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Does Female Empowerment Promote Economic Development?

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Abstract

Empirical evidence suggests that money in the hands of mothers (as opposed to fathers) increases expenditures on children. From this, should we infer that targeting transfers to women is good economic policy? In this paper, we develop a non-cooperative model of household decision making to answer this question. We show that when women have lower wages than men, they may spend more on children, even when they have exactly the same preferences as their husbands. However, this does not necessarily mean that giving money to women is a good development policy. We show that depending on the nature of the production function, targeting transfers to women may be beneficial or harmful to growth. In particular, such transfers are more likely to be beneficial when human capital, rather than physical capital or land, is the most important factor of production.

1 Introduction

Across countries and time, there is a strong positive correlation between the relative position of women in society and the level of economic development (Duflo 2012; Doepke, Tertilt, and Voena 2012). Based on this correlation, among policy makers the idea has taken hold that there may be a causal link running from female empowerment to development. If this link were to prove real, empowering women would not just be a worthy goal in its own right, but could also serve as a tool to accelerate economic growth.

Indeed, in recent years female empowerment has become a central element of development policy. In 2006, the World Bank launched its Gender Action Plan, which was explicitly justified with the effects of female empowerment on economic development.[1] Female empowerment also made its way into the United Nations' Millennium Development Goals, again with reference to the claimed effects on development: "putting resources into poor women's hands while promoting gender equality in the household and society results in large development payoffs. Expanding women's opportunities [...] accelerates economic growth."[2]

To the extent that female empowerment means reducing discrimination against women in areas such as access to education and labor markets, the existence of a positive feedback from empowerment to development may be uncontroversial. However, a number of empowerment policies go beyond gender equality, and explicitly favor giving resources to women while excluding men. For example, in 2008 the World Bank committed $100 million in credit lines specifically to female entrepreneurs. Further, the majority of micro credit programs around the world and many cash transfer programs such as *Oportunidades* in Mexico are now available exclusively to women.

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[1] At the launch of the Gender Action Plan, World Bank president Paul Wolfowitz said that "women's economic empowerment is smart economics [...] and a sure path to development" (quoted on World Bank web page, accessed on January 17, 2014). Similarly, in 2008 then-president Robert Zoellick claimed that "studies show that the investment in women yields large social and economic returns" (speech on April 11, 2008, quoted on the World Bank web page, accessed on January 17, 2014).

[2] See `http://www.worldbank.org/mdgs/gender.html`, accessed on January 17, 2014.

These are reverse discrimination policies that are not easily justified on equality grounds. Rather, they are founded on the belief that they yield returns in terms of economic development. In this paper, we provide the first study to examine the basis for this belief from the perspective of economic theory. Specifically, we incorporate a theory of household bargaining in a model of economic growth, and examine whether targeting transfer payments to women really promotes economic development.

At first sight, it may appear that existing empirical evidence is sufficient to conclude that these policies boost economic growth. A number of studies suggest that when transfer payments are given to women rather than to their husbands, expenditures on children increase.[3] To the extent that more spending on children promotes human capital accumulation, this may seem to imply that empowering women will result in faster economic growth. Nonetheless, we argue that the true effect of targeted transfers depends on the specific mechanism that leads women to spend more money on children.

The conventional interpretation of the observed gender expenditure patterns relies on women and men having different preferences.[4] And indeed, if all women highly valued children's human capital whereas all men just wanted to consume, putting women in charge of allocating resources would probably be a good idea. However, we show that the facts can also be explained without assuming that women and men have different preferences. We develop a model in which women and men value private and public goods (such as children's human capital) in the same way, but that nevertheless is consistent with the empirical observation that an increase in female resources leads to more spending on children. Our theory does not lead to clear-cut implications for economic development.

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[3]There is strong evidence against income pooling (e.g., Attanasio and Lechene 2002), and many studies document that higher female income shares are associated with higher child expenditures (Thomas 1993; Lundberg, Pollak, and Wales 1997; Haddad, Hoddinot, and Alderman 1997; Duflo 2003; Qian 2008; Bobonis 2009). We discuss this literature in more detail in an earlier version of this paper, Doepke and Tertilt (2011).

[4]Studies that feature a preference gap between husband and wife include Lundberg and Pollak (1993), Anderson and Baland (2002), Basu (2006), Atkin (2009), Bobonis (2009), Browning, Chiappori, and Lechene (2009), and Attanasio and Lechene (2013), although none of these papers explicitly considers the growth effects of transfers to women. We examine the effects of transfers in a preference-based model in an earlier version of this paper (Doepke and Tertilt 2011).

In particular, we find that empowering women is likely to accelerate growth in advanced economies that rely mostly on human capital, but may actually hurt growth in economies where physical capital accumulation is the main engine of growth.

We begin our analysis by developing a tractable theory of decision making in a household composed of a wife and a husband. The spouses split their time between working in the market and in household production, with the only asymmetry between the spouses being a difference in their market wages. The couple plays a noncooperative equilibrium, i.e., each spouse makes decisions taking the actions of the other spouse as given. A key feature of the environment is that a large number (in fact, a continuum) of public goods is produced within the household. Public goods are goods from which both spouses derive utility; examples include shelter, furniture, and the many aspects of spending on and investing in children. Household public goods are differentiated by the importance of goods and time in producing them. In equilibrium, the low-wage spouse (i.e., typically the wife) specializes in providing relatively time-intensive household public goods.[5]

We then ask how a mandated wealth transfer from husband to wife affects the equilibrium allocation. Even though preferences are symmetric, mandated transfers affect male- and female-provided public goods differently, due to the endogenous specialization pattern in household production. In particular, a transfer to the wife increases the provision of female-provided, i.e. time-intensive, public goods. Assuming that child-related public goods are relatively intensive in time, the model is consistent with the observed effects that transfers targeted to women have on spending on children. In addition, a mandated transfer also increases the wife's private consumption and lowers the husband's private consumption. Hence, the model also rationalizes that transfers lead to more spending on female clothing (Phipps and Burton 1998; Lundberg, Pollak, and Wales 1997), while lowering spending on male clothing, alcohol, and tobacco (Hod-

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[5]Specialization within the household was first discussed in the literature on the sexual division of labor (Becker 1981). However, most of this literature employs unitary models of the household, whereas we embed household production in a noncooperative model.

dinott and Haddad 1995; Duflo and Udry 2004).[6]

Turning to implications for development, we find that our household production mechanism leads to a fundamentally different tradeoff than does the preference-based mechanism when considering the implications of mandated transfers from men to women. In a model where women derive more utility from public goods, the higher public-good spending (i.e., spending on children) induced by a transfer comes at the expense of male private consumption. In contrast, in the household production model the increase in the provision of female-provided public goods comes at least partly at the expense of male-provided public goods.

To spell out what this means for economic growth, we embed our model of household decision making into an endogenous growth model driven by the accumulation of human and physical capital. Parents care about their private consumption and their children's future income, which they can raise by investing in children's human capital (which is time-intensive) and by leaving bequests of physical capital. In equilibrium, bequests are provided by husbands, whereas wives play a large role in human capital accumulation. We show that a mandated transfer from husband to wife leads to an increase in children's human capital, but a decrease in the physical capital stock. Whether such a policy increases economic growth depends on the state of technology. In a setting where human capital is the main driver of growth, mandated transfers to women do promote development, but they slow down economic growth when the share of physical capital in production is large. Given that the human capital share tends to increase in the course of development, our results imply that mandated transfers to women may be beneficial in advanced, human capital-intensive countries, but are unlikely to promote growth in less developed economies.

Of course, the implications of female empowerment for economic development also depend on the relative importance of the household production mechanism developed here versus the preference-based mechanism. It is not our intention to deny the possibility that men and women have different preferences,[7] but it is not

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[6]Assuming, of course, that men spend a greater share of their private consumption on alcohol and tobacco, and that they are more likely to dress in male versus female clothing.

[7]In fact, we allow for a preference gap in our own previous work (Doepke and Tertilt 2009) and provide evolutionary justifications for why such a gap may exist.

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obvious how important such differences are for explaining the data. Experimental evidence shows that women are more risk-averse than men, but in regard to social preferences (which would be more relevant here) results are inconclusive (Croson and Gneezy 2009).[8] In addition, there is a fair amount of empirical evidence supporting the implication of the household production mechanism that mandated transfers induce a reallocation from male- to female-provided public goods, rather than an increase in public goods overall. For example, a number of studies suggest that mandated transfers to women raise household expenditure overall, implying that savings (which is what remains of income after expenditure) would benefit more from targeting transfers to men.[9] In addition, recent randomized field experiments have found that transfers to men running small businesses lead to a substantial increase in business profits a few years later, whereas no such effect is found for women (De Mel, McKenzie, and Woodruff 2009; Fafchamps et al. 2011). Once again, this finding is consistent with the view that men are more likely to use additional funds for investment. Another distinct implication of the household production mechanism is that the size of the effects of mandated transfers depend on the size of the wage gap. In particular, we show that mandated transfers have a big effect only when the gender wage gap is large. While existing empirical evidence does not speak to this prediction, it could be easily tested in future research.

Our analysis builds on the literature on the noncooperative model of the household, which in turn is closely related to the literature in public economics on the voluntary provision of public goods.[10] Relative to these literatures, a key novelty of our paper is that we consider a setting with a continuum of public goods that are distinguished by the time-intensity of production; without these features, our theory would not be able to address the facts we are trying to explain. An-

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[8]There is also evidence that women and men have different preferences as policymakers (Chattopadhyay and Duflo 2004; Miller 2008), but it is not obvious whether such differences are due to "deep" preferences or to the different roles that women and men play in society.

[9]In particular, studies of micro finance institutions have found that that the provision of credit to women led to a large increase in household expenditures (Pitt and Khandker 1998; Khandker 2005) which is consistent with the view that women spend the additional money while men save more of it.

[10]See Lundberg and Pollak (1994) and Konrad and Lommerud (1995) for the noncooperative model of the household, and Bergstrom, Blume, and Varian (1986) for a related discussion of the voluntary provision of public goods.

other branch of the literature on family decision making relies on cooperative models, in which couples achieve efficient outcomes.[11] We rely on a noncooperative model here, because in a cooperative model preference differences between women and men are the only possible explanation for the observed effects of mandated transfers.[12] We are not suggesting that it is truly impossible for couples to cooperate; after all, couples are in a long-term relationship and often care about each other. Rather, our objective is to describe, in a stark setting, a new mechanism that is present when decision making is not completely frictionless. The empirical literature on the collective model finds some support for efficiency, but at the same time, other empirical papers provide direct evidence of significant inefficiencies in family decision making in the developing-country context (Udry 1996; Duflo and Udry 2004; Goldstein and Udry 2008). The household production mechanism is relevant if at least a fraction of households fails to achieve efficiency, which Del Boca and Flinn (2012) argue to be the case even in a rich-country setting.[13] Our work also relates to a recent political-economy literature on the causal link from development to women's rights (Doepke and Tertilt 2009; Fernández 2013). In contrast to these papers, here we explore the reverse link from female empowerment to economic development.[14]

In the following section, we introduce our baseline model and demonstrate that mandated transfers to women affect the supply of public goods. In Section 3, we show that depending on the relative importance of female- versus male-provided public goods, mandated transfers can either raise or lower the total supply of

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[11]See in particular the collective model introduced by Chiappori (1988, 1992).

[12]The reason is that an efficient bargaining problem is equivalent to a Pareto problem with joint budget constraints. In such a problem, in the budget constraint all resources are pooled, so that mandated transfers cannot affect the outcome through the constraint set. Rather, the only possibility is that mandated transfers affect bargaining power, and that bargaining power affects outcomes because spouses have different preferences.

[13]Del Boca and Flinn (2012) estimate a model that allows for cooperative and non-cooperative decision making in the household. Based on PSID data, they find that about one-fourth of American couples behave in a non-cooperative way (see also Mazzocco 2007 for a related test of ex-ante efficiency in an environment with limited commitment). Similarly, Ashraf (2009) finds that spousal observability has large effects on financial choices, which also suggests efficiencies. Inefficiencies can also arise from pre-marital investments, see Iyigun and Walsh (2007).

[14]The role of gender equality for economic growth is also analyzed in Lagerlöf (2003) and de la Croix and Vander Donckt (2010), but these papers do not analyze the effects of transfers, and instead focus on the link between gender equality and demographic change.

public goods in the household. In Section 4, we embed our model of household decision making in a model of endogenous growth, and demonstrate that the growth effect of mandated transfers hinges on the importance of physical versus human capital in production. Section 5 concludes. All proofs are contained in the mathematical appendix.

2 Public-Good Provision in a Noncooperative Model of the Household

2.1 The Household Decision Problem

We consider a model of noncooperative marital decision making in an environment with a continuum of household public goods. Preferences are symmetric between women and men. In particular, the husband and wife have utility functions:

$$\log(c_g) + \int_0^1 \log(C_i) \ di. \tag{1}$$

Here c_g is the private-good consumption of the spouse of gender $g \in \{f, m\}$ (female and male), and the $\{C_i\}$ are a continuum of public goods for the household, indexed from 0 to 1. The public goods represent all final or intermediate goods that the spouses jointly care about, such as shelter or goods related to children. In Section 4 below, we provide a concrete example where all public goods are intermediate goods that affect child quality, but the general analysis is equally applicable to other kinds of public goods. We use log utility to simplify the analysis; however, the main results carry over to more general settings.[15]

A key characteristic of the environment is that the public goods C_i are produced within the household using household production functions that combine purchased inputs and time. The spouses split their time between household production and participating in the formal labor market. The only asymmetry between the spouses is a difference in their market wages w_g.

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[15]Generalizations in terms of preferences and technologies are discussed in Appendix B.

Different public goods are distinguished by the relative importance of goods and time in producing them. Specifically, each public good is produced using a Cobb-Douglas technology where the share of goods and time varies across goods. Public good i has share parameter $\alpha(i) \in [0,1]$ for the time input and $1 - \alpha(i)$ for goods. We assume (without loss of generality) that the function $\alpha(i)$ is such that the public goods are ordered from the least to the most time-intensive, i.e., $\alpha(i)$ is non-decreasing, with $\alpha(0) = 0$ and $\alpha(1) = 1$. Each public good can be produced by either spouse; however, each spouse has to combine labor with his or her own goods contribution. Thus, it is not possible to provide only the goods input for a particular C_i and leave it to the spouse to provide the labor. This assumption captures that time and goods inputs often cannot be separated. For example, the public good "getting children fed" requires shopping for groceries first, which takes time and knowledge of what the children like to eat. The spouse who typically does not do the feeding may lack such knowledge.[16]

Each spouse maximizes utility, taking the other spouse's behavior (in particular, contributions to public goods, $C_{g,i}$) as given. In other words, the solution concept is a Nash equilibrium, which is the sense in which decision making is noncooperative. The maximization problem of the spouse of gender $g \in \{f, m\}$ is to maximize (1) subject to the following constraints:

$$C_i = C_{f,i} + C_{m,i} \quad \forall i, \tag{2}$$

$$C_{g,i} = E_{g,i}^{1-\alpha(i)} T_{g,i}^{\alpha(i)} \quad \forall i, \tag{3}$$

$$c_g + \int_0^1 E_{g,i} \, di = w_g(1 - T_g) + x_g, \tag{4}$$

$$\int_0^1 T_{g,i} \, di = T_g. \tag{5}$$

Here $E_{g,i}$ is goods spending on good i by spouse g, $T_{g,i}$ is the time input for good i, T_g is the total amount of time spouse g devotes to public goods production, w_g is the market wage, and x_g is wealth (e.g., an initial endowment or lump-sum

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[16]The requirement for provision of goods and time by the same spouse can also be micro-founded through a monitoring friction, i.e., spouses can provide cash to each other, but they cannot monitor how the cash is being spent. This still leaves open the possibility of general transfers between spouses that are not targeted towards specific public goods. Such general transfers are considered in Section 2.3 below.

transfer). Equation (2) states that the total provision C_i of public good i is the sum of the wife's and the husband's contributions. Equation (3) gives the household production function for good i, where the share parameters depend on i. Equation (4) is the budget constraint of spouse g. Each spouse has a time endowment of 1, so that $1 - T_g$ is the time supplied to the labor market. Equation (5) is the time constraint, which states that all time contributions to public goods add up to T_g.[17]

Definition 2.1 (Noncooperative Equilibrium). *An equilibrium for given wages w_g and wealth levels x_g consists of a consumption allocation $\{c_g, C_i\}$ for $g \in \{f, m\}$ and $i \in [0,1]$ and household production inputs and outputs $\{E_{g,i}, T_{g,i}, T_g, C_{g,i}\}$ for $g \in \{f, m\}$ and $i \in [0,1]$ such that for $g \in \{f, m\}$, the choices c_g, $E_{g,i}$, $T_{g,i}$, T_g, $C_{g,i}$, and C_i maximize (1) subject to (2) to (5), taken the spouse's public good supplies as given.*

We now show that the household bargaining game has a generically unique equilibrium. The reason is that as long as male and female wages are different, each spouse has a comparative advantage in providing either time- or goods-intensive public goods. Hence, the low-wage spouse provides a range of time-intensive goods, whereas the high-wage spouse provides goods-intensive goods. The following proposition summarizes the properties of the equilibrium. We focus on the case of the husband having a higher wage. The case where the wife has a higher wage is analogous.

