Would Empowering Women Initiate the Demographic Transition in Least Developed Countries?

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We examine the pathways by which several dimensions of gender inequality affect fertility and growth in a model with nonunitary households. This approach allows for a corner regime with maximum fertility, the absence of women from the labor market, and gender inequality in education. Policies to ease countries out of the corner regime are promoting mothers' survival and curbing infant mortality, while reducing the social and institutional gender gap (SIGG) is useless. In the interior regime, parents consider the impact of their children's education on their future marital bargaining power, and reducing the SIGG lowers fertility and fosters growth.

I. Introduction

The drop of fertility close to—or below—replacement level has accompanied all developed countries along the transition toward faster growth. Many less developed countries have now started their demographic transitions, and fertility is sharply decreasing there too. Still a group of countries seems not to have started its demographic transition yet, with the regions of sub-Saharan Africa and South Asia dominating this group. Alongside high fertility, these countries are characterized by gender

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TABLE 1
The Global Gender Gap Index 2007: Iran and Mozambique

	Educational Attainment	Political Empowerment	Economic Opportunity	Births per Woman
Iran	.96	.03	.40	2.07
Mozambique	.75	.23	.80	5.30

Source.—*Global Gender Gap Report 2007* and World Bank World Development Indicators (2005).

inequality in education, with women enjoying lower levels of schooling than men.[1]

Apart from being valuable on its own, a range of socioeconomic virtues are widely attached to gender equality. These include improved children's development (through better health and education), reduced poverty, and the promotion of long-term economic growth. In response to the positive link between the status of women in a country and its economic development, programs aiming at the promotion of gender equality have emerged. Two emblematic examples are the World Bank's Gender Action Plan as Smart Economics and the United Nations third Millennium Development Goal, which is explicitly concerned with the promotion of gender equality and women's empowerment.

Gender equality is clearly a multidimensional concept that encompasses many other aspects as well as access to education. Any comprehensive measure of gender parity in a society should include a range of indicators capturing such features as women's access to economic resources, women's access to health programs, and women's legal rights and civil liberties. In line with this mind-set, the World Economic Forum has implemented the Global Gender Gap (GGG) index, which provides a concise measure of gender equality for a list of 128 countries. This index sums up a large variety of gender-based equality indicators along four main dimensions: "economic participation and opportunity," "educational attainment," "political empowerment," and "health and survival."[2]

The usefulness of embracing multiple dimensions when considering the issue of gender equality is best disclosed by comparing the four GGG subindex scores of specific countries. Scores for Iran and Mozambique are displayed in table 1 for illustration.[3] Despite being relatively

[1] See United Nations Statistics Division's country data on total fertility rates and education indicators for women and men (http://unstats.un.org/unsd/databases.htm).

[2] See the *Global Gender Gap Report 2007* (Hausmann, Tyson, and Zahidi 2007). An alternative to this index of gender disparity is the very rich Gender, Institutions and Development Database from the OECD.

[3] Subindex scores range between 0 (inequality) and 1 (equality). The index is built from female-to-male ratios in order to capture the gender gaps independently of the absolute women's and men's attainment levels (which would not be independent of the level of resources available). This makes intercountry comparisons possible regardless of the general level of development of the countries.

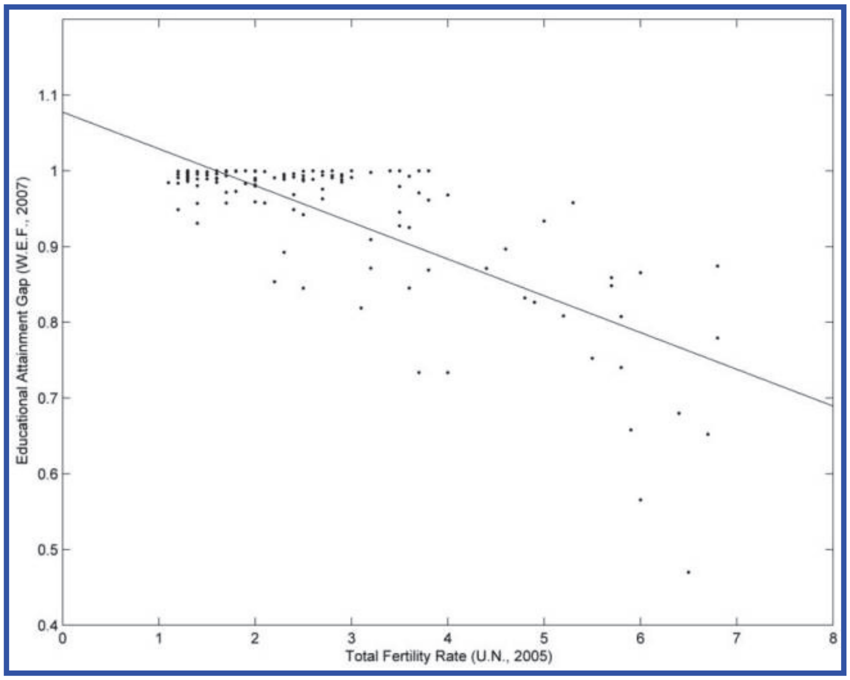

Figure 1.—Female-to-male education and fertility: cross-country plot

more egalitarian in the educational attainment dimension, Iran scores lower than Mozambique in terms of women's political empowerment and women's economic participation and opportunity. In addition, the number of births per woman illustrates the negative relationship between fertility and the gender gap in education: Iran, where gender parity is nearly completed in education, has births per woman of only 2.03, whereas Mozambique combines an educational attainment female-to-male ratio well below unity with a high number of births per woman but gives more political and economic power to women than Iran does. This observation raises the question of the pertinence of the various gender equality concepts when considering the issue of the economic development process.

Broader evidence for the negative link between female access to education and fertility comes from a cross-country data analysis. Figure 1 depicts the gender gap scores for the educational attainment GGG subindex and the total fertility rate for a list of 128 countries. The correlation coefficient between the two variables is $-.76$ (significant at the .005 probability level).

In this paper, we want to formally clarify the role of various dimensions of gender equality in fostering the transition toward faster growth. Acknowledging the enhancing effect of a reduced population growth in the shift toward faster growth, we especially want to examine the pathways by which increases in gender equality may affect fertility. We do so by means of a household bargaining model in which we explicitly distinguish between the following gender-based gaps: the survival gap, the wage gap, the social and institutional gap, and the educational gap. The latter is endogenous to our analysis and the first three gender-based concepts are exogenous. Specifically, we integrate a collective representation of household decision making into a two-sex overlapping-generations (OLG) model with endogenous fertility and parental investment in children's human capital.[4] In this model, agents of both sexes are assumed to be identical except in their time constraint since women bear a higher time cost of child rearing. Fully abstracting from allegedly socially ascribed gender roles, this assumption is grounded on the inherent biological differences between the sexes that entail a higher time commitment to child care for women during pregnancy, childbirth, and breast-feeding.[5]

In addition, parents are assumed to care for the well-being of their children without favoring boys or girls a priori. A distinctive feature of the model comes with our specification of household decision making. It is based on the notion of intrahousehold bargaining power: pursuant to the collective household model, the welfare function of the couple is represented as a weighted sum of individual utilities, where the weights can be interpreted as the bargaining power of the spouses in the decision-making process. We assume that these weights depend on the earning abilities of the spouses and, in particular, on the spouses' relative levels of human capital. Altruistic parents make decisions on individual consumption levels, fertility, and the education of their children. Hence, parents face an intertemporal arbitrage problem that involves decisions on consumption across generations with the double peculiarity of a quality-quantity trade-off with respect to the offspring and a gender power variable that evolves over time. As in the standard model of parental investment in children's human capital, our model predicts that parents invest less, ceteris paribus, in the education of their daughters because of the lower amount of time devoted to labor market activities by women, which reduces the returns to girls' education relative to that of boys (see, e.g., Becker 1991; Davies and Zhang 1995). However, an additional consideration enters this investment decision as parents

[4] Initiated by Chiappori (1988, 1992), collective models of household behavior emerged in response to the lack of both theoretical foundations and empirical support for the unitary—or "head of household"—representation of family decision making. See Chiappori and Donni (2006) for a survey of the literature on nonunitary models of household behaviors.

[5] Albanesi and Olivetti (2007) provide evidence for the time cost associated with breast-feeding. Combining information from the National Association of Pediatrics charts on the number of daily feedings by age of infant with an estimated duration of 20–30 minutes for each feed, the authors evaluate that a woman spends on average 13.6–17.3 hours per week breast-feeding. On the basis of this analysis, they conclude that, on average, a woman spends up to 43 percent of her working time nursing during the first 12 months of life of the child, given an average workweek of 40 hours.

recognize that the equilibrium share their children, as adults, will extract from the household decision is linked to the human capital they have been endowed with, and this may affect the direction of the gender gap in education.

In spite of the relatively abundant empirical literature on the impact of gender inequality on economic growth (e.g., Knowles, Lorgelly, and Owen 2002), macroeconomic studies that formally explore the role of gender heterogeneity remain relatively sparse.[6] Examples of dynamic models with endogenous fertility that explicitly embody a nonunitary model of household behavior are Echevarria and Merlo (1999) and Iyigun and Walsh (2007). In both studies, prior gender asymmetries are limited to biological disparities, and gender differences in education are the equilibrium outcome of intrahousehold bargaining. However, since growth is exogenous in both models, the authors do not use their model to investigate how these gender disparities may affect the long-run pattern of economic development. Echevarria and Merlo are interested in deriving a measure of the cost of having children that they estimate in a cross-country analysis. Iyigun and Walsh assume that education is not chosen by parents but is a premarital strategic investment decision that an agent makes taking into account its implications in terms of the future intrahousehold allocation of resources.

By relating changes in gender discrimination in education to long-run economic and demographic development in Europe, the work of Lagerlöf (2003) borders on our research program. The author develops a two-sex dynamic model with endogenous fertility and household formation. Without assuming gender asymmetries in preferences and abilities, differences in parental investment in human capital between boys and girls may arise as a Nash equilibrium of a coordination game between families: when all other families discriminate, it is optimal for an atomistic parent to do the same. The author assumes that economies recoordinate on more gender-equal equilibria over time without analyzing the driving forces toward gender equality. In addition, although integrating gender variables, the model builds on the unitary approach of the family. In that sense, the model does not respond to the call for multiperson representation of the household. As the author notes, the model captures the concept of gender stereotypes, but it does not capture the notion of gender decisional empowerment.

Our study also relates to the contribution of Doepke and Tertilt (2008), which explicitly addresses the issue of the change in women's status during the development process. Their work differs from other studies in its angle of inquiry as the authors look at the opposite direction of causality in the relationship between women's empowerment and economic development. That is, they examine what economic forces

[6] Here, we refer in particular to dynamic models with gender discrimination that does not result from supposed asymmetries in terms of preferences or abilities.

may have induced the progressive extension in women's rights during the industrialization process. They propose an OLG model with a quality-quantity trade-off on children and some political process to explain the distribution of power between men and women. As they rely on the assumption of greater male physical strength, political power in this economy is initially concentrated in the hands of men. However, technological progress that augments the return to human capital may induce men to give more rights to women since this will allow for higher-quality children and faster economic growth. We do not look at the political process through which advances in technology lead to women's empowerment. Rather, we focus on the reverse direction of causality. The specific question here can be summarized in the following terms: what are the dimensions of gender inequality that are important for growth, and through what mechanisms do they affect the economic development process?

By introducing several dimensions of gender inequality into a two-sex OLG model that encompasses a nonunitary representation of household decision making, we are able to characterize a corner regime in addition to the interior growth regime. The low-growth corner equilibrium is characterized by strong gender inequality in education and high fertility. The model displays this low-type equilibrium without the need to assume nonconvexities in the returns to human capital (as is generally the case in human capital–driven growth models following Becker, Murphy, and Tamura [1990]). Indeed, while these authors required this assumption in order to produce the inferior equilibrium, the introduction in our setup of gender heterogeneity in parental time requirements suffices to introduce a motive for discrimination in the minds of the parents and so to admit a corner equilibrium.

We also derive the model's implications in terms of the impact of the various dimensions of gender disparity in shaping the economic development process. In particular, we show that reducing the social and institutional gender gap in economies in the corner regime does not help to escape from it. Reducing the wage gender gap does not help either. The key policy measures that are most likely to succeed are promoting mothers' health and survival probability and curbing infant mortality. As we will argue when discussing the results, these facts are consistent with existing empirical findings. In addition, we find both in theory and in the data that reducing the gender gap in wages lowers fertility only in countries that have already escaped from the corner regime.

The remainder of the paper is organized as follows. Section II sets out the model and outlines some broad implications of the intrahousehold allocation process. Section III describes the corner equilibrium with high fertility and gender disparities in education. It also discusses the condition on the different gender gaps to escape this corner equilibrium. The modern growth balanced growth path (BGP) is in turn presented in Section IV. Section V provides a numerical analysis of this interior regime. In Section VI, we confront the testable implications of the model to empirical evidence. Section VII presents conclusions.

II. The Model

We assume an OLG model in which individuals are either males or females and live for two periods: childhood and adulthood. Men and women are assumed to be identical except for the biologically founded difference of a longer child-rearing time for women. In the first period of life, children simply accumulate human capital, and their consumption level is set to zero. At the beginning of adulthood, men and women are randomly matched into married couples. Adults are altruistic as they care for the well-being of their children. Subject to the household resource constraint, married couples make decisions on the spouses' consumption levels, the number of children, and the amount of educational spending on daughters and sons. The preferences of the representative agent i, $i \in \{f, m\}$, in period t are given by the utility function

$$V_t^i = u(c_t^i) + b(n_t)n_t \frac{(1-\theta_{t+1})V_{t+1}^f + \theta_{t+1}V_{t+1}^m}{2}, \tag{1}$$

where c_t^i is the consumption level, and the function $b(n_t)$ characterizes the degree of altruism toward children (following Barro and Becker [1988]).[7] The term n_t is the number of children, half of whom are girls. That is, if single, individuals do not have children and derive utility only from consumption; if married, individuals have preferences over consumption, the number of children, and the utility of their children.

Notice that weights are attached to the welfare of daughters and sons via the variable θ_{t+1}. This variable is an agglomerate that captures both "social norms" toward gender equality and some balance-of-power measures grounded on the distribution of human capital between men and women. In the household decision process, this welfare weight $\theta_t \in [0, 1]$ for all t will be interpreted as the bargaining power of the husband.

