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OF GENDER NORMS
IN AN ENDOGENOUS GROWTH MODEL**

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On the Undesirable Repercussions of Gender Norms in an Endogenous Growth Model

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Sustainable growth has emerged as a critical policy challenge worldwide. We investigate the influence of conventional gender norms on fertility and economic growth to explain the phenomena recently observed across high-income countries. To this end, we construct an overlapping generations model with endogenous fertility and labor supply, incorporating gender norms and R&D activities. We demonstrate that conventional gender norms can impede fertility and economic growth. Specifically, when gender norms are sufficiently conservative, income growth stagnates and population erosion eventually occurs. Conversely, when gender norms are sufficiently less conservative, the economy follows a sustained growth path characterized by simultaneous growth in both population and income per capita. Our results underscore the need to address and correct gender norms to achieve sustainable growth and improve welfare.

Keywords: Gender norms, economic growth, fertility, domestic production

JEL classifications J13, J16, O40

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1 Introduction

Sustainable growth has emerged as a critical policy challenge worldwide. Nevertheless, several of the important objectives articulated in the UN Sustainable Development Goals related to economic growth and gender equality remain unmet. Additionally, several developed countries, including Italy and Japan, are facing rapid population declines, which makes it difficult to maintain the social security system and address the problem of labor shortages. Therefore, ongoing discourse is necessary to identify and analyze the elements that both facilitate and hamper sustainable growth.

Among the elements considered to be potentially important, we focus on how the values or culture related to gender roles within and outside households (hereafter referred to as gender norms) have repercussions on sustainable growth. Specifically, our study is closely related to the idea proposed by [Feyrer *et al.* \(2008\)](#), who argued that there are “three distinct phases in women’s status generated by the gradual increase in women’s workforce opportunities.”¹ The authors’ important suggestion is that gender norms are relatively persistent over time and change more slowly than women’s actual labor market opportunities. Consequently, in the intermediate phase, despite the improved status of women in the labor market, they are still likely to bear a greater burden of housework and childcare than men, impeding the compatibility of career and family for women and decreasing fertility ([Doepke *et al.*, 2023](#)). However, in the final phase when less conventional gender norms prevail, the increased involvement of men in housework and childcare not only supports women’s labor market participation, but also enhances fertility.

Based on this idea, we theoretically investigate the influence of gender norms on fertility and income per capita. In particular, we focus on the differences across high-income countries because although women’s labor market opportunities have improved in the de-

¹In the first phase, “women earn low wages relative to men and are expected to shoulder all of the child care at home.” In the intermediate phase, “women have improved (but not equal) labor market opportunities but their household status lags. Women in this stage are still expected to do the majority of child care and household production.” In the final phase, “women’s labor market opportunities begin to equal those of men. In addition, the increased household bargaining power that comes from more equal wages results in much higher (if not gender-equal) male participation in household production.”

veloped world, significant heterogeneity persists in the conservativeness of gender norms. Before conducting the theoretical analysis, an examination of country-level data over the past 40 years reveals several notable trends and relationships between the variables. First, total fertility rates have remained relatively constant over time and appear to be converging. However, while the total fertility rates of some countries are close to the replacement level, others display significantly lower rates. Second, although GDP per capita has grown continuously in many countries during this period, it diverges across countries and positively correlates with total fertility rates. Finally, both total fertility rates and GDP per capita are lower in countries with more conventional gender norms than in those with less conventional ones. Taken together, the heterogeneity in the conservativeness of gender norms may account for international differences in fertility rates and economic growth.

To explain these phenomena, we construct an overlapping generations model with endogenous fertility and labor supply. Additionally, we explicitly incorporate gender norms by assuming that women bear greater responsibility for housework and childcare than men do within the framework of R&D-based growth. We demonstrate that more conventional gender norms decrease fertility and income per capita. The underlying mechanism operates as follows: fertility (i.e., the number of children) is modeled through a home production function that features complementarities between women's and men's home production time inputs as well as between time and monetary inputs. Although this complementarity uniquely determines the efficient input ratio, conventional gender norms prevent households from adopting this ratio. This inefficiency increases the cost of having and raising children, thereby decreasing the population and labor force in subsequent periods. The reduced labor force diminishes the number of researchers in the R&D sector, impeding R&D activities and consequently lowering the economic growth rate. If the degree of conservativeness exceeds a threshold, the economy displays a population decline and a transitory increase in income per capita, followed by stagnation in income growth and eventual population erosion. Conversely, if the degree of conservativeness is below this threshold, the economy follows a sustained growth path characterized by

simultaneous growth in both population and income per capita.

Our study builds on and contributes to two strands of the literature. The first strand explores the influence of social norms on household behavior. The rationale for investigating social norms stems from the observation that certain aspects of household behavior cannot be adequately explained by conventional economic theory, which endeavors to describe household decisions based solely on financial incentives. To address this issue, [Akerlof and Kranton \(2000\)](#) introduced notions of identity from sociology and social psychology to economics, with their framework since extensively used to understand the relationships between social norms and household behavior ([Fernández *et al.*, 2004](#); [Feyrer *et al.*, 2008](#); [Gimenez-Nadal *et al.*, 2012](#); [Bertrand *et al.*, 2015](#); [Hwang, 2016](#); [Goussé *et al.*, 2017](#); [Bursztyn *et al.*, 2020](#); [Bertrand *et al.*, 2021](#); [Jessen *et al.*, 2024](#); [Sakamoto and Kohara, 2024](#)). For instance, [Fernández *et al.* \(2004\)](#) developed a model that accounted for a man's preference for his wife's labor force participation to explain why the wives of men whose mothers worked were significantly more likely to work. Furthermore, [Sakamoto and Kohara \(2024\)](#) introduced gender norms as a time constraint in the household problem, demonstrating that conventional gender norms not only affect resource allocation within households, but also reduce household welfare. While previous research has predominantly focused on the influence of social norms on household behavior, our study extends this analysis to present the macroeconomic consequences of gender norms, highlighting their negative repercussions on fertility rates and economic growth.

Second, our study contributes to the literature on the causes and consequences of economic development. Specifically, numerous studies demonstrate the interplay between economic growth and fertility (or demographic transition) by focusing on the quantity–quality trade-off of children ([Becker and Barro, 1988](#); [Barro and Becker, 1989](#); [Becker *et al.*, 1990](#)), technological progress ([Galor and Weil, 1996, 2000](#)), inequality ([De La Croix and Doepke, 2003](#)), and child labor ([Hazan and Berdugo, 2002](#); [Doepke, 2004](#)).² Recently,

²Other crucial elements include life expectancy ([Castelló-Climent and Doménech, 2008](#); [Futagami and Konishi, 2019](#)), variety expansion ([Maruyama and Yamamoto, 2010](#)), delay in childbearing ([Dioikitopoulos and Varvarigos, 2023](#)), and childcare policies ([Day, 2016](#)).

Jones (2022) addressed the demographic transition and economic growth in contemporary times, noting that the assumption typically employed in the semi-endogenous growth literature—constant or growing population—is no longer valid. The author argued that with negative population growth rates, both endogenous and semi-endogenous growth models yield *empty planet* outcomes, wherein knowledge and living standards stagnate for a population that gradually erodes. Furthermore, recent research demonstrates that various aspects of women’s empowerment either promote or interact with economic development (Bloom *et al.*, 2009; Doepke and Tertilt, 2009; Fernández and Fogli, 2009; De la Croix and Vander Donckt, 2010; Fernández, 2014; Anderson and Kohler, 2015; Doepke and Tertilt, 2019). Our study complements this literature by showing that the recent positive correlation between fertility rates and income per capita across high-income countries can be attributed to international differences in the conservativeness of gender norms. Most importantly, our model underscores the need to address and correct gender norms promptly; failure to do so risks economies with conventional gender norms succumbing to the empty planet scenario.

The remainder of this paper is organized as follows. Section 2 provides suggestive evidence for the relationships among gender norms, fertility rates, and income per capita. Section 3 introduces a theoretical model for exploring the influence of gender norms on fertility and economic growth. Section 4 presents a dynamic analysis that explains and interprets the observed phenomena. Section 5 concludes.

2 Macroeconomic Evidence among High-income Countries

Before proceeding with our theoretical analysis, we briefly provide suggestive evidence for the relationships among gender norms, fertility, and income.

