Worth Fighting For: Daughters Improve their Mothers' Autonomy in South Asia

Rachel Heath and Xu Tan [*]

November 25, 2015

Abstract

In South Asia, parents prize sons for both economic and cultural reasons, and having a son is often thought to improve his mother's status within the household. However, using data from Bangladesh and India, we show that such high regard does not necessarily translate into improved autonomy for her. In fact, a daughter raises her mother's participation in household decisions and her freedom of mobility relative to a son. A daughter also prompts her mother to work more but not necessarily to consume more. These effects are strongest among mothers of older girls. We argue that these results suggest a model in which mothers have greater relative preferences for spending on their daughters than fathers do, and so seek more autonomy to direct resources to their daughters.

1 Introduction

Many mothers and fathers in South Asia report a preference for sons over daughters. Sons do not require dowries, are thought to be more likely to provide support to their aging parents, and are important in certain religious and cultural ceremonies. Accordingly, there is qualitative evidence that a woman's status within the household increases when she has a son. For instance, Das Gupta et al. (2003) argue that "a woman's main source

of standing in her husband's family is as the mother of the future men of the family" (p. 172) and Puri et al. (2011) quote a woman who observes that "everyone in the family is very nice to a woman with a son because she has done her job" (p. 1171).

Despite this high regard, we document that in India and Bangladesh, a woman's participation in household decision-making and freedom of mobility (which we refer to as autonomy[1]) actually increase after having a daughter, relative to a son. A woman's labor supply also increases, but her consumption (as proxied by her body mass index and the occurrence of anemia) does not. By contrast, her husband's labor supply falls after a daughter, relative to son. These patterns persist when we look at a sample of only first-born children – where we find no evidence of sex-selective abortion in either country – so our results do not seem to be driven by the fact that conservative households are less likely to have daughters.

These results are consistent with a model in which a mother cares more about her daughter's consumption than her husband does. We endogenize female autonomy and show that these differential preferences for spending on a daughter prompt a mother increase her autonomy (even when doing so is costly) and her labor supply in order to direct more resources to her daughter.[2] While daughters have many other effects on households in South Asia, we argue that models based on other effects of daughters – but without endogenous female autonomy – do not naturally predict the pattern of empirical results we see. For instance, several models predict that daughters increase their mother's labor supply (daughters decrease a household's permanent income but can help with home production), but we argue that these models make no direct prediction on a mother's autonomy. Working itself could increase a mother's autonomy through improving her negotiation skills or her future earning ability (Atkin 2009; Anderson and Eswaran 2009), but we show that labor supply and autonomy increases when the child is roughly the same age, whereas one might expect for working itself to improve bargaining power with a lag.

A well-known body of research has documented that resources allocated to mothers (or grandmothers) in developing countries differentially improve children's, especially girls', health and education (Thomas 1990; Duflo 2003; Rangel 2006; Doepke and Tertilt 2014). We make a complementary point: women do not only dedicate a greater share of

---

[1]In section 2.1 we discuss how these measures – and the way we model autonomy – relates to theoretical conceptions of autonomy in economics and other disciplines.

[2]By contrast, Li and Wu (2011) focus on women's participation in purchases of consumer durables for the household and find that sons increase their mother's participation in these decisions in China. Since these purchases are not necessarily targeted towards children – the most common include fans, television, and radio – we view this measure of bargaining power as capturing a different dimension from autonomy as we model and examine empirically.

an exogenous income transfer to their daughters than men would. Instead, we argue that they also attempt to exert a greater control over household-wide division of resources if they have stronger preferences for spending on their daughters than their husbands do.

This is a different determinant of women's autonomy than has been highlighted in the economics literature. This literature has highlighted either the characteristics of a woman entering marriage, such as her age (Jensen 2003; Field and Ambrus 2005), caste (Field, Jayachandran and Pande, 2010), or education (Mocan and Cannonier, 2012), or other determinants of her outside option such as her legal rights to property (Field, 2003) and inheritance (Roy 2008; Harari 2013), job availability (Majlesi, 2014), or her own labor market experience (Atkin 2009; Anderson and Eswaran 2009). We argue additionally that even holding constant a woman's characteristics and her institutional environment, she can choose to seek greater autonomy if her gains from doing so are sufficiently high. By extension, the fact that not all women choose to do shows that seeking additional autonomy is not without cost. Our model can then help explain the findings of recent randomized control trials that give women productive inputs or cash transfers but find little effect (Blattman et al. 2014; Haushofer and Shapiro 2013) – or even reductions (Roy et al., 2015) – on standard measures of autonomy, such as their participation in household decision-making. We argue that even if the treatments increase a woman's outside option and could theoretically increase her autonomy, if exercising this autonomy is costly, then women will only do so if they perceive ways in which they would like to change household behavior.

This decision to seek autonomy has been described in qualitative research. Kabeer (1999) describes a women's empowerment as "the process by which those who have been denied the ability to make strategic life choices acquire such an ability" (p. 435). We argue that a desire to direct household spending towards a daughter is one factor that motivates women to undertake this process. Indeed, Kabeer (1997) argues that "women who manage to retain control over their earnings" tend to focus on "altruistic sorts of expenditures" like children's school expenses or private tuition (p. 297).[3]

The desire to spend on a daughter also raises a mother's gains from working, and thereby increases her labor supply. Heath and Tan (2015) also argue that the gains from working increase female labor supply, but focus on inheritance rights that improve a

---

[3]Kabeer mentions this focus on altruistic spending as part of a broader argument that the fact that many women do not seek control over income – and that women who do tend to spend it on others – suggests that there are still "pre-existing hierarchies of claims and decision-making within the household." This theory of uneven baseline levels of autonomy between spouses complements our argument: if women in our model had higher baseline autonomy, the marginal gain from seeking higher autonomy after having a daughter would be lower greater autonomy after having a daughter.

woman's bargaining power and thus affect her ability to control the income that she does earn. In this paper we provide a different – although complementary – explanation: the woman's endogenous desire to control income (not just her exogenous ability to do so) also affects her labor supply.

Finally, our results also help explain the origins of mothers' reported son preference, which in some cases is even stronger than fathers' reported preference (Jayachandran, 2014). We argue that this preference does not necessarily reflect mothers' deeply rooted animosity toward fellow females. Instead, in our model, mothers' equilibrium utility is higher after a son than a daughter even if mothers get the same utility from the well-being of daughters and sons, as long as fathers prefer spending on sons. The mechanism is that mothers know that their husbands are unlikely to spend on daughters, so mothers have to decrease their own consumption and increase their autonomy (which is costly) in order to ensure that resources are devoted to daughters.

The rest of the paper proceeds as follows. Section 2 models the decisions of mothers and fathers to invest in children in a noncooperative household. In section 3 we describe the data and empirical strategy we use to the test the predictions of the model. Section 4 provides results, and section 5 discusses in detail potential alternative models that could explain the fact that daughters raise their mothers' autonomy. Section 6 concludes.

2 A Model of Endogenous Female Autonomy and Investments in Children

2.1 Overview

In this section, we set up a simple model that identifies how a child's gender affects the mother's autonomy in a household setting. In accordance with recent literature that shows that bargaining outcomes between husbands and wives are not necessarily efficient (Duflo and Udry 2004; Robinson 2012; Heath and Tan 2015), we use a noncooperative model that does not impose Pareto efficiency, although the main mechanism would be similar in a collective model (Browning and Chiappori, 1998).[4] In this context, we assume that autonomy is a choice variable that is costly for the wife to exercise.[5] That is, in order to get more say in how money is spent – including on children's human capital

---

[4]In appendix B.4, we explain the collective model in details.

[5]This is not to deny that the woman's outside option also matters for autonomy. In particular, suppose there is baseline level of autonomy that is determined by each spouse's outside option, and the wife gets this autonomy for free. For a given household, the outside options are exogenous, so the baseline autonomy is constant and is normalized to zero in the model.

investments – the wife pays some direct utility cost. So the wife is willing to get more autonomy only when her preferences are sufficiently different from her husband's.

There are several forms that the cost of seeking autonomy could take. It could reflect some sort of (non-monetary) compensation she gives her husband in exchange for greater control over resources. Alternatively, seeking autonomy could create conflicts, as suggested by papers that find that the economic empowerment of women in developing countries can lead to domestic violence (Eswaran and Malhotra 2011; Heath 2014; Anderson and Genicot 2015).[6] Finally, it could represent a psychic cost of deviating from social norms that women do not control resources within the household.

It is worth discussing how autonomy (as we model and assess empirically) relates to theoretical conceptions of autonomy in economics and other disciplines. Anderson and Eswaran (2009) posit that "female autonomy is typically defined as the ability of women to make choices/decisions within the household relative to their husbands." Self determination theory in psychology (Ryan and Deci 2000; Deci and Ryan 2012) defines autonomy similarly as an individual's ability to make decisions that reflect his/her own values rather than those imposed by others, and argues that it is a key source of intrinsic motivation for actions. Of course, the ability to make decisions is fundamentally unobservable, so we follow Anderson and Eswaran (2009) in using measures of realized decision-making, such as whether a woman reports participating in decisions about household purchases. Even if these measures depart to some extent from the precise conceptual definition of autonomy, they still capture the key decision in our model, which relates to the wife's decision to seek control over a certain share of financial resources within the household.[7] Note also that our empirical measures of freedom of mobility (whether a woman needs permission from her husband to go various places) correspond more closely to the ability to make decisions about where to go rather than whether she chooses to make the decisions or not and thus closely reflect theoretical conceptualizations of autonomy.

We begin by laying out a baseline model of parental investments in their children and

---

[6]Of course, women's economic empowerment also improves their outside option, which allows women to either leave or credibly threaten to leave bad marriages and would (ceteris paribus) tend to decrease violence. Indeed, Heath (2014) finds suggestive evidence of these two countervailing effects. Our point is merely that if a woman seeks greater autonomy, violence could result, especially if the greater autonomy is not prompted by an increase in her outside option (as we assume in our theoretical model).

[7]While we could have used the term "control over household resources" throughout the paper to more precisely describe the behavior we capture, we call the key choice variable in the model "autonomy" given its correspondence to autonomy in the model of Anderson and Eswaran (2009). Other papers use the terms "bargaining power" (Atkin 2009; Mocan and Cannonier 2012), "decision-making power" (Majlesi 2014), "participation in household decisions" (Field 2003), or "status" (Jensen 2003), but all relate fundamentally to her participation or ability to make decisions within the household.

the wife's decision to seek autonomy.[8] In the baseline case, the only difference between sons and daughters is the utility their mother and father get from their well-being. Then in section 2.3 we build in various other differences between sons and daughters. Specifically, we consider three cases: daughters contribute time to help mothers with housework, daughters require dowry, and daughters provide lower returns to parental investments of either time or money. In each extension, we show how this additional difference between sons and daughters affects the prediction on increased autonomy. Broadly, these extensions show that incorporating many other effects of daughters in our baseline model does not affect its key prediction that women seek higher autonomy after having daughters.

2.2 Baseline Model

Suppose the wife's utility has the following form:

$$u_f(x_f, z, l_f, a_f) = \beta_f lnx_f + \gamma_f lnz + \delta_f lnl_f + \alpha_f ln(1 - a_f)$$

where her utility depends on her consumption x_f, the well-being of her child z, her leisure l_f, and a cost (α_f) to obtain a given level of autonomy a_f. In this simple model, there is only one exogenous child in the household. As will be seen in the budget constraints to each spouse's maximization problem (equations 1 and 2), the more autonomy the wife has, the more of her income she controls. The wife spends a unit of time on working outside the home e_f, working at home (taking care of the child) h_f, and leisure l_f, so $e_f + h_f + l_f = 1$. An alternative conceptualization of autonomy could be the wife's control of her time. In appendix B.3 we formalize this model and show that it also predicts that daughters prompt their mothers to seek more autonomy.[9]

The husband's utility has an analogous form:

$$u_m(x_m, z, l_m) = \beta_m lnx_m + \gamma_m^{s,d} lnz + \delta_m lnl_m$$

where his utility depends on his consumption x_m, the well-being of his child z, and his

---

[8]Because the model takes the presence of a child as given, we use woman/wife/mother and man/husband/father interchangeably. The variables related to the female always have subscript f and those related to the male always have subscript m.

[9]Our empirical measures of autonomy are a mixture of measures that relate more closely to financial control (a woman's participation in decisions about large household purchases) and those that relate more closely to control over time (whether she can visit her family alone). Others are a mixture of both (whether she can go to a health facility alone). In appendix table A1 we show the effects of daughters on each autonomy measure and we broadly find that daughters seem to increase mothers' control over both financial and time resources.

leisure l_m. The husband spends a unit of time on working e_m and his leisure l_m, so $e_m + l_m = 1$.

To study the effect of child's gender, our baseline model assumes that the husband's utility from a son's well-being is higher than the utility from the daughter's well-being, $\gamma_m^s > \gamma_m^d$. Because the key to our model is the husband's relative preference for spending on a son relative to a daughter (compared to the wife), we assume for simplicity that the wife's preference for child's well-being is independent of a child's gender.[10] Qualitative evidence from South Asia supports the assumption that women tend to have greater relative preference for spending on daughters than do their husbands (Kabeer 2001; Ahmad and Neman 2013), as does the quantitative finding elsewhere in the developing world that money in the hands of women differentially benefits girls' health (Thomas 1990; Duflo 2003).

A possible extension to the model would allow the husband to pay a cost to reduce the wife's autonomy. We show in a related paper (Heath and Tan 2015) that giving women more autonomy can increase their labor supply and thus increase household income, which then improves the husband's utility under fairly general assumptions on the set up of a non-cooperative bargaining game. So it is not necessarily profitable for the husband to reduce the wife's autonomy, and we omit this option in our model. Even aside from the case where more autonomy for the woman benefits the husband, allowing the husband to respond to the wife's pursuit of greater autonomy would not change the main conclusions of the model unless the cost to the husband to do so is so small that he can completely counteract the wife's desire to seek more autonomy after having a daughter.[11]

The well-being of the child depends on the wife's labor contribution h_f and the financial contribution from both spouses $y_f + y_m$. In other words, the child can be viewed as a household public good produced by both spouses. We assume it follows a Cobb-Douglas production function:

$$z = f(h_f, y_f + y_m) = (h_f)^\lambda (y_f + y_m)^\rho$$

in which $\lambda, \rho > 0$. If $\lambda + \rho = 1$, it has a constant return to scale.

