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Gender Equality
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in India: A Quantitative
Framework

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Jan Mares,
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GENDER EQUALITY AND ECONOMIC GROWTH IN INDIA: A QUANTITATIVE FRAMEWORK
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By Pierre-Richard Agénor, Jan Mares and Piritta Sorsa

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ABSTRACT/RÉSUMÉ

Gender equality and economic growth in India: a quantitative framework

This paper studies how public policies, including pro-women interventions, can raise female labour force participation and promote economic growth in India. The first part provides a brief review of gender issues in the country. The second part presents a gender-based OLG model, based on Agénor (2015) and Agénor and Canuto (2015), that accounts for women's time allocation between market work, child rearing, human capital accumulation, and home production. Bargaining between spouses depends on relative human capital stocks. The model is calibrated and various experiments are conducted, including investment in infrastructure, conditional cash transfers, and a reduction in gender bias in the market place. The analysis shows raising female labour force participation with a package of pro-growth and pro-women policies could boost the growth rate by about 2 percentage points over time.

This Working Paper relates to the 2014 *OECD Economic Survey of India* (<http://www.oecd.org/eco/surveys/economic-survey-india.htm>).

JEL classification: I15, I25, J16, O41

Keywords: *India, gender, female labour force participation, gender equality*

L'égalité des genres et la croissance économique en Inde: un cadre quantitatif

Cet article étudie la façon dont les politiques publiques, y compris les interventions en faveur des femmes, peuvent accroître la participation des femmes au marché du travail et de promouvoir la croissance économique en Inde. La première partie donne un bref aperçu des questions liées au genre dans le pays. La deuxième partie présente un modèle, basé sur Agénor (2015) et Agénor et Canuto (2015), qui tient compte de la répartition du temps des femmes entre le marché du travail, l'éducation des enfants, l'accumulation de capital humain, et de la production à la maison. La négociation entre conjoints dépend sur les stocks relatifs au capital humain. Le modèle est calibré et diverses expériences sont menées, y compris les investissements dans les infrastructures, les transferts monétaires conditionnels, et une réduction des préjugés sexistes dans le marché du travail. L'analyse montre comment une augmentation dans le taux d'activité des femmes avec un paquet des politiques pro-croissances et pro-femmes pourrait faire progresser le taux de croissance d'environ 2 points de pourcentage au cours du temps.

Ce Document de travail se rapporte à l'*Étude économique de l'OCDE de l'Inde, 2014* (<http://www.oecd.org/fr/eco/etudes/etude-economique-inde.htm>).

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Mots clefs : l'Inde, l'activité économique des femmes, l'égalité des sexes

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Gender Equality and Economic Growth in India: A Quantitative Framework

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1 Introduction

Reigniting the growth engine and making it more inclusive have become major objectives of India's new government. To do so a wide range of reforms are being considered; but there is growing consensus that to achieve these objectives Indian women will have to be given the chance and the incentives to participate more in the labor market. Currently, female labor force participation in India is among the lowest in the emerging markets and declining. And according to the World Economic Forum (2014, Table 3), India was ranked 114 out of 142 countries in 2014, in terms of how wide its gender gap index is.

A key issue in this context is the need to quantify the effects of general public policies and gender-specific policies on women's labor market participation and economic growth in India. This paper uses a computable overlapping generations (OLG) model to provide quantitative estimates of these effects. The model extends the contributions in Agénor (2015) and Agénor and Canuto (2015) to account for endogenous life expectancy (which implies an endogenous savings rate) and cash benefits.¹ As in these contributions, the model is solved analytically and its steady-state solution calibrated. It is then used to perform a variety of policy experiments, including pro-growth and pro-women policies.

The paper is organized as follows. Section 1 provides a background on gender issues in India. Section 2 presents the model. Section 3 derives the balanced growth equilibrium, with all derivations relegated to the Appendix. Section 4 describes the calibration procedure, which dwells on a wide range of sources, including national household surveys. Three types of experiments are considered: changes in public investment in infrastructure; child- and gender-related policies (an increase in targeted cash benefits per child, a reduction in gender bias in the market place, an autonomous increase in women's bargaining power, and an increase in mothers' time

¹These contributions dwell themselves on Agénor and Agénor (2014).

allocated to their daughters); and a composite, pro-growth and pro-women reform program.

2 Background

Less than a third of working-age women in India have jobs, which is low among the BRICS (Brazil, Russia, India, China, and South Africa). Participation in the labor force is higher in south and west India compared to east and north, which may reflect variation in customs (Eswaran et al. (2013)). Participation is also higher in rural than urban areas and among the poor, and declines with family income and education of the women, but rises again among the highly educated women or in high-income families. The poor work for necessity, while social norms among higher-income groups have a strong impact on participation. Women staying home are often considered to increase a family's social status, explaining part of the negative association between family income and women's economic participation in India (Klasen and Peters (2013)).

In contrast to other emerging markets, female labor force participation in India has dropped over the past decade (OECD (2014)). Much of the decline, especially since 2005, reflects a decline in unpaid female self-employment (which is counted as part of the labor force) in agriculture. This may reflect the rise in agricultural incomes since 2005, together with the strong negative correlation between family incomes and female labor force participation. Moreover, women tend to work in less productive jobs than men, as in many developed and emerging countries (World Bank (2011)). More than 30 percent are unpaid self-employed helpers (for instance, a woman working in her husband's shop), compared to 11 percent of working men. Women also have higher than average labor shares in low-productivity agriculture, traditional small-scale manufacturing, and in services such as education and household employment. Only about 6 percent of women employed are in the formal sector

with social benefits, such as pensions or maternity leave—factors that can influence participation. This is not necessarily gender-specific as most jobs in India are in the informal sector, because many companies stay informal to avoid stringent regulations on labor or business establishment (Government of India (2013)). Even among men, only about 9 percent of workers get social benefits.

The quality of female jobs has improved somewhat over the past seven years as the share of female unpaid work declined in rural areas, and employment with regular salaries rose slightly in services and manufacturing in the urban areas. However, most of the rise in these jobs was still in the informal sector without social benefits (Mesrotha et al. (2014)). Participation may also be influenced by the large wage differential that women face in India, especially among unskilled workers. A barely literate man earns nearly twice as much as a woman with similar skills. The difference decreases somewhat with education, especially in services.

Due to the gender wage gap, it can make more sense for the men in the household to take up paid employment outside, leading the woman to stay at home to do household work. In a survey in rural areas, Khera and Nayak (2009) found that many women do not engage in paid work because of the low wage. With large wage differentials, the value of non-market goods production (or regular housework) at home can be larger than the market production wage. This may have been reflected in the drop of rural women from unpaid or low paid self-employment outside the house, as discussed above, as more men found wage jobs and got higher wages. At the same time, MNREGA (Mahatma Gandhi National Rural Employment Guarantee Act)—which offers women equal pay and quotas in rural work programmes—has helped raise female labor force participation. This suggests that reducing wage gaps and increasing active labor market policies (such as the MNREGA programme) can raise female labor force participation (OECD (2014)).

Given the opportunity, many women in India would like to work more. Household

surveys show that a large proportion of stay-at-home women would prefer to work on a regular basis, provided the conditions are right (NSSO). The right conditions may include better wages, availability of safe transport, day care, etc. Unemployment is also high among the most educated; despite higher labor market participation in this category, the proportion of women looking for work and not finding it is high. This may be because of a lack of suitable jobs or a lack of marketable skills.

A lack of jobs has also been a cause of the low labor force participation of women. A large part of the rise in female working-age population over the past decade stayed outside the labor force (even after taking into account those in school), as most of the net job creation since 2000 has been taken up by men. The burden of jobless growth was borne mostly by women, as the rise in male working-age population has been nearly fully absorbed by the labor market. Over 60 million women that entered the working-age population stayed out of the labor force.

Finally, the evidence confirms the strong impact of social norms and outdated labor laws on female participation. Daymard (2015) and Sorsa et al. (2015)) quantitatively estimate key determinants of low participation of women in the job market in India. It confirms the strong impact of socioeconomic factors, especially in south and west India, in reducing participation. In east and north India, other cultural factors, such as religion, dominate. Other deterrents to participation are stringent labor laws that discourage formal job creation with social benefits, weak infrastructure, and access to financial services (potentially affected by impact of biased inheritance laws and dowry payments on access to collateral). The study also confirms the positive impact of MNREGA on participation, and of other factors such as rising education levels over time, and training for skills.

3 The Model

As noted earlier, the main purpose of this paper is to examine, in the context of a formal growth model, how pro-growth and pro-women policies can raise female labor force participation and promote economic growth in India. To do so, the starting point of the analysis is an economy where two goods are produced, a marketed good and a home good, and individuals live for (at most) three periods: childhood (period $t - 1$), adulthood (period t) and retirement (period $t + 1$). The marketed good can be either consumed in the period it is produced or stored to yield capital at the beginning of the following period. Each individual is either male or female, and is endowed with one unit of time in childhood and adulthood, and zero units in old age.

3.1 Family Preferences

At the beginning of adulthood in t , all men and women are randomly matched into married couples. Each couple produces n_t children, which depend on their parents for consumption and any spending associated with schooling and health care. It is also assumed that parents do not have control over the gender composition of their family, so that half of their children are daughters and half of them sons.² A mother must spend $\varepsilon_t^{f,R} \in (0, 1)$ units of rearing time on each child (which involves home tutoring, taking children to medical facilities, and so on). Raising a child also involves a cost of $\theta_t^R \in (0, 1)$ of the family's net income.

All individuals, males and females, work in middle age; the only source of income is therefore wages in the second period of life. Savings can be held only in the form of physical capital. Agents have no other endowments, except for an initial stock of physical capital at $t = 0$, which is the endowment of an initial old generation. A

²This assumption is somewhat at odds with the evidence on “missing girls” for India (see World Bank (2011)). However, it is analytically necessary because it helps to keep the gender composition of the population balanced over time.

male (female) adult is endowed with e_t^m (e_t^f) units of human capital. Each unit of time (adjusted for human capital and productivity) earns an effective market wage, w_t^m for men and w_t^f for women, per unit of time worked.

While husbands allocate inelastically all their time to market work, female spouses must consider four alternatives to allocate their time: market work, raising children, home production, and human capital accumulation. Let $\varepsilon_t^{f,P}$ denote time allocated by women to home production and $\varepsilon_t^{f,E}$ time allocated to human capital accumulation; mothers' time allocated to market activity, $\varepsilon_t^{f,W}$, is thus

$$\varepsilon_t^{f,W} = 1 - \varepsilon_t^{f,P} - \varepsilon_t^{f,E} - n_t \varepsilon_t^{f,R}. \quad (1)$$

It is assumed in what follows that $\varepsilon_t^{f,W} \in (0, 1 - \varepsilon_m^{f,P})$, where $\varepsilon_m^{f,P} \geq 0$ is the minimum amount of time that women must allocate to household chores in the family.

The family's (collective) utility takes the composite form

$$U_t = \varkappa_t U_t^f + (1 - \varkappa_t) U_t^m, \quad (2)$$

where U^j is partner j 's utility function and $\varkappa_t \in (0, 1)$ is a weight that measures the wife's bargaining power in the household decision process.

Assuming that consumption of children is subsumed in the family's consumption, the sub-utility functions are given by, with $j = f, m$,

$$U_t^j = \eta_C^j \ln c_t^{t-1} + \eta_Q \ln Q_t + \eta_N \ln n_t \quad (3)$$

$$+ \eta_E^j \ln e_t^f + \eta_H^j (\ln h_t^{C,f} + \ln h_t^{C,m}) + \frac{p_t^j}{1 + \rho} \ln c_{t+1}^{t-1},$$

where c_t^{t-1} (c_{t+1}^{t-1}), is the family's total consumption in adulthood (old age), Q_t consumption (and production) of home goods, $h_t^{C,j}$ health status of a child of gender j , $\rho > 0$ the discount rate, and $p_t^j \in (0, 1)$, $j = m, f$ the probability of survival from

adulthood to old age.^{3,4} Parents care about all of their children and their health. For analytical tractability, the utility function is assumed to be separable in health status and the number of children.

