Discussion Paper Series

A Theory of Social Norms, Women's Time Allocation, and Gender Inequality in the Process of Development

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February 2018
Number 237

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Abstract

This paper studies how social norms influence gender bias in the workplace and in the family, how these two forms of discrimination interact among themselves and with intra-household bargaining, and how gender norms evolve in the course of development. The presence of women in the labor market is a key determinant of the degree of gender bias in the workplace. Household preferences towards girls' education depend on women's bargaining power which, through the male-female wage gap, depends itself on gender bias in the labor market. Experiments with a calibrated version of the model for a stylized low-income country show that interactions between social norms, women's time allocation, and gender gaps are a critical source of growth dynamics. Initial measures aimed at mitigating the influence of discriminatory norms regarding gender roles in the workplace and in the family can magnify over time the benefits of standard policy prescriptions (aimed for instance at fostering childhood education) in promoting development and gender equality.

JEL Classification Numbers: I15, I25, J16, O41

*School of Social Sciences, University of Manchester. I am grateful to Baris Alpaslan, Jennifer Golan, and participants at various seminars for helpful comments and discussions, and to King Yoong Lim for excellent research assistance. I bear sole responsibility for the views expressed in this paper.

1 Introduction

A growing consensus among economists and policymakers is that economic development can promote gender equality only if it is accompanied by cultural and social changes regarding gender roles. Norms that require women to stay at home and devote themselves to household chores and child rearing, instead of education and market activity, or norms that discourage parents from sending their daughters to school and devote time to rearing them, can represent significant obstacles to development. These norms may exert a self-perpetuating influence on gender stereotypes, which may create obstacles to women's participation in the labor force. In turn, low female labor force participation may make social norms about women not working more acceptable to society and hamper their ability to organize through the political or legislative process in order to stand up to discrimination. This two-way causality may in effect generate a gender inequality trap, that is, an equilibrium with low growth and high discrimination against women.

If social norms—broadly defined, along the lines discussed by Burke and Young (2011) and Eriksson (2015) as customary rules of behavior that coordinate interactions between individuals in a given society—play a critical role in determining the status of women in society, understanding how they change over time becomes of paramount importance. The prevailing view among social scientists is that social norms persist mainly because of *path dependency* (created by traditions or religious beliefs for instance, and sometimes sustained by legal institutions), *coordination problems* (related to the difficulty of agreeing on, and coordinating around, a new norm, even when there is broad consensus that the existing norm is inadequate), *interdependence* (changing one norm requires changing others), and *transition costs* (which occur when those who are adversely affected by a change in norms must be temporarily compensated).[1] The perspective taken in this paper is that although gender norms display path dependency over time they also respond endogenously to economic forces, as broadly documented by Kleven and Landais (2017). This endogenous response shapes in significant ways their evolution in the course of development.

Studies focusing on endogenous social norms, gender inequality, and economic development are relatively few and include de la Croix and Vander Donckt (2010), Hiller

[1] See the various contributions collected in Hechter and Opp (2005) and more specifically Giuliano (2017) on intergenerational transmission of gender norms from parents to children.

(2014), and Prettner and Strulik (2017).[2] In de la Croix and Vander Donckt (2010), the introduction of gender heterogeneity in rearing time creates a motive for discrimination by parents and may generate a corner equilibrium with both gender inequality in education and the complete absence of women in the labor force. However, their analysis abstracts from gender bias and gender-based differences in preferences between spouses, while at the same keeping time allocation and wage gaps exogenous.

In Hiller (2014), by contrast, social norms about gender roles affect the family's preferences for women's education; these preferences are endogenous and evolve as a function of the relative supply of female labor—or, equivalently in his setting, the gender gap in education. In turn, these norms influence how much the family spends on educating boys and girls. Hiller's analysis also abstracts from the microeconomic process of norm formation and assumes instead that cultural norms, embodied in household preferences, evolve with the average behavior within the population. This helps to create intergenerational persistence of the earning gap between men and women in a simple way, and to study analytically the joint dynamics between gender roles, gender inequality, and economic development. The key result is that the two-way causality between gender norms and the gender gap in education may generate high gender inequality and a low development trap, of the type alluded to earlier. But as female labor supply grows, stereotypes with regard to their role in society change as well and norms become less discriminatory—eventually allowing countries to escape from a bad equilibrium.

However, Hiller's model does not account for women's time allocated to child rearing and the fact that social norms may affect *both* the level, and the allocation, of parental rearing time between sons and daughters. It also abstracts from gender bias in the work place and intra-household bargaining, the possible interactions between them and gender norms, and the role that bargaining power may play in the allocation of time to home production between spouses—above and beyond wage differentials. In addition, its focus is on the *level* of income, rather than the rate of economic growth; its long-run implications for development are therefore not fully worked out.

[2]Endogenous theories of social norms related to female labor force participation have also been developed most notably by Fogli and Veldkamp (2011) and Fernández (2013). Both contributions emphasize an intergenerational learning mechanism through which beliefs (and female participation itself) evolve over time. However, while the emphasis on the diffusion of (noisy) information and learning may be useful to explain post-World War II outcomes in some developed countries, it is far removed from the key mechanisms for low-income countries that are emphasized int this paper.

An explicit growth dimension is accounted for by Prettner and Strulik (2017), who consider gender-specific child rearing effort and two distinct dimensions of gender-specific preferences: *a*) a greater desire of fathers for a large number of offspring (quantity margin) and a higher desire of mothers for education per child (quality margin); and *b*) a greater desire of both spouses for the education of boys, relative to girls, as in Hiller (2014). They show analytically that if the child quantity-quality preferences of spouses differ sufficiently (that is, along the first dimension described earlier), female empowerment can promote the transition from a state of high fertility, low education, and slow economic growth to a state of low fertility, high education, and rapid growth. The reason is that a large gender difference in preferences along dimension *a*) helps to accelerate the demographic transition and thus directly affects the take-off to sustained economic growth. However, even though fertility and women's bargaining power are both endogenous, changes in preferences are not; and again, interactions between gender bias in the market place and in the home are not considered. They also limit women's time allocation to market work and child rearing (given their focus on fertility effects) while ignoring home production—a component of women's time that may itself depend on intra-household bargaining, and changes in which may affect significantly time allocated to market work.

This paper fills several gaps in the existing literature by offering an integrated, dynamic theory of the interactions between gender norms (which translate into gender biases in wage earnings, household preferences toward girls' education, and time devoted by spouses to home production), women's time allocation, and intra-household bargaining power in the course of development. In line with Hiller (2014), working women are agents of change; as women engage more intensively in market work, social norms and attitudes toward women engaged in paid work become more favorable—thereby mitigating gender wage gaps in the labor market. Reductions in these gaps do not affect directly women's incentives to work; instead, by increasing women's bargaining power in the family, it allows them to spend relatively less time in home production—which, in the model, depends on both male and female labor. In addition, because women's bargaining power affects the family's preference for girls' education, they end up devoting more time to child rearing in general and more time to girls specifically—thereby raising their human capital relatively more in adulthood. Thus, while women's presence in the

labor force is influenced by social norms that condone gender inequality, in turn gender inequality affects directly the evolution of these norms in the market place, as well as indirectly family norms and preferences toward girls education' and time that parents devote to their daughters.[3]

The model is calibrated for a stylized low-income country and used to perform a core experiment involving a development policy aimed at promoting human capital accumulation. This policy (which by itself has no impact whatsoever on male or female time allocation) is then combined with policies aimed at promoting gender equality in the workplace and in the family, individually and jointly. Numerical experiments show that interactions between social norms, women's time allocation, and gender gaps are a critical source of growth dynamics.[4] The key implication is that measures aimed at mitigating the combined influence of social norms and beliefs regarding gender roles in the office and in the home can be a significant complement to standard policy prescriptions aimed at promoting growth and development. Indeed, when social norms are endogenous and interact in the way predicted by the theory proposed in this paper, initial policies aimed at promoting gender equality can generate a virtuous circle (with possible nonlinearities) that helps to magnify over time the short-run gains associated with these policies.

The remainder of the paper is organized as follows. Section 2 presents the model, whereas Section 3 characterizes the balanced growth equilibrium and its implications for gender inequality. Section 4 describes the calibration to a stylized developing economy. The impact of public policy, involving both increased spending on child education and measures aimed at promoting gender equality, on the dynamics of social norms, women's time allocation, and growth are discussed in Section 5. Sensitivity analysis is reported in Section 6. Some supportive empirical evidence for the model's main predictions is presented in Section 7. The final section discusses some possible extensions.

[3] Postlewaite (2011) emphasized the importance of accounting for the "underlying foundations" of social norms in assessing their impact on household preferences, as is done here. Bertrand (2011) provided a review of the literature on social norms and gender preferences, albeit with a focus on labor market outcomes.

[4] The link between wage equality, women's bargaining power and time allocated by husbands and wives to home production is consistent with the interpretation by Feyrer et al. (2008) of what they refer to as the "last phase" of the behavior of fertility rates in high-income countries. However, their analysis remains partial equilibrium in nature; in particular, they do not account for the endogeneity of wages and the feedback effect of increases in women's labor force participation on gender bias in the market place, as is done here.

2 The Model

Consider an economy where two goods are produced, a market good and a home good, and individuals live for three periods: childhood (period $t-1$), adulthood (period t) and retirement (period $t+1$). The market good can be either consumed in the period it is produced or stored to yield capital at the beginning of the next period. Each individual is either male or female, and is endowed with one unit of time in each period of life. In childhood time is devoted entirely to schooling, whereas in old age time is devoted entirely to leisure. For simplicity, only the market good is consumed in old age. At the beginning of adulthood, individuals meet randomly with someone of the opposite sex to form a family. Once married, individuals do not divorce; couples retire together and die together.[5] All income is pooled and there is full consumption insurance in each household.

Husbands consider three alternatives to allocate their time: home production, market work, and leisure and personal time. Wives, in addition to these alternatives, also engage in child rearing. These assumptions capture the well-documented fact that women in low- and middle-income developing countries bear a disproportionate part of the burden of child rearing (see World Bank (2011) and Charmes (2015)).[6] At the same time, as further discussed in the concluding section, the assumption that men do not engage in that activity makes the model more relevant to explaining women's time allocation during the transition from low- to middle-income status, rather than from middle- to high-income status.

2.1 Family Preferences

Procreation occurs at the beginning of adulthood in t, after all men and women are randomly matched into married couples, and produces n_t children per family. Children do not consume but rearing each child entails a cost of $\theta^R \in (0,1)$ of the family's net income. To ensure that the gender composition of the population remains balanced over time, children consist of daughters and sons in equal numbers. A mother must spend

[5] The assumption that spouses die together is consistent with the evidence on the so-called *broken heart syndrome*, clinically known as stress cardiomyopathy. See Templin (2015) for instance.

[6] The model does not account for the impact of access (or lack thereof) to infrastructure on women's time allocation—an important matter for many developing economies, but one that is largely tangential to the main issue of this paper.

$\varepsilon_t^{f,R} \in (0,1)$ units of rearing time on each child; this involves taking children to school, home tutoring, and so on.

The only source of income for all individuals, male or female (identified with superscripts m and f, respectively), is wages earned from market work in middle age. Agents have no other endowments, except for a stock of physical capital at $t = 0$, which is the endowment of an initial old generation. This stock is accumulated through family savings. Each adult $j = f, m$ is endowed with $e_t^{j,A}$ units of human capital and earns an effective market wage, w_t^j, per unit of time worked.

Let $\varepsilon_t^{j,P}$, $\varepsilon_t^{j,W}$, and $\varepsilon_t^{j,R}$ denote time allocated to home production, market activity, and child rearing, respectively, by adult j. Abstracting from economies of scope between child rearing and home production, and economies of scale in rearing children, time allocated to leisure, $\varepsilon_t^{j,L}$, is thus

$$\varepsilon_t^{j,L} = 1 - \varepsilon_t^{j,P} - \varepsilon_t^{j,W} - n_t \varepsilon_t^{j,R}, \tag{1}$$

with $\varepsilon_t^{j,R} = 0$ for $j = m$.

Each parent's utility function is given by

$$U_t^j = \eta_Q \ln Q_t + \eta_C^j \ln c_t^{j,t-1} + \eta_N^j \ln n_t \tag{2}$$

$$+\eta_L \ln \varepsilon_t^{j,L} + \eta_G(\chi_t \ln e_t^{f,C} + \ln e_t^{m,C}) + \frac{1-\eta_C^j}{1+\rho} \ln c_{t+1}^{j,t-1},$$

where $c_t^{j,t-1}$ ($c_{t+1}^{j,t-1}$), is adult j's consumption in adulthood (old age), Q_t production of home goods, $e_t^{j,C}$ human capital in childhood, and $\rho > 0$ the discount rate. Parents value in the same way consumption of the home good and leisure; the preference parameters η_Q and η_L therefore do not carry an index j. However, spouses differ with respect to the weights that they attach to today's consumption of market goods, as measured by $\eta_C^j \in (0,1)$, and the number of children, as measured by η_N^j. Specifically, the restrictions $\eta_C^f < \eta_C^m$ and $\eta_N^f \leq \eta_N^m$ are imposed. Thus, women are less (more) concerned than men about current (future) consumption, which creates an incentive to save more today, and prefer to have fewer children than men. These assumptions have been documented in a large number of studies since Thomas (1990), including Quisumbing (2010), World Bank (2011), and Doepke and Tertilt (2014). In particular, as noted by Prettner and Strulik (2017), the second assumption is consistent with the evidence which suggests

that gender-specific differences in preferences regarding the number of children play a substantial role in high-fertility environments.[7]

Both parents also care about the education of their children, as measured by the altruism parameter η_G. However, as a result of gender bias in the family—itself the consequence of social norms that discriminate againts women—the weight attached to the human capital of girls is only $\chi_t < 1$. This is similar in spirit to the specification in Hazan and Maoz (2002) and Hiller (2014), but as discussed later there is a crucial difference—in the present setting gender bias in preferences affects *both* the level of mothers' rearing time and its allocation between girls and boys.