The wife earns $w_f e_f$ from her labor force participation, but only controls a fraction of

---

[10]As we mention in the introduction, the assumption that the wife gets equal utility from the well-being of a son and a daughter is not inconsistent with the fact that they tend to report preferences for sons over daughters if these reported preferences represent the equilibrium utility the wife would have in each case and not parameters of the utility function.

[11]For instance, Eswaran and Malhotra (2011) argue that violence is costly to men, but they still sometimes use violence to thwart women's pursuit of higher autonomy. Then unless the cost of violence is very small, the man would respond to – but not completely cancel out – the wife's pursuit of higher autonomy, and the key predictions of our model would go through.

her income, determined by her autonomy a_f.[12] The wife's optimization problem can then be summarized as follows:

$$\max_{x_f,h_f,y_f,e_f,a_f} \beta_f lnx_f + \gamma_f(\lambda lnh_f + \rho ln(y_f + y_m)) + \delta_f ln(1 - e_f - h_f) + \alpha_f ln(1 - a_f)$$

$$s.t. \ e_f, h_f, a_f \in [0,1], \ x_f, y_f > 0$$

$$p_f x_f + y_f \leq a_f(w_f e_f) \tag{1}$$

where p_f is the price of the wife's private good and w_f is the wage the wife can earn. In this baseline case, we assume the only income source for both spouses is their earned income, which simplifies the problem by assuring interior solution to labor supply for both spouses. In section 2.4 and particularly Proposition 2.8, we show that incorporating un-earned income and thereby allowing for corner solutions in labor supply does not change the main conclusion of the model. This is important, since as table 2 shows, less than half of women work outside the home, and the main labor supply data we use provides data on labor supply on the extensive margin.

The husband's optimization problem is similar:

$$\max_{x_m,y_m,e_m} \beta_m lnx_m + \gamma_m^{s,d}(\lambda lnh_f + \rho ln(y_f + y_m)) + \delta_m ln(1 - e_m)$$

$$s.t. \ e_m \in [0,1], \ x_m, y_m > 0,$$

$$p_m x_m + y_m \leq w_m e_m + (1 - a_f)(w_f e_f) \tag{2}$$

where p_m is the price of the husband's private good, w_m is the husband's salary, and the husband controls the rest of the wife's income, $(1 - a_f)w_f e_f$.

The key innovation of the model is letting the wife have the ability to fight for higher autonomy if it is profitable. This endogenous autonomy has a complicated bi-directional relationship with labor supply. On one hand, a higher autonomy increases the gains from working and thereby incentivizes the wife to work more (Heath and Tan 2015). At the same time, a higher labor supply raises the gains from seeking autonomy. This bidirectionality makes the model complicated and potentially non-monotonic. We thus

---

[12]We postulate the same set-up in Heath and Tan (2015). It can be viewed as the reduced form from a wide class of bargaining games. In Heath and Tan (2015), exogenous increases in inheritance rights increased a_f. Here we argue that if the wife wants to increase a_f, she can pay a cost to do so, but we do not take a stand on the exact structure of the bargaining process.

introduce a critical value a^*, which is useful when making monotone predictions.

$$a^* = \frac{\sqrt{\gamma_f \lambda + \delta_f}}{\sqrt{\gamma_f \lambda + \delta_f} + \sqrt{\alpha_f}}$$

We will explain where it comes from after presenting the results.

An equilibrium is *interior* if all variables don't have corner solutions. We focus on interior solution since when both spouse contribute money to the household public good (the well-being of the child), there is a natural link between their utilities and they bargain through it. The corner solution with only one spouse contributing money is discussed in appendix B.2.

Proposition 2.1. *Suppose the Nash equilibrium is interior. If the husband's preference for the public good is lower for a daughter than a son ($\gamma_m^s > \gamma_m^d$), then when the child is a daughter (relative to son):*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the household public good decreases ($y_f + y_m$), if $a_f \geq a^*$.*

All proofs are in appendix A. When the child is a daughter, the husband has a lower preference for spending on the child, prompting the wife to contribute more to the child's financial expenses. So she both works more and fights for a higher autonomy to control more of that income. The increase in her labor supply leads to a decrease in both time working at home and her leisure. The husband, on the other hand, can works less because he doesn't need to pay as much for the child's well-being.

There are two effects moving the monetary contribution to the household public good in opposite directions: a direct effect is the husband's decrease in his contribution, and an indirect effect is the wife's increase in her contribution after working more and fighting for a higher autonomy. As long as $a_f \geq a^*$, the direct effect outweighs the indirect effect, since increasing the contribution is costly for the wife given that she had to pay a price for higher autonomy. In this case, the wife's private consumption and her overall utility are also lower (despite her higher autonomy), because she pays a cost for her autonomy and contributes more to the child's well-being when $\gamma_m^s > \gamma_m^d$.[13]

---

[13]See details in the proof of Proposition 2.1. The predictions on women's consumption and utility are in general ambiguous in the extensions we describe in section 2.3. The woman's real income increases (due to both a higher autonomy and higher labor supply) would tend to increase consumption, but her

We now return to the discussion of a^*. Considering the first-order conditions (FOCs) for e_f, y_f and a_f, we have

$$[e_f]: \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f}, [y_f]: \frac{\beta_f}{a_f w_f e_f - y_f} = \frac{\gamma_f \rho}{y}, [a_f]: \frac{\beta_f w_f e_f}{a_f w_f e_f - y_f} = \frac{\alpha_f}{1 - a_f}$$

The first FOC incorporates an optimal level of h_f. Combining them, we have

$$\frac{\gamma_f \lambda + \delta_f}{1 - e_f} = \frac{\gamma_f \rho a_f w_f}{y}, \quad \frac{\alpha_f}{1 - a_f} = \frac{\gamma_f \rho w_f e_f}{y}$$

Putting the solution of e_f from the first equation into the second equation,

$$\frac{\gamma_f \rho w_f}{y} = \frac{\gamma_f \lambda + \delta_f}{a_f} + \frac{\alpha_f}{1 - a_f} \tag{3}$$

As a_f increases, the RHS of (3) increases when $a_f > a^*$ and decreases otherwise. So when $a_f > a^*$, y decreases as a_f increases. That is, given the husband's preference lower preference for spending on the daughter, the indirect effect – a increase in the wife's investment – doesn't outweigh the direct effect of a decrease of the husband's investment.

By contrast, if $a_f < a^*$, it is possible that the indirect effect outweighs the direct effect, and total financial contribution is actually higher with a daughter. This is due to the non-monotone behavior of e_f and a_f mentioned earlier, due to the reinforcement of labor supply and autonomy: higher autonomy increases the marginal utility from working and higher labor supply increases the marginal utility of autonomy. This reinforcement is stronger when a_f and e_f are not very high, such that it is not very costly both to fight for autonomy and to work more and reduce leisure. With a sufficiently strong reinforcement, indirect effect, more investment from the wife, could outweigh the direct effect, and total investment could actually be higher for daughters than sons. While we point out this theoretical possibility, we do not think it is particularly relevant empirically; while tests of whether spending on children differs by their gender in South Asia do not always detect differences (Duflo, 2005), other studies do greater spending on boys (Kingdon 2005; Zimmermann 2012b), and we are unaware of any studies finding bias in expenditures towards girls. Thus our theoretical predictions consider the case where $a_f > a^*$, which both fits better with existing evidence and yields clearer predictions.

---

the financial contribution to the daughters lowers her consumption (and this autonomy has a utility cost to her). Because of this ambiguity, we focus on predictions on female autonomy and labor supply, which are more straightforward.

Remark 1: High-paying jobs vs. low-paying jobs

Aside from choosing hours of work, suppose women can also choose between different types of jobs. Say there are high-paying jobs w_f^H as managers and supervisors, and low-paying jobs w_f^L as those in agriculture. Assume $w_f^H > w_f^L$, but there is a sunk cost (c) to get a high-paying job. The cost could be a search cost, a training cost and/or a cost to get the husband's consent.

We argue that more women would want to work on high-paying jobs when the child is a daughter. This is because the wife works more and gets a higher autonomy when the child is a daughter from Proposition 2.1, which makes the high salary more attractive. To be more precise, say e_f^* and a_f^* are the equilibrium strategies in a low-paying job, the wife would want to deviate to a high-paying job if $a_f^* w_f^H e_f^* - a_f^* w_f^L e_f^* > c$. It is easier for the inequality to hold when e_f^* and a_f^* are higher. So we get an additional prediction that daughters increase female labor supply particularly into high-paying jobs.

Remark 2: Alternative assumption – daughters lower the cost of autonomy.

The husband's preference of a son over a daughter may have additional effects on his behavior, beyond the effects on his labor supply and contribution to the household public good in the baseline model. For instance, he could pay more attention to supervising the wife when he has a son, in order to make sure the investments in the child more closely align with his preferences. One easy way to incorporate this story is to assume that the cost of autonomy to the wife is lower with a daughter than a son, $\alpha_f^s > \alpha_f^d$.[14]

Proposition 2.2. *Suppose the Nash equilibrium is interior. If the cost of autonomy is smaller with a daughter than a son ($\alpha_f^s > \alpha_f^d$), then when the child is a daughter (relative to son):*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the public good increases ($y_f + y_m$).*

The lower cost of autonomy with a daughter prompts the wife to seek a higher autonomy, which makes working outside more profitable, and as a result she works more outside and less at home. As the wife brings more money back from working, the husband gets to work less. But the household's total income still increases, as does the monetary

---

[14]The husband's response could also be modeled in a principle-agent framework, as in Eswaran and Malhotra (2011). The result would be very similar; a husband would devote less costly monitoring effort to his wife after a daughter than a son, allowing the wife to gain more autonomy.

investment to the public good. So allowing the husband to respond to a son by behaving in a way that makes it more costly for the wife to seek autonomy reinforces our main prediction that wives seek more autonomy after daughters.

2.3 Other Effects of Daughters on the Household

In this section, we extend the baseline model to include several other effects that daughters have on households. Specifically, they can contribute time to housework and present two types of income effects: they require a lump sum payment of a dowry and parents perceive lower returns on human capital investments in them due to lower anticipated future transfers. We shut down the differential preferences channel in these extensions (i.e., we assume that $\gamma_m^s = \gamma_m^d$) to highlight the effects of daughters in these channel, independently of the effects of daughters driven by differential parental preferences. Then, in section 5, we argue that these assumptions about households cannot naturally generate the prediction that women's autonomy goes up in a standard model where female autonomy is a function only of a woman's outside option.

Extension I: daughters help with housework.

One possible difference between daughters and sons is that daughters could help their mothers with some housework. In particular, suppose they contribute H^d hours to produce the household public good. Alternatively, this parameter can reflect daughters' ability to take care of themselves, thereby requiring less time from their mother.

The wife's optimization problem can be summarized as follows ($H^s = 0$ if it is a son),

$$\max_{x_f, h_f, e_f, a_f} \beta_f ln x_f + \gamma_f (\lambda ln(h_f + H^{s,d}) + \rho ln(y_m)) + \delta_f ln(1 - e_f - h_f) + \alpha_f ln(1 - a_f)$$

$$s.t.\ e_f, h_f, a_f \in [0,1],\ x_f > 0,\ p_f x_f \le a_f(w_f e_f)$$

Proposition 2.3. *Suppose the Nash equilibrium is interior. If daughter helps with housework, i.e. the total time on housework is $h_f + H^d$ with a daughter, then when the child is a daughter (relative to son):*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the public good increases ($y_f + y_m$).*

12

Since the daughter frees the wife from housework, the wife can work more outside the home and less at home. As she earns more, it is beneficial to get a higher autonomy. With the wife working more and contributing more to the household hold public good, the husband can work less and enjoy more leisure.

Extension II: daughters cost more – dowry

The second difference between sons and daughters is the need to provide daughters with dowry, which decreases a household's permanent income and could prompt both parents to work more (Deolalikar and Rose, 1998). In a static model, we assume that the household needs to save an exogenous amount D^d for the daughter's dowry. So after paying the dowry, the total contribution to the household public good is $y_f + y_m - D^d$, while we set $D^s = 0$.

Proposition 2.4. *Suppose the Nash equilibrium is interior. If daughter requires dowry, i.e. the monetary investment in a daughter is $y_m + y_f - D^d$, then when the child is a daughter (relative to son):*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works more outside (e_m), if $a_f \geq a^*$.*

- *The monetary investment to the public good decreases ($y_f + y_m - D^d$), if $a_f \geq a^*$.*

Since the daughter brings a negative income shock, both spouses have to work more to pay for the dowry. The wife fights for a higher autonomy because her increased labor supply raises the marginal gains to autonomy, and because the lump-sum dowry taken out of the contribution to the household public good raises the marginal returns to investment in the daughter (since the production of child quality is concave).

Extension III: daughters give lower return to investment.

It is possible that the income effect of daughters is of a different form than the lump-sum dowry cost in extension II. Specifically, consider the possibility that there are lower returns to parents to investment in a daughter compared to a son (Rosenzweig and Schultz 1982; Rose 2000), either because the labor market returns to girls' human capital are lower or parents value returns less (even if they are equal) if they anticipate lower transfers from daughters after marriage. Specifically, we assume the return to financial contribution ($\rho^{s,d}$) and/or to time contribution ($\lambda^{s,d}$) depends on the child's gender, and investments

13

in daughters give a lower return: $\rho^s > \rho^d$ and/or $\lambda^s > \lambda^d$.

$$z = f(h_f, y_f + y_m) = (h_f)^{\lambda^{s,d}}(y_f + y_m)^{\rho^{s,d}}$$

Proposition 2.5. *Suppose the Nash equilibrium is interior. If the return to monetary investment decreases when it is a girl ($\rho^s > \rho^d$),*

- *The wife works less outside (e_f), more at home (h_f), and gets a lower autonomy (a_f).*

- *The husband works less outside (e_m), if $a_f \geq a^*$.*

- *The monetary investment to the public good decreases ($y_f + y_m$).*

As the return to monetary investment is lower with a daughter, both spouses work less outside, and the wife works more at home. She needs a lower autonomy because she doesn't need to spend much on the household public good and she works less. Thus, the total financial contribution into the public good goes down.

Proposition 2.6. *Suppose the Nash equilibrium is interior. If the return to time investment in the public good decreases when it is a girl ($\lambda^s > \lambda^d$),*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the public good increases ($y_f + y_m$).*

As the return to the time investment is lower with a daughter, the wife works less at home and more outside. She fights for a higher autonomy because she works more. Since the wife earns more, she contributes more to the household public good, which allows the husband to contributes less and thus works less. But the decrease in the husband's contribution will not completely offset the increase from the wife's contribution, so the monetary investment to the household public good increases.