Proposition 2.1 (Separate Spheres in Equilibrium). *Assume $0 < w_f < w_m$. There is a generically unique Nash equilibrium with the following features. There is a cutoff $\bar{i}$ such that all public goods in the interval $i \in [0, \bar{i}]$ are provided by the husband (i.e., the husband provides goods-intensive goods), while public goods in the range $i \in (\bar{i}, 1]$ are provided by the wife (the wife provides time-intensive goods). Private and public consumption satisfies*

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C_i = \begin{cases} (1 - \alpha(i))^{1-\alpha(i)} \left(\frac{\alpha(i)}{w_m}\right)^{\alpha(i)} c_m & \text{for } i \in [0, \bar{i}], \\ (1 - \alpha(i))^{1-\alpha(i)} \left(\frac{\alpha(i)}{w_f}\right)^{\alpha(i)} c_f & \text{for } i \in (\bar{i}, 1]. \end{cases} \tag{6}
$$

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[17]For simplicity, throughout the paper we do not impose a constraint requiring that time spent on market work has to be non-negative. This constraint is never binding if there is only wage income, and imposing the constraint leaves all results intact, while complicating the notation.

If the cutoff $\bar{i}$ is interior, it is determined such that female and male provision of public goods is equalized at the cutoff. Hence, if $\bar{i} \in (0,1)$, the cutoff and private consumption satisfy the condition:

$$\left(\frac{w_m}{w_f}\right)^{\alpha(\bar{i})} = \frac{c_m}{c_f}. \tag{7}$$

The result that household production is divided into husband and wife tasks is in line with an empirical literature that finds that many couples separate spheres of responsibility. For example, Pahl (1983) reports a sharp division of tasks in a study of British couples. Husbands are often in charge of moving, finances, and the car, while women make decisions regarding interior decoration, food, and children's clothing. The phenomenon that husbands and wives are in charge of different purchasing decisions is studied also in the marketing literature.[18] The idea of separate spheres was first introduced into economics by Lundberg and Pollak (1993). However, Lundberg and Pollak assume an exogenous separation of spheres, whereas our model features an endogenous separation. This distinction is important, since the division of spheres may change in response to government policy, as we will see in the next section.

2.2 Effect of Mandated Transfers on Public-Good Provision

With the equilibrium characterization at hand, we can now ask how changes in relative female and male wealth affect outcomes. Consider a mandated wealth transfer from the husband to the wife, i.e., an increase $\epsilon > 0$ in the wife's wealth x_f and a corresponding decline in the husband's wealth x_m. Given (6), we see that any two public goods that are provided by the same spouse both before and after a change in transfers will still be provided in the same proportion, because public-good provision is proportional to private consumption. However, the wife's private consumption rises relative to the husband's private consumption after the transfer, which also implies that the transfer increases the provision of female-provided public goods relative to male-provided public goods.

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[18]For example, Wolgast (1958) finds that women are more likely to be in charge of general household goods, while husbands are often in charge of car purchase decisions. Green and Cunningham (1975) finds that groceries fall in the female sphere, whereas life insurance and car purchase decisions are typically in the male sphere. See also Davis (1976) for a survey.

Proposition 2.2 (Effect of Mandated Transfers on Public Good Provision). *Assume $0 < w_f < w_m$. Consider the effects of a transfer $\epsilon > 0$ from the husband to the wife, i.e., the wife's wealth increases from x_f to $\tilde{x}_f = x_f + \epsilon$, and the husband's wealth decreases from x_m to $\tilde{x}_m = x_m - \epsilon$. Let $\tilde{i}$ be the new cutoff between male and female provision, and let $\tilde{c}_f$, $\tilde{c}_m$, and $\tilde{C}_i$ denote the new equilibrium allocation. If the cutoff is interior both before and after the transfer, then the cutoff decreases, $\tilde{i} < \bar{i}$. The ratio of female private consumption to male private consumption $\tilde{c}_f / \tilde{c}_m$ increases after the transfer. The ratio of always female-provided public goods ($i \geq \bar{i}$) to always male-provided public goods ($i \leq \tilde{i}$) increases by the same percentage. Hence, a transfer to the low-wage spouse increases the relative provision of public goods provided by this spouse.*

At first sight, the finding that a transfer to a spouse increases the public-good provision of this spouse may seem unsurprising. However, it stands in contrast to a well-known result in public economics on the private provision of public goods. The result states that when the equilibrium is interior in the sense that all providers make voluntary contributions (in this case, husband and wife), a redistribution of income between the providers leaves the equilibrium allocation unchanged, so that a (local) version of income pooling prevails.[19]

In our model, the income pooling result breaks down because of the continuum of public goods. It is well-known that income redistribution does matter in voluntary contribution games with a finite number of goods if the equilibrium is at a corner.[20] Because of our continuum of goods, even though the allocation is interior in the sense that both spouses contribute to public goods, each good is provided by only one spouse, so that there is a corner solution for any given public good. In this setting, the key determinant of the new level of public-good provision after a transfer is the move in the cutoff between male and female provision of public goods. The force that increases female provision is that the wife receives the transfer; the force that lowers female provision is that in the new equilibrium, the wife provides a wider range of public goods. In the classic public-economics result, the increased contributions of one spouse are fully offset by a reduction in contributions of the other spouse. In contrast, in our model the move in the

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[19]See Warr (1983) and Bergstrom, Blume, and Varian (1986).

[20]Browning, Chiappori, and Lechene (2009) make this point in the context of a household bargaining model with a discrete number of public goods.

cutoff does not fully offset the direct effect of the transfer. When wealth is transferred to the wife, the provision cutoff moves towards public goods that are more goods-intensive, and hence public goods where the wife has a smaller comparative advantage. This unfavorable shift in comparative advantage slows down the adjustment of the provision cutoff.

The model implications are consistent with the empirical evidence on the effects of targeted transfers described in the introduction. Notice that there are no empirical studies that have information on all public and private goods produced and consumed within a household. Rather, the nature of the good is usually known only for a few specific spending categories. Studies that point to an increase in public-good spending after a mandated transfer to the wife often focus on food and children's clothing. To the extent that these goods are usually female-provided, our theory also predicts that spending on these goods should rise after a transfer to the wife. Regarding private goods, empirical studies often consider male and female clothing and luxuries such as alcohol. Our theory predicts that after a mandated transfer, female private consumption should rise and male consumption should fall. Thus, the theory is consistent with the observation that after a transfer, female clothing purchases increase relative to male purchases, while spending on alcohol declines, as long as (realistically) men have a higher propensity to spend on alcohol than women do.[21]

We now illustrate these results with a computed example. The household production functions are parameterized by $\alpha(i) = i$, i.e., time intensity varies linearly with the index of the public good. This setting is of special interest, because it implies that the overall household production technology is symmetric in terms of time versus goods intensity. We also set the female wage to half the male wage, $w_f = 0.5$ and $w_m = 1$, and initial wealth is zero, $x_f = x_m = 0$.

Figure 1 shows the preferred provision of each public good by the wife and husband, holding the marginal utility of wealth constant at its equilibrium level. The preferred provision curves of both spouses are U-shaped. This shape is due to the

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[21]Our model only allows for a single homogeneous private consumption good, but it is straightforward to reinterpret the findings in a setting where male and female private consumption correspond to different bundles of goods.
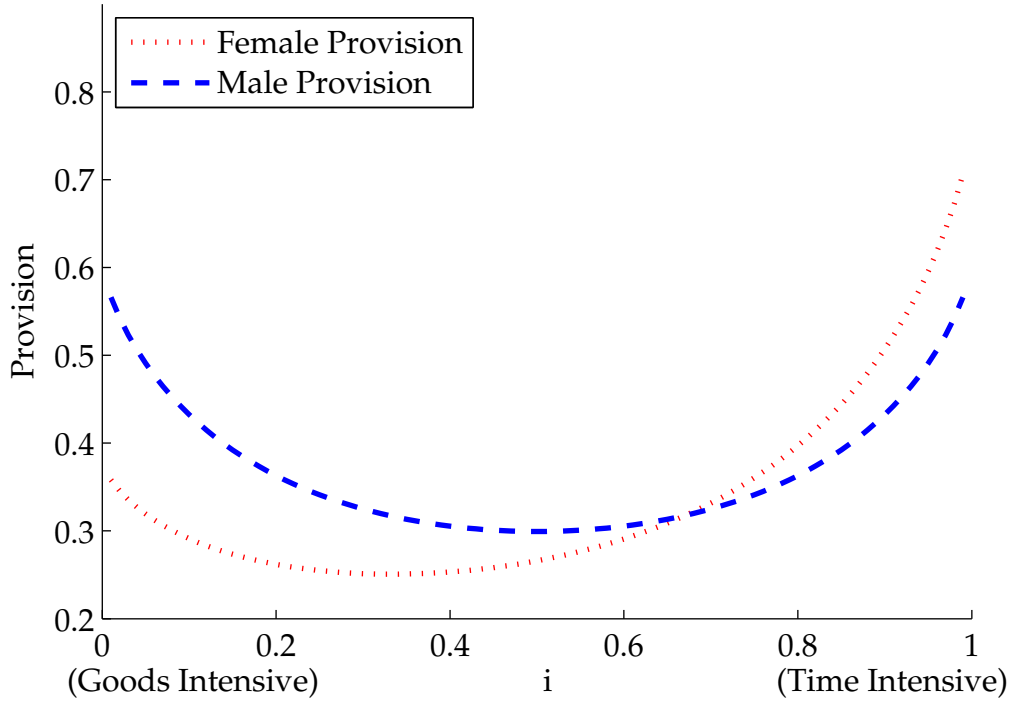
Figure 1: Preferred Provision of Each Public Good for $w^f/w^m = 0.5$. Dotted line: Preferred Provision by Wife. Dashed Line: Preferred Provision by Husband.

Cobb-Douglas production technology, which induces a U-shape in unit production costs of the public goods. More importantly, the wife's preferred provision curve has a uniformly larger slope than the husband's, i.e., the wife's preferred provision increases relative to the husband's as the index i increases. This follows because time intensity is increasing in i, and the wife has a comparative advantage at providing time-intensive public goods because of her lower market wage w_f.

In equilibrium, each public good is provided by the spouse with the higher preferred provision level. Hence, as displayed in Figure 2, the equilibrium provision curve is the upper envelope of the female- and male-preferred provision curves. The vertical line in Figure 2 denotes the cutoff $\bar{i}$: to the left of this point, goods are provided by the husband, and to the right they are provided by the wife.

Next, consider how the equilibrium provision of public goods changes if a man-
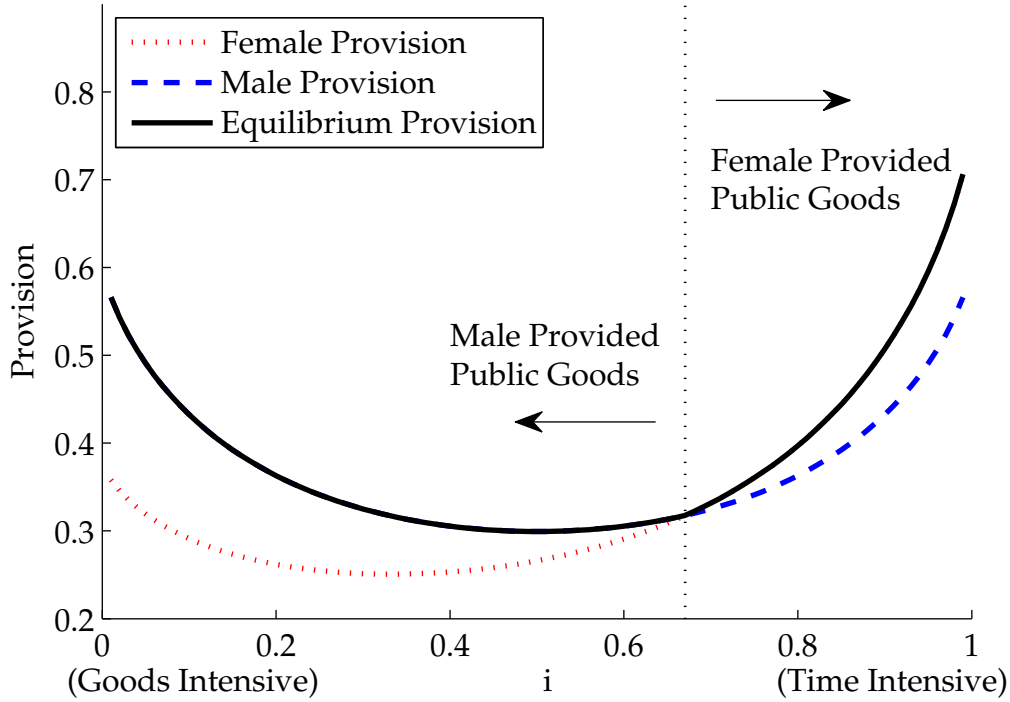
Figure 2: Provision of Each Public Good for $w^f/w^m = 0.5$. Dotted line: Preferred Provision by Wife. Dashed Line: Preferred Provision by Husband. Solid Line: Actual Provision.

dated wealth transfer from the husband to the wife is imposed. Figure 3 compares the baseline displayed in Figure 2 to the equilibrium outcome when the husband has to make a transfer of $\epsilon = 0.3$ to the wife (given that initial wealth was set to zero, this implies that the new wealth levels are $x_f = 0.3$ and $x_m = -0.3$). After the transfer, the equilibrium cutoff between male and female provision of public goods moves to the left, i.e., the wife (who now has higher wealth) provides a wider range of public goods. However, in line with Proposition 2.2, the move in the cutoff does not fully offset the impact of the wealth transfer: equilibrium provision of all public goods that were female-provided before the transfer goes up, and equilibrium provision of public goods that are always male-provided goes down. In between the old and the new cutoff, the equilibrium provider switches from husband to wife, implying that the new equilibrium provision curve is steeper after the transfer compared to the initial equilibrium.
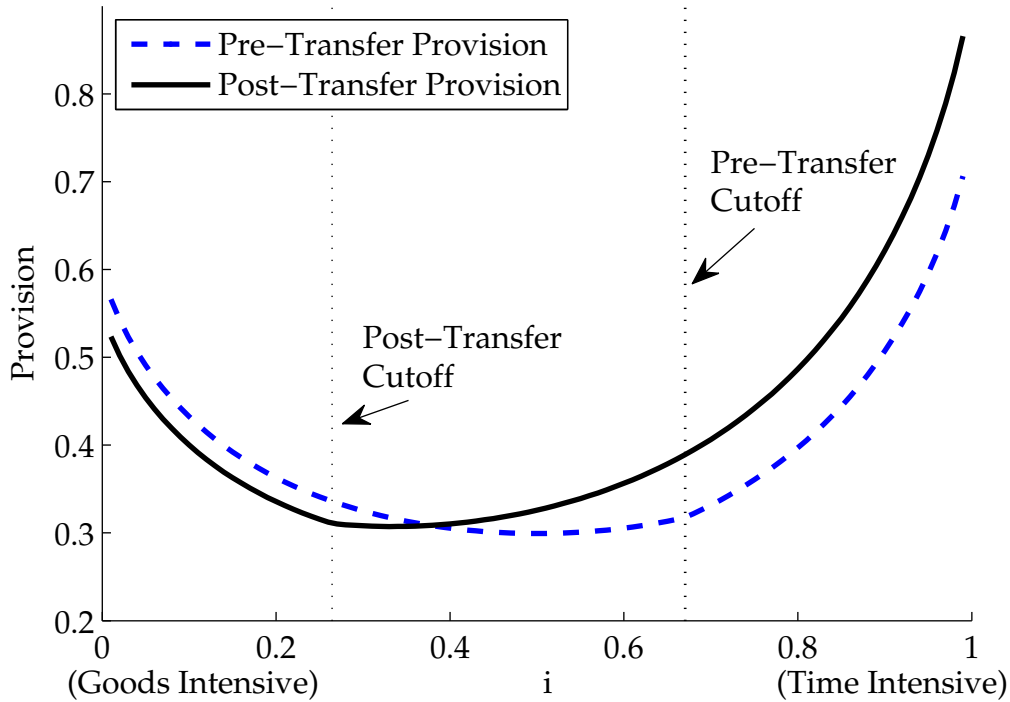
Figure 3: Provision of Each Public Good for $w^f = 0.5$, $w^m = 1$ Before and After Transfer of $\epsilon = 0.3$ from Husband to Wife. Dashed Line: Pre-Transfer Equilibrium Provision. Solid Line: Post-Transfer Equilibrium Provision.

Notice that the wife's comparative advantage in providing time-intensive goods (which follows from the lower female market wage) is the only force in our model that slows down the shift in the cutoff between male and female provision after a transfer. Any additional forces that also slow down the shift in the cutoff would further strengthen our results. For example, consider a setting with learning by doing, i.e., the spouses become more efficient over time at producing the public goods that they provide. In such a setting each spouse would gain an absolute advantage at providing a certain range of public goods, which would make the cutoff shift even more slowly and result in even larger effects of mandated transfers on public good provision.

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2.3 Voluntary Transfers between the Spouses

In our baseline model, the only way in which the spouses interact is through their provision of public goods. We now explore how results change if we allow for voluntary transfers between the spouses. Even though the spouses act noncooperatively, it may still be in the interest of the richer spouse to make a voluntary transfer, because this may induce the other spouse to provide more public goods. To model this possibility, we extend our model by adding an initial stage in which the spouses can make voluntary transfers, followed by the noncooperative provision game as described above.

To simplify the analysis, we focus on a voluntary transfer from the high-wage spouse (the husband) to the low-wage spouse (the wife). A transfer in this direction is more likely to be attractive, because it allows the low-wage spouse to spend more time on home production, which increases overall efficiency and public good provision. The transfer takes the form of a lump sum payment (an "allowance"), which the receiving spouse is then able to use in her preferred way in the second stage. Notice that this rules out transfers that are made for the provision of a specific public good. The reason for this assumption is that we envision that time and goods components of a given public good are required at the same time, and the other spouse is not able to monitor ex post how funds are used. This is a realistic assumption, because it would not be possible to enforce a specific use of funds without actively spending time on monitoring the activity, at which point it would be more attractive to provide the public good in question oneself. We start by formally defining an equilibrium with voluntary transfers.