Parents pool all their resources. The family's budget constraints for periods t and $t+1$ are thus given by

$$c_t^{m,t-1} + c_t^{f,t-1} + m_t + s_t = (1 - \theta^R n_t)(1 - \tau)w_t, \tag{3}$$

$$c_{t+1}^{m,t-1} + c_{t+1}^{f,t-1} = (1 + r_{t+1})s_t, \tag{4}$$

where $\tau \in (0,1)$ is the tax rate on wages, m_t spending on market goods used to produce the home good, s_t family saving, r_{t+1} the net rental rate of capital, and w_t total gross wage income of the family, defined as

$$w_t = e_t^{f,A}\varepsilon_t^{f,W}w_t^f + e_t^{m,A}\varepsilon_t^{m,W}w_t^m. \tag{5}$$

Combining (3) and (4), the family's consolidated budget constraint is thus

$$c_t^{f,t-1} + c_t^{m,t-1} + m_t + \frac{c_{t+1}^{f,t-1} + c_{t+1}^{m,t-1}}{1 + r_{t+1}} = (1 - \theta^R n_t)(1 - \tau)w_t. \tag{6}$$

The family's utility takes the form

$$U_t = \varkappa_t U_t^f + (1 - \varkappa_t)U_t^m, \tag{7}$$

where $\varkappa_t \in (0,1)$ measures the wife's bargaining power in the household decision process.

2.2 Home Production

The home good is produced by combining adult time and market goods:

$$Q_t = \left(\frac{\varepsilon_t^{f,P}}{\varkappa_t} + \frac{\varepsilon_t^{m,P}}{1 - \varkappa_t}\right)^{\pi^Q} m_t, \tag{8}$$

[7] Given that the model does not account endogenously for health status, child mortality is abstracted from—even though it may itself depend on gender differences in health investments, as documented for instance by Oster (2009) and Jayachandran and Kuziemko (2011).

where adult time is a composite input, with each component inversely weighted by each spouse's bargaining power, and $\pi^Q \in (0,1)$.[8] Thus, although male and female (effective) time are perfect substitutes in the production of home goods, productivity of each type of labor in home production varies inverserly with each spouse's bargaining power. Intuitively, with weaker bargaining power women can be pressured to perform household tasks, or otherwise face conflict with their partners and be subject to abuse. These tasks include laundry, ironing, cleaning, and food shopping or preparation, which tend to be time intensive and are typically disliked by men. Thus, if women internalize the risk of conflict or the threat of abuse, and if these risks or threats become more potent when their bargaining power is weak, the *effective* amount of time that they devote to these activities will increase. This specification helps to establish (as shown later) in a simple manner a direct relationship between the allocation of time to household chores among spouses and the distribution of power within the family, as documented in some studies.[9]

2.3 Market Production

Firms engaged in market production are identical and their number is normalized to unity. Each firm $i \in (0,1)$ produces a single market good, using male and female effective labor, $L_t^{j,i}$, and physical capital, K_t^i.

The production function of firm i takes the Cobb-Douglas form

$$Y_t^i = (L_t^{f,i})^{\beta^f} (L_t^{m,i})^{\beta^m} (K_t^i)^{1-\beta^f-\beta^m}, \tag{9}$$

where $\beta^f, \beta^m \in (0,1)$ and $L_t^{j,i} = \varepsilon_t^{j,W} E_t^{j,A} N_t^{j,i}$, where $\varepsilon_t^{j,W}$ and $E_t^{j,A}$ are average time spent in market work and average human capital of type j, respectively. Thus, inputs are imperfect substitutes and production exhibits constant returns to scale. Furthermore,

[8] Because time allocation is constant in equilibrium, the assumption that the home good technology is linear in m_t ensures that production of these goods grows at a constant rate along the balanced growth path. As in Albanesi and Olivetti (2009) and Siegel (2017), a more general CES function in (effective) time allocated by husband and wife to home production could be used—at the cost, however, of less tractability.

[9] See Doss (2013, p. 70) for instance. Yet another specification that also yields an inverse (albeit indirect) relationship between women's bargaining power and time allocated to household chores involves relating home production again to both types of effective labor, but with productivity now being a function of each type's human capital. This specification is discussed in the Appendix. However, the difficulty here is that household chores consist mainly of routine tasks; productivity in performing them is not likely to be much improved by increased human capital.

the elasticity of output with respect to each labor input is taken to be the same, so that $\beta^f = \beta^m = \beta$. But although the production technology itself is gender neutral, women experience wage discrimination in the labor market.

Specifically, as a result of gender bias in the workplace, women earn only a fraction $b_t \in (0,1)$ of their marginal product. In addition, discrimination to the extent $1-b_t$ benefits men in the proportion $\theta^B \in (0,1)$. Thus, assuming for simplicity full depreciation of physical capital, profit maximization with respect to production inputs gives

$$\varepsilon_t^{f,W} E_t^{f,A} w_t^f = b_t(\frac{\beta Y_t^i}{N_t^{f,i}}), \quad \varepsilon_t^{m,W} E_t^{m,A} w_t^m = \frac{\beta Y_t^i}{N_t^{m,i}} + \theta^B(1-b_t)(\frac{\beta Y_t^i}{N_t^{f,i}}), \tag{10}$$

$$1 + r_t = (1-2\beta)\frac{Y_t^i}{K_t^i}.$$

As long as $b < 1$ and $\theta^B > 0$, men benefit from gender bias in the workplace. By contrast, when $b < 1$ and $\theta^B = 0$, gender inequality is a pure deadweight loss.

In a symmetric equilibrium, and given that men and women are in equal numbers in the adult population ($N_t^m = N_t^f$), the wage ratio is

$$\frac{\varepsilon_t^{f,W} E_t^{f,A} w_t^f}{\varepsilon_t^{m,W} E_t^{m,A} w_t^m} = \frac{b_t}{1+\theta^B(1-b_t)}. \tag{11}$$

Thus, the smaller b_t is or the higher θ^B is, the larger will be the observed wage differential between men and women in the workplace.

Given that firms are identical, and that their number is normalized to 1, $K_t^i = K_t \; \forall i$ and aggregate output is, from (9),

$$Y_t = \int_0^1 Y_t^i di = (\frac{\varepsilon_t^{f,W} N_t^f E_t^{f,A}}{K_t})^\beta (\frac{\varepsilon_t^{m,W} N_t^m E_t^{m,A}}{K_t})^\beta K_t. \tag{12}$$

2.4 Human Capital Formation

Boys and girls have identical innate abilities and devote all their time to schooling.[10] But even though the learning environment is the same for all, social norms affect the allocation of mothers' rearing time between their sons and daughters.

Formally, human capital in childhood is given by

$$e_t^{m,C} = (E_t^{f,A})^{1-\nu_1}(\frac{G_t^E}{n_t 0.5 N_t})^{\nu_1}[(1-0.5\chi_t)\varepsilon_t^{f,R}]^{\nu_2}, \tag{13}$$

[10] The model therefore abstracts from the possibility that girls may be involved in home production—a well-documented form of child labor in developing countries. See Agénor and Alpaslan (2013) for a formal analysis, albeit with a focus on access to infrastructure.

$$e_t^{f,C} = (E_t^{f,A})^{1-\nu_1}(\frac{G_t^E}{n_t 0.5 N_t})^{\nu_1}(0.5\chi_t \varepsilon_t^{f,R})^{\nu_2}, \tag{14}$$

where $\nu_1, \nu_2 \in (0,1)$. Human capital in childhood is influenced by three factors. First, it depends on a mother's human capital, given that women are the only parents involved in home tutoring. This specification is also consistent with the evidence which suggests that more educated mothers are better able to respond to their children's nutritional needs, which in turn allows them to develop their cognitive skills and to perform better in school.[11] Because individuals in each gender group are identical within a generation, a mother's human capital at t is equal to the average human capital of the female adults of the previous generation, $E_t^{f,A}$.

Second, knowledge accumulation depends on government spending on education per child, $G_t^E/n_t 0.5 N_t$, where $0.5N_t$ denotes the number of families. Third, it depends on the time that mothers allocate to tutoring their children. As a result of social norms biased against girls' education, or more generally the role of women in society, they allocate a smaller fraction of their rearing time to their daughters. To capture this assumption in the simplest possible way, this fraction is defined as $0.5\chi_t$, where χ_t is the gender bias parameter defined earlier in parental preferences; because $\chi_t < 1$, the fraction of time allocated to girls is less than 0.5, and conversely for time allocated to sons. This assumption is consistent with the evidence (reviewed by Lundberg (2005) and Rossi and Rouanet (2015)) which suggests that parents in developing countries often invest more in sons than in daughters, and that mothers (as noted earlier) bear the brunt of child rearing responsibilities within the family. In the present setting, this bias is not due to economic motives, such as for instance the need for old age suppport discussed by Zhang et al. (1999), or desired fertility rates, as documented by Jayachandran and Kuziemko (2011); rather, it is solely the result of social norms and cultural beliefs that tend to discriminate against women. Both government spending and rearing time are subject to diminishing marginal returns in terms of their impact on human capital accumulation in childhood.

In adulthood, individuals do not engage in additional learning. This assumption is consistent with the evidence for Sub-Saharan Africa for instance, which suggests that only 6.8 percent of youth engage in tertiary education, compared to a world average of

[11] See Paxson and Schady (2007) for specific evidence and World Bank (2018, Chapter 1) for a broad discussion.

30 percent (United Nations (2016, p. 46)). Assuming for simplicity no depreciation and full persistence in learning, the human capital that adult men and women are endowed with is thus given by:

$$e_{t+1}^{j,A} = e_t^{j,C}. \tag{15}$$

Combining equations (13) and (14) yields

$$\frac{e_t^{m,C}}{e_t^{f,C}} = (\frac{1 - 0.5\chi_t}{0.5\chi_t})^{\nu_2}, \tag{16}$$

which can be substituted in (15) to give

$$\frac{e_{t+1}^{m,A}}{e_{t+1}^{f,A}} = (\frac{1 - 0.5\chi_t}{0.5\chi_t})^{\nu_2}. \tag{17}$$

Equation (17) implies that an increase in χ_t, which represents a decrease in gender bias, raises a girl's human capital later in life relative to a boy's human capital.

2.5 Government

The government taxes wages and spends a total of G_t^E on education and G_t^U on unproductive items. Public services are provided free of charge. Assuming a balanced budget gives

$$G_t^E + G_t^U = \tau \sum_{j=f,m} w_t^j \varepsilon_t^{j,W} E_t^{j,A} N_t^j. \tag{18}$$

Spending shares are constant fractions of government revenues:

$$G_t^h = \upsilon_h \tau \sum_{j=f,m} w_t^j \varepsilon_t^{j,W} E_t^{j,A} N_t^j, \tag{19}$$

where $h = E, U$.

Combining (18) and (19) therefore yields

$$\upsilon_E + \upsilon_U = 1. \tag{20}$$

2.6 Bargaining Power

In line with the evidence, the relative bargaining power of women evolves as a function of the average (economy-wide) ratio of earned incomes in the family:[12]

$$\varkappa_t = \varkappa_m (\frac{\varepsilon_t^{f,W} E_t^{f,A} w_t^f}{\varepsilon_t^{m,W} E_t^{m,A} w_t^m})^{\mu_B}, \tag{21}$$

[12] For a discussion of the evidence, see for instance Frankenberg and Thomas (2003), Quisumbing (2010), and Doss (2013). Theoretical contributions that follow a similar approach include Iyigun and Walsh (2007) and Prettner and Strulik (2017).

where $\varkappa_m > 0$ and $\mu_B > 0$ measures the sensitivity of bargaining power to relative wages.

Substituting (11) in (21) yields

$$\varkappa_t = \varkappa_m[\frac{b_t}{1+\theta^B(1-b_t)}]^{\mu_B}, \tag{22}$$

which depends on the degree of gender bias in the market place. Thus, autonomous changes in b_t—in the form of anti-discrimination laws in the labor market, for instance—have a direct influence on bargaining dynamics in the family as well.[13]

2.7 Social Norms and Gender Bias

To model social norms and their impact on gender bias in the workplace, the key assumption is that b_t displays persistence—to capture path dependency, or the fact that these norms may change only slowly over time, as noted earlier—but also responds to the relative presence of women in the labor market, that is, $\varepsilon_t^{f,W} N_t^f / \varepsilon_t^{f,m} N_t^m = \varepsilon_t^{f,W} / \varepsilon_t^{f,m}$, or equivalently the average (economy-wide) participation gap:

$$b_t = \min\left\{ b_{t-1}^{\mu_2^S}[b_m(\frac{\varepsilon_t^{f,W}}{\varepsilon_t^{m,W}})^{\mu_1^S}]^{1-\mu_2^S}, 1 \right\}, \tag{23}$$

where $b_m > 0$ is an autonomous factor, $\mu_1^S > 0$, and $\mu_2^S \in (0,1)$. Thus, women's decisions regarding the time that they allocate to paid activity have a direct impact on gender inequality in the market place. The underlying view, alluded to earlier, is that working women can be *agents of change* with respect to their perceived role in society in general, and the workplace in particular. Moreover, inequality in the market place determines women's bargaining power in the family (as implied by (22)), which in turn affects women's time allocation. This feedback effects disappear when $\mu_2^S = 1$, in which case gender bias in the workplace and intra-household bargaining power are independent of economic forces.

[13] In other studies, women's bargaining power has been alternatively related to, or measured by, the share of assets that women hold within the household, women's access to financial services or, as in de la Croix and Vander Donckt (2010), Diebolt and Perrin (2013), and Agénor and Canuto (2015) for instance, relative stocks of human capital. While the first two determinants are not accounted for in the model, the third could in principle be introduced. However, the direct link between gender bias in the workplace and in the home—a central element of the theory proposed in this paper—would be lost. A more general specification, of course, would be to account for *both* relative wages and human capital; but this would simply complicate the analysis without adding much insight.