To summarize the extensions to the baseline model presented in this subsection, most of these extensions reinforce the tendency for mothers to seek higher autonomy. In particular, while proposition 2.5 and proposition 2.6 give different predictions on the effect of lower returns to investment on girls in the wife's autonomy, the aggregate effect of a decreased return to both time and financial investment depends on which effect dominates. If the decrease in the return of time investment is more severe, we still predict an increase in female autonomy, especially if the channel linking dowry to mother's autonomy (proposition 2.4) or the effect of daughters' help with housework on their mother's autonomy (proposition 2.3) are also important.

2.4 Focusing on Women Who Do Not Work Outside the Home

In our baseline model, a woman seeks higher autonomy for two reasons: one is driven by preferences and the desire to spend on things she values more than her husband (such as a daughter), the other is that an increase in income raises the marginal returns to autonomy. By assuming parental preferences for spending on sons and daughters are equal ($\gamma_m^s = \gamma_m^d$), the previous subsection isolated the latter channel.[15] This channel predicts that a woman will seek more autonomy if she is compelled to work more for any reason, which could be a daughter (as in the previous subsection) or any other income or labor demand shock.

While this channel still relates daughters to mother's autonomy in an endogenous autonomy model, we provide suggestive evidence that differential preferences for spending on daughters are at least part of the mother's decision to seek autonomy after having a daughter. To do so, we consider a restricted scenario in which women do not have the option to work outside the home. If women still seek higher autonomy after having a daughter in this scenario, this autonomy would be used to change the spending of a fixed budget rather than assert control over income from increased female labor supply prompted by the daughter. Focusing on women who cannot work also separates the endogenous decision to seek more autonomy from the possibility that working more increases baseline autonomy (Anderson and Eswaran 2009).

Of course, the women we observe empirically who do not work have endogenously chosen to do so. If the decision to work is related to their baseline autonomy (as in Heath and Tan (2015)), focusing on this does not give the causal relationship between daughters and mothers' autonomy if women did not have the option to work (as we will model theoretically). So we first use our model to assess how this selection effect would affect an empirical assessment of the relationship between daughters and mothers who do not work. In order to do so, we add two new components to the model: the wife's baseline autonomy a_0 and unearned income R_f.[16] The wife's maximization problem becomes:

$$\max_{x_f, e_f, h_f, y_f, a_f} \beta_f \ln x_f + \gamma_f(\lambda \ln h_f + \rho \ln(y_f + y_m)) + \delta_f \ln(1 - e_f - h_f) + \alpha_f \ln(1 - a_f)$$

---

[15]One of the wife's motives for seeking dowry in extension III represents an intermediate case: the lump sum payment for dowry raises the marginal returns to investment in the public good, and the wife fights for more autonomy given the increasing gains to contributing. So this channel results from a desire to spend on the daughter, but unlike the main model it remains even if the wife and husband have the same preference for spending on a daughter, versus a son.

[16]Building in unearned income is necessary when we focus on the extensive margin of labor supply because otherwise she would have zero consumption – and infinitely negative utility – when she does not work.

$$s.t. \ e_f, h_f, a_0 + a_f \in [0,1], \ x_f, y_f > 0, \ p_f x_f + y_f \leq (a_0 + a_f)(w_f e_f + R_f)$$

The wife gets her baseline autonomy for free, so the cost is only related to the additional autonomy a_f, which yields overall autonomy $a_0 + a_f$.

Proposition 2.7. *Suppose the Nash equilibrium is interior. If the baseline autonomy increases, the wife works more outside the home (e_f).*

As the wife gets a higher baseline autonomy, she gets a higher control over her earnings so it is optimal for her to work more. Suppose there are two thresholds t^d and t^s, and if the wife's baseline autonomy is higher than t^d (or t^s) she goes out to work when it is a daughter (or a son). When we predict a daughter increases the wife's incentive to work, $t^d < t^s$. When we focus on women who don't work, we compare women with $a_0 < t^d$ with a daughter to women with $a_0 < t^s$ with a son. If anything, this selection bias itself makes women with a daughter show a lower autonomy. With this potential bias in mind, we focus on women who don't work and re-examine the possible effects of a girl. (We omit the baseline autonomy.)

Proposition 2.8. *Suppose the Nash equilibrium is interior and the wife gets an unearned income R_f but cannot work outside the home. Then when a child is a girl, relative to a son,*

- *If $\gamma_m^s > \gamma_m^d$, the wife seeks a higher autonomy (a_f), works the same at home (h_f), the husband works less (e_m), and the investment to the public good decreases ($y_f + y_m$).*

- *If $\alpha_f^s > \alpha_f^d$, the wife seeks a higher autonomy (a_f), works the same at home (h_f), the husband works the same (e_m), and the investment to the public good remains the same ($y_f + y_m$).*

- *If $H^d > 0$, the wife seeks the same autonomy (a_f), works less at home (h_f), the husband works the same (e_m), and the investment to the public good remains the same ($y_f + y_m$).*

- *If $D^d > 0$, the wife seeks a higher autonomy (a_f), works the same at home (h_f), the husband works more (e_m), and the investment to the public good decreases ($y_f + y_m - D^d$).*

- *If $\rho^s > \rho^d$, the wife seeks a lower autonomy (a_f), works the same at home (h_f), the husband works less (e_m), and the investment to the public good decreases ($y_f + y_m$).*

- *If $\lambda^s > \lambda^d$, the wife seeks the same autonomy (a_f), works less at home (h_f), the husband works the same (e_m), and the investment to the public good remains the same ($y_f + y_m$).*

When the channel of working outside is shut down, the predictions on female autonomy in point 2 and point 5 change from increased autonomy to constant autonomy.

In these two channels, the direct effect of a daughter is on the time spent on household public good, i.e. the daughter helps with housework or she gives a lower return to it. When working outside is feasible, the wife responds by increasing her labor supply, which makes it is profitable to fight for a higher autonomy. While when working outside is not feasible, the effect of housework is no longer related to the wife's autonomy. By contrast, the wife still seeks higher autonomy to spend more of her unearned income on her daughter if her husband prefers spending on a son ($\gamma_m^s > \gamma_m^d$).

Table 1 summarizes the predictions on autonomy in scenarios both with and without female labor supply. The first column points out that the baseline model, which is driven by differential preferences for spending on a daughter, the wife seeks more autonomy – even when she cannot work outside the home – in order to spend more on her daughter. If she can work outside the home, the autonomy is also driven by the desire to increase control over increased income prompted by her daughter. The assumption that the cost of seeking autonomy is lower with a daughter ($\alpha_f^s > \alpha_f^d$) delivers similar predictions, and we consider it closely related to the main model. By contrast, the extensions to the model in columns 3 through 6 do not predict higher autonomy if the wife cannot work outside, with the exception of the dowry scenario. Because the increased autonomy prompted by the need to pay dowry – given the high return on the marginal investment after paying the dowry – is still motivated by a desire to direct resources to her daughter (even when it is costly to do so), we also view it as closely related to the main model.

	(1) $\gamma_m^s > \gamma_m^d$	(2) $\alpha_f^s > \alpha_f^d$	(3) $H^d > 0$	(4) $D^d > 0$	(5) $\rho^s > \rho^d$	(6) $\lambda^s > \lambda^d$
wife can work outside	higher a_f	higher a_f	higher a_f	higher a_f	lower a_f	higher a_f
wife cannot work outside	higher a_f	higher a_f	constant a_f	higher a_f	lower a_f	constant a_f

Table 1: *The effect of a daughter on women's autonomy, when the husband has a lower preference for a girl ($\gamma_m^s > \gamma_m^d$), when daughter lowers the cost of autonomy ($\alpha_f^s > \alpha_f^d$), when the daughter helps with the housework ($H^d > 0$), when daughter costs dowry ($D^d > 0$), and when daughter gives a lower return to monetary and/or time investment ($\rho^s > \rho^d$ and/or $\lambda^s > \lambda^d$).*

2.5 Summary of Testable Predictions of Theoretical Model

In the following empirical analysis, we concentrate on predictions on the wife, the key actor of interest in the model. The testable predictions on her behavior are: conditional

on having a child, when it is a daughter, the mother's labor supply increases, especially into high-paying jobs. The mother seeks more autonomy for two reasons – to direct more resources to her daughter given her greater relative preference for investment in her daughter, and because her increased labor supply increases the marginal gains to additional autonomy. To focus on the preference channel, we look at the relationship between daughters and mother's autonomy in the endogenous subsample of women who do not work outside the home. Our model predicts that daughters increase their mother's autonomy in this subsample, as long as the selection effect (that women who choose not work even with a daughter have particularly low baseline autonomy) does not outweigh the causal effect of daughters on mother's autonomy.

While the empirical component of this paper focuses on predictions on the mother's behavior, it is also worth noting that the model's other predictions are broadly consistent with empirical findings about gender in South Asia. In particular, the baseline model predicts that both money investment in girls will generally be lower than investment in boys, since the mother's increased investment is unlikely to compensate for the father's decreased investment. Time investment is also lower in girls as mothers devote more time to working outside the home. This prediction also holds in unitary household models if girls represent a negative income effect (as in extension III to our model) or if parents perceive lower returns on investment in girls (as in extension II to our model). While not every study finds evidence for differential treatment (Duflo, 2005), other studies in South Asia find evidence that parents invest less money (Kingdon 2005; Zimmermann 2012*b*) and less time (Jayachandran and Kuziemko 2011; Bharadwaj and Lakdawala 2013; Barcellos, Carvalho and Lleras-Muney 2014) in girls than boys, especially after bad economic shocks (Rose, 1999).

The model's prediction that male labor supply falls as the father invests less in the daughter (unless the income effects of a dowry, as in extension II, counteract this effect) are also supported by Rose (2000). In particular, she finds that while female labor supply increases after a daughter, male labor supply falls. Her explanation for these results focuses on the premise that returns to time investment in son are higher than time investments in daughters in a unitary household model, which prompts women to work more at home and husbands to work more outside the home to compensate for the wife's decreased labor supply. While extension III to our model shows that a noncooperative bargaining model also predicts a similar increase in male labor supply after a boy if time investments in a boy are more valuable than time investments in girls, our baseline model predicts that fathers work less after daughters even if the returns to time investment do not differ by gender of the child.

18

Empirically, we assess whether the relationship between daughters and male and female labor supply on the intensive margin (shown by Rose (2000) in three ICRISAT villages) holds in National Sample Survey data from India.[17] We explain the estimation in appendix C and give the results in table A2. While we highlight some caveats to those results – in particular, only children currently living in the household are observed – the results are nonetheless broadly consistent with Rose (2000) and the predictions of our theoretical model: male labor supply decreases after a daughter and female labor supply increases.

3 Empirical Strategy

3.1 Data and Measures of Autonomy

For India our main measures of women's autonomy come from the National Family Health Survey of 2005-2006. For Bangladesh, we use the 2007 and 2011 rounds of the Demographic and Health Survey (DHS). Each survey includes a nationally representative sample of ever-married women between the ages of 15 and 49. Thus, we cannot estimate the effects of child gender on older women, or on the small sample of births that are to women who have never been married.[18]

Because the National Family Health Survey is designed to be comparable to DHS surveys conducted worldwide, several of the questions we use to capture autonomy are asked in both surveys. In particular, both surveys ask women who typically makes decisions about the woman's own health care, large household decisions, and purchases for daily life; possible options are the husband, wife, or both. The India survey additionally asks who makes decisions about spending the husband's earnings and visiting relatives. It also contains measures of a woman's freedom of mobility, in particular, whether she can go alone to the market, health facility, or places outside her village. Finally, it asks whether she has access to a bank account.

Table 2 provides summary statistics for sampled women with at least one child in both countries. In both countries this sample of women tends to have low education (5.1 years in India and 4.7 years in Bangladesh) and were married at a young age (17.9 years in India and 15.4 in Bangladesh). Women in India are more likely to work outside the home than women in Bangladesh (37 percent of women with at least one child in India, versus

---

[17]The Bangladesh census does not collect labor supply data. While the nationally representative Housing Income and Expenditure Survey does, it only collects individual-level labor supply data on wage labor.

[18]Fledderjohann et al. (2014) report that only 2 percent of births in India were to unmarried mothers.

	India	Bangladesh
age	32.879	31.51
years of education	5.139	4.72
age at first marriage	17.829	15.47
children	3.04	2.95
bmi	21.495	21.36
works outside home	0.351	0.191
say in own health care	0.683	0.628
say in large household purchases	0.606	0.601
say in visits to family	0.674	
say in purchases for daily needs	0.684	0.632
say in spending husband's earnings	0.732	
can go to market alone	0.635	
can go to health facility alone	0.592	
can leave village alone	0.468	
has access to a bank account	0.188	
N	79,827	25,036

Table 2: Summary Statistics

20 percent of women in Bangladesh). Nonetheless, in the decision-making variables that were asked in both countries, women describe similar levels of autonomy; between sixty and seventy percent of women in both countries report some say in decisions about their own health care, large household purchases, and daily household purchases.

Because we have many outcomes that reflect autonomy, our main outcome of interest is an index of the individual autonomy measures. For the decision-making variables, we focus on whether a woman has some power over each decision.[19] We construct this index by normalizing each variable so that it has mean zero and standard deviation one, and then summing the normalized variables. In appendix table A1 we provide the estimation results of child gender on each component of the index to show that the results are not just driven by a small portion of the autonomy measures.

---

[19]The fact that a woman has sole control over a decision (relative to having some say in) may not capture additional bargaining power if this outcome reflects the fact that her husband leaves her on her own to control the household.

3.2 Estimating Equations and Identification Concerns

We estimate the effects of a child's gender on her mother's autonomy and labor supply (on the extensive margin) using two different specifications. The first uses the gender of the entire sample of a mother's children. So for a woman i, we test whether the number of daughters affects an outcome Y_i conditional on her total number of children:

$$Y_i = \beta_1 Children_i + \beta_2 Daughters_i + x_i'\delta + \epsilon_i \tag{4}$$

The mother-level control variables in $x_i'\delta$ are a set of variables that are very unlikely to change in response to overall fertility or the children's gender: the mother's years of education, state of residence, whether she lives in a rural area, and dummies for her year of birth and whether she is a member of a scheduled caste, scheduled tribe, or other backward caste (in India).

Importantly, $Children_i$ and $Daughters_i$ report total children ever born to the women, regardless of whether the children are still alive at the time of the survey, which avoids the reverse causality concern that would arise if only mothers who have high autonomy already can dedicate enough resources to daughters to ensure that they survive. This equation then estimates the causal effect of child gender on the mother's outcomes under the assumption that conditional on the number of children and their order, the gender of a child at birth is random. While the spread of ultrasound technology that facilitates sex-selective abortion may cause this assumption to fail – a possibility we discuss in detail below – we nonetheless think that a useful point of departure is to use all of the variation in gender that we observe.

