a woman works for $l_i \in [0, 1]$ hours, child survival probability is given by $\psi_i(h_i, l_i) = \left[\Psi\left(h_i\right)\right]^{l_i}$. We impose $\Psi\left(0\right) = \underline{\psi} \in (0, 1)$, $\lim\limits_{h_i \to \infty} \Psi\left(h_i\right) = 1$ and $\Psi'(h_i) > 0$.[9] This guarantees a minimum survival probability for children, given by $\underline{\psi}$, even for families without any human capital.[10] On the contrary, the mortality gradient vanishes among high-human capital families. Consequently, such families need not trade off maternal employment for its risk and women join the labour force, and women in such

[7] Gobbi et al. (2018) find that parental leave allocation within the household in Germany is Pareto-efficient although data supports a collective model instead of a unitarian one.

[8] The model abstracts from education expenditures for children. In this pre-human capital economy, children quality is captured by their survival rate.

[9] The model can also accommodate a more complex specification for child survival probability. In particular, results hold for a U-shaped relationship.

[10] Lagerlöf (2003) also models child mortality as decreasing with human capital.

families can work without endangering children.[11] Proposition 1 presents the optimal solution.

Proposition 1. *The solution to the family's maximisation problem consists of three optimal decision rules. In particular,*

$$l^\star = -\frac{\sqrt{\phi^2\left(h^2w^2 + \gamma\delta\eta\log(\Psi)(\gamma\delta\eta\log(\Psi) - 2(2\gamma+1)hw)\right)} + \gamma\eta\phi\log(\Psi)(2hw-\delta) + hw\phi}{2\gamma hw\phi\log(\Psi)}$$

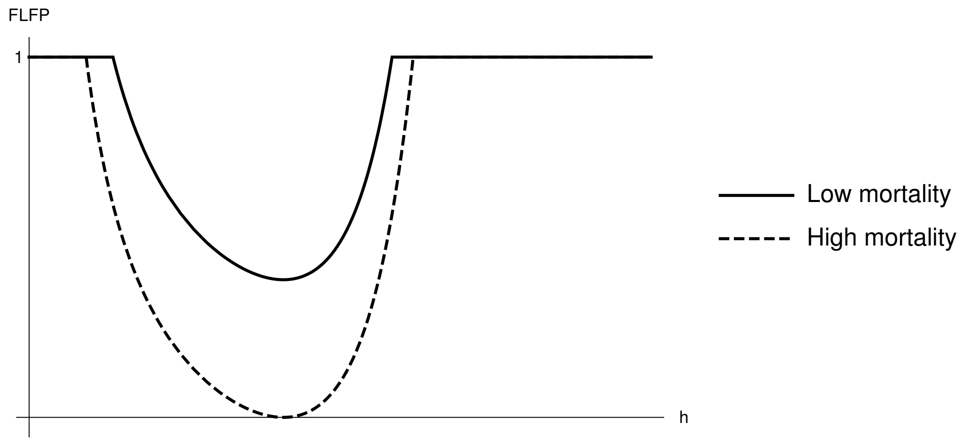
and

$$n^\star = -\frac{\gamma\delta\eta\phi\log(\Psi) + \sqrt{\phi^2\left(h^2w^2 + \gamma\delta\eta\log(\Psi)(\gamma\delta\eta\log(\Psi) - 2(2\gamma+1)hw)\right)} + (2\gamma+1)(-h)w\phi}{2(\gamma+1)hw\phi^2}$$

in the interior solution. The interior solution is reached at intermediate levels of $\Psi(h)$ such that $\exp\left(-\frac{\gamma\delta+hw}{\gamma\eta hw-\gamma\delta\eta}\right) < \Psi(h) < \exp\left(-\frac{\gamma\delta\eta+(\eta+1)hw}{\gamma(\eta+1)((\eta+1)hw-\delta\eta)}\right)$. Two sets of corner solutions determined by $l^\star = 0, n^\star = \frac{\gamma hw-\gamma\delta}{(\gamma+1)hw\phi}$; and $l^\star = 1, n^\star = \frac{\gamma((\eta+1)hw-\delta\eta)}{(\gamma+1)(\eta+1)hw\phi}$ arise when $\Psi(h)$ is larger (smaller) than the previous bounds, respectively.

Figure 1 illustrates the behaviour of $l^\star$ as a function of human capital. The dashed line represents the optimal female labour-force participation under higher child mortality differentials than the solid line.[12] The model delivers two relevant outcomes. First, a clear positive relationship

Figure 1: Optimal choices



Note: This Figure depicts the optimal $l^\star$, on the vertical axis, as a function of human capital, represented on the horizontal axis. In particular, the Figure shows the model can reproduce a U-shaped relationship between economic development and the female labour-force participation. The dashed line corresponds to a higher child mortality differential —lower value for $\underline{\psi}$— than the solid line.

between $\underline{\psi}$ and female labour-force participation emerges. This is, as the negative effect of

[11] A similar result could be obtained if households purchased external childcare services.

[12] Mortality differentials measure the change in mortality between working and non-working mothers: $\left[1-\Psi\left(h_i\right)^{l_1}\right] - \left[1-\Psi\left(h_i\right)^{l_2}\right]$, $l_1 > l_2$.

maternal employment vanishes —captured by an increase in $\underline{\psi}$—, mothers devote more time to market activities. From an economic perspective, an increase in $\underline{\psi}$ is equivalent to a decrease in the utility-cost of maternal work. Hence, families optimally allocate more female's time to this less costly activity. Notice, though, that low- and high-income families follow different regimes characterised by corner solutions, and, consequently, the description above does not apply. This result is a corollary of Proposition 1, and we formally establish it below and devote the rest of the paper to test it.

Corollary 1. *The derivative of $l^\star$ with respect to $\underline{\psi}$, the minimum child survival probability, is either null or increasing.*

Proof. For corner solutions, $l^\star = 0$ and $l^\star = 1$, female labour-force participation is already constrained and it does not react to changes in $\underline{\psi}$. In the intermediate case, following from $\frac{\partial \Psi(h)}{\partial \underline{\psi}} > 0$, the derivative is given by:

$$\frac{-\gamma(2\gamma+1)\delta\eta\log(\Psi) + \sqrt{(h^2w^2 + \gamma\delta\eta\log(\Psi)(\gamma\delta\eta\log(\Psi) - 2(2\gamma+1)hw))} + hw}{2\gamma\Psi\log^2(\Psi)\sqrt{(h^2w^2 + \gamma\delta\eta\log(\Psi)(\gamma\delta\eta\log(\Psi) - 2(2\gamma+1)hw))}} \frac{\partial\Psi(h)}{\partial\underline{\psi}} > 0.$$

□

Second, the model can generate a U-shaped relationship between human capital and female labour-force participation. The initial decreasing part intertwines two related explanations. First, the existence of a minimum consumption δ requires women to work at low levels of human capital. Second, at these stages, maternal work is still detrimental to children. Consequently, women work the minimum number of hours needed to assure subsistence. Finally, as human capital rises and labour-income increases, the working-hours threshold wanes. The increasing portion of the U-shaped pattern is easier to explain. As human capital increases, so does $\Psi(h)$. In particular, this means that maternal work endangers children less, enabling mothers to participate in the labour force. Moreover, a reinforcing income effect brought about by h further hastens female market activities.