According to equation (1), parents evaluate the welfare of their children through the lens of their expected bargaining position in their future marriage. Put differently, parents' preferences are affected not only by the consumption of their adult child but also by the future bargaining position of that adult. This preference specification ensures that the maximization problem can be written in a recursive way, that the chosen policy is time consistent, and that the intrahousehold dis-

[7] Adopting a log utility specification with separability between n and V_{t+1} as in Doepke and Tertilt (2008) is of little help in getting sharper analytical results because of the way we choose to model the cost of education. In our specification, education carries both a fixed cost (expressed in terms of the consumption good) and a time cost (measured in terms of the mother's forgone labor income). We therefore choose to retain the usual Barro-Becker specification of preferences.

tribution of resources in all future generations indeed depends on the distribution of power.[8] As to the substantive justification, there are several reasons to believe that parents value their children's marital bargaining position per se. Parents may get satisfaction from the intergenerational transmission of sociocultural norms they deem as valuable, which would be facilitated if their children had marital bargaining power.[9] Old-age support and companionship, as introduced by Ehrlich and Lui (1991), are additional motives of parental "preferences" for the intrafamily bargaining power of the children: if financial support, informal caregiving, and emotional gratification provided by the adult children to their old parents are expected to depend on the bargaining position of the adult children, parents will value their children's future bargaining power.

Adults live for one period, during which they have children and work in the labor market. The effective time endowment, p_t^i, represents the number of years an adult may expect to live over his or her labor-active life span. To put it differently, p_t^i can be thought of as the survival probability from ages 20 to 50 (a working life that coincides with women's reproductive period). We allow this parameter to be gender specific in order to examine the impact of survival probability differentials between men and women on the intrahousehold resource allocation and on economic dynamics. Men inelastically supply their time endowment to the labor market. Women are constrained in the amount of time they can devote to the labor market since they are assumed to provide the whole time requirement associated with child rearing. With ϕ representing the fixed time cost per child, women are left with $p_t^f - \phi n_t$ units of time to supply to the labor market. Labor earnings of an individual i depend on the current wage rate, w_t^i, and on his or her productivity as measured by the stock of human capital, h_t^i. This is a result of the parents' decision on education expenditures. Therefore, men's and women's total labor incomes are, respectively, $p_t^m w_t^m h_t^m$ and $(p_t^f - \phi n_t) w_t^f h_t^f$.[10]

In the following, we assume that everybody gets married. In order to

[8] Dropping the θ's in the individual utility specification could result in a time inconsistency problem. As the time inconsistency is not central to our question, we would like to abstract from it here.

[9] Forums on marriage relationships, divorce, and family talk are full of anecdotal evidence that bargaining power per se matters for the families. For example, a Briton complains: "My wife chooses her parents' happiness over mine. . . . My family is British whereas hers is Italian. . . . The situation is that my family and hers do not get along and my wife constantly chooses her family's beliefs and her family's traditions over mine without any concern for my feelings or what I want for us or for my child."

[10] Allowing for gender-specific wage rates is consistent with the well-documented persistence of a gender wage gap in competitive labor markets even after controlling for hours of work, labor market sectors, and human capital characteristics. There exists a literature showing that unequal treatment in pay may arise as a coordination equilibrium between firms in competitive labor markets even under the assumption that women and men are identical ex ante. See Francois (1998) and Francois and van Ours (2000).

capture the multiperson dimension of the household, decisions are made by maximizing the weighted welfare function

$$V^h(h_t^f, h_t^m) = \theta_t V^m(h_t^f, h_t^m) + (1 - \theta_t)V^f(h_t^f, h_t^m). \tag{2}$$

The welfare weight θ_t, $\theta_t \in [0, 1]$ for all t, can be interpreted as the bargaining power of the husband in the household decision process. It is assumed to be a function of the human capital stock of the spouses with the specific representation

$$\theta_t = (1 - \gamma)\bar{\theta} + \gamma \frac{(h_t^m)^\mu}{(h_t^m)^\mu + (h_t^f)^\mu} \equiv \Theta(h_t^f, h_t^m), \tag{3}$$

where $\gamma \in [0, 1]$. This parameter measures the marginal impact of the man's relative human capital intensity on his intrafamily bargaining power.[11] When $\gamma = 0$, bargaining power is exogenous and equal to $\bar{\theta} \in [0, 1]$. The ratio on the right-hand side of this expression shows how human capital affects bargaining power, with the parameter $\mu \geq 0$ describing the sensitivity of the function to relative human capital. It is equal to one-half when $\mu = 0$, and as $\mu \to \infty$, it approaches unity as soon as the human capital of i surpasses that of j, $j \neq i$, even very slightly.[12]

We see education as taking place outside the family in a formal education sector and requiring some amount of expenditure by the parents. Let e_t^f and e_t^m denote the amounts of education parents provide to daughters and sons. Total parental education expenditure on children is then equal to $(e_t^f + e_t^m)(n_t/2)$. If we assume income pooling and denote income net of education spending by y_t, the budget constraint of the couple is

$$c_t^f + c_t^m = (p_t^f - \phi n_t)w_t^f h_t^f + p_t^m w_t^m h_t^m - (e_t^f + e_t^m)\frac{n_t}{2} \equiv y_t. \tag{4}$$

In accordance with the presumption of men and women having identical abilities, we assume the same human capital technology for both gender groups:

$$h_{t+1}^i = (e_t^i)^\delta (\bar{h}_t)^{1-\delta}, \tag{5}$$

where δ is the human capital elasticity with respect to education, and $\bar{h}_t$ is the average level of human capital in the parents' generation that captures a positive intergenerational externality in the process of human capital accumulation, which could, for example, reflect the quality of

[11] The specification of individual human capital as a determinant of intrahousehold decision power is consistent with recent empirical findings. Lührmann and Maurer (2007) found that education was associated with more individual decision-making power in the couple. In addition, Friedberg and Webb (2006) found that the effect of skill, measured by education and occupation, on bargaining power raised individual and reduced spouses' relative decision-making power. Oropesa (1997) found that education was a determinant of marital bargaining power.

[12] Our representation of bargaining power shares its ratio functional representation with the contest success function presented by Skaperdas (1996).

the teacher.[13] According to this production function, a gender gap in human capital can arise solely from a parental bias in the education expenditure decision toward children of a specific sex.

Below, we make additional assumptions on functional forms: we chose a constant intertemporal elasticity of substitution specification with parameter σ for the inverse of the intertemporal elasticity of substitution, which governs how much inequality individuals are willing to tolerate between their sons' and daughters' consumption. For the degree of parental altruism, we adopt the functional constant elasticity form $b(n_t) = \beta n_t^{-\epsilon}$, with $\beta \in [0, 1]$ denoting the psychological discount factor and $\epsilon \in [0, 1]$ representing the elasticity of altruism with respect to the number of children.[14] It is such that for a given utility per pair of children $(V_{t+1}^f + V_{t+1}^m)/2$, parental utility increases at a diminishing rate with the number of children n_t. In order to have a positive number of children, we need the following parametric restriction.[15]

Assumption 1. $\sigma > \epsilon$.

This requires that the exponent of consumption $1 - \sigma$ is smaller than that associated with children, $1 - \epsilon$. If this did not hold, parents would always prefer consumption to having children.

In all periods t, the couple solves the following optimization program:

$$\begin{aligned} V^h(h_t^f, h_t^m) = \max_{\{c_t^f, c_t^m, n_t, e_t^f, e_t^m\}} \Bigg\{ & [1 - \Theta(h_t^f, h_t^m)] \frac{(c_t^f)^{1-\sigma}}{1-\sigma} + \Theta(h_t^f, h_t^m) \frac{(c_t^m)^{1-\sigma}}{1-\sigma} \\ & + \frac{1}{2}\beta n_t^{1-\epsilon} \{[1 - \Theta(h_{t+1}^f, \tilde{h}_{t+1}^m)] V^f(h_{t+1}^f, \tilde{h}_{t+1}^m) \\ & + \Theta(\tilde{h}_{t+1}^f, h_{t+1}^m) V^m(\tilde{h}_{t+1}^f, h_{t+1}^m)\} \Bigg\} \end{aligned} \tag{6}$$

subject to (3), (4), and (5) and to the following inequality constraints:

$$\frac{p_t^f}{\phi} - n_t \geq 0, \quad e_t^f \geq 0, \quad e_t^m \geq 0. \tag{7}$$

The tilde variables in the objective function, $\tilde{h}_{t+1}^f$ and $\tilde{h}_{t+1}^m$, represent the

[13] In eq. (5) we have not included a specific effect of mother's human capital. Recent empirical evidence reported by Cunha and Heckman (2008) shows that the mother's education per se plays no role in the skill formation of the children after controlling for parental investment, e_t^i. Even if it does and if we include h_t^f in the production of education, the results would not change unless h_t^f were an indispensable input. If $h_t^f > 0$ is required to get positive human capital for the children, then one would have to educate the girls even in the corner regime in order to build boys' future human capital. In that case, propositions 1 and 2 would be more intricate, and the scope of the corner regime is likely to be reduced.

[14] We chose here the standard assumption on ϵ. An alternative suggested by Jones and Schoonbroodt (2010) is to have $\epsilon > 1$, which would allow a lower intertemporal elasticity of substitution $1/\sigma$ to be used (see assumption 1).

[15] For further discussion of this result, see Barro and Becker (1988, 1989).

stock of human capital of the male and female children's future wife and husband, respectively. These are taken as given as they result from the human capital investment choices made by the parents of the children's future spouses. Hence, the decision on children's education by parents configures a strategic game played among families: when choosing the amount to spend on children's education, parents need to solve the intrahousehold allocation problem their children will encounter as adults, recognizing that both the total amount of resources to bargain over and the relative bargaining power of their own children will be functions of the human capital of the children's spouses. Therefore, the decision by parents on the education level of their own children is a best response to the other parents' educational decision about their children.

Later on, we will consider a symmetric equilibrium in which all households behave in an identical manner so that perfect homogeneity within gender groups holds in every period and the issue of assortative mating does not come into play.

Let us now look at the first-order conditions of the household problem, which will allow us to identify some properties of the solution.

A. Consumption

The optimality condition with respect to the spouses' consumption is such that the consumption levels of the husband and the wife are proportional:

$$\theta_t (c_t^f)^\sigma = (1 - \theta_t)(c_t^m)^\sigma.$$

By combining this with the budget constraint, we obtain the individual consumption levels,

$$\begin{aligned} c_t^m &= \vartheta_t y_t, \\ c_t^f &= (1 - \vartheta_t) y_t, \end{aligned} \tag{8}$$

with ϑ_t being the intrahousehold distribution variable:

$$\vartheta_t = \frac{\theta_t^{1/\sigma}}{\theta_t^{1/\sigma} + (1 - \theta_t)^{1/\sigma}}. \tag{9}$$

As well as the spouses' relative bargaining powers, θ_t and $1 - \theta_t$, the inverse of the intertemporal elasticity of substitution σ also affects the final intrahousehold distribution of resources. When this elasticity is low (high σ), the final distribution is less sensitive to any imbalance between the individual bargaining powers. In the limit case in which σ becomes infinitely large we have $\lim_{\sigma\to\infty} \vartheta_t = 1/2$, and the distribution of consumption between the spouses is perfectly equal whatever the level of θ_t. Conversely, a high elasticity renders the distribution of consumption very sensitive to an unbalanced distribution of the spouses' bargaining powers.

Our model implies complete compensation by the husband for the wife's labor income loss due to the presence of children in the household. Each spouse receives a fraction of the total household labor earnings and contributes the same fraction to the education expenditure. When $\gamma = 0$ and $\theta_t = \bar{\theta} = 1/2$, both spouses get exactly half of the household resources over and above education expenditure.

B. *Education*

Regarding optimal education levels, we obtain the set of first-order conditions

$$\frac{\theta_t}{(c_t^m)^\sigma} n_t^\epsilon \geq \beta \frac{\partial V^m(\tilde{h}_{t+1}^f, h_{t+1}^m)}{\partial e_t^m}, \tag{10}$$

$$\frac{\theta_t}{(c_t^m)^\sigma} n_t^\epsilon \geq \beta \frac{\partial V^f(h_{t+1}^f, \tilde{h}_{t+1}^m)}{\partial e_t^f}, \tag{11}$$

where

$$\frac{\partial V^m(\tilde{h}_{t+1}^f, h_{t+1}^m)}{\partial e_t^m} = \left[\frac{\partial \Theta_{t+1}(\tilde{h}_{t+1}^f, h_{t+1}^m)}{\partial h_{t+1}^m} V_{t+1}^m + \frac{\theta_{t+1}}{(c_{t+1}^m)^\sigma} p_{t+1}^m w_{t+1}^m\right] \frac{\partial h_{t+1}^m}{\partial e_t^m} \tag{12}$$

and

$$\begin{aligned} \frac{\partial V^f(h_{t+1}^f, \tilde{h}_{t+1}^m)}{\partial e_t^f} = &\left[\frac{-\partial \Theta_{t+1}(h_{t+1}^f, \tilde{h}_{t+1}^m)}{\partial h_{t+1}^f} V_{t+1}^f \right. \\ &\left. + \frac{\theta_{t+1}}{(c_{t+1}^m)^\sigma} (p_{t+1}^f - \phi n_{t+1}) w_{t+1}^f\right] \frac{\partial h_{t+1}^f}{\partial e_t^f}. \end{aligned} \tag{13}$$

At an interior solution, the optimality conditions hold as equalities. The left-hand side in expressions (10) and (11) represents the cost of an additional unit of education and the right-hand side is the associated marginal benefit. As in the standard model of parental investment in children's human capital, the higher the marginal productivity or "earning ability" of the son or daughter, the higher the marginal utility for the parents from investing in their education. This is captured by the second terms on the right side of expressions (12) and (13). The first term on the right side captures the additional effect of the impact of the education decision on the next generation's distribution of bargaining power. Indeed, within this framework, parental decisions on investment in human capital of sons and daughters will tilt the intrahousehold allocation of their children's future marriages.

C. Fertility

The first-order condition with respect to the number of children is given by

$$(1-\epsilon)\frac{\beta n_t^{-\epsilon}}{2}V^h(h_{t+1}^f, h_{t+1}^m) \geq \frac{\theta_t}{(c_t^m)^\sigma}\left[\frac{1}{2}(e_t^f + e_t^m) + \phi w_t^f h_t^f\right], \tag{14}$$

with strict equality at an interior solution. The left-hand side represents the marginal gain for parents from an additional pair of children, and the right-hand side corresponds to the effect of children on utility in terms of forgone individual consumption for a given quality of children. It includes both the direct education cost and the opportunity cost in terms of lost earnings for the mother.