To address the possibility that unobserved household-level factors drive both women's outcomes and the sex ratio at birth of their children in several ways, we consider the sample of first births, where previous research has found little evidence of sex selective abortion (Pörtner 2010; Bhalotra and Cochrane 2010; Rosenblum 2013). Indeed, figure 1 shows that 48.5 percent of first births in India are female, which is within the natural range (Chahnazarian, 1988). In Bangladesh, the confidence interval for all births lies within the natural range.

By contrast, subsequent births in India do fall outside of this range, suggesting sex-selective abortion at higher parities. To help understand the effects that this potential selection may have in equation 4, figure 2 examines the relationship between parental and household characteristics and the probability that a child is a girl. In India, the largest determinant is wealth: a one standard-deviation increase in wealth decreases the probability that a child is a girl by 0.73 percentage points. This pattern likely reflects both their

better access to ultrasounds and the fact that their smaller desired family increases son bias (Bhalotra and Cochrane, 2010), and also the possibility that biological channels such as poor nutrition during pregnancy (Almond and Mazumder, 2011) may cause boys to be missing in poor families.[20] Regardless of the cause, because wealth is associated with higher female autonomy – a one standard deviation increase in wealth corresponds to a 0.26 standard deviation increase in autonomy ($P < 0.001$) – it is likely that any bias from wealth or related measures of socioeconomic status would work against finding higher autonomy. Urban households,[21] Muslim households, and households from scheduled castes and scheduled tribes are marginally more likely to have female children. Interestingly, conditional on the other controls, neither mother's nor father's education increases the probability of a girl.

Even though we argue that the most likely selection bias goes in the opposite direction, the evidence of sex-selective abortion in India for births after the first nonetheless motivates our second empirical strategy, which involves re-estimating equation 4 using only the gender of the firstborn child:

$$Y_i = \beta FirstBirthFemale_i + x_i'\delta + \epsilon_i \tag{5}$$

This gives the causal effect of having a first-born girl on the mother's outcome, under the assumption (supported by figure 1) that there is no selection in the gender of the first child.

Even if child sex at birth is random, there is considerable theoretical justification and empirical evidence that South Asian families change subsequent behavior in response to the sex of a child. For instance, son-biased stopping rules for fertility predict that parents are more likely to have another child after the birth of a girl than a boy (Clark 2000; Jensen 2003; Rosenblum 2013). The prevalence of dowries and lower anticipated lifetime transfers also dictate that the birth of a daughter (relative to son) decreases a family's permanent income (Deolalikar and Rose, 1998). Thus, if we continue to include only predetermined controls in $x_i'\delta$, the effect of child gender on household outcomes reflects both direct responses to the child's gender and indirect effects of actions a household taken by a household to reoptimize after learning a child's gender.

Some authors have argued that examining outcomes in a short time horizon after a

---

[20]Moreover, since wealth is measured at the time of the survey and not at the time of the child's birth, these channels appear to dominate the fact that daughters increase savings as households save for their dowries (Deolalikar and Rose, 1998).

[21]When we eliminate the other control variables, the sign of the coefficient reverses: rural households are more likely to have daughters, driven largely by the fact that they are less wealthy and disproportionately lower caste.

child's birth limits the opportunity that households have to reoptimize in response to a child's gender and therefore isolates direct behavioral responses to the gender of the child (Zimmermann 2012*a*; Barcellos, Carvalho and Lleras-Muney 2014). However, because the differential preferences in the main model may be especially salient at different ages of the daughter, we consider the overall effect of child gender at all ages of the offspring, inclusive of these indirect effects. Therefore, we do not limit our sample to the mothers of very young children, but instead, in section 2.3 we built these behavioral responses into our model and show that in general the main prediction that mothers seek more autonomy after having daughters remains. Relatedly, in section 5 we will argue that behavioral responses to the birth of a daughter are unlikely to explain the entire increase in mother's autonomy unless we also consider the endogenous autonomy response we model. Note, however, that because equation 4 estimates the effect of the number of daughters conditional on total fertility, this equation shuts down the effect of daughters on mothers' subsequent fertility as a potential channel linking daughters to autonomy.

The ages of children indeed matter for the relationship between child gender and mother's autonomy. Using the same India data as we do but focusing on only the mothers of young children, Zimmermann (2012*a*) finds small positive effects of a having a boy on a mother's autonomy in the child's first months of life, but these effects disappear once the child is 6 months old. Our overall finding that daughters increase their mother's autonomy suggests that the autonomy sought by mothers of older daughters eventually dominate the short-term boost in status a mother enjoys after having a boy. In section 4 we explicitly consider how the effects of child gender vary by the child's age and confirm that the positive effect of daughters on mother's autonomy is driven by older daughters.

4   Results

In table 3 we present results from equations 4 and 5 that estimate the effects of a daughter on her mother's autonomy and labor supply in India and Bangladesh, first using all births and then just the first birth. In both countries and in both samples, having a daughter leads to positive and statistically significant increases in her mother's autonomy. To contextualize the size of the effect, we compare it to the coefficient on an additional year of education. In India, the autonomy index increases by 0.058 units for each child that is a daughter, relative to a son, (versus 0.156 for an additional year of education), and if her first child is a girl a mother's autonomy index increases by 0.115 units compared to when her first child is a son. Note that the sum of the positive coefficient on the number of daughters and the negative coefficient on children overall is slightly positive (al-

India
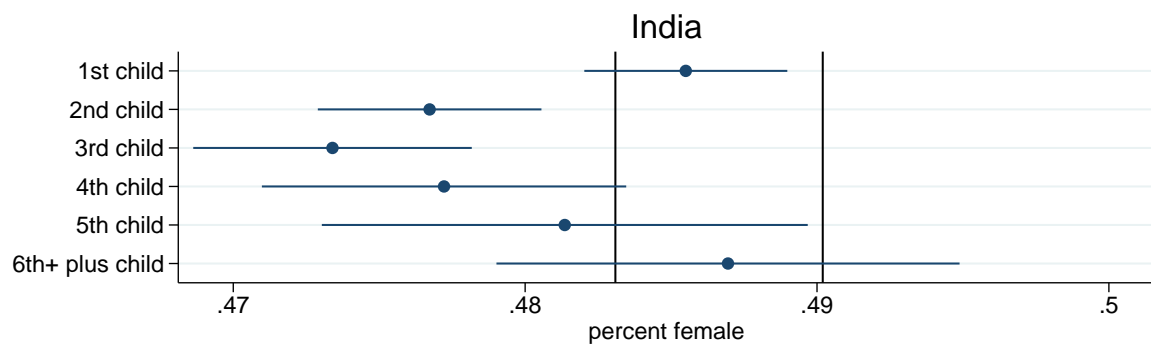
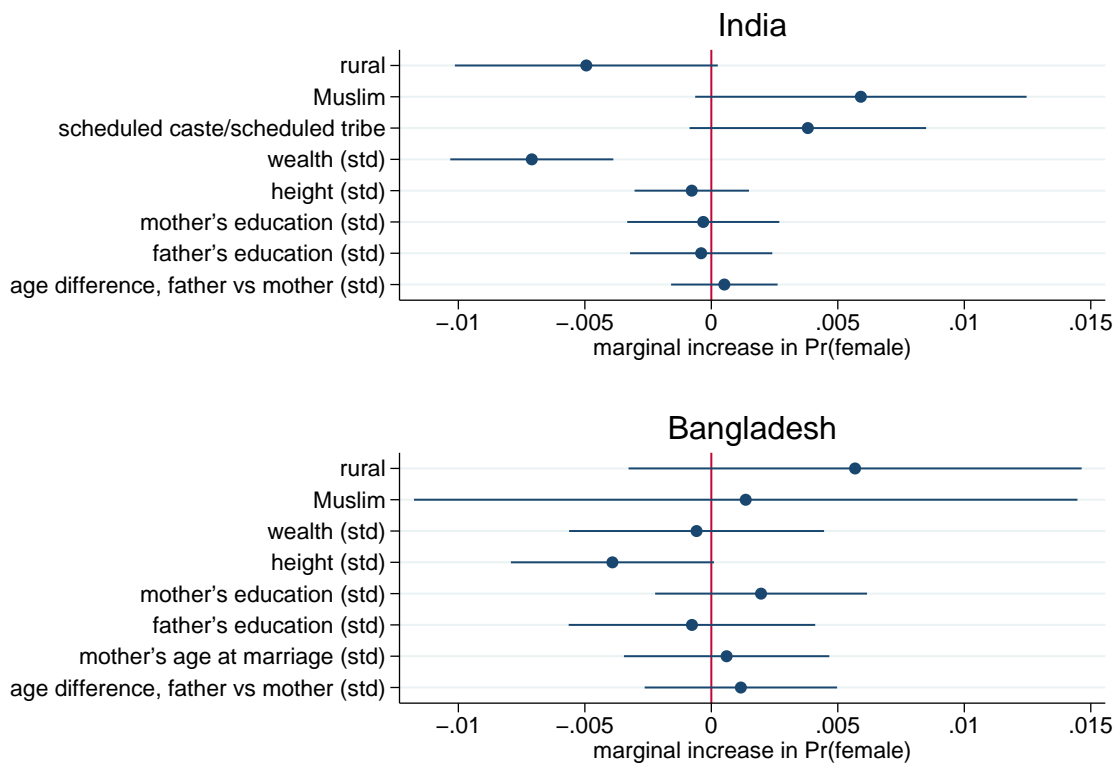Sample: married women in NFHS, 2005–2006.

Bangladesh
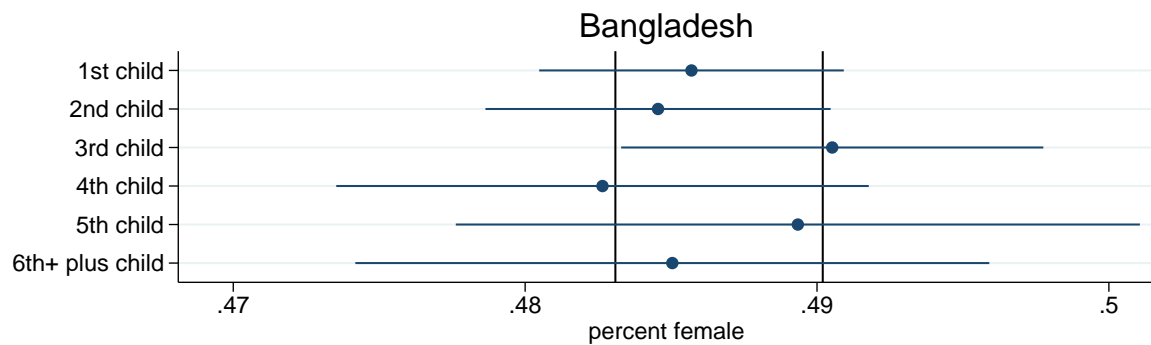
Sample: married women in DHS, 2007 and 2011.

Vertical lines denote natural range of sex ratio at birth in Chahnazarian (1988)

Figure 1: Sex ratio, by birth order

Figure 2: Correlates of a female birth

though not significantly different from zero), implying that the negative correlation between the number of children she has and a mother's autonomy is driven entirely by sons. In Bangladesh, the effect of a daughter, relative to a son, on the autonomy index is actually several times larger than the increase from an additional year of education: 0.083 for each child that is a daughter (versus 0.022 for each additional year of education), and 0.101 in the sample of the first child. While, unlike in India, the overall effect of a daughter on autonomy is negative ($P = 0.093$), it is still several orders of magnitude lower for a girl (0.028 units) than for a boy (0.110 units).

Turning to labor supply, in India each daughter is associated with a 0.46 percentage point increase in the probability that her mother works outside the home (relative to the effect of a son); a firstborn daughter is associated with a 0.84 percentage point increase. Note that the effects of a daughter on both labor supply and autonomy in India are if anything larger in the sample of only firstborn children, coinciding with figure 2 in suggesting that if anything, sex selective abortions are biasing the true causal effect of daughters downward. In Bangladesh the effects are again even larger. Each daughter there is associated with a 1.20 percentage point increase in the probability that her mother works, while a firstborn daughter increases the probability that her mother works by 1.64 percentage points.

In table 4 we break down the labor supply by the type of job that a woman enters. A consistent pattern emerges: daughters prompt women to work in jobs outside of the home throughout the year, for cash, and for another person (rather than for themselves or for a family member). Furthermore, these jobs are in professional, clerical, or manual sectors, but not agriculture.[22] In Heath and Tan (2015) we find that an inheritance law reform increased women's autonomy, which increased their labor supply into these jobs, which we argued were likely to be high-paying. Increased labor supply into high-paying jobs is consistent with remark 1 of our baseline model, in which there is a cost to obtaining higher wage jobs, which women are more likely to seek out after having a daughter.

We now assess whether the effects of child gender vary with the age of the child. Specifically, we allow the effects of child gender in equations 4 and 5 to vary based on

---

[22]Our result stands in contrast to Rose (2000), who found that daughters increase their mother's labor supply in agriculture. Note that her measure of labor supply is on the intensive margin, and one way of reconciling these two sets of results is a model in which the extensive margin of labor supply in agriculture is more responsive to factors that predate child gender such as the household's landholdings.