Definition 2.2 (Equilibrium with Voluntary Transfer). *Let $V_m(w_f, w_m, x_f, x_m)$ denote the equilibrium utility of the husband corresponding to the equilibrium in Definition 2.1, given wages w_f, w_m and wealth levels x_f, x_m (this utility is unique because of Proposition 2.1). An equilibrium of the model where voluntary transfers are allowed consists of an initial transfer X and an equilibrium as defined in Definition 2.1 for wages w_f, w_m and wealth levels $x_f + X, x_m - X$ such that the transfer satisfies:*

$$X = \operatorname*{argmax}_{0 \leq X \leq w_m + x_m} \{V_m(w_f, w_m, x_f + X, x_m - X)\}.$$

16

That is, the husband picks a non-negative transfer to maximize his own ex-post utility.

The possibility of voluntary transfers is important, because if such transfers are present, mandated transfers imposed from the outside may no longer be effective. Intuitively, if the husband finds it optimal to transfer money to his wife, he can reduce his voluntary transfer by the amount of the mandated transfer, resulting in the same ultimate equilibrium. The following proposition makes this point precise.

Proposition 2.3 (Offsetting Voluntary and Mandated Transfers)**.** *Consider an equilibrium with transfers as defined in Definition 2.2 where the optimal transfer satisfies $X > 0$. If before the voluntary transfer takes place a mandated transfer of $\epsilon \leq X$ to the wife is imposed on the husband, the husband will reduce the voluntary transfer to $X - \epsilon$, and the resulting equilibrium allocation will be unchanged.*

Hence, for our theory of the effects of mandated transfers to be viable, we need to check that it is not always in the husband's interest to make a voluntary transfer. The attraction of a voluntary transfer is that it allows the wife to spend more time on home production, from which the husband benefits. This motive for making transfers is especially pronounced if the wage gap between husband and wife is large. However, there is also a downside to making a transfer, which is that at least part of the transfer will be diverted for the wife's private consumption. We now establish that even if the wage gap between the spouses is arbitrarily large, the husband does not always want to make a transfer.

Proposition 2.4 (Optimality of Voluntary Transfers)**.** *Consider the marginal impact of a voluntary transfer on the husband's utility. As the relative wealth of the spouses approaches the level at which $\bar{i} = 0$ (all public goods are provided by the wife), this marginal impact is negative:*

$$\lim_{x_f \to 2(w_m + x_m) - w_f} \left\{ \left. \frac{\partial V_m(w_f, w_m, x_f + X, x_m - X)}{\partial X} \right|_{X=0} \right\} < 0.$$

Hence, the husband does not provide voluntary transfers if relative wealth is close to this level.

In practice, for realistic wage gaps the husband does not want to provide a voluntary transfer for most of the range of initial income distributions. Specifically, voluntary transfers do not arise for all numerical examples that we present. In reality, of course, there are families where voluntary transfers do take place. Notice, however, that for the household production mechanism to matter empirically it is not necessary that voluntary transfers are absent in all families. Rather, it is sufficient that there are at least some families where such transfers do not take place, and where transfers mandated from the outside are therefore effective. Our theory should be thought of as modeling the less-cooperative couples who do not make voluntary transfers and who therefore account for the empirically observed effects of mandated transfers.

2.4   Equilibrium versus Efficient Public Good Provision

Given that the spouses in our model act noncooperatively, equilibrium allocations generally fail to be efficient. To highlight the sources of inefficiency in the model, we now contrast the equilibrium outcome to efficient (i.e., Pareto optimal) allocations. Efficient allocations are defined as follows:

Definition 2.3 (Efficient Allocation). *An efficient allocation is a solution to a social planning problem with a Pareto weight for the wife of μ, where $0 \leq \mu \leq 1$. The social planning problem is to maximize:*

$$\mu \log(c_f) + (1 - \mu) \log(c_m) + \int_0^1 \log(C_i) \, di$$

subject to the following constraints:

$$C_i = C_{f,i} + C_{m,i},$$
$$C_{g,i} = E_{g,i}^{1-\alpha(i)} T_{g,i}^{\alpha(i)},$$
$$\sum_{g \in \{f,m\}} \left(c_g + \int_0^1 E_{g,i} \, di \right) = \sum_{g \in \{f,m\}} w_g \left(1 - \int_0^1 T_{g,i} \, di \right) + x_f + x_m.$$

That is, the efficient allocation is constrained by the same technological constraints as is

the equilibrium, but there is a joint budget constraint for the household, as opposed to separate budget constraints for the two spouses.

The presence of a joint budget constraint immediately implies that mandated transfers between the spouses do not affect efficient allocations, because only the couple's total wealth enters the constraint. The following proposition characterizes efficient allocations in more detail.

Proposition 2.5 (Efficient Specialization). *Efficient allocations are characterized by a Pareto weight μ, where $0 \leq \mu \leq 1$, such that:*

$$c_f = \frac{1}{2}\mu\left(w_f + x_f + w_m + x_m\right),$$

$$c_m = \frac{1}{2}(1 - \mu)\left(w_f + x_f + w_m + x_m\right),$$

$$C_i = \frac{1}{2}(1 - \alpha(i))^{1-\alpha(i)}\alpha(i)^{\alpha(i)}w_f^{-\alpha(i)}\left(w_f + x_f + w_m + x_m\right).$$

Hence, the provision of public goods is independent of the Pareto weight μ, which only matters for the allocation of private consumption between wife and husband. All home production is carried out by the wife. For given wages and wealth levels, the provision of public goods C_i that are provided by the wife in equilibrium is always higher in the efficient allocation compared to the equilibrium allocation.

Efficient allocations and equilibrium allocations differ for two reasons. First, efficient allocations feature full specialization, in the sense that only the wife is engaged in home production. This is because the wife has a comparative advantage in home production given her lower wage. In contrast, full specialization is not observed in the equilibrium allocation, unless the wife has at least twice as much total income as the husband has. As we will see below, this feature of efficient allocations provides one reason for why a mandated transfer from husband to wife may move the equilibrium closer to efficiency.

There is a second distinction between efficient and equilibrium allocations, related to the weight attached to public goods in the objective function. In the social planning problem, the planner takes into account the utility that both spouses derive from public goods. In contrast, in the equilibrium allocation the provider of

a given public good takes into account only his or her own utility, and not that of the spouse. This is the well-known problem of the underprovision of voluntarily provided public goods, and explains why in the efficient allocation public good provision is usually higher. This source of inefficiency would be less important if we allowed for some altruism between the spouses, because then each provider would take into account at least some of the benefit of public good provision for the other spouse. Such an extension would be straightforward, as it amounts solely to a higher relative weight for public goods in the utility function, while leaving the analysis otherwise unchanged. For simplicity, we abstract from altruism in our exposition, but it should be kept in mind that none of our results relies on the absence of altruism.

3 Do Mandated Transfers Increase the Total Provision of Public Goods?

3.1 Decomposing the Effect of Mandated Transfers

Our analysis so far provides a new rationale for why, empirically, mandated transfers to women have an impact on the household allocation that is different from the impact of transfers to men. From the perspective of policy implications, there is a central difference between our household production mechanism, where the gender wage gap is key, and a mechanism based on gender preference gaps. In a model where mandated transfers affect allocations because women value public goods more than men do, the increase in public-good spending brought about by a transfer comes exclusively at the expense of men's private consumption. In contrast, in the household production model an increase in public good spending by women comes at least partially at the expense of male-provided public goods. For this reason, whether mandated transfers to women are good policy is not obvious.

To assess the desirability of mandated transfers in our model, we now examine the effect of transfers on the total utility derived from public goods, which is

given by:[22]

$$\int_0^1 \log\left(C_i\right)\ di.$$

While maximizing the utility derived from public goods is not equivalent to maximizing welfare, public good provision is inefficiently low in our model generally, so that an increase in public good provision moves the economy closer to efficiency.

There are three channels through which a mandated transfer affects the total provision of public goods. The *expenditure-share channel* implies that a transfer towards the spouse who spends a higher share of total income on public goods raises total public goods spending. This is particularly obvious in a corner solution where one spouse provides all of the public goods (which can happen if this spouse has much higher wealth). At this corner, the non-providing spouse has a marginal propensity to spend on public goods of zero, implying that transferring funds from the non-provider to the provider (who has a positive propensity to spend on public goods) will increase total provision.

In an interior solution, there are two additional channels that are related to the change in the cutoff $\bar{i}$ between male and female public good provision brought about by a mandated transfer. The *efficiency channel* arises because the spouse with a lower market wage has a comparative advantage in household production. Hence, if the low-wage spouse substitutes into household production and the high-wage spouse into market production, the overall efficiency of time use in the household is improved (it moves closer to the first-best allocation described in Proposition 2.5). This channel suggests that transferring resources to the low-wage spouse (inducing this spouse to substitute from market work to household production) will increase total provision of public goods. Finally, the change in the cutoff $\bar{i}$ also implies that the resources of the provider receiving the transfer are spread over more public goods, while the other spouse can focus on a smaller range. This *reallocation channel* leads to an increase in the provision of public goods if the receiver of the transfer initially provides a small range of public goods compared to his or her spouse. The following proposition formalizes

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[22]In Section 4, we develop an extension of our model where maximizing utility derived from public goods corresponds to maximizing the growth rate of the economy.

the decomposition of the total effect of a transfer on public good provision.

Proposition 3.1 (Decomposition of Effect of Mandated Transfers on Total Public Good Provision). *Let $\epsilon \geq 0$ denote a mandated transfer from husband to wife, at given wages w_f, w_m and pre-transfer wealth x_f, x_m. If there is an interior equilibrium with $0 < \bar{i} < 1$, the total provision of public goods is given by:*

$$\int_0^1 \log(C_i) \; di = B - \bar{i} \log\left(\frac{1+\bar{i}}{w_m + x_m - \epsilon}\right) - (1-\bar{i}) \log\left(\frac{2-\bar{i}}{w_f + x_f + \epsilon}\right) - \int_0^{\bar{i}} \alpha(i) \; di \log(w_m) - \int_{\bar{i}}^1 \alpha(i) \; di \log(w_f),$$

where B is a constant and $\bar{i}$ is the equilibrium cutoff between male and female provision of public goods. Consequently, the derivative of total public goods provision with respect to ϵ evaluated at $\epsilon = 0$ can be expressed as:

$$\frac{d \int_0^1 \log(C_i) \; di}{d\epsilon} = \underbrace{-\frac{\bar{i}}{w_m + x_m} + \frac{1 - \bar{i}}{w_f + x_f}}_{\text{Expenditure Share Channel}}$$

$$+ \underbrace{\left[\log\left(\frac{(2-\bar{i})(w_m + x_m)}{(1+\bar{i})(w_f + x_f)}\right) + \frac{1-\bar{i}}{2-\bar{i}} - \frac{\bar{i}}{1+\bar{i}} \right] \frac{\partial \bar{i}}{\partial \epsilon}}_{\text{Reallocation Channel}}$$

$$\underbrace{- \alpha(\bar{i}) \log\left(\frac{w_m}{w_f}\right) \frac{\partial \bar{i}}{\partial \epsilon}}_{\text{Efficiency Channel}}. \qquad (8)$$

3.2 Conditions under which Mandated Transfers Increase Public Good Provision

Note that $\frac{\partial \bar{i}}{\partial \epsilon} \leq 0$, that is, a transfer to the wife increases the range of public goods provided by the wife. Hence, when $w_m > w_f$ the efficiency channel is always positive. However, this does not imply that a mandated transfer to the wife always increases the provision of public goods overall, because the sign of the other channels is ambiguous. Indeed, we can establish that depending on the shape of the $\alpha(i)$ function, a transfer from husband to wife may either

lower or raise total public good provision. To work towards this result, we first characterize the expenditure share channel in more detail.

Proposition 3.2 (Expenditure Share Channel). *Assume $0 < w_f < w_m$. For given initial wealth x_f and x_m, consider the marginal effect of a wealth transfer ϵ from the husband to the wife, holding constant the equilibrium cutoff $\bar{i}$ (as if each spouse had zero productivity in providing public goods provided by the other spouse). Notably, this implies that only the expenditure share channel is present. The transfer increases the total utility derived from public goods if and only if:*

$$\frac{1 - \bar{i}}{\bar{i}} > \frac{w_f + x_f}{w_m + x_m}.$$

That is, holding $\bar{i}$ constant, transferring resources to the wife increases the total provision of public goods if and only if the share of public goods provided by the wife exceeds the wife's share in total resources of the couple.

Depending on the shape of the $\alpha(i)$ function and the overall distribution of resources, the expenditure share channel can therefore favor making transfers to either spouse. In particular, transferring resources to the husband may increase the overall provision of public goods if a wide range of public goods are goods-intensive, which tends to increase the share of public goods provided by the husband.

Of course, for the expenditure channel to dominate, the remaining channels have to be sufficiently weak. The next proposition demonstrates that depending on the shape of the $\alpha(i)$ function, the other channels can be arbitrarily weak.

Proposition 3.3 (Expenditure Share Channel Can Dominate). *Assume $0 < w_f < w_m$ and that $\alpha(i)$ is continuously differentiable. For given initial wealth x_f and x_m, consider the marginal effect of a mandated transfer ϵ from the husband to the wife on the equilibrium cutoff $\bar{i}$. The derivative $\frac{\partial \bar{i}}{\partial \epsilon}$ is declining in $\alpha'(\bar{i})$ and can thus be arbitrarily small if $\alpha'(\bar{i})$ is arbitrarily large. Given that $\frac{\partial \bar{i}}{\partial \epsilon}$ appears in both the reallocation channel and the efficiency channel, this implies that by choosing $\alpha(i)$ these channels can be arbitrarily weakened, so that the expenditure share channel dominates.*

An even simpler case obtains when $\alpha(i)$ has a discontinuity at $\bar{i}$, in which case $\bar{i}$ can be constant for a range of ϵ.

Taken together, these results imply that the question of whether mandated transfers from husbands to wives increase public good provision has no clear-cut answer. Instead, the effect of such transfers depends on the specifics of the technology for producing public goods and on the initial distribution of wealth and relative wages. This finding is important because of the contrast it provides to a model that is based on differences between women and men in preferences for public goods. In a preference-based model, mandated transfers to the spouse who values public goods more always increases public good provision. In contrast, our household production model suggests that the effects of such a policy are not uniform, and may depend on the stage of development and on local economic conditions.

Even though these results show that the effects of mandated transfers on public good provision are generally ambiguous, it is also true that the efficiency channel always favors transfers to the low-wage spouse. Thus, one may conjecture that if the environment is symmetric apart from the wage gap between women and men, then the efficiency channel should dominate, and mandated transfers to women should increase public good provision. Hence, we now consider the case when $\alpha(i) = i$, i.e., time intensity varies linearly with the index of the public good. In this setting the overall household production technology is symmetric in terms of time versus goods intensity. It can indeed be shown that in the symmetric case the efficiency channel always dominates in the interior, so that on the margin total provision of public goods is increased if wealth is transferred to the low-wage spouse.

Proposition 3.4 (Efficiency Channel Dominates in Symmetric Case). *Assume $0 < w_f < w_m$ and $\alpha(i) = i$. For given initial wealth x_f and x_m, consider the effects of a mandated transfer ϵ from the husband to the wife, so that the new wealth levels are $x_f + \epsilon$ and $x_m - \epsilon$. If for given x_f and x_m the equilibrium is interior, i.e., the cutoff $\bar{i}$ between male and female provision of public goods satisfies $0 < \bar{i} < 1$, a marginal increase in the transfer from husband to wife increases the total provision of public goods. Formally, we*

have:

$$\frac{\partial \int_0^1 \log\left(C_i\right) \, di}{\partial \epsilon} > 0.$$

Hence, if public goods are, on average, equally time- versus goods-intensive, the efficiency channel (which favors the wife specializing in time-intensive goods) dominates.

3.3   The Effectiveness of Transfers When the Wage Gap Shrinks

One determinant of the effect of transfers on public good provision is the wage gap between men and women. The wage gap is an essential ingredient in the household production mechanism, because it is what leads the two spouses to specialize in providing different types of public goods. We now show that when the size of the wage gap approaches zero, the effect of mandated transfers (whichever the sign) also goes to zero. Intuitively, given that the wage gap is the only difference between the sexes in our model, when the wage gap disappears so does the distinction between women and men. In that case, it no longer matters much who controls resources.

Proposition 3.5 (Role of Wage Gap). *Assume $0 < w_f \leq w_m$. For given initial wealth x_f and x_m, consider the effects of a wealth transfer ϵ from the husband to the wife on public good provision. When the female wage converges to the male wage, the marginal effect of a transfer ϵ on the total provision of public goods converges to zero:*

$$\lim_{w_f \to w_m} \frac{\partial \int_0^1 \log\left(C_i\right) \, di}{\partial \epsilon} = 0.$$

Thus, the model yields the testable prediction that the effects of mandated transfers should be large in places where women earn very little, and small in places where equality in the workplace has been nearly achieved.