In the strategic game played by families in choosing their children's human capital given that of children in other families, parents simultaneously face a perfectly symmetric decision problem resulting in the best-response functions (10) and (11). At equilibrium, all parents choose the same level of education for their sons and their daughters so that $\tilde{h}_t^f = h_t^f$ and $\tilde{h}_t^m = h_t^m$ in a symmetric pure strategy Nash equilibrium. As a result, the household welfare at equilibrium can be computed as

$$V^h(h_t^f, h_t^m) = (1-\theta_t)\frac{(c_t^f)^{1-\sigma}}{1-\sigma} + \theta_t\frac{(c_t^m)^{1-\sigma}}{1-\sigma} + \frac{\beta n_t^{1-\epsilon}}{2}V^h(h_{t+1}^f, h_{t+1}^m),$$

where $\{c_t^f, c_t^m, n_t, h_{t+1}^f, h_{t+1}^m\}_{t\geq 0}$ are the optimal policy choices resulting from the maximization program (6).

Let us conclude the presentation of the model by highlighting the different concepts of gender inequality embedded in it. Three of them are exogenous: we define the *survival gap* by the ratio of total time endowments, p^m/p^f. Second, the *wage gap* is measured by w^m/w^f. The last exogenous indicator is our so-called *social and institutional gap* embodied in the parameter $\bar{\theta}$. This concept captures the societal and institutional propensity of a country toward higher gender equality (think of it as a compound indicator encompassing a wide set of elements ranging from family norms and codes, physical integrity, and civil liberties to women's open access to political decision making). Additionally, the following gaps are endogenous to our model: the *educational gap*, e^m/e^f; the *participation gap*, $p^m/(p^f - \phi n)$; and the *distribution gap*, which we define as the ratio of individual consumption levels, c^m/c^f. Note that by expression (8), the distribution gap is also measurable by the ratio of the distribution factors, $\vartheta/(1-\vartheta)$. Interestingly, the above list of gender gap concepts can be reframed in the four-pillars structure of the GGG indicator. There are elements falling into each of the four categories defined by the World Economic Forum: the ratios w^m/w^f and $p^m/(p^f - \phi n)$ pertain to the economic participation and opportunity category, the ratio e^m/e^f to the educational attainment indicator, and health and survival is captured by our p^m/p^f. Finally, $\bar{\theta}$ could be classified as political empowerment. While characterizing the various possible regimes of our model economy, we will pay special attention to the relationship between these different measures of gender inequalities.

III. The Corner Equilibrium

Before defining the BGP equilibrium, let us characterize the dynamics of our economy in terms of stationary variables. The stationary variables are defined as $1 + g_t = \bar{h}_{t+1}/\bar{h}_t$, $\hat{c}^f_t = c^f_t/\bar{h}_t$, $\hat{c}^m_t = c^m_t/\bar{h}_t$, $\hat{e}^f_t = e^f_t/\bar{h}_t$, $\hat{e}^m_t = e^m_t/\bar{h}_t$, $\hat{h}^f_t = h^f_t/\bar{h}_t$, $\hat{h}^m_t = h^m_t/\bar{h}_t$, $\hat{V}_t = V_t/\bar{h}^{1-\sigma}_t$, $\hat{V}^m_t = V^m_t/\bar{h}^{1-\sigma}_t$, $\hat{V}^f_t = V^f_t/\bar{h}^{1-\sigma}_t$, and $\hat{y}_t = y_t/\bar{h}_t$.

Definition 1. Given initial conditions (h^f_0, h^m_0), an equilibrium is a vector $\{\theta_t, \hat{y}_t, g_t, \hat{h}^f_{t+1}, \hat{h}^m_{t+1}, \hat{V}_t, \hat{V}^m_t, \hat{V}^f_t, \hat{c}^m_t, \hat{c}^f_t, \vartheta_t, \hat{e}^f_t, \hat{e}^m_t, n_t\}$ satisfying the conditions given in Appendix A for $t = 0, \ldots, \infty$.

Along a BGP, we assume that all the exogenous variables are constant:

$$p^f_t = p^f, \qquad p^m_t = p^m, \qquad w^f_t = w^f, \qquad \text{and} \qquad w^m_t = w^m \quad \forall t \geq 0.$$

The stationary variables $\{\theta_t, \hat{y}_t, g_t, \hat{h}^f_{t+1}, \hat{h}^m_{t+1}, \hat{V}_t, \hat{c}^m_t, \hat{c}^f_t, \vartheta_t, \hat{e}^f_t, \hat{e}^m_t, n_t\}$ are constant, which implies that the original variables h^f_t, h^m_t, c^m_t, c^f_t, e^f_t, and e^m_t grow at rate $g \in \mathbb{R}$ and V grows at rate $(1 - \sigma)g$.

A. *Exogenous Bargaining Power*

Different types of dynamic paths are possible, depending on which constraint binds. We first focus on a situation in which the constraint $n_t \leq p^f_t/\phi$ is an equality; that is, women spend all their time having and raising children. We start by analyzing the simple case in which bargaining power is exogenous, that is, $\gamma = 0$ and $\theta_t = \bar{\theta}$ for all $t \geq 0$. In this case, the only motive for educating children is to provide them with a higher labor income in the future. When the entire female time endowment is devoted to child-rearing activities, the motive for educating daughters based on higher labor market returns fades away. In such a world, the incentive to educate girls is limited: with human capital not being rewarded in the labor market, its only interest lies in the increase of the bargaining power of daughters in their future marriage. However, this motive does not apply here since we have assumed that bargaining power is not influenced by relative human capital. Therefore, we also have at equilibrium $e^f_t = 0$, and the first-order condition with respect to the education of girls (11) holds with strict inequality.

Let us stress one important difference from the existing literature. Becker et al. (1990) show that a poverty trap obtains as the consequence of a threshold effect in human capital accumulation. By adding a constant term to equation (5), they obtain an equilibrium with low education and economic stagnation as well as the usual sustained growth equilibrium. Here, the mechanism is different: education expenditure on girls is low because it is not worthwhile to invest in female human capital when women do not spend time in the labor market (because fertility is maximum). Moreover, as education expenditure on boys remains positive in this high-fertility regime, we obtain sustained growth driven by male human capital accumulation. In this, our results also depart from those of the Becker et al. model, where the economy stagnates in the high-fertility/low-education regime.

We can now characterize the long run in this case, which we label the "corner regime BGP."

Proposition 1. Assume $\gamma = 0$. Along a corner regime BGP, where fertility is constrained by the biological maximum, that is, $n = p^f/\phi$, it is optimal for households not to educate the girls, that is, $e^f = 0$. Growth is driven by men's human capital, with a growth rate given by

$$1 + g^M = \left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}(p^f/\phi)^\epsilon}\right]^{\delta/[1-\delta(1-\sigma)]}.$$

The proof is in Appendix B.

The growth rate depends positively on the time survival probability of male workers. This is a Ben-Porath (1967) effect, where education investment depends positively on the time span during which this investment pays off. In an endogenous growth model, this translates into higher growth (Boucekkine, de la Croix, and Licandro 2002).[16] Growth also depends positively on the cost of rearing children. In countries with higher costs (e.g., where infant mortality is high), the net number of children per woman is lower, which promotes growth per capita.

For this equilibrium to hold in the long run, two conditions should be met. The first is

$$1 - \frac{\beta}{2} n^{1-\epsilon}(1 + g^M)^{1-\sigma} > 0.$$

This condition is necessary and sufficient for the value function to be defined. The second condition is that fertility is indeed constrained by the biological maximum p^f/ϕ; that is, inequality (14) holds strictly. An analysis of these two conditions is detailed in Appendix C and leads to the following result.

Proposition 2. Assume $\gamma = 0$. Then a corner regime BGP exists if there is an equilibrium in which maximum fertility is binding, that is,

$$1 > \frac{\beta}{2}\left(\frac{p^f}{\phi}\right)^{1-\{\epsilon/[1-\delta(1-\sigma)]\}} \left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}}\right]^{[\delta(1-\sigma)]/[1-\delta(1-\sigma)]}.$$

The proof is in Appendix C.

[16] This departs from the neutrality result in Hazan and Zoabi (2006) according to which greater longevity has no effect on optimal investment in human capital and thereby neither on growth. The reason we do not find such a result follows from our specific functional choice, which is such that the condition of homothetic preferences of parents with respect to the number and the level of education of their children required to obtain the neutrality result does not hold.

This inequality defines a threshold $\bar{p}^f(p^m)$ such that the condition $p^f < \bar{p}^f(p^m)$ is a necessary condition for the corner regime BGP to exist.[17] Four important implications derive from proposition 2.

- First, low survival probability for women is associated with the corner regime. If women have a better chance of survival, it is more likely that they will be active in the labor market, and this makes girls' education worthwhile. Hence, high survival probability is incompatible with the corner regime, and empowering women by augmenting their survival probability, p^f, that is, reducing the survival gap, is a promising way of escaping from the corner regime.
- Second, lowering the cost of children, for example, by reducing child mortality, may also help a country to escape from the corner regime. Shortening the time needed to raise one living child also increases women's presence in the labor market and the return to girls' education. Hence, active implementation of policy measures aimed at reducing the total parental time requirement per living child will help countries in a corner regime. This implication can also be found in Soares (2005).
- Third, observe that the female wage, w^f, does not appear in these conditions. Since women's human capital is zero in this corner regime, their income is nil, whatever the wage per unit of human capital they could earn. Acting on the wage gap is of no help.
- Finally, the parameter driving societal and institutional gender equality $\bar{\theta}$ does not appear in the above condition. From this we may conclude that, in the event of initial gender inequality in social institutions, empowering women by reducing the social and institutional gap $\bar{\theta}$ toward a balanced level does not allow an escape from the corner regime. It would, however, allow women to enjoy a larger share of household consumption.

Let us conclude this section by a clarification remark on the scope of proposition 2. For given parameters and other players' actions, there is a unique consumption, education, and fertility policy maximizing households' objectives, because the value function of the households exists and is bounded. At the (Nash) equilibrium, though, we cannot rule out the possibility of multiple equilibria. Indeed, both the human capital technology and, in the endogenous bargaining power case, the dependence of the bargaining power on other players' actions introduce externalities: more education for one household's children affects the utility of all other households. In turn, these externalities generate some strategic interdependencies in the education choices, which can be at the root of multiple equilibria. Given the high degree of complexity of our model and the intractability of the first-order conditions in the

[17] Note that the function $\bar{p}^f(p^m)$ is decreasing in p^m under assumption 1 since it implies that the inequality on parameters $1 - \delta(1 - \sigma) > \epsilon$ is satisfied.

interior regime (mainly due to the fertility choice), we cannot analyze the conditions under which multiplicity occurs. Still, in proposition 2, we are able to specify the conditions under which a corner regime BGP is an equilibrium. This condition leads to interesting insights into what is needed to sustain such an equilibrium characterized by a high degree of imbalance between the education of boys and girls. We are also able to study the comparative static properties of this particular equilibrium. The results should be interpreted with caution, though. Nothing says that the corner equilibrium can be seen as the limit of the interior equilibrium when some parameters reach a certain threshold. Carrying out a global analysis of the interactions between the education choices of different households is unfortunately not possible here but could perhaps be achieved in a simpler model with exogenous fertility.

B. Endogenous Bargaining Power

We now lift the assumption of exogenous bargaining power and readdress the condition for the corner equilibrium to prevail. With $\gamma \neq 0$, the bargaining power is a function of the relative human capital levels of the spouses as described by expression (3). For the corner regime BGP to prevail in this context, we need the education of girls to be nil, requiring expression (11) to hold with strict inequality. Once $h^f = e^f = 0$, we are back to the previous case with exogenous bargaining power with

$$\theta = (1-\gamma)\bar{\theta} + \gamma \frac{(h^m)^\mu}{(h^m)^\mu + (h^f)^\mu} = (1-\gamma)\bar{\theta} + \gamma$$

from expression (3). Let us now find a condition under which the above is true. For expression (11) to hold with strict inequality, a sufficient condition is that $\partial(1-\theta_{t+1})/\partial e_t^f$ in expression (13) is equal to zero (recall that the upper bound on fertility is binding, $n = p^f/\phi$). Writing the first derivative of the bargaining power variable with respect to education and looking at the limit when girls' education tends toward zero gives the expression

$$\lim_{e_t^f} \frac{\partial(1-\theta_{t+1})}{\partial e_t^f} = \frac{\mu(h_{t+1}^m)^\mu}{[(h_{t+1}^m)^\mu + (h_{t+1}^f)^\mu]^2} \delta(\bar{h}_t)^{\mu(1-\delta)}(e_t^f)^{\delta\mu-1},$$

which is equal to zero whenever $\delta\mu - 1 > 0$. Hence $\delta\mu - 1 > 0$ is sufficient to have $e^f = 0$. At low levels of human capital, this requirement of a nil effect of education on future bargaining power is satisfied under the following condition.

Proposition 3. If the conditions of proposition 2 are met in addition to $\mu > 1/\delta$, the corner equilibrium is a BGP of the model with $\gamma > 0$.

The proof is in Appendix D.

When human capital is very low and $\mu > 1/\delta$, bargaining power is insensitive to human capital. As a result, $e^f = 0$ in equilibrium as both motives to educate girls vanish (no labor market return and no bargaining power distribution effect). The model thus comes closer to the unitary model of the family. This model thus seems more defensible when it represents economies in the corner regime than those in the interior regime.

IV. Modern Growth Equilibrium

We complete the theoretical analysis by considering the interior regime in which all inequality constraints in expression (7) are nonzero. In this regime, fertility is strictly below the upper fertility bound, p^f/ϕ, and women allocate their time between child rearing and labor market activities. Education expenditure on boys and girls is strictly positive.

A. Exogenous Bargaining Power

Let us again start with the exogenous bargaining power case in which $\gamma = 0$ and $\theta_t = \bar{\theta} \geq 0$ for all t.

In this setup, the human capital of men and women grows at the same rate g along a BGP. The system of equations characterizing the steady-state vector $\{\theta, \hat{y}, \hat{h}^f, \hat{h}^m, g, \hat{V}, \hat{c}^f, \hat{c}^m, \vartheta, \hat{e}^f, \hat{e}^m, n\}$ is presented in Appendix E. This system can be simplified so that the BGP is fully characterized by a vector $\{g, \hat{e}^m, \hat{e}^f, n\}$ that satisfies

- the equality between boys' and girls' marginal return on education,
$$p^m w^m (\hat{e}^m)^{\delta-1} = (p^f - \phi n) w^f (\hat{e}^f)^{\delta-1};$$
- the equality between the marginal return and the marginal cost of education for boys,
$$n^\epsilon = \beta(1+g)^{-\sigma} p^m w^m \delta (\hat{e}^m)^{\delta-1};$$
- the equality between the marginal cost and the marginal benefit of children,
$$\frac{1}{2}(\hat{e}^f + \hat{e}^m)(1+g) + \phi w^f (\hat{e}^f)^\delta =$$
$$\frac{(1-\epsilon)\beta}{(1+g)^{\sigma-1} n^\epsilon - (\beta/2)n}\left[(p^f - \phi n) w^f (\hat{e}^f)^\delta + p^m w^m (\hat{e}^m)^\delta - (1+g)(\hat{e}^f + \hat{e}^m)\frac{n}{2}\right];$$
- the definition of the growth rate,
$$2(1+g) = (\hat{e}^f)^\delta + (\hat{e}^m)^\delta.$$

We have then the following result.