2.1 Selection of Countries and Periods

We use country-level data on high-income countries (as classified by the World Bank) in Europe, Asia, and North America. As in [Bertrand *et al.* \(2021\)](#), we exclude very small countries (those with populations smaller than four million in 2015). In addition, we exclude countries for which fertility data are unavailable. Our final sample consists of the following 24 developed countries: Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, the United Kingdom, and the United States. To examine the long-term trends and relationships between the variables, we use data from 1980 to 2019.

2.2 Data

The variables of interest are gender norms, fertility, and income. For the first variable, following [Bertrand *et al.* \(2021\)](#), we use the 1990–1994 and 2010–2014 waves of the Integrated Values Survey, a harmonized dataset that covers both the European Values Study and the World Values Survey. This dataset includes participants’ responses to various gender-related questions asked across a set of countries. In particular, we use participants’ responses (agree, disagree, or neither) to the following question: “When jobs are scarce, men have more right to a job than women.” We use this question because it covers the broadest range of countries and survey periods. Although it asks about the values of gender roles outside the home, combined with time constraints, it may also reflect the values of gender roles within households (i.e., the division of housework and childcare between couples). Using the answers given by respondents aged 18 years or older for each country, we create a variable that indicates the ratio of respondents who answer “agree.” A higher value of this variable implies more conventional and conservative gender norms.

Although this question clearly measures the conservativeness of gender norms, it does not directly capture the values of gender roles outside and within households. In

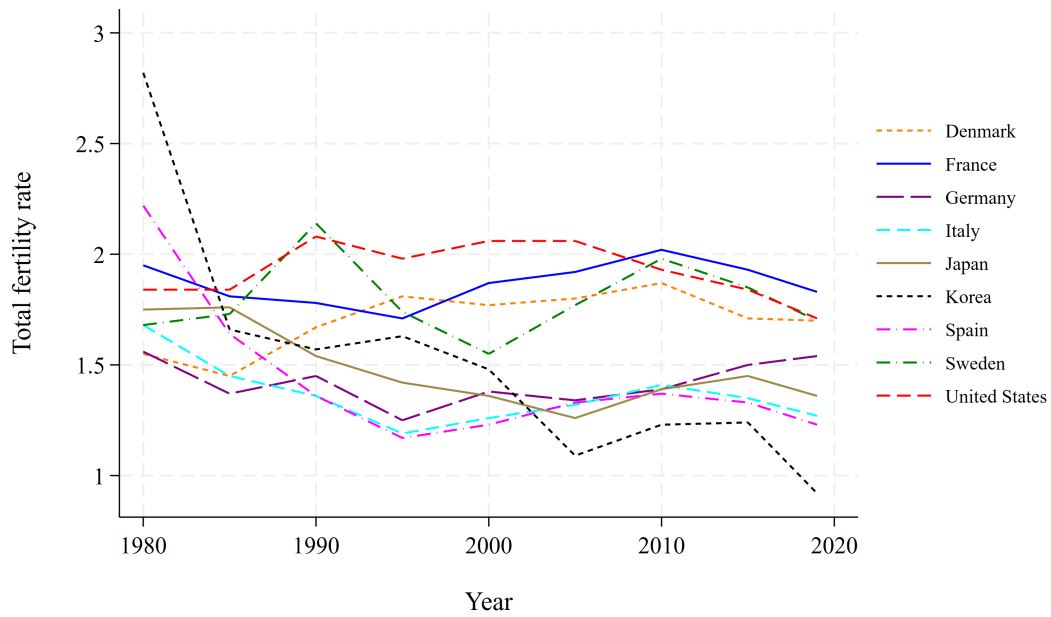
our theoretical model presented below, we introduce gender norms as “Women should be more responsible for housework and childcare than men.” Hence, there is a slight divergence between the theory and data. To address this issue, we also use the 2002 and 2012 waves of the International Social Survey Programme as in [Feyrer *et al.* \(2008\)](#). We focus on participants’ responses to the following question: “A man’s job is to earn money; a woman’s job is to look after the home and family.” Respondents must answer agree strongly, agree, neither agree nor disagree, disagree, or disagree strongly. We create a variable that indicates the ratio of respondents who answer “agree strongly” or “agree,” which measures conventional gender norms.

For the second variable, we use the total fertility rate between 1980 and 2019 from the OECD Family Database. Conceptually, the total fertility rate indicates the number of children that would be born to a woman if she were to live until the end of her childbearing years and bear children in accordance with the age-specific fertility rates currently observed. Finally, our income measure is GDP per capita, based on World Bank data. This measure is adjusted to current US dollars to ensure that the figures in different countries and periods are comparable.

2.3 Trends in Fertility and Income

First, we examine fertility and income across countries and over time. [Figure 1](#) illustrates the trends in the total fertility rate for nine countries (Denmark, France, Germany, Italy, Japan, Korea, Spain, Sweden, and the United States) from 1980 to 2019. Over recent years, their total fertility rates are almost constant and typically below the replacement level of 2.1. Hence, these countries seem to have completed their demographic transition.

As the literature suggests ([Bongaarts, 2002](#); [Adsera, 2004](#)), fertility rates behave differently across countries. In particular, when focusing on 2010, these nine countries can be classified into countries with a total fertility rate of approximately 2 (i.e., Denmark, France, Sweden, and the United States) and those with a total fertility rate below 1.5 (i.e., Germany, Italy, Japan, Korea, and Spain). This is a well-known pattern in the literature.

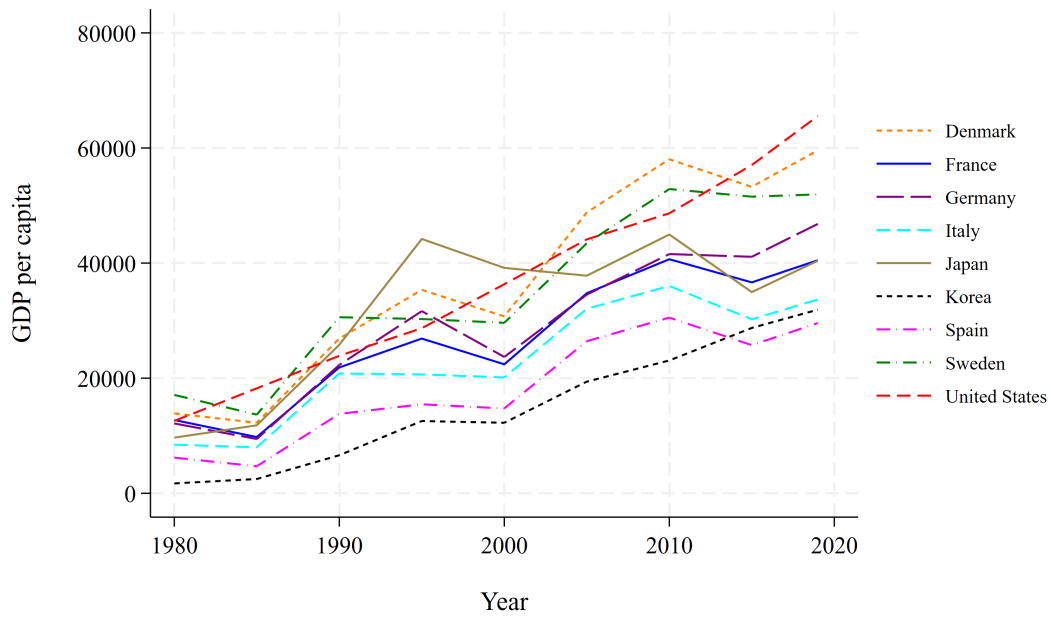


Notes. The vertical and horizontal axes indicate the total fertility rate and year, respectively. The source is the OECD Family Database.

Fig. 1 Trends in the total fertility rate across countries

The United States, Nordic countries, and Western European countries are typically characterized by high fertility rates, whereas Eastern and Southern European countries and East Asian countries tend to have lower fertility rates (Feyrer *et al.*, 2008; Chatterjee and Vogl, 2018; Delventhal *et al.*, 2021). In the past 10 years, however, the rates of the countries in the second group have diverged. While the total fertility rate has increased in Germany, it has remained relatively constant in Italy, Japan, and Spain, while Korea has experienced a drastic decline. Hence, the important question is “What generates these differences in total fertility rates across countries?”

Before answering this question, we also explore the trends in GDP per capita in the same countries between 1980 and 2019. Unlike the total fertility rate, GDP per capita has continued to increase over the past 40 years, excluding in Japan where it has remained almost constant since 1995. However, the income growth rates differ across countries. Specifically, the United States, Nordic countries, and Western European countries have higher growth rates than Eastern and Southern European and East Asian countries. Interestingly, income growth rates are positively associated with total fertility



Notes. The vertical and horizontal axes indicate GDP per capita and year, respectively. The source is World Bank data.