Coefficients η_C^j measure relative preference for today's consumption, η_N relative preference for children, η_Q the family's relative preference for the home-produced good, η_H^j relative preference for children's health, and η_E^j relative preference for women's education. The restrictions $\eta_C^f < \eta_C^m$, $\eta_H^f > \eta_H^m$, and $\eta_E^f > \eta_E^m$ are also imposed. Thus, both parents benefit equally from consumption of the home good and value fertility in the same way. But women are less concerned than men about current consumption and care more about the health of their children and their own level of education.⁵ They also have longer longevity than men ($p_t^f > p_t^m$), implying a higher weight on consumption in old age. For simplicity, only the marketed good is consumed in old age.

The family's budget constraints for period t and $t + 1$ are given by⁶

$$c_t^{t-1} + s_t = (1 - \theta_t^R \eta_t)(1 - \tau)w_t^T, \quad (4)$$

$$c_{t+1}^{t-1} = [(1 + r_{t+1})s_t]/p_t, \quad (5)$$

where $\tau \in (0, 1)$ is the tax rate on wages, s_t saving, r_{t+1} the net rental rate of private capital, p_t is the weighted survival rate (defined later), and w_t^T total gross wage

³There is some evidence for industrial countries that women are more patient than men (see for instance Croson and Gneezy (2009) and Dittrich and Leipold (2014)), which would imply in principle setting $\rho^m > \rho^f$ and defining ρ as a weighted average. As discussed later, this gender difference in time preference is captured indirectly through η_C .

⁴Child mortality is not explicitly considered here. In recent years child mortality has fallen significantly in India. According to World Bank data (World Development Indicators), the infant mortality rate (per 1,000 live births) fell from 66.6 in 2000 to 43.8 in 2012. During the same period, the under-5 mortality rate fell from 91.5 to 56.3.

⁵For evidence on these facts, see UNICEF (2007) and World Bank (2011).

⁶To abstract from unintended bequests, the saving left by agents who do not survive to old age is assumed to be confiscated by the government, which transfers them in lump-sum fashion to surviving members of the same cohort. The rate of return to saving is thus $(1 + r_{t+2})/p$, as shown in (5). See Agénor (2012, p. 73) for a derivation.

income of the family, defined as

$$w_t^T = e_t^m a_t^m w_t^m + e_t^f \varepsilon_t^{f,W} a_t^f w_t^f, \quad (6)$$

with a_t^j denoting productivity of labor $j = m, f$. Combining (4) and (5), the family's consolidated budget constraint is thus

$$c_t^{t-1} + \frac{p_t c_{t+1}^{t-1}}{1 + r_{t+1}} = (1 - \theta_t^R n_t)(1 - \tau)w_t^T. \quad (7)$$

The coefficient θ_t^R is a weighted average of male- and female-specific parameters, $\theta^{m,R}$ and $\theta^{f,R}$:

$$\theta_t^R = \varkappa_t \theta^{f,R} + (1 - \varkappa_t) \theta^{m,R}. \quad (8)$$

Thus, if to begin with women attach more value to spending on children ($\theta^{f,R} > \theta^{m,R}$), an increase in their bargaining power will raise the family-wide spending share, θ_t^R .

Let N_t denote the number of adults alive in period t ; it is given by

$$N_t = n_{t-1} 0.5 N_{t-1}, \quad (9)$$

where n_{t-1} is the number of children born in the previous period and $0.5 N_{t-1}$ is the number of families in $t-1$. Each family maximizes (2) subject to (1), (3), and (7), as well as (10) and (19) below, with respect to c_t^{t-1} , c_{t+1}^{t-1} , $\varepsilon_t^{f,P}$, $\varepsilon_t^{f,R}$, $\varepsilon_t^{f,E}$, and n_t , taking the tax rate, the survival rate, the rental rate of private capital, bargaining power, and the share of spending on children, as given; $\varepsilon_t^{f,W}$ is then solved residually from (1).

3.2 Home Production

Home production involves combining women's time allocated to that activity with infrastructure services:

$$Q_t = [\varepsilon_t^{f,P} + \zeta^P (\frac{K_t^I}{K_t^P})]^{\pi^Q}, \quad (10)$$

where K_t^I is the stock of public capital in infrastructure, K_t^P the aggregate stock of private capital, $\pi^Q \in (0, 1)$, and $\zeta^P \in (0, 1)$ is a coefficient that helps to parameterize the degree of substitutability between women's time and infrastructure services, with $\zeta^P = 0$, $\zeta^P = 1$, and $\zeta^P < 1$ corresponding to from zero, perfect, and imperfect substitutability, respectively. Access to infrastructure is not excludable but subject to congestion (and thus partially rival), as discussed next.⁷

3.3 Market Production

Firms engaged in market production are identical and their number is normalized to unity. Each firm i produces a single nonstorable good, using male effective labor, $A_t^m L_t^{m,i}$, where A_t^m is average male labor productivity in the economy, and female effective labor, defined as $A_t^f \varepsilon_t^{f,W} L_t^{f,i}$, where A_t^f is economy-wide female labor productivity, and $L_t^{i,j} = E_t^j N_t^{i,j}$ (where E_t^j is average human capital for $j = m, f$), private capital, $K_t^{P,i}$, and public infrastructure. Public capital is subject to congestion, which is taken to be proportional to the aggregate private capital stock, $K_t^P = \int_0^1 K_t^{P,i} di$. Thus, the intensive use of public infrastructure assets by firms reduces the availability of those assets for use by all firms, as well as (from (10)) households.

The production function of individual firm i takes the form

$$Y_t^i = \left(\frac{K_t^I}{K_t^P}\right)^\alpha (A_t^m L_t^{m,i})^\beta (A_t^f \varepsilon_t^{f,W} L_t^{f,i})^\beta (K_t^{P,i})^{1-2\beta}, \quad (11)$$

where $\alpha > 0$ and $\beta \in (0, 0.5)$.

Due to direct discrimination in the workplace, women only earn a fraction $b \in (0, 1)$ of their marginal product.⁸ Thus, assuming for simplicity full depreciation of

⁷The assumption that public capital is nonexcludable justifies the introduction of the *aggregate* stock in the home production function.

⁸Discrimination in the workplace, in the form of the exclusion of females from managerial positions, may generate distortions in the allocation of talent between managerial and unskilled positions—both of which may reduce economic growth. See Esteve-Volart (2004) for a discussion and some empirical evidence for India.

private capital, profit maximization with respect to private inputs gives

$$A_t^m E_t^m w_t^m = \frac{\beta Y_t^i}{N_t^{m,i}}, \quad A_t^f \varepsilon_t^{f,W} E_t^f w_t^f = b \frac{\beta Y_t^i}{N_t^{f,i}}, \quad r_t = (1 - 2\beta) \frac{Y_t^i}{K_t^{P,i}} - 1. \quad (12)$$

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

$$\frac{A_t^f \varepsilon_t^{f,W} E_t^f w_t^f}{A_t^m E_t^m w_t^m} = b. \quad (13)$$

Thus, all else equal, the smaller b is, the larger will be the observed wage differential between men and women in the workplace.

Given that all firms are identical, and that their number is normalized to 1, $K_t^P = K_t^{P,i} \forall i$ and aggregate output $Y_t = \int_0^1 Y_t^i di$ is, from (11) and $L_t^j = E_t^j N_t^j$,

$$Y_t = (k_t^I)^\alpha \left(\frac{E_t^m N_t^m}{K_t^P} \right)^\beta \left(\frac{E_t^f N_t^f}{K_t^P} \right)^\beta (\varepsilon_t^{f,W})^\beta (A_t^m)^\beta (A_t^f)^\beta K_t^P, \quad (14)$$

where $k_t^I = K_t^I / K_t^P$ is the public-private capital ratio.

3.4 Human Capital Formation

Schooling is mandatory, so all children must devote all their time to education.⁹ Boys and girls have identical innate abilities and have access to the same learning technology. However, each group's education outcomes depend also on the amount of time that parents devote to tutoring.

Let e_{t+1}^j , $j = m, f$ be the human capital of men and women born in period t and used in period $t + 1$. The production of either type of human capital requires several inputs, in addition to children's time. First, it depends on the time that mothers allocate to tutoring their children. Mothers determine first the total amount of time allocated to child rearing, $\varepsilon_t^{f,R}$, and then subdivide that time into a fraction

⁹The model therefore abstracts from child labor—a potentially important issue for India. See Agénor and Alpaslan (2013) for a discussion and a formal analysis.

$\chi^R \in (0, 1)$ allocated to sons and $1 - \chi^R$ allocated to daughters.¹⁰ Parameter χ^R is assumed constant and reflects social norms regarding the role of women in society.

Second, the production of human capital depends on the stock of public infrastructure, taking into account a congestion effect measured again by the (aggregate) private capital stock. This effect captures the importance of infrastructure for education outcomes.¹¹

Third, knowledge accumulation depends on average government spending on education per child, $\varphi_E G_t^E / n_t 0.5 N_t$, where $\varphi_E \in (0, 1)$ is an indicator of efficiency of spending.

Fourth, human capital accumulation depends on a mother's human capital. Because individuals are identical within a generation, a mother's human capital at t is equal to the average human capital of the previous generation. Finally, women's human capital at $t + 1$ depends also on the amount of time that they choose to invest in the acquisition of skills.

Assuming no depreciation for simplicity, the human capital that men and women have in the second period of life is

$$e_{t+1}^m = \left(\frac{\varphi_E G_t^E}{n_t 0.5 N_t} \right)^{\nu_1} (E_t^f)^{1-\nu_1} (k_t^I)^{\nu_2} (\chi^{R,m} \varepsilon_t^{f,R})^{\nu_3}, \quad (15)$$

$$e_{t+1}^f = \left(\frac{\varphi_E G_t^E}{n_t 0.5 N_t} \right)^{\nu_1} (E_t^f)^{1-\nu_1} (k_t^I)^{\nu_2} (\chi^{R,f} \varepsilon_t^{f,R})^{\nu_3} (\varepsilon_{t+1}^{f,E})^{\nu_4}, \quad (16)$$

where $\nu_1 \in (0, 1)$, $\nu_i > 0$, $i = 2, 3, 4$, and

$$\chi^{R,j} = \begin{cases} \chi^R & \text{for } j = m \\ 1 - \chi^R & \text{for } j = f \end{cases}. \quad (17)$$

¹⁰Alternatively, it could be assumed that, as a result of scale economies, mothers allocate a fraction of total rearing time to both boys and girls, and the remaining fraction between them, in specific proportions. This would not change the analysis.

¹¹For India, Kanagawa and Nakata (2008) found that, in the state of Assam, a 1 percentage point increase in electrification of the state yields a 0.17 percentage point improvement in the literacy rate; the study also predicts greater literacy gains if power networks are built out further in rural areas. See Agénor (2011, 2012, Chapter 2) for a broader review of the evidence.

Combining equations (15), (16), and (17) yields, for period t ,

$$\frac{e_t^m}{e_t^f} = \left(\frac{\chi^R}{1 - \chi^R}\right)^{\nu_3} (\varepsilon_t^{f,E})^{-\nu_4}, \quad (18)$$

which implies that, an increase in χ^R raises a boy's human capital later in life relative to a girl's human capital, whereas an increase in women's time allocated to education has the opposite effect. As shown later, because access to infrastructure has a positive effect on $\varepsilon_t^{f,E}$, improved access to public capital raises women's relative human capital—and thus their bargaining power, as discussed later.