Proposition 4. Along a BGP in the interior regime, the vector $\{g, \hat{e}^m, \hat{e}^f, n\}$ does not depend on $\bar{\theta}$ when $\gamma = 0$.

Hence, we find that the social and institutional gap $\bar{\theta}$ matters neither for fertility decisions nor for education choices; it affects only the allocation of consumption within the couple. The impact of the other exogenous gender gaps (the survival gap and the wage gap) on the interior BGP cannot be assessed analytically and is evaluated through numerical simulations in Section V below.

B. Endogenous Bargaining Power

The last case to consider is the interior regime with endogenous bargaining power. In this case, parameter γ is nonzero in expression (3). In contrast to the previous cases, we do not have any analytical results. Applying the implicit function theorem to the system described above to get comparative static results would also be too much involved. Therefore, in the next section, we rely on numerical simulations to investigate some properties of this equilibrium.

V. Numerical Illustration

This section provides a numerical illustration of the model. The simulation exercise is aimed at evaluating the impact of changes in exogenous gender-related variables on the long-run interior equilibrium. Emphasis is laid on the joint development of fertility, education, and growth.

A. Calibration

At this stage, we do not aim to reproduce the demographic transition in any particular country. An empirical evaluation of the model implications using cross-country data is deferred to the next section. However, the parameter values are chosen to be consistent with the characterization of a stylized industrialized economy along its BGP. The parameters are of three types. The first set are fixed at values similar to their accredited values in the macro literature. The second set, on which there is a prevailing lack of consensus, are arbitrarily chosen. The model robustness will be assessed in a sensitivity analysis based on these parameter values. The remaining free parameters are chosen so as to generate a number of assumptions on empirical moments featuring our benchmark model. Table 2 summarizes the procedure.

The model is calibrated under the assumption that a period lasts for 30 years. For the time cost parameter ϕ associated with children, we follow de la Croix and Doepke (2003) and choose $\phi = 0.075$.

Consistent with U.S. data for 2008 based on the Current Population Survey, we set the female-to-male wage ratio to 80 percent.[18] Gender-specific survival probabilities from ages 20 to 50 are based on U.S. life

[18] Data are issued in U.S. Bureau of Labor Statistics (2009).

TABLE 2
Calibration

	(1)	(2)	(3)	(4)	Calibration Set
Parameters set in accord with the literature:					
ϕ	.075	.075	.075	.075	de la Croix and Doepke (2003)
w^f	$.8w^m$	$.8w^m$	$.8w^m$	$.8w^m$	Bureau of Labor Statistics
p^f	.9645	.9645	.9645	.9645	Human Life-Table database
p^m	.9315	.9315	.9315	.9315	Human Life-Table database
Parameters set a priori:					
σ	1/4	1/3	1/3	1/3	
ϵ	1/4	1/4	1/3	1/4	
γ	0	0	0	.1	
$\underline{\mu}$	. . .	. . .	. . .	2	
$\bar{\theta}$	1/2	1/2	1/2	1/2	
Parameters calibrated to match moments:					
δ	.525	.610	.525	.494	Education exp. (% of GDP) = 6%
w^m	67.4	57.9	67.4	71.5	$n = 2$
β	.084	.075	.094	.083	Annual growth = 2%

tables for 2000 published in the Human Life-Table Database (http://www.lifetable.de). The resulting values for men and women are $p^m = 0.9315$ and $p^f = 0.9645$.

As our starting set of simulations assumes exogenous intrahousehold welfare weights, we set $\gamma = 0$. As a result, the social and institutional parameter $\bar{\theta}$ strictly determines the intrahousehold distribution of power, and we fix it at 0.5. The altruism elasticity with respect to the number of children embodied in the parameter ϵ is set to 1/4.[19] According to our model specification, the parameter σ is the inverse of the intertemporal elasticity of substitution. We choose a value of 1/4 for it so that assumption 1 holds. Below, we also calibrate the model under the alternative assumptions that $\sigma = 1/3$ and that both $\sigma = 1/3$ and $\epsilon = 1/3$.

The remaining set of parameters are pinned down as follows. First, we assume that output growth per capita is 2 percent per year. To tally with the observed fertility rates, which are close to the replacement level in many industrialized countries, we impose two children per household. Moreover, the education expenditure to GDP ratio is set to 0.06. This set of assumptions enables us to pin down three parameters: the elasticity

[19] Doepke (2005) provides a sensitivity analysis of the Barro-Becker model to this parameter.

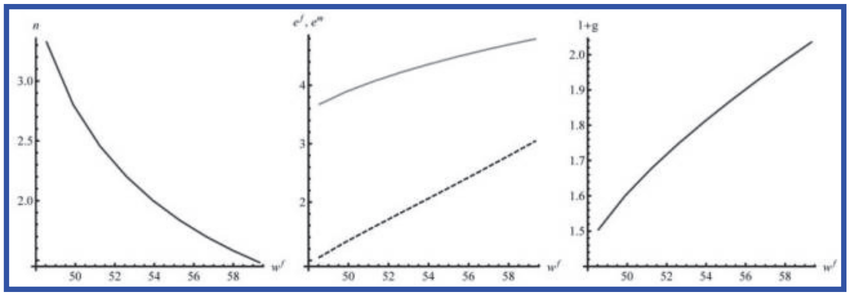

Figure 2.—Effect of w^f on fertility n, education e^f (dashed) and e^m, and growth $1 + g$

of education in human capital production, the male wage rate, and the discount factor.

B. Simulation Results with Exogenous Bargaining Power

The purpose here is to analyze how fertility and other characteristics of the economy adjust to changes occurring along various dimensions of gender inequality. In particular, we successively look at the impact of changes in the female wage rate and in the female total time endowment. A sensitivity analysis closes this section.

First, we consider the impact of changing relative wages by considering improvements in the wage rate of women keeping that of their male counterparts unchanged. More specifically, under calibration set 1, we let w^f range from 90 percent to 120 percent of its initial value. The results, displayed in figure 2, indicate that an upward shift in the wage rate of women relative to that of men has a fertility moderating effect. As the female wage rate increases, parents reduce the number of children they have, which enables women to increase their labor market supply. Education in both gender groups increases as parents substitute quality for quantity in the quantity-quality trade-off with respect to children. However, the increase is steeper for girls because of improved labor market returns to female human capital investment. Lower fertility and higher education have an enhancing effect on growth.

The next numerical exercise evaluates the effect of a rise in the time endowment of women. Recall that p^f is a survival probability. More specifically, given our assumption that one period of life lasts for 30 years, p^f is the probability that women survive from age 20 to age 50. In the numerical simulation, we let this probability range from 0.9 to 1. As depicted in figure 3, the relationship between p^f and n is downward sloping: the demand for children decreases and education spending increases as parents substitute quality for quantity. Driven by higher investment in female human capital relative to their male counterparts, a female-to-male catch-up in human capital is observed and average

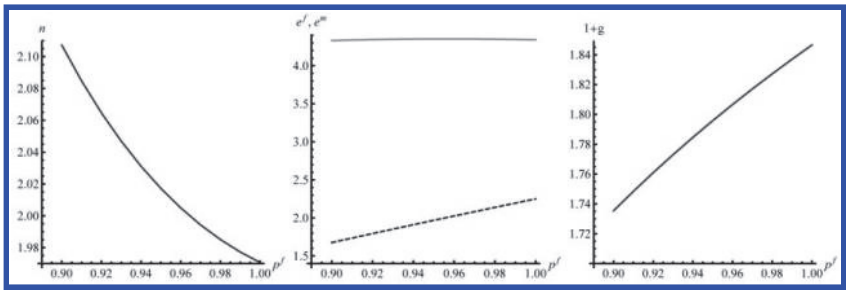

Figure 3.—Effect of p^f on fertility n, education e^f (dashed) and e^m, and growth $1 + g$

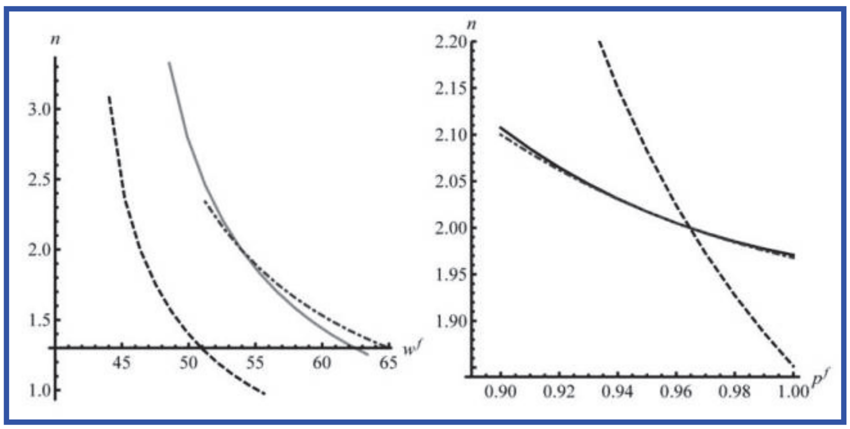

Figure 4.—Effects of w^f and p^f on fertility under calibration set 1 (solid), calibration set 2 (dashed), and calibration set 3 (dot dashed).

education in the economy increases. This translates into an upward-sloping curve for the growth rate.

C. Sensitivity Analysis

We will close this section by assessing the sensitivity of the simulation to changes in the free parameters. We first look at the impact of choosing different values for the elasticity of intertemporal substitution, σ. Figure 4 reports the results of simulations with the model with $\sigma = 1/3$ (calibration set 2). As before, an upward shift in the female wage rate has a negative impact on fertility. There is a female-to-male catch-up in education, and growth increases. The positive impact on growth is strengthened under this new calibration: when the wage rate is allowed to vary from 90 percent to 110 percent of its initial value, the fertility drop is sharper in the $\sigma = 1/3$ case than in the $\sigma = 1/4$ case (calibration set 1). Simulation results in the context of improving female survival probability also remain consistent under the various calibration scenarios. As the right-hand side of figure 4 shows, an increase in p^f is associated with a downward-sloping fertility pattern. The decrease in the demand for children results from the substitution effect in which parents choose to increase the amount of education on girls substantially, which in turn augments the opportunity cost of having children. We again find that improvements in women's survival probability have a positive effect on growth.

As well as affecting the intertemporal allocation of resources, the parameter σ also affects the intratemporal allocation of resources. Recall from equation (9) that the effective intrahousehold distribution depends on the value of σ: a low intertemporal elasticity of substitution (high σ) implies a willingness to distribute resources more equally between the spouses. On the contrary, a smaller σ exacerbates the imbalance in the intrahousehold distribution of resources between the spouses.

Finally, observe that changing the value of the altruism elasticity with respect to the number of children, ϵ, from 1/3 to 1/4 does not alter the results (right side of fig. 4).

D. *Simulation Results with Endogenous Bargaining Power*

Proceeding to the numerical evaluation of the model with endogenous gender power requires us to revise the parameterization. This is done by dropping the assumption of $\gamma = 0$ and setting $\gamma = 0.1$ instead (a conservative value so as not to overestimate the effect of endogenous bargaining power). Recall from expression (3) that parameter μ is a sensitivity measure of the bargaining power distribution with respect to relative human capital. We set this parameter at 2. Given these changes, we obtain new calibrated values for the male wage rate ($w^m = 71.5$), the elasticity of education ($\delta = 0.494$), and the discount factor ($\beta = 0.083$).

From a theoretical perspective, the main effect of adding the endogenous bargaining power specification in the model is to introduce a further motive for parents to educate their children: as well as the traditional labor market return on the investment in human capital, parents now also ascribe to it an "intrahousehold return" formulated in terms of enhanced intrahousehold bargaining power. This effect is distinctly evidenced in our next numerical experiment in which a favorable exogenous shift in the bargaining position of women is considered (i.e., we let the social and institutional parameter, $\bar{\theta}$, decrease in eq. [3]).

Figure 5 depicts the shift in the equilibrium values of the model variables following an increase in $1 - \bar{\theta}$ from to 0.275 to 0.75. The decreases in the educational gender gap and in fertility are particularly noteworthy. Subsequent to an exogenous amelioration of the bargaining position of women, parents begin to increase education spending on

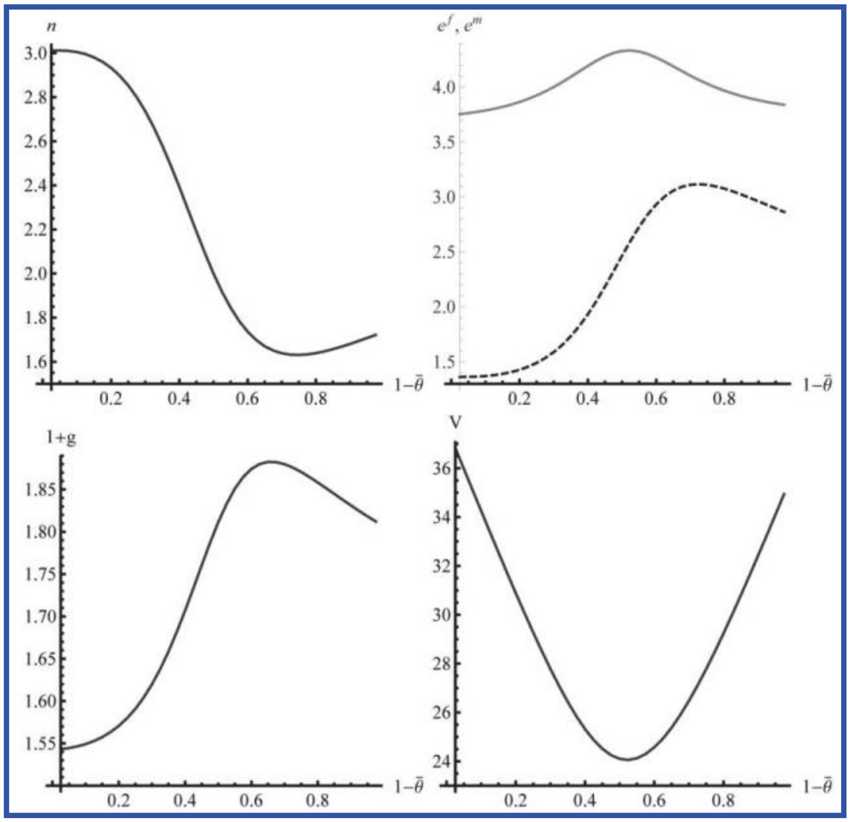

Figure 5.—Effect of $\bar{\theta}$ on fertility n, education e^f (dashed) and e^m, growth $1 + g$, and welfare V.

girls in order to grasp their future utility gain. Notice, however, that the shifts in e^f, e^m, and $1 + g$ are nonmonotonic in $1 - \bar{\theta}$. In a first stage, the demand for children decreases sharply, whereas education for both girls and boys increases: parents substitute quality for quantity. However, after some threshold, growth starts to swell. Indeed, when too great a weight is put on women, the incentive to invest in male human capital falls, which hampers growth. We find that the growth-maximizing level of $1 - \theta$ is around 0.65. This growth-maximizing θ does not maximize the welfare V of the household. As the term $\theta(\vartheta Y)^{1-\sigma} + (1 - \theta)[(1 - \vartheta)Y]^{1-\sigma}$ is U-shaped in θ at given Y, the welfare-maximizing θ is likely to be zero or one, as we find in our numerical examples.