Fig. 2 Trends in GDP per capita across countries

rates.

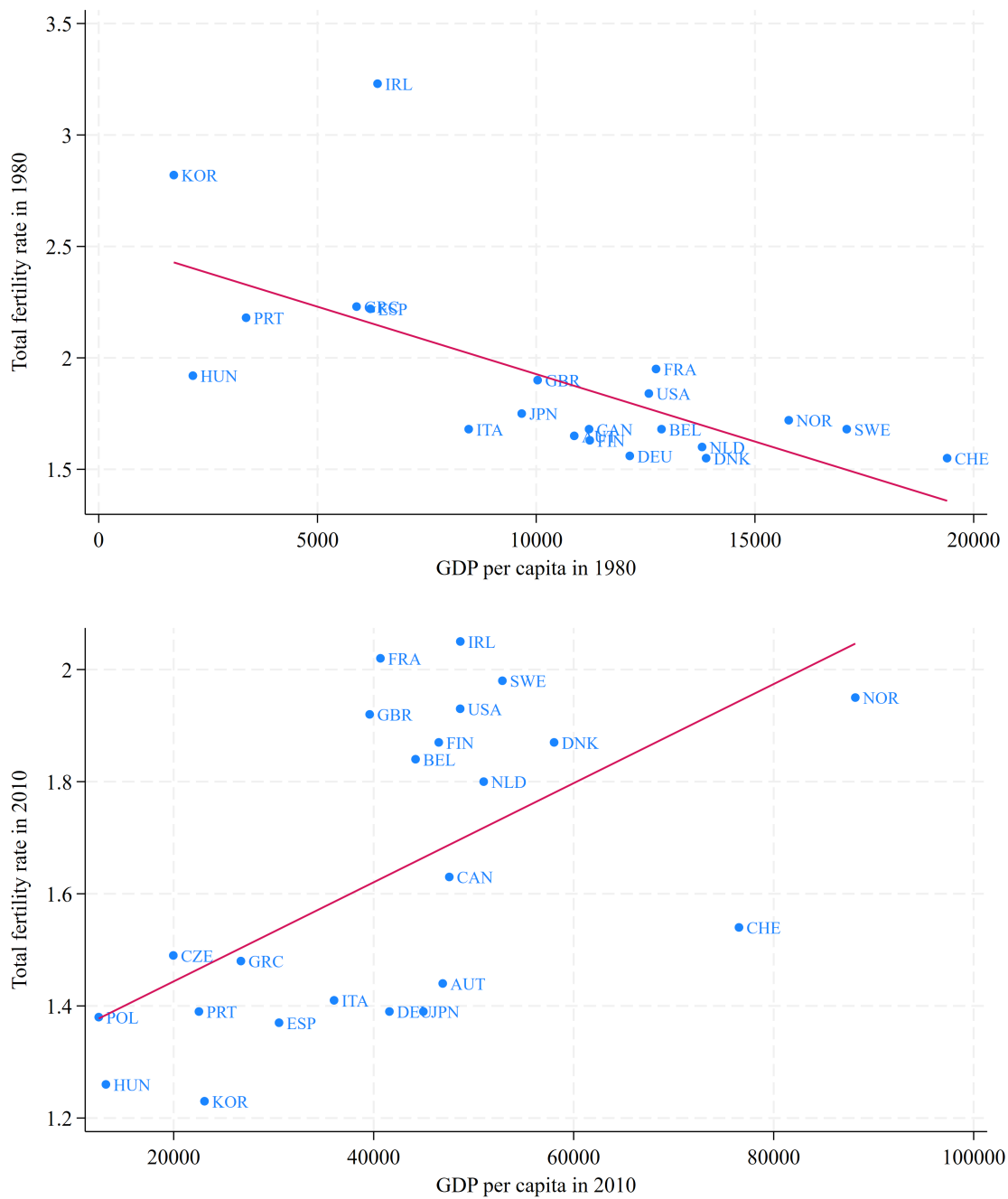
The positive relationship between fertility and income has been widely acknowledged in recent years. For instance, [Ahn and Mira \(2002\)](#) argued that fertility rates were negatively associated with income per capita until the mid-1980s, but that this relationship became positive toward the end of that decade. We confirm their findings using more recent data. Figure 3 shows the relationship between the total fertility rate and GDP per capita in 1980 and 2010. Concurring with the findings of [Ahn and Mira \(2002\)](#), the relationship is negative in 1980; the correlation coefficient is -0.664 , statistically significant at the 1% level (see the upper panel). This negative relationship disappears by 1990 (data not shown); the correlation coefficient becomes -0.001 , statistically insignificant. However, a positive and statistically significant relationship begins to be observed when the data from 2000 are used. As shown in the lower panel, a clear positive relationship is observed in 2010, with a correlation coefficient of 0.588 , statistically significant at the 1% level. This positive relationship remains in 2019, the most recent year of our analysis. In summary, when focusing on the past (at least) 20 years, there has been a stable positive relationship

between the total fertility rate and GDP per capita.

2.4 Relationships among Gender Norms, Fertility, and Income

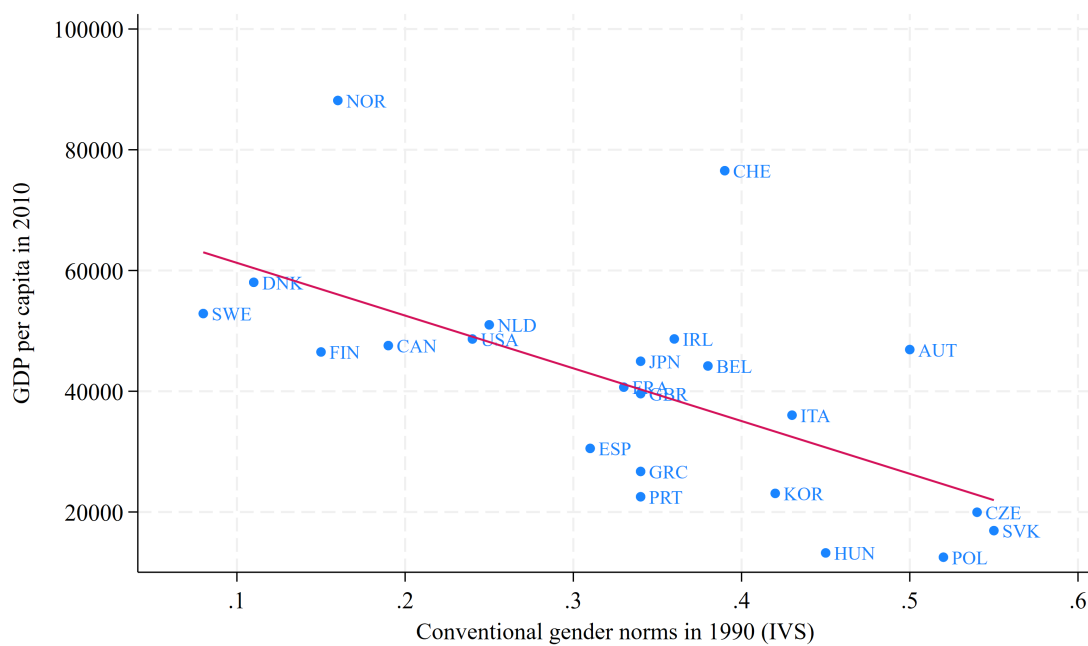
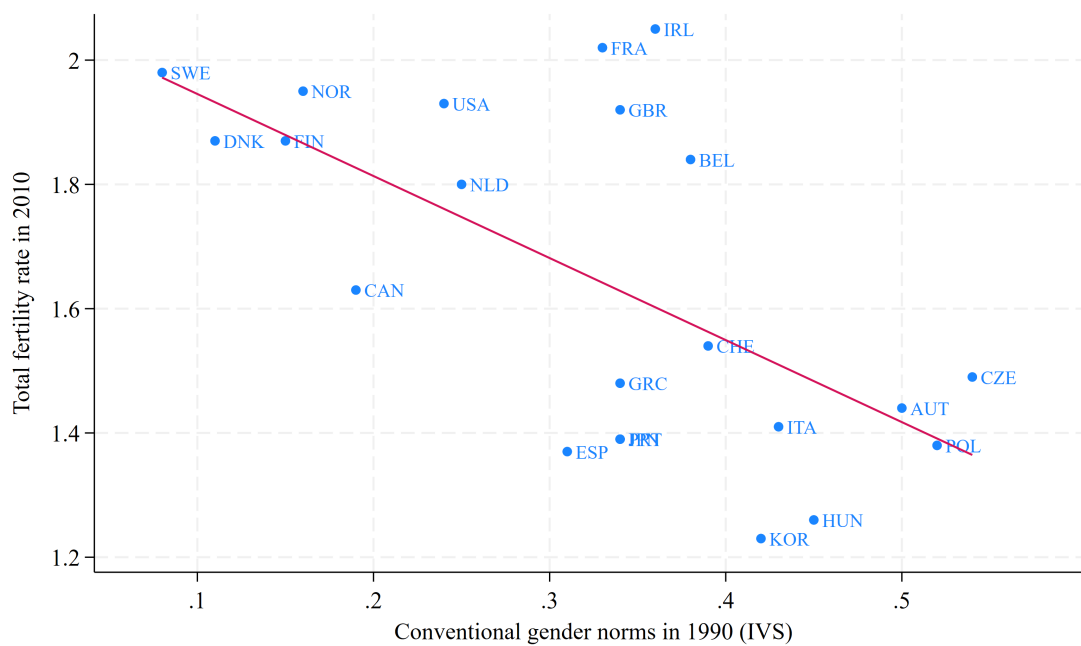
Among the sources that may generate this positive relationship between fertility and income per capita, we focus on international differences in gender norms. In a modern economy, gender norms are likely to play an important role in determining fertility because they influence the division of labor between genders outside and within households (Fernández *et al.*, 2004; Hwang, 2016; Bertrand *et al.*, 2021; Sakamoto and Kohara, 2024). Moreover, gender norms may also influence income per capita (or, equivalently, economic growth) because population growth rates and income growth rates interact in various ways (Becker *et al.*, 1990; Galor and Weil, 1996, 2000; Hazan and Berdugo, 2002; De La Croix and Doepke, 2003; Prettner, 2013; Jones, 2022; Cervellati *et al.*, 2023).