3 Data and stylised facts

The basic data set pools together surveys from the Demographic and Health Survey project (DHS) covering various countries. These focus on developing countries and provide individual-level data for a rich host of variables for both spouses. We consider the most recent instalment for sub-Saharan countries that is accompanied by respondents' geographical location. The main outcome of interest is whether a woman works.Since, often, individuals in developing regions are informally occupied, the DHS encompasses under the term *work* any income generating activity, paid in kind or cash, as self-employed, as an employee or even as a helper.[13]

Working individuals have "done any work in the last seven days", have a "job or business from which [they] were absent for leave, illness, vacation, or any other such reason" or have "done any work in the last 12 months".[14] Employment status is encoded as a four-level indicator stating whether an individual a) did not work, b) worked during the year before the interview, c) is currently working or d) is employed but has been on leave for the last seven days. As we are interested in the current occupation status, we transform it into a binary indicator taking value zero in the first two cases and value one otherwise. Formally, we define $works_{i,r}$ as follows:

$$works_{i,r} = \begin{cases} 1\, if\ i \,\text{is currently working or on leave,} \\ 0\, \text{otherwise.} \end{cases} \tag{3}$$

The DHS contains demographic characteristics: spouses' age and education, the number of household members, ethnic and religious affiliation; socio-economic data: regional location, dwelling's urban/rural status, self-reported wealth and occupation of both spouses;[15] child information: birth date for each child and age at death for the relevant cases; and health and sanitary conditions: water source and toilet type. We group children in several age bins to control for childcare supply and demand at the household level.[16] Religious denominations are classified in major denominations: Christianity, Islam, traditional religion, voodoo, animism, other religion, and no religion.

According to the theoretical model, wages determine female employment. In particular, women must work to reach subsistence if the husband's wage is low. Regrettably, the DHS does not report income.[17] For this reason, the husband's occupation proxies for his wage.[18] Finally,

[13] Although we referred to female labour-force participation, the DHS does not account for it in the narrow and precise sense used by statistical entities.

[14] ICF International (2011, q.601-603, p. M-17).

[15] Our analysis covers only occupations that are consistently identified across surveys: not working; professional, technical and managerial; clerical; sales; agriculture (as self-employed or employee); household and domestic; services; skilled and unskilled manual occupations.

[16] Categories cover children aged zero to five, five to ten, and ten to 15.

[17] The unique variable related to income, wealth, is self-assessed and includes wife's earnings.

[18] Occupations have been used in the literature to proxy for income. Jones and Tertilt (2006) derive a lifetime income measure based on census occupations. Skirbekk (2008) analyzes the historical relationship between occupations and fertility. Finally, occupations are also used to proxy for income by Westoff (1954). Closer to our objective, Howe et al. (2012) review measures of socio-economic position for low- and middle-income countries.

we restrict the analysis to households where either the husband or the wife is the household head.[19] The full sample comprises 70716 women aged 15 to 49. Although some women in these age categories may have completed their fertility, by focusing on relatively young workers we can ascertain the effect of the mortality gradient on *mothers*. In that sense, a sample comprising older cohorts would not allow testing the mechanism the theoretical model proposes.

The basic data set is augmented using additional information sources. First, soil suitability for agriculture is included since a non-negligible fraction of the population works in agriculture. The abundance of fertile soil can induce individuals to specialise in subsistence agriculture, especially those low-skilled. Low wages associated with agriculture may require women to work.[20] We control for land suitability using a rich host of controls: a) potential caloric yield before and after the Columbian exchange, following Galor and Özak (2016), b) soil pH and carbon levels, from the Atlas of the Biosphere[21], and c) soil suitability and workability for agriculture, from the Atlas of the Biosphere, Ramankutty et al. (2002) and Fischer et al. (2008), respectively. Potential caloric yields before the Columbian exchange control for potential, persistent gender-based roles originating in agrarian societies. Second, we introduce geographical characteristics, including absolute latitude, distance to rivers, coast and large cities, temperature and precipitation. Third, following Henderson et al. (2012), night-light luminosity measured from satellite images proxy for regional development.[22] Raw average luminosity in a 10 km-radius area around reported locations is normalized by population using estimates from Africa Continental Population Datasets (2000 - 2020). Finally, we derive measures of malaria prevalence and mosquito-net usage from Bhatt et al. (2015) since malaria can directly impede working, force mothers to care for children and raises child mortality. These are averaged values in a 10 km-radius area around DHS reported coordinates over the years 2000-2015.[23] Table 1 presents the summary statistics.

The authors emphasize some variables available in the DHS as good proxies, in particular, asset ownership, education and occupations. Asset ownership is determined by total income, including that generated by women. For this reason, we do not use it in this paper. Otherwise, all regressions control for spouses' education.

[19] This removes from the sample more complex families wherein the interviewed woman is a relative or in-law of the household head. Further, non-permanent residents are excluded.

[20] Carranza (2014) explores the Indian case and finds that sub-par soils are related with increased female participation rates as men alone are not capable of tending the land.

[21] These data are originally derived from Global Soil Data Task (2014)

[22] Data on night-light luminosity from National Oceanic and Atmospheric Administration-National Geophysical Data Center (2013). Such measure is well-suited to proxy economic activity in developing countries that lack enough governmental reach, especially at the regional level, see Michalopoulos and Papaioannou (2017).

[23] This approach does not consider random respondent's displacements introduced in the DHS for confidentiality.

Table 1: Summary statistics

	Mean	St. Dev.	Min.	Max.
Socio-economic characteristics				
Works (0/1)	0.66	0.00	0	1
Age	29.94	0.05	15	49
Educ. years	3.98	0.04	0	22
Hus. age	36.89	0.06	15	64
Hus. educ. years	5.30	0.04	0	22
Urban/Rural (0/1)	0.69	0.00	0	1
Child. aged 0-5	1.32	0.00	0	5
Child. aged 5-10	0.96	0.01	0	6
Child. aged 10-15	0.56	0.01	0	5
Births	0.28	0.00	0	3
Pregnant (0/1)	0.13	0.00	0	1
Husband occupation				
Did not work	0.01	0.11	0	1
Prof./Tech./Man.	0.09	0.28	0	1
Clerical	0.01	0.11	0	1
Sales	0.09	0.29	0	1
Agri. self-employed	0.41	0.49	0	1
Agri. employee	0.12	0.32	0	1
Household, domestic	0.00	0.06	0	1
Services	0.08	0.27	0	1
Skilled manual	0.12	0.33	0	1
Unskilled manual	0.06	0.24	0	1
Religion				
Animism	0.00	0.04	0	1
Christianism	0.65	0.48	0	1
Islam	0.28	0.45	0	1
No religion	0.03	0.18	0	1
Other religion	0.01	0.10	0	1
Traditional	0.02	0.14	0	1
Voodoo	0.01	0.08	0	1
Other variables				
Light intensity	0.03	0.81	0.00	63.44
Dist. river, log-km	2.89	0.93	0.01	5.33
Dist. coast, log-km	5.41	1.73	0.00	7.48
Avg. precipitation	2.95	1.74	0.00	7.89
Dist. large city, log-km	12.29	1.06	9.16	14.70
Soil suitability for agri.	0.38	0.20	0.00	1.00
Soil workability	1.55	0.83	0.08	7.00
Soil pH level	5.81	0.57	4.66	8.06
Soil carbon content	5.41	1.73	0.74	14.40
Caloric yield, pre-1550	1283.85	426.56	0.00	2400.68
Caloric yield, post-1550	10360.53	2244.26	0.00	15843.43
Malaria prevalence	0.31	0.20	0.00	0.84
Mosquito-net usage	0.24	0.10	0.00	0.52
Observations	70716			

Note: The description for each variable is provided in the text. Weighted averages and standard deviations.

3.1 Stylised fact 1: Economic development and female employment

Our data set validates the existence of U-shaped association between development and female employment in line with the economic literature. Departing from it, we evidence the relationship on individual-level data and for a set of developing countries. Moreover, we proxy for development using novel indicators in place of GDP estimates: husband's years of education, husband's occupation-specific wealth[24] and per capita night-light intensity. Using individual data complements previous findings at the country level. It also better reflects participation rates in developing countries where informality is high and the geographical reach of governmental agencies limited. Our last variable departs from individual measures, capturing regional macroeconomic conditions. Figures 2a, 2b and 2c illustrate the relationship between development and female employment. Although the Figures are not perfect, they all suggest a U-shaped pattern, more so for the first two indicators. In particular, participation rates decrease in Figure 2a from about 70% to 55% between zero and eleven years of education to rise later back to 70%. Figure 2b is tighter, concentrating the bulk of the decrease among the lowest values of wealth. The fact that over half of the male population is employed in agriculture with low wages produces this result. Finally, Figure 2c presents a similar drop in participation rates although it displays a much slower recovery.