In our last two numerical experiments, we examine the impact of exogenous shifts in w^f and p^f, respectively. The direction of the shifts is in line with the exogenous bargaining case: an improvement in the female wage rate leads to a smaller number of children per household, who get more education on average, and to higher growth. Moreover, a rise in the female survival probability causes the education gap to decrease and growth to fasten. However, as regards the amplitude of the results, we find that the shifts are more limited. In particular, the changes in the gender gaps are more limited as parents also take into account the "intrahousehold motive" in their investment decision.

VI. Empirical Analysis

The above theoretical model yields a number of predictions. Economies can be in a corner regime, characterized by strong gender inequality in education and high fertility, or in an interior regime. In the corner regime, fertility is at its maximum, p^f/ϕ. Neither a narrower social and institutional gap nor a higher wage for women (closing the wage gap) affects fertility in this regime. However, in the interior regime, countries with more social and institutional gender parity and/or with more balanced wages should display lower fertility and faster growth. In this section we will evaluate the pertinence of the model empirically using cross-country data. The main data sources are briefly outlined, and a description of the empirical strategy and associated results follows.

A. Data

This study examines the relationship between gender equality in its various dimensions and fertility for a sample of 157 countries. The data used are listed in Appendix F (table F1); unless otherwise stated, data refer to the year 2005. Country-specific births per woman are published by the World Bank in its World Development Indicators. This same source of information provides us with a first indicator on education gender gap by country. It is measured as the girls-to-boys primary completion ratio. As a second indicator, we refer to the GGG educational attainment subindex 2007 compiled by the World Economic Forum. This is a weighted combination of the ratios of female-to-male enrollment in primary-, secondary-, and tertiary-level education and of the female-to-male adult literacy rates. Wherever needed in our computations, survival probabilities are taken from life tables available from the World Health Organization.

B. Methodology, Cross-Country Evidence, and Related Results

1. The Maximum Net Fertility Rate

It was shown in Section III that a low female survival probability and an extensive fixed time cost per surviving child, possibly due to high infant mortality, are more likely to be typical of countries in the corner regime. Let us first define *the maximum net fertility rate* that captures the maximum number of living children women can consistently have over their entire fecund life span. This concept of maximum net fertility is contingent on the overall health condition in a society: in a country with high infant mortality and a short fecund reproductive period for women (due to low female survival probability, for instance), the maximum number of surviving children that a woman can give birth to will be smaller than in a country with lower rates of infant and adult mortality. From this, we define, country by country, an upper frontier on the maximum average number of living children per woman, and we then gauge how close to this frontier the observed number of children per woman is. For ease of description, we will henceforth term the difference between maximum net fertility and actual fertility the "fertility margin." A country that has a fertility margin approaching zero is a country in which observed fertility is high, given the prevailing overall health and survival conditions.

Specifically for the measurement approach, the maximum net fertility is computed as the ratio of the expected number of years a 20-year-old woman will live over a 30-year period (p^f in our model) to the total time cost associated with every surviving child (ϕ in the model). Formally, the maximum net fertility, $\bar{n}$, is written as

$$\bar{n} = \frac{p^f}{\phi} = \frac{(\text{L50f/L20f}) \times 20}{[a/(1 - \text{IMR})] + b}, \tag{15}$$

where L20f and L50f represent the proportion of women surviving to ages 20 and 50, respectively. Hence, the distance ratio L50f/L20f gives the fraction of 20-year-old women who reach the age of 50. Multiplying this figure by 30 produces the average number of years a woman entering adulthood may expect to live over her fertile life span.

The denominator captures the net parental time cost per surviving child, with a standing for the fraction of time spent by a mother raising each newborn child during its first year of life and b representing the additional time cost associated with surviving children. The term 1 − IRM is the proportion of newborns who survive the first year of life. Infant mortality rates are directly available from survival tables. To fix the value of parameters a and b, we follow the methodology presented by Bar and Leukhina (2010). They introduced the ratio of the total parental time cost of a surviving child to that of a nonsurviving child and set it to 4, that is, $(a + b)/a = 4$.[20] This equation, combined with the expression of net parental time cost per surviving child,

$$\phi = \frac{a}{1 - \text{IMR}} + b,$$

forms a system that can be solved for a and b. In order to do this, we set IMR = 0.04 (sample average). In addition, following the discussion

[20] See Bar and Leukhina (2010) for a detailed explanation of the calibration strategy for this ratio. Briefly, it involves using the data on age-specific mortality and the assumption that the instantaneous cost function of raising a child is a decreasing linear function of the child's age.

TABLE 3
MAXIMUM NET FERTILITY: IRAN, MEXICO, AND MOZAMBIQUE

	L20f (1)	L50f (2)	p^f (3)	1 −IMR (4)	ϕ (5)	$\bar{n}$ (6)	n (7)	$\bar{n} - n$ (8)	e^f/e^m (9)
Iran	.96	.92	28.64	.97	2.24	12.76	2.01	10.75	1.00
Mexico	.97	.94	28.90	.98	2.24	12.91	2.06	10.84	1.01
Mozambique	.83	.42	15.22	.90	2.29	6.65	4.77	1.88	.66

in de la Croix and Doepke (2003), it is supposed that the opportunity cost of a child is equivalent to about 15 percent of the mother's total time endowment and that children live with their parents for 15 years. This allows us to set $\phi = 0.15 \times 15 = 2.25$. Thus, we obtain $a = 0.5567$ for the time cost per newborn child and $b = 1.6701$ as the additional cost per child who reaches adult age. By way of example, table 3 reports the computational steps of the maximum net fertility for Iran, Mexico, and Mozambique.

We see that, given the parameter choice and the countries' data on survival rates, a woman devoting all her time to raising children could have, on average, over 12 living children in Iran and Mexico but only somewhat fewer than seven in Mozambique. In column 8, we report the fertility margin, $\bar{n} - n$, with n being the observed number of living children per woman in the 20–50 age bracket. It is computed as the number of births per woman from the World Development Indicators adjusted for the infant mortality rate associated with the first year of life.

Interestingly, Mozambique is the country for which the distance between actual fertility and maximum net fertility rates is smallest. That is, despite having the lowest maximum net fertility, due to the low female survival rate and the high cost of having living children, Mozambique has the highest fertility rate out of the three countries. As a result, we can say that Mozambique has a higher fertility rate in both absolute and relative terms (i.e., in distance terms) than either Iran or Mexico. Mexico has a higher fertility rate in absolute terms, but in relative terms, Mexico's fertility is lower (the fertility margin is larger) than Iran's.

Figure 6 displays the fertility margin for the countries sorted in ascending order of maximum net fertility. As we move from left to right along the x-axis, maximum net fertility and the observed number of living births per woman first increase together up to some break point beyond which the distance between the two variables starts to widen. This provides us with a good illustration of what constitutes the essence of proposition 2: countries with high infant mortality and low female survival probability (resulting in a low maximum net fertility) are more likely to be in the corner regime. In figure 6, we indeed observe that countries with a lower $\bar{n}$ also tend to display a smaller fertility margin, $\bar{n} - n$, than countries that enjoy a larger $\bar{n}$ because of longer female survival probability and lower infant mortality rates.

To provide further evidence that, in countries in the corner regime,

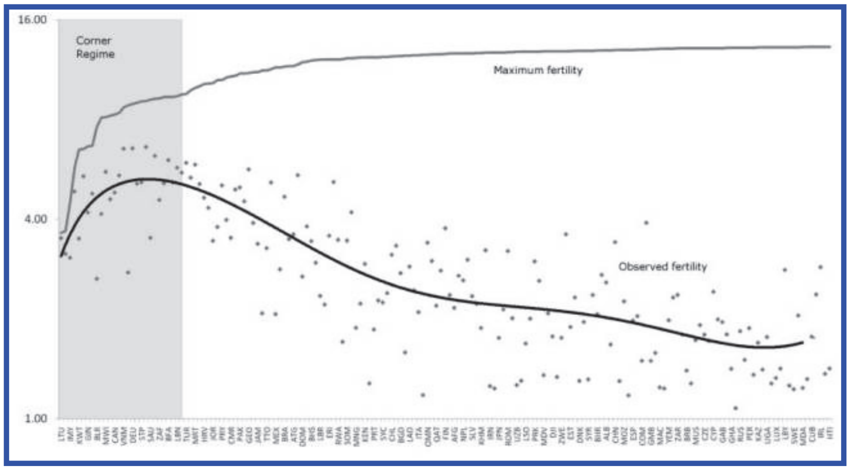

Figure 6.—The fertility margin: cross-country data

fertility is constrained by the supply side, we categorize countries into corner and interior regimes. Fixing our separation criterion at a fertility margin of 1.96 standard deviations, we find that 20 countries can be listed in the corner regime category. In other words, in 20 countries, the difference between the computed maximum net fertility and the observed fertility is lower than 1.96 standard deviations. In all other countries, there is a bigger positive distance between the maximum net and the effective fertility. Within the corner regime category, we compute the correlation between observed and maximum fertility. It stands at .85, which is not significantly different from one (p-value = .66).

2. Fertility and Gender Power

In table 4, we present the correlations between the fertility margin and various measures of the gender gap. The first row shows these correlations for the entire cross-country sample. In line with other researchers, we find a positive relationship between our measures of gender equality in education and the fertility margin (see, e.g., Dollar and Gatti 1999; Klasen 2002). The fertility margin relates noticeably less strongly to the other dimensions of the gender gap. However, interesting patterns in these correlations emerge when we consider the two groups of countries. We observe that in the corner regime group, no correlation is significant. This is perfectly in line with the model, where the fertility margin is always equal to zero in this regime. In the interior regime group of countries, the correlations with the various dimensions are always stronger than in the full sample. As well as the strong correlation between the gender gap in education and the fertility margin, we find a positive correlation with our two measures of women's political power.

TABLE 4
CORRELATIONS WITH THE FERTILITY MARGIN

	Educational Attainment	Education Gap (WDI)	Economic Participation and Opportunity	Political Empowerment	Women in Parliament (UN)
All countries	.616	.515	.069	.141	.158
	(.00; 128)	(.00; 146)	(.44; 128)	(.11; 126)	(.04; 163)
Corner	−.242	−.220	.393	−.117	.190
	(.47; 11)	(.40; 17)	(.23; 11)	(.73; 11)	(.47; 19)
Interior	.730	.657	.285	.229	.303
	(.00; 117)	(.00; 129)	(.00; 117)	(.01; 117)	(.00; 144)

Note.—*p*-values and degrees of freedom (observations − 2) are in parentheses.

If we accept that these are an indicator of the social and institutional gender gap, it may be that reducing the gender gap along this dimension would help to speed the demographic transition. This is in line with our result in Section IV when bargaining power is endogenous. In a similar vein, the correlations between the fertility margin and the economic participation and opportunity gender gap index are positive.[21] That the female-to-male wage gap is an important built-in factor for this gender equality index[22] strengthens the argument that a lower gender gap is fertility reducing and growth enhancing for economies in the interior regime (see fig. 3).

Without ignoring the fact that our separation criterion of 1.96 standard deviations is somewhat arbitrary, we calculated the correlation coefficients and their associated *p*-values for different cutoffs ranging from one to three standard deviations. In all cases, the results were consistent with the conclusions above. Regarding the potential problem associated with the relatively small sample size in the corner group, let us point out that when we choose three standard deviations as the cutoff value, we have 38 countries in the corner regime, and the results from the correlations analysis in this enlarged sample remain fully consistent.

3. Corner Regimes, Interior Regimes, and Growth

Our last empirical exercise looks at the implications for growth of being in a regime with high fertility and gender inequality in education. When investment in women's education is lacking, growth is driven solely by

[21] The correlations between the fertility margin and the economic participation and opportunity gender gap index for the whole sample are noticeably low and not statistically significant.

[22] In the construction of the Economic Participation and Opportunity gender equality index, the World Economic Forum attributed a weight of 0.310 to the female-to-male wage ratio (for similar work). The second main component is the ratio of the estimated female-to-male earned income with a weight of 0.221. The other factors are the ratio of female-to-male labor force participation; the ratio of female-to-male legislators, senior officials, and managers; and the ratio of female-to-male professional and technical workers over the male value.

the accumulation of the human capital of men. Therefore, we expect countries in the corner regime to experience a lower growth rate than countries in which education is provided equally to men and women. This idea can be assessed by performing a one-sided student test that compares the average growth rates in the two groups of countries (the corner regime and the interior regime countries).

More specifically, using historical series on GDP from Maddison (2010), we computed the average annual growth rates over the period 1976–2006 for our list of countries. Over this 30-year time period, the mean annual growth rate for the countries categorized in the corner regime group in 2005 was 0 percent whereas that of the interior regime group was 1.23 percent. The hypothesis of equal means in the low- and the high-fertility groups was tested against the alternative hypothesis that the mean growth in the low-fertility group is larger than in the high-fertility group. The null hypothesis is rejected at the 5 percent significance level, which enables us to assert that the data support the hypothesis of a lower growth rate for countries in the corner regime. Going beyond this result based on simple bivariate statistics is left for future research. Promising lines of inquiry have been provided by Ehrlich and Kim (2007) on social security and by Ehrlich and Kim (2008) on inequality and growth.

VII. Conclusion

The promotion of gender equality is endorsed by all the world's leading development institutions and has become a major challenge for sustainable development in all regions of the world. In spite of the apparent consensus on the positive link between gender equality and economic growth, macroeconomic studies that formally explore the role of gender heterogeneity remain relatively rare. In this paper, we have tried to formally clarify the part played by various dimensions of gender inequality in fostering the transition toward faster growth. Fully recognizing the economic growth–enhancing impact of a slower population growth, we especially focused on the pathways by which increases in gender equality may affect fertility.