To illustrate the workings of this mechanism, Figure 4 displays the impact on public good provision of a mandated transfer of $\epsilon = 0.3$ from husband to wife when the wages are $w_f = 0.8$, $w_m = 1$. Compared to the case of a larger wage gap
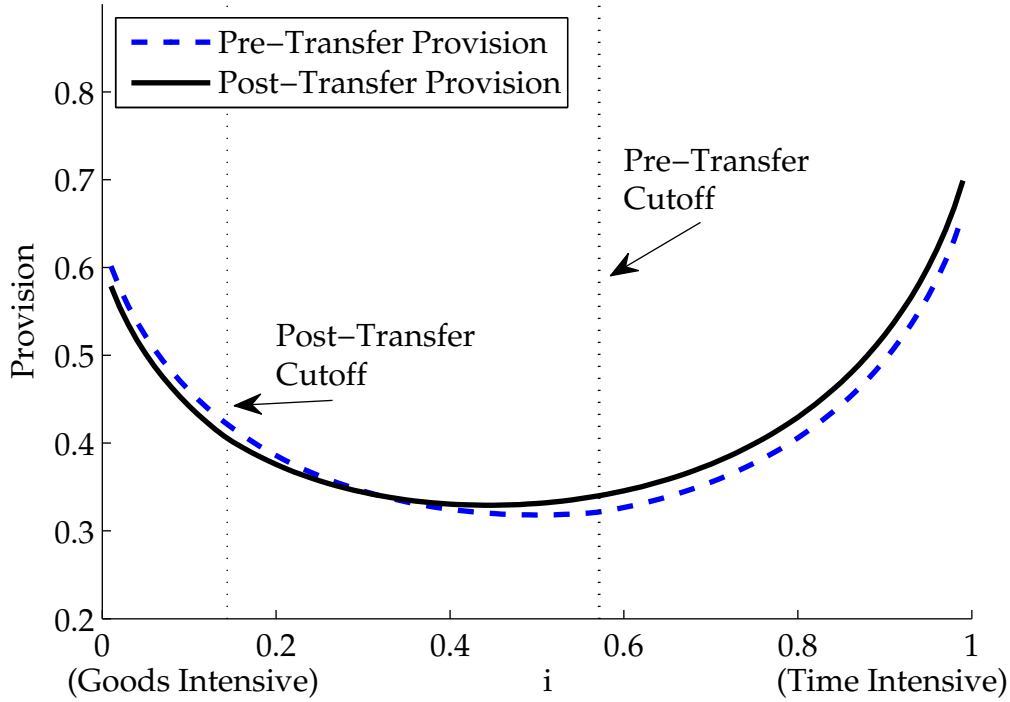
Figure 4: Provision of Each Public Good for $w^f = 0.8$, $w^m = 1$ Before and After Transfer of $\epsilon = 0.3$ from Husband to Wife. Dashed Line: Pre-Transfer Equilibrium Provision. Solid Line: Post-Transfer Equilibrium Provision.

($w_f = 0.5$, $w_m = 1$) shown in Figure 3, the quantitative impact on the relative provision of female- and male-provided public goods is much smaller. Indeed, the impact on equilibrium public good provision is related directly to the difference in the slope between the female and male preferred provision curve, and this difference converges to zero as the wage gap disappears. Once the female wage exceeds about 90 percent of the male wage, the impact of a mandated transfer on equilibrium provision is barely discernible.

4   Growth Implications of Mandated Transfers

The results in the analysis above suggest that the effect of gender-targeted transfers on development depend on the relative importance of male- versus female-

provided public goods in production. In this section, we spell out this link in more detail using a simple growth model in which we identify male-provided public goods with household saving and investment. Buying land, farm animals, or physical capital involves mostly money and little time, and thus falls on the goods-intensive side of the range of public goods. In contrast, we identify time-intensive inputs in child rearing, which are predominantly female-provided, as being associated with the accumulation of human capital. In this framework, we show that the growth effect of mandated transfers that redistribute wealth from men to women switches signs as the economy becomes relatively more intensive in human capital.

We consider a model economy that is populated by successive generations of constant size. Thus, each couple has two children, one boy and one girl. There is measure one of couples in each generation. The preferences of a spouse of gender g are given by the utility function:

$$\log(c_g) + \log(y').\tag{9}$$

Here c_g is the private consumption of spouse g, and y' is the full income[23] of the children in the next period (i.e., when the children are adults). Thus, we capture altruism towards children in a warm-glow fashion.

Output is produced using an aggregate production function that employs physical capital K and human capital H:

$$Y = AK^{1-\theta}H^{\theta}.\tag{10}$$

Below, we consider how the effects of mandated transfers depend on the share of human capital θ. We denote the endowment of a specific couple with physical and human capital by k and h.

Given the production function, parents can raise their children's future income in two different ways: by investing in their human capital, or by leaving them

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[23]The full income of a couple consists of market income plus the value of time used for home production; defining preferences in terms of market income would leave the results qualitatively unchanged.

a bequest in the form of physical capital. The children's physical capital k' is simply the sum of the bequests b_f and b_m left by the mother and father:

$$k' = b_f + b_m. \tag{11}$$

The production of human capital, in contrast, is a more complex process that involves combining many different inputs in a household production function. The log of the children's human capital h' is given by:

$$\log(h') = \int_0^1 \log(C_j) dj, \tag{12}$$

where, as in the analysis in the preceding sections, C_j is composed of the contributions of both spouses: $C_j = C_{f,j} + C_{m,j}$, and each spouse's contribution is produced with a Cobb-Douglas technology using expenditure inputs $E_{g,j}$ and time inputs $T_{g,j}$, the productivity of which depends on human capital h:

$$C_{g,i} = E_{g,j}^{1-j} \ (T_{g,j}h)^j . \tag{13}$$

Hence, the various $C_{g,j}$ serve as intermediate inputs in the production of children's human capital. The interpretation is that the accumulation of human capital requires some relatively goods-intensive inputs such as food, clothing, shelter, and health investments, but also more time-intensive inputs such as child-rearing, education, and enrichment activities. The essential point here is that compared to physical capital (which consists entirely of goods), human capital is more intensive in parental time.

We assume that the production technology (10) for the final good (which can be used for consumption, for intermediate goods in the production of human capital, or for bequests) is operated by a competitive industry, so that the market wage w and the return on capital r are given by marginal products. The children's full income that enters the parents' utility function is then given by:

$$y' = r'k' + w'h', \tag{14}$$

where r' and w' denote the return to capital and the wage in the next period.

Capital fully depreciates each generation. There is an exogenous gender gap in the sense that women's market productivity relative to men is given by $\delta < 1$, so that the female wage per unit of human capital supplied to the labor market is $w_f = \delta w$, whereas the male wage is simply $w_m = w$. We also assume that the total endowments of physical and human capital left to the children are divided equally between the daughter and the son. Clearly, it would be interesting to endogenize both the division of endowments between the children and the gender gap. However, since our focus is on mandated transfers, we abstract from these issues here.[24]

As in the preceding analysis, husband and wife individually decide on labor supply, household production inputs, and also on bequests. Each spouse thus maximizes (9) subject to (11)–(14) and the following budget constraint:

$$c_g + b_g + \int_0^1 E_{g,j} \, dj = \frac{1}{2} \left[w_g h \left(1 - \int_0^1 T_{g,j} \, dj \right) + rk \right] + \tau_g. \tag{15}$$

The factor of one-half on the right-hand side appears because each spouse controls only one-half of the total physical and human capital endowments provided by his or her respective parents (given two-child families). In addition to capital income, a spouse also receives the mandated wealth transfer τ_g where (to allow for market clearing) we impose:

$$\tau_f + \tau_m = 0.$$

We interpret the transfer as government-mandated redistribution of wealth between husbands and wives, and we will consider how such transfers affect the growth rate of the economy.

To close the economy, we specify the market clearing conditions for physical and

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[24]Notice that given our warm-glow utility function, parents do not prefer any specific allocation of endowments between sons and daughters over any other allocation. To model a strategic motive, a more sophisticated form of altruism would be required.

human capital, which (given measure one of identical families) are given by:

$$K = k,$$

$$H = \frac{1}{2} \left[1 - \int_0^1 T_{m,j} \, dj + \delta \left(1 - \int_0^1 T_{f,j} \, dj \right) \right] h.$$

We start our analysis of the growth model with a closer look at the household decision problem. First, we provide an alternative representation of the utility function (9).

Lemma 4.1 (Representation of Preferences). *The preferences given by the utility function* (9) *can be represented equivalently by the utility function:*

$$U(c_g, k', h') = \log(c_g) + \beta_k \log(k') + (1 - \beta_k) \log(h'), \tag{16}$$

where β_k is given by:

$$\beta_k = \frac{(1 - \theta)\phi}{\theta + (1 - \theta)\phi}, \tag{17}$$

and ϕ denotes the fraction of human capital employed in market production (which is taken as given by the individual).

Hence, the implicit weight β_k on the bequest k' in utility is decreasing in the share θ of human capital in goods production (10), whereas the weight on the children's human capital h' is increasing in θ.

Next, we show that the household decision problem in the growth model is a special case of the general noncooperative model analyzed in Sections 2 and 3.

Lemma 4.2 (Relation to General Decision Problem). *The individual decision problem in the growth model of maximizing* (16) *subject to* (11) *to* (15) *is a special case of the general decision problem in Section 2 of maximizing* (1) *subject to* (2) *to* (5)*. Specifically, to map the problem in the growth model into the general decision problem, the function $\alpha(i)$ is set to:*

$$\alpha(i) = \begin{cases} 0 & \text{for} \quad 0 \leq i \leq \beta_k, \\ \frac{i - \beta_k}{1 - \beta_k} & \text{for} \quad \beta_k < i \leq 1, \end{cases} \tag{18}$$

where β_k is given by (17). *Let $\tilde{w}_g$ and $\tilde{x}_g$ denote the wages and wealth levels pertaining to the general decision problem. These are set to:*

$$\tilde{w}_g = \frac{1}{2} w_g h, \tag{19}$$

$$\tilde{x}_g = \frac{1}{2} rk + \tau_g. \tag{20}$$

Let $\tilde{c}_g$, $\tilde{C}_i$, $\tilde{C}_{g,i}$, $\tilde{E}_{g,i}$, $\tilde{T}_{g,i}$, and $\tilde{T}_g$ denote the equilibrium choices in the general decision problem given $\alpha(i)$, $\tilde{w}_g$, and $\tilde{x}_g$ as specified in (18) *to* (20). *The equilibrium choices in the decision problem in the growth model can then be recovered as follows:*

$$c_g = \tilde{c}_g, \tag{21}$$

$$b_g = \int_0^{\beta_k} \tilde{C}_{g,i} \, di, \tag{22}$$

$$E_{g,j} = (1 - \beta_k)\tilde{E}_{g,\beta_k+j(1-\beta_k)} \quad \forall j \in [0,1], \tag{23}$$

$$T_{g,j} = (1 - \beta_k)\tilde{T}_{g,\beta_k+j(1-\beta_k)} \quad \forall j \in [0,1]. \tag{24}$$

Intuitively, the bequest in the growth model corresponds to a range of household public goods in the general model for which we have $\alpha(i) = 0$, i.e., the time component is zero and the goods component is one. The remaining public goods contribute to the production of human capital. The implicit weight of the bequest in the utility function depends on the weight of physical capital in the production function. The more important physical capital is for production, the more important the physical bequest becomes in the parent's utility function, and the more goods-intensive public goods are on average. Conversely, an increase in the human capital intensity of production also increases the implicit weight on children's human capital in parental preferences, which enhances the importance of time in producing public goods.

Lemma 4.2 implies that, given state variables k and h, the results from Sections 2 and 3 apply. Specifically, this means that in equilibrium only husbands provide bequests. Further, assuming the equilibrium is interior, there is a cutoff such that among the public goods that are inputs into human capital, the husband will be in charge of the less time-intensive inputs (such as shelter), while the wife spe-

cializes in time-intensive activities such as doing homework with the children. It follows that a mandated transfer to women will increase human capital, while a transfer to men will increase bequests and hence physical capital. This is consistent with the evidence, cited in the introduction, that transfers to women tend to increase total household spending (which by construction must lower savings).

We now would like to assess the implications of these relationships for the effect of mandated transfers on economic growth. As a first step, the following proposition characterizes the equilibrium for the model economy in the case where mandated wealth transfers are proportional to output. The economy converges to a balanced growth path with a constant growth rate. Even during the transition to the growth path, the time allocation is constant, and consumption and bequests are constant fractions of income per capita.

Lemma 4.3 (Equilibrium Characterization). *If mandated transfers are proportional to output, $\tau_f = -\tau_m = \gamma Y$ for some $\gamma \geq 0$, equilibrium consumption and bequests are a fixed fraction of output also, and the time allocation is constant, i.e. independent of the state variables k and h.*

Next, we establish the key result of this section: The effect of mandated transfers on growth rates depends on the share of human capital in production.

Proposition 4.1 (Growth Implications of Mandated Transfers). *Let mandated transfers be proportional to output, $\tau_f = -\tau_m = \gamma Y$ for some fixed scalar γ. Consider an increase in the transfer in one period. If both spouses contribute to human capital accumulation (i.e., the equilibrium is interior) and the share of human capital θ is sufficiently small, output Y' in the next period is decreasing in today's transfer γ:*

$$\frac{\partial Y'}{\partial \gamma} < 0.$$

Conversely, if the share of human capital θ is sufficiently large, future output is increasing in the transfer γ:

$$\frac{\partial Y'}{\partial \gamma} > 0.$$

The intuition for the proposition is that the share of human capital θ controls the extent to which male- versus female-provided public goods matter for economic
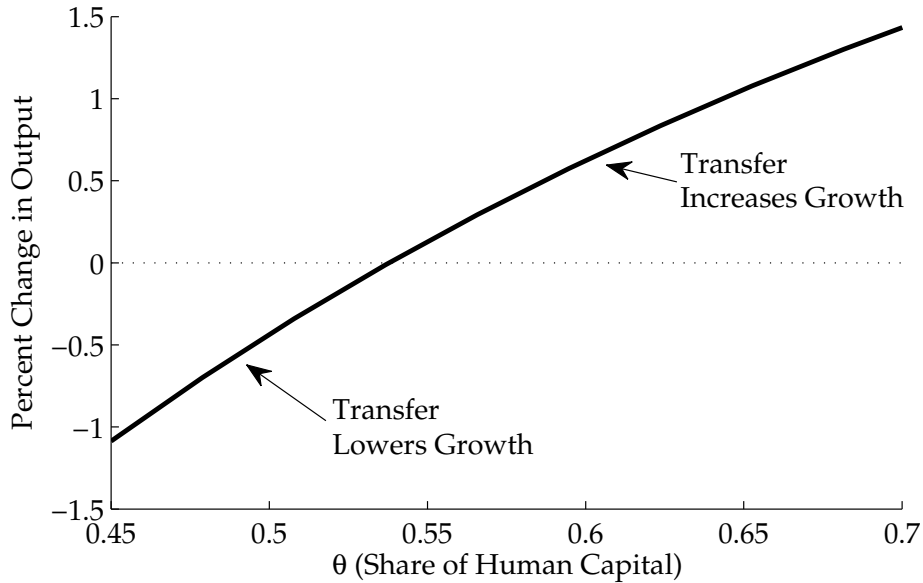
Figure 5: Effect of a Mandated Transfer of 10 percent of Income per Capita from Husband to Wife on Output in the Next Generation as a Function of Human Capital Share θ

growth. In the limit case $\theta = 1$ (production linear in human capital only), the couple's bargaining problem is of the form analyzed in Proposition 3.4, where transfers to women on the margin always increase public good provision (or, in this application, the rate of economic growth). The reason is that at $\theta = 1$ time and money inputs are equally important, so that the efficiency channel dominates, which favors transfers to the low-wage spouse. Conversely, as θ tends to zero (production close to linear in physical capital), growth depends mostly on goods-only public goods provided by men, i.e., men provide most of the public goods. In this case the expenditure-share channel dominates, and transfers to women lower growth (following the intuition of the results in Propositions 3.2 and 3.3).[25]

Figure 5 illustrates these results with a computed example. The gender gap is set to $\delta = 0.5$; i.e., men are twice as productive as women in the market. The figure displays the effect of a mandated transfer from husband to wife, amounting to 10

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[25]The expenditure share channel also dominates in the case of a corner solution where only one spouse is contributing to public goods, i.e., a transfer to the spouse providing the public goods increases economic growth.
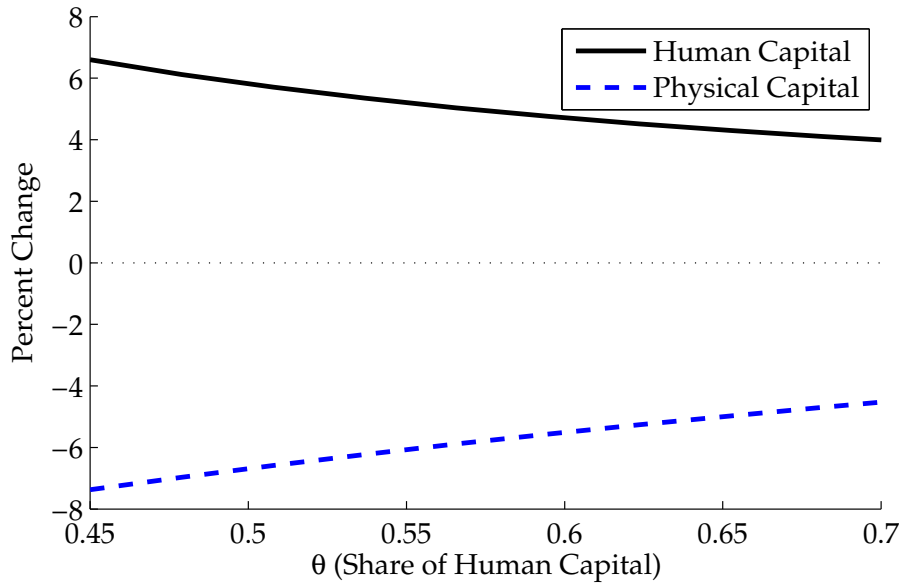
Figure 6: Effect of a Mandated Transfer of 10 percent of Income per Capita from Husband to Wife on Phyiscal and Human Capital in the the Next Generation as a Function of Human Capital Share θ

percent of income per capita, on output in the children's generation as a function of the human capital share θ. For low values of θ, this transfer lowers future output. In this range men provide the majority of public goods. At a human capital share of $\theta = 0.53$, the transfer leaves future output unchanged. For even higher levels of θ, transfers to women increase future output. At $\theta = 1$, the transfer increase future output in the children's generation by almost 2.9 percent.