3.2 Stylised fact 2: The effects of maternal employment on child mortality

This Section documents a mortality gradient over maternal employment using our data set. We estimate it regressing two child mortality variables on maternal working status. In particular, these are a) the number of under-five deceases, and b) an indicator for the death of the last-born, under-five child; both measured during the previous 12 months.[25] Regressions control for demographic and socioeconomic characteristics of the family, sanitation, malaria prevalence and regional economic development and include regional fixed-effects. Formally, regressions follow:

$$y_{i,r} = \alpha \, works_{i,r} + X_{i,r}\beta + \gamma_r + \epsilon_{i,r}, \tag{4}$$

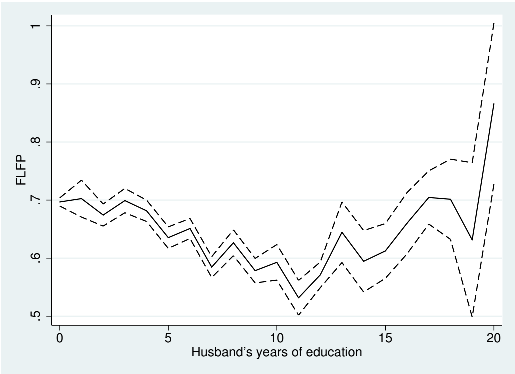
where $y_{i,r}$ is child mortality indicator, $works_{i,r}$ denotes whether a woman works, $X_{i,r}$ is a vector of covariates and γ_r are region fixed-effects. Table 2 presents the results. In the first two

[24]This corresponds to the average wealth reported for each occupation, considering only couples wherein the wife does not work.

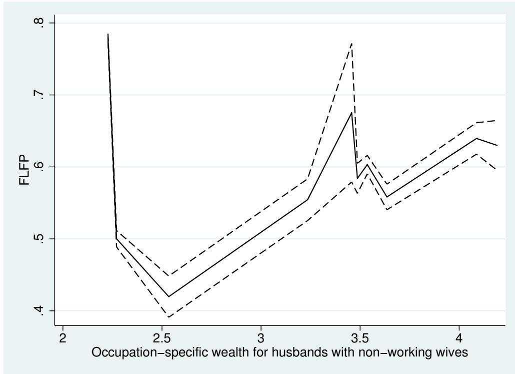
[25]The under-five death rate is 20 per year. Considering only cadets, the figure reduces to 14.

Figure 2: Female labour-force participation and economic development

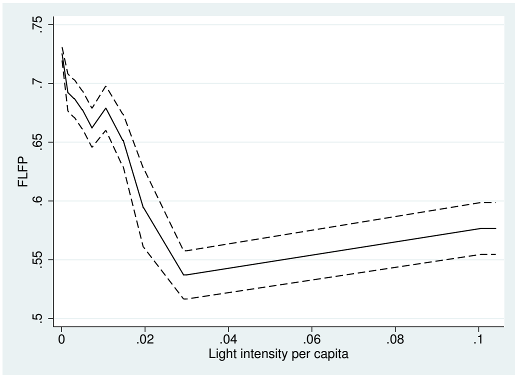
(a) Husband's years of education



(b) Husband's occupation wealth



(c) Per capita night-light intensity



Note: These Figures relate female labour-force participation with economic development where the latter is proxied by husband's years of education in Figure 2a, husband's occupation-specific wealth in Figure 2b and by per capita night-light intensity in Figure 2c. See the text for additional details. Figures display weighted averages of female labour-force participation.

Columns, the dependent variable counts under-five deceased children while Column 3) focuses on the youngest child's death. However, the outcomes of interest are nil for a large percentage of the population. For this reason, we employ non-linear methods that are non-biased when outcomes have many zeros. In particular we use tobit, negative binomial and probit models, respectively. Overall, results evidence a mortality gradient penalising working mothers.[26] In particular, we estimate a rise of half a percentage point in the probability that the youngest child dies when the mother works and she has no education. This represents a quarter of the total probability the last-born dies, which equals 0.02. However, the increase is virtually zero when she has ten years of schooling. Although the probability of the last-born diying and the increase we measure may appear small in magnitude, the effects they represent in the expected utility framework can be large considering the dire outcome these represent. In particular, the death of a child is a large, negative utility impact, and individuals may follow costly strategies to minimise the

[26]Estimating Table 2 under yields similar results.

Table 2: Child mortality and maternal employment

	Dep. var: Children 0-5 died		Dep. var: Youngest child died
	Tobit	Neg. Binomial	Probit
	(1)	(2)	(3)
Works	0.207***	0.223*	0.134**
	(0.006)	(0.120)	(0.067)
Educ. years	0.004**	0.006	0.007
	(0.002)	(0.021)	(0.011)
Works × Educ Years	−0.019***	−0.021	−0.012
	(0.002)	(0.024)	(0.013)
Demographic controls	Yes	Yes	Yes
Husband controls	Yes	Yes	Yes
Sanitary controls	Yes	Yes	Yes
Other controls	Yes	Yes	Yes
Fixed-effects	Region	Region	Region
Observations	43257	43257	40961
Pseudo R^2	0.168	0.205	0.212

Note: The unit of observation is a household. Demographic controls: age its square, children aged zero to five, five to ten, and ten to 15, births during the last 12 months and a pregnancy indicator. Husband controls: age, years of education and occupation. Sanitary controls: the source of water used, toilet type, malaria prevalence and mosquito-net usage. Other controls: per capita night-light intensity, population density and urban-rural status of the dwelling and household members. Standard errors clustered at the regional level in Columns 1) and 2) and at the country level in Column 3). $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

probability of such events. Moreover, prospect theory indicates that individuals value losses more than gains —in absolute terms—, and overweight small probabilities, see Kahneman and Tversky (1979). These considerations, taken together, rationalise the findings

The relationship we document in Table 2 between maternal employment and child mortality does not preclude the possibility of these results arising from reverse causality. This would be the case if mothers resumed working after experiencing the death of a child. That would be the case if childcare prevented mothers from working and, after a kid's death, women devoted that time to work. In that sense, having recently lost a child would be a positive and significant predictor of maternal employment. We test that possibility in Table 3 comparing the working status between those who recently lost a child and those that did not for several time frames, in particular, during the last 30, 60, 180 and 365 days. Coefficients associated with the loss of a child are in general negative and never significant. Our findings do not support reverse causality.

Table 3: Child mortality and maternal employment, reverse causality

	Dep. var: Mother works			
	30 days (1)	60 days (2)	180 days (3)	365 days (4)
Lost child	−0.125	−0.108	−0.030	0.025
	(0.078)	(0.073)	(0.046)	(0.043)
Demographic controls	Yes	Yes	Yes	Yes
Husband controls	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Fixed-effects	Region	Region	Region	Region
Observations	40703	40765	41009	41307
R^2	0.172	0.171	0.172	0.172

Note: The unit of observation is a household. The sample comprises families in which no child under the age of five has died and those in which there has been a death in the prior 30, 60, 180 and 365 days. See text for details. Demographic controls: age and education years and their squares, children aged zero to five, five to ten, and ten to 15, births during the last 12 months and a pregnancy indicator. Husband controls: age, years of education and occupation, and their squares. Religion controls: Religious affiliation. Other controls: per capita night-light intensity, population density and urban-rural status of the dwelling and household members. OLS estimates. Standard errors clustered at the regional level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4 Empirical strategy

This paper proposes child mortality differentials as a determinant of maternal labour-force participation. Unfortunately, the estimates of mortality differentials are not readily available. Therefore, the empirical strategy consists of two separate parts:

1. Estimate child mortality differentials regionally and

2. relate these to maternal employment.