In the same vein, gender bias in family preferences and in women's rearing time allocation is modeled as being subject not only to path dependency but also as responding directly to average (economy-wide) female bargaining power in the family:

$$\chi_t = \min\left\{\chi_{t-1}^{\mu_G}(\chi_m \varkappa_t)^{1-\mu_G}, 1\right\}, \tag{24}$$

where $\chi_m > 0$ and $\mu_G \in (0,1)$. Thus, the stronger women's bargaining power is, the more the family as a whole values girls' education, and the larger the fraction of total rearing time that mothers allocate to their daughters. This, in turn, helps to improve their human capital in adulthood and to mitigate the gender education gap. This specification, combined with (16), is consistent with the evidence discussed by Doss (2013) for instance, which suggests that women's increased bargaining power has positive effects on girls' education.

2.8 Saving-Investment Equilibrium

The number of adults alive in period t is given by

$$N_t = n_{t-1} 0.5 N_{t-1}, \tag{25}$$

where n_{t-1} is the number of children per family born in the previous period and $0.5N_{t-1}$ is the number of families in $t-1$.

The saving-investment equilibrium condition requires the physical capital stock in $t+1$ to be equal to savings by families formed in t. Given that s_t is savings per family, that the number of families is equal to $0.5(N_t^f + N_t^m)$, and that $N_t^f = N_t^m$, this condition is

$$K_{t+1} = N_t^f s_t. \tag{26}$$

3 Balanced Growth Equilibrium

The following definitions characterize a competitive equilibrium and a balanced growth equilibrium in this economy.

Definition 1. *A competitive equilibrium* is a sequence of prices $\{w_t^f, w_t^m, r_{t+1}\}_{t=0}^{\infty}$, household allocations $\{c_t^{j,t-1}, m_t, Q_t, c_{t+1}^{j,t-1}, s_{t+1}, \varepsilon_t^{j,P}, \varepsilon_t^{f,R}, \varepsilon_t^{j,W}\}_{t=0}^{\infty}$, physical capital $\{K_{t+1}\}_{t=0}^{\infty}$, human capital $\{e_t^{j,C}, e_{t+1}^{j,A}\}_{t=0}^{\infty}$, for $j = f, m$, a constant tax rate, and constant public spending shares, such that, given initial stocks $K_0 > 0$ and $e_0^{f,A}$, $e_0^{m,A} > 0$,

families maximize utility subject to their time and budget constraints, firms maximize profits, markets clear, and the government budget is balanced. In equilibrium, it must also be that $e_t^{j,A} = E_t^{j,A}$, for $j = f, m$.

Definition 2. A *balanced growth equilibrium* is a competitive equilibrium in which $c_t^{j,t-1}$, m_t, Q_t, K_{t+1}, Y_t, $e_{t+1}^{j,C}$, $e_{t+1}^{j,A}$ grow at the constant, endogenous rate $1+g$, the rate of return on capital r_{t+1} is constant, men's and women's time allocation shares, $\varepsilon_t^{j,L}$, $\varepsilon_t^{j,P}$, $\varepsilon_t^{f,R}$, and $\varepsilon_t^{j,W}$ are all constant, and gender bias in the workplace and in preferences, b_t and χ_t, as well as women's bargaining power, $\varkappa_t$, are constant.

Each family maximizes (7) subject to (1), (2), and (6), as well as (8), (13), (14) and (15), with respect to $c_t^{j,t-1}$, $c_{t+1}^{j,t-1}$, m_t, $\varepsilon_t^{j,P}$, $\varepsilon_t^{f,R}$, $\varepsilon_t^{j,W}$, and n_t, taking $\varkappa_t$, χ_t, w_t, r_{t+1} and $e_t^{j,A}$ as given, for $j = f, m$; $\varepsilon_t^{j,L}$ is then solved residually from (1).[14] As shown in the Appendix, the solution to this problem gives[15]

$$c_t^{t-1} = (1-\sigma_t)(1-\theta^R n_t)(1-\tau)w_t, \tag{27}$$

$$m_t = (\frac{\eta_Q}{\eta_t^C})c_t^{t-1}, \tag{28}$$

$$c_{t+1}^{t-1} = (\frac{1-\eta_t^C}{\eta_t^C})(\frac{1+r_{t+1}}{1+\rho})c_t^{t-1}, \tag{29}$$

$$s_t = \sigma_t(1-\theta^R n_t)(1-\tau)w_t, \tag{30}$$

$$\varepsilon_t^{f,W} = \frac{1-\varepsilon_t^{f,P}}{\Lambda_t^f}, \tag{31}$$

$$n_t\varepsilon_t^{f,R} = [\frac{(1-\sigma_t)B_t^f\eta_G\nu_2(\chi_t+1)}{\eta_t^C}]\varepsilon_t^{f,W}, \tag{32}$$

$$\varepsilon_t^{f,P} = \frac{\varkappa_t\eta_Q\pi^Q(1-\sigma_t)B_t^f}{\eta_t^C}\varepsilon_t^{f,W} - (\frac{\varkappa_t}{1-\varkappa_t})\varepsilon_t^{m,P}, \tag{33}$$

$$\varepsilon_t^{f,L} = 1 - \varepsilon_t^{f,P} - \varepsilon_t^{f,W} - n_t\varepsilon_t^{f,R},$$

$$\varepsilon_t^{m,W} = \frac{1-\varepsilon_t^{m,P}}{\Lambda_t^m}, \tag{34}$$

$$\varepsilon_t^{m,P} = (1-\varkappa_t)\frac{\eta_Q\pi^Q(1-\sigma_t)B_t^m}{\eta_t^C}\varepsilon_t^{m,W} - (\frac{1-\varkappa_t}{\varkappa_t})\varepsilon_t^{f,P}, \tag{35}$$

$$\varepsilon_t^{m,L} = 1 - \varepsilon_t^{m,P} - \varepsilon_t^{m,W}, \tag{36}$$

[14] In this setting, where the possibility of divorce is excluded, Nash bargaining is efficient. See Doepke and Tertilt (2016) for a discussion of the solution of cooperative and noncooperative household bargaining models.

[15] To avoid convergence of population size toward zero, it is assumed that $n \geq 2$ in the steady state.

$$n_t = (\frac{1-\sigma_t}{\theta^R})\frac{\eta_t^N - \eta_G\nu_2(\chi_t+1)}{\eta_t^C + (1-\sigma_t)[\eta_t^N - \eta_G\nu_2(\chi_t+1)]}, \tag{37}$$

where $c_{t+h}^{t-1} = c_{t+h}^{f,t-1} + c_{t+h}^{m,t-1}$ for $h = 1, 2$,

$$\eta_t^h = \varkappa_t\eta_h^f + (1-\varkappa_t)\eta_h^m, \qquad h = C, N \tag{38}$$

$$\sigma_t = \frac{(1-\eta_t^C)/(1+\rho)\eta_t^C}{1+\eta_Q/\eta_t^C + (1-\eta_t^C)/(1+\rho)\eta_t^C}, \tag{39}$$

$$B_t^f = 1 + \frac{1+\theta^B(1-b_t)}{b_t}, \tag{40}$$

$$B_t^m = 1 + \frac{b_t}{1+\theta^B(1-b_t)}, \tag{41}$$

$$\Lambda_t^f = 1 + \left\{1 + \frac{\eta_G\nu_2(\chi_t+1)}{\varkappa_t\eta_L}\right\}\frac{(1-\sigma_t)\varkappa_t\eta_L B_t^f}{\eta_t^C},$$

$$\Lambda_t^m = 1 + \frac{(1-\sigma_t)(1-\varkappa_t)\eta_L B_t^m}{\eta_t^C}.$$

Through η_t^C and η_t^G, the bargaining parameter $\varkappa_t$ affects men's and women's time allocation, the fertility rate, and the family's savings rate. In addition, because gender bias in the workplace, b_t, affects $\varkappa_t$ directly, it also affects all these variables as well.

Let $x_t^f = K_t/E_t^{f,A}N_t^f$ denote the physical capital-female effective labor ratio. As shown in the Appendix the model can be condensed into a dynamic system in 3 equations, b_{t+1}, χ_{t+1}, and x_{t+1}^f, given that the relationship between gender bias in the workplace and women's bargaining power is contemporaneous. As also established in the Appendix, the steady-state growth rate of market output is given by

$$1+g = (\frac{\tilde{\varepsilon}^{f,W}}{\tilde{x}^f})^\beta(\frac{\tilde{\varepsilon}^{m,W}}{\tilde{x}^m})^\beta\frac{\tilde{\sigma}(1-\theta^R\tilde{n})\beta}{\{(1-\tau)[\tilde{b}+1+\theta^B(1-\tilde{b})]\}^{-1}}, \tag{42}$$

where a tilde is used to denote a steady-state value, and $\tilde{x}^f$ is given by

$$\tilde{x}^f = \left\{\frac{\tilde{\sigma}(1-\theta^R\tilde{n})\beta\tilde{\Phi}}{0.5\tilde{n}^{1-\nu_1}}\{\upsilon_E\tau[\tilde{b}+1+\theta^B(1-\tilde{b})]\beta\}^{-\nu_1}\right. \tag{43}$$

$$\left.\times\left[(\tilde{\varepsilon}^{f,W})^\beta(\tilde{\varepsilon}^{m,W})^\beta(\frac{1-0.5\tilde{\chi}}{0.5\tilde{\chi}})^{\beta\nu_2}\right]^{1-\nu_1}1(0.5\tilde{\chi}\tilde{\varepsilon}^{f,R})^{-\nu_2}\right\}^{1/[1-(1-\nu_1)(1-2\beta)]}.$$

where

$$\tilde{\Phi} = (1-\tau)[\tilde{b}+1+\theta^B(1-\tilde{b})],$$

$$\tilde{\varkappa} = \varkappa_m [\frac{\tilde{b}}{1+\theta^B(1-\tilde{b})}]^{\mu_B},$$

$$\tilde{b} = \min\left\{ b_m (\frac{\tilde{\varepsilon}^{f,W}}{\tilde{\varepsilon}^{m,W}})^{\mu_1^S}, 1 \right\}, \quad \tilde{\chi} = \min\left\{\chi_m \tilde{\varkappa}, 1\right\}, \tag{44}$$

with $\tilde{x}^m$, the physical capital-male effective labor ratio, is given by

$$\tilde{x}^m = \tilde{x}^f (\frac{1-0.5\tilde{\chi}}{0.5\tilde{\chi}})^{-\nu_2}, \tag{45}$$

and $\tilde{\varepsilon}^{f,R}$, $\tilde{\varepsilon}^{f,W}$, $\tilde{\varepsilon}^{m,W}$, $\tilde{n}$, and $\tilde{\sigma}$ are obtained from the solutions provided earlier.

In the particular case where b_t and χ_t are constant over time, the model's dynamics are driven solely by x_t; the following proposition can then be established:

Proposition 1. *Under full path dependency in social norms, $\mu_2^S = \mu_G = 1$, dynamic stability requires $(1-\nu_1)(1-2\beta) < 1$. This condition always holds.*

In the general case, however, the dynamic system is too complex for its stability to be studied analytically. Nevertheless, it can be established numerically, using the calibration discussed next.

Figure 1 illustrates the interactions between discriminatory social norms, women's bargaining power, and time allocation. Consider for instance a policy that promotes greater participation by women in the workplace. This reduces gender discrimination in the labor market and translates into higher average wages for them and an increase in women's bargaining power in the family. This raises in turn the family's preference for girls' education and leads to relatively more time allocated by mothers to rearing their daughters—with longer-term effects on both male and female human capital. Importantly, the increase in women's bargaining power also affects directly time allocated by both spouses to home production—with women devoting less time, and men more time, to that activity. This effect is directly related to the fact that each spouse's contribution to household chores is inversely related to own bargaining power.

However, the macroeconomic effects associated with this reallocation depend crucially on whether the reduction in women's time spent in home production translates into more leisure (which is not productive), more time allocated to child rearing (which is productive, given persistence in human capital), or market work. An increase in the latter component would magnify the benefit of the initial policy in the sense that it would help to reduce further the degree of discrimination against women in the market place, thereby improving their bargaining power, and so on. Thus, there is a two-way

causality between social norms and gender inequality. Similarly, the aggregate effects of the increase in men's time allocated to home production depend on whether this increase is offset by less leisure or less market work—and, in the latter case, whther this reduction is compensated by women's greater participation to the labor market.

The long-run properties of the model and the foregoing discussion suggest the following definition:[16]

Definition 3. *An equilibrium with gender parity is a balanced growth equilibrium in which* $\tilde{b} = \tilde{\chi} = 1$ *and* $\tilde{\varkappa} = 0.5$.

Conversely, an equilibrium with gender bias is a balanced growth equilibrium with either $\tilde{b} < 1$, $\tilde{\chi} < 1$, $\tilde{\varkappa} < 0.5$, or any combination of these conditions. Thus, while equal bargaining power in the family is necessary and sufficient (assuming $\chi_m = 1$ in (44)) to eliminate gender bias in the family, it is necessary (because of its impact on labor supply) but not sufficient to create gender equality in the workplace. Conversely, gender equality in the market place is necessary (through its effect on the wage gap) but not sufficient to promote gender equality in the home and parity among spouses in bargaining power.[17] Note also that these definitions do not establish a strict correspondence between gender equality and growth; an equilibrium with gender parity can be characterized by a low growth rate (or quasi stagnation), whereas an equilibrium with gender bias can be associated with a high growth rate. A possible reason for this ambiguity, alluded to earlier, is the fact that when women shift time away from home production, and husbands become more engaged in household chores, there may be opposite effects (depending in particular on male and female preferences for leisure) on total family time allocated to market work, with potentially conflicting effects on savings, fertility, and growth.

Another *prima facie* source of ambiguity may be the fact that (as also noted earlier) a reallocation of mothers' total rearing time between their children has conflicting effects on their human capital in adulthood. However, the following result clarifies the *net* effect of this reallocation on the relative human capital stock:

[16] An equilibrium with gender parity as defined here does not imply uniform preferences; in particular, differences may still exist between preferences for current consumption and the number of children. It requires, nevertheless, appropriate restrictions on the shift parameters b_m, χ_m, and $\varkappa_m$.

[17] See Duflo (2012) for a broader discusion of the view that empowering women may not be sufficient to promote gender equality.