Figure 4 illustrates the relationships among gender norms, fertility, and income per capita. Although all the analyses are correlational, we use lagged variables to mitigate the concern about reverse causality; that is, the norm measure is drawn from the 1990–1994 wave of the Integrated Values Survey, whereas we use the fertility and income measures in 2010. The upper panel indicates that more conventional gender norms are negatively associated with the total fertility rate. The correction coefficient is -0.625 , statistically significant at the 1% level. Additionally, the lower panel confirms the negative relationship between conventional gender norms and GDP per capita. The correlation coefficient is -0.625 , significant at the 1% level. Similar results are obtained when using the fertility and income measures in 1990 and 2000. Furthermore, the results remain consistent if we instead use the norm measure from the 2002–2012 wave of the International Social Survey Programme and combine it with the fertility and income measures in 2019. Therefore, a series of observations provides suggestive evidence that conventional gender norms have long-term negative repercussions on both fertility and income per capita. The theoretical model presented in the next section attempts to clarify the underlying mechanisms.



Notes. The upper and lower panels illustrate the relationship between the total fertility rate and GDP per capita in 1980 and 2010, respectively. For each panel, the vertical and horizontal axes indicate the total fertility rate and GDP per capita, respectively. The regression lines are also depicted. The fertility measure is from the OECD Family Database, while the income measure is from World Bank data.

Fig. 3 Relationship between fertility and income per capita in 1980 and 2010



Notes. The upper panel illustrates the relationship between gender norms in 1990 and the total fertility rate in 2010. The lower panel shows the relationship between gender norms in 1990 and GDP per capita in 2010. The regression lines are depicted. The norm measure is from [Bertrand et al. \(2021\)](#) (see Table 4 in the authors' online appendix), the fertility measure is from the OECD Family Database, and the income measure is from World Bank data.

Fig. 4 Relationships among gender norms, fertility and income per capita

3 Model

3.1 Structure

Following Galor and Weil (1996), we consider a three-period overlapping generations model with two genders, men and women. Individuals live for three periods: childhood, adulthood, and old age. In childhood, they do not make decisions. At the beginning of adulthood, each individual enters the marriage market and is matched with a member of the opposite sex. The couple (i.e., household) then determines the consumption plan, number of children to have, and labor supply. In old age, household members retire, consume their savings, and have no bequest motive.

Men and women are identical in childhood and old age. In adulthood, couples invest equal amounts of time and money in their male and female children, resulting in the accumulation of the same level of human capital between genders. However, in adulthood, the couple's labor decision is influenced by gender norms, which stipulate that women should do $s \in (0, \infty)$ times more housework and childcare than men, which we refer to as the *male-dominant social norm*. For simplicity, the probability of having male and female children is the same; hence, the male-to-female ratio is one for all generations.

3.2 Households

Each individual in adulthood in period t maximizes the following utility:

$$U_t(c_{1,t}, c_{2,t+1}, n_t) = \ln c_{1,t} + \beta \ln c_{2,t+1} + \gamma \ln n_t, \quad (1)$$

where $c_{1,t}$ denotes consumption in adulthood, $c_{2,t+1}$ is consumption in old age, n_t is the number of children each couple has in adulthood, and $\beta > 0$ and $\gamma > 0$ represent the preference parameters. The two genders, female and male, are denoted by $i \in \{f, m\}$ and we assume an equal probability of having a boy and a girl; the choice $n_t = 1$ implies

having one boy and one girl. Hence, the population dynamics equation is given by

$$N_{t+1} = n_t N_t, \quad (2)$$

where N_t denotes the number of couples in adulthood in period t . Women and men jointly consume the final good in adulthood and old age. In addition, the presence of children is public to their spouses. Hence, the couple's utility function equals the individual utility function of each household member.

Each adult is endowed with $1/2$ units of time divided into housework time, including childcare, $h_{i,t}$, and labor supply in the market, $\ell_{i,t}$. Hence, the household's time constraint is

$$\sum_{i \in \{f,m\}} (h_{i,t} + \ell_{i,t}) = 1. \quad (3)$$

Additionally, the household's decision on housework is influenced by the male-dominant social norm as follows:

$$h_{f,t} = s h_{m,t}. \quad (4)$$

Hence, although the household can choose the total housework time, $h_{f,t} + h_{m,t}$, optimally, it cannot choose the ratio of women's housework time to that of men.

The household budget constraint in adulthood in period t is given by

$$c_{1,t} + a_t + e_t = w_t(1 - h_{f,t} - h_{m,t}), \quad (5)$$

where e_t denotes financial investment in children and a_t represents savings for old age. w_t is the market wage, which is the same for both genders because women and men have the same level of human capital in adulthood and there is no gender discrimination in the

labor market. The budget constraint in old age in period $t + 1$ is given by

$$c_{2,t+1} = (1 + r_{t+1})a_t, \quad (6)$$

where r_{t+1} is the interest rate.

The number of children is determined using the following home production function:

$$n_t = H(h_{f,t}, h_{m,t}, e_t) = \xi(h_{f,t})^{\eta_f} (h_{m,t})^{\eta_m} \left(\frac{e_t}{w_t} \right)^{1-\eta_f-\eta_m}, \quad (7)$$

where $\xi > 0$ is the scale parameter. $\eta_f \in (0, 1)$ and $\eta_m \in (0, 1)$, such that $\eta_f + \eta_m < 1$ are the parameters representing the relative importance of the time inputs for women and men, respectively. The Cobb–Douglas form in Equation (7) indicates the complementarity between $h_{f,t}$, $h_{m,t}$, and e_t . Importantly, the financial investment in children, e_t , is discounted by the wage, w_t . This assumption captures the fact that as the economy grows, the standard level of investment in children also increases.³

We first consider the following cost minimization problem for raising children given the number of children \tilde{n} :

$$\begin{aligned} \min_{e_t, h_{f,t}, h_{m,t}} \quad & e_t + w_t h_{f,t} + w_t h_{m,t}, \\ \text{s.t.} \quad & H(h_{f,t}, h_{m,t}, e_t) = \tilde{n}, \\ & h_{f,t} = s h_{m,t}. \end{aligned}$$

The first-order conditions yield the following intratemporal condition:

$$\frac{\eta_f + \eta_m}{1 - \eta_f - \eta_m} \cdot \frac{e_t}{h_{m,t}} = (1 + s)w_t,$$