Notice that even though for low θ a transfer to women lowers growth, it still increases the accumulation of human capital. Figure 6 breaks down the effect of the mandated transfer on the accumulation of human and physical capital. Physical capital (the bequest) is always provided entirely by the husband in this range, whereas the wife provides most of the time-intensive inputs to human capital production. Hence, regardless of θ a transfer from husband to wife results in lower bequests, but more investment in children's human capital. Nevertheless, for low θ (production intensive in physical capital) the positive effect on human capital is insufficient to compensate for the lower bequest.

If the human capital share θ were to increase slowly in the course of development, our results imply that targeting transfers to women might be beneficial at an advanced, human capital-intensive production stage, but less so at an earlier stage when human capital plays a small role. Similarly, in a cross section of countries, targeting transfers to women may be counterproductive in less advanced economies where physical accumulation is still the main driver of growth. Moreover, if female empowerment takes the form of a rise in δ, i.e. a decline in the gender wage gap, then the growth effect of mandated transfers (whether positive or negative) shrinks with empowerment (see Proposition 3.5).

5   Conclusions and Outlook

In this paper we have addressed, from a theoretical perspective, the empirical observation that money in the hands of women leads to higher spending on children. This observation has already fueled a trend in development policy to channel more resources towards women and, more generally, to envision female empowerment as a conduit to economic development. If we are to fully understand the effects of such gender-based development policies, however, we must first pin down the mechanism that generates the observed empirical findings. The conventional interpretation of the facts is that women and men have different preferences, in the sense that women attach more weight to children's welfare. However, in this paper we show that the facts can be explained also by an alternative mechanism that relies on the endogenous division of labor in household production.

Under the household production mechanism, it is not obvious whether targeting transfers to women is good policy. In particular, we show that targeting transfers to women increases the growth rate only if human capital is the key engine of growth. In contrast, in economies that are driven primarily by physical capital accumulation, targeting transfers to women can lower economic growth, because increased spending on children crowds out savings and hence physical capital accumulation.[26] Moreover, we show that the effects of targeted transfers disappear

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[26]The mutual complementarity between human capital accumulation, female empowerment,

when the wage gap between women and men approaches zero. In other words, when women are fully empowered in the labor market, then further empowering them through transfers has no effect on the provision of public goods in the household.

The links among the effects of targeted transfers, the share of human capital, and the degree of labor-market discrimination suggest that there is no fixed relationship between female empowerment and economic development, but rather that the effectiveness of empowerment policies depends on the stage of development. The theory suggests that mandating wealth transfers from men to women lowers economic growth at an early stage of development, when there is little demand for human capital. At a highly advanced stage of development when human capital is the dominant factor of production and when women and men earn similar wages, transfers would have little effect because in this case women and men behave similarly. The best case for these kinds of targeted transfers could be made for countries at an intermediate stage of development, when human capital is already a key driver of growth, but women's labor market opportunities still lag behind men's.

We have limited our attention here to the implications of a narrow concept of female empowerment, namely the transfer of resources from husbands to wives. In reality, of course, female empowerment can take other forms. For example, there are many facets of discrimination against women, not just in labor markets but also in consumption markets, some of which may lead men and women to act as if they had different preferences.[27] That is, if women had access to a more limited set of private goods than men do, they would endogenously place less weight on their private consumption compared to spending on public goods. Such a mechanism might be relevant in countries like Saudi Arabia where laws explicitly prohibit certain behaviors for women, such as driving. Female empowerment that reduces such consumption discrimination would lead to lower child expenditure shares. Another important dimension of female empowerment concerns access

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and economic development in our model resembles features of the political-economy analysis in Doepke and Tertilt (2009), although the mechanism is entirely different, because the model of Doepke and Tertilt (2009) relies on preference differences.

[27]In Doepke and Tertilt (2011) we analyze simple examples of this kind, but do not pursue them in the context of a growth model.

to education, which could be analyzed in the context of our growth model with human capital accumulation. Reducing discrimination against women in terms of education is more likely to promote economic development, but even here there are potential effects going in the opposite direction (such as repercussions on the time spent educating children). The bottom line is that female empowerment cannot be regarded as a generic concept that has uniform effects at all stages of development. Rather, the effects of female empowerment depend both on the specific form that an empowerment policy takes, and on the nature of the economy where the policy is implemented. While many of these interdependencies remain to be disentangled in future research, we see our paper as a step towards a more differentiated view.

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A   Proofs for Propositions and Lemmas

Proof of Proposition 2.1: We start by showing that the equilibrium satisfies the cutoff rule. The first-order conditions characterizing the wife's optimization problem are given by:

$$c_f = \frac{1}{\lambda_f}, \tag{25}$$

$$E_{f,i} \leq \frac{1 - \alpha(i)}{\lambda_f}, \tag{26}$$

$$T_{f,i} \leq \frac{\alpha(i)}{w_f \lambda_f}, \tag{27}$$

where (26) and (27) hold with equality for all public goods i that the wife contributes to, and λ_f denotes the multiplier on the budget constraint. The corresponding optimality conditions for the husband are:

$$c_m = \frac{1}{\lambda_m}, \tag{28}$$

$$E_{m,i} \leq \frac{1 - \alpha(i)}{\lambda_m}, \tag{29}$$

$$T_{m,i} \leq \frac{\alpha(i)}{w_m \lambda_m}. \tag{30}$$

In Nash equilibrium, each spouse contributes only to those public goods for which she or he has a higher willingness to pay. To show that there is an equilibrium that satisfies the cutoff rule, we therefore have to show that the wife's relative willingness to pay increases with i. Given the first-order conditions, the ratio of female to male preferred public-good provision for good i (in each case assuming that each spouse would be the sole provider) is:

$$\frac{C_{f,i}}{C_{m,i}} = \frac{E_{f,i}^{1-\alpha(i)} T_{f,i}^{\alpha(i)}}{E_{m,i}^{1-\alpha(i)} T_{m,i}^{\alpha(i)}} = \left(\frac{w_m}{w_f} \right)^{\alpha(i)} \frac{\lambda_m}{\lambda_f}. \tag{31}$$

This expression is increasing in i (given the assumption $w_f < w_m$), which implies that there is an equilibrium that satisfies the cutoff rule. Intuitively, women provide public goods using relatively more time compared to goods because of their low wages, which induces them to provide relatively more of the time-intensive goods. Given the cutoff rule, (6) follows from substituting the expressions for $E_{g,i}$ and $T_{g,i}$ from the first-order conditions into the production function for public goods, and (7) follows from equating

42

male and female contributions at the cutoff.

To establish generic uniqueness of the equilibrium, we need to characterize the cutoff $\bar{i}$ more sharply by solving for the multipliers on the budget constraint. Plugging the first-order conditions for the wife back into the budget constraint and using the cutoff rule gives:

$$\frac{1}{\lambda_f} + \int_{\bar{i}}^1 \frac{1 - \alpha(i)}{\lambda_f} \, di = w_f - w_f \int_{\bar{i}}^1 \frac{\alpha(i)}{w_f \lambda_f} \, di + x_f.$$

Canceling terms we get:

$$\frac{1}{\lambda_f} + \int_{\bar{i}}^1 \frac{1}{\lambda_f} \, di = w_f + x_f,$$

which gives:

$$\lambda_f = \frac{2 - \bar{i}}{w_f + x_f}. \tag{32}$$

Proceeding along the same lines with the male budget constraint gives:

$$\lambda_m = \frac{1 + \bar{i}}{w_m + x_m}. \tag{33}$$

If the cutoff $\bar{i}$ is interior, it is characterized by the condition that at $\bar{i}$ female- and male-preferred provision of the public good is equal. Using (31), this can be written as:

$$\left(\frac{2 - \bar{i}}{1 + \bar{i}}\right) \left(\frac{w_m + x_m}{w_f + x_f}\right) = \left(\frac{w_m}{w_f}\right)^{\alpha(\bar{i})}. \tag{34}$$

Notice that the left-hand side is strictly decreasing in $\bar{i}$ while the right-hand side is increasing. Hence, there can be at most one solution to the equation. When the equation does not have a solution the equilibrium is a corner. Specifically, if:

$$2 \left(\frac{w_m + x_m}{w_f + x_f}\right) < 1$$

holds we have $\bar{i} = 0$ (the wife is sufficiently rich to provide all public goods). Conversely, if:

$$\frac{1}{2} \left(\frac{w_m + x_m}{w_f + x_f}\right) > \frac{w_m}{w_f}$$

holds, we have $\bar{i} = 1$, and the husband provides all public goods.

The equilibrium is only generically unique because we allow for the possibility that $\alpha(i)$ is constant over some range. If the equilibrium cutoff $\bar{i}$ falls into such a constant range,

there is indeterminacy in terms of which spouse is providing which goods in this range. However, the private consumption and equilibrium provision of public goods is independent of who provides which goods in this range, so that there is no loss in generality from restricting attention to equilibria that satisfy the cutoff rule. □

Proof of Proposition 2.2: The equilibrium cutoff conditions (34) before and after the transfer ϵ read:

$$\left(\frac{2-\bar{i}}{1+\bar{i}}\right)\left(\frac{w_m + x_m}{w_f + x_f}\right) = \left(\frac{w_m}{w_f}\right)^{\alpha(\bar{i})},$$

$$\left(\frac{2-\tilde{i}}{1+\tilde{i}}\right)\left(\frac{w_m + x_m - \epsilon}{w_f + x_f + \epsilon}\right) = \left(\frac{w_m}{w_f}\right)^{\alpha(\tilde{i})}.$$

Since $\epsilon > 0$, the second term on the left-hand side is smaller in the second equation, implying that we must have $\tilde{i} < \bar{i}$. It then follows from (7) that the ratio $\tilde{c}_f/\tilde{c}_m$ has to increase after the transfer. Moreover, due to (6) the provision of public goods is proportional to the private consumption of the spouse providing the good. For public goods that have the same provider both before and after the change, the ratio of provision therefore changes by the same amount as the ratio of private consumption. □

Proof of Proposition 2.3: From Definition 2.2, X satisfies:

$$X = \underset{0 \leq X \leq w_m + x_m}{\mathrm{argmax}} \ \{V_m(w_f, w_m, x_f + X, x_m - X)\}.$$

Now define $X^\star = X - \epsilon$. Substituting into the last expression we get:

$$X^\star = \underset{0 \leq X^\star + \epsilon \leq w_m + x_m}{\mathrm{argmax}} \ \{V_m(w_f, w_m, x_f + \epsilon + X^\star, x_m - \epsilon - X^\star)\}.$$

or:

$$X^\star = \underset{-\epsilon \leq X^\star \leq w_m + x_m - \epsilon}{\mathrm{argmax}} \ \{V_m(w_f, w_m, x_f + \epsilon + X^\star, x_m - \epsilon - X^\star)\}.$$

Thus, $X^\star$ is the optimal voluntary transfer if an initial transfer of ϵ is imposed and negative transfers up to ϵ are allowed. Moreover, because $\epsilon \leq X$ we have $X^\star \geq 0$, so that $X^\star$ also satisfies:

$$X^\star = \underset{0 \leq X^\star \leq w_m + x_m - \epsilon}{\mathrm{argmax}} \ \{V_m(w_f, w_m, x_f + \epsilon + X^\star, x_m - \epsilon - X^\star)\},$$

implying that $X^\star$ is indeed the optimal transfer after the initial transfer is imposed, lead-

ing to identical post-transfer wealth and hence an identical ex-post equilibrium. □

Proof of Proposition 2.4: We start by rewriting the husband's utility derived from the provision of public goods. In the case of an interior $\bar{i}$ (which we focus on here) this is given by:

$$
\int_0^1 \log(C_i) \, di
$$

$$
= \int_0^1 \log(E_i^{1-\alpha(i)} T_i^{\alpha(i)}) \, di
$$

$$
= \int_0^{\bar{i}} [(1 - \alpha(i)) \log(E_{m,i}) + \alpha(i) \log(T_{i,m})] di
$$

$$
+ \int_{\bar{i}}^1 [(1 - \alpha(i)) \log(E_{f,i}) + \alpha(i) \log(T_{i,f})] di
$$

$$
= \int_0^{\bar{i}} \left[(1 - \alpha(i)) \log \left(\frac{1 - \alpha(i)}{\lambda_m} \right) + \alpha(i) \log \left(\frac{\alpha(i)}{w_m \lambda_m} \right) \right] di
$$

$$
+ \int_{\bar{i}}^1 \left[(1 - \alpha(i)) \log \left(\frac{1 - \alpha(i)}{\lambda_f} \right) + \alpha(i) \log \left(\frac{\alpha(i)}{w_f \lambda_f} \right) \right] di.
$$

Denote as B the constant that does not depend on wages or multipliers. Then the expression can be written as:

$$
\int_0^1 \log(C_i) \, di
$$

$$
= B - \int_0^{\bar{i}} [\log(\lambda_m) + \alpha(i) \log(w_m)] \, di - \int_{\bar{i}}^1 [\log(\lambda_f) + \alpha(i) \log(w_f)] \, di
$$

$$
= B - \bar{i} \log(\lambda_m) - (1 - \bar{i}) \log(\lambda_f)
$$

$$
- \int_0^{\bar{i}} \alpha(i) \, di \log(w_m) - \int_{\bar{i}}^1 \alpha(i) \, di \log(w_f). \tag{35}
$$

Hence, noting that $c_m = 1/\lambda_m$ from (28), total male utility is given by:

$$
V_m(w_f, w_m, x_f + X, x_m - X) =
$$

$$
B - (1 + \bar{i}) \log(\lambda_m) - (1 - \bar{i}) \log(\lambda_f) - \int_0^{\bar{i}} \alpha(i) \, di \log(w_m) - \int_{\bar{i}}^1 \alpha(i) \, di \log(w_f). \tag{36}
$$

From (32) and (33), the multipliers λ_f and λ_m are given by:

$$\lambda_f = \frac{2 - \bar{i}}{w_f + x_f + X},$$

$$\lambda_m = \frac{1 + \bar{i}}{w_m + x_m - X}.$$

Plugging these into (36) and taking a derivative with respect to X yields:

$$\left. \frac{\partial V_m(w_f, w_m, x_f + X, x_m - X)}{\partial X} \right|_{X=0} = -\frac{1 + \bar{i}}{w_m + x_m} + \frac{1 - \bar{i}}{w_f + x_f}$$
$$+ \left[\log\left(\frac{(2 - \bar{i})(w_m + x_m)}{(1 + \bar{i})(w_f + x_f)} \right) + \frac{1 - \bar{i}}{2 - \bar{i}} - 1 \right] \frac{\partial \bar{i}}{\partial X}$$
$$- \alpha(\bar{i}) \log\left(\frac{w_m}{w_f} \right) \frac{\partial \bar{i}}{\partial X}.$$

Now taking the desired limit and recognizing that in the limit we have $\bar{i} = 0$ gives:

$$\lim_{x_f \to 2(w_m + x_m) - w_f} \left\{ \left. \frac{\partial V_m(w_f, w_m, x_f + X, x_m - X)}{\partial X} \right|_{X=0} \right\}$$
$$= \lim_{x_f \to 2(w_m + x_m) - w_f} \left\{ -\frac{1}{w_m + x_m} + \frac{1}{w_f + x_f} + \left[\log\left(\frac{2(w_m + x_m)}{w_f + x_f} \right) - \frac{1}{2} \right] \frac{\partial \bar{i}}{\partial X} \right\}$$
$$= -\frac{1}{2} \left[\frac{1}{w_m + x_m} + \lim_{x_f \to 2(w_m + x_m) - w_f} \left\{ \frac{\partial \bar{i}}{\partial X} \right\} \right]. \tag{37}$$

Consider two cases: if x_f converges to $2(w_m + x_m) - w_f$ from above, then there is no change in $\bar{i}$ in the limit since the equilibrium remains at a corner. Thus,

$$\lim_{x_f \searrow 2(w_m + x_m) - w_f} \left\{ \left. \frac{\partial V_m(w_f, w_m, x_f + X, x_m - X)}{\partial X} \right|_{X=0} \right\} = -\frac{1}{2} \frac{1}{w_m + x_m} < 0.$$

The more interesting case happens when x_f converges to $2(w_m + x_m) - w_f$ from below. For this case there is a negative change in $\bar{i}$ on the margin. We now show that even taking this into account, the overall expression in (37) is still negative. Using the multipliers (32) and (33) in the cutoff condition (7) for $\bar{i}$ and taking logs yields:

$$\log\left(\frac{2 - \bar{i}}{w_f + x_f + X} \right) - \log\left(\frac{1 + \bar{i}}{w_m + x_m - X} \right) = \alpha(\bar{i}) \log\left(\frac{w_m}{w_f} \right).$$

Taking a derivative on both sides with respect to X and evaluating the expression at

$X = 0$ leads to:

$$\frac{\partial \bar{i}}{\partial X} = -\frac{\frac{1}{w_f + x_f} + \frac{1}{w_m + x_m}}{\alpha'(\bar{i}) \log\left(\frac{w_m}{w_f}\right) + \frac{1}{2-\bar{i}} + \frac{1}{1+\bar{i}}},$$

We therefore have:

$$\lim_{x_f \nearrow 2(w_m + x_m) - w_f} \left\{ \frac{\partial \bar{i}}{\partial X} \right\} = -\frac{\frac{3}{2} \frac{1}{w_m + x_m}}{\alpha'(0) \log\left(\frac{w_m}{w_f}\right) + \frac{3}{2}}.$$

Using this in (37) gives the desired result:

$$\lim_{x_f \nearrow 2(w_m + x_m) - w_f} \left\{ \left. \frac{\partial V_m(w_f, w_m, x_f + X, x_m - X)}{\partial X} \right|_{X=0} \right\} =$$

$$-\frac{1}{2} \frac{1}{w_m + x_m} \left(1 - \frac{1}{\frac{2}{3} \alpha'(0) \log\left(\frac{w_m}{w_f}\right) + 1} \right) < 0.$$

Intuitively, at $\bar{i} = 0$, on the margin a transfer leads the wife to replace the husband as the provider of a public good that only requires a goods input, so that the wife does not have a comparative advantage as the provider. □

Proof of Proposition 2.5: Let λ denote the multiplier on the budget constraint. Given $w_m > w_f$, the cost of female time is strictly lower than the cost of male time, implying $T_{m,i} = 0$ and $T_{f,i} > 0$ for all i. Moreover, since in producing a given public good the time and goods contributions have to come from the same spouse, this also implies $E_{m,i} = 0$ and $E_{f,i} > 0$ for all i. Taking these features into account, the first-order conditions for the social planning problem are:

$$c_f = \frac{\mu}{\lambda},$$

$$c_m = \frac{1 - \mu}{\lambda},$$

$$E_{f,i} = \frac{1 - \alpha(i)}{\lambda}, \tag{38}$$

$$T_{f,i} \leq \frac{\alpha(i)}{w_f \lambda}. \tag{39}$$

Plugging these expressions into the budget constraint and solving for the multiplier yields:

$$\lambda = \frac{2}{w_f + x_f + w_m + x_m}.$$

47

Using this to solve for the efficient allocation yields:

$$c_f = \frac{1}{2}\mu \left(w_f + x_f + w_m + x_m\right),$$

$$c_m = \frac{1}{2}(1-\mu)\left(w_f + x_f + w_m + x_m\right),$$

$$C_i = \frac{1}{2}(1-\alpha(i))^{1-\alpha(i)}\alpha(i)^{\alpha(i)}w_f^{-\alpha(i)}\left(w_f + x_f + w_m + x_m\right),$$

as stated in the proposition.