The first step is crucial and overcomes the lack of data on the child mortality gradient. We propose a methodology aimed at correctly estimating it. In particular, our flexible specification allows for regional variation in the effect of counfounders. Section 4.1 carefully details the necessary steps to correctly estimate child mortality differentials. Once we are in possession of a measure gauging the change in child mortality maternal employment causes —labelled Δ_r later—, we can proceed to correlate it with maternal job-taking. Notice that, in fact, Δ_r correspond to average changes in child mortality, which should decrease endogeneity concerns in our final regressions.[27] Regressions at this second stage exploit the cross-sectional variation

[27] Moreover, as will become clear later, we estimate Δ_r on a restricted sample, and apply the values we retrieve to larger number of individuals.

present in Δ_r. Section 4.2 presents this set in detail.

4.1 Estimating child mortality differentials

For the moment, we are concerned with obtaining an unbiased and precise estimate that measures the child mortality gradient between working and non-working mothers. The general idea is simple, and consits in regressing an indicator of child mortality on maternal employment while controlling for other potential determinants of child death.[28]

Equation 5 represents such approach. The variable mm denotes a mortality indicator, and $works$ is an indicator variable for maternal employment, i indexes families, r regions and $X_{i,r}$ is a vector of additional control variables. The coefficient associated to maternal employment, Δ_r, measures the child mortality gradient. Notice that we estimate separate regressions for each region.

$$mm_{i,r} = \Delta_r works_{i,r} + X_{i,r}\beta_r + \epsilon_{i,r} \forall i \in r \quad (5)$$

Although simple in spirit, this generic approach suffers from an endogeneity issue. In particular, including all households i residing in region r biases the estimated value Δ. More precisely, Δ_r is upward-biased because mothers work in poor households while experiencing higher child mortality. We can mitigate the extent of the endogeneity issue by restricting the sample.

4.1.1 Sub-population choice

Let $\mathcal{W}$ represent the relevant set of households on which we estimate Equation 5. Importantly, $\mathcal{W}$ must be such that maternal employment considerations are free choices, this is, not constrained by income. If this is the case, then Δ correctly measures the change in child mortality maternal employment causes. Lacking precise income data, we exploit the information on husbands' occupations and reported wealth to construct occupation-specific average wealth levels.[29] Table 4 reports the estimated wealth level for each occupation. The set $\mathcal{W}$ must balance being as restrictive as possible and comprising enough observations. In our case, we decided that $\mathcal{W}$ includes households wherein the husband works in any of the three top-paying occupations, this is, professional, technical and managerial; clerical; and sales.[30]

[28]The model assumed a negative relationship between maternal employment and child survival rate but, in general, nothing prevents estimates from being positive. For instance, piecework at home may prevent youngsters from remaining unsupervised in unsafe urban environments.

[29]To avoid counting women's contribution, we exclude households with a working wife.

[30]$\mathcal{W}$ also includes skilled manual workers when the sample size is, otherwise, too small. Moreover, expanding the set $\mathcal{W}$ to always include this additional category provides similar results.

Table 4: Wealth levels per occupation

Did not work	2.545	(0.1001)
Prof./Tech./Man.	4.260	(0.0432)
Clerical	4.318	(0.0791)
Sales	3.641	(0.0419)
Agri. self-employed	2.124	(0.0276)
Agri. employee	2.252	(0.0258)
Household, domestic	3.595	(0.166)
Services	3.573	(0.0633)
Skilled manual	3.652	(0.0375)
Unskilled manual	3.693	(0.0542)
Observations	15784	

Note: This Table presents average wealth levels for husbands' occupation categories. Weighted averages and standard errors to correct the non-random sampling techniques in the DHS.

4.1.2 Regressions and child mortality differentials

The final step to obtain an estimated value of the child mortality gradient Δ consists in regressing Equation 5 by OLS. As mentioned, we allow our estimates to be fully flexible running separate regressions for each region r. Moreover, the sample only includes observations that belong to $\mathcal{W}$.

The outcome of interest is our mortality measures mm. At this stage, we capture child mortality by the number of under-five infants that died in household i during a calendar year. Nonetheless, the results we present are robust to different mortality measures.[31] Regressions control for demographic characteristics: age and its square and education years of both spouses and dwelling's urban/rural status; water source; malaria prevalence; mosquito net usage; the total number of children aged zero to five; and the number of births during one calendar year. For the sake of clarity, the exact regression we estimate at this stage is a slightly refined version of Equation 5. In particular, it clearly states that the sample comprises exclusively households in the set $\mathcal{W}$:

$$mm_{i,r} = \Delta_r mother\, works_{i,r} + X_{i,r}\beta_r + \epsilon_{i,r}, \quad \forall\forall r,\, \forall i \in \mathcal{W}. \tag{6}$$

As stated before, estimating this equation yields unbiased estimates of the child mortality gradient over maternal employment status, as captured by Δ_r.[32] Coefficients Δ_r reflect regional

[31] In particular, using the family-specific, under-five child mortality rate; focusing on the death of the last-born; or taking the logarith of mm do not qualitatively alter our results.

[32] Data limitations only allow computing Δ_r for 251 regions. In some regions, all women were observed as

characteristics, for instance, availability of healthcare facilities, variation in informal childcare or compatibility between maternal work and child-rearing, as they average across several individuals, smoothing out idiosyncratic variations. In fact, the value of Δ_r can be interpreted as regional-specific penalty levels to be paid for having a working wife in terms of child mortality.[33]

4.2 Child mortality and maternal employment

We have previously discussed that no data offered estimates of child mortality differentials. The preceding paragraphs introduced a specific econometric approach to correctly estimate it, and we are now in a position to relate maternal employment and the child mortality risk it poses to children. To this end, following the second step described before, we estimate an OLS model that incorporates Δ_r as its main regressor, exploiting the cross-section variation in Δ_r.[34] In doing so, the coefficient associated to Δ_r measures the partial effect of the child mortality gradient on maternal employment. Although the theoretical model suggests a non-linear relationship between variables, we first introduce Δ_r linearly, and later interacted with husband's occupation to proxy for his income. Interaction tems allow testing the non-linear nature of the relation, in particular, whether the effects are larger for well-off families. Moreover, these highlight the mechanism generating the U-shaped pattern in our model.[35]

Our basic econometric specification reads:

$$works_{i,r,c} = \alpha\Delta_{r,c} + X_{i,r,c}\beta + \gamma_c + \epsilon_{i,r,c} \tag{7}$$

where household i lives in region r of country c, and γ_c represent fixed-effects at the country level. The augmented econometric model including interaction terms follows:

$$works_{i,o,r,c} = \alpha\Delta_{r,c} + \theta_o occ_{i,o,r,c}\Delta_{r,c} + \phi_o + X_{i,o,r,c}\beta + \gamma_c + \epsilon_{i,o,r,c} \tag{8}$$

where o denotes husband's occupation in household i belonging to region r and γ_c represent fixed-effects at the country level. All regressions are estimated using weighted OLS to correct for the

either working or not working, making impossible group comparisons.

[33] The estimates Δ are equivalent to a pooled regression, but with all coefficients interacted with region. In that sense, the estimation captures the direct effect of maternal employment on child mortality while allowing regressors to impact differently child mortality across regions.

[34] Henceforth, we use again the full sample: the more restrictive $\mathcal{W}$ was only useful to correctly estimate Δ_r.