To this end, we set up an overlapping-generations model with gender heterogeneity, endogenous fertility, and parental investment in children's human capital. Distinctive to our model is the specification of a household decision-making process based on the notion of intrahousehold bargaining power. In this setting we are able to identify three exogenous dimensions of gender equality (mortality, socio-institutional, and wage) and to analyze their impact on both demographic and economic outcomes. Table 5 summarizes the results.

We first characterized two equilibrium regimes: a corner regime with low growth, high fertility, and strong gender inequality in education and an interior growth regime in which low fertility and a more balanced

TABLE 5

Summary of the Results

Type of Women's Empowerment	Corner Regime		Interior Regime	
	Exogenous Power	Endogenous Power	Exogenous Power	Endogenous Power
Increased women's life expectancy ($p^f \uparrow$)	Increases fertility; helps escape the regime (prop. 2)	Ditto if $\mu > 1/\delta$ (prop. 3)	Fosters growth; abates fertility; lowers education gap (fig. 3)	Ditto
Increased women's institutional power ($(1 - \bar{\theta}) \uparrow$)	No effect (props. 1, 2)	Ditto if $\mu > 1/\delta$ (prop. 3)	No effect (prop. 4)	Fosters growth; abates fertility; lowers education gap (fig. 5)
Increased women's wage ($w^f \uparrow$)	No effect as women do not work (props. 1, 2)	Ditto if $\mu > 1/\delta$ (prop. 3)	Fosters growth; abates fertility; lowers education gap (fig. 2)	Ditto

distribution of education between men and women prevail. Next, we derived the condition to escape the corner regime. Reducing the social and institutional gender gap in economies in the corner regime does not prove to be the way out. Nor is lowering the gender wage gap. The key policy measures to ease these countries out of the corner regime are to promote female survival probability and infant survival rates. These findings were corroborated by our cross-country data analysis, which provided evidence that countries with high infant mortality and low female survival probability were more likely to be in the corner regime. In addition, the distance between maximum and observed fertility was only weakly correlated with the various dimensions of gender equality among countries in the corner regime.

We furthered our understanding of how fertility and other characteristics of the economy adjust to changes in gender equality by proceeding to some numerical simulations of the benchmark interior regime. When bargaining power is exogenous, augmenting the female wage rate relative to that of men reduces fertility and fosters growth. We also found that improving female survival probability was positive for growth. When bargaining power is endogenous, the sole additional result comes from the social and institutional gender gap: the implementation of policy measures aimed at strengthening gender parity in the social and institutional setup of a given economy in the interior regime promotes economic growth by lowering the population growth rate.

Let us close by insisting on the fact that, as unsettling as it may sound, reducing the social and institutional gender gap is of no immediate help to escape the high-fertility regime in low-income countries. Nevertheless, we do not discard the importance of achieving gender parity. To start with, it is certainly a worthy objective in itself. More work needs to be done to obtain a clear understanding of the mechanisms linking gender equality and economic growth. The present study is just one step in this direction.

Appendix A

Dynamics with Stationary Variables

Given initial conditions (h_0^f, h_0^m), an equilibrium trajectory is a vector $\{\theta_t, \hat{y}_t, g_t, \hat{h}_{t+1}^f, \hat{h}_{t+1}^m, \hat{V}_t, \hat{V}_t^m, \hat{V}_t^f, \hat{c}_t^m, \hat{c}_t^f, \vartheta_t, \hat{e}_t^f, \hat{e}_t^m, n_t\}$ satisfying the following conditions for all $t \geq 0$:

$$\theta_t = (1-\gamma)\bar{\theta} + \gamma \frac{(\hat{h}_t^m)^\mu}{(\hat{h}_t^m)^\mu + (\hat{h}_t^f)^\mu}, \tag{A1}$$

$$\hat{y}_t = (p_t^f - \phi n_t) w_t^f \hat{h}_t^f + p_t^m w_t^m \hat{h}_t^m - (\hat{e}_t^f + \hat{e}_t^m) \frac{n}{2}, \tag{A2}$$

$$(1 + g_t) \hat{h}_{t+1}^i = (\hat{e}_t^i)^\delta, \tag{A3}$$

$$\hat{h}_t^f + \hat{h}_t^m = 2, \tag{A4}$$

$$\hat{V}_t = (1 - \theta_t) \hat{V}_t^m + \theta_t \hat{V}_t^f, \tag{A5}$$

$$\hat{V}_t^m = \frac{(\hat{c}_t^m)^{1-\sigma}}{1-\sigma} + \frac{1}{2} \beta n_t^{1-\epsilon} (1 + g_t)^{1-\sigma} \hat{V}_{t+1}, \tag{A6}$$

$$\hat{V}_t^f = \frac{(\hat{c}_t^f)^{1-\sigma}}{1-\sigma} + \frac{1}{2} \beta n_t^{1-\epsilon} (1 + g_t)^{1-\sigma} \hat{V}_{t+1}, \tag{A7}$$

$$\hat{c}_t^m = \vartheta_t \hat{y}_t, \tag{A8}$$

$$\hat{c}_t^f = (1 - \vartheta_t) \hat{y}_t, \tag{A9}$$

$$\vartheta_t = \frac{\theta_t^{1/\sigma}}{\theta_t^{1/\sigma} + (1 - \theta_t)^{1/\sigma}}, \tag{A10}$$

$$\begin{aligned} \frac{\theta_t n_t^\epsilon}{(\hat{c}_t^m)^\sigma} \geq \beta (1 + g_t)^{-\sigma} \Bigg\{ & \frac{\gamma \mu (\hat{h}_{t+1}^f)^\mu (\hat{h}_{t+1}^m)^{\mu-1}}{[(\hat{h}_{t+1}^m)^\mu + (\hat{h}_{t+1}^f)^\mu]^2} \hat{V}_{t+1}^m \\ & + \frac{\theta_{t+1}}{(\hat{c}_{t+1}^m)^\sigma} p_{t+1}^m w_{t+1}^m \Bigg\} \delta (\hat{e}_t^m)^{\delta-1}, \end{aligned} \tag{A11}$$

$$\begin{aligned} \frac{(1 - \theta_t) n_t^\epsilon}{(\hat{c}_t^f)^\sigma} \geq \beta (1 + g_t)^{-\sigma} \Bigg\{ & \frac{\gamma \mu (\hat{h}_{t+1}^f)^{\mu-1} (\hat{h}_{t+1}^m)^\mu}{[(\hat{h}_{t+1}^m)^\mu + (\hat{h}_{t+1}^f)^\mu]^2} \hat{V}_{t+1}^f \\ & + \frac{1 - \theta_{t+1}}{(\hat{c}_{t+1}^f)^\sigma} (p_{t+1}^f - \phi n_{t+1}) w_{t+1}^f \Bigg\} \delta (\hat{e}_t^f)^{\delta-1}, \end{aligned} \tag{A12}$$

$$\hat{V}_{t+1} \geq \frac{\theta_t}{(\hat{c}_t^m)^\sigma} \frac{2(1 + g_t)^{\sigma-1}}{(1 - \epsilon) \beta n_t^{-\epsilon}} \left[\frac{1}{2} (\hat{e}_t^f + \hat{e}_t^m) + \phi w_t^f \hat{h}_t^f \right], \tag{A13}$$

$$\hat{e}_t^f, \hat{e}_t^m \geq 0, \tag{A14}$$

$$n_t \leq p_t^f / \phi. \tag{A15}$$

Appendix B

Corner Regime Growth Rate—Proposition 1

In deriving the expression for the growth rate in the corner regime, $1 + g^M$, we first use equations (A3) and (A4) with $\hat{h}^f = 0$ so as to express the education expenditure on boys in an efficient form as a function of the growth rate:

$$\hat{e}^m = [2(1 + g^M)]^{1/\delta}.$$

The growth rate in the corner equilibrium is then derived from the optimality condition for the education of boys, (A11). Bear in mind that the first term in the right-hand-side brackets of this condition vanishes as $\gamma = 0$ (implying $\partial\vartheta_{t+1}/\partial e_t^m = 0$) in this regime. Hence, we may write

$$\frac{\theta n^\epsilon}{(\hat{c}^m)^\sigma} = \beta(1 + g^M)^{-\sigma}\frac{\theta}{(\hat{c}^m)^\sigma}p^m w^m \delta(\hat{e}^m)^{\delta-1}.$$

With $n = p^f/\phi$ and $\hat{e}_t^m = [2(1 + g^M)]^{1/\delta}$, it is straightforward to derive the expression for the corner regime growth rate:

$$1 + g^M = \left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}(p^f/\phi)^\epsilon}\right]^{\delta/[1-\delta(1-\sigma)]}.$$

Appendix C

Threshold Determination—Proposition 2

We next direct our analysis to the conditions for such an equilibrium to arise. The inequality $1 > \frac{1}{2}\beta n^{1-\epsilon}(1 + g^M)^{1-\sigma}$ is required to hold in order to obtain a finite objective function. This implies the restriction

$$1 > \frac{1}{2}\beta\left(\frac{p^f}{\phi}\right)^{1-\epsilon}\left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}(p^f/\phi)^\epsilon}\right]^{\delta(1-\sigma)/[1-\delta(1-\sigma)]}$$

$$\Leftrightarrow 1 > \frac{1}{2}\beta\left(\frac{p^f}{\phi}\right)^{1-\{\epsilon/[1-\delta(1-\sigma)]\}}\left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}}\right]^{\delta(1-\sigma)/[1-\delta(1-\sigma)]}.$$

This defines a threshold $\bar{p}^f(p^m)$ such that the condition $p^f < \bar{p}^f(p^m)$ is a necessary condition for the corner regime BGP to exist. The term $\bar{p}^f(p^m)$ is a decreasing function of p^m assuming $1 - \delta(1 - \sigma) > \epsilon$, which always holds under assumption 1.

As in the corner equilibrium the upper bound on the maximum number of children is reached, $n = p^f/\phi$, the optimality condition with respect to the number of children (A13) holds as a strict inequality:

$$\hat{V} > \frac{\theta}{(\hat{c}^m)^\sigma}\frac{2(1 + g^M)^{\sigma-1}}{(1 - \epsilon)\beta n^{-\epsilon}}\left(\frac{\hat{e}^m}{2}\right).$$

We compute the steady-state welfare level $\hat{V}$ using equation (A5):

$$\left[1 - \frac{1}{2}\beta n^{1-\epsilon}(1 + g^M)^{1-\sigma}\right]\hat{V} = (1 - \theta)\frac{(\hat{c}^f)^{1-\sigma}}{1 - \sigma} + \theta\frac{(\hat{c}^m)^{1-\sigma}}{1 - \sigma}.$$

Since from equation (A4) $\hat{h}^m = 2$, income can be derived from equation (A2) as

$$\hat{y} = 2p^m w^m - \frac{n}{2}\hat{e}^m,$$

with $n = p^f/\phi$. Next, the individual demands for private consumption expressed in terms of the net income, $\hat{y}_t$, given by equations (A8) and (A9) are substituted into the expression $\hat{V}$, and the following equation for the welfare sum is then obtained:

$$(1-\sigma)\left[1 - \frac{1}{2}\beta n^{1-\epsilon}(1+g^M)^{1-\sigma}\right]\hat{V} = k\left(2p^m w^m - \frac{n}{2}\hat{e}^m\right)^{1-\sigma},$$

with

$$k = (1-\theta)(1-\vartheta)^{1-\sigma} + \theta\vartheta^{1-\sigma}.$$

Substituting this result into the optimality condition with respect to the number of children and replacing $\hat{c}^m$ by its value produces

$$\frac{k[2p^m w^m - (n/2)\hat{e}^m]^{1-\sigma}}{(1-\sigma)[1-(1/2)\beta n^{1-\epsilon}(1+g^M)^{1-\sigma}]} > \frac{\theta}{\{\vartheta[2p^m w^m - \hat{e}^m(p^f/2\phi)]\}^{\sigma}} \frac{2(1+g^M)^{\sigma-1}}{(1-\epsilon)\beta n^{-\epsilon}}\left(\frac{\hat{e}^m}{2}\right),$$

which can be simplified into

$$\frac{k\vartheta^{\sigma}}{\theta} \frac{2p^m w^m - (n/2)\hat{e}^m}{1-(1/2)\beta n^{1-\epsilon}(1+g^M)^{1-\sigma}} > 2(1-\sigma)\frac{(1+g^M)^{\sigma-1}}{(1-\epsilon)\beta n^{-\epsilon}}\left(\frac{\hat{e}^m}{2}\right).$$

Developing the term $k\vartheta^{\sigma}/\theta$ leads us to conclude that it equals one. Since the inequality $1 > \frac{1}{2}\beta n^{1-\epsilon}(1+g^M)^{1-\sigma}$ is required to hold in order to obtain a finite objective function, we can rewrite the above inequality condition as

$$2p^m w^m > \left[(1+g^M)^{\sigma-1} - \frac{1}{2}\beta n^{1-\epsilon}\right]\frac{2(1-\sigma)}{(1-\epsilon)\beta n^{-\epsilon}}\left(\frac{1}{2}\hat{e}^m\right) + \frac{n}{2}\hat{e}^m.$$

Rearranging the terms further leads to

$$\frac{4p^m w^m}{n\hat{e}^m} > \frac{2(1-\sigma)[(1+g^M)^{\sigma-1}n^{\epsilon-1} - (1/2)\beta]}{(1-\epsilon)\beta} + 1.$$

Replacing $\hat{e}^m$ by its value gives

$$\frac{2^{2-(1/\delta)}p^m w^m}{n(1+g^M)^{1/\delta}} > \frac{2(1-\sigma)[(1+g^M)^{\sigma-1}n^{\epsilon-1} - \beta/2]}{(1-\epsilon)\beta} + 1.$$

For ease of notation, let us define $z \equiv \beta\delta p^m w^m / 2^{(1-\delta)/\delta}$. We can then express the growth rate as

$$1 + g^M = (zn^{-\epsilon})^{\delta/[1-\delta(1-\sigma)]} = z^{\delta/[1-\delta(1-\sigma)]}n^{-\epsilon\delta/[1-\delta(1-\sigma)]}.$$