Regarding the relative provision of public goods in the equilibrium and in the efficient allocation, notice that the multiplier λ enters (38) and (39) in the same way as the multiplier λ_f enters (26) and (27) in the characterization of the equilibrium allocation. To show that for an i where the wife is the equilibrium provider, the efficient provision of C_i is higher than the equilibrium provision, it is therefore sufficient to show that $\lambda < \lambda_f$, or, using (32):

$$\frac{2}{w_f + x_f + w_m + x_m} < \frac{2 - \bar{i}}{w_f + x_f}.$$

In the case of a corner solution with $\bar{i} = 0$ the required inequality is immediate, and if $\bar{i} = 1$ there are no female-provided public goods in equilibrium. For interior solutions, the cutoff condition (34) yields the following inequality:

$$w_m + x_m \geq \frac{1 + \bar{i}}{2 - \bar{i}}(w_f + x_f).$$

Using this inequality, we get:

$$\frac{2}{w_f + x_f + w_m + x_m} \leq \frac{2}{\left(1 + \frac{1+\bar{i}}{2-\bar{i}}\right)(w_f + x_f)}$$

$$= \frac{2}{3}\frac{2 - \bar{i}}{w_f + x_f}$$

$$< \frac{2 - \bar{i}}{w_f + x_f},$$

as required. □

Proof of Proposition 3.1: Recall from (35) that the total provision of public goods can be

written as:

$$\int_0^1 \log(C_i) \, di = B - \bar{i} \log(\lambda_m) - (1 - \bar{i}) \log(\lambda_f)$$

$$- \int_0^{\bar{i}} \alpha(i) \, di \log(w_m) - \int_{\bar{i}}^1 \alpha(i) \, di \log(w_f), \quad (40)$$

where B is a constant. From (32) and (33), the multipliers λ_f and λ_m are given by:

$$\lambda_f = \frac{2 - \bar{i}}{w_f + x_f + \epsilon},$$

$$\lambda_m = \frac{1 + \bar{i}}{w_m + x_m - \epsilon}.$$

Plugging these into (40) yields the first expression stated in the proposition. Further, differentiating with respect to ϵ and evaluating at $\epsilon = 0$ gives equation (8). $\qquad\square$

Proof of Proposition 3.2: The derivative of (35) with respect to ϵ for $\bar{i}$ held constant is:

$$\frac{\partial \int_0^1 \log(C_i) \, di}{\partial \epsilon} = -\bar{i} \frac{\frac{\partial \lambda_m}{\partial \epsilon}}{\lambda_m} - (1 - \bar{i}) \frac{\frac{\partial \lambda_f}{\partial \epsilon}}{\lambda_f}. \quad (41)$$

From (32) and (33), the multipliers λ_f and λ_m are given by:

$$\lambda_f = \frac{2 - \bar{i}}{w_f + x_f + \epsilon}, \quad (42)$$

$$\lambda_m = \frac{1 + \bar{i}}{w_m + x_m - \epsilon}, \quad (43)$$

and the derivatives with respect to ϵ evaluated at $\epsilon = 0$ are:

$$\frac{\partial \lambda_f}{\partial \epsilon} = -\frac{2 - \bar{i}}{(w_f + x_f)^2},$$

$$\frac{\partial \lambda_m}{\partial \epsilon} = \frac{1 + \bar{i}}{(w_m + x_m)^2}.$$

Plugging these expressions into (41) gives:

$$\frac{\partial \int_0^1 \log(C_i) \, di}{\partial \epsilon} = -\frac{\bar{i}}{w_m + x_m} + \frac{1 - \bar{i}}{w_f + x_f}.$$

We therefore have:

$$\frac{\partial \int_0^1 \log(C_i) \, di}{\partial \epsilon} > 0$$

if and only if:

$$\frac{1 - \bar{i}}{\bar{i}} > \frac{w_f + x_f}{w_m + x_m}.$$

That is, holding $\bar{i}$ constant, transferring resources to the wife increases the total provision of public goods if and only if the share of public goods provided by the wife exceeds the wife's share in total resources of the couple. □

Proof of Proposition 3.3: The cutoff condition (7) characterizing $\bar{i}$ can be written as:

$$\frac{\lambda_f}{\lambda_m} = \left(\frac{w_m}{w_f}\right)^{\alpha(\bar{i})}.$$

Taking logs yields:

$$\log\left(\frac{\lambda_f}{\lambda_m}\right) = \alpha(\bar{i}) \log\left(\frac{w_m}{w_f}\right).$$

For varying ϵ, this equation is an identity, with λ_f, λ_m, and $\bar{i}$ all being functions of ϵ. Differentiating both sides of the identity with respect to ϵ and solving for $\frac{\partial \bar{i}}{\partial \epsilon}$ yields:

$$\frac{\partial \bar{i}}{\partial \epsilon} = \frac{1}{\alpha'(\bar{i}) \log\left(\frac{w_m}{w_f}\right)} \left[\frac{1}{\lambda_f} \frac{\partial \lambda_f}{\partial \epsilon} - \frac{1}{\lambda_m} \frac{\partial \lambda_m}{\partial \epsilon}\right].$$

Thus, the derivative becomes arbitrarily small as $\alpha'(\bar{i})$ becomes arbitrarily large. □

Proof of Proposition 3.4: From (35), the total provision of public goods can be written as:

$$\int_0^1 \log(C_i) \, di = B - \bar{i} \log(\lambda_m) - (1 - \bar{i}) \log(\lambda_f)$$

$$- \int_0^{\bar{i}} \alpha(i) \, di \log(w_m) - \int_{\bar{i}}^1 \alpha(i) \, di \log(w_f).$$

For the case $\alpha(i) = i$ considered here this can be further simplified:

$$\int_0^1 \log(C_i) \, di = B - \bar{i} \log(\lambda_m) - (1 - \bar{i}) \log(\lambda_f) - \frac{1}{2}\left[\bar{i}^2 \log\left(\frac{w_m}{w_f}\right) + \log(w_f)\right]. \quad (44)$$

Next, combining the cutoff condition (7) with the first-order conditions (25) and (28)

gives:

$$\left(\frac{w_m}{w_f}\right)^{\bar{i}} = \frac{\lambda_f}{\lambda_m}. \tag{45}$$

Taking logs and solving for $\log(\lambda_m)$ gives:

$$\log\left(\lambda_m\right) = \log\left(\lambda_f\right) - \bar{i}\log\left(\frac{w_m}{w_f}\right). \tag{46}$$

Using the expression to replace λ_m in (44) gives:

$$\int_0^1 \log(C_i)\,di = B - \log(\lambda_f) + \frac{1}{2}\bar{i}^2 \log\left(\frac{w_m}{w_f}\right) - \frac{1}{2}\log(w_f). \tag{47}$$

We would like to characterize the derivative of this expression with respect to ϵ. The only variables that depend on ϵ are $\bar{i}$ and λ_f. The derivative can therefore be written as:

$$\frac{\partial \int_0^1 \log\left(C_i\right)\,di}{\partial \epsilon} = -\frac{1}{\lambda_f}\frac{\partial \lambda_f}{\partial \epsilon} + \bar{i}\frac{\partial \bar{i}}{\partial \epsilon}\log\left(\frac{w_m}{w_f}\right). \tag{48}$$

Given (42), at $\epsilon = 0$ we have:

$$\lambda_f = \frac{2 - \bar{i}}{w_f + x_f},$$

$$\frac{\partial \lambda_f}{\partial \epsilon} = -\frac{2 - \bar{i}}{(w_f + x_f)^2} - \frac{1}{w_f + x_f}\frac{\partial \bar{i}}{\partial \epsilon}.$$

Plugging these expressions into (48) gives:

$$\frac{\partial \int_0^1 \log\left(C_i\right)\,di}{\partial \epsilon} = \frac{1}{w_f + x_f} + \left(\frac{1}{2 - \bar{i}} + \bar{i}\log\left(\frac{w_m}{w_f}\right)\right)\frac{\partial \bar{i}}{\partial \epsilon}. \tag{49}$$

Totally differentiating (46) leads to:

$$\frac{\partial \bar{i}}{\partial \epsilon} = -\frac{\frac{1}{w_f + x_f} + \frac{1}{w_m + x_m}}{\log\left(\frac{w_m}{w_f}\right) + \frac{1}{2 - \bar{i}} + \frac{1}{1 + \bar{i}}}.$$

Plugging this into (49) gives:

$$\frac{\partial \int_0^1 \log\left(C_i\right)\,di}{\partial \epsilon} = \frac{\log\left(\frac{w_m}{w_f}\right) + \frac{1}{2 - \bar{i}} + \frac{1}{1 + \bar{i}} - \left(\frac{1}{2 - \bar{i}} + \bar{i}\log\left(\frac{w_m}{w_f}\right)\right)\left(1 + \frac{w_f + x_f}{w_m + x_m}\right)}{(w_f + x_f)\left(\log\left(\frac{w_m}{w_f}\right) + \frac{1}{2 - \bar{i}} + \frac{1}{1 + \bar{i}}\right)}. \tag{50}$$

51

The denominator is positive. To prove the claim, we need to show that the numerator is positive as well. Using the cutoff condition (45) combined with the multipliers (42) and (43) to replace the term $(w_f + x_f)/(w_m + x_m)$, we need to establish the following inequality:

$$\log\left(\frac{w_m}{w_f}\right) + \frac{1}{2-\bar{i}} + \frac{1}{1+\bar{i}} - \left(\frac{1}{2-\bar{i}} + \bar{i}\log\left(\frac{w_m}{w_f}\right)\right)\left(1 + \frac{2-\bar{i}}{1+\bar{i}}\left(\frac{w_f}{w_m}\right)^{\bar{i}}\right) > 0.$$

It can be verified numerically that the expression on the left-hand side is decreasing in $\bar{i}$ for all $w_m/w_f > 1$. It is therefore sufficient to check the inequality at the point $\bar{i} = 1$, i.e., at the point where the husband is providing all public goods and, therefore, the expenditure-share channel favors transfers to the husband. Plugging in $\bar{i} = 1$ yields:

$$\log\left(\frac{w_m}{w_f}\right) + \frac{3}{2} - \left(1 + \log\left(\frac{w_m}{w_f}\right)\right)\left(1 + \frac{w_f}{2w_m}\right) > 0.$$

Simplifying the expression yields:

$$1 - \left(1 + \log\left(\frac{w_m}{w_f}\right)\right)\frac{w_f}{w_m} > 0,$$

or:

$$\frac{w_m}{w_f} > 1 + \log\left(\frac{w_m}{w_f}\right),$$

which is satisfied because we assume $w_m > w_f$. $\qquad\square$

Proof of Proposition 3.5: From (8), the derivative of the total provision of public goods with respect to the transfer ϵ (evaluated at $\epsilon = 0$) is given by:

$$\frac{\partial \int_0^1 \log\left(C_i\right)\, di}{\partial \epsilon} = -\frac{\bar{i}}{w_m + x_m} + \frac{1 - \bar{i}}{w_f + x_f}$$
$$+ \left[\log\left(\frac{(2-\bar{i})(w_m + x_m)}{(1+\bar{i})(w_f + x_f)}\right) + \frac{1 - \bar{i}}{2 - \bar{i}} - \frac{\bar{i}}{1 + \bar{i}}\right]\frac{\partial \bar{i}}{\partial \epsilon}$$
$$- \alpha(\bar{i})\log\left(\frac{w_m}{w_f}\right)\frac{\partial \bar{i}}{\partial \epsilon}.$$

Using the multipliers (32) and (33) in the cutoff condition (7) for $\bar{i}$ yields:

$$\left(\frac{w_m}{w_f}\right)^{\alpha(\bar{i})} = \frac{(2-\bar{i})(w_m + x_m - \epsilon)}{(1+\bar{i})(w_f + x_f + \epsilon)}. \tag{51}$$

52

In the limit as $w_f \to w_m$, the left hand side converges to 1 and thus we have (evaluated at $\epsilon = 0$):

$$\frac{2 - \bar{i}}{w_f + x_f} = \frac{1 + \bar{i}}{w_m + x_m}.$$

Solving this expression for $\bar{i}$, we get:

$$\lim_{w_f \to w_m} \bar{i} = \lim_{w_f \to w_m} \frac{2(w_m + x_m) - (w_f + x_f)}{w_f + x_f + w_m + x_m}. \tag{52}$$

The derivative $\frac{\partial \bar{i}}{\partial \epsilon}$ can be derived from (51) by taking logs, then differentiating both sides with respect to ϵ, and collecting terms. Evaluated at $\epsilon = 0$ the derivative is:

$$\frac{\partial \bar{i}}{\partial \epsilon} = -\frac{\frac{1}{w_f + x_f} + \frac{1}{w_m + x_m}}{\alpha'(\bar{i}) \log\left(\frac{w_m}{w_f}\right) + \frac{1}{2 - \bar{i}} + \frac{1}{1 + \bar{i}}},$$

In the limit $w_f \to w_m$, the first term in the denominator disappears. Then, using (52), the derivative simplifies to:

$$\lim_{w_f \to w_m} \frac{\partial \bar{i}}{\partial \epsilon} = -\frac{\frac{1}{w_f + x_f} + \frac{1}{w_m + x_m}}{\frac{1}{2 - \bar{i}} + \frac{1}{1 + \bar{i}}} = -\frac{3}{2w_m + x_f + x_m}. \tag{53}$$

Now plugging the derived limits for $\bar{i}$ and $\frac{\partial \bar{i}}{\partial \epsilon}$ into the expression for the total provision of public goods and simplifying, we get:

$$\lim_{w_f \to w_m} \frac{d \int_0^1 \log(C_i) \, di}{d\epsilon} = \lim_{w_f \to w_m} \left\{ -\frac{\bar{i}}{w_m + x_m} + \frac{1 - \bar{i}}{w_f + x_f} + \left[\frac{1 - \bar{i}}{2 - \bar{i}} - \frac{\bar{i}}{1 + \bar{i}}\right] \frac{\partial \bar{i}}{\partial \epsilon} \right\}$$

$$= \frac{1}{w_m + x_m} - \frac{1}{w_m + x_f} - \frac{1}{w_m + x_m} + \frac{1}{w_m + x_f}$$

$$= 0,$$

which completes the proof. $\qquad\square$

Proof of Lemma 4.1: Substituting (14) into the utility function (9) gives:

$$U(c_g, k', h') = \log(c_g) + \log(r'k' + w'h'). \tag{54}$$

The derivatives of (54) with respect to k' and h' are given by:

$$\frac{\partial U}{\partial k'} = \frac{r'}{r'k' + w'h'} = \frac{(1-\theta)\left(\frac{\phi h'}{k'}\right)^\theta}{(1-\theta)\left(\frac{\phi h'}{k'}\right)^\theta k' + \theta\left(\frac{k'}{\phi h'}\right)^{1-\theta}h'} = \frac{(1-\theta)\phi}{(1-\theta)\phi + \theta}\frac{1}{k'},$$

$$\frac{\partial U}{\partial h'} = \frac{w'}{r'k' + w'h'} = \frac{\theta}{(1-\theta)\phi + \theta}\frac{1}{h'}.$$

Here the prices r' and w' were replaced by marginal products given technology (10), and ϕ denotes the fraction of human capital employed in market production, which is taken as given by the individual. Since only marginal utilities matter for choices, preferences (54) can be expressed as:

$$U(c_g, k', h') = \log(c_g) + \frac{\partial U}{\partial k'}k' + \frac{\partial U}{\partial h'}h' = \log(c_g) + \beta_k \log(k') + (1 - \beta_k)\log(h'), \quad (55)$$

which is (16). $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\square$

Proof of Lemma 4.2: Start with the original formulation of maximizing (1) subject to (2) to (5), where we denote all variables with a tilde to distinguish them from the ones used in the growth formulation:

$$\max\left\{\log(\tilde{c}_g) + \int_0^1 \log\left(\tilde{C}_i\right)\,di\right\} \quad (56)$$

subject to:

$$\tilde{C}_i = \tilde{C}_{f,i} + \tilde{C}_{m,i} \quad \forall i, \quad (57)$$

$$\tilde{C}_{g,i} = \tilde{E}_{g,i}^{1-\alpha(i)}\tilde{T}_{g,i}^{\alpha(i)} \quad \forall i, \quad (58)$$

$$\tilde{c}_g + \int_0^1 \tilde{E}_{g,i}\,di = \tilde{w}_g\left(1 - \int_0^1 \tilde{T}_{g,i}\,di\right) + \tilde{x}_g. \quad (59)$$

Here have already substituted the time constraint into the budget constraint. Substituting (19) and (20) into the budget constraint (59) gives:

$$\tilde{c}_g + \int_0^1 \tilde{E}_{g,i}\,di = \frac{1}{2}\left[w_g h\left(1 - \int_0^1 \tilde{T}_{g,i}\,di\right) + rk\right] + \tau_k. \quad (60)$$

For i such that $0 \le i \le \beta_k$, we have $\alpha(i) = 0$, so that it is optimal to set $\tilde{T}_{g,i} = 0$ and $\tilde{C}_{g,i} = \tilde{E}_{g,i}$ to a constant $\tilde{C}_g$. Noting this fact, we can substitute (21) to (24) into the

budget constraint (60) to get:

$$c_g + b_g + \int_{\beta_k}^1 \frac{E_{g,(i-\beta_k)/(1-\beta_k)}}{1-\beta_k}\, di = \frac{1}{2}\left[w_g h \left(1 - \int_{\beta_k}^1 \frac{T_{g,(i-\beta_k)/(1-\beta_k)}}{1-\beta_k}\, di \right) + rk \right] + \tau_k. \quad (61)$$

Notice that in equation 61 the inputs corresponding to human capital are indexed from β_k to 1 (index i), whereas in the growth model the index runs from 0 to 1 (index j). Applying the change of variables $i = \beta_k + j(1-\beta_k)$ to the two integrals gives:

$$c_g + b_g + \int_0^1 E_{g,j}\, dj = \frac{1}{2}\left[w_g h \left(1 - \int_0^1 T_{g,j}\, dj \right) + rk \right] + \tau_k, \quad (62)$$

which is the budget constraint (15) of the decision problem in the growth model. The equivalence of the remaining constraints is immediate.