3.5 Health Status and Productivity

Health status in childhood, $h_t^{C,j}$, $j = m, f$, depends on the mother's health (to capture intergenerational health persistence), on the effective amount of time allocated by the child's mother to child rearing, the provision of (congested) health services by the government, H_t^G , and on the amount of family resources spent on each child, given by the sum of the share spent on each child, θ_t^R , augmented by a targeted cash benefit per child at the rate cb^G provided by the government, multiplied by after-tax income before spending on children, defined as $(1 - \sigma_t)(1 - \tau)w_t^T$. In this expression, $\sigma_t \in (0, 1)$ is the family's savings rate. Thus,

$$h_t^{C,j} = (h_t^{A,f})^{\kappa_1} (\chi^{R,j} \varepsilon_t^{f,R})^{\kappa_2} \left(\frac{H_t^G}{K_t^P}\right)^{\kappa_3} \left[\frac{(cb^G + \kappa^H \theta_t^R)(1 - \sigma_t)(1 - \tau)w_t^T}{c_t^{t-1}}\right]^{\kappa_4},$$

where $\kappa_1 \in (0, 1)$ and $\kappa_i > 0$, for $i = 2, 3, 4$, $\kappa^H \in (0, 1)$ is the fraction of the family's spending share on each child devoted to health. Thus, the cash benefit is targeted specifically at children's health, rather than being a general subsidy that adds directly to the family's income.¹² And in terms of its impact on health, it is assumed to complement family resources rather than displace them. The term c_t^{t-1}

¹²As a result, the cash benefit does not affect directly the family's consumption and saving decisions. This helps to better isolate the impact of public policy on health outcomes.

captures a negative externality associated with the family's current consumption (net of total spending on child rearing). As total spending increases, unhealthy habits develop (higher meat consumption for instance) and this tends to mitigate the benefit of targeted health spending on each child.¹³

As shown in the Appendix, $c_t^{t-1} = (1 - \sigma_t)(1 - \theta_t^R n_t)(1 - \tau)w_t^T$. Using this result, the above equation can be rewritten as

$$h_t^{C,j} = (h_t^{A,f})^{\kappa_1} (\chi^{R,j} \varepsilon_t^{f,R})^{\kappa_2} \left(\frac{H_t^G}{K_t^P}\right)^{\kappa_3} \left(\frac{cb^G + \kappa^H \theta_t^R}{1 - \theta_t^R n_t}\right)^{\kappa_4}. \quad (19)$$

Thus, an increase in the share of total spending on each child has both a direct effect (by raising targeted health spending) and an indirect effect (by mitigating the negative spillover associated with total consumption) on health outcomes in childhood.

Health status of both males and females in adulthood, $h_{t+1}^{A,j}$, is determined by health status in childhood and by the relative, average level of women's human capital:

$$h_{t+1}^{A,j} = h_t^{C,j} \left(\frac{E_t^f}{E_t^m}\right)^{\nu_A}, \quad (20)$$

where $\nu_A > 0$.

The second effect indicates that when women are relatively more educated, it benefits not only their own health but also the health of their husbands.¹⁴

Adult productivity, a_{t+1}^j , is positively related to health status, with decreasing

¹³The congestion factor in access to public health services could be measured in terms of the number of children in period t , $n0.5N_t$, but that the *efficiency* with which these services are delivered depends positively again on access to (congested) public capital and on the number of families in the population, $0.5N_t$, because of scale economies in delivery. As discussed in Agénor (2012), it is easy to verify then that the results would be qualitatively unchanged, as long as an appropriate restriction is imposed on the degree of congestion induced by private capital. In any case, in the present setting the assumption that the congestion effects on health spending and the supply of health services are proportional are necessary to ensure stationary of health status.

¹⁴McMahon (2004) discusses externalities associated with women's education in terms of husbands' health.

marginal returns:

$$a_{t+1}^j = (h_{t+1}^{A,j})^{\nu_P}, \quad (21)$$

where $\nu_P \in (0, 1)$.

3.6 Government

As noted earlier, the government taxes only the wage income of adults. It spends a total of G_t^I on infrastructure investment, G_t^E on education, G_t^H on health, and G_t^U on unproductive items, which includes total cash benefits to children of all existing families, $n_t 0.5 N_t c b^G (1 - \tau) w_t^T$. All its services are provided free of charge. It cannot issue bonds and must therefore run a balanced budget:

$$G_t = \sum G_t^h = \tau (w_t^m A_t^m L_t^m + w_t^f A_t^f \varepsilon_t^{f,W} L_t^f). \quad (22)$$

Shares of spending are all assumed to be constant fractions of government revenues:

$$G_t^h = v_h \tau (w_t^m A_t^m L_t^m + w_t^f A_t^f \varepsilon_t^{f,W} L_t^f), \quad (23)$$

where $h = E, H, I, U$.

Combining (22) and (23) therefore yields

$$\sum v_h = 1. \quad (24)$$

Assuming again full depreciation for simplicity, public capital in infrastructure evolves according to

$$K_{t+1}^I = \varphi_I G_t^I, \quad (25)$$

where $\varphi_I \in (0, 1)$ is an indicator of efficiency of spending on infrastructure.

The production of health services by the government is assumed to exhibit constant returns to scale with respect to the stock of public capital in infrastructure, K_t^I , and government spending on health services, G_t^H :

$$H_t^G = (\varphi_H G_t^H)^{\mu_H} (K_t^I)^{1-\mu_H}, \quad (26)$$

where $\mu_H \in (0, 1)$ and $\varphi_H \in (0, 1)$ is an indicator of efficiency of spending on health. This specification captures the fact that access to infrastructure is essential to the production of health services.

3.7 Bargaining Power

The relative bargaining power of women is here assumed to evolve as a function of the *average* human capital stocks of husbands and wives:¹⁵

$$\alpha_t = \bar{\alpha}^{1-\gamma_B} \left[\left(\frac{E_t^f}{E_t^m} \right)^{\mu_B} \right]^{\gamma_B}, \quad (27)$$

where $\bar{\alpha} \in (0, 1)$ measures the autonomous component of women's bargaining power and $\gamma_B \in (0, 1)$ the relative importance of the endogenous component. The parameter $\mu_B \geq 0$ measures the sensitivity of the endogenous component of bargaining power to relative human capital stocks.

3.8 Adult Survival Rate

The survival rate from adulthood to old age, for both males and females, depends solely on health status in adulthood. In addition, it is assumed that it is *average* health status for each group, $H_t^{A,j}$ that matters. This implies therefore that (as postulated earlier) survival probabilities are taken as given when the family solves its optimization problem. Formally, for $h = m, f$:¹⁶

$$p_t^h = p_L^h + \bar{p} \left(\frac{H_t^{A,h}}{1 + H_t^{A,h}} \right)^{\nu_S}, \quad (28)$$

with $\nu_S > 0$ which for simplicity is taken to be independent of gender type. Thus, the relationship between p_t^h and $h_t^{A,h}$ is concave. In addition, $p_0^h = p_L^h$, and $\lim_{h_t^{A,h} \rightarrow \infty} p_t^h =$

¹⁵As discussed by Doss (2013) for instance, other measures of women's bargaining power—including male-female ratio of earned incomes or the share of assets that women hold within the household—are highly correlated with relative human capital stocks in the family. Note that because only average human capital matters, bargaining power is taken as fixed in the household optimization process.

¹⁶See Agénor (2012, Chapter 3) for a discussion of alternative functional forms.

$p_L^h + \bar{p} \leq 1$.¹⁷ Note also that from (19) and (20), average male health status is given by

$$H_t^{A,m} = \left(\frac{\chi^R}{1 - \chi^R} \right)^{\kappa_2} H_t^{A,f}, \quad (29)$$

which implies male health status is strictly proportional to female health status.

3.9 Market-Clearing Conditions

The asset-market clearing condition requires tomorrow's private capital stock to be equal to savings in period t by individuals born in $t - 1$. Given that s_t is savings per family, that the number of families is $(N_t^m + N_t^f)/2$, and that $N_t^f = N_t^m$,

$$K_{t+1}^P = 0.5(N_t^m + N_t^f)s_t = N_t^f s_t. \quad (30)$$

4 Balanced Growth Equilibrium

As in Agénor (2015) and Agénor and Canuto (2015), a *competitive equilibrium* in this economy is a sequence of prices $\{w_t^m, w_t^f, r_{t+1}\}_{t=0}^\infty$, allocations $\{c_t^{t-1}, c_{t+1}^{t-1}, s_{t+1}, \varepsilon_t^{f,E}, \varepsilon_t^{f,P}, \varepsilon_t^{f,R}, \varepsilon_t^{f,W}\}_{t=0}^\infty$, physical capital stocks $\{K_{t+1}^P, K_{t+1}^I\}_{t=0}^\infty$, human capital stocks $\{E_{t+1}^m, E_{t+1}^f\}_{t=0}^\infty$, a constant tax rate, and constant spending shares such that, given initial stocks $K_0^P, K_0^I > 0$ and $E_0^m, E_0^f > 0$, initial health statuses $h_0^{C,j}, h_0^{A,j} > 0$, 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 $a_t^j = A_t^j$, $e_t^j = E_t^j$, and $h_t^j = H_t^j$, for $j = m, f$. A *balanced growth equilibrium* is a competitive equilibrium in which c_{t+1}^{t-1} , c_{t+1}^{t-1} , K_{t+1}^P , K_{t+1}^I , E_{t+1}^m , E_{t+1}^f grow at the constant, endogenous rate γ_Y , the rate of return on private capital r_{t+1} is constant, women's time allocation and bargaining power are constant, and health status of both children, $h_t^{C,f}$ and $h_t^{C,m}$, and adults, $h_t^{A,f}$ and $h_t^{A,m}$, are constant.

¹⁷As shown in the next section, health status is a stationary variable.

As shown in the Appendix, the solution of the model yields the public-private capital ratio as

$$k_t^I = \frac{\varphi_I U_{IT}}{\sigma_t(1-\tau)(1-\theta_t^R n_t)}, \quad (31)$$

where σ_t is the family's propensity to save, defined as

$$\sigma_t = \frac{p_t}{(1+\rho)\eta_C + p_t} < 1, \quad (32)$$

and

$$\theta_t^R = \varkappa_t \theta^{f,R} + (1-\varkappa_t) \theta^{m,R}, \quad (33)$$

$$p_t = \omega p_t^m + (1-\omega) p_t^f,$$

and $\omega \in (0, 1)$ is a relative weight defined later.

Women's time allocation and the total fertility rate is given by¹⁸

$$\varepsilon_t^{f,P} = \begin{cases} \{1 + \Lambda_1 \Lambda_2^{-1}\}^{-1} \{\Lambda_1 \Lambda_2^{-1} - \zeta^P k_t^I\} & \text{If } k_t^I \leq k_C^I \\ \varepsilon_m^{f,P} & \text{If } k_t^I > k_C^I \end{cases}, \quad (34)$$

$$\varepsilon_t^{f,E} = \nu_4 [1 + \eta_E (1 - \sigma_t) \eta_C^{-1}] \left(\frac{1 - \varepsilon_t^{f,P}}{\Lambda_2} \right), \quad (35)$$

$$\varepsilon_t^{f,R} = \frac{\Lambda_3 \theta_t^R \eta_H \kappa_2 (1 - \sigma_t)}{\eta_C (1 - \eta_H \kappa_2 / \eta_N)} \left(\frac{1 - \varepsilon_t^{f,P}}{\Lambda_2} \right), \quad (36)$$

$$\varepsilon_t^{f,W} = 1 - \varepsilon_t^{f,P} - \varepsilon_t^{f,E} - n_t \varepsilon_t^{f,R}, \quad (37)$$

$$n_t = \frac{(1 - \eta_H \kappa_2 / \eta_N)}{\Lambda_3 \theta_t^R}, \quad (38)$$

where k_C^I is a threshold level of the public-private capital ratio given by

$$k_C^I = \frac{1}{\zeta^P} \left\{ \frac{\Lambda_1}{\Lambda_2} - \left(1 + \frac{\Lambda_1}{\Lambda_2} \right) \varepsilon_m^{f,P} \right\},$$

and

$$\eta_h = \varkappa_t \eta_h^f + (1 - \varkappa_t) \eta_h^m, \quad h = C, E, H \quad (39)$$

¹⁸To avoid convergence of population size toward zero, it is also assumed that $n \geq 2$ in the steady state.

$$\begin{aligned}\Lambda_1 &= \eta_Q \pi^Q (1 - \sigma_t) \eta_C^{-1} > 0, \\ \Lambda_2 &= 1 + \nu_4 [1 + \eta_E (1 - \sigma_t) \eta_C^{-1}] + \eta_H \kappa_2 (1 - \sigma_t) \eta_C^{-1} > 1, \\ \Lambda_3 &= 1 - \frac{\eta_H \kappa_2}{\eta_N} + \frac{\eta_C}{\eta_N (1 - \sigma_t)}.\end{aligned}$$

Equation (34) holds as long as $\varepsilon_t^{f,P} > \varepsilon_m^{f,P}$. Through η_C , η_E and η_H , the bargaining parameter \varkappa_t affects the fertility rate, the survival probability, and the savings rate.