[35] More precisely, low income constrains mothers in poor households to work, despite its risk, to reach subsistence. In contrast, it is possible that wealthy families do not modify maternal employment because the child mortality gradient vanishes with human capital. Alternatively, these families can combine maternity and female work purchasing childcare services.

non-random sampling procedure of the DHS. Moreover, OLS facilitates interpreting coefficients when the sample changes, and the marginal effect of interacted variables is straightforward to compute, whereas non-linear models involve cumbersome computations This is important baceuse many of our results are based on estimated marginal effects. Furthermore, the mean of the dependent variable is around 60%, making OLS a good approximation to the more apt non-linear models. Finally, non-linear models encountered numerical issues related to the concavity of the objective function in some of the regressions below.

In this framework, we exploit within-country variation in the mortality gradient including country fixed-effects. All regressions control for socio-economic indicators: spouses' age and years of education, both squared; husband's occupation and a wife's pregnancy dummy and religious affiliation; household characteristics: dwelling urban/rural status, number of children of ages zero to five, five to ten, and ten to 15; births and deaths of under-five kids during the prior year; household members and its square and the number of wives; and regional controls: per capita night-light intensity and population density.

5 Results

This Section presents the results. It advances that maternal job-taking decreases with the mortality risk it poses to children, although the results are mostly confined to well-off families where the need for additional income urges less and can afford a non-working wife. Our results additionally distinguish between areas with night-light intensity levels above and below the median. We measure greater reductions in well-lit zones, reaching 5.6 percentage points among affluent families in these more developed areas. This result further stresses the relevance of income, highlighting that women in impoverished areas must work despite its effects on children. These results are compatible with our model. In general, and as noted before, replacing our measure *mm* for others and repeating the procedure reveals similar results.[36]

Regional level: Table 5 presents the negative relationship between the mortality gradient and maternal employment. Overall results under Column 1) already indicate a negative association between maternal employment and the mortality gradient, but its magnitude is relatively small. In particular, maternal employeemnt decreases by half a percentage point when its associated risk raises by one standard deviation. However, that initial result conceals great

[36]These results are available from the author upon request.

heterogeneity.

First, allowing the estimates to vary with husband's occupation, as in Column 2), reveals that reductions are confined to high-earning husbands.[37] Moreover, in these more affluent households, the estimates are larger in magnitude and represent more sizeable drops in maternal employment. In concrete, mothers' job-taking dwindles by three percentage points among women married to professionals and managers. For comparison, being pregnant reduces women's participation by one percentage point for the same group. This suggests the effect we document is not negligible and provides credence to our hypothesis, namely, that constrained households are unable to trade off income and risk.

We now divide the sample according to night-light intensity levels, as in Columns 3) to 6), with above-the-median locations being relatively more developed. In doing so, we confirm our previous results insofar employment reductions are only significant among wealthy households. Moreover, we document a more intense dwindle in well-lit areas. Overall, it reaches 1.7 percentage points when regression pool occupation categories —see Column 3)—, and rises up to 5.6 points among more affluent households —see Column 4)—. In contrast, results vanish in less developed regions, except for women married to skilled manual workers —a relatively highly paying occupation—, as Columns 5) and 6) indicate.

Taken together, our results suggest that households decrease maternal employment to limit the danger posed to children. Furthermore, the association we document is confined among wealthy families and in well-lit areas, evincing the importance of development. The results we obtain are compatible with our model.

Robustness tests: The previous results demonstrate that maternal employment is depressed by the risk it poses to children. In this Section, we introduce several additional controls that could affect female employment. First, regressions are augmented with land and geographical characteristics to rule out competing explanations, namely, persistent traits caused, ultimately, by geography. Furthermore, we also introduce control variables for malaria prevalence and mosquito-net usage. Regressions in Table 6 first incorporate these additional controls one at a time, and then simultaneously. Overall, the previous findings remain, and the uncovered association is not challenged. In particular, the pattern relating development to diminished maternal employment resurfaces, and only well-off families display significant reductions.

[37] Not all high-earning categories of employment display negative and significant results. For instance, we never estimate negative and significant results for the clerical category, albeit being the wealthiest.

Table 5: Child mortality and maternal employment, Δ_r^1

	Dep. var: Mother works					
	All sample		Light int. > median		Light int. < median	
	Baseline (1)	Interacted (2)	Baseline (3)	Interacted (4)	Baseline (5)	Interacted (6)
Diff. child mort.	-0.062^{***}	-0.289	-0.213^{***}	-0.650^{***}	-0.034	-0.264
	(0.021)	(0.242)	(0.074)	(0.213)	(0.028)	(0.487)
Marginal effects						
Did not work		-0.289		-0.650^{***}		-0.264
		(0.242)		(0.213)		(0.487)
Prof./Tech./Man.		-0.386^{**}		-0.702^{***}		0.012
		(0.153)		(0.156)		(0.240)
Clerical		0.154		0.005		0.295
		(0.183)		(0.165)		(0.371)
Sales		-0.186		-0.573^{***}		0.029
		(0.163)		(0.193)		(0.186)
Agri. self-emp		-0.034		-0.105		-0.012
		(0.056)		(0.148)		(0.058)
Agri. employee		-0.034		-0.257		0.074
		(0.219)		(0.379)		(0.197)
Domestic		-0.415		-1.003		-0.154
		(0.576)		(0.834)		(0.678)
Services		0.210		0.380		0.062
		(0.246)		(0.447)		(0.165)
Skilled man.		-0.228^{*}		-0.079		-0.410^{***}
		(0.116)		(0.166)		(0.109)
Unskilled man.		0.310		0.225		0.158
		(0.191)		(0.418)		(0.156)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects	Country	Country	Country	Country	Country	Country
Observations	40463	40463	11314	11314	29149	29149
R^2	0.175	0.176	0.155	0.157	0.188	0.189

Note: The unit of observation is a household. The dependent variable is whether a woman works. Individual controls: age, years of education and occupation, and their squares for both spouses and pregnancy status of women. Number of children aged zero to five, five to ten, and ten to 15, last-born child age, deceased children and a recent death indicator. Other controls: per capita night light intensity, population density and urban-rural status of the dwelling. Regressions control for the number of household members, its square and the number of other wives. OLS estimates. Standard errors clustered at the regional level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6: Child mortality and maternal employment, Δ_r^1, additional covariates