³Similarly, [Prettner \(2013\)](#) assumed that children's consumption is proportional to that of adults and then derived that fertility is constant to income. We show that without the income effect on fertility, international differences in the conservativeness of gender norms could explain the observed positive relationships between fertility rates and income per capita across high-income countries. Moreover, as mentioned in [Section 2](#), constant fertility rates over time are consistent with the real-world observations for high-income countries over the past 40 years.

implying that the marginal rate of substitution between the time and monetary inputs for raising children equals their price ratio. The input demand functions are given by

$$h_{f,t}(n_t) = sh_{m,t}(n_t), \quad (8)$$

$$h_{m,t}(n_t) = \frac{\eta_f + \eta_m}{1 + s} \cdot \chi n_t, \quad (9)$$

$$e_t(n_t) = (1 - \eta_f - \eta_m)\chi w_t n_t, \quad (10)$$

where

$$\chi := \frac{s^{-\eta_f} (1 + s)^{\eta_f + \eta_m}}{\xi(\eta_f + \eta_m)^{\eta_f + \eta_m} (1 - \eta_f - \eta_m)^{1 - \eta_f - \eta_m}}. \quad (11)$$

Substituting Equations (8), (9), and (10) into the objective function yields the following cost function:

$$\widehat{C}(n_t) = \chi w_t n_t, \quad (12)$$

which is linear with respect to n_t because the home production function is homogeneous of degree one. We can interpret χw_t as the shadow price of having and raising children. As χ hinges on s , social norms affect fertility decisions through price effects. Referring to [Sakamoto and Kohara \(2024\)](#), we obtain the following result.

Lemma 1. There exists s^* such that χ increases in s if and only if $s > s^*$.

Proof. Taking the derivative of χ with respect to s yields

$$\frac{\partial \chi}{\partial s} = \frac{s^{-\eta_f - 1} (1 + s)^{\eta_f + \eta_m - 1} (s\eta_m - \eta_f)}{\xi(\eta_f + \eta_m)^{\eta_f + \eta_m} (1 - \eta_f - \eta_m)^{1 - \eta_f - \eta_m}},$$

which is positive if and only if

$$s\eta_m - \eta_f > 0 \iff s > s^*,$$

where $s^* := \frac{\eta_f}{\eta_m}$. □

Panel (a) in Figure 5 illustrates the relationship between the shadow price of having children, χ , and social norm, s . This lemma implies that when social norms are sufficiently male-dominant (i.e., s is higher than s^*), the shadow price increases with s . Additionally, although this is not the subject of our analysis, it should be noted that χ increases as s decreases when s is less than s^* . This U-shaped relationship follows the fact that housework and childcare are complementary for both women and men.⁴ Complementarity, combined with their price ratio (i.e., the woman's wage relative to that of the man), uniquely determines the efficient ratio of housework, $h_{f,t}/h_{m,t}$, which equals s^* . In other words, without the male-dominant social norm, the household chooses $h_{f,t}$ and $h_{m,t}$ such that $h_{f,t}/h_{m,t} = s^*$. However, households cannot adopt the efficient ratio because of the male-dominant social norm unless $s = s^*$.

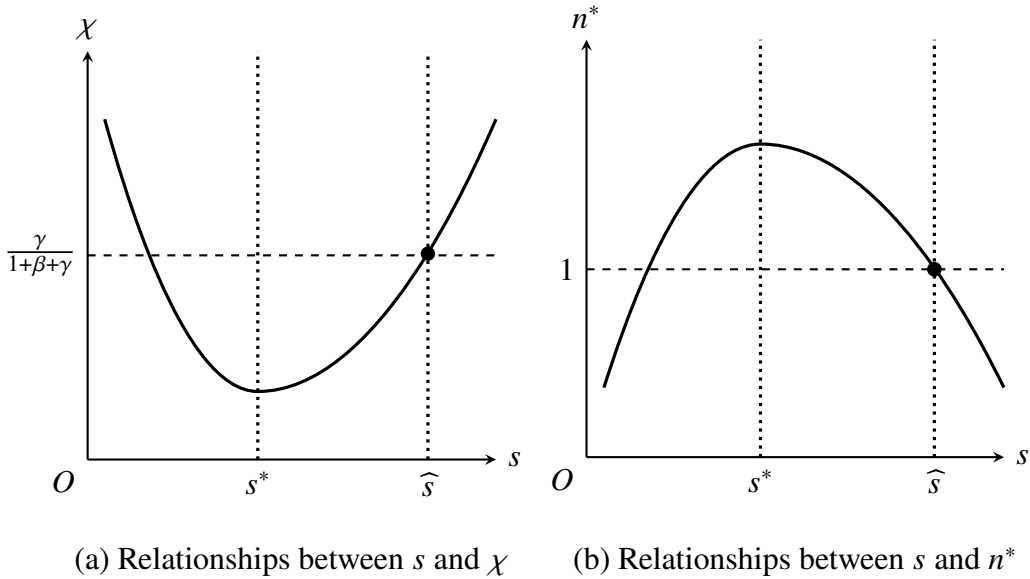


Fig. 5 Relationships between male-dominant social norms and the shadow price and fertility

Hence, we focus on the case in which $s \in [s^*, \infty)$ because we investigate the repercussions of the male-dominant social norm. Therefore, we interpret a society in which

⁴Many studies on intrahousehold resource allocation and time use suggest that wives' and husbands' housework and childcare are complementary (Cherchye *et al.*, 2012; Hazan and Zoabi, 2015; Greenwood *et al.*, 2016; Goussé *et al.*, 2017; Gayle and Shephard, 2019; Lise and Yamada, 2019).

s is sufficiently close to s^* as a gender-equal society, whereas a society in which s is sufficiently high (compared with s^*) faces male-dominant social norms.

Substituting the input demand functions (8) and (10) into the budget constraint in adulthood (5), we rewrite the household problem as follows:

$$\begin{aligned} \max_{c_{1,t}, c_{2,t}, n_t} \quad & \ln c_{1,t} + \beta \ln c_{2,t+1} + \gamma \ln n_t, \\ \text{s.t.} \quad & c_{1,t} + \frac{c_{2,t+1}}{1+r_{t+1}} + \chi w_t n_t = w_t. \end{aligned}$$

Using the first-order conditions, we obtain the intertemporal and intratemporal conditions as follows:

$$\begin{aligned} c_{2,t+1} &= \beta(1+r_{t+1})c_{1,t}, \\ \frac{\gamma c_{1,t}}{n_t} &= \chi w_t. \end{aligned}$$

The latter condition implies that the marginal rate of substitution between consumption in adulthood and having children equals the price ratio. Arranging these conditions yields the following demand functions:

$$c_{1,t}^* = \frac{w_t}{1+\beta+\gamma}, \quad (13)$$

$$c_{2,t+1}^* = \frac{\beta w_t (1+r_{t+1})}{1+\beta+\gamma}, \quad (14)$$

$$n_t^* = \frac{\gamma}{(1+\beta+\gamma)\chi}. \quad (15)$$

Using the budget constraint in old age (6), we derive the saving function:

$$a_t^* = \frac{\beta w_t}{1+\beta+\gamma}. \quad (16)$$

Equations (13)–(16) indicate that the male-dominant social norm only affects the fertility choice, n_t^* , and has no effect on the consumption plan because each individual's utility

function is additively separable. In addition, Equation (15) indicates that the equilibrium fertility rate depends neither on wages nor on time, and thus wage growth does not affect fertility. Hereafter, we denote the fertility rate as n^* .

Proposition 1. n^* decreases in s if and only if $s > s^*$. In addition, when ξ is sufficiently high, there exists $\widehat{s} \in [s^*, \infty)$ such that $n^* \geq 1$ if and only if $s \leq \widehat{s}$. Conversely, when ξ is sufficiently low, it always holds that $n^* < 1$.