Equations (34)-(37) imply that a reduction in time allocated by mothers to home production translates in general into an equilibrium increase in time allocated to child rearing, own human capital formation, and market work—all of which being productive activities. Note also that, as can be inferred from (35), even if $\eta_E = 0$ optimal women's time allocated to human capital accumulation in adulthood is not zero. The reason is that even though devoting more time to such activity reduces time spent in market work (thereby reducing wage income), it increases effective labor supply (thereby increasing wage income). Internalizing this trade-off leads to a nonzero equilibrium value of $\varepsilon_t^{f,E}$. By contrast, $\nu_4 = 0$ always implies $\varepsilon_t^{f,E} = 0$. These results will be useful for understanding the simulation experiments reported later.

Substituting (18) in (27) yields

$$\varkappa(k_t^I; \chi^R) = \bar{\varkappa}^{1-\gamma_B} \left\{ \left(\frac{\chi^R}{1-\chi^R} \right)^{-\nu_3} [\varepsilon^{f,E}(k_t^I)]^{\nu_4} \right\}^{\mu_B \gamma_B}, \quad (40)$$

where $d\varepsilon^{f,E}(k_t^I)/dk_t^I > 0$. This expression shows that in equilibrium women's bargaining power depends on the allocation of mothers' time to their sons and daughters, as measured by χ^R , and on women's access to infrastructure. The higher k_t^I , the lower the amount of time allocated to home production (as implied by (34)) and the more time they can devote in adulthood to accumulating human capital (as implied by (35))—thereby increasing their bargaining power in the family.

Defining $x_t^f = K_t^P / E_t^f N_t^f$ as the private capital-female effective labor ratio, and as also shown in the Appendix, the model can be condensed into a dynamic system in two equations:¹⁹

$$h_{t+1}^{A,f} = \Gamma_4 (\varepsilon_t^{f,R})^{\kappa_2} (cb^G + \kappa^H \theta_t^R)^{\kappa_2 \kappa_4} (k_t^I)^{\Omega_1} (\varepsilon_t^{f,W})^{\Omega_2} (\varepsilon_t^{f,E})^{-\Omega_3} \frac{(h_t^{A,f})^{\kappa_1 + \nu_P 2\Omega_2}}{(x_t^f)^{2\Omega_2}}, \quad (41)$$

$$x_{t+1}^f = \Gamma_6 (k_t^I)^{-\nu_2 + \alpha(1-\nu_1)} (h_t^{A,f})^{\nu_P 2\beta(1-\nu_1)} (x_t^f)^{(1-2\beta)(1-\nu_1)} \frac{(\varepsilon_t^{f,W})^{\beta(1-\nu_1)}}{(\varepsilon_t^{f,R})^{\nu_3} (\varepsilon_t^{f,E})^{\nu_4}}, \quad (42)$$

where

$$\begin{aligned} \Gamma_1 &= \left(\frac{\chi^R}{1 - \chi^R} \right)^{\beta(\nu_3 + \kappa_2 \nu_P)}, \\ \Gamma_2 &= [\varphi_H \nu_H \tau (1 + b) \beta]^{\mu_H}, \\ \Gamma_3 &= \Gamma_1^{\mu_H} \Gamma_2, \\ \Gamma_4 &= (1 - \chi^R)^{\kappa_2} \Gamma_3^{\kappa_3} \left(\frac{\chi^R}{1 - \chi^R} \right)^{-\nu_3 \nu_A}, \\ \Gamma_5 &= \left[\frac{b\beta\Phi\sigma_t(1 - \theta_t^R n_t)}{(1 - \chi^R)^{\nu_3} n_t^{1-\nu_1} 0.5} \right] [\varphi_E \nu_E \tau (1 + b) \beta]^{-\nu_1}, \\ \Phi &= (1 - \tau)(b^{-1} + 1), \\ \Gamma_6 &= \Gamma_5 \Gamma_1^{1-\nu_1}, \\ \Omega_1 &= \kappa_3 [1 - \mu_H (1 - \alpha)] > 0, \\ \Omega_2 &= \kappa_3 \beta \mu_H \in (0, 1), \\ \Omega_3 &= \kappa_3 \beta \mu_H \nu_4 \in (0, 1), \end{aligned}$$

with σ_t defined in (32) and, from (28) and (29),

$$p_t^h = p_L^h + \bar{p} \left(\frac{h_t^{A,h}}{1 + h_t^{A,h}} \right)^{\nu_S}, \quad h = m, f$$

¹⁹From the results in Agénor and Canuto (2015), in the case where life expectancy is constant, a sufficient (although not necessary) condition for dynamic stability of the system (41) and (42) is $\Pi_1 > 0$. This condition holds numerically for the calibration adopted here.

$$h_t^{A,m} = \left(\frac{\chi^R}{1 - \chi^R} \right)^{\kappa_2} h_t^{A,f}.$$

As also shown in the Appendix, the steady-state growth rate of output is given by

$$1 + \gamma_Y = \Gamma_1 (\tilde{k}^I)^\alpha (\tilde{\varepsilon}^{f,W})^\beta \frac{\beta \tilde{\sigma} (1 - \tilde{\theta}^R \tilde{n})}{[(1 - \tau)(1 + b)]^{-1}} (\tilde{h}^{A,f})^{\nu_P 2\beta} (\tilde{x}^f)^{-2\beta}, \quad (43)$$

where \tilde{h}^f and \tilde{x}^f are the steady-state solutions obtained by setting $\Delta h_{t+1}^f = \Delta x_{t+1}^f = 0$ in (41) and (42):

$$\tilde{h}^{A,f} = \left\{ \Gamma_4 (\tilde{\varepsilon}^{f,R})^{\kappa_2} (cb^G + \kappa^H \tilde{\theta}^R)^{\kappa_4} (\tilde{k}^I)^{\Omega_1} (\tilde{\varepsilon}^{f,W})^{\Omega_2} (\tilde{\varepsilon}^{f,E})^{-\Omega_3} (\tilde{x}^f)^{-2\Omega_2} \right\}^{1/\Pi_1}, \quad (44)$$

$$\tilde{x}^f = \left\{ \Gamma_6 (\tilde{k}^I)^{-\nu_2 + \alpha(1 - \nu_1)} (\tilde{h}^{A,f})^{2\nu_P \beta(1 - \nu_1)} \frac{(\tilde{\varepsilon}^{f,W})^{\beta(1 - \nu_1)}}{(\tilde{\varepsilon}^{f,R})^{\nu_3} (\tilde{\varepsilon}^{f,E})^{\nu_4}} \right\}^{1/\Pi_2}, \quad (45)$$

with

$$\Pi_1 = 1 - \kappa_1 - \nu_P 2\Omega_2,$$

$$\Pi_2 = 1 - (1 - 2\beta)(1 - \nu_1) > 0.$$

5 Calibration

To calibrate the model a variety of data sources are used, including the World Bank's *World Development Indicators* (WDI) database, data from National Sample Surveys (conducted at 5-year intervals) and Time Use Surveys (available for only a few states), and data available in published papers and official reports, as needed.

On the *household side*, the annual discount rate is set at 0.03, a significantly higher value than the standard choice of 0.02, to capture the evidence that households in India (at least in the rural sector) tend to have a lower degree of impatience (see Bauer and Chytilová (2013)). This implies that the discount factor is equal to 0.97 on a yearly basis. Interpreting a period as 22 years (to match an average life expectancy *at birth* of 66 years) in this framework yields an intergenerational discount rate of $0.97^{22} = 0.511$.

To calibrate women's bargaining power, as defined in equation (40), requires setting six parameters: γ_B , $\bar{\varkappa}$, χ^R , ν_3 , ν_4 , and μ_B , and knowledge of the equilibrium value $\varepsilon^{f,E}$. As discussed below, coefficients ν_3 and ν_4 are both set equal to 0.1, respectively, and $\varepsilon^{f,E} = 0.14$. The parameter μ_B is set to a neutral value of $\mu_B = 1$ and γ_B is set at 0.6, to capture the view that in India relative human capital stocks play a positive but possibly limited role in determining women's bargaining power; sensitivity analysis is reported later on. It is also assumed that there is initial bias in mothers' rearing time allocation toward boys, and therefore set $\chi^R = 0.6$; using higher values to begin with would simply magnify the benefit of a reduction in χ^R , to the extent that it would magnify the impact of the policy on female human capital. The initial bargaining power of women \varkappa is calibrated by using a proxy for the relative human capital of women: the ratio of the female labor force with secondary education (in proportion of the total female labor force), relative to the sum of the male and females ratios. In the WDI database, the last year for which both data points are available is 2010; this gives $\varkappa = 20.2/(20.2 + 40.9) = 0.33$.²⁰ Expression (40) can therefore be solved backward for the parameter $\bar{\varkappa}$, thereby giving $\bar{\varkappa} = 0.089$.

To calibrate the survival rates p^m , p^f , and p , we start with estimates of the probability of death. According to WHO data, in 2011 in India the probability of dying between ages 15 and 60 was 0.247 for men and 0.159 for women, with an average of 0.205.²¹ The implicit weight ω used in the average measure is thus $0.247\omega + (1 - \omega)0.159 = 0.205$, or $(0.247 - 0.159)\omega = 0.205 - 0.159$, that is, $\omega = (0.205 - 0.159)/(0.247 - 0.159) = 0.523$. The survival rates for men and women can

²⁰An alternative proxy would be, as in Agénor (2015), the relative literacy rate of adult females (ages 15 and above), divided by the sum of literacy rates of adult males and females. In the WDI database, the last year for which both data points are available is 2006; this gives $\varkappa = 50.8/(50.8 + 75.2) = 0.403$. However, this would not alter drastically the results.

²¹See <http://apps.who.int/gho/data/node.main.11?lang=en>. To match the model's definition of the survival rate, what one would normally want to use is the probability that a young adult in period t dies before reaching the third phase of life, that is, given the generational structure, the probability of dying before age 44, conditional on surviving until 22. This measure is not available.

therefore be measured as $p^m = 1 - 0.247 = 0.753$ and $p^f = 1 - 0.159 = 0.841$, with an average rate given by

$$p = 0.523 \cdot 0.753 + (1 - 0.523)0.841 = 0.795. \quad (46)$$

The family savings rate for India, σ , is set equal to the household savings rate in proportion of GDP, which is estimated by the Planning Commission (2011, Table 3) at 23.3 percent during the period 2000-11. Solving (32) backward for the preference parameter η_C yields, using the intergenerational discount factor 0.97²² and the survival rate given in (46),

$$\eta_C = 1.366. \quad (47)$$

According to data from the 2009-10 National Sample Survey, average expenditure of an India family is 6,582 rupees, whereas average spending on children is estimated at 496 rupees. This is obtained by adding family spending on education (books, tuition fees, etc.) and health-related outlays on children, calculated by multiplying the family's total spending on health by the ratio of the number of children in the family (1.3, according to the survey) divided by the total number of members (4.35, according to the survey), that is, a ratio of 0.299. Thus, assuming no significant scale economies in raising children, the share of spending on children is thus $496/6,582 = 0.075$. In terms of the model, this can be taken as an approximation of the share of total family income devoted to child rearing, which corresponds to $n\theta^R$. As noted earlier, according to the survey the average number of children in the family is 1.3; given that value, the share of family spending on each child can therefore be estimated at $\theta^R = 0.075/1.3 = 0.058$. We assume that male spouses prefer to spend a smaller fraction, $\theta^{m,R} = 0.04$, on children; given (8), and that $\varkappa = 0.33$, this gives women's preference parameter for child spending $\theta^{f,R} = 0.095$.

In the *home good production sector*, the parameter ζ^P is set to unity initially to capture the "best case scenario" of perfect substitutability between women's time

and infrastructure services; a smaller, and more realistic value of $\zeta^P = 0.5$ is also used later on. The curvature of the home production function initially at $\pi^Q = 0.7$, to capture rapidly decreasing marginal returns in terms of women’s time and infrastructure services. In the experiments reported in the next section, a smaller value of $\pi^Q = 0.12$, similar to the value used by Kimura and Yasui (2010, Table 4) for a production function with labor only, will also be used to capture smaller decreases in marginal returns.