	Dep. var: Mother works											
	All sample				Light int. > median				Light int. < median			
	Geo. (1)	Agri. (2)	Mal. (3)	All (4)	Geo. (5)	Agri. (6)	Mal. (7)	All (8)	Geo. (9)	Agri. (10)	Mal. (11)	All (12)
	Panel A: Baseline											
Diff. child mort.	−0.052**	−0.061**	−0.059**	−0.061*	−0.227***	−0.234***	−0.200**	−0.197**	−0.021	−0.020	−0.029	−0.018
	(0.026)	(0.024)	(0.024)	(0.032)	(0.076)	(0.083)	(0.077)	(0.088)	(0.036)	(0.030)	(0.032)	(0.039)
Observations	40463	40171	40463	40171	11314	11200	11314	11200	29149	28971	29149	28971
R^2	0.176	0.180	0.176	0.181	0.156	0.159	0.155	0.161	0.189	0.193	0.188	0.195
	Panel B: Interactions											
Diff. child mort.	−0.272	−0.291	−0.276	−0.272	−0.640***	−0.669***	−0.632***	−0.614***	−0.231	−0.217	−0.234	−0.181
	(0.241)	(0.235)	(0.241)	(0.232)	(0.211)	(0.210)	(0.211)	(0.213)	(0.487)	(0.487)	(0.486)	(0.488)
Marginal effects												
Did not work	−0.272	−0.291	−0.276	−0.272	−0.640***	−0.669***	−0.632***	−0.614***	−0.231	−0.217	−0.234	−0.181
	(0.241)	(0.235)	(0.241)	(0.232)	(0.211)	(0.210)	(0.211)	(0.213)	(0.487)	(0.487)	(0.486)	(0.488)
Prof./Tech./Man.	−0.380**	−0.339**	−0.386**	−0.339**	−0.716***	−0.618***	−0.693***	−0.591***	0.036	0.060	0.016	0.064
	(0.152)	(0.154)	(0.155)	(0.152)	(0.163)	(0.153)	(0.156)	(0.161)	(0.232)	(0.236)	(0.246)	(0.234)
Clerical	0.162	0.067	0.156	0.073	−0.014	−0.144	0.017	−0.131	0.336	0.338	0.302	0.353
	(0.185)	(0.208)	(0.184)	(0.210)	(0.167)	(0.241)	(0.165)	(0.239)	(0.369)	(0.391)	(0.371)	(0.391)
Sales	−0.170	−0.070	−0.182	−0.060	−0.581***	−0.382	−0.555***	−0.319	0.064	0.073	0.033	0.085
	(0.171)	(0.168)	(0.163)	(0.170)	(0.192)	(0.309)	(0.198)	(0.308)	(0.194)	(0.190)	(0.185)	(0.197)
Agri. self-emp	−0.031	−0.020	−0.034	−0.029	−0.133	−0.105	−0.094	−0.082	−0.015	0.000	−0.010	−0.010
	(0.058)	(0.057)	(0.060)	(0.064)	(0.149)	(0.166)	(0.149)	(0.161)	(0.061)	(0.057)	(0.063)	(0.063)
Agri. employee	0.040	−0.049	−0.014	0.007	−0.226	−0.266	−0.234	−0.204	0.166	0.039	0.097	0.112
	(0.220)	(0.189)	(0.232)	(0.201)	(0.383)	(0.389)	(0.406)	(0.405)	(0.210)	(0.167)	(0.209)	(0.192)
Domestic	−0.397	−0.398	−0.398	−0.383	−0.996	−0.989	−0.946	−0.900	−0.140	−0.126	−0.152	−0.129
	(0.586)	(0.579)	(0.575)	(0.587)	(0.886)	(0.863)	(0.829)	(0.875)	(0.690)	(0.678)	(0.679)	(0.686)
Services	0.229	0.003	0.212	0.012	0.381	−0.177	0.393	−0.114	0.086	0.073	0.069	0.077
	(0.247)	(0.189)	(0.246)	(0.192)	(0.443)	(0.362)	(0.444)	(0.365)	(0.173)	(0.167)	(0.165)	(0.172)
Skilled man.	−0.221*	−0.246**	−0.224*	−0.238*	−0.094	−0.064	−0.068	−0.025	−0.385***	−0.384***	−0.405***	−0.376***
	(0.119)	(0.124)	(0.115)	(0.127)	(0.180)	(0.187)	(0.166)	(0.188)	(0.126)	(0.117)	(0.107)	(0.126)
Unskilled man.	0.322*	0.316	0.324*	0.319	0.202	0.091	0.231	0.143	0.187	0.183	0.175	0.198

Continued on next page

Table 6 – *Continued from previous page*

	All sample				Light int. > median				Light int. < median			
	Geo.	Agri.	Mal.	All	Geo.	Agri.	Mal.	All	Geo.	Agri.	Mal.	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	(0.194)	(0.205)	(0.185)	(0.204)	(0.417)	(0.485)	(0.417)	(0.482)	(0.166)	(0.164)	(0.151)	(0.171)
Controls (both panels)												
Geography	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Agriculture	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Malaria	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country
Observations	40463	40171	40463	40171	11314	11200	11314	11200	29149	28971	29149	28971
R^2	0.177	0.180	0.176	0.181	0.158	0.159	0.157	0.162	0.190	0.194	0.189	0.195

Note: The unit of observation is a household. The dependent variable is whether a woman works. Geographical controls: absolute latitude; distance to the closest river, coast and large city; temperature and precipitation. Agricultural controls: soil suitability and workability for agriculture, soil levels of pH and carbon and potential caloric yield before and after 1550. Malaria controls: malaria prevalence and mosquito-net usage. Individual controls: age, years of education and occupation, and their squares for both spouses and pregnancy status of women. Number of children aged zero to five, five to ten, and ten to 15, last-born child age, deceased children and a recent death indicator. Other controls: per capita night light intensity, population density and urban-rural status of the dwelling. Regressions control for the number of household members, its square and the number of other wives. OLS estimates. Standard errors clustered at the regional level. $^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Finally, we acknowledge the possibility that families adopt different behaviour for sons than for daughters. This strategy may be rationalised if parents believe, for instance, that boys are more resilient and expect milder consequences for them. Alternatively, biased gender perception may attach to boys a higher valuation, protecting them more than girls. To this end, we construct gender-specific measures $\Delta^1_{r,b}, \ldots, \Delta^4_{r,g}$ and $\Delta^1_{r,g}, \ldots, \Delta^4_{r,g}$. These are analogous to those introduced before but computed exclusively considering boys and girls. Table 7 presents the results when these are simultaneously introduced in regressions. Further, we distinguish between only sons and only daughters families. This distinction permits documenting how a mother of only sons changes her employment when it endangers girls. In principle, girl's endangerment should not impart any significant influence on the decision, as she has none.

Results from this exercise offer some evidence of a differentiated treatment between genders. In particular, we document that maternal employment decreases when it poses danger to daughters. We do not find similar evidence for sons. In general, the effects are confined to well-lit areas and surface mostly for wealthy families, see the results in Column 6) and under the heading *marginal effects, girls.* This new set of results complements our previous findings illustrating a differentiated effect between genders. It also reinforces the main effect we had already identified, strengthening it.

Finally, Appendix A modifies the region on which we compute Δ. Departing from regions, it introduces ethnic homelands and values Δ are computed on that geographical basis. The results are similar but weaker.

Placebo: The data so far has provided supporting evidence for our hypothesis. It relates maternal employment to the risk borne by children of working mothers. This set-up gives rise naturally to two additional tests. First, we focused on under-five mortality indicators as these reflect the consequences maternal employment has on children's health. Therefore, more general mortality measures not connected with maternal employment or those not concerned with infants should wield little influence on maternal employment. We construct such a measure, Δ^{15}_r, following the principles we outlined for Δ^1_r. However, we shift from focusing on under-five mortality to deaths occurred to individuals aged 15 or more. Further, we expand the time horizon, covering all deaths ever occurred. This dissociates maternal employment from our measure. Second, the uncovered relation pertains to families with under-five children. Older infants are unaffected if left alone, and the bulk of child mortality concentrates before the age of five. Consequently, we explore the effect of Δ^1_r on a sample consisting of families with only

Table 7: Child mortality and maternal employment, $\Delta^1_{r,b}$, $\Delta^1_{r,g}$