	India		Bangladesh	
	Autonomy index	1(Work)	Autonomy index	1(Work)
daughters	0.0584**	0.0046*	0.0829***	0.0120***
	[0.0267]	[0.0024]	[0.0206]	[0.0033]
children	-0.0312	0.0000	-0.1108***	-0.0229***
	[0.0229]	[0.0021]	[0.0175]	[0.0028]
first birth female	0.1153**	0.0084**	0.1010***	0.0164***
	[0.0458]	[0.0041]	[0.0352]	[0.0058]
mother's education	0.1558***	-0.0124***	0.0218***	-0.0039***
	[0.0057]	[0.0005]	[0.0039]	[0.0008]
Mean Dep. Var.	0.000	0.351	0.000	0.192
Std Dev of Dep. Var.	5.233	0.477	2.500	0.393
Observations	79,827	79,686	25,028	25,025
R-squared	0.198	0.145	0.052	0.102

*Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights included. Controls not shown include age fixed effects, dummy for rural location, Hindu religion, region FE's (Bangladesh), state FE's (India), dummies for scheduled caste, scheduled tribe, and other backward caste (India) and survey round (Bangladesh). The autonomy index in India is an aggregate of whether the woman has say in large household decisions, purchases for daily life, her own health care, visits to family, and spending her husband's income. Additionally, it includes whether she has access to a bank account and whether she can go alone to the market, the health clinic, and locations out of town. In Bangladesh the autonomy index is an aggregate of whether the woman has say in large household decisions, purchases for daily life, and her own health care. (See section 2 for details).*

Table 3: Effects of Child's Gender on Mother's Autonomy and Labor Supply

work for…

	self		family		another		work away from home	
daughters	-0.0007		0.0015		0.0057***		0.0055**	
	[0.0013]		[0.0021]		[0.0019]		[0.0023]	
children	0.0001		0.0029		-0.0015		0.0042**	
	[0.0011]		[0.0018]		[0.0016]		[0.0020]	
first birth female		-0.0033		0.0039		0.0099***		0.0098**
		[0.0022]		[0.0035]		[0.0032]		[0.0039]
Mean Dep Var	0.063		0.205		0.168		0.351	
Observations	79,827		79,827		79,827		79,827	
R-squared	0.030		0.135	0.134	0.086	0.086	0.199	0.199

pay scheme…   / regularity

	unpaid		cash		in kind		all year		occasionally	
daughters	-0.0003		0.0075***		-0.0017		0.0049**		0.0016	
	[0.0016]		[0.0023]		[0.0018]		[0.0023]		[0.0021]	
children	0.0017		-0.0048**		0.0086***		-0.0006		0.0021	
	[0.0013]		[0.0020]		[0.0016]		[0.0019]		[0.0018]	
first birth female		0.0004		0.0117***		-0.0003		0.0092**		0.0013
		[0.0026]		[0.0039]		[0.0028]		[0.0038]		[0.0034]
Mean Dep Var	0.104		0.281		0.110		0.257		0.179	
Observations	79,827		79,827		79,827		79,827		79,827	
R-squared	0.100		0.097		0.112	0.113	0.079		0.118	

Table 4: Effects of Child's Gender on Mother's Labor Supply, by Sector (India only)

	professional /manage/tech		clerical / sales / service		manual		agriculture	
daughters	0.0011**		0.0007		0.0046***		0.0004	
	[0.0006]		[0.0011]		[0.0014]		[0.0022]	
children	-0.0023***		-0.0005		-0.0027**		0.0068***	
	[0.0005]		[0.0009]		[0.0012]		[0.0019]	
first birth female		0.0006		0.0036*		0.0016		0.0051
		[0.0012]		[0.0019]		[0.0025]		[0.0036]
Mean Dep Var	0.031	0.031	0.069	0.069	0.084	0.084	0.220	0.220
Observations	79,827	79,827	79,827	79,827	79,827	79,827	79,827	79,827
R-squared	0.091	0.091	0.033	0.033	0.032	0.032	0.262	0.261

sector

*Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights included. Controls not shown include a dummy for rural location, age fixed effects, Hindu religion, state FE's, dummies for scheduled caste, scheduled tribe, and other*

Effects of Child's Gender on Mother's Labor Supply, by Sector (India only – continued)

five-year bins, from birth to age 25:

$$Y_i = \sum_{a \in \{0,5,...,20\}} \beta_{1,a} 1(\text{Mother has child aged } a \text{ to } a+4) \tag{6}$$

$$+ \sum_{a \in \{0,5,...,20\}} \beta_{2,a} 1(\text{Mother has daughter aged } a \text{ to } a+4) + x_i'\delta + \epsilon_i$$

$$Y_i = \sum_{a \in \{0,5,...,20\}} \beta_{1,a} 1(\text{Firstborn child aged } a \text{ to } a+4) \tag{7}$$

$$+ \sum_{a \in \{0,5,...,20\}} \beta_{2,a} 1(\text{Firstborn daughter aged } a \text{ to } a+4) + x_i'\delta + \epsilon_i$$

Figures 3 and 4 graph the $\beta_{2,a}$ coefficients for autonomy and labor supply, for India and Bangladesh, respectively. Figure 3 shows that the effects of a daughter in India are driven by older girls, roughly beginning at age 10 to 14 (although this pattern is less strong in the sample of first children) for autonomy and ages 15 to 19 for labor supply. In Bangladesh, shown in figure 4, a broadly similar pattern emerges, although the results are more consistent for autonomy than for labor supply, especially in the sample of just the oldest children.

In the context of the model, the fact that autonomy increases do not come immediately after birth could reflect the fact that parents' differential preferences for spending on girls versus boys are stronger for older girls than younger girls. For instance, parents may agree that children of both genders should complete primary school, but differ in whether girls should go to secondary school. Then, if mothers either do not have full information about these divergent preferences or face constraints in saving up for future spending on a daughter, they would wait to exercise their autonomy until the differential preferences emerge.

Because the survey only sampled women up to age 50, the sample of older children does not capture women who had children relatively late. For instance, the sample of children aged 20 and above loses mothers older than age 30 when the child was born; this represents the 85th percentile of age at birth among surveyed women in India and the 88th percentile in Bangladesh. Inasmuch as women who delay childbirth are somewhat more liberal, the effects of child gender at older ages should be interpreted as the effects on a relatively more conservative sample.

We conclude our empirical tests of the main model by assessing the relationship between child gender and mother's autonomy among women who do not work outside the home. Table 5 gives these results. We emphasize that they should no longer be interpreted as the causal effects of child gender, given that they are estimated on a selective
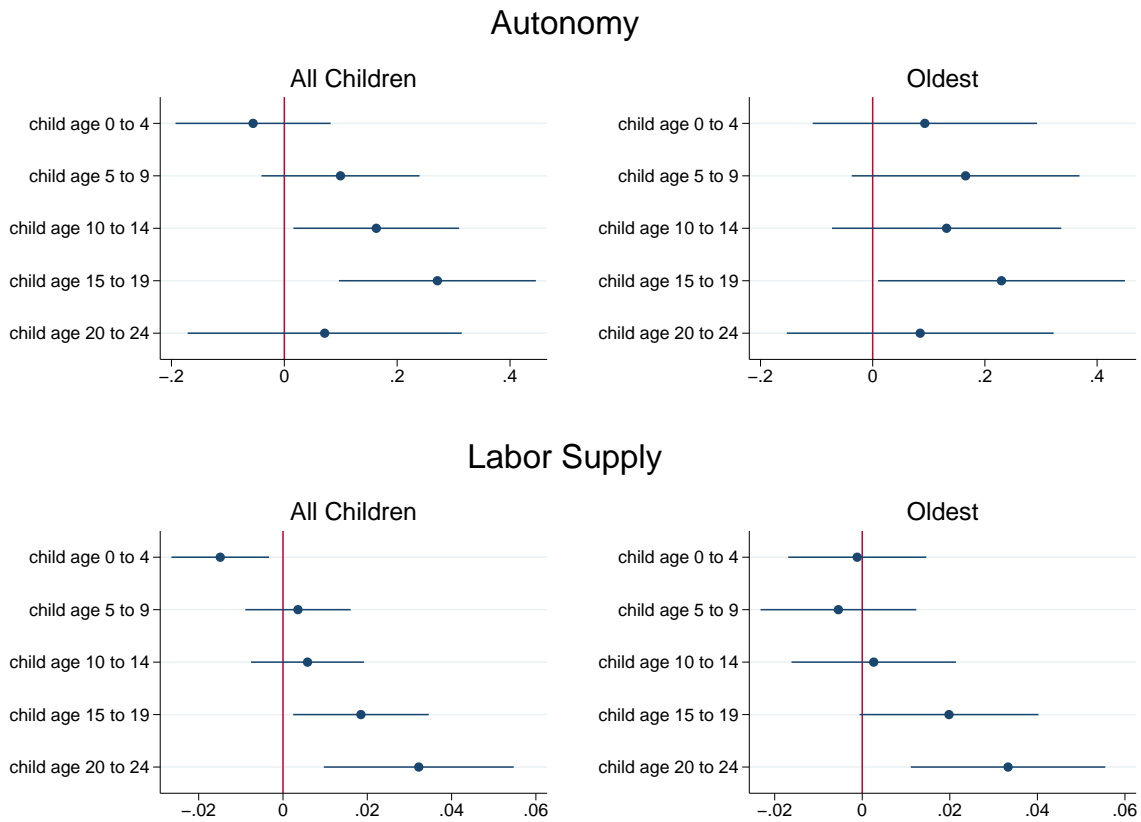
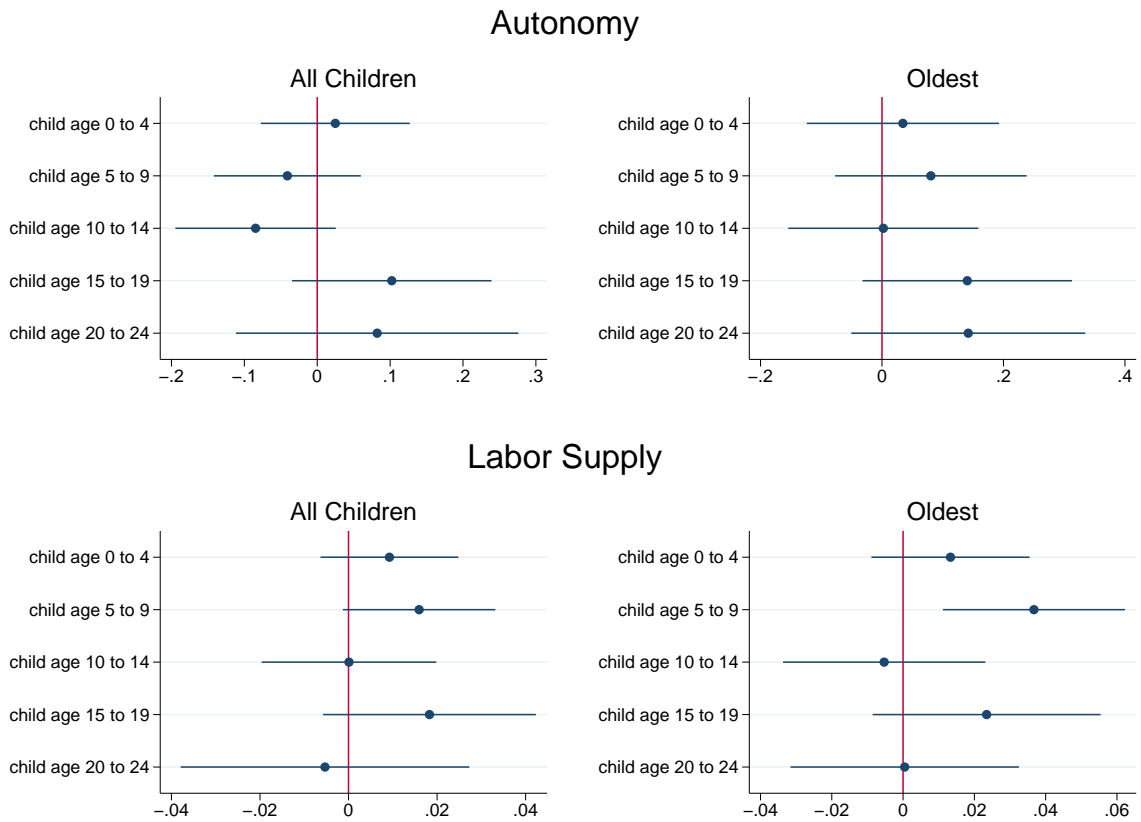Figure 3: Effects of a daughter on mother's autonomy and labor supply in India, by daughter's age

Figure 4: Effects of a daughter on mother's autonomy and labor supply in Bangladesh, by daughter's age

sample that is affected by child gender (recall that table 3 demonstrated that daughters increase the probability that their mother works outside the home). Recall that our model suggested that the subset of women who don't work (those whose desired hours of work, e^*, are negative) have low baseline autonomy. Given our finding that daughters prompt women to seek higher autonomy, women with daughters who do not work presumably have even lower baseline autonomy, so this selection bias would tend to attenuate the relationship between daughters and autonomy in this sample. Nevertheless, table 5 shows a significant positive impact of daughters on mothers' autonomy. As those women do not work outside the home even with a daughter, the increase in their autonomy is unlikely to be driven entirely by the increased gains to autonomy given a greater labor supply. Instead, consistent with our baseline model, the increased autonomy suggests that at least some of the relationship between daughters and mother's autonomy is driven by a stronger desire to control a fixed amount of income, in light of differential preferences between parents for spending on a daughter.

5   Alternative Explanations

As we explained in the extensions to the baseline model in section 2.3, previous research has found that daughters have many effects on their families in South Asia. In section 2.3 we incorporated several of these alternative explanations into our main model to show that the prediction that daughters increase their mothers' autonomy persists. In this section, we make a related argument: models based on other effects of daughters – but without allowing the mother to choose to seek greater autonomy after having a daughter – do not naturally predict the results from section 4 on the nature and timing of increases in a woman's autonomy after having a daughter. That is, while we do not seek to definitively rule out all other ways in which daughters affect their mother's autonomy, we argue that our endogenous autonomy model is likely to be one of the factors.

A central question during this exercise is that if we shut down the endogenous autonomy channel in our model, what does determine a woman's autonomy? Standard household bargaining models say that a spouse's outside option determines the payoff she or he gets in the marriage, so one class of alternate theories would predict that – directly or indirectly – a daughter increases her mother's outside option, which raises her autonomy. We argue in subsection 5.1 that these explanations are unlikely: if anything, a daughter (versus a son) lowers her mother's outside option. In section 5.2 we consider a second possibility, that autonomy is a function of a mother's beliefs about gender equality, which are affected by the presence of a daughter.

| | India | | Bangladesh | |
	Autonomy index		Autonomy index	
daughters	0.0851**		0.0639***	
	[0.0345]		[0.0232]	
children	-0.0338		-0.0822***	
	[0.0293]		[0.0198]	
first birth female		0.1264**		0.1115***
		[0.0577]		[0.0396]
mother's education	0.1412***	0.1403***	0.0279***	0.0324***
	[0.0072]	[0.0069]	[0.0048]	[0.0048]
Mean Dep. Var.	-0.488	-0.488	-0.116	-0.116
Std Dev of Dep. Var.	5.462	5.462	2.528	2.528
Observations	51,687	51,687	20,238	20,238
R-squared	0.195	0.195	0.051	0.046

*Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights included. Controls not shown include a dummy for rural location, age fixed effects, Hindu religion, region FE's (Bangladesh), state FE's (India), survey round (Bangladesh), and dummies for scheduled caste, scheduled tribe, and other backward caste (India). The autonomy index is an aggregate of whether the woman has say in large household decisions, purchases for daily life, her own health care, visits to family, spending her husband's income. Additionally, it includes whether she has access to a bank account and whether she can go alone to the market, the health clinic, and locations out of town. In Bangladesh the autonomy index is an aggregate of whether the woman has say in large household decisions, purchases for daily life, and her own health care. (See section 2 for details).*

Table 5: Relationship between Child's Gender and Mother's Autonomy among Women who do not Work

5.1 Daughters effects on their mothers' outside option

5.1.1 Daughters affect subsequent fertility and their mothers' health

Many effects of a daughter would likely hurt her mother's outside option. For instance, daughters tend to prompt higher fertility as their families try again for a son (Clark 2000; Jensen 2003; Rosenblum 2013). As a results, mothers tend to breastfeed daughters for shorter time than sons in order to be able to get pregnant again more quickly (Jayachandran and Kuziemko, 2011). The ensuing subsequent pregnancies at close intervals can hurt a mother's health (Milazzo, 2014). While there is some evidence that breastfeeding can temporarily lead to increased anemia (Sharman, 2000) – so that mothers of daughters might actually be better nourished in the short run – the ultimate findings of Milazzo (2014) suggest that eventually the subsequent pregnancies effect is even more harmful, so that eventually the net effect of daughters on mothers' health is negative.