Proposition 2. *For a given time allocation of men and women, an autonomous reduction in gender bias in the family (a higher χ_m) raises the equilibrium female-male human capital ratio in adulthood, $\tilde{e}^{f,A}/\tilde{e}^{m,A}$.*

These partial equilibrium results can readily be established from (17), (44) and (45).[18] The key reason is that, as long as there are diminishing returns to mothers' rearing time ($\nu_2 < 1$), the slope of $\tilde{e}^{f,A}$ with respect to $\tilde{\chi}$ is stronger in absolute terms than the slope of $\tilde{e}^{m,A}$ for $\tilde{\chi} < 1$. Thus, the marginal effect of an increase in rearing time allocated to girls increases their human capital more than it lowers the human capital of boys, which translates given full persistence into an increase in the (equilibrium) adult female-male human capital ratio. The smaller ν_2 is, the larger the difference in slopes at low values of χ, implying that the marginal impact of an increase in χ_m on the adult female-male human capital ratio is larger. With constant returns to rearing time, the net effect on that ratio would be zero.

4 Calibration

To understand further the dynamic interactions between social norms, gender bias, time allocation, and economic development, the model must be solved numerically. Rather than trying to reproduce closely the evolution of these variables in any particular country—a difficult task given available data for most developing economies—the model is instead calibrated for a stylized low-income country and used to simulate the impact of various types of public policies under different parameter configurations.[19]

On the household side, the annual discount rate is set to a standard value of 0.04. Interpreting a period as 20 years in this framework yields an intergenerational discount factor of $[1/(1+0.04)]^{20} = 0.456$.

The family savings rate, σ, is set at 12 percent, which corresponds to the average value for low-income countries reported in Agénor and Alpaslan (2013). The (effective) number of children, n, is given by the gross fertility rate (number of births per woman), 5.0, multiplied by the child survival probability estimated by Agénor (2017), 0.854, which gives 4.3. The same value is used by Bloom et al. (2015).

[18] From (17) and the definitions provided earlier, $\tilde{e}^{f,A}/\tilde{e}^{m,A} = \tilde{x}^m/\tilde{x}^f$; and from (45), $\tilde{x}^m/\tilde{x}^f = [(1 - 0.5\tilde{\chi})/0.5\tilde{\chi}])^{-\nu_2}$. Using (44), and keeping $\tilde{\varkappa}$ constant, this expression yields therefore $\partial \ln(\tilde{e}^{f,A}/\tilde{e}^{m,A})/\partial\chi_m > 0$.

[19] Sensitivity analysis with respect to several key parameters is reported later on.

Based on data from the 2005-07 round of Multiple Indicator Cluster Survey (MICS) by the United Nations, Agénor (2017) also estimated that consumption by children aged between 0 and 14, in proportion to total household consumption, is about 45 percent in West and Central Africa. In terms of the model, this can be taken as an approximation of the share of total family income devoted to spending on children, which corresponds to $n\theta^R$. As noted earlier, $n = 4.3$; thus, θ^R (the share of family spending on each child) can be estimated as 0.45/4.3, that is, $\theta^R = 0.105$.

In the home good production sector, the curvature of the home production function with respect to family labor is set initially at $\pi^Q = 0.7$. This value is significantly higher than the one used by Kimura and Yasui (2010, Table 4) for instance, but is more appropriate to capture rapidly decreasing marginal returns to labor allocated to household chores in a low-income environment with limited access to energy, water, and transportation.

Calibration of men's and women's time allocation dwells on the data reported in the various studies collected in Blackden and Wodon (2006), the comparisons in Budlender (2008), the calculations in Agénor et al. (2014), and the data compiled by Charmes (2015). Time spent in home production (including household chores) by mothers is set at 3.5 hours a day. With total daily time of 10 hours (excluding physiological time, that is, sleeping time, time spent on personal care, and so on), this gives $\varepsilon^{f,P} = 0.35$. Total time allocated to children is set at 0.125, which implies, given that $n = 4.3$, that time allocated to each child is $\varepsilon^{f,R} = 0.029$. Time allocated to market work is set at $\varepsilon^{f,W} = 0.36$. The time constraint (equation (1)) is thus used to calculate $\varepsilon^{f,L}$ residually; this gives $\varepsilon^{f,L} = 0.165$, in line with the data on time allocated by women to social life, entertainment and other free time for Mauritius, South Africa and (urban) Mali reported by Charmes (2015, p. 28). Men's time allocation is calibrated so that they spend much of their time in market work and allocate to household chores only one-fifth of the time that women devote to these activities, in line with the data for Madagascar and Mauritius for instance reported by Blackden and Wodon (2006, Table 3.13). This gives $\varepsilon^{m,W} = 0.85$ and $\varepsilon^{m,P} = 0.07$. By implication, the female-to-male ratio of time allocated to home production, $\varepsilon^{f,P}/\varepsilon^{m,P}$, is equal to 5.0, and to market work, $\varepsilon^{f,W}/\varepsilon^{m,W}$, to 0.424.

The initial bargaining power of women is set at $\varkappa = 0.3$, as in Prettner and Strulik

(2017). This value is close to the average literacy rate of adult females (ages 15 and above), divided by the sum of literacy rates of adult males and females, reported in Agénor (2017) for Benin, a low-income Sub-Saharan African country. This value must be matched with the right-hand side of (22), which involves setting three parameters, θ^B, μ_B, and $\varkappa_m$, as well as the degree of gender bias in the workplace, b. The latter is set at 0.6, in line with the average value of male-female earning gaps for professionals and technicians in Sub-Saharan Africa reported in Nopo et al. (2012). The coefficient θ^B is set initially to 0 (so that from (40) and (41) $B^f = 1+b^{-1}$ and $B^m = 1+b$), which implies that wage discrimination in the workplace entails a pure deadweight loss for society. The parameter μ_B is set initially to 0.7 to ensure decreasing marginal gains to improvements in wage equality. Expression (22) can therefore be solved for $\varkappa_m$ residually, thereby giving $\varkappa_m = 0.429$.

Using these data on women's and men's time allocation, the calibrated values of n, σ, θ^R, and $\varkappa$ provided earlier, and the definitions of Λ^f and Λ^m, the first-order conditions of the family's optimization problem can be combined and solved backward to generate simultaneously estimates of the five preference parameters η^C, η^N, η_Q, η_G, and η_L.[20] This gives $\eta^C = 0.551$, $\eta^N = 0.544$, $\eta_Q = 0.954$, $\eta_G = 0.488$, and $\eta_L = 0.129$. Thus, households value almost equally current consumption of the market good and children, and value the home good significantly more than the market good.

Having determined η^C and η^N, the values η^m_C, η^f_C and η^m_N, η^f_N must be calculated. For η^m_N and η^f_N, the relative difference between the equivalent estimates of η^f_N and η^N selected by Prettner and Strulik (2017, Table 1) are used. Given their bargaining power parameter value of 0.3 (which is also used here) this gives $\eta^f_N/\eta^N = 0.6/(0.7 \cdot 0.8 + 0.3 \cdot 0.6) = 0.811$. In turn, this implies that, given the estimate of η^N reported earlier, $\eta^f_N = 0.441$. The same ratio is used for η^f_C/η^C, which gives $\eta^f_C = 0.447$. The values of η^m_N and η^m_C can thus be determined residually using (38), so that $\eta^m_N = 0.588$ and $\eta^m_C = 0.595$. Thus, by construction, $\eta^f_C < \eta^m_C$ and $\eta^f_N < \eta^m_N$.

The elasticity of output of final goods with respect to each type of labor, β, is set equal to 0.35. This yields a value of the elasticity of output with respect to capital equal to $1 - 2\beta = 0.3$, in line with the empirical evidence.

[20] The solution involves an iterative procedure, given that the system is highly nonlinear. See the Appendix for details.

In the human capital sector, the elasticity with respect to government spending on education, ν_1, is set equal to 0.4, a lower value than the one used for instance by de la Croix and Vander Donckt (2010) for private education spending (namely, 0.53), to account for lower efficiency of public expenditure. There is not much evidence regarding the elasticity with respect to time allocated by mothers, ν_2; accordingly, ν_2 is set initially equal to a relatively low value, 0.1, and sensitivity analysis is conducted later on.

The effective tax rate on wages, τ, is calculated by multiplying the average ratio of tax revenues to GDP for low-income countries estimated by Baldacci et al. (2004*b*, Table 1) for the period 2001-08, 15.1 percent, divided (to match the model's definition) by the average share of labor income from the model, 0.7. This gives $\tau = 21.6$ percent. The share of government spending on education, υ_E, is estimated as follows. Based on the data in Baldacci et al. (2004*a*, Table 1), the share of government spending on education, in proportion to GDP, is 3.6 percent. From Baldacci et al. (2004*b*, Table 1), the share of total government expenditure in GDP can be estimated by adding tax revenues and the fiscal deficit, both as a share of GDP, or $15.1 + 6.2 = 21.3$ percent.[21] The share of government spending on education can thus be calculated as $\upsilon_E = 0.036/0.213 = 16.9$ percent.

The inertia parameters μ_2^S and μ_G are both set at relatively high values initially, $\mu_2^S = \mu_G = 0.7$, to capture the fact that gender bias is highly path dependent and that the endogenous macroeconomic factors highlighted in the theory proposed in this paper play a limited role in determining them. In addition, the sensitivity of b with respect to relative wages, μ_1^S, is set initially at 0.4. Given the initial values of b and the time allocation ratio $\varepsilon^{f,W}/\varepsilon^{m,W}$ provided earlier, the steady-state solution (23) can be solved backward for b_m; this gives $b_m = 0.846$. The scale parameter χ_m is normalized to unity; from the steady-state solution (24), this gives $\chi = \varkappa = 0.3$. Thus, there is also significant initial gender bias in family preferences regarding girls' education and (by implication) in mothers' rearing time allocated to their daughters. Finally, the annual growth rate of market output per worker is set to 3.3 percent, the average value reported by Baldacci et al. (2004*b*) for low-income countries over 1975-2000.

The benchmark parameter values are summarized in Table 1. Based on these para-

[21] In principle, to match the definition in the model, a direct measure of noninterest (primary) government spending should be used. However, this would not affect the results in any significant manner.

meter and initial values, the model is solved for an initial steady state that satisfies the properties of the balanced growth equilibrium defined earlier. These equilibrium values are shown in Table 2.

5 Public Policy and Gender Inequality

In order to focus on interactions between changes in social norms, gender equality, time allocation and economic growth, the benchmark experiment is a development policy that focuses on increasing government spending on primary education—a policy pursued in many Sub-Saharan African countries during the past two decades (United Nations (2016, Chapter 3))—including classroom equipment, free school uniforms and meals, and so on. This policy takes the form of a permanent increase in υ_E by 10 percent, from 0.169 to 0.186. From the model's solution provided earlier, the following result can readily be established:

Proposition 3. *A budget-neutral increase in the share of government spending on education, υ_E, has no steady-state effects on time allocation, gender bias, or women's bargaining power.*

Indeed, an increase in education spending raises equally the human capital of men and women, and promotes growth. But because such spending is gender neutral (as can be inferred from the knowledge ratio (17)) it has no effect on time allocation decisions—and, by implication, no effect on gender bias nor women's bargaining power.

The results of this experiment are shown in the second column of Tables 3 to 5. The long-run effect on the growth rate of final output is fairly small, of the order of 0.11 percentage points. A key reason for this, of course, is the relatively low elasticity of human capital to education spending, as noted earlier. Put differently, in this benchmark case, boosting spending on child education by the proposed proportion does relatively little to promote growth.

Suppose therefore that, in addition to an increase in spending on education, the government engages concomitantly in a public campaign—along the lines for instance of Program H, as described in http://promundoglobal.org/programs/program-h/, or the HeforShe agenda of UN Women—designed to increase awareness among parents of the importance of girls' education. To the extent that this policy involve some outlays, I assume that this is achieved through a reallocation of unproductive government spending;

it entails therefore no distortionary fiscal effects.[22] Specifically, this policy is assumed to translate into an autonomous change in the family's preference parameter for girls' education, as measured (for illustrative purposes) by a 10 percent increase in the scale parameter χ_m, or equivalently an initial increase in χ itself from 0.3 to 0.33.[23]

Alternatively, suppose that the government initiates in parallel to the increase in education spending legal reforms designed to promote gender equality in the market place. By requiring firms to release publicly their pay statistics by gender for instance, anti-discrimination laws may induce employers to voluntarily try to mitigate wage gaps between male and female workers. Once again, to abstract from fiscal effects, I assume that any costs associated with these reforms are absorbed through a reallocation of unproductive spending. Formally, the policy is assumed to translate into a similar 10 percent increase in the scale parameter b_m, from 0.824 to 0.906, or equivalently an initial increase in b itself from 0.6 to 0.613. A third scenario, which involves combining both changes in b_m and χ_m with an increase in education spending, is also considered.

To assess the short- and long-run impact of these policies over time, two alternative regimes are considered: *a*) predetermined b_t and χ_t (except for the initial increase in these variables), which corresponds to the case of full path dependency in gender bias alluded to earlier; and *b*) endogenous b_t and χ_t, which corresponds to partial persistence. For convenience, these regimes are referred to as 1 and 2, respectively. Because women's bargaining power depends only on gender bias in the workplace, it is also exogenous under Regime 1. Thus, a comparison of outcomes under the two regimes helps to assess the importance of accounting for the fact that social norms related to gender in the market place and in the family, as well women's bargaining power in regime 2, are interrelated and respond endogenously to economic factors.

Simulation results are reported in Table 3, and in Figures 2 and 3, for the "pure" cases. To summarize the results I focus mainly on the following variables: men's and

[22] Government spending specifically allocated to promoting gender equality can actually be quite large in practice; see for instance the estimates reported by the United Nations (2016, Table 7.1) for Sub-Saharan Africa.