Using this in the above inequality conditions, we get

$$\frac{2}{nz^{1/[1-\delta(1-\sigma)]}n^{-\epsilon/[1-\delta(1-\sigma)]}} \frac{\overbrace{\beta\delta p^m w^m}^{=z}}{2^{(1-\delta)/\delta}} \frac{1}{\beta\delta} >$$

$$\frac{2(1-\sigma)\{z^{\delta(\sigma-1)/[1-\delta(1-\sigma)]}n^{-\epsilon\delta(\sigma-1)/[1-\delta(1-\sigma)]}n^{\epsilon-1} - \beta/2\}}{(1-\epsilon)\beta} + 1,$$

or, equivalently,

$$\frac{2}{\beta\delta}\frac{z^{-\delta(1-\sigma)/[1-\delta(1-\sigma)]}}{n^{[1-\delta(1-\sigma)-\epsilon]/[1-\delta(1-\sigma)]}} >$$

$$\frac{2(1-\sigma)(z^{\delta(1-\sigma)/[1-\delta(1-\sigma)]}n^{\{\epsilon\delta(1-\sigma)+(\epsilon-1)[1-\delta(1-\sigma)]\}/[1-\delta(1-\sigma)]} - \beta/2)}{(1-\epsilon)\beta} + 1$$

$$\Leftrightarrow \frac{2}{\beta\delta} z^{-\delta(1-\sigma)/[1-\delta(1-\sigma)]} n^{-[1-\delta(1-\sigma)-\epsilon]/[1-\delta(1-\sigma)]} >$$

$$\frac{2(1-\sigma)\{z^{-\delta(1-\sigma)/[1-\delta(1-\sigma)]}n^{-[1-\delta(1-\sigma)-\epsilon]/[1-\delta(1-\sigma)]} - \beta/2\}}{(1-\epsilon)\beta} + 1,$$

which can be rewritten as

$$\Leftrightarrow \frac{2}{\beta\delta} Z > \frac{2(1-\sigma)Z}{(1-\epsilon)\beta} - \frac{2(1-\sigma)\beta/2}{(1-\epsilon)\beta} + 1,$$

with

$$Z = z^{-\delta(1-\sigma)/[1-\delta(1-\sigma)]} n^{-[1-\delta(1-\sigma)-\epsilon]/[1-\delta(1-\sigma)]}.$$

Rearranging the terms produces

$$2Z - \frac{2\delta(1-\sigma)}{1-\epsilon} Z > \beta\delta - \frac{2\beta\delta(1-\sigma)}{2(1-\epsilon)}$$

$$\Leftrightarrow Z - \frac{\delta(1-\sigma)}{1-\epsilon} Z > \frac{\beta\delta}{2}\left(1 - \frac{1-\sigma}{1-\epsilon}\right)$$

$$\Leftrightarrow Z[(1-\epsilon) - \delta(1-\sigma)] > \frac{\beta\delta}{2}[(1-\epsilon) - (1-\sigma)].$$

Given that $1 - \delta(1-\sigma) > \epsilon$ holds under assumption 1, we can write

$$Z > \frac{\beta\delta}{2}\left[\frac{(1-\epsilon) - (1-\sigma)}{(1-\epsilon) - \delta(1-\sigma)}\right]. \tag{C1}$$

It is easy to show that this condition is always satisfied given our inequality requirement that $1 > \frac{1}{2}\beta n^{1-\epsilon}(1 + g^M)^{1-\sigma}$, which ensures a finite objective function. We previously showed that this latter requirement translates into the condition

$$\Leftrightarrow 1 > \frac{1}{2}\beta\left(\frac{p^f}{\phi}\right)^{1-\{\epsilon/[1-\delta(1-\sigma)]\}}\left[\frac{\beta\delta p^m w^m}{2^{(1-\delta)/\delta}}\right]^{\delta(1-\sigma)/[1-\delta(1-\sigma)]}.$$

With our previous notation, this inequality condition reduces to

$$1 > \frac{\beta}{2Z} \Leftrightarrow Z > \frac{\beta}{2}. \tag{C2}$$

A little side calculation indicates that the inequality

$$\frac{\beta}{2} > \frac{\beta\delta}{2}\left[\frac{(1-\epsilon) - (1-\sigma)}{(1-\epsilon) - \delta(1-\sigma)}\right]$$

is satisfied for $\delta < 1$, and, as a direct result, we may conclude that whenever inequality (C2) is satisfied, equation (C1) also holds true.

Appendix D

Proof of Proposition 3

Writing the first derivative of the bargaining power variable with respect to education and looking at the limit when girls' education goes toward zero gives the expression

$$\lim_{e^f \to 0} \frac{\partial(1-\theta_{t+1})}{\partial e_t^f} = \frac{\mu (h_{t+1}^m)^\mu}{[(h_{t+1}^m)^\mu + (h_{t+1}^f)^\mu]^2} \delta(\bar{h}_t)^{\mu(1-\delta)} (e_t^f)^{\delta\mu - 1}.$$

Clearly this expression is equal to zero whenever $\mu\delta - 1 > 0$. Hence $\mu\delta - 1 > 0$ is sufficient to have $e^f = 0$, which in turn implies exogenous bargaining power.

Appendix E

Interior BGP with Exogenous Bargaining Power

$$\theta = \bar{\theta},$$

$$\hat{y} = (p^f - \phi n) w^f \hat{h}^f + p^m w^m \hat{h}^m - (\hat{e}^f + \hat{e}^m) \frac{n}{2},$$

$$(1+g)\hat{h}^i = (\hat{e}^i)^\delta,$$

$$\hat{h}^f + \hat{h}^m = 2,$$

$$\hat{V} = (1-\theta) \frac{(\hat{c}^f)^{1-\sigma}}{1-\sigma} + \theta \frac{(\hat{c}^m)^{1-\sigma}}{1-\sigma} + \frac{1}{2} \beta n^{1-\epsilon} (1+g)^{1-\sigma} \hat{V},$$

$$\hat{c}^m = \vartheta \hat{y},$$

$$\hat{c}^f = (1-\vartheta)\hat{y},$$

$$\vartheta = \frac{\theta^{1/\sigma}}{\theta^{1/\sigma} + (1-\theta)^{1/\sigma}},$$

$$n^\epsilon = \beta(1+g)^{-\sigma} p^m w^m \delta (\hat{e}^m)^{\delta-1},$$

$$n^\epsilon = \beta(1+g)^{-\sigma} (p^f - \phi n) w^f \delta (\hat{e}^f)^{\delta-1},$$

$$\hat{V} = \frac{\theta}{(\hat{c}^m)^\sigma} \frac{2(1+g)^{\sigma-1}}{(1-\epsilon)\beta n^{-\epsilon}} \left[\frac{1}{2} (\hat{e}^f + \hat{e}^m) + \phi w^f \hat{h}^f \right].$$

Appendix F

TABLE F1
DATA

	World Health Organization					Our Computations					World Economic Forum			
	L1	L20 Females	L50 Females	Eq. (15): Max Net Fertility	WDI: Births per Woman	Net Births per Woman	Fertility Margin	Corner Regime	WDI: Girls/Boys Primary Completion	UN: Parliamentary Seats Occupied by Women (%)	Economic Participation and Support	Educational Attainment	Health and Survival	Political Empowerment
Swaziland	89,555	81,800	22,700	3.63	3.91	3.50	.13	1	1.07	6.95				
Zimbabwe	93,987	89,262	24,786	3.68	3.34	3.14	.54	1	.95	12.30	.604	.925	.952	.105
Lesotho	89,834	85,178	29,435	4.53	3.40	3.05	1.47	1	1.37	8.20	.661	1.000	.980	.190
Zambia	89,626	78,337	34,264	5.73	5.40	4.84	.89	1	.81	11.76	.571	.848	.961	.135
Namibia	95,390	93,106	45,271	6.47	3.66	3.49	2.98	1	1.12	25.11	.672	.993	.968	.172
Malawi	92,156	84,640	41,847	6.52	5.84	5.38	1.14	1	.95	10.26	.675	.865	.961	.090
Central African Republic	88,460	77,387	39,348	6.63	4.73	4.18	2.45	1	.57	8.37				
Mozambique	89,996	82,949	42,092	6.65	5.30	4.77	1.88	1	.66	31.20	.797	.752	.978	.226
South Africa	94,923	91,305	52,048	7.58	2.78	2.64	4.94	0	1.03	30.79	.586	.991	.975	.326
Ivory Coast	88,161	80,007	49,762	8.11	4.70	4.14	3.96	0	.65	8.43				
Angola	84,615	69,916	44,089	8.13	6.56	5.55	2.58	1		15.33	.585	.779	.980	.070
Kenya	92,167	86,349	53,732	8.21	4.98	4.59	3.62	1	.97	5.57	.649	.934	.968	.053
Tanzania	92,429	83,740	52,457	8.27	5.20	4.81	3.46	1	1.01		.780	.859	.969	.180
Sierra Leone	83,491	66,419	43,296	8.37	6.48	5.41	2.96	1		12.36				
Niger	84,993	67,741	45,638	8.69	7.67	6.52	2.17	1	.67	4.93				
Botswana	91,041	85,397	57,301	8.82	3.03	2.76	6.06	0	1.15	13.73	.640	.998	.953	.129
Uganda	92,063	83,260	56,176	8.90	7.10	6.54	2.36	1	.86	22.83	.676	.874	.976	.207
Rwanda	88,177	75,770	52,274	8.99	5.80	5.11	3.88	1	.94	34.06				
Equatorial Guinea	87,686	76,066	53,001	9.07	5.89	5.16	3.90	1	.85	9.76				

Afghanistan	83,498	68,111	48,216	9.09	7.90	6.60	2.49	1	.39	27.30				
Gabon	94,084	90,272	62,470	9.18	3.73	3.51	5.67	0	1.04	9.39				
Guinea-Bissau	87,602	76,769	54,525	9.24	7.08	6.20	3.04	1	.56	10.77				
Cameroon	91,315	82,782	58,174	9.25	5.00	4.57	4.68	0	.87		.511	.826	.969	.061
Nigeria	89,918	76,981	54,805	9.33	5.70	5.13	4.20	0	.83	4.87	.621	.808	.969	.052
Burundi	88,588	77,296	55,319	9.34	6.80	6.02	3.32	1	.76	18.01				
Congo	92,057	87,101	61,734	9.35	5.60	5.16	4.19	0	.95	10.14				
Liberia	84,306	72,915	53,229	9.40	6.78	5.72	3.68	1		8.79				
Chad	87,580	75,209	55,041	9.52	6.30	5.52	4.00	0	.46	4.52	.652	.470	.976	.054
Mali	87,968	74,634	54,613	9.53	6.72	5.91	3.62	1	.65	11.09	.695	.652	.969	.091
Burkina Faso	90,358	76,858	57,482	9.81	5.90	5.33	4.48	0	.73	10.10	.631	.680	.970	.084
Congo (D.R.)	87,090	76,413	58,598	9.96	6.70	5.84	4.13	0	.67	11.10				
Benin	91,090	81,776	62,701	10.08	5.60	5.10	4.98	0	.60	6.67	.543	.658	.975	.086
Togo	92,170	84,671	65,680	10.23	5.03	4.64	5.60	0	.69	6.00				
Djibouti	91,200	84,729	66,067	10.26	4.74	4.32	5.93	0	.73	6.75				
Haiti	91,681	85,712	66,898	10.28	3.75	3.44	6.84	0		3.66				
Ghana	93,205	86,636	68,785	10.50	4.06	3.78	6.72	0	.95	9.71	.781	.871	.967	.071
Guinea	90,214	82,506	66,147	10.52	5.60	5.05	5.46	0	.62	14.63				
Gambia	90,344	84,506	69,013	10.72	4.40	3.98	6.74	0		8.53	.687	.808	.980	.094
Cambodia	90,215	84,435	69,394	10.78	3.89	3.51	7.27	0	.88	8.70	.664	.845	.980	.053
Ethiopia	92,263	86,268	70,899	10.84	5.32	4.91	5.94	0	.70	9.53	.585	.740	.969	.102
Eritrea	95,031	91,232	75,394	10.99	5.24	4.98	6.01	0	.75	19.46				
Senegal	92,292	84,196	70,229	11.01	4.90	4.52	6.49	0	.82	16.56				
Somalia	91,036	82,090	68,915	11.04	6.20	5.64	5.39	0		7.90				
Sudan	93,792	89,544	74,957	11.09	4.15	3.89	7.20	0	.86	10.94				
Laos	93,792	89,862	75,313	11.11	3.59	3.37	7.74	0	.89	22.40				
Guyana	95,300	92,118	77,709	11.23	2.18	2.08	9.15	0	.93	23.45				
Nepal	94,376	89,729	76,023	11.25	3.46	3.27	7.98	0	.84	7.68	.457	.734	.955	.085
Mauritania	92,213	86,119	73,936	11.33	5.59	5.15	6.17	0	.90	6.12	.505	.832	.980	.092
Myanmar	92,591	88,851	77,214	11.48	2.23	2.06	9.41	0	1.01					
Bangladesh	94,601	90,884	78,570	11.48	2.98	2.82	8.66	0	1.06	6.87	.437	.871	.950	.267
Madagascar	92,598	86,321	75,405	11.54	5.04	4.67	6.87	0	1.02	6.54	.609	.958	.980	.038
Sao Tome and Principe	92,502	86,290	75,691	11.58	3.76	3.48	8.10	0	1.09	8.88				
Papua New Guinea	94,559	91,058	79,478	11.59	3.80	3.59	8.00	0	.88	1.30				
Yemen	92,402	88,042	78,247	11.73	5.87	5.42	6.31	0	.54	.52	.251	.565	.980	.008

TABLE F1
(*Continued*)