	Dep. var: Mother works								
	All sample			Light int. > median			Light int. < median		
	Both (1)	No Daughters (2)	No Sons (3)	Both (4)	No Daughters (5)	No Sons (6)	Both (7)	No Daughters (8)	No Sons (9)
	Panel A: Baseline								
Diff. child mort., boys	−0.018*	0.001	−0.023	−0.054	0.166	−0.008	−0.013	−0.012	−0.021
	(0.010)	(0.022)	(0.021)	(0.079)	(0.136)	(0.121)	(0.014)	(0.030)	(0.020)
Diff. child mort., girls	−0.017	0.028	−0.049	−0.241***	−0.233*	−0.384**	0.042	0.110	0.008
	(0.023)	(0.059)	(0.043)	(0.092)	(0.122)	(0.157)	(0.037)	(0.105)	(0.032)
Observations	38644	16934	16738	10891	5014	4960	27753	11920	11778
R^2	0.175	0.186	0.180	0.158	0.186	0.166	0.187	0.186	0.199
	Panel B: Interactions								
Diff. child mort., boys	−0.500**	−1.247*	−0.349	−0.287	−1.299	0.664	−0.735**	−1.314	−0.674**
	(0.239)	(0.655)	(0.277)	(0.568)	(1.315)	(0.462)	(0.299)	(0.873)	(0.302)
Diff. child mort., girls	0.296	1.824**	−0.174	−0.751	1.694	1.118	0.732	1.680**	−0.363
	(0.366)	(0.716)	(0.647)	(0.932)	(1.515)	(1.335)	(0.569)	(0.679)	(0.690)
Marginal effects, boys									
Did not work	−0.500**	−1.247*	−0.349	−0.287	−1.299	0.664	−0.735**	−1.314	−0.674**
	(0.239)	(0.655)	(0.277)	(0.568)	(1.315)	(0.462)	(0.299)	(0.873)	(0.302)
Prof./Tech./Man.	−0.130	−0.017	−0.188	−0.157	0.218	−0.988**	−0.121	−0.073	−0.036
	(0.125)	(0.202)	(0.198)	(0.241)	(0.390)	(0.484)	(0.146)	(0.296)	(0.152)
Clerical	0.076	0.292	0.205	0.407	0.843	0.414	−0.182	−0.003	−0.299
	(0.174)	(0.295)	(0.296)	(0.282)	(0.574)	(0.450)	(0.153)	(0.207)	(0.444)
Sales	−0.084	−0.058	0.013	−0.178	−0.119	0.173	−0.078	0.045	−0.071
	(0.122)	(0.222)	(0.103)	(0.222)	(0.291)	(0.357)	(0.137)	(0.264)	(0.101)
Agri. self-emp	−0.002	0.017	−0.046	−0.140	0.163	−0.251	0.000	0.011	−0.042*
	(0.033)	(0.038)	(0.034)	(0.255)	(0.245)	(0.391)	(0.029)	(0.035)	(0.025)
Agri. employee	0.039	0.028	0.214	−0.001	0.441	0.099	0.069	0.005	0.246
	(0.215)	(0.187)	(0.317)	(0.494)	(0.791)	(0.641)	(0.153)	(0.140)	(0.264)
Domestic	0.038	0.238	0.856**	−1.640*	−0.810	−1.538	0.348	0.463	1.210***
	(0.322)	(0.306)	(0.373)	(0.870)	(1.535)	(1.344)	(0.220)	(0.329)	(0.144)
Services	−0.004	−0.005	−0.030	1.148***	1.890***	1.227**	−0.043	−0.075	−0.081
	(0.138)	(0.116)	(0.221)	(0.395)	(0.708)	(0.482)	(0.057)	(0.085)	(0.092)
Skilled man.	−0.130	−0.159	−0.101	−0.074	0.080	−0.072	−0.127	−0.179	−0.133
	(0.114)	(0.136)	(0.164)	(0.334)	(0.493)	(0.318)	(0.107)	(0.150)	(0.156)
Unskilled man.	0.095	−0.000	0.223	−0.256	−0.206	0.563	0.171	0.010	0.272

Continued on next page

Table 7 – *Continued from previous page*

	All sample			Light int. > median			Light int. < median		
	Both (1)	No Daughters (2)	No Sons (3)	Both (4)	No Daughters (5)	No Sons (6)	Both (7)	No Daughters (8)	No Sons (9)
	(0.214)	(0.263)	(0.307)	(0.428)	(0.558)	(0.498)	(0.136)	(0.233)	(0.189)
Marginal effects, girls									
Did not work	0.296	1.824**	−0.174	−0.751	1.694	1.118	0.732	1.680**	−0.363
	(0.366)	(0.716)	(0.647)	(0.932)	(1.515)	(1.335)	(0.569)	(0.679)	(0.690)
Prof./Tech./Man.	−0.233	−0.292*	−0.345*	−0.531***	−0.584***	−0.820***	0.133	0.167	0.048
	(0.150)	(0.174)	(0.190)	(0.156)	(0.189)	(0.239)	(0.256)	(0.234)	(0.369)
Clerical	0.309	1.293***	−0.021	0.022	1.441***	−0.335	0.927	1.090	0.485
	(0.203)	(0.306)	(0.186)	(0.183)	(0.252)	(0.307)	(0.796)	(1.373)	(0.837)
Sales	−0.101	−0.126	−0.047	−0.353***	−0.231	−0.367	0.147	−0.197	0.123
	(0.107)	(0.106)	(0.181)	(0.105)	(0.158)	(0.260)	(0.160)	(0.232)	(0.164)
Agri. self-emp	−0.051	−0.019	−0.050	−0.199	−0.033	−0.759**	−0.023	−0.040	0.019
	(0.103)	(0.118)	(0.098)	(0.238)	(0.306)	(0.341)	(0.089)	(0.100)	(0.087)
Agri. employee	0.036	0.249	0.034	−0.393**	−0.958***	−0.006	0.169	0.783***	−0.058
	(0.130)	(0.264)	(0.142)	(0.186)	(0.172)	(0.276)	(0.112)	(0.212)	(0.129)
Domestic	0.118	1.009***	−0.028	−0.240	0.717	−0.362	0.244	1.170	−1.365
	(0.468)	(0.266)	(0.429)	(0.571)	(0.539)	(0.423)	(0.845)	(1.574)	(1.940)
Services	0.492	0.734**	0.256	0.401	0.722*	0.177	0.577*	0.841	−0.056
	(0.303)	(0.295)	(0.451)	(0.407)	(0.400)	(0.549)	(0.319)	(0.540)	(0.406)
Skilled man.	−0.120	−0.306***	−0.204	−0.240*	−0.337	−0.633**	−0.172	−0.312	−0.036
	(0.094)	(0.104)	(0.131)	(0.122)	(0.206)	(0.267)	(0.169)	(0.216)	(0.206)
Unskilled man.	0.276*	0.346*	0.284	0.006	0.036	−0.200	0.241	0.554	0.173
	(0.149)	(0.207)	(0.184)	(0.120)	(0.243)	(0.204)	(0.340)	(0.613)	(0.239)
Controls (both panels)									
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects	Country	Country	Country	Country	Country	Country	Country	Country	Country
Observations	38644	16934	16738	10891	5014	4960	27753	11920	11778
R^2	0.176	0.189	0.182	0.161	0.196	0.172	0.188	0.189	0.201

Note: The unit of observation is a household. The dependent variable is whether a woman works. Individual controls: age, years of education and occupation, and their squares for both spouses and pregnancy status of women. Number of children aged zero to five, five to ten, and ten to 15, last-born child age, deceased children and a recent death indicator. Other controls: per capita night light intensity, population density and urban-rural status of the dwelling. Regressions control for the number of household members, its square and the number of other wives. OLS estimates. Standard errors clustered at the regional level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

children above the age of five or with no infants.

Table 8 explores these two extremes in Columns 1) and 2); and 3) and 4), respectively. The estimated coefficients cease being negatively significant.[38] Further, concentrating on households with older or no children, Column 4) displays a few positive coefficients, all associated with affluent households. It may be indicative that women in such families resumed working after their children became old enough, and thus unaffected by maternal employment.

Table 8 reveals that, first, the results we advanced cannot be ascribed to general measures of mortality.[39] Moreover, it also makes evident that mortality changes induced by maternal employment are relevant, insofar Δ_r^{15} does not convey information in that sense. Second, results vanish for the sample of households with no infants, and signs reverse among affluent families. These results further confirm our previous findings, lending credence to our hypothesis.

6 Conclusions

This paper identifies a neglected determinant of female employment in developing countries. Based on a novel empirical approach, it advances that maternal employment decreases with the mortality risk it poses to children. In the sub-Saharan context, maternal employment may not be compatible with simultaneous childcare. Moreover, alternative caregivers may compromise toddlers' and infants' health, and leaving them unsupervised can result in catastrophic consequences. Consistent with the medical literature, we corroborate that children born to working mothers experience higher mortality rates.