Proof. Equation (15) implies that n_t^* decreases with χ . Combining this with Lemma 1, we obtain the following result. For the second result, Equation (15) implies that $n^* \geq 1$ if and only if $\chi \leq \frac{\gamma}{1+\beta+\gamma}$. This inequality holds only when the scale parameter ξ is sufficiently high. In this case, $\chi \leq \frac{\gamma}{1+\beta+\gamma}$ if and only if $s \leq \widehat{s}$ because χ increases with s when $s \geq s^*$, and the threshold \widehat{s} is implicitly given by

$$\frac{\widehat{s}^{-\eta_f} (1 + \widehat{s})^{\eta_f + \eta_m}}{\xi (\eta_f + \eta_m)^{\eta_f + \eta_m} (1 - \eta_f - \eta_m)^{1 - \eta_f - \eta_m}} = \frac{\gamma}{1 + \beta + \gamma}.$$

□

Panels (a) and (b) of Figure 5 illustrate the implications of Proposition 1. Panel (a) shows that when the social norm s is lower than \widehat{s} , the shadow price χ is below $\frac{\gamma}{1+\beta+\gamma}$. However, the scale parameter ξ governs the vertical position of the U-shaped curve on the graph and an increase in ξ shifts it downward. Hence, unless ξ is sufficiently high, the curve will not intersect the horizontal line (i.e., $\chi = \frac{\gamma}{1+\beta+\gamma}$). By contrast, Panel (b) illustrates the hump-shaped relationship between the social norm and equilibrium fertility rate. In particular, focusing on our region of interest (i.e., $s \geq s^*$), n^* decreases with s because of the increased shadow price. When s is higher than \widehat{s} , the equilibrium fertility rate is below 1, implying that the population declines over time, and vice versa. Thus, we assume that ξ is sufficiently high to ensure \widehat{s} in Proposition 1.

Substituting (15) into (8)–(10) yields the following demand functions for housework

time and expenditure on children:

$$h_{f,t}^* = \frac{\gamma(\eta_f + \eta_m)s}{(1 + \beta + \gamma)(1 + s)}, \quad (17)$$

$$h_{m,t}^* = \frac{\gamma(\eta_f + \eta_m)}{(1 + \beta + \gamma)(1 + s)}, \quad (18)$$

$$e_t^* = \frac{\gamma(1 - \eta_f - \eta_m)w_t}{1 + \beta + \gamma}. \quad (19)$$

Combined with the time constraint, the labor supply function (for market work) is $\ell_{i,t}^* = 1/2 - h_{i,t}^*$. Equations (17)–(19) have crucial implications for the aggregate labor supply over generations. First, by assumption, the male-dominant social norm increases the ratio of a woman’s home production time to that of a man, whereas their sum $h_{f,t}^* + h_{m,t}^*$ is unaffected. Combined with the time constraint in Equation (3), the male-dominant social norm does not affect the per-couple labor supply, denoted by $\ell_t^* := \ell_{f,t}^* + \ell_{m,t}^*$, which follows from the additive separability in the home production function.⁵ As the aggregate labor supply in this economy is defined as $L_t^* = N_t^* \ell_t^*$, the social norm influences L_t^* through N_t^* but not through ℓ_t^* (Proposition 1).

3.3 Production Sectors

As in [Jones \(1995\)](#) and [Futagami and Konishi \(2019\)](#), the economy is characterized by three production sectors: final goods, intermediate goods, and R&D. The first sector produces final goods that utilize both labor and intermediate goods. The second sector produces intermediate goods solely using labor. Finally, the third sector generates new ideas by integrating labor with existing knowledge, subsequently earning profits by selling these new ideas to entrepreneurs.

⁵Using a home production function of the CES form, [Sakamoto and Kohara \(2024\)](#) showed that the male-dominant social norm increases the woman’s and man’s total labor supply.

3.3.1 Final Goods Sector

In this economy, a single type of final good exists and this is traded in a perfectly competitive market comprising numerous homogeneous firms. These firms purchase intermediate goods, denoted by $x_{j,t}$, from the intermediate goods sector and combine them with labor inputs. The production function of a representative firm is expressed as

$$Y_t = L_{Y,t}^{1-\alpha} \int_0^{A_t} x_{j,t}^\alpha dj, \quad 0 < \alpha < 1, \quad (20)$$

where A_t denotes the variety of intermediate goods available in period t . The total cost of production is given by $\int_0^{A_t} q_{j,t} x_{j,t} dj + w_t L_{Y,t}$, where $q_{j,t}$ and $L_{Y,t}$ denote the price of each intermediate good and labor employed by the final goods sector, respectively. The first-order conditions yield the following demand functions for intermediate goods and labor:

$$q_{j,t} = \alpha L_{Y,t}^{1-\alpha} x_{j,t}^{\alpha-1}, \quad (21)$$

$$w_t = (1 - \alpha) \frac{Y_t}{L_{Y,t}}, \quad (22)$$

implying that the quantities of each intermediate good and labor demand must equal their respective prices.

3.3.2 Intermediate Goods Sector

There are A_t types of intermediate goods, each monopolistically produced and sold to the final goods sector by one of the A_t intermediate goods firms. Each firm produces one unit of intermediate goods using one unit of labor. Hence, the profit of each firm, $\pi_{j,t}$, is given by $(q_{j,t} - w_t)x_{j,t}$. Combining the first-order condition with Equation (21) yields

$$q_{j,t} = \frac{w_t}{\alpha}, \quad x_{j,t} = \left(\frac{\alpha^2}{w_t} \right)^{\frac{1}{1-\alpha}} L_{Y,t}. \quad (23)$$

Given the symmetry among intermediate goods firms, all firms produce identical quantities of intermediate goods traded at a uniform equilibrium price. Therefore, we denote these quantities and prices by $x_t \equiv x_{j,t}$ and $q_t \equiv q_{j,t}$, respectively.

Because each intermediate goods firm possesses market power, it can generate a flow profit, denoted by π_τ , for every $\tau \in [t + 1, \infty)$ following its inception in period t . Consequently, the market value of each firm, denoted by v_t , is defined as the sum of the discounted present value of the flow profits accrued from period $t + 1$ to perpetuity.

3.3.3 R&D Sector

In the R&D sector, each firm produces new blueprints, denoted by $A_{t+1} - A_t$, by integrating labor (i.e., researchers), $L_{A,t}$, and existing knowledge in period t . These blueprints are then traded in a perfectly competitive market. The R&D process is expressed as

$$A_{t+1} - A_t = A_t^\phi L_{A,t}, \quad 0 < \phi < 1. \quad (24)$$

When researchers produce a new blueprint, they can leverage existing knowledge, A_t^ϕ (i.e., *knowledge spillover*). Equation (24) indicates that the cost of producing one unit of a new blueprint is w_t/A_t^ϕ , while the revenue equals v_t . In conjunction with the perfect competition in this sector, the free entry condition ensures that the following expression holds in equilibrium:

$$v_t \leq \frac{w_t}{A_t^\phi}, \quad \text{with equality when } L_{A,t} > 0, \quad (25)$$

implying that when the cost of producing a new blueprint exceeds the generated revenue, no R&D activities are undertaken.

3.4 Market-clearing Conditions

The economy is characterized by three markets: capital, final goods, and labor. Aggregate demand for assets is $(A_{t+1} - A_t)v_t + A_t v_t$. Combined with the household's saving decision in

Equation (16), we express the market-clearing condition for the capital market as follows:

$$(A_{t+1} - A_t)v_t + A_tv_t = a_tN_t. \quad (26)$$

The first term on the left-hand side, $(A_{t+1} - A_t)v_t$, represents the value of newly established firms in period t , whereas the second term, A_tv_t , is the value of existing firms at the beginning of period t .

The final goods are produced by firms in the final goods sector and consumed by households in adulthood and old age. Hence, the market-clearing condition for the final goods market is $Y_t = c_{1,t}N_t + c_{2,t}N_{t-1} + e_tN_t$.

Aggregate labor demand is the sum of labor demand by firms in the final goods, intermediate goods, and R&D sectors, whereas the aggregate labor supply by households is given by $(1 - h_{f,t} - h_{m,t})N_t$. Using Equations (17) and (18) yields the following labor market-clearing condition:

$$L_{Y,t} + A_tx_t + L_{A,t} = \left[1 - \frac{\gamma(\eta_f + \eta_m)}{1 + \beta + \gamma} \right] N_t. \quad (27)$$

4 Dynamics and Effects of Male-dominant Social Norms

4.1 Demographic Transition and Knowledge Accumulation

To analyze the dynamic system of the model, we derive a phase diagram for the (A_t, N_t) -plane. First, we focus on the case in which the free entry condition in the R&D sector in Equation (25) holds with equality (i.e., R&D activities are undertaken). Substituting Equations (16) and (25) into (26), we obtain

$$A_{t+1} = \frac{\beta}{1 + \beta + \gamma} N_t A_t^\phi. \quad (28)$$

Conversely, when Equation (25) does not hold with equality, the knowledge stock in this economy does not increase over time, and thus $A_{t+1} = A_t$. As the idea does not depreciate,

there is no region such that $A_{t+1} < A_t$ in the phase diagram. Consequently, the $\Delta A_t = 0$ locus is expressed as follows:

$$N_t = \frac{1 + \beta + \gamma}{\beta} A_t^{1-\phi} \quad (29)$$

Knowledge capital increases above the $\Delta A_t = 0$ locus, but remains unchanged below this locus.