[23] Alternatively, it could be assumed that the government engages in legal reforms that directly help to empower women within the household, that is, a change in $\varkappa_m$. Such reforms, as advocated in some recent studies on promoting gender equality in Sub-Saharan Africa, could take the form of measures aimed at eliminating restrictions on women's rights to own or inherit property through changes in the country's family code (see for instance Hooley (2016) and United Nations (2016, Chapter 7)). The results are qualitatively similar to those reported here.

women's time allocated to home production and market work, the female-male time ratios allocated to home production and market work, the fertility rate, the family's savings rate, gender bias in the workplace and in the home, women's bargaining power, and the growth rate of market output.[24]

Consider first the combination of higher υ_E and χ_m. In Regime 1, because the degree of gender bias in the workplace is exogenous, women's bargaining power does not change. Nevertheless, the increase in the family preference parameter for girls' education exerts both *level* and *composition* effects on women's time allocation. On the one hand, because the family's preference for girls' education increases, it induces mothers to allocate more time to child rearing. On the other, it induces a concomitant reallocation of mothers' rearing time from boys to girls—which promotes the human capital of their daughters in adulthood, albeit to the detriment of boys. The increase in total rearing time is associated with an increase in women's market work and a reduction in time allocated to both home production and leisure. The opposite occurs for men: they allocate more time to home production and reduce both time devoted to market work and, to a lesser extent, leisure. The fertility rate drops as well, as a result of a standard substitution of quality (more time allocated by mothers to each child) and quantity. Because the family's preference for current consumption remains constant, there is no effect on the savings rate. The fact that there are conflicting effects on the human capital of boys and girls today (due to the composition effect alluded to earlier) does not adversely affect growth; indeed, because of the concavity of the human capital accumulation functions (13) and (14), and the fact that time allocated to boys is initially higher than time allocated to girls, the net marginal effect is positive (as implied by Proposition 2), with growth now increasing by 0.14 percentage points in the long run.[25]

Under Regime 2, the degree of gender bias in the workplace is endogenous, and so is women's bargaining power. The reallocation of time devoted to market work

[24] Implicit in the results is the assumption that time is perfectly divisible. Otherwise, changes in time allocation could be subject to thresholds.

[25] To verify that the net impact of the composition effect on growth is positive, it was abstracted from by keeping χ constant at its initial value of 0.3 in the physical capital-effective labor ratios x^f and x^m defined earlier. The increase in the steady-state growth rate of output is now of the order of 0.12 percentage points under Regime 1 and 0.14 under Regime 2, as a result solely of the level effect. By comparison, in Table 2, when both the level and the composition effects are accounted for, these numbers are 0.14 and 0.16, respectively. Thus, not only is the growth effect of the reallocation of mothers' time from boys to girls positive, it is also slightly higher than the level effect. Similar results can be shown for the other experiments reported in Table 3.

between spouses (as described above) induces therefore an endogenous increase in b. The immediate effect of this increase (at the initial levels of wages and time allocation) is to raise family income. Higher income leads to a higher *level* of private savings and capital stock, which has a direct positive effect on growth, as well as tax revenues. In turn, higher revenues lead to higher public spending on education, which also exerts a positive effect on human capital in childhood and adulthood. Because women's bargaining power depends on the relative female-male wage, and thus on the degree of gender bias in the market place, it also improves.

In the present setting, the increase in women's bargaining power affects the economy through four channels: a savings effect, a fertility effect, a time allocation effect, and a preference effect—the last two of which being specific features of the model developed in this paper.[26] First, because women's preference for current consumption is lower than that of men ($\eta_C^f < \eta_C^m$), it reduces (raises) the average family preference parameter for today's (tomorrow's) consumption, η_C $(1 - \eta_C)$. As a result, the family's savings rate, defined in (30), increases. At the aggregate level, the increase in savings translates into a higher physical capital stock, which again promotes growth. As shown in Table 3, however, this effect is quantitatively small. Second, because women's preference for children is also lower than that of men ($\eta_N^f < \eta_N^m$), the increase in their bargaining power translates into a lower average family preference parameter for children, which magnifies the reduction in the fertility rate observed under Regime 1. This benefits growth as well, in part because it lowers spending on children and raises the level of savings.

Third, the increase in $\varkappa$ allows women to reduce the time that they spend in household production and to get their husbands—given that the home good is valued equally by both spouses—to devote more time to that activity. Women are thus able to devote more time on other (productive) activities, market work and child rearing. Fourth, a rise in $\varkappa$ (through a higher χ) magnifies the increase in the family's preference for girls' education, which induces, as noted earlier, mothers to allocate more time to child rearing—thereby adding to the direct effect of an increase in χ_m. Induced effects on the time allocated by husbands and wives to other activities are also amplified; as a result, changes in the female-male ratios of time allocated to home production and market

[26] The first two effects are discussed in more detail in several other contributions, including Agénor and Alpaslan (2013), Doepke and Tertilt (2014), and Prettner and Strulik (2017).

work are significantly larger than in Regime 1. Because the net effect of an increase in the fraction of rearing time allocated by mothers to girls on the female-male human capital ratio is positive, the impact on growth is magnified in Regime 2, reaching 0.16 percentage points.

Consider now the combination of higher υ_E and b_m. The results are by and large qualitatively similar to those reported earlier under both regimes. In particular, under Regime 2, the net effect on growth is of the order of 0.17 percentage points. When *both* χ_m and b_m are increased jointly with υ_E, naturally enough the difference between regimes 1 and 2 is magnified; the growth rate in the latter case rises by 0.23 percentage points—more than double the value obtained when gender-based policies are not implemented concomitantly with the increase in public spending on education.

The transitional dynamics displayed in Figures 2, 3 and 4 illustrate in stark fashion how the different effects described above combine to determine the co-evolution over time of gender bias, male and female time allocation, women's bargaining power, and economic growth when social norms are endogenous. In all cases the adjustment process under Regime 2 is monotonic and converges fairly rapidly.[27] More importantly, the magnitude of the steady-state effects differs markedly from the impact effects, which suggests that when social norms interact in the way predicted by the theory, an initial policy aimed at promoting gender equality can create a virtuous circle that helps to magnify in the long run the short-run gains associated with that policy. In particular, with an autonomous change in gender bias in the workplace (Figure 3), while the female-male home production time ratio drops by only about -0.2 on impact, it falls by about -1.4 in the long run—a factor of 7. Similarly, while the female-male market work time ratio rises by only 0.002 on impact, it increases by almost 0.016 in the long run—an eightfold increase. Similar magnitudes are observed for short- and long-run changes in gender bias in the workplace and the family, as well as women's bargaining power.

At the same time, the foregoing discussion suggests that although autonomous measures aimed at improving gender equality in the market place and in the home (as well as,

[27] As noted earlier, a period corresponds in principle to a generation in this OLG structure. This is reflected, in particular, in the calibration of the discount factor, time allocation, and the assumption of full depreciation of physical and human capital. However, all of the other parameters and variables (including the growth rate of output) either do not have a time dimension or are calibrated on the basis of average annual data. Thus, rather than precise predictions (in years) about the length of the transition, what is of interest here are the *qualitative* features of the adjustment path.

indirectly in this setting, women's bargaining power) may generate important benefits at the microeconomic level for mothers and daughters, at the aggregate level outcomes are less certain. The key reason is that in this setting changes in time allocation and saving behavior that are associated with policies aimed at promoting gender equality may generate conflicting effects on the rate of economic growth. Indeed, the previous results showed that one reason why the growth effects of promoting gender equality can be muted is that, given the calibration (most importantly, a relatively high family preference for the home good), the increase in time that men spend in household chores is offset almost entirely by a reduction in the time that they allocate to market work. Suppose instead that, through appropriate incentives, men are induced to continue to work just the same; formally this requires imposing that $\varepsilon^{m,W}$ remains constant across shocks. This experiment (which is not reported in the tables to save space) was performed for both of the paired combinations highlighted earlier under Regime 2. In the first case (combination of higher υ_E and χ_m) the resulting effect on growth is now larger, with the steady-state growth rate increasing by 0.18 (instead of 0.16) percentage points, whereas in the second case (combination of higher υ_E and b_m) it increases by 0.19 (instead of 0.17) percentage points. Combining changes in υ_E, χ_m and b_m gives similar outcomes.

6 Sensitivity Analysis

To assess the robustness of the previous results, several experiments were conducted. First, in light of the mixed evidence in favor of son preference in Sub-Saharan Africa documented by Rossi and Rouanet (2015), the restriction $\eta_N^f = \eta_N^m = \eta^N$ was imposed. Second, the preference parameter for the home good was set equal to the preference parameter for the market good, $\eta_Q = \eta^C$, with and without the restriction $\eta_C^f = \eta_C^m = \eta^C$, that is, uniform preferences for current (and thus future) consumption. Third, the parameter characterizing the curvature of the home production function, π^Q, was set at 0.12, as in Kimura and Yasui (2010, Table 4). Fourth, the degree of persistence in gender bias in the workplace and in the home was uniformly lowered, from 0.7 to $\mu_2^S = \mu_G = 0.1$, to capture the case where social norms display weak path dependency.[28] Fifth, the parameter θ^B was increased from 0 (pure deadweight loss) to 1, so that

[28] See Eriksson (2015) for some illuminating examples of how sudden changes in social norms can occur.

men benefit fully from discrimination against women in the market place. Sixth, the sensitivity of bargaining power to relative wages, μ_B, was raised from 0.7 to 1.3 to account for increasing marginal effects at low levels of income. Finally, unit rearing costs, as measured by θ^R, were endogenized, by setting $\theta_t^R = \varkappa_t \theta^{f,R} + (1 - \varkappa_t)\theta^{m,R}$ and $\theta^{f,R} > \theta^{m,R}$, to account for a widely held view among development economists since Sen (1990) that increased bargaining power by women within the family translates into higher spending on children.[29] However, although these experiments generated in some cases nonnegligible quantitative differences (including with respect to the time needed for convergence), none had major qualitative differences with respect to the dynamics described earlier. In particular, eliminating the savings and fertility effects by imposing uniform preferences with respect to consumption of the market good and the number of children had no discernible impact on the results.

Another experiment involved increasing the elasticity of human capital with respect to mother's rearing time, ν_2, from 0.1 to 0.4. The results are reported in Table 4 and Figure 4 (in the latter case only under Regime 2, to avoid cluttering the graph). A comparison with those reported in Table 3 and Figure 2 shows that although in general the results are magnified (including with respect to the growth rate), qualitatively they remain again similar to those obtained under the benchmark experiment.

Yet another sensitivity test involved an increase in the coefficient μ_1^S, which measures the elasticity of the degree of gender bias in the workplace with respect to the female-male working time ratio, from 0.4 to 0.9. The steady-state results are reported in Table 5. Once again they show no significant qualitative differences in the steady-state effects on gender bias, women's time allocation, and economic growth, even though (as one would expect) the adjustment process is significantly faster.

Finally, although the transitional dynamics reported earlier consistently displayed monotonic behavior, discontinuities and nonlinearities with respect to changes in social norms can easily be accounted for by combining elements of Regimes 1 and 2. Suppose for instance that women's ability to sway family preferences toward equal weights on their children's education can occur only when their bargaining power has strengthened sufficiently, that is, $\varkappa_t > \varkappa^C$, where $\varkappa^C$ is a critical value. Instead of (24), the family

[29] See World Bank (2011) for empirical evidence that mothers have a higher propensity to spend on their children than fathers.

preference parameter for girls' education evolves now according to

$$\chi_t = \begin{cases} \chi_{t-1}, \text{ for } \varkappa_t \leq \varkappa^C \\ \min\left\{\chi_{t-1}^{\mu_G}(\chi_m \varkappa_t)^{1-\mu_G}, 1\right\}, \text{ for } \varkappa_t > \varkappa^C \end{cases}, \tag{46}$$

which in turn generates nonlinearities in men's and women's time allocation, savings, and ultimately the economy's growth rate.

Consider for instance an autonomous reduction in gender bias in the workplace, which (as illustrated in Figure 3) is associated with a smooth increase in $\varkappa_t$ and χ_t during the adjustment process to the new equilibrium under Regime 2. With (46), until women's bargaining power is sufficiently high, gender bias in the family's preferences is now constant, as in Regime 1; but once the critical value $\varkappa^C$ is reached, χ_t begins to rise, as in Regime 2. In turn, once χ_t becomes endogenous, the speed of adjustment toward the new equilibrium accelerates during a "catching up" period. Subsequently, all variables converge in the same manner as shown in Figure 3.[30] Thus, this specification helps to capture in a simple way the *tipping point effect* that appears to characterize in some circumstances the evolution of social norms (Burke and Young (2011), and Young (2014)): when shifts in these norms occur, the transition is often sudden rather than incremental, with changes gaining momentum for a while.

7 Some Supporting Evidence

A key implication of the model presented earlier is that the intensity with which men and women participate to the labor market is determined by the interaction between preferences and social norms. A policy targeted toward initiating initial changes in these norms can create a virtuous circle that can lead to a higher supply of female labor and reduced gender bias in the workplace and the family. Indeed, the experiments reported earlier showed that economic and legal measures that help to mitigate the influence of social norms regarding gender roles in the workplace and in the family can be highly effective in complementing standard policy prescriptions (such as those aimed at fostering human capital accumulation in childhoold) to promote growth and development, while at the same time contributing to greater gender equality. This prediction

[30] The full results of the experiment with higher υ_E and b_m, and with $\varkappa^C = 0.315$, are not reported here but are available upon request. Note also that the threshold value $\varkappa^C$ itself could depend not only on exogenous factors (such as existing family laws), as assumed here, but also on endogenous forces.

is consistent with the empirical evidence for low-income countries which suggests that more equal laws—including those aimed at increasing women's control over household resources—tend to boost female labor force participation (Gonzales et al. (2015) and United Nations (2016)) and that gender equality tends to be positively correlated with the rate of economic growth (Amin et al. (2015) and Hakura et al. (2016)).