	World Health Organization					Our Computations				UN:	World Economic Forum			
	L1	L20 Females	L50 Females	Eq. (15): Max Net Fertility	WDI: Births per Woman	Net Births per Woman	Fertility Margin	Corner Regime	WDI: Girls/Boys Primary Completion	Parliamentary Seats Occupied by Women (%)	Economic Participation and Support	Educational Attainment	Health and Survival	Political Empowerment
India	94,399	90,108	80,736	11.89	2.84	2.68	9.21	0	.87	8.60	.398	.819	.931	.227
Pakistan	92,214	88,645	80,215	11.94	4.12	3.80	8.14	0	.72	18.23	.372	.734	.950	.148
Kiribati	95,277	92,042	83,255	12.04	3.60	3.43	8.61	0	.93	4.54				
Grenada	98,350	97,398	87,781	12.09	3.00	2.95	9.14	0	.94	25.86				
Bhutan	93,727	92,028	84,056	12.10	2.50	2.34	9.76	0		6.94				
Indonesia	97,194	95,335	86,342	12.11	2.27	2.21	9.91	0	1.01	9.66	.599	.949	.972	.101
Comoros	94,696	92,041	84,004	12.13	3.76	3.56	8.57	0	.91	2.25				
Iraq	96,317	92,805	84,350	12.13	5.37	5.17	6.96	0	.76	12.37				
Bolivia	94,801	92,162	84,140	12.13	3.65	3.46	8.67	0	.95	15.56	.607	.968	.967	.087
Kazakhstan	97,331	96,583	87,730	12.15	1.75	1.70	10.45	0	.99	10.73	.737	.989	.979	.089
Cape Verde	97,498	95,807	87,506	12.23	3.53	3.44	8.78	0	1.02	12.03				
Guatemala	96,793	94,567	86,645	12.24	4.33	4.19	8.05	0	.86	8.76	.471	.897	.980	.110
Korea (P.R.)	95,800	93,473	86,132	12.28	1.96	1.88	10.40	0		20.10				
Bahamas	98,740	98,339	90,097	12.30	2.25	2.22	10.08	0	1.01	17.78				
Belize	98,555	97,782	89,652	12.31	2.97	2.93	9.38	0	1.03		.552	1.000	.980	.039
Russian Federation	98,906	98,159	89,957	12.31	1.29	1.28	11.04	0		8.89	.735	.999	.979	.034
Thailand	98,202	97,037	89,125	12.32	1.89	1.86	10.46	0	.98	8.39	.724	.973	.980	.050
Kyrgyzstan	94,196	93,223	86,561	12.32	2.41	2.27	10.05	0	.99	5.01	.653	.994	.980	.035
Mongolia	96,083	95,296	88,289	12.36	2.33	2.24	10.12	0	1.05	8.66	.668	.999	.980	.046
Turkmenistan	91,891	90,447	84,799	12.36	2.60	2.39	9.97	0		22.50				
Philippines	97,505	96,328	88,947	12.36	3.20	3.12	9.24	0	1.08	15.09	.789	1.000	.980	.283
Tajikistan	94,100	92,630	86,632	12.41	3.53	3.32	9.08	0	.94	11.82	.710	.869	.979	.074
Fiji	98,400	97,458	90,199	12.42	2.79	2.75	9.67	0	1.03	7.10				
Trinidad and Tobago	98,300	97,784	90,875	12.47	1.61	1.58	10.88	0	.99	16.99	.639	.996	.980	.130

Dominican Republic	97,402	96,553	89,951	12.47	2.95	2.87	9.59	0	1.09	17.03	.585	1.000	.980	.117
Suriname	97,000	95,166	88,896	12.49	2.51	2.43	10.05	0	1.17	19.35	.617	.989	.973	.139
Uzbekistan	94,276	93,874	88,476	12.51	2.22	2.09	10.41	0	1.00	10.46	.754	.963	.977	.075
Ukraine	98,024	97,503	91,050	12.52	1.20	1.18	11.34	0	1.00	6.80	.708	.984	.973	.050
Honduras	97,744	96,692	90,577	12.55	3.47	3.39	9.16	0	1.06	11.21	.549	1.000	.980	.136
Nicaragua	97,028	95,875	90,186	12.58	3.08	2.99	9.59	0	1.11	16.91	.434	.991	.976	.181
Lebanon	97,322	96,453	90,703	12.58	2.25	2.19	10.39	0						
Peru	97,702	96,653	90,818	12.58	2.86	2.79	9.79	0	.98	18.03	.537	.976	.971	.165
Saudi Arabia	97,919	96,862	90,988	12.59	3.83	3.75	8.84	0	1.01	.00	.321	.961	.976	.000
Algeria	96,602	95,350	90,150	12.63	2.44	2.36	10.27	0	1.00	4.91	.464	.942	.971	.049
Azerbaijan	92,582	90,991	87,025	12.63	2.33	2.16	10.47	0	.99	11.16	.732	.971	.926	.083
El Salvador	97,694	96,839	91,346	12.63	2.76	2.70	9.94	0	1.01	12.30	.576	.988	.980	.197
Ecuador	97,800	96,728	91,228	12.64	2.67	2.61	10.02	0	1.01	17.00	.634	.994	.980	.145
Egypt	97,198	95,832	90,537	12.64	3.10	3.01	9.62	0	.95	2.26	.421	.909	.972	.022
Jamaica	98,319	97,489	91,979	12.66	2.38	2.34	10.32	0	1.05	12.44	.701	1.000	.971	.098
Brazil	97,244	96,507	91,493	12.68	2.28	2.22	10.47	0	1.01	7.46	.645	.969	.980	.062
Dominica	98,697	98,155	92,773	12.69	1.90	1.88	10.82	0	.93	15.05				
Jordan	97,798	96,776	91,754	12.70	3.29	3.22	9.48	0	1.00	2.73	.483	.979	.971	.048
Moldova	98,601	98,158	92,875	12.70	1.27	1.25	11.45	0	.99	14.36	.778	.994	.979	.117
Belarus	99,390	98,937	93,453	12.71	1.24	1.23	11.47	0	.98		.728	.983	.979	.155
Vietnam	98,403	97,546	92,533	12.73	1.78	1.75	10.98	0	.94	26.74	.745	.892	.970	.148
Turkey	97,398	96,512	91,839	12.73	2.19	2.13	10.60	0	.90	4.11	.431	.854	.971	.052
Syria	98,818	98,418	93,369	12.74	3.24	3.20	9.54	0	.95	11.11	.524	.927	.976	.059
Iran	96,995	96,040	91,683	12.76	2.07	2.01	10.75	0	1.00	4.12	.395	.958	.978	.031
Lithuania	99,311	98,812	93,932	12.78	1.27	1.26	11.52	0	.99	16.24	.761	.998	.979	.155
Latvia	99,230	98,770	93,918	12.79	1.31	1.30	11.49	0	1.00	19.00	.734	.986	.980	.233
Antigua and Barbuda	99,000	98,487	93,774	12.80	1.70	1.68	11.11	0		7.25				
Tunisia	98,100	97,453	93,036	12.80	2.04	2.00	10.80	0	1.00	14.81	.474	.959	.970	.110
Libyan Arab Jamahiriya	98,300	97,582	93,115	12.80	3.03	2.98	9.82	0		6.20				
Venezuela	98,200	97,491	93,096	12.81	2.65	2.60	10.20	0	1.06	12.00	.631	.999	.980	.110
Georgia	97,175	96,488	92,486	12.82	1.39	1.35	11.47	0	1.01	7.90	.630	.998	.933	.104
Seychelles	98,839	98,200	93,795	12.83	2.10	2.08	10.75	0	1.00	26.78				
China	97,688	96,298	92,337	12.84	1.81	1.77	11.07	0		21.11	.648	.957	.941	.111
Armenia	97,399	97,013	93,104	12.84	1.37	1.33	11.51	0	1.02	4.36	.721	.999	.923	.017
Albania	98,400	97,217	93,073	12.85	1.78	1.75	11.09	0	1.00	6.01	.689	.992	.955	.038
Paraguay	98,000	97,375	93,326	12.85	3.67	3.60	9.25	0	1.01	6.25	.594	.945	.980	.144

TABLE F1
(*Continued*)

	World Health Organization					Our Computations					World Economic Forum			
	L1	L20 Females	L50 Females	Eq. (15): Max Net Fertility	WDI: Births per Woman	Net Births per Woman	Fertility Margin	Corner Regime	WDI: Girls/Boys Primary Completion	UN: Parliamentary Seats Occupied by Women (%)	Economic Participation and Support	Educational Attainment	Health and Survival	Political Empowerment
Sri Lanka	98,882	98,168	93,926	12.85	1.91	1.89	10.97	0		4.81	.557	.990	.980	.365
Morocco	96,567	96,147	92,582	12.86	2.40	2.32	10.54	0	.88	6.27	.401	.845	.972	.053
Romania	98,383	97,898	93,919	12.87	1.32	1.30	11.57	0	.99	10.13	.697	.993	.979	.074
Mauritius	98,764	98,284	94,268	12.88	1.98	1.96	10.93	0	1.02	8.66	.547	.983	.980	.085
Hungary	99,366	99,088	94,913	12.88	1.32	1.31	11.57	0	1.00	9.04	.653	.991	.979	.069
Colombia	98,296	97,573	93,765	12.89	2.40	2.36	10.53	0	1.05	11.49	.691	1.000	.980	.166
Mexico	97,794	97,122	93,568	12.91	2.11	2.06	10.84	0	1.01	19.51	.489	.992	.980	.116
Malaysia	99,000	98,399	94,519	12.91	2.74	2.71	10.20	0	1.00	9.60	.567	.985	.969	.056
Panama	98,180	97,345	93,737	12.91	2.62	2.57	10.34	0	1.00	12.43	.655	.994	.980	.153
Barbados	98,920	98,537	94,802	12.93	1.69	1.67	11.25	0	1.00	11.86				
Oman	98,999	98,424	94,738	12.94	3.44	3.41	9.53	0	.99	2.40	.384	.971	.971	.035
Bulgaria	98,973	98,374	94,702	12.94	1.31	1.30	11.64	0	.98	20.20	.699	.989	.979	.167
Argentina	98,567	98,061	94,519	12.94	2.29	2.26	10.68	0	1.05	31.01	.613	.996	.980	.204
Bosnia and Herzego-vina	98,700	98,225	94,689	12.94	1.19	1.17	11.77	0		16.69				
Uruguay	98,730	98,312	94,829	12.95	2.00	1.97	10.98	0	1.04	11.32	.634	.991	.980	.039
United States	99,341	98,971	95,485	12.98	2.05	2.04	10.94	0		14.40	.738	.982	.979	.102
Estonia	99,550	99,224	95,685	12.98	1.50	1.49	11.48	0	.98	17.48	.694	.999	.979	.131
Maldives	97,383	96,733	93,912	12.99	4.00	3.90	9.10	0	1.02	8.29	.514	1.000	.951	.075
Cuba	99,484	99,089	95,884	13.02	1.50	1.49	11.53	0	.99	32.27	.681	.990	.974	.222
Macedonia	98,538	98,296	95,424	13.03	1.60	1.58	11.45	0	1.01	14.63	.665	.985	.963	.173
Slovakia	99,277	98,989	96,082	13.05	1.25	1.24	11.81	0	1.00	16.16	.667	.995	.980	.077
Poland	99,355	99,047	96,122	13.05	1.24	1.23	11.82	0		17.84	.617	1.000	.979	.107
Costa Rica	98,930	98,547	95,754	13.06	2.00	1.98	11.08	0	1.03		.554	.995	.980	.277
Bahrain	99,084	98,568	95,778	13.06	2.34	2.32	10.74	0	1.02	.50	.390	.989	.961	.031

Brunei Darussalam	99,201	98,831	96,281	13.10	2.38	2.36	10.74	0	0.99					
Denmark	99,590	99,349	96,796	13.11	1.80	1.79	11.32	0	1.00	37.56	.734	1.000	.970	.305
Portugal	99,635	99,239	96,679	13.11	1.40	1.39	11.72	0	1.06	18.63	.684	.989	.973	.138
Czech Republic	99,654	99,365	96,829	13.12	1.28	1.28	11.84	0	1.00	15.94	.630	.991	.979	.088
Netherlands	99,564	99,355	96,857	13.12	1.73	1.72	11.40	0	.98	36.39	.667	.993	.974	.319
France	99,628	99,398	96,893	13.12	1.92	1.91	11.21	0		11.62	.646	1.000	.980	.104
United Kingdom	99,502	99,246	96,794	13.12	1.80	1.79	11.33	0		18.47	.695	1.000	.974	.307
Belgium	99,628	99,384	96,903	13.12	1.72	1.71	11.41	0		27.26	.668	1.000	.979	.232
United Arab Emirates	99,247	99,013	96,642	13.12	2.43	2.41	10.71	0	.97	2.50	.421	.987	.961	.105
New Zealand	99,466	99,088	96,664	13.13	2.00	1.99	11.14	0		30.02	.755	.999	.974	.331
Chile	99,186	98,894	96,578	13.13	1.97	1.95	11.18	0	.96	12.49	.517	.980	.980	.116
Finland	99,690	99,394	96,993	13.14	1.80	1.79	11.34	0	1.00	36.72	.723	.999	.980	.517
Croatia	99,486	99,151	96,814	13.14	1.42	1.41	11.73	0	.99	19.04	.678	.989	.979	.238
Korea, Rep.	99,504	99,195	96,916	13.15	1.08	1.07	12.07	0	1.01	7.82	.580	.949	.967	.067
Norway	99,686	99,332	97,079	13.16	1.84	1.83	11.32	0	1.00	36.87	.751	1.000	.979	.494
Canada	99,505	99,256	97,076	13.16	1.51	1.50	11.66	0		20.70	.743	.999	.979	.159
Ireland	99,602	99,252	97,053	13.16	1.88	1.87	11.29	0	1.01	12.72	.667	1.000	.973	.343
Germany	99,614	99,387	97,227	13.17	1.36	1.35	11.81	0	1.00	31.67	.700	.995	.978	.374
Luxembourg	99,580	99,391	97,293	13.17	1.70	1.69	11.48	0	1.03	19.27	.606	1.000	.973	.135
Austria	99,587	99,293	97,248	13.18	1.41	1.40	11.78	0	.99	30.49	.582	.980	.980	.282
Australia	99,491	99,242	97,239	13.18	1.77	1.76	11.42	0		24.19	.744	1.000	.974	.163
Greece	99,617	99,292	97,330	13.19	1.28	1.28	11.92	0	.99	9.71	.630	.989	.979	.061
Spain	99,622	99,376	97,413	13.19	1.33	1.32	11.87	0	.99	29.72	.589	.994	.973	.421
Switzerland	99,578	99,369	97,437	13.20	1.42	1.41	11.78	0	1.02	23.61	.676	.957	.978	.158
Israel	99,595	99,326	97,397	13.20	2.82	2.81	10.39	0	1.00		.671	.995	.970	.150
Japan	99,722	99,483	97,568	13.20	1.26	1.26	11.95	0		7.10	.549	.986	.979	.067
Slovenia	99,654	99,388	97,521	13.21	1.23	1.23	11.98	0	1.00	11.22	.705	.999	.973	.060
Iceland	99,786	99,536	97,635	13.21	2.05	2.05	11.16	0	.99	32.44	.721	.987	.970	.456
Singapore	99,733	99,537	97,674	13.21	1.24	1.24	11.97	0			.655	.931	.958	.101
Italy	99,630	99,414	97,630	13.22	1.32	1.32	11.90	0	.99	11.82	.543	.997	.972	.087
Sweden	99,696	99,480	97,699	13.22	1.77	1.76	11.46	0		44.37	.761	.999	.974	.525
Kuwait	99,053	98,564	96,960	13.22	2.39	2.37	10.85	0	1.00	.33	.604	.989	.961	.010
Qatar	99,065	98,683	97,075	13.22	2.89	2.86	10.36	0	1.00	.00	.456	.993	.947	.021
Malta	99,514	99,265	97,589	13.23	1.37	1.36	11.87	0	.99	9.20	.549	.998	.974	.126
Cyprus	99,673	99,429	97,824	13.24	1.42	1.42	11.83	0	1.01	10.72	.602	.989	.966	.052

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