Thus, we have shown that the set of constraints of the decision problem in the growth model is equivalent to the set of constraints for a special case of the general decision problem. What remains to be shown is that the objective functions are equivalent as well. To this end, given (22) and (11) we have:

$$\int_0^{\beta_k} \log\left(\tilde{C}_i \right) di = \beta_k \, \log\left(\frac{b_f + b_m}{\beta_k} \right) = \beta_k \, \log\left(\frac{k'}{\beta_k} \right). \quad (63)$$

Similarly, using (23), (24), and (12) and applying a change of variables as above gives:

$$\begin{aligned}
\int_{\beta_k}^1 \log\left(\tilde{C}_i \right) di &= \int_{\beta_k}^1 \log\left(\sum_{g\in\{f,m\}} \tilde{E}_{g,i}^{1-\alpha(i)} \tilde{T}_{g,i}^{\alpha(i)} \right) di \\
&= \int_{\beta_k}^1 \log\left(\sum_{g\in\{f,m\}} \frac{E_{g,(i-\beta_k)/(1-\beta_k)}^{1-\alpha(i)} T_{g,(i-\beta_k)/(1-\beta_k)}^{\alpha(i)}}{1-\beta_k} \right) di \\
&= (1-\beta_k) \int_0^1 \log\left(\sum_{g\in\{f,m\}} \frac{E_{g,j}^{1-j} T_{g,j}^{j}}{1-\beta_k} \right) dj \\
&= (1-\beta_k) \left(\log\left(h' \right) - \log(1-\beta_k) \right). \quad (64)
\end{aligned}$$

Using (21), (63), and (64), the objective function (56) can be written as:

$$\log(c_g) + \beta_k \log\left(k' \right) + (1-\beta_k) \log\left(h' \right) - \beta_k \log\left(\beta_k \right) - (1-\beta_k) \log\left(1-\beta_k \right). \quad (65)$$

This is (16) up to an additive constant. The utility function in the special case of the

55

general decision problem therefore induces the same preferences as the utility function of the decision problem in the growth model, which completes the proof. □

Proof of Lemma 4.3: Fix the state variables $k > 0$ and $h > 0$, and let c_g, $k' = b_m$, $E_{g,i}$, $T_{g,i}$, and $\bar{i}$ denote the equilibrium choices in the current generation given k and h. Now consider alternative state variables $\tilde{k} > 0$ and $\tilde{h} > 0$. Define ξ as the ratio of output under these and the original state variables:[28]

$$\xi = \frac{\tilde{k}^{1-\theta}\tilde{h}^{\theta}}{k^{1-\theta}h^{\theta}}.$$

We would like to show the following are equilibrium choices given $\tilde{k}$ and $\tilde{h}$: $\tilde{c}_g = \xi c_g$, $\tilde{k}' = \xi k'$, $\tilde{E}_{g,i} = \xi E_{g,i}$, $T_{g,i}$, and $\bar{i}$. We will show this by showing that given these choices, the decision problem at state variables $\tilde{k}$ and $\tilde{h}$ can be reduced to the decision problem at state variables k and h. Recall that the decision problem of spouse g is to maximize (9) subject to constraints (11)–(15).

The budget constraint (15) for spouse g at state variables $\tilde{k}$ and $\tilde{h}$ is given by:

$$\tilde{c}_g + \tilde{b}_g + \int_0^1 \tilde{E}_{g,i}\, di = \frac{1}{2}\left[\tilde{w}_g\tilde{h}\left(1 - \int_0^1 T_{g,i}\, di\right) + \tilde{r}\tilde{k}\right] + \tilde{\tau}_g,$$

where $\tilde{w}_g$ and $\tilde{r}$ are factor prices at state variables $\tilde{k}$ and $\tilde{h}$. Given our conjecture, this can be written as:

$$\xi c_g + \xi b_g + \int_0^1 \xi E_{g,i}\, di = \frac{1}{2}\left[\tilde{w}_g\tilde{h}\left(1 - \int_0^1 T_{g,i}\, di\right) + \tilde{r}\tilde{k}\right] + \xi\tau_g,$$

Next, notice that given our conjecture we have $\tilde{w}_g\tilde{h} = \xi w_g h$ and $\tilde{r}\tilde{k} = \xi rk$. Substituting these expressions and dividing by ξ gives:

$$c_g + b_g + \int_0^1 E_{g,i}\, di = \frac{1}{2}\left[w_g h\left(1 - \int_0^1 T_{g,i}\, di\right) + rk\right] + \tau_g,$$

which is the budget constraint for the state variables k, h. Similarly, we can plug the conjectured values into the constraints (11)–(14), and in each case reduce the constraint for $\tilde{k}$, $\tilde{h}$ to the original constraint for k, h by dividing by ξ or, in the case of constraint (12), by subtracting $\log(\xi)$ on both sides.

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[28]The ratio of output takes this form because the time allocation is the same for the original and the new state variables, which will be verified below.

Hence, we have found so far that the constraint set for ξc_g, $\xi k'$ etc. at state variables $\tilde{k}$, $\tilde{h}$ is the same as the constraints set for c_g, k' etc. at state variables k, h. To show that the conjectured choices at $\tilde{k}$, $\tilde{h}$ are indeed optimal, we still need to show that the preferences over ξc_g, $\xi k'$ and $\tilde{h}'$ given state variables $\tilde{k}$, $\tilde{h}$ are equivalent to the preferences over c_g, k, and h given state variables k and h. Here $\tilde{h}'$ the children's human capital at current state variables $\tilde{k}$, $\tilde{h}$ given the conjectured choices, which is given by:

$$\tilde{h}' = \exp\left(\int_0^1 \log\left((\xi E_i)^{1-i} \left(T_i \tilde{h} \right)^i \right) di \right).$$

Here $E_i = E_{m,i}$ and $T_i = T_{m,i}$ for $i < \bar{i}$ and $E_i = E_{f,i}$ and $T_i = T_{f,i}$ for $i \geq \bar{i}$. To simplify notation, let ϕ denote the fraction of human capital used for production:

$$\phi = \frac{1}{2}\left[1 - \int_0^1 T_{m,i}\, di + \delta\left(1 - \int_0^1 T_{f,i}\, di \right) \right]. \tag{66}$$

Note that under our conjecture, ϕ is a constant that does not depend on current state variables. We can now write the objective function (16) at state variables $\tilde{k}$, $\tilde{h}$ as:

$$\log(\tilde{c}_g) + \beta_k \log(\tilde{k}') + (1 - \beta_k) \log(\tilde{h}')$$

$$= \log(\xi c_g) + \beta_k \log(\xi k') + (1 - \beta_k) \int_0^1 \log\left((\xi E_i)^{1-i} \left(T_i \tilde{h} \right)^i \right) di$$

$$= \log(c_g) + \beta_k \log(k') + (1 - \beta_k) \int_0^1 \log\left((E_i)^{1-i} (T_i h)^i \right) di$$

$$+ \left(1 + \beta_k + \frac{1 - \beta_k}{2} \right) \log(\xi) + \frac{1 - \beta_k}{2} \left(\log\left(\tilde{h} \right) - \log\left(h \right) \right).$$

This is the objective function at state variables k, h plus a constant that does not depend on choices. The objective function thus induces the same preferences, which completes the proof. □

Proof of Proposition 4.1: It will be useful to first characterize the equilibrium choices. Define $\beta_h = 1 - \beta_k$. Using Lemma 4.1, the first-order conditions characterizing the wife's

optimization problem are given by:

$$c_f = \frac{1}{\lambda_f}, \tag{67}$$

$$E_{f,i} \leq \frac{(1-i)\beta_h}{\lambda_f}, \tag{68}$$

$$T_{f,i} \leq \frac{i\beta_h}{w_f \frac{h}{2} \lambda_f}, \tag{69}$$

$$b_f \leq \frac{\beta_k}{\lambda_f}, \tag{70}$$

where (68) and (69) hold with equality for all public goods i that the wife contributes to, and λ_f denotes the multiplier on the budget constraint. The corresponding optimality conditions for the husband are:

$$c_m = \frac{1}{\lambda_m}, \tag{71}$$

$$E_{m,i} \leq \frac{(1-i)\beta_h}{\lambda_m}, \tag{72}$$

$$T_{m,i} \leq \frac{i\beta_h}{w_m \frac{h}{2} \lambda_m}, \tag{73}$$

$$b_m \leq \frac{\beta_k}{\lambda_m}. \tag{74}$$

We can now solve for the multipliers on the budget constraint. Plugging the first-order conditions for the wife back into the budget constraint and using the cutoff rule gives:

$$c_f + \int_{\bar{i}}^1 E_{f,i} \, di = \frac{1}{2} \left[w_f h \left(1 - \int_{\bar{i}}^1 T_{f,i} \, di \right) + rk \right] + \tau_f,$$

$$\frac{1}{\lambda_f} + \int_{\bar{i}}^1 \frac{(1-i)\beta_h}{\lambda_f} \, di = \frac{1}{2} \left[w_f h \left(1 - \int_{\bar{i}}^1 \frac{i\beta_h}{w_f \frac{h}{2} \lambda_f} \, di \right) + rk \right] + \tau_f,$$

$$\frac{1}{\lambda_f} + \int_{\bar{i}}^1 \frac{(1-i)\beta_h}{\lambda_f} \, di = w_f \frac{h}{2} - \int_{\bar{i}}^1 \frac{i\beta_h}{\lambda_f} \, di + r\frac{k}{2} + \tau_f,$$

$$\frac{1}{\lambda_f} + \int_{\bar{i}}^1 \frac{\beta_h}{\lambda_f} \, di = \frac{w_f h + rk}{2} + \tau_f.$$

Solving for λ_f yields:

$$\lambda_f = \frac{1 + \beta_h(1-\bar{i})}{\frac{w_f h + rk}{2} + \tau_f}. \tag{75}$$

Proceeding along the same lines with the male budget constraint (but noting that he will

58

provide the bequests in equilibrium) gives:

$$\lambda_m = \frac{1 + \beta_k + \beta_h \bar{i}}{\frac{w_m h + rk}{2} + \tau_m}. \tag{76}$$

Next, we characterize the cutoff rule for an interior solution. We focus on interior equilibria in which each spouse provides at least part of the human capital input, which implies that the husband (who has the higher wage) provides all of the bequest. Given the first-order conditions, the ratio of female to male preferred public-good provision for human capital good i is:

$$\frac{C_{f,i}}{C_{m,i}} = \frac{E_{f,i}^{1-i}(T_{f,i}h)^i}{E_{m,i}^{1-i}(T_{m,i}h)^i} = \left(\frac{w_m}{w_f}\right)^i \frac{\lambda_m}{\lambda_f}. \tag{77}$$

The condition for the cutoff $\bar{i}$ is therefore:

$$\frac{\lambda_f}{\lambda_m} = \left(\frac{w_m}{w_f}\right)^{\bar{i}} = \delta^{-\bar{i}}, \tag{78}$$

where $\delta < 1$ is the gender gap. The cutoff $\bar{i}$ is characterized by the condition that at $\bar{i}$ female- and male-preferred provision of the public good is equal. Using (77) and the computed multipliers, we can write the cutoff condition as:

$$\left(\frac{1 + \beta_h(1 - \bar{i})}{1 + \beta_k + \beta_h \bar{i}}\right) \left(\frac{\frac{w_m h + rk}{2} + \tau_m}{\frac{w_f h + rk}{2} + \tau_f}\right) = \left(\frac{1}{\delta}\right)^{\bar{i}}. \tag{79}$$

Now, express the transfers as a fraction of output (or output per capita, population size is normalized to one):

$$\tau_f = -\tau_m = \gamma Y,$$

and factor prices as:

$$w_m = \delta^{-1} w_f = \frac{\theta Y}{\phi h},$$

$$r_t = \frac{(1 - \theta)Y}{k},$$

where ϕ is defined in (66) from Lemma 4.3. The cutoff condition can then be written as:

$$\left(\frac{1 + \beta_h(1 - \bar{i})}{1 + \beta_k + \beta_h \bar{i}}\right) \left(\frac{\frac{\theta}{\phi} + 1 - \theta - 2\gamma}{\frac{\delta\theta}{\phi} + 1 - \theta + 2\gamma}\right) = \left(\frac{1}{\delta}\right)^{\bar{i}}. \tag{80}$$

Notice that the left-hand side is strictly decreasing in $\bar{i}$ while the right-hand side is strictly increasing, implying that there is a unique equilibrium. When the equation does not have a solution, the equilibrium is a corner where either husband or wife provide all of the public goods that involve time inputs.

We are now ready to address the issue of the effect of a transfer on growth. The log of output in the next generation is:

$$
\begin{aligned}
\log(Y') &= \log(A) + (1 - \theta)\log(k') + \theta \log(\phi h') \\
&= \log(A) + (1 - \theta)\log(k') + \theta \int_0^1 \left[(1 - i)\log(E_{i,t}) + i\log(T_{i,t})\right]\ di \\
&\quad + \frac{\theta}{2}\log(h) + \theta \log(\phi) \\
&= \log(A) + (1 - \theta)\log(k') + \theta \int_0^{\bar{i}} \left[(1 - i)\log(E_{m,i}) + i\log(T_{m,i})\right]\ di \\
&\quad + \theta \int_{\bar{i}}^1 \left[(1 - i)\log(E_{f,i}) + i\log(T_{f,i})\right]\ di + \frac{\theta}{2}\log(h) + \theta \log(\phi).
\end{aligned}
$$

Plugging in the solutions from the first-order conditions this is:

$$
\begin{aligned}
\log(Y') &= \log(A) + (1 - \theta)\log\left(\frac{\beta_k}{\lambda_m}\right) \\
&\quad + \theta \int_0^{\bar{i}} \left[(1 - i)\log\left(\frac{(1 - i)\beta_h}{\lambda_m}\right) + i\log\left(\frac{i\beta_h}{w_m \frac{h}{2}\lambda_m}\right)\right]\ di \\
&\quad + \theta \int_{\bar{i}}^1 \left[(1 - i)\log\left(\frac{(1 - i)\beta_h}{\lambda_f}\right) + i\log\left(\frac{i\beta_h}{w_f \frac{h}{2}\lambda_f}\right)\right]\ di \\
&\quad + \frac{\theta}{2}\log(h) + \theta \log(\phi).
\end{aligned}
$$

Denote by B the constant that does not depend on current prices or multipliers (and thus not on transfers) to get:

$$
\begin{aligned}
\log(Y') &= B - (1 - \theta)\log(\lambda_m) \\
&\quad - \theta \left[\bar{i}\log(\lambda_m) + (1 - \bar{i})\log(\lambda_f) + \frac{1}{2}\left[\bar{i}^2 \log(w_m) + (1 - \bar{i}^2)\log(w_f)\right]\right].
\end{aligned}
$$

Given that $w_f = \delta w_m$, we can further simplify to:

$$\log(Y') = B - (1 - \theta)\log(\lambda_m)$$
$$- \theta\left[\bar{i}\log(\lambda_m) + (1 - \bar{i})\log(\lambda_f) + \frac{1}{2}\left[\log(w_m) + (1 - \bar{i}^2)\log(\delta)\right]\right]$$

Now consider the effect of a marginal change in the transfer ϵ from husband to wife on output in the next period (i.e., on growth). The derivative of Y' with respect to ϵ is given by:

$$\frac{\partial \log(Y')}{\partial \epsilon} = -(1 - \theta(1 - \bar{i}))\frac{1}{\lambda_m}\frac{\partial \lambda_m}{\partial \epsilon} - \theta(1 - \bar{i})\frac{1}{\lambda_f}\frac{\partial \lambda_f}{\partial \epsilon} - \frac{\theta}{2}\frac{1}{w_m}\frac{\partial w_m}{\partial \epsilon}$$
$$- \theta[\log(\lambda_m) - \log(\lambda_f) - \bar{i}\log(\delta)]\frac{\partial \bar{i}}{\partial \epsilon}.$$