The model also predicts *a*) a negative correlation between gender bias in the market place and the intensive margin of (married) women's labor market participation, relative to men; *b*) a positive correlation between gender bias in the market place, through its impact on wages and women's bargaining power in the family, and (married) women's time allocation to home production, relative to men; and *c*) a positive correlation between women's bargaining power, family preferences for girls' education relative to boys', and time devoted by married women to their daughters relative to their sons. In particular, by raising women's bargaining power in the family, greater wage equality allows them to allocate less time to household chores (with husbands contributing more) and more time to paid work, as well as more time to their daughters' education.[31]

A rigorous testing of these predictions is a daunting task, not least because consistent and sufficiently long time-series data on household gender preferences and gender inequality in the family for individual countries at different levels of development are either not directly observable or not available.[32] However, gender-specific data on hourly wage gaps and (more recently) time allocation are available for a large group of countries, thereby allowing a partial examination of predictions *a*) and *b*) in a cross-section dimension. Specifically, I compiled and matched two sets of data: the wage gap database of the *Global Gender Gap Report* published by the World Economic Forum since 2006 and the time-use surveys of the United Nations, which cover a longer period and provide information on paid and unpaid time allocated by men and women, in terms of hours per day.[33] All countries for which data from these two sources overlapped over the pe-

[31] The evidence reviewed by Blau and Kahn (2016) and provided by Kleven and Landais (2017) suggests that gender wage gaps tend also to be negatively correlated with the female-male labor force participation rate for married women. However, as discussed next, the model presented here focuses on the link between gender bias in the market place and the *intensive* margin of labor supply.

[32] The OECD's Gender, Institutions and Development database (available at https://stats.oecd.org/) provides for instance data on "Son preference in education." However, they refer to the percentage of people agreeing that *university* is more important for boys than for girls (rather than primary education, as emphasized here) and are available apparently for a single year only.

[33] The data from the World Economic Forum were provided directly to the author and are partly based on those published by the ILO. The data on time use (usually for men and women above age

riod 2006-14 were used; simple averages were calculated when two observations or more were available. This gave a sample of 48 countries, 19 of them advanced economies and 29 developing economies. Although the time-use data compiled by the United Nations are not fully consistent across countries (in particular, the minimum age of respondents varies significantly in national surveys, and the marital status of individuals is not always explicitly identified) and do not exactly match the model's definitions (unpaid work includes time spent not only in home production but also basic child care), they represent nevertheless the most comprehensive dataset available at this time.

Figure 5 displays scatter diagrams relating the gender wage gap (with the value 1 representing gender equality, as in the model) and either the female-male paid work ratio (corresponding to $\varepsilon^{f,W}/\varepsilon^{m,W}$ in the model) or the unpaid work ratio (corresponding to $\varepsilon^{f,P}/\varepsilon^{m,P}$). The figures show that, indeed, as predicted by the model, the correlation between the wage gap and the paid work ratio is positive, whereas the correlation between the wage gap and the unpaid work ratio is negative. Although the correlation coefficients are not very high, this is a rather remarkable result given that differences in definitions of the underlying data can be significant (see Charmes (2015)) and that heterogeneity among countries with respect to several potentially relevant dimensions are not accounted for. Formal econometric work, based on more refined datasets, could indeed control for a number of determinants of paid and unpaid work ratios that have been left out of the model—such as cultural and religious differences across countries regarding the role of women in society, or differences among households regarding access to technology, infrastructure services, and time-saving market goods.

Finally, it is worth noting that some of the predictions of the model are also supported by microeconomic evidence. Heath and Tan (2016) for instance found that women's labor supply increased following a reduction in gender bias in inheritance-laws in India—a measure that they interpret as an exogenous variation in women's unearned income but which can be viewed instead, in the context of the present model, as an autonomous increase in women's bargaining power within the family, which operates in a very similar way to an antonomous reduction in gender inequality in the market place.

15) are available online at https://unstats.un.org/unsd/gender/timeuse/. Paid work is time in wage employment, whereas unpaid work is usually measured as time spent in home production and basic child care. More details on how the data were constructed are available upon request.

8 Concluding Remarks

The purpose of this paper was to study how social norms regarding the role of women determine gender bias in the workplace and in the family, how these two forms of gender bias interact among themselves and with the intra-household bargaining process, and how gender norms change in the course of development. In line with the collective household model, spouses were assumed to have heterogeneous preferences with respect to consumption and fertility, and to maximize a weighted utility function subject to a common budget constraint. Home production was taken to depend on both male and female labor, the effective quantities of which varying inversely with each spouse's bargaining power. A key assumption is that discriminatory social norms generate a pay gap in the workplace in favour of men, but that this gap depends endogenously on the presence of women in the labor market. In addition, household preferences towards girls' education were assumed to depend endogenously on women's bargaining power which, through the male-female wage gap, depends itself on gender bias in the workplace. These interactions were shown to be a critical source of growth dynamics.

The key results were summarized in the introduction and supporting evidence for the model's main predictions was discussed in the previous section. To conclude, it is worth highlighting three directions in which the analysis could be extended. First, the model focused on the *intensive* margin of women's labor supply (hours worked when employed) but did not consider the *extensive* margin (that is, the labor force participation rate), given the assumption that all adults are employed outside the home. This assumption was made, to some extent, for tractability. It is also consistent with the evidence, for both industrial and developing countries, which shows that working women supply significantly fewer hours of work on aggregate than men, because women engage more in part-time employment.[34] Nevertheless, a more general approach would be to account for both margins. This would also allow the analysis of two other well-documented facts—structural differences in labor force participation rates between men and women, which tend to be very high in some regions of the world, and the greater incidence of

[34]For industrial countries, Christiansen et al. (2016) found that in the Netherlands for instance, a high female labor force participation rate coincides with a considerable gap in hours worked between men and women, as more than half of women between the ages of 25 and 54 are employed part time. They also found that in Germany women work about 30 hours per week, while men work for nearly 40 hours per week.

unemployment among women (see International Labour Office (2010, 2017)). It may also help to account for the fact that gender-biased technological change may be a key determinant of changes in female participation to the labor market, because (as argued by Albanesi (2014) for instance) tasks at which women have a comparative advantage become more important compared to those that favor men, such as those relying on physical strength.

Second, it would be useful to account explicitly for the role of female managers in promoting changes in discriminatoty norms against women in the market place. In almost all countries, a sizable gap remains between the gender distribution of the workforce and the gender composition of senior positions. A multi-country company survey by the International Labour Office (2015, Table 3.4) for instance found that although the proportion of women employed as managers is correlated with the proportion of women in the labour force, 34 percent of the companies surveyed had no women at the top executive level, and a further 21 percent had only 10 percent or fewer women in that category of management.[35] Social norms may generate bias against appointing women as managers and leaders. In turn, lack of exposure to, or visibility of, female leaders may perpetuate biased perceptions of women's effectiveness in leadership roles—helping therefore to perpetuate discrimination in high-level positions. By contrast, policies aimed at promoting the presence of women in top managerial positions could help to initiate virtuous dynamics by increasing pressure—above and beyond the mere presence of women in the labor force—for further changes in gender norms in the workplace. However, for this to be successful may require convincing potential losers (male managers) that they may also benefit indirectly from greater gender equality, through improved aggregate productivity for instance or higher rates of economic growth.

Finally, the model was designed and calibrated for a low-income economy, under the assumption (supported by the evidence) that only women engage in child rearing and with an emphasis on government spending on early childhood education as a core development policy. However, to understand how gender equality evolves during the transition from developing to developed status, it would be useful to adapt it and cali-

[35] By contrast, Christiansen et al. (2016) found that the overall female labor force participation rate is not a good predictor of the representation of women in senior positions in the corporate sector. However, they also found a strong negative association between the incidence of part-time employment among working women and the share of women in senior corporate positions, which provides support to the supply-side explanations for the gender gaps in these positions.

brate it to a high-income environment, where gender wage gaps in the labor market—as documented by Mohan (2014), Olivetti and Petrongolo (2016), Stotsky et al. (2016), and International Labour Office (2010, 2017) for instance—remain significant. This could involve modeling not only the extensive margin of men's and women's labor supply (as noted earlier) but also joint parental involvement in child rearing (given that men's involvement tends to increase with the level of development), time allocated by adults to their own human capital accumulation (as in Agénor and Canuto (2015) or Erosa et al. (2016) for instance), and government spending on tertiary education to study the impact of public policy on human capital accumulation in adulthood.

While these extensions may well change—possibly in significant ways—the quantitative nature of the results reported in this paper, they are unlikely to affect in a fundamental manner its central contribution regarding the endogenous interactions between social norms, gender inequality in the home and in the workplace, and women's time allocation in the early stages of development.

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Table 1
Benchmark Calibration

Parameter	Value	Description
Households		
ρ	0.04	Annual discount rate
σ	0.12	Family's savings rate out of wages
θ^R	0.105	Unit share of family income allocated to child rearing
n	4.3	Gross fertility rate
η^C	0.551	Family preference for current consumption
η_C^f, η_C^m	$0.447, 0.595$	Preference parameters, current consumption
η^N	0.544	Family preference parameter, number of children
η_N^f, η_N^m	$0.441, 0.588$	Preference parameters, children's education
η_G	0.488	Preference parameters, own human capital
η_Q	0.954	Family preference parameter, home good
η_L	0.129	Preference parameters, leisure and personal time
Home production		
π^Q	0.7	Curvature of production function with respect to labor
Market production		
β	0.35	Elasticity with respect to male labor and female labor
α	0.3	Elasticity with respect to physical capital
Human capital		
ν_1	0.4	Elasticity with respect to public spending in education
ν_2	0.1	Elasticity with respect to mothers' rearing time
Government		
τ	0.216	Tax rate on wage income, adjusted for labor share
υ_E	0.169	Share of noninterest spending on education
Bargaining power		
$\varkappa_m$	0.429	Scale parameter, women's bargaining power
μ_B	0.7	Elasticity of women's bargaining power to wage ratio
Gender bias		
χ_m	1.0	Scale parameter, gender bias in family preferences
μ^G	0.7	Degree of persistence, gender bias in family preferences
b_m	0.846	Scale parameter, gender bias in the workplace
μ_1^S	0.4	Elasticity of gender bias to relative time in market work
μ_2^S	0.7	Degree of persistence, gender bias in the workplace

Table 2
Initial Steady-State Values of Key Variables

Parameter	**Value**	**Description**
Women's time allocation		
$\varepsilon^{f,P}$	0.35	Time allocated to home production
$\varepsilon^{f,R}$	0.029	Time allocated to each child
$n\varepsilon^{f,R}$	0.125	Total time allocated to child rearing
$\varepsilon^{f,W}$	0.36	Time allocated to market work
$\varepsilon^{f,L}$	0.165	Time allocated to leisure
Men's time allocation		
$\varepsilon^{m,P}$	0.07	Time allocated to home production
$\varepsilon^{f,W}$	0.85	Time allocated to market work
$\varepsilon^{f,L}$	0.08	Time allocated to leisure
Time allocation ratios		
$\varepsilon^{f,P}/\varepsilon^{m,P}$	5.0	Female-male home production time ratio
$\varepsilon^{f,W}/\varepsilon^{m,W}$	0.424	Female-male market work time ratio
Gender bias		
b	0.6	Gender bias in workplace
χ	0.3	Gender bias in family preferences
Bargaining power		
$\varkappa$	0.3	Women's intra-family bargaining power
Output growth rate		
$1+g$	0.033	Growth rate of market output

Table 3

Steady-state Effects: Education Spending and autonomous Reductions in Gender Bias, Benchmark Parameters

		Absolute Deviations from Baseline						
	Baseline	Benchmark Increase in υ_E	Increases in υ_E and χ_m		Increases in υ_E and b_m		Increases in υ_E, χ_m, and b_m	
			Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Women's time allocation								
Home Production	0.3500	0.0000	-0.0139	-0.0163	0.0006	-0.0088	-0.0142	-0.0252
Child rearing (unit time)	0.0290	0.0000	0.0034	0.0036	-0.0011	0.0007	0.0022	0.0044
Market work	0.3600	0.0000	0.0042	0.0053	0.0006	0.0039	0.0054	0.0091
Leisure and personal time	0.1653	0.0000	-0.0043	-0.0038	0.0034	0.0021	-0.0004	-0.0019
Men's time allocation								
Home Production	0.0700	0.0000	0.0341	0.0402	0.0014	0.0238	0.0359	0.0604
Market work	0.8500	0.0000	-0.0312	-0.0371	-0.0026	-0.0234	-0.0341	-0.0571
Leisure and personal time	0.0800	0.0000	-0.0029	-0.0030	0.0012	-0.0005	-0.0018	-0.0033
Family-wide variables								
Female-male home production time ratio	5.0000	0.0000	-1.7729	-1.9712	-0.0872	-1.3638	-1.8301	-2.5093
Female-male market work time ratio	0.4235	0.0000	0.0213	0.0258	0.0020	0.0167	0.0243	0.0420
Fertility rate	4.3000	0.0000	-0.0134	-0.0167	-0.0023	-0.0111	-0.0158	-0.0288
Family's savings rate	0.1200	0.0000	0.0000	0.0002	0.0007	0.0008	0.0007	0.0011
Gender bias in the workplace [1]	0.6000	0.0000	0.0000	0.0144	0.0428	0.0528	0.0428	0.0676
Women's bargaining power	0.3000	0.0000	0.0000	0.0050	0.0148	0.0183	0.0148	0.0233
Gender bias in family preferences [1]	0.3000	0.0000	0.0300	0.0355	0.0000	0.0183	0.0300	0.0556
Growth rate of final output	0.0330	0.0011	0.0014	0.0016	0.0014	0.0017	0.0018	0.0023

Notes: Regime 1 corresponds to the case where b and χ are both exogenous, and Regime 2 to the case where both b and χ are endogenous. The increase in υ_E is from 0.169 to 0.186, the increase in b_m is from 0.846 to 0.931 (or b from 0.6 to 0.613), and the increase in χ_m is from 1 to 1.1 (or χ from 0.3 to 0.33).

[1] An increase indicates a reduction in gender bias.