We estimate the effects of daughters on their mothers' nutritional status using the same empirical strategy as equations 4 and 5, in light of these previously documented health effects and the ambiguous prediction of the theoretical model in section 2 on a mother's consumption. On one hand, the mother sacrifices her own consumption to give more to her daughter. On the other hand, once she fights for autonomy (and begins working more) she has greater control over the income she does have. So the effects of daughters on a mother's nutritional status we estimate are a combination of any health effects of subsequent fertility and the net effect (illustrated by our model) of the mother increasing her labor supply and seeking more autonomy but needing to divert resources to a girl in response to her husband's possible withdrawal of support.

Note, however, that the fact that figures 3 and 4 suggest that autonomy doesn't increase until a daughter is older, while the health effects would operate more when the daughter is younger and her mother is more likely to still be having children. Accordingly, we first provide the overall effects of daughters on their mother's nutrition in table 6, but then we also break them down by age. We find, in accordance with the results of Milazzo (2014) in India, that younger daughters tend to hurt their mother's nutritional status in both India and Bangladesh. The effects go away in mothers of older girls, suggesting that the positive effect of increased autonomy on consumption is roughly equal in magnitude to the personal consumptions she sacrifices to increase investment in her daughter, as well as any persistent health effects that began when their daughters were younger.

In any case, given the generally consistent evidence that daughters tend hurt their mother's health, if seems unlikely that health effects could actually improve a mother's

autonomy. The higher subsequent fertility a daughter prompts could also affect a mother's autonomy directly by changing her outside option, but if anything, more children would likely decrease a mother's autonomy by making it harder for her to survive on her own, given biological reasons and social norms that children would remain with the mother upon dissolution of a marriage. Overall, we argue that the tendency for daughters to have more siblings cannot explain the increases in autonomy we see.

5.1.2 Daughters affect their mothers' labor supply

There are several reasons why daughters would increase their mother's labor supply (relative to sons), even absent the intrahousehold bargaining channel we emphasize. Daughters can help with home production, allowing mothers to enter the labor force (as in extension I to the main model). The need to provide daughters with dowry decreases a household's permanent income, which tends to prompt both parents to increase their labor supply. If the higher future expected transfers from sons (discussed in extension III to the main model) are more important to mothers than fathers given the probability they will be widowed (Lambert and Rossi, 2014), mothers of daughters may work more to compensate for the lack of insurance from sons. Finally, if high returns to investment in boy's human capital also prompt mothers to invest more time in boys (Rose, 2000), mothers may drop out of the labor force to spend more time with their sons, which would imply that daughters are associated with higher maternal labor supply than sons. In any case, working itself could increase a woman's autonomy if it improves her outside option, either through returns to labor market experience or if the act of working itself decreases her psychic cost of working outside the home. Note that unlike the discussion of these issues in section 2.3, if these labor supply channels increase a woman's outside option, daughters would increase their mother's autonomy even if autonomy was no longer a choice variable, as in the main model.

However, we might expect that in all of these cases, increases in labor supply would precede increases in autonomy, while figures 3 and 4 show that if anything, the increases in autonomy come before increases in labor supply. The fact that the strongest labor supply and autonomy effects are seen in mothers of older girls also argues against a tendency for women to drop out of the labor force to spend more time with boys, since the greatest returns to time inputs in children would likely come before they start school. Finally, if increased labor supply is the main channel to explain the increase in female autonomy with a daughter, we might expect the increase to get smaller and insignificant when we focus on women who don't work, but table 5 provides evidence against this possibility.

Panel A: Consumption

Outcome	India BMI		India Anemia		Bangladesh BMI	
daughters	0.0251		0.0188*		0.0274	
	[0.0189]		[0.0104]		[0.0287]	
children	-0.1663***		0.0084		-0.2821***	
	[0.0163]		[0.0090]		[0.0267]	
first birth female		0.0066		0.0216		-0.0088
		[0.0326]		[0.0179]		[0.0500]
Mean Dep. Var.	21.291	21.291			21.357	21.357
Observations	75,874	75,874	72,423	72,423	24,552	24,552
R-squared	0.234	0.232			0.163	0.146

Panel B: Perceptions of Domestic Violence

Outcome:	India 1(Domestic Violence Ever Acceptable)		Bangladesh	
daughters	-0.0044*		-0.0070*	
	[0.0026]		[0.0039]	
children	0.0132***		0.0181***	
	[0.0022]		[0.0033]	
first birth female		-0.0057		-0.0108
		[0.0043]		[0.0067]
Mean Dep. Var.	0.471	0.471	0.320	0.320
Observations	79,827	79,827	25,028	25,028
R-squared	0.107	0.106	0.028	0.026

Panel C: Domestic Violence (India)

Outcome:	1(Moderate Domestic Violence)		1(Severe Domestic Violence)	
daughters	-0.0088***		-0.0011	
	[0.0030]		[0.0022]	
children	0.0256***		0.0094***	
	[0.0026]		[0.0020]	
first birth female		-0.0035		0.0016
		[0.0049]		[0.0035]
Mean Dep. Var.	0.319	0.319	0.104	0.104
Observations	59,626	59,626	59,627	59,627
R-squared	0.108	0.104	0.044	0.043

*Notes: BMI and domestic violence equations are estimated using OLS and Anemia is estimated with an ordered logit (categories = none, mild, moderate, and severe). Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights included. ontrols not shown include age fixed effects, dummy for rural location, Hindu religion, region FE's (Bangladesh), state FE's (India), dummies for scheduled caste, scheduled tribe, and other backward caste (India) and survey round (Bangladesh).*

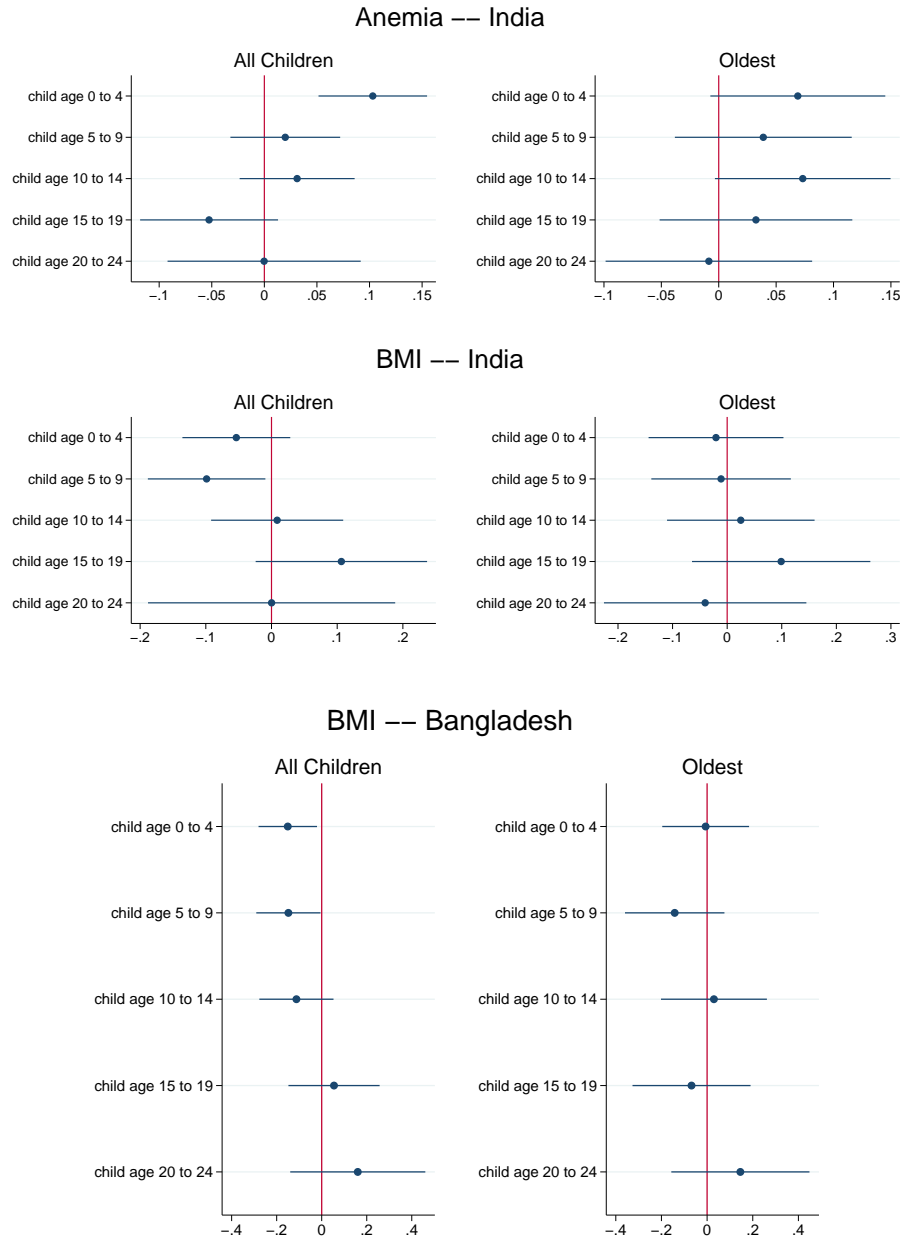Table 6: Effects of Child's Gender on Mother's Well-Being

Figure 5: Effects of a daughter on mother's nutrition, by daughter's age

5.2 Daughters affect their mothers' preferences or beliefs

A final potential alternative explanation is that a daughter directly affects her mother's preferences or beliefs. For instance, a daughter may learn about gender equality in school and convince her mother to stand up for herself. Or as the mother observes her daughter's opportunity set (which would often be larger than her prior beliefs if gender equality is increasing over time), the mother updates her beliefs on possible outcomes for women. There is indeed some evidence that daughters decrease the probability that their mothers report that domestic violence is ever acceptable. Panel B of table 6 shows that in Bangladesh, a daughter is associated with a 0.70 percentage point decrease in the probability her mother reports that domestic violence is ever acceptable in the sample of all births; a firstborn daughter is associated with a 1.1 percentage point decrease ($P = 0.106$). In India each daughter is associated with a 0.44 percentage point decrease in the probability the mother believes domestic violence is ever acceptable; a firstborn daughter decreases the probability by 0.57 percentage points ($P = 0.188$).

A natural question is whether these suggestive changes in mother's perceptions of domestic violence lead to actual changes in domestic violence. The India survey asked women about actual incidence of domestic violence, and we report the effects of daughters on domestic violence in Panel C. While there is evidence in the sample of all children that the number of daughters is associated with lower rates of (moderate) domestic violence, this effect goes away in the sample of only firstborn children, so we do not interpret it is as causal effect of daughters. Countervailing effects could explain the zero effect in the sample of firstborn children. For instance, mothers' increased perception that domestic violence is never justified could be translated into less risk of domestic violence, but this effect could be counteracted by the possibility that the mother seeking more autonomy leads to frictions that result in violence, as in the models of Eswaran and Malhotra (2011) and Anderson and Genicot (2015). As we discuss in section 2.1, this violence could be one component of the cost of seeking autonomy in our model.

The fact that the mother's apparent decreased belief in the acceptability of domestic violence does not translate into lower domestic violence (in India) suggests that changes in preferences from daughters do not automatically translate into better treatment, and thus that changes in preferences or beliefs prompted by daughters are unlikely to singlehandedly explain increases in autonomy. Additionally, increases in beliefs in gender equality cannot explain the marginal decreases in consumption without incorporating other effects of daughters such as the differential preferences for spending on daughters posited by our model. In sum, while we do find some evidence that daughters affect their

mothers' perceptions of gender relations, we nonetheless think that it is unlikely that this model can explain the whole set of results we find.

6   Conclusion

While mothers in South Asia report preferences for sons, we show that mothers of daughters have higher participation in household decision-making and freedom of mobility than mothers of sons. These results are consistent with a model in which mothers have differentially stronger preferences for spending on daughters than do their husbands. So mothers exert greater autonomy, even when doing so it costly for them, and increase their labor supply in order to direct more resources to their daughters.

This model suggests new policies that could address son preference and its link to missing women. Women could prefer a son – and possibly be prompted to engage in sex selective abortion – even if they get the same fundamental utility from the well-being of a son and a daughter. Thus, policies to discourage mothers from participating in sex selective abortion do not necessarily need to address deep-seated social norms biasing women against female offspring. Rather, women need to be compensated for the sacrifice in their own consumption and cost of obtaining autonomy to divert resources to their daughters. And policies that either increase women's baseline autonomy or lower the cost to women of seeking autonomy would also tend to decrease sex selective abortion.

Our results also provide new insights into the ways to assess whether women's preferences are taken into account in household decision-making. We argue that low reported levels of autonomy in the way it is typically measured (such as a woman's say in household decision-making) do not necessarily imply that the woman's preferences are ignored, if the household member who is making decisions has similar preferences. Conversely, since fighting for autonomy can have a cost to the woman, high reported values of autonomy may not always imply that the woman's utility is higher. Ultimately, we argue that outcomes such as taking part in household decisions are a means to an end – the woman's preferences are reflected in household decisions – rather than a goal in and of itself.

References

Ahmad, Syed Munir, and Muhammad Neman. 2013. "Mothers, Daughters and Education: Exploring the Role and Relationship between Culture and Socio-Economic Factors." *PUTAJ Humanities and Social Sciences*, 20.