The cutoff condition (78) implies that the term involving $\frac{\partial \bar{i}}{\partial \epsilon}$ cancels, leaving us with:

$$\frac{\partial \log(Y')}{\partial \epsilon} = -(1 - \theta(1 - \bar{i}))\frac{1}{\lambda_m}\frac{\partial \lambda_m}{\partial \epsilon} - \theta(1 - \bar{i})\frac{1}{\lambda_f}\frac{\partial \lambda_f}{\partial \epsilon} - \frac{\theta}{2}\frac{1}{w_m}\frac{\partial w_m}{\partial \epsilon}. \tag{81}$$

Now consider the limit cases when the share of human capital goes to either zero or one. When θ approaches zero, only the first term remains. This term is negative in the limit (an increase in ϵ lowers male consumption, and hence increases λ_m). Hence, when physical capital is the main factor of production, a transfer from husband to wife lowers growth. Next, consider the limit case $\theta = 1$, i.e., human capital is the only factor of production. Totally differentiating the cutoff condition (78) yields:

$$\frac{\partial \bar{i}}{\partial \epsilon}\log(1/\delta) = \frac{1}{\lambda_f}\frac{\partial \lambda_f}{\partial \epsilon} - \frac{1}{\lambda_m}\frac{\partial \lambda_m}{\partial \epsilon}.$$

Using this in (81) together with $\theta = 1$ gives:

$$\frac{\partial \log(Y')}{\partial \epsilon} = -\frac{1}{\lambda_f}\frac{\partial \lambda_f}{\partial \epsilon} + \bar{i}\frac{\partial \bar{i}}{\partial \epsilon}\log(1/\delta) - \frac{1}{2}\frac{1}{w_m}\frac{\partial w_m}{\partial \epsilon}.$$

This expression is identical to equation (48) in the proof of Proposition 3.4 except for the last term. In Proposition 3.4 (which applies here because of Lemma 4.2), we showed that the first two terms combine to be positive, and the last term is positive as well. Hence, the entire derivative is positive: If human capital accounts for all of production, a transfer to the wife increases growth. □

B   The Model with More General Preferences

In the main analysis above, we have relied on log utility and Cobb-Douglas technology to simplify the analysis. In this section, we discuss the extent to which our results can be extended to more general functional forms for utility and the home-production technology. Let preferences be given by:

$$u(c_f) + \int_0^1 U(C_i) \, di,$$

$$u(c_m) + \int_0^1 U(C_i) \, di,$$

where $u(\cdot)$ and $U(\cdot)$ are strictly increasing, strictly concave, and continuously differentiable utility functions that satisfy Inada conditions. The maximization problem of the spouse of gender $g \in \{f, m\}$ is subject to the following constraints:

$$C_i = C_{f,i} + C_{m,i}, \tag{82}$$

$$C_{g,i} = F_i(E_{g,i}, T_{g,i}), \tag{83}$$

$$c_g + \int_0^1 E_{g,i} \, di = w_g(1 - T_g) + x_g, \tag{84}$$

$$\int_0^1 T_{g,i} \, di = T_g. \tag{85}$$

Here $F_i(E_{g,i}, T_{g,i})$ is a home production function that, for each i, is strictly increasing in both inputs, displays constant returns to scale to both inputs combined, strictly diminishing returns to each input individually, and is continuously differentiable.

In equilibrium, each public good i will be provided by only one of the spouses. Denoting by λ_g the multiplier on the budget constraint, the first-order conditions for the individual maximization problem for private consumption c_g and the provision of public goods i that are provided by spouse g are given by:

$$u'(c_g) = \lambda_g,$$

$$U'(F_i(E_{g,i}, T_{g,i}))F_{i,E}(E_{g,i}, T_{g,i}) = \lambda_g,$$

$$U'(F_i(E_{g,i}, T_{g,i}))F_{i,H}(E_{g,i}, T_{g,i}) = w_g\lambda_g.$$

Notice that these constraints hold as equalities only for those i that are provided by spouse g. Given this provision, the constraints have to hold as equalities because the

utility functions are strictly concave, differentiable, and satisfy Inada conditions.

We can use the first-order conditions to derive the preferred provision of public good i by spouse g as a function of private consumption c_g. Namely, let:

$$\tilde{C}_{g,i}(c_g) = F_i(\tilde{E}_{g,i}, \tilde{T}_{g,i}),$$

where $\tilde{E}_{g,i}$ and $\tilde{T}_{g,i}$ are the solution to the system of equations:

$$U'(F_i(\tilde{E}_{g,i}, \tilde{T}_{g,i}))F_{i,E}(\tilde{E}_{g,i}, \tilde{T}_{g,i}) = u'(c_g), \tag{86}$$

$$U'(F_i(\tilde{E}_{g,i}, \tilde{T}_{g,i}))F_{i,H}(\tilde{E}_{g,i}, \tilde{T}_{g,i}) = w_g u'(c_g). \tag{87}$$

This system of equations can be defined for all $i \in [0,1]$. Intuitively, $\tilde{C}_{g,i}(c_g)$ is how much spouse g would provide of good i if he/she were the sole provider and if the value of the Lagrange multiplier on the budget constraint were given by $u'(c_g)$.

We assume for now that a unique solution to the system (86)–(87) exists for all i and all c_g, so that the preferred provision levels $\tilde{C}_{g,i}(c_g)$ are well defined (later, we will also discuss specific functional forms that guarantee that this is the case). We can then ask what properties the preferred provision levels have to satisfy in order to generate a generalized version of Proposition 2.1 above.

Assumption B.1. *The function $\tilde{C}_{g,i}(c_g)$ is strictly increasing and continuous in c_g for $g \in \{f, m\}$ and the expression:*

$$\frac{\tilde{C}_{f,i}(c_f)}{\tilde{C}_{m,i}(c_m)} \tag{88}$$

is strictly increasing in i, for all $c_f, c_m > 0$ (i.e., relative female willingness to pay is increasing in i).

Proposition B.1. *If Assumption B.1 is satisfied, there exists a unique equilibrium characterized by a cutoff $\bar{i}$ such that all public goods in the interval $i \in [0, \bar{i}]$ are provided by the husband m (i.e., the husband provides goods-intensive goods), while public goods in the range $i \in (\bar{i}, 1]$ are provided by the wife f (the wife provides time-intensive goods). If the cutoff $\bar{i}$ is interior, it is determined such that female and male provision of public goods is equalized at the cutoff. Hence, if $\bar{i} \in (0,1)$, the cutoff and private consumption satisfy the condition:*

$$\tilde{C}_{f,\bar{i}}(c_f) = \tilde{C}_{m,\bar{i}}(c_m). \tag{89}$$

Consider now the effects of a transfer from the husband to the wife, i.e., the wife's wealth increases

from x_f to $\tilde{x}_f = x_f + \epsilon$, and the husband's wealth decreases from x_m to $\tilde{x}_m = x_m - \epsilon$, where $\epsilon > 0$. In the new equilibrium, the cutoff $\bar{i}$ is lower. Let $\tilde{i}$ be the new cutoff. If $w_f < w_m$ and if the cutoff is interior both before and after the change, i.e., if $0 < \tilde{i} < \bar{i} < 1$ holds, the provision of public goods that are female-provided both before and after the change ($i > \bar{i}$) goes up. In other words, a transfer to the low-wage spouse increases the provision of public goods provided by this spouse.

Proof of Proposition B.1: Equilibrium requires that each public good is provided by the spouse with the higher willingness to pay. Given that we assume that the ratio of willingness to pay (88) is strictly increasing in i, for any c_f, c_m there either has to be a $\bar{i}(c_f, c_m) \in (0,1)$ that satisfies $\tilde{C}_{f,\bar{i}}(c_f) = \tilde{C}_{m,\bar{i}}(c_m)$, or we can set $\bar{i} = 0$ with $\tilde{C}_{f,0}(c_f) \geq \tilde{C}_{m,0}(c_m)$ or $\bar{i} = 1$ with $\tilde{C}_{f,1}(c_f) \leq \tilde{C}_{m,1}(c_m)$. Moreover, given that willingness to pay is continuously increasing in c_g, $\bar{i}(c_f, c_m)$ is a continuous function of c_f and c_m and at least weakly decreasing in c_f and weakly increasing in c_m. To have an equilibrium, in addition to the public-good provision condition we also need to satisfy individual budget constraints. We can define total spending by the two spouses as:

$$Y_f(c_f, c_m) = c_f + \int_{\bar{i}(c_f, c_m)}^{1} \left(\tilde{E}_{f,i}(c_f) + w_f \tilde{T}_{f,i}(c_f) \right) \, di,$$

$$Y_m(c_f, c_m) = c_m + \int_{0}^{\bar{i}(c_f, c_m)} \left(\tilde{E}_{m,i}(c_m) + w_m \tilde{T}_{m,i}(c_m) \right) \, di.$$

Given Assumption B.1, these functions are guaranteed to be continuous, $Y_f(c_f, c_m)$ is strictly increasing in c_f, and $Y_m(c_f, c_m)$ is strictly increasing in c_m. An equilibrium is given by two numbers c_f, c_m such that the two budget-clearing conditions:

$$Y_f(c_f, c_m) = w_f + x_f,$$
$$Y_m(c_f, c_m) = w_m + x_m$$

are satisfied. A solution exists, because the functions are continuous, $Y_f(c_f, c_m)$ approaches zero as c_f approaches zero, and exceeds $w_f + x_f$ as c_f approaches $w_f + x_f$, with parallel conditions holding for c_m. The solution is also unique. To see why, assume to the contrary that there are two different equilibrium values of female consumption, c_f and $\hat{c}_f < c_f$. For the female budget constraint to be satisfied, $\hat{c}$ would have to correspond to a larger female provision of public goods and thus a lower $\bar{i}$. The lower cutoff, in turn, implies that male consumption must be lower, $\hat{c}_m < c_m$, because male willingness to pay for public goods has to be lower. But this leads to a contradiction, because then the

husband would both have lower private consumption and provide fewer public goods, implying that the budget constraint cannot be satisfied for c_m and $\hat{c}_m$ at the same time.

So far, we have established that for given w_f, w_m, x_f, and x_m, there exists a unique equilibrium characterized by a cutoff $\bar{i}$ for the provision of public goods. Consider now the effects of a transfer from the husband to the wife, i.e., the wife's wealth increases from x_f to $\tilde{x}_f = x_f + \epsilon$, and the husband's wealth decreases from x_m to $\tilde{x}_m = x_m - \epsilon$, where $\epsilon > 0$. Let $\tilde{i}$ be the provision cutoff in the new equilibrium, where we must have $\tilde{i} \leq \bar{i}$ because of the increase in female resources. Consider the case where the cutoff is interior both before and after the change, i.e., if $0 < \tilde{i} < \bar{i} < 1$ holds. We would like to show that the provision of public goods that are female-provided both before and after the change ($i > \bar{i}$) goes up. This is equivalent to showing that we must have $\tilde{c}_f > c_f$, i.e., private female consumption increases. To show this, assume to the contrary that $\tilde{c}_f \leq c_f$. Then we must have that goods with i such that $\tilde{i} \leq i < \bar{i}$ are provided at a lower level than before, because provision is equal to female preferred provision, which has not increased and is strictly lower than the original preferred male provision (because of the restriction on (88) in Assumption B.1), which was the original equilibrium provision. This also implies that $\tilde{C}_{m,\tilde{i}}(\tilde{c}_m) < \tilde{C}_{m,\tilde{i}}(c_m)$ and hence we must have $\tilde{c}_m < c_m$. This, in turn, implies that all male provided goods are provided at a lower level than previously. The fact that male private consumption and male contributions to public goods both fall implies that the amount of the transfer has to be larger than the original full cost of providing the public goods in the range $[\tilde{i}, \bar{i}]$. But this leads to a contradiction, because then the wife receives a transfer that is more than sufficient (given $w_f < w_m$) for the original provision of public goods in the range $[\tilde{i}, \bar{i}]$, yet she lowers the provision of these goods and does not increase the provision of any other goods, implying that the budget constraint has to be violated. □

The proposition shows that the key condition for our main result is that relative female willingness to pay varies across public goods. A wage difference combined with differences in the time-versus-goods intensity of different public goods is one way of generating such differences in the willingness to pay, but clearly any mechanism that creates variation in spouses' comparative advantage at providing different public goods would create similar results.

In the model contained in the main text we generate a difference in willingness to pay that depends only on the time-versus-goods intensity of the production function. While the log-Cobb-Douglas setup that we use leads to the most straightforward characteriza-

tion, this feature carries over to CES production and CRRA utility. To demonstrate this, assume the following functional forms:

$$u(c_g) = \frac{c_g^{1-\sigma}}{1-\sigma},$$

$$u(C_i) = \frac{C_i^{1-\sigma}}{1-\sigma},$$

$$F_i(E_i, T_i) = ((1-i)E_i^\rho + iT_i^\rho)^{\frac{1}{\rho}}.$$

Given these functional forms, the first-order conditions (86)–(87) that pin down the preferred goods and time contributions $\tilde{E}_{g,i}$ and $\tilde{T}_{g,i}$ to public goods can be written as:

$$\left(\left((1-i)\tilde{E}_i^\rho + i\tilde{T}_i^\rho \right)^{\frac{1}{\rho}} \right)^{-\sigma} (1-i)\tilde{E}_i^{\rho-1} \left((1-i)\tilde{E}_i^\rho + i\tilde{T}_i^\rho \right)^{\frac{1-\rho}{\rho}} = (c_g)^{-\sigma}, \tag{90}$$

$$\left(\left((1-i)\tilde{E}_i^\rho + i\tilde{T}_i^\rho \right)^{\frac{1}{\rho}} \right)^{-\sigma} i\tilde{T}_i^{\rho-1} \left((1-i)\tilde{E}_i^\rho + i\tilde{T}_i^\rho \right)^{\frac{1-\rho}{\rho}} = w_g (c_g)^{-\sigma}. \tag{91}$$

Taking the ratio of (90) and (91), we get:

$$\frac{1-i}{i} \left(\frac{\tilde{E}_i}{\tilde{T}_i} \right)^{\rho-1} = \frac{1}{w_g},$$

or:

$$\frac{\tilde{E}_i}{\tilde{T}_i} = \left(w_g \frac{1-i}{i} \right)^{\frac{1}{1-\rho}}. \tag{92}$$

Not surprisingly, the spouse with a lower wage provides public goods in a more time-intensive manner. Notice that the first term in the two-first order conditions contains the preferred provision level $\tilde{C}_{g,i}(c_g)$. Rewriting (91) yields:

$$\left(\tilde{C}_{g,i}(c_g) \right)^{-\sigma} i \left((1-i) \left(\frac{\tilde{E}_i}{\tilde{T}_i} \right)^\rho + i \right)^{\frac{1-\rho}{\rho}} = w_g (c_g)^{-\sigma}.$$

Plugging in (92) gives:

$$\left(\tilde{C}_{g,i}(c_g) \right)^{-\sigma} i \left((1-i) \left(w_g \frac{1-i}{i} \right)^{\frac{\rho}{1-\rho}} + i \right)^{\frac{1-\rho}{\rho}} = w_g (c_g)^{-\sigma}.$$

Simplifying and solving for the preferred provision gives:

$$\left(\tilde{C}_{g,i}(c_g)\right)^{-\sigma}\left((1-i)^{\frac{1}{1-\rho}}\left(w_g\right)^{\frac{\rho}{1-\rho}}+i^{\frac{1}{1-\rho}}\right)^{\frac{1-\rho}{\rho}}=w_g\left(c_g\right)^{-\sigma},$$

$$\left(\tilde{C}_{g,i}(c_g)\right)^{-\sigma}\left((1-i)^{\frac{1}{1-\rho}}+\left(\frac{i}{w_g^\rho}\right)^{\frac{1}{1-\rho}}\right)^{\frac{1-\rho}{\rho}}=\left(c_g\right)^{-\sigma},$$

$$\tilde{C}_{g,i}(c_g)=c_g\left((1-i)^{\frac{1}{1-\rho}}+\left(\frac{i}{w_g^\rho}\right)^{\frac{1}{1-\rho}}\right)^{\frac{1-\rho}{\sigma\rho}}.$$

Notice that these preferred provision levels satisfy the continuity and monotonicity restrictions in Assumption B.1. Moreover, the ratio of preferred female to preferred male provision is:

$$\frac{\tilde{C}_{f,i}(c_f)}{\tilde{C}_{m,i}(c_m)}=\frac{c_f}{c_m}\left(\frac{(1-i)^{\frac{1}{1-\rho}}+\left(\frac{i}{w_f^\rho}\right)^{\frac{1}{1-\rho}}}{(1-i)^{\frac{1}{1-\rho}}+\left(\frac{i}{w_m^\rho}\right)^{\frac{1}{1-\rho}}}\right)^{\frac{1-\rho}{\sigma\rho}}.$$

Since we have $w_f < w_m$, this ratio is indeed strictly increasing in i, which meets the second part of Assumption B.1.

If we combine the CES production function with still more general preferences (such as Stone-Geary), additional effects arise, because relative female willingness to pay for different public goods might vary with both relative and absolute female wealth. However, the presence of a wage gap combined with variation in the time intensity of public goods always creates a force towards female specialization in time-intensive goods. With more general utility functions additional forces may be present, but these will not completely offset the force towards specialization except in knife-edge cases. Even in cases where Assumption B.1 is not satisfied, income transfers between the spouses will have an effect on the equilibrium allocation as long as there is some variation in relative willingness to pay. The direction of the effects could be different, however, if the differences in willingness to pay are mainly due to a factor other than female specialization in time-intensive production.