To estimate *women’s time allocation*, we use the results of a study by Sivakami (2010, Table 2) on South India, based on a survey conducted between August 1998 and January 1999.²² The study found that on a 24-hour day, women on average allocate 5.6 hours to housework, 1.8 hours to fetching water and firewood, 2.5 hours to child care, 7.8 hours to market work, and the rest to “personal” activity (eating, sleeping, and so on). In the same sample, the mean number of living children was 2.1 (*op. cit.*, Table 1). Adding up the first two components, female time allocated to home production—given that total time is normalized to unity—can be therefore estimated as $\varepsilon^{f,P} = (5.6 + 1.8)/24 = 0.31$. Time spent in market activity can be estimated as $\varepsilon^{f,W} = 7.8/24 = 0.325$. Total time allocated to child care is $n\varepsilon^{f,R} = 2.5/24 = 0.104$. this means therefore that rearing time allocated per child can be estimated as $\varepsilon^{f,R} = 0.104/2.1 = 0.049$.

Sivakami (2010) does not provide any estimate of (adult) female time spent in learning or education. To construct such an estimate, as defined in the model, we calculate the average number of years devoted by women to human capital accumulation, divided by the length of the period in adulthood. Calculations yield an estimate of 3.1 years for time spent in formal, tertiary education during adult life.²³ Thus, fe-

²²Other studies on women’s time allocation in India include George et al. (2009) and Binswanger-Mkhize et al. (2012).

²³This is obtained by breaking down the data on women currently enrolled in tertiary education, and by assigning the number of years needed to finish each type of program; a weighted average is then used to get to the average number of years spent in tertiary education. Note that, as a

male time spent in human capital accumulation in adulthood is estimated by $\varepsilon^{f,E} = 3.1/22 = 0.14$. Time allocated to personal activity and presumably (some) leisure is thus determined residually and is given by $1 - 0.31 - 0.325 - 0.049 \cdot 2.5 - 0.14 = 0.101$; this value is introduced exogenously in coding and solving the model. As explained later, the fertility rate that is used for simulation purposes is $n = 2.53$, rather than 2.1 as in the survey mentioned earlier; the value of total rearing time used to estimate personal activity/leisure time is therefore $0.049 \cdot 2.5 = 0.123$.

Using the above data on women's time allocation ($\varepsilon^{f,P}$, $\varepsilon^{f,W}$, $\varepsilon^{f,E}$, and $n\varepsilon^{f,R}$), the estimates of n , the calibrated values for σ and η_C derived earlier, $\nu_4 = 0.1$, $\kappa_2 = 0.15$, the value of k^f given below, the definitions of Λ_1 , Λ_2 , and Λ_3 provided earlier, the nonlinear equations (34), (35), (36) and (38) can be solved backward and jointly for the preference parameters η_E , η_H , η_N , and η_Q . This gives $\eta_E = 4.071$, $\eta_H = 3.454$, $\eta_N = 0.824$, and $\eta_Q = 2.235$.

Having determined η_C , η_H , and η_E , the values $\eta_C^m, \eta_C^f, \eta_H^m, \eta_H^f$, and η_E^m, η_E^f can now be determined. Given that $\varkappa = 0.33$, and setting $\eta_C^m = 1.8$, $\eta_H^m = 3.0$, and $\eta_E^m = 3.0$, the last three values can be determined residually by solving using (39) backward; this gives $\eta_C^f = 0.484$, $\eta_H^f = 4.376$, and $\eta_E^f = 6.244$. Thus, by construction $\eta_C^f < \eta_C^m$, and $\eta_H^f > \eta_H^m$, and $\eta_E^f > \eta_E^m$.²⁴

In the *marketed good production sector*, the elasticities of production of final goods with respect to public capital and each type of labor, α and β , are set equal to 0.17 and 0.325, respectively. The value of α is equal to the long-run value estimated by Bom and Ligthart (2014, Table 4), using meta-regression analysis, for core public capital at the national level. The value of β implies that a total elasticity of output

result, time spent during adulthood accumulating human capital through other means—on-the-job training, personal reading, and so on—is not accounted for explicitly.

²⁴The numerical results discussed later are not highly sensitive to this particular choice of η_C^m , η_H^m , and η_E^m , because it is the *average* values that matter, and these are constant for all shocks—except for those involving changes in \varkappa , induced by either changes in mothers' time allocated to sons and daughters, and changes in the public-private capital ratio. However, for the experiments considered, changes in \varkappa are relatively small.

with respect to labor (male and female) of 0.65, and thus a value of the elasticity of output with respect to private capital equal to 0.35. These values are fairly standard. The parameter b , which captures the degree of gender bias in the workplace, is estimated as the average female-to-male daily earnings ratio estimated by Eswaran et al. (2013, Table 3), based on the Time Use Survey data for 1998-99; that is, $b = 38.7/58.6 = 0.66$.

In the *human capital sector*, the parameter measuring the intergenerational externality associated with the transmission of human capital through mothers, $1 - \nu_1$, is set equal to 0.85, to capture a high degree of persistence. This implies an elasticity with respect to government spending on education, ν_1 , equal to 0.15 a relatively low value. The elasticity with respect to the public-private capital ratio, ν_2 , is set equal to 0.15, close to the value used in Agénor (2011). There is not much evidence regarding the elasticity with respect to time allocated by mothers, ν_3 ; we use an initial low value of 0.1 and perform a sensitivity analysis where relevant. For ν_4 a low value of 0.1 is used, as in Agénor and Canuto (2015), and results with an alternative (higher) are reported later on where relevant.

Regarding *health status and productivity*, the degree of intergenerational persistence κ_1 is set equal to 0.45, the same implicit value used by Osang and Sarkar (2008). The elasticity of child health status with respect to mothers' rearing time, κ_2 , is set equal to 0.15, whereas the elasticity with respect to public health services, κ_3 , is set equal to 0.2. These values are fairly conservative, to capture costly delivery in the second case and to avoid biasing the results toward overstating the benefits of mothers' time or public spending on productive services. There is not much information regarding the elasticity with respect to total spending (family plus government cash benefit) on health per child, κ_4 ; it is set initially at 0.1; sensitivity analysis with a higher value of 0.2 is reported later on for the cash benefit experiment. There are no good benchmarks in the literature to guide the choice of the elasticity of health

status in adulthood with respect to the ratio of human capital stocks, ν_A , so it is set initially at a relatively low value, 0.2. The elasticity of both male and female productivity with respect to health status is set at $\nu_P = 0.8$, which is consistent with some of the population-wide cross-country econometric estimates reported in Cole and Neumeyer (2006). Sensitivity analysis is conducted subsequently with respect to several of these parameter values.

Spending on each child's health as a proportion of family income, $\kappa^H \theta^R$, can be approximated by the share of spending on each child's health in total household expenditure, which is calculated as follows. As noted earlier, from the 2009-10 National Sample Survey average expenditure of an India family is 6,582 rupees. Medical spending on children is calculated by multiplying total spending on health in the family, 315 rupees, adjusted by the average children-to-adult ratio per family, 0.299, that is, 94.2 rupees. With an average of 1.3 children per family, this gives spending per child equal to 72.5 rupees. Thus, assuming again no scale economies in health spending on children, $\kappa^H \theta^R$ can be approximated by $72.5/6,582 = 0.011$. Given that $\theta^R = 0.058$, as shown earlier, this implies $\kappa^H = 0.189$.

Regarding the *government*, the effective tax rate on output, τ , is calculated by multiplying the average ratio of tax revenues to GDP given in WDI for the years 2002-11, 10.2 percent, divided (to match the model's definition) by the share of (male and female) labor income in the model, 0.65. Thus, $\tau = 15.7$ percent. The initial share of government spending on health, ν_H , is based on the average estimate from WDI for the period 2002-11 and is equal to 0.067. The initial share of government spending on education, ν_E , is also based on the average estimate from WDI for the years 2009 and 2010 (the last two years for which the data are available), which gives 0.102. The initial share of government investment on infrastructure, ν_I , is set at 0.181. This number, which appears to be quite large, is obtained by multiplying the share of public investment in GDP, estimated by McKinsey & Co. (2013) to be

on average 4.7 percent per year over the period 1992-2011,²⁵ by the inverse of the share of government spending in GDP, estimated from the IMF’s World Economic Outlook database at 25.9 percent over the period 1992-11.

These numbers imply from the budget constraint that the share of spending on other items, v_U , is 0.65. The cash benefit per child, cb^G , is set equal initially to 0.01, with the total amount of spending taken to be subsumed in other spending, G_t^U , as noted earlier.

There is no direct estimate of the efficiency parameter φ_I for public investment in India; we use the average value estimated by Dabla-Norris et al. (2012, Table 1) for a group of Asian countries—Cambodia, Pakistan, and Indonesia. This gives $\varphi_I = 0.38$.²⁶ Thus, according to these numbers, more than 60 percent of public spending on infrastructure investment is “wasted,” in the sense that it does not turn into public capital.²⁷ In the absence of data specific to the education and health sectors, the efficiency parameters for spending on education and health, φ_E and φ_H , respectively, are also set at the same value. Using (31), the equilibrium public-private capital ratio can be computed to give $k^I = 0.064$. Thus, by this measure, public capital remains a relatively scarce factor in India.²⁸ The elasticity of output of health services with respect to public spending on health is set at $\mu_H = 0.85$. There are no good benchmarks in the literature but this value appears to be a reasonable starting point, given that most of these services are measured based on salaries paid

²⁵Chakraborty and Zhang (2009, Table 4) estimated that ratio to be 3.6 percent in 2006.

²⁶Dabla-Norris et al. (2012) define their metric on a range of 1 to 4, the calculated average value for the Asian countries was simply divided by 4 to obtain an indicator bounded by unity. Note also that the median value estimated in that study is 0.41.

²⁷By way of comparison, the World Economic Forum (2015, p. 213) estimates the quality of India’s infrastructure to be 3.7 on a scale of 1 to 7, which gives a rate of 0.53. Although higher than the value used here, this estimate is still consistent with the assumption of relatively low quality of infrastructure.

²⁸McKinsey & Co. (2012) estimate the current value of the infrastructure stock (roads, rail, ports, airports, power, water, and telecommunications) to be about 58 percent of GDP. However, data on the output-private capital ratio are not available, so it is difficult to relate this estimate and our calibrated value.

to medical workers, and the correspondence between elasticities and shares in the Cobb-Douglas function with constant returns to scale. By implication, the elasticity with respect to public capital in infrastructure is 0.15.

The benchmark parameter values are summarized in Table 1. For all experiments, the (net) fertility rate, n , is calculated by multiplying the gross fertility rate (number of births per woman), by the survival rate for children. Using average values over the period 2002-11 from World Bank data, the gross fertility rate is equal to 2.7. The survival rate for children is estimated by taking one minus the under-five mortality rate (the number of deaths of children under five per 1,000 live births), which is estimated at 64.6/1000 over the same time period. Thus, the survival rate is $1 - 0.0646 = 0.9354$ and the fertility rate used is 2.53. Finally, the survival rate function (28) is calibrated by setting the minimum values p_L^f and p_L^m at 0.6 and setting ν_S to 0.5. The shift parameter \bar{p} is then solved residually from (28).

Based on these parameter and initial values—from which it can be established that $\Pi_1 = 0.462$, which implies that the model is indeed stable—the model is solved for the steady-state growth rate of output. A multiplicative constant is also introduced, in order to yield an annual growth rate of marketed output equal to 7.7 percent, the average rate of growth of real GDP for India over the period 2002-2011.

6 Experiments

To illustrate the role of public policy in the model, two types of experiments are considered: changes in public investment in infrastructure and the efficiency of government spending; and child- and gender-related policies (an increase in family benefits per child, a reduction in gender bias in the market place, and an increase in mothers' time allocated to their daughters). These experiments are all highly relevant in the

current debate on economic policy in India.²⁹ A composite reform program, involving a combination of some of these policies, is also considered.