Subsequently, we address the dynamics of population growth. Substituting the equilibrium fertility rate from Equation (15) into Equation (2), we express the resulting population dynamics as follows:

$$N_{t+1} = \underbrace{\frac{\gamma}{(1 + \beta + \gamma)\chi}}_{n^*} N_t. \quad (30)$$

This equation implies $N_{t+1} \geq N_t$ if and only if $n^* \geq 1$. In addition, from Proposition 1, it holds that $n^* \geq 1$ if and only if $s \leq \widehat{s}$.

The dynamic system in this economy is characterized by Equations (28) and (30), with the phase diagram on the (A_t, N_t) -plane illustrated in Panels (a) and (b) of Figure 6. Notably, because both population and knowledge capital serve as state variables, the dynamics are examined given their initial points, N_0 and A_0 . Figure 6 indicates that the male-dominant social norm significantly influences demographic transition and knowledge accumulation. Panel (a) shows the phase diagram when the degree of conservativeness of the male-dominant social norm is sufficiently low (i.e., $s < \widehat{s}$). In this case, the equilibrium fertility rate n^* exceeds 1, leading to population growth over time. Additionally, if N_0 is sufficiently large relative to A_0 , the free entry condition in the R&D sector, as specified in Equation (25), holds with equality, resulting in the accumulation of knowledge capital over time. Consequently, the economy experiences a virtuous cycle: an increased labor force (i.e., the number of researchers) boosts R&D activities, enhances the productivity of firms in the final goods sector, and ultimately raises household living standards. Importantly, as the population grows exponentially, the growth rate of knowledge capital remains constant, suggesting the economy can sustain a balanced growth path.

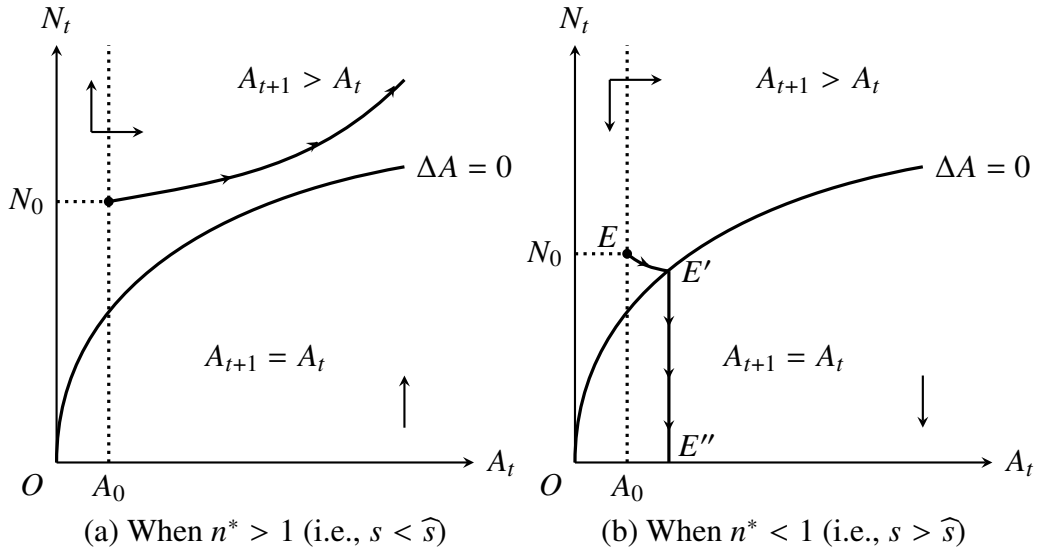


Fig. 6 Phase diagram on the (A_t, N_t) plane

Conversely, Panel (b) shows the phase diagram for $s > \widehat{s}$. In this case, the population decreases over time because n^* is less than 1. By contrast, unless the free entry condition in Equation (25) is satisfied with equality, R&D activities are conducted, leading to the accumulation of knowledge capital over time. Indeed, Equation (28) indicates that the knowledge spillover effect captured by $\phi > 0$ allows for the accumulation of knowledge capital even under a negative population growth rate. However, Panel (b) suggests that such knowledge accumulation is unsustainable; a persistent decline in the population will eventually negate the knowledge spillover effect. Consequently, R&D activities cease, thereby halting the accumulation of knowledge capital. Thus, the economy enters a phase of stagnation in its accumulation of knowledge capital coupled with a continuous population decline, described as the empty planet scenario (Jones, 2022).

4.2 Aggregate Labor Supply and Income Growth

We next analyze the influence of the male-dominant social norm on income growth. To this end, we first derive the equilibrium condition in the production sectors.

As each intermediate goods firm possesses the market power over the final goods firms, substituting Equation (23) into (20) yields the equilibrium quantity of the final goods as

follows:

$$Y_t = \left(\frac{\alpha^2}{w_t} \right)^{\frac{\alpha}{1-\alpha}} A_t L_{Y,t}. \quad (31)$$

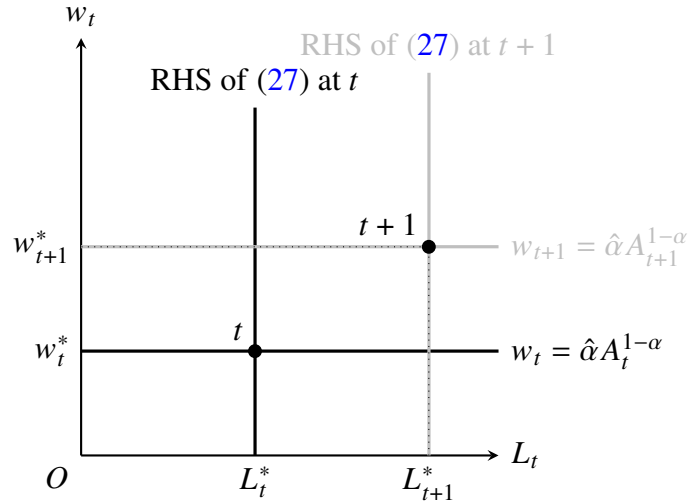
Additionally, substituting Equation (31) into (22), we obtain the equilibrium wage as follows:

$$w_t = \hat{\alpha} A_t^{1-\alpha}, \quad (32)$$

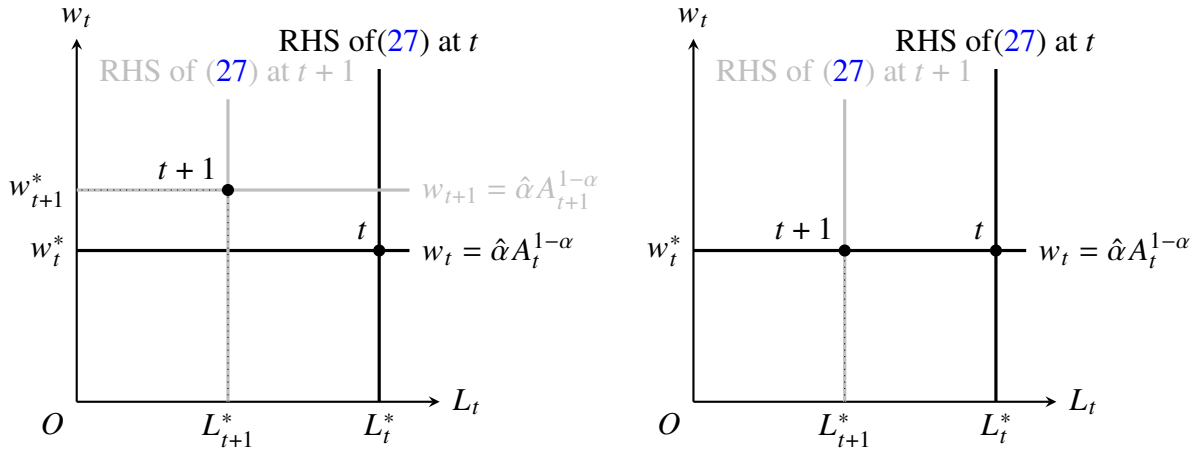
where $\hat{\alpha} \equiv \alpha^{2\alpha} (1-\alpha)^{1-\alpha}$. Notably, Equation (32) is derived using the optimality conditions for both the final and the intermediate goods firms. This equation implies that the wage is uniquely determined by the knowledge stock and they are positively associated. Given that the final goods are numéraire, their price relative to the wage decreases as the variety of intermediate goods increases.