Table 4

Steady-state Effects: Education Spending and autonomous Reductions in Gender Bias, $\nu_2 = 0.4$

	Baseline	Absolute Deviations from Baseline						
		Benchmark	Increases in υ_E and χ_m		Increases in υ_E and b_m		Increases in υ_E, χ_m, and b_m	
		Increase in υ_E	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Women's time allocation								
Home Production	0.3500	0.0000	-0.0199	-0.0221	0.0031	-0.0093	-0.0177	-0.0316
Child rearing (unit time)	0.0290	0.0000	0.0038	0.0041	-0.0010	0.0011	0.0028	0.0054
Market work	0.3600	0.0000	0.0002	0.0010	0.0021	0.0036	0.0032	0.0044
Leisure and personal time	0.1653	0.0000	0.0071	0.0078	-0.0012	0.0032	0.0061	0.0111
Men's time allocation								
Home Production	0.0700	0.0000	0.0372	0.0423	-0.0001	0.0241	0.0377	0.0626
Market work	0.8500	0.0000	-0.0340	-0.0390	-0.0012	-0.0236	-0.0357	-0.0590
Leisure and personal time	0.0800	0.0000	-0.0032	-0.0033	0.0013	-0.0005	-0.0020	-0.0036
Family-wide variables								
Female-male home production time ratio	5.0000	0.0000	-1.9208	-2.0798	0.0543	-1.3790	-1.9145	-2.5981
Female-male market work time ratio	0.4235	0.0000	0.0179	0.0216	0.0031	0.0164	0.0225	0.0371
Fertility rate	4.3000	0.0000	-0.0636	-0.0749	-0.0043	-0.0439	-0.0682	-0.1241
Family's savings rate	0.1200	0.0000	0.0000	0.0002	0.0007	0.0008	0.0007	0.0010
Gender bias in the workplace [1]	0.6000	0.0000	0.0000	0.0121	0.0428	0.0526	0.0428	0.0648
Women's bargaining power	0.3000	0.0000	0.0000	0.0042	0.0148	0.0182	0.0148	0.0223
Gender bias in family preferences [1]	0.3000	0.0000	0.0300	0.0346	0.0000	0.0182	0.0300	0.0546
Growth rate of final output	0.0330	0.0011	0.0028	0.0031	0.0012	0.0023	0.0030	0.0044

Notes: Regime 1 corresponds to the case where b and χ are both exogenous, and Regime 2 to the case where both b and χ are endogenous. The increase in υ_E is from 0.169 to 0.186, the increase in b_m is from 0.846 to 0.931 (or b from 0.6 to 0.613), and the increase in χ_m is from 1 to 1.1 (or χ from 0.3 to 0.33).

[1] An increase indicates a reduction in gender bias.

Table 5

Steady-state Effects: Education Spending and autonomous Reductions in Gender Bias, $\mu^{S}_{1} = 0.9$

	Baseline	Absolute Deviations from Baseline						
		Benchmark Increase in υ_E	Increases in υ_E and χ_m		Increases in υ_E and b_m		Increases in υ_E, χ_m, and b_m	
			Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Women's time allocation								
Home Production	0.3500	0.0000	-0.0104	-0.0223	0.0004	-0.0092	-0.0104	-0.0310
Child rearing (unit time)	0.0290	0.0000	0.0040	0.0033	-0.0015	0.0003	0.0024	0.0037
Market work	0.3600	0.0000	0.0012	0.0097	0.0017	0.0056	0.0034	0.0147
Leisure and personal time	0.1653	0.0000	-0.0075	-0.0013	0.0045	0.0024	-0.0025	0.0009
Men's time allocation								
Home Production	0.0700	0.0000	0.0324	0.1297	0.0014	0.0714	0.0340	0.1823
Market work	0.8500	0.0000	-0.0299	-0.1228	-0.0026	-0.0689	-0.0326	-0.1739
Leisure and personal time	0.0800	0.0000	-0.0025	-0.0070	0.0011	-0.0025	-0.0014	-0.0085
Family-wide variables								
Female-male home production time ratio	5.0000	0.0000	-2.0833	-1.5444	-0.1222	-0.5930	-2.1438	-3.8072
Female-male market work time ratio	0.4235	0.0000	0.0160	0.0425	0.0032	0.0228	0.0199	0.0643
Fertility rate	4.3000	0.0000	-0.0131	-0.0169	-0.0017	-0.0099	-0.0149	-0.0277
Family's savings rate	0.1200	0.0000	0.0000	0.0007	0.0005	0.0008	0.0005	0.0015
Gender bias in the workplace [1]	0.6000	0.0000	0.0000	0.0364	0.0279	0.0403	0.0279	0.0782
Women's bargaining power	0.3000	0.0000	0.0000	0.0159	0.0110	0.0175	0.0110	0.0334
Gender bias in family preferences [1]	0.3000	0.0000	0.0300	0.0346	0.0000	0.0175	0.0300	0.0539
Growth rate of final output	0.0330	0.0011	0.0014	0.0018	0.0013	0.0016	0.0016	0.0024

Notes: Regime 1 corresponds to the case where b and χ are both exogenous, and Regime 2 to the case where both b and χ are endogenous. The increase in υ_E is from 0.169 to 0.186, the increase in b_m is from 0.846 to 0.931 (or b from 0.6 to 0.613), and the increase in χ_m is from 1 to 1.1 (or χ from 0.3 to 0.33).

[1] An increase indicates a reduction in gender bias.

Figure 1
Gender Bias, Time Allocation, and Bargaining Power

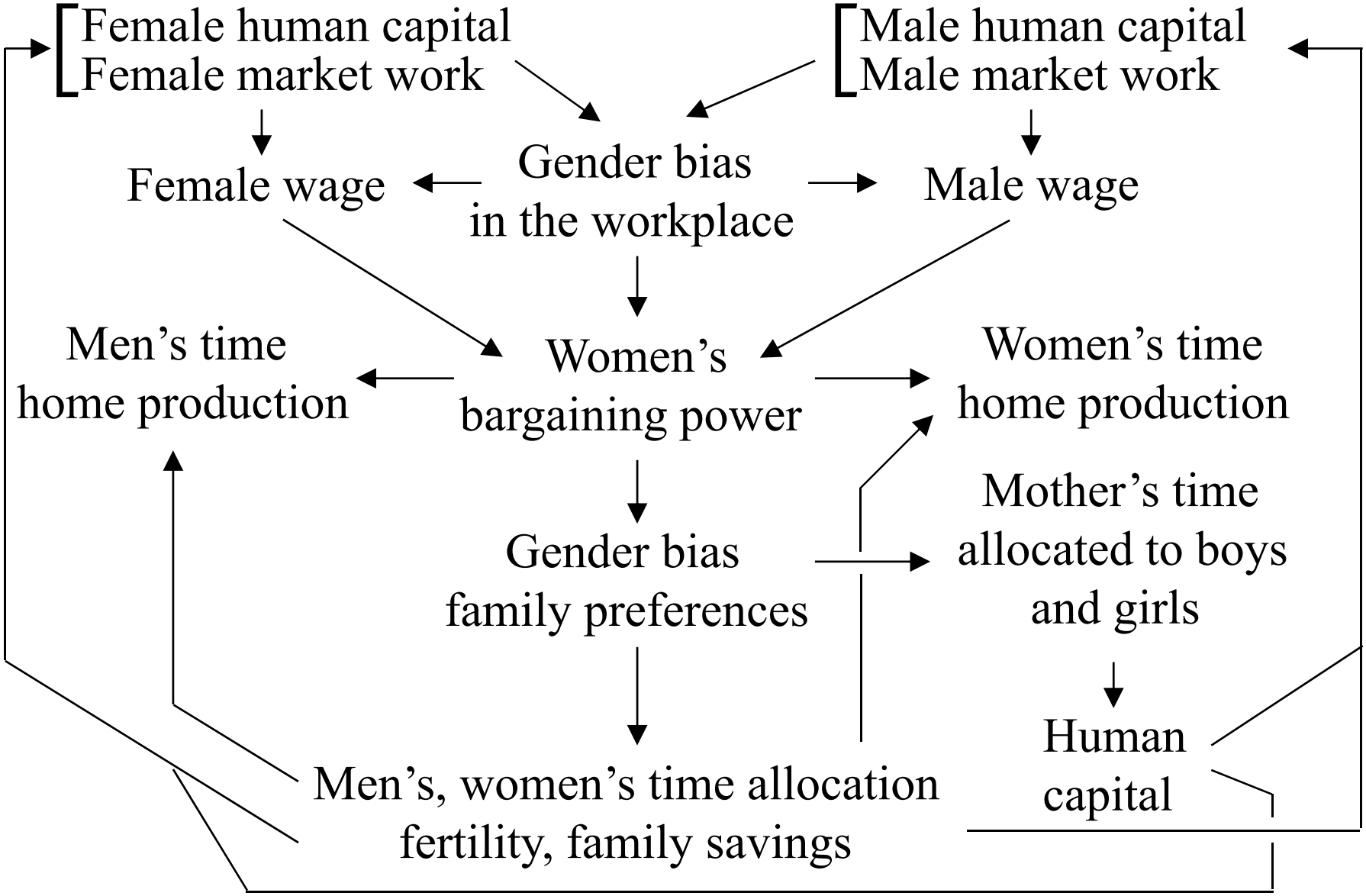


Figure 2

Education Spending and Autonomous Change in Gender Bias in Preferences

(Absolute deviations from baseline)

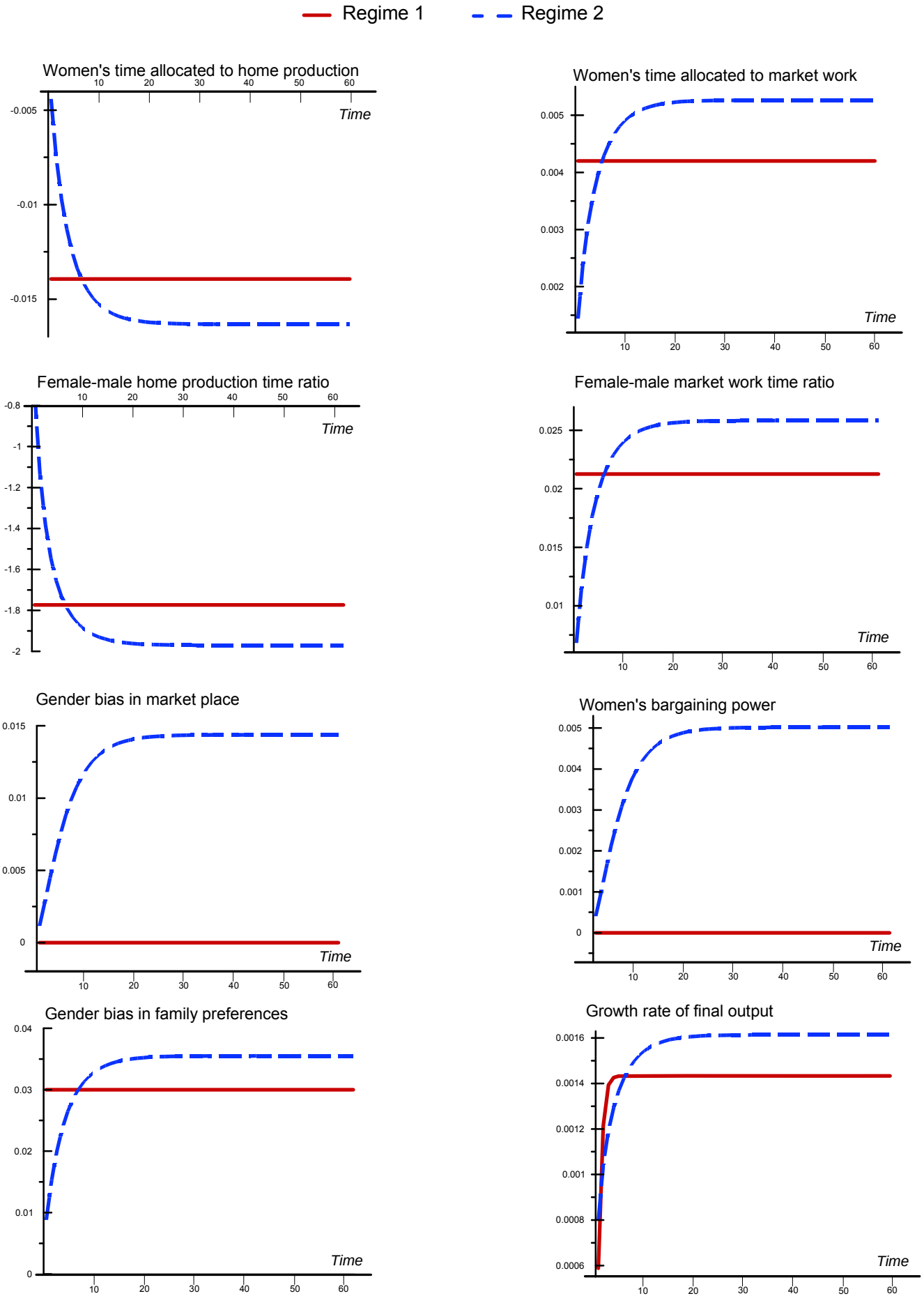


Figure 3

Education Spending and Autonomous Change in Gender Bias in Market Place

(Absolute deviations from baseline)