The analysis is conducted throughout under the assumption that $k^I < k_C^I$, or equivalently $\varepsilon^{f,P} > \varepsilon_m^{f,P}$, which implies from equation (34) that women's time allocated to home production is sensitive to changes in access to infrastructure. To summarize the simulation results, the focus is on the following variables: women's time allocation, women's bargaining power, the fertility rate, the adult survival rate, the savings rate, the public-private capital ratio, and the growth rate of output. Finally, in all of the experiments reported here, the implicit assumption is that labor supply decisions are divisible, or equivalently that part-time work is feasible. Otherwise, changes in women's time allocation could be subject to thresholds.³⁰

6.1 Increase in Share of Spending on Infrastructure

Consider the case of a public policy aimed at promoting access to infrastructure, by investing in rural roads, power grids, etc. This can be captured by considering an increase in v_I , the share of government spending allocating to infrastructure investment. Specifically, a two-percentage point increase in v_I , from an initial value of 0.181 to 0.201 is considered. The case where the increase in investment in infrastructure is financed by a cut in unproductive spending ($dv_I + dv_U = 0$) is considered first. The potential trade-offs that may arise if financing occurs through a cut in

²⁹For instance, the Indian government recently announced an ambitious Direct Benefit Transfer scheme to replace multiple welfare programs with cash transfers to households. It has also initiated a number of gender equality programs. For example, the Beedi and Cigar Workers Act and the Beedi Workers Welfare Fund Act should protect around 4 million home-based workers. The acts provide social security such as healthcare, childcare and housing for Beedi workers. This model is being replicated to protect other categories of home-based workers and sectors, and to a national policy to that effect. Also the rural employment programme (NREGS) sets a one-third quota for women and equal pay obligation. See also Khemani (2010), Ahmed (2012), and World Economic Forum (2015, Box 2).

³⁰Lack of divisibility may explain why studies, such as Koolwal and Van de Waal (2013) for instance, did not find any significant effects of improved access to water on women's paid labor.

other components of (productive) spending, either health or education outlays, is considered next.

The impact of this experiment is shown in Table 2 for the benchmark set of parameters and alternative values for some of them. Consider first the benchmark case. The direct effect of the shock is of course an increase in the public-private capital ratio \tilde{k}^I (which rises from an initial value of 0.064 to 0.071), thereby promoting growth directly through standard productivity effects. In addition, improved access to infrastructure services lowers mothers' time allocated to home production. This, in turn, raises women's time allocated to market work and time spent on child rearing. Indeed, time allocated to home production drops from a share of 0.31 initially to about 0.305, whereas time spent in market work increases from 0.325 to 0.328. At the same time, total time allocated to child rearing increases from 0.124 to 0.125 and fertility falls slightly. The increase in rearing time leads to improved health in both childhood and adulthood, thereby increasing effective labor supply. At the same time, the increase in time allocated to human capital accumulation has a slight positive effect on women's bargaining power—and thus on the family's preferences for current consumption, children's health, and women's education. Thus, time allocation effects, even though they are fairly muted, also contribute to promoting growth and health outcomes.

The improvement in health raises the survival rate from adulthood to old age, and this tends to increase the family's savings rate, through the familiar life-cycle effect.

And because the increase in income also raises the level of private savings and investment, the higher stock of private capital exerts a direct, positive effect on the growth rate of output per worker. At the same time, female health in adulthood also improves—partly as a result of more rearing time (as noted earlier) but also because of higher government spending on health (due to higher tax revenues induced by

the increase in wages and time allocated to market work). This “health effect” compounds the “savings effect” (through higher family income) on growth. The long-run effect is improved female health status and higher steady-state growth, which increases by about 0.2 percentage points in the benchmark case.

Table 2 also shows results for a lower value of $\zeta^P = 0.5$, a lower value of $\pi^Q = 0.12$ (to capture smaller decreases in marginal returns initially between women’s time and infrastructure services) and a higher $\eta_N = 2.0$ (the family preference parameter for the number of children), as well as a lower value $\eta_C^m = 1.5$ (the male preference parameter for current consumption). Importantly, in India’s context the lower value of ζ^P , which captures a lower degree of substitutability between women’s time and access to infrastructure services, can also be viewed as reflecting the social and cultural constraints that prevent women from moving away from their perceived role as being responsible for a range of household chores, with subsequent effects on their ability to engage in market work. In terms of growth effects, the results are not very different from the benchmark. In terms of women’s time allocation, however, they are quite significant. A lower π^Q magnifies the shift in women’s time allocation away from home production and toward productive uses (child rearing and market work). By contrast, a lower degree of substitutability between women’s time and access to infrastructure services mitigates of course the benefits of the increase in the public capital stock for women’s time allocated to market. A higher male preference parameter for current consumption has only marginal effects on women’s time allocation, compared to the benchmark case; the drop in the fertility rate is slightly larger. Finally, a reduced family preference for children leads to a larger reduction in the fertility rate, but there is a substitution of “quality” for “quantity” and total time allocated to child rearing is actually slightly higher than in the benchmark case; eventually, the health outcomes are also larger. The drop in the fertility rate tends to lower family spending on children, but the increase in women’s bargaining

power tends to raise the family's share allocated to that category of spending; the net effect is actually an increase in total spending, which implies (as can be inferred from (31)) that the increase in the public-private capital ratio is larger with a higher η_N , compared to the result obtained in the benchmark case. This, in turn, magnified the benefits of an increase in infrastructure investment for women's time allocation.

These results—especially those corresponding to the benchmark case and with a lower π^Q —are broadly consistent with the evidence reported by Ghani et al. (2012) for India. They found that better electricity and water access reduce the burden of women in providing essential household inputs for their families, and allow them to reallocate their time toward entrepreneurial activities in both manufacturing and services.³¹ They argue that infrastructure affects women more than men as they have often larger responsibilities of time consuming household activities (poor access to electricity and water), leaving less time for employment or entrepreneurship.

At the same time, however, the simulations indicate that the effects on women's time allocation—given the magnitude of the shock—are relatively muted. The low response of time allocated to market work, as predicted by the model, is consistent with studies suggesting that the caste-based culture in India stigmatizes market work by married women, especially in rural areas (see Eswaran et al. (2013)). In that case, growth-enhancing effects may well come from time allocated to education (which generates externalities in terms of health and education) and to child rearing. In the same vein, as noted by Kingdon and Unni (2001), specific cultural and social norms in India, according to which women's labor is less socially acceptable in higher caste, may reduce labor force participation rates of women with intermediate levels of education.

To illustrate the possible trade-offs that may arise when the increase in infrastructure investment is financed by a cut in another productive component of spending,

³¹They also found that transport infrastructure and paved roads influence ease of mobility for women as they relate to safety concerns and social norms.

Table 2 also presents simulation results when the increase in v_I is matched by a drop in spending on education ($dv_I + dv_E = 0$). By and large the results are qualitatively similar to those discussed earlier, but the overall impact on growth is now insignificant, given that there are now offsetting effects between productive components of public spending. Qualitatively, similar results would obtain by considering an offsetting decrease in the share of spending on health services ($dv_I + dv_H = 0$); the net effect on female health status would now be ambiguous as well, given that the benefits associated with higher spending on infrastructure would be offset by the direct, negative effect related to a reduction in health spending.

6.2 Improved Efficiency of Public Spending

Consider an increase in efficiency of each component of productive public spending (infrastructure, education, and health), φ_E , φ_H , and φ_I , from an initial, uniform value of 0.38, to 0.6, first for each component separately and then for all components simultaneously. In broad terms, this policy experiment can be viewed as capturing the benefits of an ambitious program of governance reform.

The steady-state effects of this policy are displayed in Table 3. When the increase in efficiency occurs only with infrastructure investment, the public-private capital ratio rises significantly, from 0.064 to 0.101. As a result, time spent by women in home production drops by 2.4 percentage points, whereas time allocated to market work increases by 1.5 percentage points. Total time allocated to rearing children increases as well, and so does the time allocated by women to human capital accumulation; this in turn, generates a slight increase in their bargaining power. Overall, the effects on growth and women's health are quite sizable. The growth rate of output, for instance, increases by almost 0.8 percentage points. Health status of adult females also improves, both because of the time reallocation effect, and because of the effect of the higher public capital stock and higher public health spending on the supply

of health services.

The increase in efficiency of education and health spending has only negligible effects on the public-private capital ratio, and consequently only a limited impact on women's time allocation. However, the increase in the quality of education spending, to the extent that it helps to promote human capital of both men and women, has a sizable effect on the steady-state growth rate of output, of the order of 0.5 percentage points; with health, the increase is only of the order of 0.1 percentage points. Conversely, as can be expected, the increase in efficiency of health spending has a much more substantial impact on health outcomes than the increase in efficiency of education.

When the improvement in spending efficiency occurs across the board, the impact on growth is magnified—the long-run growth rate in output increases by 1.43 percentage points, whereas the sum of the direct effects is $0.76 + 0.52 + 0.09 = 1.37$ percentage points. The difference between these two numbers can be viewed as a rough measure of the positive externality associated with the simultaneous implementation of a combination of reforms aimed at improving spending efficiency.

6.3 Increase in Targeted Cash Benefit Rate

Suppose that the government increases the targeted cash benefit rate cb^G from 0.01 initially to 0.04. This additional spending is assumed to result from a reallocation among unproductive outlays, G_t^U , so that shares of all spending components remain constant. Thus, the increase in cash benefits is budget neutral and can be considered in isolation from other changes.

The effects of this experiment are shown in Table 4. The direct effect of this policy is to improve health in childhood and, because of health persistence, in adult health and productivity as well. This helps to promote growth. In the benchmark case, the health is sizable. In terms of growth, the net increase is of the order of 0.1

percentage points.

This policy also affects women's time allocation. Because improved health raises the survival rate in adulthood, it also raises the savings rate, which raises the level of investment and the private capital stock. This tends to promote growth directly, but at the same time it increases congestion effects on the public capital stock; as a result, the public-private capital ratio falls slightly. This would tend to *increase* time spent in home production. At the same time, however, the life-cycle effect associated with the higher survival rate induces women to work more and to have less children; this is achieved by a reduction in *total* time allocated to child rearing, together with a reduction in time allocated to human capital accumulation and time allocated to household chores. The reduction in the latter, thus, occurs despite the drop in the public-private capital ratio, because of the life-cycle effect. But these effects are fairly small and their consequences are therefore limited; in particular, the reduction in time allocated by women to human capital has only a negligible effect on their bargaining power.

Table 4 also shows results for a higher value of κ_4 (the elasticity of health in childhood with respect to family spending on health services, inclusive of the cash benefit), 0.2 instead of 0.1; a higher η_H^m (the male preference parameter for children's health), from 3.0 to 5.0; and a higher η_N (the family's preference parameter for children), from 0.824 to 2.0. In the first two cases the health effect is magnified, but only in the first case is the growth effect amplified; this is due to the fact that improved health raises further the savings rate, and thus the growth rate of the private capital stock.

In assessing this result, it is important to keep in mind that the model does not account for the possibility that better health in childhood may improve education outcomes—a fairly well documented fact (see for instance Behrman (2009)). In turn, improved education may lead to further welfare gains not only in terms of the quality

of the labor force but also in terms of health status in adulthood (see for instance McGuire (2006)). If the elasticity of human capital with respect to health is relatively large, the results reported here could even underestimate the benefit of targeted cash benefits in improving human development outcomes and promoting growth.

6.4 Reduction in Gender Bias in the Market Place

Suppose now that the government implements measures to improve women's political representation or anti-discrimination laws that lead to a permanent reduction in gender bias against women in the work place; analytically, this can be captured by considering an *increase* in b . Specifically, increases in b from an initial value of 0.66 to either 0.8 or 1.0 (complete elimination of gender bias) are considered.

The effects of this policy are summarized in Table 5. The direct effect of a higher b (at the initial level of wages) is to reduce the deadweight loss associated with discrimination and to raise family income. In turn, higher income leads to a higher level of private savings and private capital stock, which has a direct positive impact on growth, as well as higher tax revenues. Because changes in b affect tax revenues and private savings in exactly the same way, the public-private capital ratio is not affected much. Women's time allocation, and the fertility and savings rates, are not affected substantially either. But higher tax revenues also lead to higher public spending on health, which has a positive effect on health in childhood and female health in adulthood. In the long run, a reduction in gender bias leads therefore to an improvement in women's health status and an increase in the growth rate of output. With the benchmark set of parameters, an increase in b from 0.66 to 0.8 (respectively, to 1.0) raises the steady-state growth rate by about 0.1 (respectively, 0.3) percentage points.³²

³²Note that the model does not capture the possibility that gender gaps in access to managerial positions and employment may distort the allocation of talent and the production and productivity of human capital. Had these effects been we accounted for, the benefits of an increase in b on

Table 5 also provides simulation results when an increase in b (from 0.66 to 0.8) is combined either with a higher ν_1 (the elasticity of human capital with respect to government spending on education, from 0.15 to 0.25), or a higher government spending share on education, v_E (by 2 percentage points), to capture a government campaign aimed at producing and disseminating new training material designed to enhance women's image in textbooks and schools in general. Both experiments lead to higher growth and improved health outcomes, compared to the benchmark case.