Using the optimality condition in the production sector in Equation (32) and aggregate labor supply function specified on the right-hand side of Equation (27), we investigate the influence of male-dominant social norms on income growth. Figure 7 illustrates the relationship between wages and labor quantity in equilibrium over time. Panel (a) of Figure 7 depicts the case in which the conservativeness of the male-dominant social norm is sufficiently low (i.e., $s \leq \widehat{s}$) and the free entry condition in the R&D sector is satisfied with equality in period t . The horizontal lines correspond to Equation (32) and the vertical lines represent the aggregate labor supply.⁶ Panel (a) indicates that over time, both wages and the quantity of labor increase concurrently. In this economy, R&D activities are undertaken, causing wages to rise over time because of the positive relationship between wages and knowledge capital, as specified in Equation (32). Simultaneously, a less conventional social norm (i.e., $s < \widehat{s}$) facilitates labor force growth. Therefore, the horizontal line shifts upward, whereas the vertical line moves to the right. This finding aligns with the phase diagram in Panel (a) of Figure 6, which highlights that income growth that occurs simultaneously with population growth is sustainable.

⁶The logarithmic utility function in Equation (1) combined with the Cobb–Douglas form of the home production function in (7) implies that the substitution effect is precisely offset by the income effect. Consequently, the (aggregate) labor supply function does not hinge on wages, resulting in the vertical line in Figure 7. The positive elasticity of labor supply does not change the qualitative results.



(a) When $s^* < s < \hat{s}$, $A_{t+1} > A_t$, the wage and labor increase.



(b) When $s > \hat{s}$, $A_{t+1} > A_t$, labor decreases, while the wage increases. (c) When $s > \hat{s}$, $A_{t+1} = A_t$, labor decreases, while the wage is constant

Fig. 7 Wages and labor quantities in equilibrium over time

By contrast, Panel (b) in Figure 7 depicts the relationship between wages and the quantity of labor over time when s is higher than \hat{s} and the free entry condition in Equation (25) holds with equality in period t . Despite R&D activities leading to wage growth over successive periods, there is a concomitant reduction in the labor force. Consequently, the horizontal line shifts upward, whereas the vertical line shifts to the left. This phenomenon corresponds to the transition from points E to E' , as depicted in the phase diagram in Panel (b) of Figure 6.

Finally, Panel (c) of Figure 7 illustrates the relationship between wages and the quantity

of labor when s exceeds \hat{s} and the free entry condition does not hold with equality. In this case, R&D activities are no longer undertaken and thus wages remain constant over time. A population decline shifts the labor supply curve (i.e., the vertical line) to the left, leading to a decrease in the quantity of labor in the subsequent period. This phenomenon is consistent with the transition from points E' to E'' , as depicted in the phase diagram in Panel (b) of Figure 6. We summarize the dynamic analysis in Sections 4.1 and 4.2.

Proposition 2. *There exists $\hat{s} \in [s^*, \infty)$ such that the economy exhibits sustained growth in both population and income per capita if and only if $s \leq \hat{s}$. Conversely, the economy displays stagnation in income per capita growth and eventual population erosion if and only if $s > \hat{s}$.*

4.3 Explaining the Observed Phenomena

We explain the phenomena described in Section 2 by classifying the high-income countries in Figure 1 into three groups: (A) countries with a total fertility rate of approximately 2 and a positive income per capita growth rate, (B) countries with a total fertility rate of approximately 1.5 and a positive income per capita growth rate, and (C) countries with a total fertility rate of approximately 1.5 and an almost negligible income per capita growth rate. Groups A, B, and C include the United States, Italy, and Japan, respectively.

First, our theoretical model suggests that fertility rates are lower in countries with conventional gender norms than in those with less conventional gender norms. Consistent with this model, cross-national comparisons confirm that Group A countries exhibit higher fertility rates and less conventional gender norms, whereas those in Groups B and C display lower fertility rates and conventional gender norms. According to our model, the households in the latter groups encounter a higher shadow price associated with having and raising children, leading to reduced fertility rates and a subsequent population decline (Proposition 1). Moreover, it is also suggested that the fertility rates in the countries in Groups B and C are unlikely to recover without addressing conventional gender norms, thereby approaching a state of population erosion.

Second, our model is useful for understanding the positive correlation between fertility rates and income per capita. In Group A countries in which the fertility rate hovers around 2, population levels are sustained, ensuring a stable labor supply. This stability in the labor supply fosters increased R&D activities, thereby promoting income per capita growth. Conversely, a declining population disrupts this virtuous cycle, making it less effective than in Group A. Therefore, conventional gender norms negatively affect fertility, subsequently impeding economic growth and generating a positive association between fertility rates and income per capita across high-income countries (Proposition 2).

Finally, we interpret the disparities between Groups B and C. As demonstrated in Section 2, the income per capita in Group B countries increases constantly despite a significant population decline. At first glance, this rapid population decline appears to be inconsequential for sustained economic growth. However, our model indicates that these countries are experiencing precarious economic growth owing to their transition from points E to E' in Panel (b) of Figure 6. Although knowledge capital and income are projected to rise over time, income growth is expected to eventually stagnate (Figure 7). Japan, classified into Group C, appears to have already entered this phase of stagnation, experiencing the economic transition from points E' to E'' in Panel (b) in Figure 6. Without intervention, Group B countries are likely to follow the same trajectory.

4.4 Policy Implications

Social norms have long been regarded as persistent (Alesina *et al.*, 2013), resulting in a temporal lag in the transition process relative to changes in the real economy (Fernández *et al.*, 2004; Feyrer *et al.*, 2008). Within this context, Group B countries are unlikely to avoid economic transition into stagnation in income growth, whereas those in Group C must wait for eventual population erosion. Is there a radical solution?

Fortunately, recent experimental studies provide evidence that social norms can be misperceived and that simple information interventions can correct these misperceptions. For instance, Bursztyn *et al.* (2020) demonstrated that the vast majority of young married

men in Saudi Arabia privately support women working outside the home and significantly underestimate the support from similar men. Moreover, correcting these beliefs increases men's willingness to help their wives search for jobs. Additionally, using extensive data from 60 countries, [Bursztyń *et al.* \(2023\)](#) showed that such misperceptions of gender norms are widespread globally. Based on these findings, the countries in Groups B and C could avoid stagnation in economic growth through simple and cost-effective information interventions. It is imperative to address conventional gender norms because Group B countries are steadily approaching a phase of economic stagnation, whereas those in Group C are already experiencing this phase, with their populations shrinking.

These policy implications are relevant for developing countries. As noted by [Cervellati *et al.* \(2023\)](#), technology spillovers have enabled developing countries to experience relatively rapid economic growth compared with their developed counterparts. Consequently, these countries are likely to display pronounced disparities between women's labor market opportunities (i.e., the real economy) and the gender roles ingrained within and outside households (i.e., gender norms). Our model suggests that to circumvent an economic transition characterized by stagnation in income growth and continuous population decline, it is essential to implement timely corrections or adjustments to gender norms that align with the current stage of economic development.

5 Conclusions

This study explains international differences in fertility rates and income per capita by constructing an overlapping generations model with endogenous fertility and labor supply. The proposed model incorporates gender norms and R&D activities to examine their potential negative impacts. We demonstrate that gender norms have undesirable effects on fertility and economic growth. Conventional gender norms distort the allocation of housework and childcare between women and men, resulting in inefficient home production. This inefficiency results in a higher shadow price associated with having and raising

children, which reduces fertility rates. The decline in fertility rates reduces the labor force and undermines R&D activities, thereby negatively affecting the accumulation of knowledge capital and impeding economic growth. Consequently, in economies in which gender norms are deeply ingrained, income growth stagnates and the population may decline over time. Conversely, in economies in which gender norms are more progressive, sustained growth is observed in both income per capita and population. Our study underscores the importance of addressing conventional gender norms to ensure that both developed and developing economies follow sustainable growth paths. Simple and cost-effective information interventions may help achieve this goal (Bursztyn *et al.*, 2020).

In future research, it would be valuable to incorporate the accumulation of human capital, which is expected to be influenced by inefficiencies in home production and impact economic growth. In addition, introducing the interaction between human and physical capital is crucial. These extensions could enhance our understanding of the repercussions of gender norms and provide more detailed policy implications.

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