Almond, Douglas, and Bhashkar Mazumder. 2011. "Health capital and the prenatal environment: the effect of Ramadan observance during pregnancy." *American Economic Journal: Applied Economics*, 56–85.

Anderson, Siwan, and Garance Genicot. 2015. "Suicide and property rights in India." *Journal of Development Economics*, 114: 64–78.

Anderson, Siwan, and Mukesh Eswaran. 2009. "What determines female autonomy? Evidence from Bangladesh." *Journal of Development Economics*, 90(2): 179–191.

Atkin, David. 2009. "Working for the future: Female factory work and child health in Mexico." *Unpublished Manuscript, Yale University*.

Barcellos, Silvia H, Leandro Carvalho, and Adriana Lleras-Muney. 2014. "Child Gender and Parental Investments in India: Are Boys and Girls Treated Differently?" *American Economic Journal: Applied Economics*, 6(1): 157–189.

Basu, Kaushik. 2006. "Gender and Say: A Model of Household Behavior with Endogenously Determined Balance of Power." *The Economic Journal*, 116(511): 558–580.

Bhalotra, Sonia R, and Tom Cochrane. 2010. "Where have all the young girls gone? Identification of sex selection in India." IZA Discussion paper series.

Bharadwaj, Prashant, and Leah K Lakdawala. 2013. "Discrimination begins in the womb: evidence of sex-selective prenatal investments." *Journal of Human Resources*, 48(1): 71–113.

Blattman, Christopher, Julian Jamison, Eric Green, and Jeannie Annan. 2014. "The returns to cash and microenterprise support among the ultra-poor: A field experiment." *Available at SSRN 2439488*.

Browning, Martin, and Pierre-Andre Chiappori. 1998. "Efficient intra-household allocations: A general characterization and empirical tests." *Econometrica*, 1241–1278.

Chahnazarian, Anouch. 1988. "Determinants of the sex ratio at birth: Review of recent literature." *Biodemography and Social Biology*, 35(3-4): 214–235.

Clark, Shelley. 2000. "Son preference and sex composition of children: Evidence from India." *Demography*, 37(1): 95–108.

Das Gupta, Monica, Jiang Zhenghua, Li Bohua, Xie Zhenming, Woojin Chung, and Bae Hwa-Ok. 2003. "Why is son preference so persistent in East and South Asia? A cross-country study of China, India and the Republic of Korea." *The Journal of Development Studies*, 40(2): 153–187.

Deci, Edward L, and Richard M Ryan. 2012. "Motivation, personality, and development within embedded social contexts: An overview of self-determination theory." *The Oxford handbook of human motivation*, 85–107.

Deolalikar, Anil, and Elaina Rose. 1998. "Gender and savings in rural India." *Journal of Population Economics*, 11(4): 453–470.

Doepke, Matthias, and Michèle Tertilt. 2014. "Does female empowerment promote economic development?" National Bureau of Economic Research.

Duflo, Esther. 2003. "Grandmothers and Granddaughters: Old-Age Pensions and Intrahousehold Allocation in South Africa." *The World Bank Economic Review*, 17(1): 1–25.

Duflo, Esther. 2005. "Gender equality in development." *BREAD Policy Paper*, 11(4).

Duflo, Esther, and Christopher Udry. 2004. "Intrahousehold resource allocation in Cote d'Ivoire: Social norms, separate accounts and consumption choices." *National Bureau of Economic Research working paper*.

Eswaran, M., and N. Malhotra. 2011. "Domestic violence and women's autonomy in developing countries: theory and evidence." *Canadian Journal of Economics*, 44(4): 1222–1263.

Field, Erica. 2003. "Fertility responses to urban land titling programs: The roles of ownership security and the distribution of household assets." *mimeo, Harvard University*.

Field, Erica, and Attila Ambrus. 2005. "Early Marriage and female schooling in Bangladesh." *Harvard University Working Paper*.

Field, Erica, Seema Jayachandran, and Rohini Pande. 2010. "Do traditional institutions constrain female entrepreneurship? A field experiment on business training in India." *The American Economic Review*, 125–129.

Fledderjohann, Jasmine, Sutapa Agrawal, Sukumar Vellakkal, Sanjay Basu, Oona Campbell, Pat Doyle, Shah Ebrahim, and David Stuckler. 2014. "Do Girls Have a Nutritional Disadvantage Compared with Boys? Statistical Models of Breastfeeding and Food Consumption Inequalities among Indian Siblings." *PloS one*, 9(9): e107172.

Harari, Mariaflavia. 2013. "Women's Inheritance Rights and Bargaining Power: Evidence from Kenya." *NEUDC Conference Presentation*.

Haushofer, Johannes, and Jeremy Shapiro. 2013. "Household response to income changes: Evidence from an unconditional cash transfer program in Kenya." *Massachusetts Institute of Technology*.

Heath, Rachel. 2014. "Women's access to labor market opportunities, control of household resources, and domestic violence: Evidence from Bangladesh." *World Development*, 57: 32–46.

Heath, Rachel, and Xu Tan. 2015. "Intrahousehold Bargaining, Female Autonomy, and Labor Supply: Theory and Evidence from India."

Jayachandran, Seema. 2014. "Fertility Decline and Missing Women." National Bureau of Economic Research.

Jayachandran, Seema, and Ilyana Kuziemko. 2011. "Why Do Mothers Breastfeed Girls Less than Boys? Evidence and Implications for Child Health in India." *The Quarterly Journal of Economics*, 126(3): 1485–1538.

Jensen, Robert. 2003. *Equal Treatment, Unequal Outcomes?: Generating Sex Inequality Through Fertility Behaviour.*

Kabeer, Naila. 1997. "Women, Wages and Intra-household Power Relations in Urban Bangladesh." *Development and Change*, 28(2): 261–302.

Kabeer, Naila. 1999. "Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment." *Development and Change*, 30(435): 464.

Kabeer, Naila. 2001. "Conflicts over credit: re-evaluating the empowerment potential of loans to women in rural Bangladesh." *World Development*, 29(1): 63–84.

Kingdon, Geeta Gandhi. 2005. "Where has all the bias gone? Detecting gender bias in the intra-household allocation of educational expenditure." *Economic Development and Cultural Change*, 53(2): 409–451.

Lambert, Sylvie, and Pauline Rossi. 2014. "Sons as widowhood insurance: Evidence from Senegal."

Li, Lixing, and Xiaoyu Wu. 2011. "Gender of children, bargaining power, and intrahousehold resource allocation in China." *Journal of Human Resources*, 46(2): 295–316.

Majlesi, Kaveh. 2014. "Labor Market Opportunities and Women's Decision Making Power within Households." *Unpublished Manuscript*.

Milazzo, Annamaria. 2014. "Why are adult women missing? Son preference and maternal survival in India." *Son Preference and Maternal Survival in India (March 1, 2014). World Bank Policy Research Working Paper*, , (6802).

Mocan, Naci H, and Colin Cannonier. 2012. "Empowering women through education: Evidence from Sierra Leone." National Bureau of Economic Research.

Pörtner, Claus C. 2010. "Sex Selective Abortions, Fertility and Birth Spacing." *University of Washington, Department of Economics, Working Paper*.

Puri, Sunita, Vincanne Adams, Susan Ivey, and Robert D Nachtigall. 2011. "There is such a thing as too many daughters, but not too many sons: A qualitative study of son preference and fetal sex selection among Indian immigrants in the United States." *Social Science & Medicine*, 72(7): 1169–1176.

Rangel, Marcos A. 2006. "Alimony rights and intrahousehold allocation of resources: Evidence from Brazil." *The Economic Journal*, 116(513): 627–658.

Robinson, Jonathan. 2012. "Limited insurance within the household: evidence from a field experiment in Kenya." *American Economic Journal: Applied Economics*, 4(4): 140–164.

Rose, Elaina. 1999. "Consumption smoothing and excess female mortality in rural India." *Review of Economics and statistics*, 81(1): 41–49.

Rose, Elaina. 2000. "Gender bias, credit constraints and time allocation in rural India." *The Economic Journal*, 110(465): 738–758.

Rosenblum, Daniel. 2013. "The effect of fertility decisions on excess female mortality in India." *Journal of Population Economics*, 26(1): 147–180.

Rosenzweig, Mark R, and T Paul Schultz. 1982. "Market opportunities, genetic endowments, and intrafamily resource distribution: Child survival in rural India." *The American Economic Review*, 803–815.

Roy, Sanchari. 2008. "Womens Inheritance Rights and Female Autonomy in India." *mimeo*.

Roy, Shalini, Jinnat Ara, Narayan Das, and Agnes Quisumbing. 2015. "Flypaper effects in transfers targeted to women: Evidence from BRAC's "Targeting the Ultra Poor" program in Bangladesh." *Journal of Development Economics*, 117: 1–19.

Ryan, Richard M, and Edward L Deci. 2000. "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being." *American psychologist*, 55(1): 68.

Sharman, Almaz. 2000. *Anemia testing in population-based surveys: general information and guidelines for country monitors and program managers.* ORC Macro.

Sultan Ahmed, Sania, and Sally Bould. 2004. "One able daughter is worth 10 illiterate sons: Reframing the patriarchal family." *Journal of Marriage and Family*, 66(5): 1332–1341.

Thomas, Duncan. 1990. "Intra-household resource allocation: An inferential approach." *Journal of human resources*, 635–664.

Zimmermann, Laura. 2012*a*. "It's a boy! Women and non-monetary benefits from a son in India." IZA Discussion Paper Series.

Zimmermann, Laura. 2012*b*. "Reconsidering gender bias in intrahousehold allocation in India." *Journal of Development Studies*, 48(1): 151–163.

Panel A: India	Variation		Mean Dependent
	All Children	Firstborn	Variable
say in own health care	0.0024	0.0053	0.649
	[0.0025]	[0.0043]	
say in large household purchases	0.0012	0.0034	0.570
	[0.0026]	[0.0044]	
say in visits to family	0.0033	0.0079*	0.649
	[0.0025]	[0.0042]	
say in purchases for daily needs	0.0035	0.0078*	0.634
	[0.0025]	[0.0044]	
say in spending husband's earnings	-0.0021	0.0055	0.717
	[0.0024]	[0.0043]	
can go to market alone	0.0047*	0.0086**	0.576
	[0.0025]	[0.0042]	
can go to health facility alone	0.0071	0.0099**	0.553
	[0.0024]	[0.0044]	
can leave village alone	0.0061**	0.0123***	0.436
	[0.0025]	[0.0042]	
has access to a bank account	0.0027	-0.0048	0.140
	[0.0017]	[0.0030]	
Panel B: Bangladesh			
say in large household purchases	0.0130***	0.0207***	0.618
	[0.0041]	[0.0070]	
say in visits to family	0.0153***	0.0149***	0.608
	[0.0041]	[0.0070]	
say in purchases for daily needs	0.0119***	0.0134***	0.638
	[0.0040]	[0.0069]	

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Sampling weights included. Controls not shown include age fixed effects, dummy for rural location, Hindu religion, region FE's (Bangladesh), state FE's (India), dummies for scheduled caste, scheduled tribe, and other backward caste (India) and survey round (Bangladesh).

Table A1: Effects of child gender on specific components of the autonomy index

Outcome = Days/week worked

Panel A: Men

daughters	-0.1465	-0.145	-0.1602	-0.1304	-0.1069	-0.0623	-0.0961
	[0.1146]	[0.1092]	[0.1027]	[0.0990]	[0.0968]	[0.0935]	[0.0906]
children	0.0732	0.122	0.1316	0.1224	0.1356	0.0985	0.1312
	[0.1161]	[0.1088]	[0.0996]	[0.0948]	[0.0912]	[0.0867]	[0.0829]
first birth female	-0.2764	-0.3002*	-0.3133*	-0.2823*	-0.2922*	-0.2469*	-0.2706*
	[0.1732]	[0.1667]	[0.1604]	[0.1563]	[0.1534]	[0.1492]	[0.1455]
max age oldest child	10	11	12	13	14	15	16
Observations	27,134	29,566	33,817	36,730	39,688	43,552	47,069

Panel B: Women

daughters	0.2533	0.3333**	0.2733*	0.3138**	0.3591***	0.3797***	0.4405***
	[0.1823]	[0.1687]	[0.1510]	[0.1420]	[0.1340]	[0.1261]	[0.1204]
children	-0.3921**	-0.3949**	-0.3430**	-0.4152***	-0.4091***	-0.4325***	-0.4542***
	[0.1751]	[0.1604]	[0.1431]	[0.1341]	[0.1260]	[0.1166]	[0.1095]
first birth female	0.3435	0.3325	0.2897	0.4403**	0.5238**	0.6451***	0.8188***
	[0.2699]	[0.2531]	[0.2339]	[0.2227]	[0.2122]	[0.2012]	[0.1931]
max age oldest child	10	11	12	13	14	15	16
Observations	28,141	30,724	35,245	38,388	41,583	45,770	49,581

Table A2: Effects of Child's Gender on Parents' Labor Supply on the Intensive Margin

A Appendix: Proofs

Proof of Proposition 2.1: The maximization problem can be rewritten as:

$$\max_{e_f, h_f, y_f, a_f} \beta_f ln(a_f w_f e_f - y_f) + \gamma_f(\lambda ln h_f + \rho ln(y_f + y_m)) + \delta_f ln(1 - e_f - h_f) + \alpha_f ln(1 - a_f)$$

$$\max_{e_m, y_m} \beta_m ln(w_m e_m + (1 - a_f) w_f e_f - y_m) + \gamma_m(\lambda ln h_f + \rho ln(y_f + y_m)) + \delta_m ln(1 - e_m)$$

Take the first-order conditions ($y = y_m + y_f$):

$$[h_f]: \quad \frac{\gamma_f \lambda}{h_f} = \frac{\delta_f}{1 - e_f - h_f} \rightarrow h_f = \frac{\gamma_f \lambda}{\gamma_f \lambda + \delta_f}(1 - e_f)$$

$$[e_f]: \quad \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\delta_f}{1 - e_f - h_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f}$$

The last equation is obtained by inserting the value of h_f.

$$[e_f, y_f]: \quad \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f} = \frac{\gamma_f \rho a_f w_f}{y}$$

$$[e_m, y_m]: \quad \frac{\beta_m w_m}{w_m e_m + (1 - a_f) w_f e_f - y_m} = \frac{\delta_m}{1 - e_m} = \frac{\gamma_m \rho w_m}{y}$$

Take the sum of two equations above:

$$\rho(w_f e_f + w_m e_m - y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y \tag{8}$$

in which

$$e_f = 1 - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f}y, \quad e_m = 1 - \frac{\delta_m}{\gamma_m \rho w_m}y$$

Put e_f and e_m into (8):

$$(\rho w_f - \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f}y + \rho w_m - \frac{\delta_m}{\gamma_m}y - \rho y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y$$

$$(\frac{\beta_f}{\gamma_f} + \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho)y = \rho(w_f + w_m) \tag{9}$$

Lastly, consider a_f,

$$[a_f] : \frac{\beta_f w_f e_f}{a_f w_f e_f - y_f} = \frac{\alpha_f}{1 - a_f} \rightarrow \frac{\gamma_f \rho w_f e_f}{y} = \frac{\alpha_f}{1 - a_f}$$

Put y and e_f into $[a_f]$,

$$\frac{\gamma_f w_f}{w_f + w_m}\left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho\right) = \frac{(\gamma_f \lambda + \delta_f)w_m}{(w_f + w_m)a_f} + \frac{\alpha_f}{1 - a_f} \tag{10}$$

As $a_f \in (0, 1)$, RHS of (10) first decreases and then increases. If there is one interior solution, there must be two solutions of a_f that satisfy (10). The FOC of a_f equals LHS minus RHS of (10), which is first negative, then positive, and then negative. So the utility of the wife must first decreases, then increases and then decreases as $a_f \in (0, 1)$. The larger solution of a_f is the utility maximizer. We will focus on this solution.