6.5 Increase in Mothers' Time Allocated to Daughters

Suppose that changes in perceptions about the role of women in society induces families to reduce the fraction of rearing time that mothers allocate to sons, χ^R , and thus increase the time devoted to their daughters, from an initial value of 0.6 to parity, at 0.5. This change in χ^R could also be policy-induced; it could be the result of a public promotion campaign (financing by spending reallocations within v_U , so that the shares of productive spending are not affected) to encourage parents to devote more time to taking care of their daughters' health, for instance.

The effects of this experiment are summarized in Table 6. In the model, mothers allocating relatively less time to their sons means that their human capital and productivity in adulthood (given that rearing time affects both schooling and health outcomes in childhood) will also be relatively lower compared to their daughters. By implication, effective male labor will tend to fall relatively to women's effective labor. However, at the same time, the increase in the relative female human capital stock induced by the reduction in time allocated to sons also improves women's bargaining power, which translates into a higher savings rate per household (due to the fact that the family preference parameter for current consumption, η_C , falls) and a higher stock of private capital. Although this positive effect on growth is mitigated by congestion

economic growth would be magnified.

effects, with the benchmark set of parameters both female health status and the rate of growth of marketed output increase, in the latter case by about 0.1 percentage points.

The increase in women's bargaining power in this experiment depends positively on the value of γ_B , which measures the relative weight attached to the endogenous component of bargaining power, and μ_B , which measures the sensitivity of that component to women's relative stock of human capital. A higher value of μ_B for instance magnifies the impact of the reduction in χ^R on women's bargaining power. As a result, the increase in the family savings rate is more substantial, thereby amplifying (despite the congestion effect) the positive effect of χ^R on the rate of economic growth.³³

More formally, Table 6 provides sensitivity analysis for a higher γ_B (from 0.6 to 0.7), a higher μ_B (from 1.0 to 1.5), and a higher ν_3 (from 0.1 to 0.4); it also considers a higher male preference parameter for child health, η_H^m (from 3.0 to 4.0). In the first two cases the increase in female bargaining power is magnified, but there are no significant differences in the effect on female health status and growth, compared to the benchmark case. By contrast, with a higher male preference for children's health, time spent by mothers rearing children and engaging in market activities both fall; the impact on health status in adulthood and growth are slightly higher than in the benchmark case.

7 Composite Reform Programs

Two composite reform programs, involving alternative combinations of the individual policies discussed earlier, have also been simulated. Both programs help to illustrate the benefits of policy complementarities.

³³The extent to which reduced gender bias in mothers' time allocation increases women's bargaining power also depends on the parameter κ_2 , which measures the response of child health status with respect to changes in women's rearing time.

Reform Program 1 involves combining the following policies: an increase in the share of public outlays on infrastructure, v_I , from 0.181 to 0.201; an increase in the share of spending on education, v_E , from 0.102 to 0.122, and spending on health, v_H , from 0.067 to 0.087; an across-the-board increase in the parameters measuring the degree of efficiency of government spending, φ_h , $h = E, H, I$, from 0.38 to 0.5 to capture governance reforms; an increase in the cash benefit rate cb^G from 0.01 to 0.04; and measures to mitigate gender bias in the workplace, which translate into an increase in b from 0.66 to 0.8. Thus, because each spending share increases by 2 percentage points, the share of other spending, v_U , drops from 0.55 to 0.59—a substantial adjustment if discretionary spending is considered to be rather limited.

Reform Program 2 involves the same increases in the shares of productive spending (v_I from 0.181 to 0.201, v_E from 0.102 to 0.122, v_H from 0.067 to 0.087), but a more ambitious across-the-board increase in the degree of efficiency of government spending, with φ_h , $h = E, H, I$ increasing now from 0.38 to 0.6. The increases in the cash benefit rate and the parameter b are the same (cb^G from 0.01 to 0.04, and b from 0.66 to 0.8); in addition, in this program it is assumed that the government implements a promotion campaign (financed through by a reallocation of spending within v_U , in such a way that the shares of productive spending are not affected) to encourage parents to devote more time to taking care of their daughters, implying that χ^R falls from 0.6 to 0.55. Thus Reform Program 2 is more ambitious than Program 1 in terms of governance reforms and in terms of attempting to mitigate gender bias in the home.

Both experiments are conducted under the assumption that $\zeta^P = 0.5$, that is, women's time and infrastructure services are imperfect substitutes. As noted earlier, this is a more realistic case than the assumption of perfect substitutability between infrastructure services and women's time devoted to home production ($\zeta^P = 1$).

The results are presented in Table 7, both for the benchmark case and for a higher

value of κ_4 (the elasticity of health in childhood with respect to family spending on health services, inclusive of the cash benefit), 0.15 instead of 0.1, and a higher γ_B (which measures the relative weight attached to the endogenous component of bargaining power), from 0.6 to 0.7. The transmission of the individual policies has been discussed earlier and need be repeated here. With Reform Program 1, the effects on women's time allocation (especially to market work) and women's bargaining power are not large, but the health and growth effects are substantial. the steady-state growth rate increases by 1.5-1.6 percentage points. Naturally enough, the results are stronger with Reform Program 2; women's time allocated to market work increases from 0.325 to 0.336 in the benchmark case, whereas women's bargaining power increases from 0.330 to 0.335. However, both effects remain relatively weak. The impact of the program on economic growth is more potent, with the steady-state growth rate increasing by about 2.4-2.5 percentage points. Overall, these experiments illustrate well the potential benefits for India of the simultaneous implementation of a combination of pro-growth, pro-gender policies.

8 Concluding Remarks

This purpose of this paper was to study how public policies, including pro-women interventions, can raise female labor force participation and promote economic growth in India. The first part provided a brief review of gender issues in the country. The second part presented a gender-based OLG model, based on Agénor (2015) and Agénor and Canuto (2015), that accounts for women's time allocation between market work, child rearing, human capital accumulation, and home production. Bargaining between spouses depends on relative human capital stocks. The model was calibrated and various experiments were conducted, including investment in infrastructure, targeted cash transfers, and a reduction in gender bias in the market place.

The model is useful to address the impact of a variety of general public policies on human development and economic growth in India, and several broad policy lessons can be drawn from it. Policies aimed at fostering women's human capital or at reducing women's time spent in home production do help to promote growth. Targeted cash benefits could have significant effects on health and growth. So would policies aimed at improving the efficiency of public spending on infrastructure, education and health. At the same time, the experiments showed that even though there are important health externalities associated with higher female education—including indirect effects on children's health—women's bargaining power changes little with relative human capital stocks. This suggests that female education, by itself, may take a very long time to translate into substantial increases in women's bargaining power; other measures, aimed at influencing cultural values and social norms, may be needed to speed up the process. Overall, composite policy experiments suggest that the potential benefits for India of the simultaneous implementation of a combination of pro-growth, pro-women policies may be substantial: raising participation with a package of pro-growth and pro-women policies could boost the growth rate by about 2 percentage points over time.

It is important, nevertheless, to keep in mind that quantitative exercises reported in this paper are inevitably subject to limitations; the conclusions are inevitably related to the assumptions, some of which few may not be firmly grounded (given the available evidence) on India's reality. For instance, improved access to infrastructure does not seem to have a large effect on women's time allocation to market work, even when the degree of substitution between women's time in home production and access to infrastructure services is assumed to be very high. At the same time, however, it is important to recognize that the model does not capture some of the *indirect effects* associated with infrastructure, such as increased safety, or the fact that through its impact on access to television it may change attitudes and behavior

toward women (Jensen and Oster (2009)). These effects could also promote labor force participation by women. It also uses a very broad concept of infrastructure; access to the type of infrastructure that could have an impact on the availability of child care services could also alter (possibly in significant ways) the conclusions of our experiments with respect to female labor force participation, especially if women's preferences for this type of services are explicitly considered.

Similarly, the assumption that only marketed good is consumed in old age does not capture the fact that family solidarity may involve younger generations taking care of older relatives, through direct support or transfers. The assumption that parents do not have control over the gender composition of their family—which implies that half of their children are daughters and half of them sons, and thus that the gender composition of the population is constant—is somewhat at odds with the evidence on “missing girls,” and the fact that in India the sex of siblings is often a key parameter of fertility decisions of the decision to use contraceptives or to have an abortion. Finally, the assumption that schooling is mandatory in childhood may appear overly strong in a context where child labor is widespread.

Several other limitations were highlighted in various parts of the paper. It is difficult to assess *a priori* how much of an impact the use of more general assumptions would have on the quantitative predictions of the model. It is possible, in fact, that the combined effect of less restrictive specifications—leaving aside the issue of tractability—may ultimately be relatively small compared to the results described earlier.

Beyond the precise numerical experiments reported here, however, it is important to keep in mind that the key contribution of the paper is that it makes it very clear that there are important complementarities that must be taken into account between a number of structural policies, both microeconomic and macroeconomic (infrastructure, cash benefits, policies aimed at reducing gender discrimination, poli-

cies that affect values and attitudes regarding girls' education, etc.) when assessing the impact of pro-gender reforms on women's economic education, labour market outcomes, bargaining power and economic growth in India.

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Table 1
Benchmark Calibration

Parameter	Value	Description
<i>Households</i>		
ρ	0.03	Annual discount rate
\varkappa	0.33	Women's bargaining power in the family
μ_B	1.0	Sensitivity of bargaining power to human capital stocks
γ_B	0.6	Weight of endogenous component of bargaining power
χ^R	0.6	Proportion of mothers' rearing time allocated to boys
p	0.795	Average survival probability
σ	0.233	Family's savings rate
η_C	1.366	Family preference parameter, current consumption
η_C^m, η_C^f	1.8, 0.484	Preference parameters for current consumption
n	2.53	Gross fertility rate
θ^R	0.058	Share of family income allocated to child rearing
η_N	0.824	Family preference parameter, number of children
η_H	3.454	Family preference parameter, children's health
η_H^m, η_H^f	3.0, 4.377	Preference parameters for children's health
η_E	4.071	Family preference parameter, women's human capital
η_E^m, η_E^f	3.0, 6.245	Preference parameters for women's human capital
η_Q	2.235	Family preference parameter, home good
<i>Home production</i>		
ζ^P	1.0	Substitution parameter
π^Q	0.7	Curvature of production function
<i>Market production</i>		
α	0.17	Elasticity wrt public-private capital ratio
β	0.325	Elasticity wrt male labor and female labor
b	0.66	Gender bias in the workplace
<i>Human capital</i>		
ν_1	0.15	Elasticity wrt public spending in education
ν_2	0.15	Elasticity wrt public-private capital ratio
ν_3	0.1	Elasticity wrt mothers' rearing time
ν_4	0.1	Elasticity wrt women's time allocated to education

Table 1 (concluded)
Benchmark Calibration

Parameter	Value	Description
<i>Health</i>		
κ_1	0.45	Degree of persistence in health status
κ_2	0.15	Elasticity of child health wrt rearing time
κ_3	0.2	Elasticity of child health wrt public health services
κ_4	0.1	Elasticity of child health wrt spending (incl. cash benefit)
ν_A	0.2	Elasticity of adult health wrt human capital ratio
ν_P	0.8	Elasticity of productivity wrt adult health
κ^H	0.189	Fraction of spending share on children devoted to health
<i>Government</i>		
τ	0.157	Tax rate on marketed output (adjusted for labor share)
v_E	0.102	Share of spending on education
v_I	0.181	Share of spending on infrastructure investment
v_H	0.067	Share of spending on health
cb^G	0.01	Cash benefit rate
μ_H	0.85	Elasticity of public health services wrt health spending
φ_h	0.38	Spending efficiency parameters, $h = I, E, H$
<i>Survival rate</i>		
p_L	0.6	Minimum value, survival rate function
ν_S	0.5	Curvature parameter, survival rate function