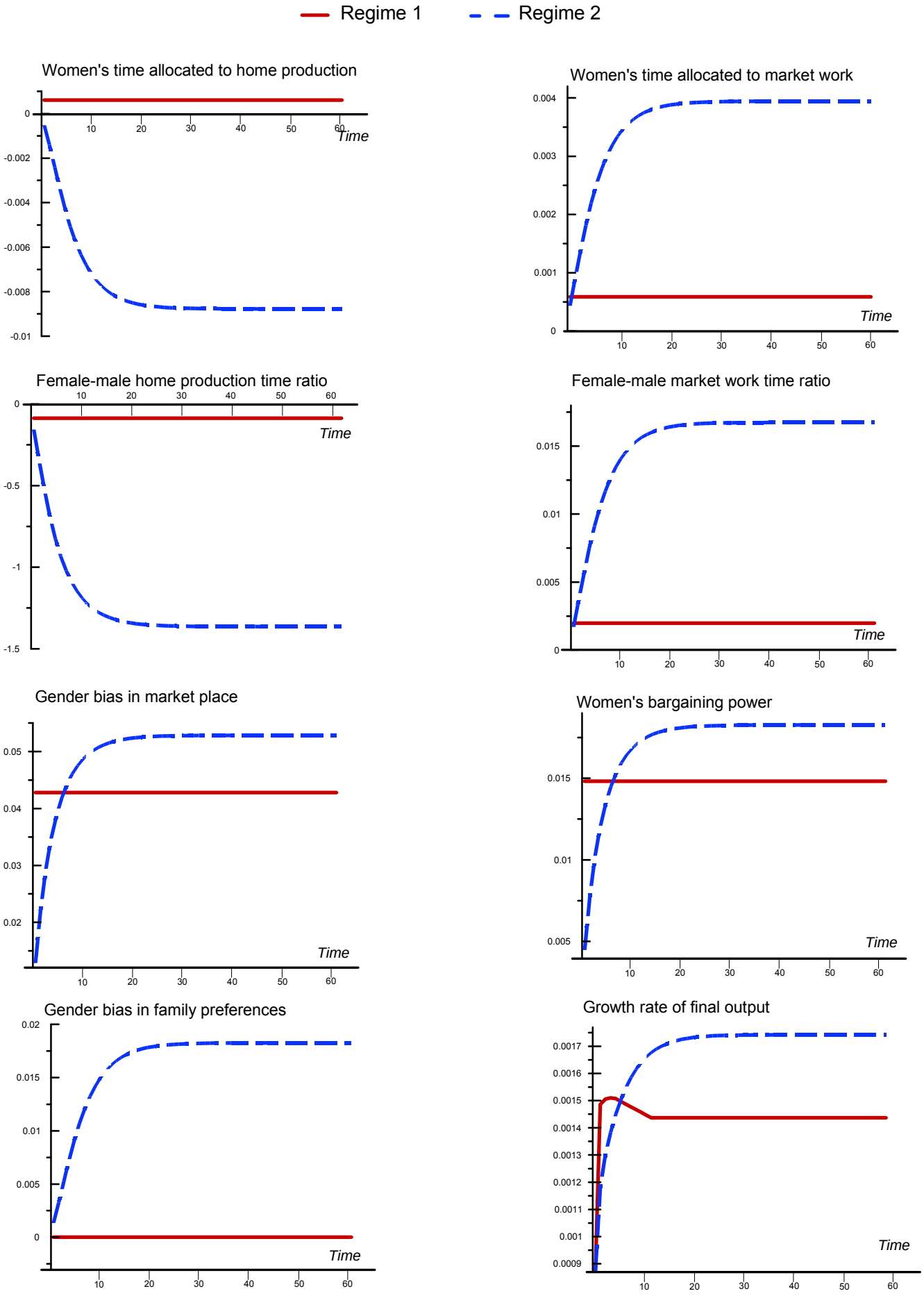


Figure 4
Education Spending and Autonomous Change in Gender Bias in Preferences
Regime 2
(Absolute deviations from baseline)

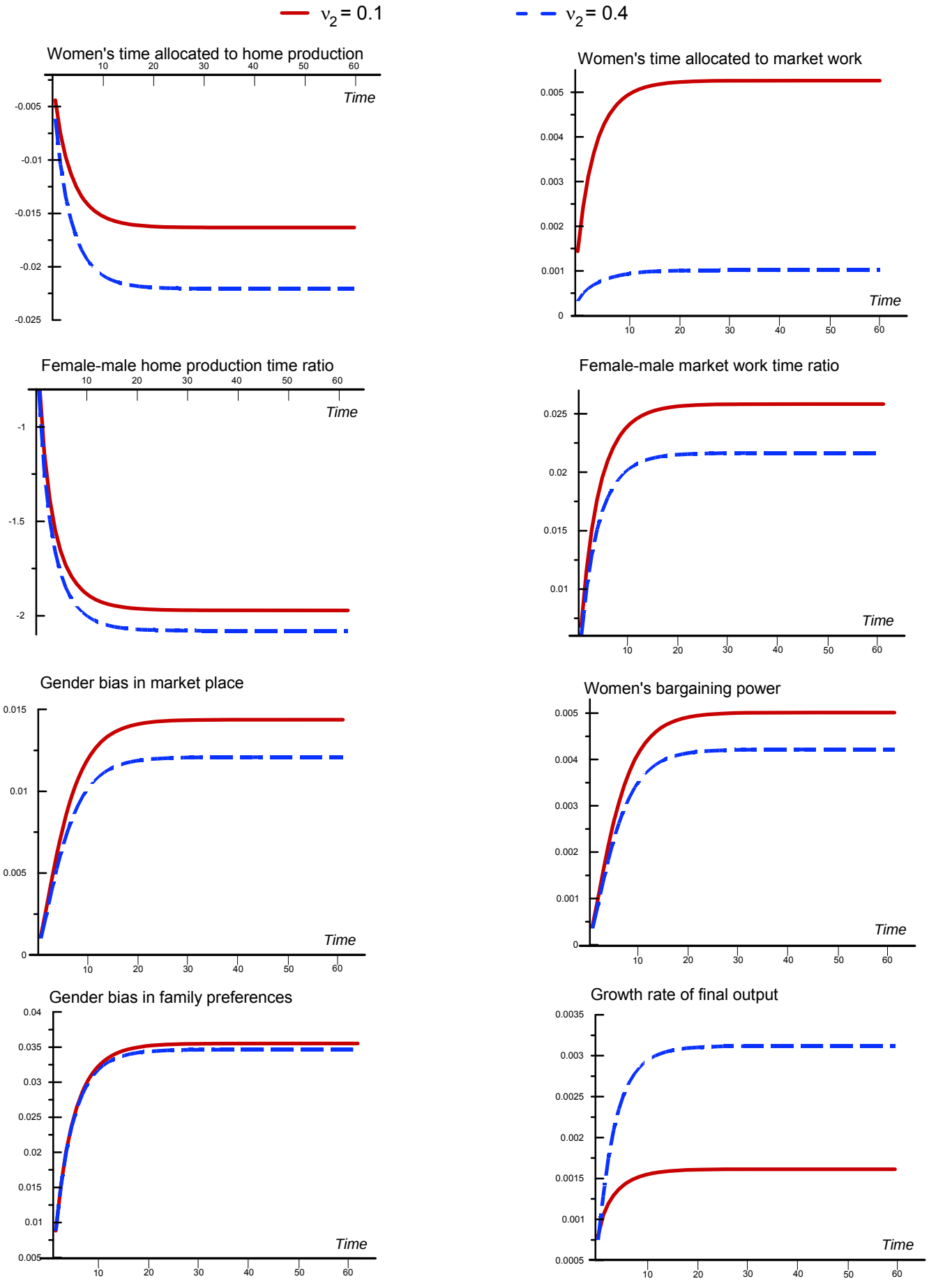
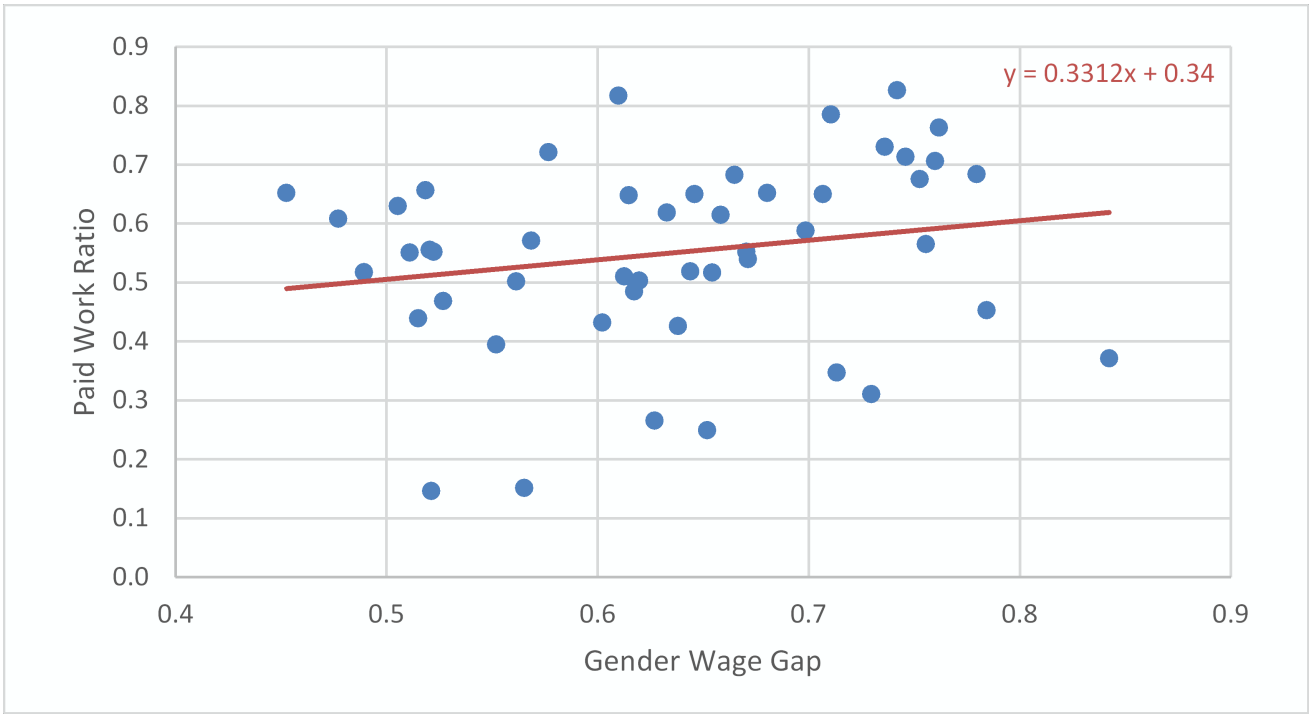
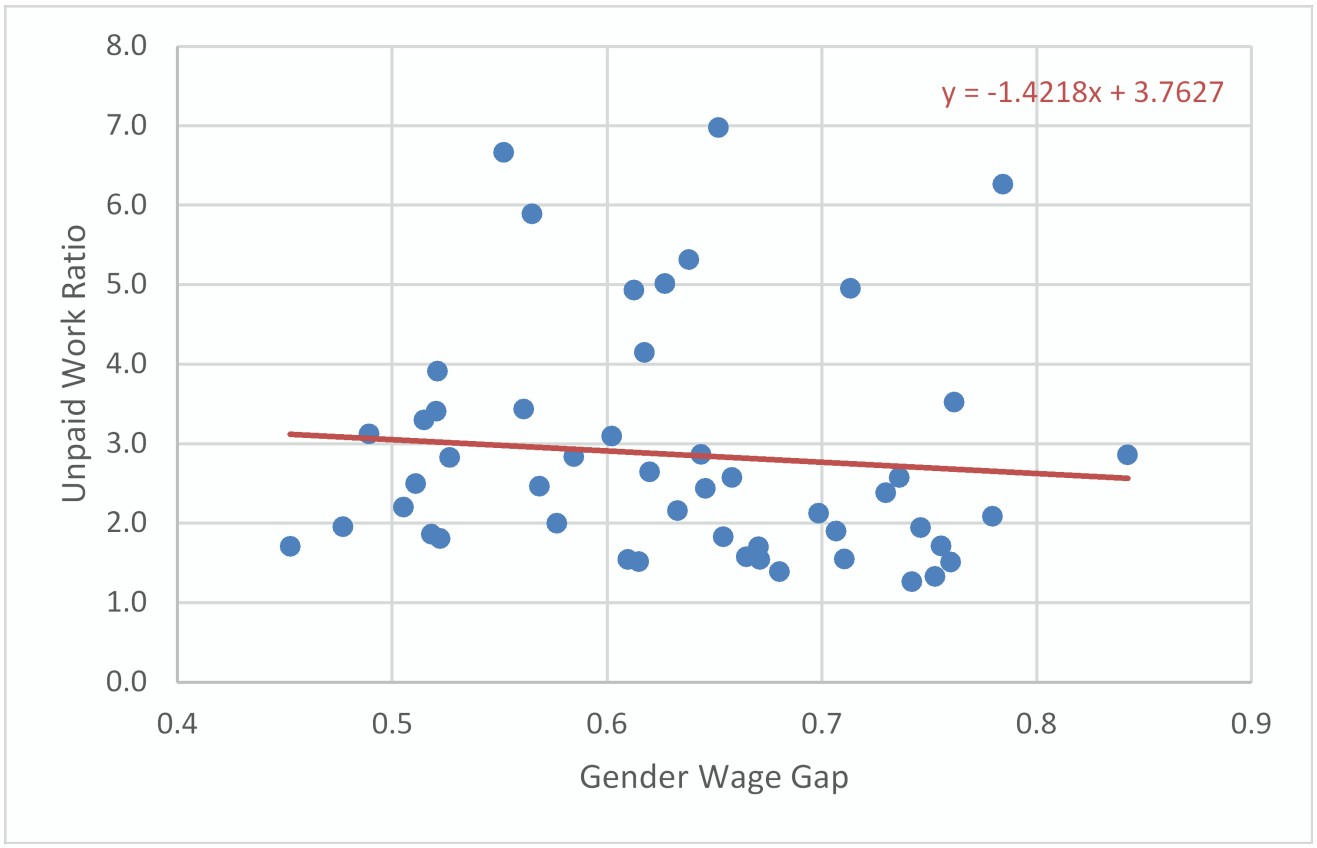


Figure 5
Gender Wage Gap, Female-Male Unpaid and Paid Work Ratios
Cross-Country Evidence





Source : Author's calculations, based on data from the United Nations and the World Economic Forum.

Notes: The gender wage gap is measured between 0 and 1, with 1 corresponding to perfect equality. Paid work is time in wage employment, whereas unpaid work is usually measured as time spent in home production and basic child care. The countries included in the sample are Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Denmark, Ecuador, Estonia, Ethiopia, Finland, France, Germany, Greece, Guatemala, Honduras, Hungary, Iran, Italy, Japan, Kazakhstan, Kyrgyzstan, Mexico, Mongolia, Morocco, Netherlands, New Zealand, Norway, Oman, Panama, Peru, Poland, Qatar, Romania, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United States, and Uruguay.