Our contribution evinces that families react to the child mortality gradient over maternal employment. In particular, regression analysis suggests that mothers work less when doing so is more detrimental to children. The reduction in maternal employment we measure is sizeable and more relevant for well-off families, especially in developed areas. We document overall reductions in female participation ranging from half a percentage point in the most parsimonious specification to 1.7 percentage points in relatively developed areas. Additionally, it reaches almost 13.5 percentage points among wealthy families in regions with above-the-median night-light intensity. We argue such households can trade off the loss of maternal labour income for children's safety. On the contrary, we do not find employment reductions among destitute families. Furthermore, the mechanism is not operative for families without infants, and we

[38]The category of domestic workers is an exception, although it comprises just 63 observations.

[39]In fact, introducing child mortality in regressions does not alter our conclusions.

Table 8: Placebo regresions

	Dep. var: Mother works			
	Older than 15		No children	
	Baseline	Interacted	Baseline	Interacted
	(1)	(2)	(3)	(4)
Diff. child mort.	0.026	−0.038	0.184**	0.219
	(0.032)	(0.097)	(0.086)	(0.808)
Marginal effects				
Did not work		−0.038		0.219
		(0.097)		(0.808)
Prof./Tech./Man.		0.044		0.648**
		(0.030)		(0.309)
Clerical		−0.016		−0.253
		(0.059)		(0.519)
Sales		−0.003		−0.051
		(0.044)		(0.278)
Agri. self-emp		0.020		0.089
		(0.037)		(0.089)
Agri. employee		0.190		−0.402
		(0.146)		(0.344)
Domestic		0.092		−2.448**
		(0.090)		(1.153)
Services		−0.039		0.365
		(0.060)		(0.382)
Skilled man.		−0.045		0.596***
		(0.048)		(0.160)
Unskilled man.		0.150**		0.278
		(0.067)		(0.392)
Individual controls	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Fixed-effects	Country	Country	Country	Country
Observations	56004	56004	8267	8267
R^2	0.047	0.050	0.150	0.154

Note: The unit of observation is a household. The dependent variable is whether a woman works. In Columns 1) and 2) differential child mortality is based on Δ_r^{15}. It captures mortality above 15 and is not directly related to current maternal employment. See text for details. Columns 3) and 4) employ Δ_r^1 and restrict the sample to households without children aged zero to five. Individual controls: age, years of education and occupation, and their squares for both spouses and pregnancy status of women. Number of children aged zero to five, five to ten, and ten to 15, last-born child age, deceased children and a recent death indicator. Other controls: per capita night light intensity, population density and urban-rural status of the dwelling. Regressions control for the number of household members, its square and the number of other wives. OLS estimates. Standard errors clustered at the regional level. $^{*}\,p < 0.1$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$.

document that employment reductions are unrelated to mortality in general.

A theoretical model rationalises all the empirical findings. It delivers a U-shaped relationship between economic development and female labour-force participation, in line with the empirical literature on the topic. Departing from previous work, a simple mechanism generates both the decreasing and increasing parts of the observed U-shaped pattern. We consider this paper represents another building block in explaining variations in female labour-force participation rates across countries, complementing other theories.

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Appendices

A Ethnic homelands

The previous analysis assessed the effect of maternal employment on child mortality at the regional level. This Appendix departs from it and uses ethnic homelands as unit of analysis. Differently from regions, homelands traditionally divided ethnic groups. Current country boundaries, following the Scramble for Africa, divide several of these. In that sense, an ethnic homeland may embody different levels of administrative reach, health-care facilities and market regulations. However, their existence allows testing the relationship at a different scale.

As before, we measure the mortality gradient by $\Delta_e^{1,2,3,4}$, this time computed at the ethnic homeland level and using only individuals who reside within ethnic boundaries. Incidentally, introducing $\Delta_e^{1,2,3,4}$ allows the inclusion of more precise regional fixed-effects. Regressions include all individuals residing on a given ethnic homeland and also restrict the observations to those with a recorded ethnicity.

The evidence Table 9 presents is weaker than before but still evinces that maternal employment shrinks when it is more detrimental for children and parents can afford not to have a working wife. Effects are confined to well-lit areas and only when we distinguish among husband's occupation. The category professional, technical and managers is related to a decrease of 5.3 percentage points in Column 8) following a one standard deviation increase in Δ_e^1, although the effect is not significant.[40] Clerical workers further reduce participation, reaching 13.45 percentage points. Additionally, swapping Δ_e^1 for $\Delta_e^2, \ldots, \Delta_e^4$ yields similar results. Overall, this robustness test confirms the previous findings.

[40] Table 5 presented a reduction of 5.6 percentage points for that same category.

Table 9: Child mortality and maternal employment, Δ_e^1

	Dep. var: Mother works											
	All sample				Light int. $>$ median				Light int. $<$ median			
	All ind.		With ethnicity		All ind.		With ethnicity		All ind.		With ethnicity	
	Base.	Int.	Base.	Int.	Base.	Int.	Base.	Int.	Base.	Int.	Base.	Int.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Diff. child mortality	−0.033	−0.691	−0.166	−1.697	0.011	−1.262*	−0.092	−2.642**	−0.065	−0.815	−0.167	−1.096
	(0.133)	(0.538)	(0.197)	(1.202)	(0.184)	(0.646)	(0.204)	(1.219)	(0.168)	(1.061)	(0.255)	(1.928)
Marginal effects												
Did not work		−0.691		−1.697		−1.262*		−2.642**		−0.815		−1.096
		(0.538)		(1.202)		(0.646)		(1.219)		(1.061)		(1.928)
Prof./Tech./Man.		−0.162		−0.168		−0.426		−0.704		0.119		0.200
		(0.182)		(0.247)		(0.293)		(0.428)		(0.178)		(0.197)
Clerical		0.135		0.165		−0.935		−1.767**		0.726		0.825
		(0.407)		(0.475)		(0.576)		(0.757)		(0.500)		(0.665)
Sales		−0.141		−0.221		−0.770**		−1.078		0.113		0.013
		(0.267)		(0.374)		(0.374)		(0.671)		(0.252)		(0.357)
Agri. self-emp		−0.078		−0.324		−0.200		−0.653		−0.053		−0.244
		(0.214)		(0.323)		(0.460)		(0.539)		(0.252)		(0.381)
Agri. employee		−0.266		−0.310		0.538		0.726		−0.543		−0.582
		(0.283)		(0.369)		(0.586)		(0.758)		(0.334)		(0.390)
Domestic		−0.807		−0.735		−0.863		−0.116		0.129		−0.009
		(0.752)		(1.164)		(1.560)		(1.654)		(0.950)		(1.631)
Services		0.288		−0.123		0.219		−1.020		0.215		0.157
		(0.312)		(0.409)		(0.657)		(0.810)		(0.239)		(0.393)
Skilled man.		0.090		0.139		0.231		0.361		−0.083		−0.016
		(0.152)		(0.207)		(0.241)		(0.393)		(0.211)		(0.248)
Unskilled man.		0.270		0.008		0.635		0.519		0.042		−0.134
		(0.381)		(0.478)		(0.499)		(0.438)		(0.376)		(0.500)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Religion controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects	Region	Region	Region	Region	Region	Region	Region	Region	Region	Region	Region	Region
Observations	25869	25869	12874	12874	7173	7173	3936	3936	18696	18696	8938	8938
R^2	0.191	0.192	0.212	0.212	0.213	0.215	0.266	0.271	0.211	0.212	0.230	0.231

Note: The unit of observation is a household. The dependent variable is whether a woman works. Individual controls: age, years of education and occupation, and their squares for both spouses, pregnancy status of women and ethnic fixed-effects for both spouses Number of children aged zero to five, five to ten, and ten to 15, last-born child age, deceased children and a recent death indicator. Other controls: per capita night-light intensity, population density and urban-rural status of the dwelling. Regressions control for the number of household members, its square and the number of other wives. OLS estimates. Standard errors clustered at the ethnic homeland level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.