Table 2
Increase in Share of Spending on Infrastructure 1/

Financed by Cut in Unproductive Spending, v_U	Baseline	Absolute deviations from baseline				
		Benchmark	$\pi^u = 0.12$	$\zeta^p = 0.5$	$\eta_c^m = 1.5$	$\eta_N = 2$
Time allocated by mothers to						
Household chores	0.310	-0.0046	-0.0063	-0.0023	-0.0041	-0.0071
Child rearing	0.049	0.0003	0.0005	0.0002	0.0003	0.0002
Child rearing (total)	0.124	0.0008	0.0011	0.0004	0.0008	0.0012
Human capital accumulation	0.140	0.0009	0.0013	0.0005	0.0009	0.0014
Market work	0.325	0.0029	0.0039	0.0015	0.0025	0.0044
Women's bargaining power	0.330	0.0001	0.0001	0.0001	0.0001	0.0002
Share of family income, child rearing	0.058	0.0000	0.0000	0.0000	0.0000	0.0000
Fertility rate	2.530	-0.0011	-0.0012	-0.0009	-0.0013	-0.0028
Average survival rate, adulthood to old age	0.795	0.0013	0.0014	0.0012	0.0013	0.0015
Family's savings rate	0.233	0.0003	0.0003	0.0003	0.0003	0.0004
Public-private capital ratio	0.064	0.0070	0.0069	0.0070	0.0064	0.0108
Female health status	1.000	0.0137	0.0136	0.0126	0.0136	0.0148
Growth rate of final output	0.077	0.0017	0.0016	0.0016	0.0016	0.0017
Financed by Cut in Education Spending, v_E						
			Absolute deviations from baseline			
	Baseline	Benchmark	$\pi^e = 0.12$	$\zeta^p = 0.5$	$\eta_c^m = 1.5$	$\eta_N = 2$
Time allocated by mothers to						
Household chores	0.310	-0.0046	-0.0064	-0.0023	-0.0041	-0.0071
Child rearing	0.049	0.0003	0.0005	0.0002	0.0003	0.0002
Child rearing (total)	0.124	0.0008	0.0011	0.0004	0.0008	0.0013
Human capital accumulation	0.140	0.0009	0.0013	0.0005	0.0009	0.0014
Market work	0.325	0.0028	0.0039	0.0014	0.0024	0.0044
Women's bargaining power	0.330	0.0001	0.0001	0.0001	0.0001	0.0002
Share of family income, child rearing	0.058	0.0000	0.0000	0.0000	0.0000	0.0000
Fertility rate	2.530	-0.0006	-0.0006	-0.0004	-0.0006	-0.0017
Average survival rate, adulthood to old age	0.795	0.0004	0.0004	0.0003	0.0004	0.0006
Family's savings rate	0.233	0.0001	0.0001	0.0001	0.0001	0.0002
Public-private capital ratio	0.064	0.0071	0.0070	0.0071	0.0064	0.0109
Female health status	1.000	0.0044	0.0043	0.0032	0.0042	0.0055
Growth rate of final output	0.077	-0.0008	-0.0008	-0.0008	-0.0008	-0.0007

1/ Increase in v_i from 0.181 to 0.201. Initial values of π^e , ζ^p , η_c^m , and η_N are equal to 0.7, 1, 1.8, and 0.82, respectively in the benchmark case.

Source: Author's calculations.

Table 3
Increase in Efficiency of Government Spending 1/

	Baseline	Absolute deviations from baseline			
		$\varphi_I = 0.6$	$\varphi_E = 0.6$	$\varphi_H = 0.6$	$\varphi_{I,E,H} = 0.6$
Time allocated by mothers to					
Household chores	0.310	-0.0240	0.0000	-0.0001	-0.0238
Child rearing	0.049	0.0018	0.0000	0.0000	0.0018
Child rearing (total)	0.124	0.0042	0.0000	-0.0003	0.0037
Human capital accumulation	0.140	0.0048	0.0000	-0.0002	0.0045
Market work	0.325	0.0149	0.0001	0.0006	0.0155
Women's bargaining power	0.330	0.0007	0.0000	0.0000	0.0006
Share of family income, child rearing	0.058	0.0000	0.0000	0.0000	0.0000
Fertility rate	2.530	-0.0053	-0.0012	-0.0088	-0.0157
Average survival rate, adulthood to old age	0.795	0.0061	0.0019	0.0141	0.0227
Family's savings rate	0.233	0.0015	0.0004	0.0032	0.0052
Public-private capital ratio	0.064	0.0366	-0.0001	-0.0009	0.0350
Female health status	1.000	0.0632	0.0196	0.1501	0.2463
Growth rate of final output	0.077	0.0076	0.0052	0.0009	0.0143

1/ Increase in φ_h from 0.38 to 0.6 where $h = I, E, H$.

Source: Author's calculations.

Table 4
Increase in Targeted Cash Benefit Rate 1/

	Baseline	Absolute deviations from baseline			
		Benchmark	$\kappa_4 = 0.2$	$\eta_H^m = 5$	$\eta_N = 2$
Time allocated by mothers to					
Household chores	0.310	-0.0001	-0.0001	-0.0001	0.0003
Child rearing	0.049	0.0000	0.0001	0.0003	0.0000
Child rearing (total)	0.124	-0.0004	-0.0006	-0.0005	-0.0005
Human capital accumulation	0.140	-0.0002	-0.0004	-0.0002	-0.0003
Market work	0.325	0.0007	0.0010	0.0008	0.0005
Women's bargaining power	0.330	0.0000	-0.0001	0.0000	0.0000
Share of family income, child rearing	0.058	0.0000	0.0000	0.0000	0.0000
Fertility rate	2.530	-0.0099	-0.0153	-0.0044	-0.0205
Average survival rate, adulthood to old age	0.795	0.0159	0.0239	0.0166	0.0166
Family's savings rate	0.233	0.0035	0.0055	0.0037	0.0037
Public-private capital ratio	0.064	-0.0010	-0.0017	-0.0009	-0.0017
Female health status	1.000	0.1737	0.3811	0.1738	0.1723
Growth rate of final output	0.077	0.0010	0.0022	0.0010	0.0011

1/ Increase in cb^G from 0.01 to 0.04. Initial values of κ_4 , η_H^m , and η_N are equal to 0.1, 3, and 0.824, respectively, in the benchmark case.

Source: Author's calculations.

Table 5
Reduction in Gender Bias in the Market Place 1/

	Baseline	Absolute deviations from baseline			
		b = 0.8	b = 1	b = 0.8 and $v_1 = 0.25$	b = 0.8 and $v_E = 0.122$
Time allocated by mothers to					
Household chores	0.310	0.0000	0.0000	0.0000	0.0000
Child rearing	0.049	0.0000	0.0000	0.0000	0.0000
Child rearing (total)	0.124	0.0000	0.0000	0.0000	0.0000
Human capital accumulation	0.140	0.0000	0.0000	0.0000	0.0000
Market work	0.325	0.0000	0.0001	0.0000	0.0001
Women's bargaining power	0.330	0.0000	0.0000	0.0000	0.0000
Share of family income, child rearing	0.058	0.0000	0.0000	0.0000	0.0000
Fertility rate	2.530	-0.0003	-0.0007	-0.0004	-0.0012
Average survival rate, adulthood to old age	0.795	0.0005	0.0012	0.0007	0.0019
Family's savings rate	0.233	0.0001	0.0003	0.0002	0.0004
Public-private capital ratio	0.064	0.0000	-0.0001	0.0000	-0.0001
Female health status	1.000	0.0053	0.0123	0.0087	0.0200
Growth rate of final output	0.077	0.0014	0.0032	0.0023	0.0053

1/ Initial value of b is set at 0.66. Initial values of v_1 and v_E are set at 0.15 and 0.102, respectively in the benchmark case.

Source: Author's calculations.

Table 6
Increase in Mothers' Time Allocated to their Daughters 1/

	Baseline	Absolute deviations from baseline				
		Benchmark	$\gamma_B = 0.7$	$\mu_B = 1.5$	$\eta_H^m = 4$	$v_3 = 0.4$
Time allocated by mothers to						
Household chores	0.310	0.0008	0.0012	0.0012	0.0009	0.0034
Child rearing	0.049	0.0006	0.0009	0.0008	0.0006	0.0022
Child rearing (total)	0.124	0.0004	0.0007	0.0007	0.0002	0.0019
Human capital accumulation	0.140	0.0005	0.0008	0.0007	0.0005	0.0020
Market work	0.325	-0.0018	-0.0027	-0.0026	-0.0016	-0.0074
Women's bargaining power	0.330	0.0082	0.0120	0.0116	0.0082	0.0316
Share of family income, child rearing	0.058	0.0004	0.0007	0.0006	0.0004	0.0017
Fertility rate	2.530	-0.0219	-0.0266	-0.0306	-0.0104	-0.0792
Average survival rate, adulthood to old age	0.795	0.0059	0.0061	0.0060	0.0059	0.0112
Family's savings rate	0.233	0.0027	0.0038	0.0033	0.0028	0.0078
Public-private capital ratio	0.064	-0.0008	-0.0009	-0.0009	-0.0007	-0.0023
Female health status	1.000	0.0878	0.0891	0.0896	0.0870	0.1733
Growth rate of final output	0.077	0.0013	0.0012	0.0011	0.0014	0.0060

1/Reduction in χ^R from 0.6 to 0.5. Initial values of γ_B , η_H^m , and v_3 are equal to 0.6, 3, and 0.1, respectively whereas μ_B is equal to unity in the benchmark case.

Source: Author's calculations.

Table 7
Composite Reform Programs

	Composite Program 1 <u>1/</u>				Composite Program 2 <u>2/</u>		
	Baseline	Absolute deviations from baseline			Absolute deviations from baseline		
	Benchmark	$\kappa_4 = 0.15$	$\gamma_B = 0.7$	Benchmark	$\kappa_4 = 0.15$	$\gamma_B = 0.7$	
Time allocated by mothers to							
Household chores	0.3100	-0.0104	-0.0106	-0.0098	-0.0161	-0.0164	-0.0150
Child rearing	0.0490	0.0009	0.0009	0.0010	0.0016	0.0017	0.0020
Child rearing (total)	0.1240	0.0009	0.0009	0.0008	0.0018	0.0019	0.0019
Human capital accumulation	0.1400	0.0015	0.0015	0.0015	0.0028	0.0028	0.0028
Market work	0.3250	0.0080	0.0082	0.0075	0.0114	0.0116	0.0103
Women's bargaining power	0.3300	0.0002	0.0002	0.0003	0.0045	0.0045	0.0065
Share of family income, child rearing	0.0580	0.0000	0.0000	0.0000	0.0002	0.0002	0.0004
Fertility rate	2.5300	-0.0262	-0.0278	-0.0258	-0.0467	-0.0473	-0.0485
Average survival rate, adulthood to old age	0.7950	0.0410	0.0430	0.0406	0.0589	0.0589	0.0584
Family's savings rate	0.2330	0.0092	0.0098	0.0095	0.0138	0.0140	0.0148
Public-private capital ratio	0.0644	0.0260	0.0265	0.0246	0.0420	0.0430	0.0395
Female health status	1.0000	0.4834	0.6103	0.4773	0.7481	0.8990	0.7405
Growth rate of final output	0.0770	0.0154	0.0162	0.0153	0.0240	0.0249	0.0238

1/ Benchmark: Increase in ν_1 from 0.181 to 0.201; increase in ν_E from 0.102 to 0.122; increase in ν_H from 0.067 to 0.087; increase in all efficiency parameters φ_h from 0.38 to 0.5; increase in cb^G from 0.01 to 0.04; and increase in b from 0.66 to 0.8.

2/ Benchmark: Increase in ν_1 from 0.181 to 0.201; increase in ν_E from 0.102 to 0.132; increase in ν_H from 0.067 to 0.097; increase in all efficiency parameters φ_h from 0.38 to 0.6; increase in cb^G from 0.01 to 0.04; increase in b from 0.66 to 0.8; and decrease in χ^R from 0.6 to 0.55.

Note: all these simulations are based on the case where $\zeta^P = 0.5$. Initial values of κ_4 and γ_B are 0.1 and 0.6, respectively.

Source: Author's calculations.