Now a decrease in γ_m increases LHS of (10), and thus increases the solution of a_f. Since

$$\frac{\gamma_f \rho w_f (1 - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f} y)}{y} = \frac{\alpha_f}{1 - a_f} \tag{11}$$

as a_f increases, y/a_f decreases, and then e_f increases and h_f decreases. By (9), y/γ_m must increase, so e_m decreases. Also by (11), as a_f increases and $a_f \geq a^*$, y decreases. $p_f x_f = a_f w_f e_f - y_f$, and by $[e_f, y_f]$ it changes in the same direction as y. As the wife gets lower x_f, h_f, y and l_f, plus a higher a_f, her overall utility must decrease. ∎

Proof of Proposition 2.2: A decrease in α_f decreases RHS of (10). Since we focus on the larger solution of a_f, the RHS increases in a_f, and thus a decrease in α_f increases the solution of a_f. By (11), as a_f increases, y/a_f decreases, so e_f increases and h_f decreases. By (10) and (11),

$$\gamma_f \rho w_f = \left(\frac{\gamma_f w_f}{w_f + w_m}\left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho\right) + \frac{(\gamma_f \lambda + \delta_f)w_f}{(w_f + w_m)a_f}\right)y$$

As a_f increases, y must increase, and then e_m decreases. ∎

Proof of Proposition 2.3: Rewrite the first-order conditions:

$$[h_f] : \frac{\gamma_f \lambda}{h_f + H} = \frac{\delta_f}{1 - e_f - h_f} \rightarrow h_f + H = \frac{\gamma_f \lambda}{\gamma_f \lambda + \delta_f}(1 - e_f + H)$$

49

$$[e_f]: \quad \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\delta_f}{1 - e_f - h_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f + H}$$

$$[e_f, y_f]: \quad \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f + H} = \frac{\gamma_f \rho a_f w_f}{y}$$

$$e_f = 1 + H - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f} y$$

Then

$$\left(\frac{\beta_f}{\gamma_f} + \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho \right) y = \rho (w_f (1 + H) + w_m) \tag{12}$$

$$\frac{\gamma_f w_f (1 + H)}{w_f (1 + H) + w_m} \left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho \right) = \frac{(\gamma_f \lambda + \delta_f) w_m}{(w_f (1 + H) + w_m) a_f} + \frac{\alpha_f}{1 - a_f} \tag{13}$$

With a positive H, LHS of (13) increases and RHS decreases, so a_f has to increase. Note that since RHS decreases and a_f is in the right half of the U shape without H, a_f is also in the right half of the U shape with H. By (12), as a_f and H increase, y must increase. Then e_m decreases. By (8), as y increases and e_m decreases, e_f must increase and then h_f decreases. ∎

Proof of Proposition 2.4: Rewrite the first-order conditions ($y' = y_f + y_m - D$):

$$[e_f, y_f]: \quad \frac{\beta_f a_f w_f}{a_f w_f e_f - y_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f} = \frac{\gamma_f \rho a_f w_f}{y'}$$

$$[e_m, y_m]: \quad \frac{\beta_m w_m}{w_m e_m + (1 - a_f) w_f e_f - y_m} = \frac{\delta_m}{1 - e_m} = \frac{\gamma_m \rho w_m}{y'}$$

$$(w_f e_f + w_m e_m - y' - D) = \left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} \right) y'$$

$$\left(\frac{\beta_f}{\gamma_f} + \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho \right) y' = \rho (w_f + w_m - D) \tag{14}$$

$$\frac{\gamma_f w_f}{w_f + w_m - D} \left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho \right) = \frac{(\gamma_f \lambda + \delta_f)(w_m - D)}{(w_f + w_m - D) a_f} + \frac{\alpha_f}{1 - a_f} \tag{15}$$

$$\frac{\gamma_f \rho w_f \left(1 - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f} y' \right)}{y'} = \frac{\alpha_f}{1 - a_f} \tag{16}$$

With a positive D, LHS of (15) increases and RHS decreases, so a_f has to increase. Note that since RHS decreases and a_f is in the right half of the U shape without D, a_f is also in the right half of the U shape with D. By (16), y'/a_f decreases, and then e_f increases and

h_f decreases. Also by (16), as a_f increases and $a_f \geq a^*$, y' decreases and then e_m increases. ∎

Proof of Proposition 2.5: A decrease in ρ decreases LHS of (10), and thus decreases the solution of a_f. By (11), as a_f decreases, $y/(\rho a_f)$ increases, and then e_f decreases and h_f increases. By (11), as a_f decreases and $a_f \geq a^*$, y/ρ increases and then e_m decreases. By (9), a_f and ρ decreases, so y decreases. ∎

Proof of Proposition 2.6: A decrease in λ decreases RHS of (10). Since we focus on the larger solution of a_f, the RHS increases in a_f, and thus a decrease in λ increases the solution of a_f. By (10) and (11),

$$\gamma_f \rho w_f = (\frac{\gamma_f w_f}{w_f + w_m}(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho) + \frac{(\gamma_f \lambda + \delta_f)w_f}{(w_f + w_m)a_f})y$$

As λ decreases and a_f increases, y must increase. By $[a_f]$, e_f increases, by $[h_f]$, h_f decreases, and by $[e_m, y_m]$, e_m decreases. ∎

Proof of Proposition 2.7: The model with unearned income is discussed in appendix B.1, and we add baseline autonomy to the proof of Proposition B.1. (20) is modified as

$$\frac{\gamma_f(w_f + R_f)}{w_f + w_m + R_f + R_m}(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho) = \frac{(\gamma_f \lambda + \delta_f)(w_m + R_m)}{(w_f + w_m + R_f + R_m)(a_0 + a_f)} + \frac{\alpha_f}{1 - a_f}$$
(17)

As a_0 increases, the RHS decreases. Since we focus on the larger solution of a_f, the RHS increases in a_f, and thus a increase in a_0 increases the solution of a_f. By (21), $y/(a_0 + a_f)$ increases, so e_f increases. ∎

Proof of Proposition 2.8: Take the first-order conditions ($y = y_m + y_f$):

$$[h_f]: \quad \frac{\gamma_f \lambda}{h_f} = \frac{\delta_f}{1 - h_f}$$

$$[a_f, y_f]: \quad \frac{\beta_f R_f}{a_f R_f - y_f} = \frac{\gamma_f \rho R_f}{y} = \frac{\alpha_f}{1 - a_f}$$

$$[e_m, y_m]: \quad \frac{\beta_m w_m}{w_m e_m + (1 - a_f)R_f - y_m} = \frac{\delta_m}{1 - e_m} = \frac{\gamma_m \rho w_m}{y}$$

Notice that h_f is independent of the rest of the outcomes. So everything remains the same except h_f decreases in case 2 and 5.

Sum $[a_f, y_f]$ and $[e_m, y_m]$,

$$\rho(R_f + w_m e_m - y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y$$

in which $e_m = 1 - \frac{\delta_m}{\gamma_m \rho w_m}y$. So

$$(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho)y = \rho(w_m + R_f)$$

In case 1, as γ_m decreases, y decreases and y/γ_m increases, so e_m decreases and a_f increases. In case 4, as ρ decreases, y decreases and y/ρ increases, so e_m decreases and a_f decreases.

In case 2, let $y = y_m + y_f - D$,

$$(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho)y = \rho(w_m + R_f - D)$$

As D increases, y decreases, so e_m increases and a_f increases.

In case 6, a decrease in α_f makes a_f increases, while the rest is independent of them. ∎

B Appendix: Robustness of the Model

B.1 Unearned Income

Let R_f be the wife's unearned income and R_m be the husband's unearned income.

The wife's optimization problem can be summarized as follows,

$$\max_{x_f, h_f, y_f, e_f, a_f} \beta_f lnx_f + \gamma_f(\lambda lnh_f + \rho ln(y_f + y_m)) + \delta_f ln(1 - e_f - h_f) + \alpha_f ln(1 - a_f)$$

$$s.t.\ e_f, h_f, a_f \in [0,1],\ x_f, y_f > 0,\ p_f x_f + y_f \le a_f(w_f e_f + R_f)$$

where p_f is the price of the wife's private good.

The husband's optimization problem is similar,

$$\max_{x_m, y_m, e_m} \beta_m lnx_m + \gamma_m^{s,d}(\lambda lnh_f + \rho ln(y_f + y_m)) + \delta_m ln(1 - e_m)$$

$$s.t.\ e_m \in [0,1],\ x_m, y_m > 0,\ p_m x_m + y_m \le w_m e_m + R_m + (1 - a_f)(w_f e_f + R_f)$$

Proposition B.1. *The predictions of Proposition 2.1 remains the same: suppose the Nash equilibrium is interior and the husband's preference for the public good decreases when it is a girl ($\gamma_m^s > \gamma_m^d$),*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the household public good decreases ($y_f + y_m$), if $a_f \geq a^*$.*

Proof of Proposition B.1: The proof is similar to the one without unearned income. Take the first-order conditions ($y = y_m + y_f$):

$$[h_f]: \quad \frac{\gamma_f \lambda}{h_f} = \frac{\delta_f}{1 - e_f - h_f} \rightarrow h_f = \frac{\gamma_f \lambda}{\gamma_f \lambda + \delta_f}(1 - e_f)$$

$$[e_f]: \quad \frac{\beta_f a_f w_f}{a_f(w_f e_f + R_f) - y_f} = \frac{\delta_f}{1 - e_f - h_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f}$$

The last equation is obtained by inserting the value of h_f.

$$[e_f, y_f]: \quad \frac{\beta_f a_f w_f}{a_f(w_f e_f + R_f) - y_f} = \frac{\gamma_f \lambda + \delta_f}{1 - e_f} = \frac{\gamma_f \rho a_f w_f}{y}$$

$$[e_m, y_m]: \quad \frac{\beta_m w_m}{w_m e_m + R_m + (1 - a_f)(w_f e_f + R_f) - y_m} = \frac{\delta_m}{1 - e_m} = \frac{\gamma_m \rho w_m}{y}$$

Take the sum of two equations above:

$$\rho(w_f e_f + R_f + w_m e_m + R_m - y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y \tag{18}$$

in which

$$e_f = 1 - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f}y, \quad e_m = 1 - \frac{\delta_m}{\gamma_m \rho w_m}y$$

Put e_f and e_m into (18):

$$(\rho w_f + \rho R_f - \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f}y + \rho w_m + \rho R_m - \frac{\delta_m}{\gamma_m}y - \rho y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y$$

$$(\frac{\beta_f}{\gamma_f} + \frac{\gamma_f \lambda + \delta_f}{\gamma_f a_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho)y = \rho(w_f + w_m + R_f + R_m) \tag{19}$$

Lastly, consider a_f,

$$[a_f] : \frac{\beta_f(w_f e_f + R_f)}{a_f(w_f e_f + R_f) - y_f} = \frac{\alpha_f}{1 - a_f} \rightarrow \frac{\gamma_f \rho(w_f e_f + R_f)}{y} = \frac{\alpha_f}{1 - a_f}$$

Put y and e_f into $[a_f]$,

$$\frac{\gamma_f(w_f + R_f)}{w_f + w_m + R_f + R_m}\left(\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m} + \frac{\delta_m}{\gamma_m} + \rho\right) = \frac{(\gamma_f \lambda + \delta_f)(w_m + R_m)}{(w_f + w_m + R_f + R_m)a_f} + \frac{\alpha_f}{1 - a_f} \quad (20)$$

As $a_f \in (0, 1)$, RHS of (20) first decreases and then increases. As discussed in the proof of Proposition 2.1, the larger solution of a_f is the utility maximizer and we will focus on this solution.

Now a decrease in γ_m increases LHS of (20), and thus increases the solution of a_f. Since

$$\frac{\gamma_f \rho w_f (1 - \frac{\gamma_f \lambda + \delta_f}{\gamma_f \rho a_f w_f} y) + \gamma_f \rho R_f}{y} = \frac{\alpha_f}{1 - a_f} \quad (21)$$

as a_f increases, y/a_f decreases, and then e_f increases and h_f decreases. By (19), y/γ_m must increase, so e_m decreases. Also by (21), as a_f increases and $a_f \geq a^*$, y decreases. ∎

B.2 Corner solutions

Since the vast majority of men in South Asia work outside the home – 97% of men work in India, and 98% of in Bangladesh in our data – we maintain the assumption that the husband's wage is high enough that he always works outside the home in equilibrium, i.e. $e_m > 0$. [23]

We focus on the corner solution in which only one spouse is the financial contributor of the child's expense. This is a generalization of models in which the wife contributes time and the husband makes a financial contribution (Anderson and Eswaran 2009). In our model this outcome will result when the husband has a high preference for the child, likely a son. However, when the child is a daughter and the husband cares very little about her well-being, the husband has little incentive to spend money on her and so the wife also takes care of her financial expenses, e.g. her education. Qualitative evidence

---

[23]A corner solution ($e_m = 0$) is not impossible because the husband gets some unearned income from the wife, but happens only if men's salary is relatively low compared to women's salary. While our data does not have earnings, in India women who report earnings earned on average 57 % as much as men (2004 census) and in Bangladesh women who reported earnings earned on average 69 % as men (2005 Housing Income and Expenditure Survey), so this case does not appear to be empirically relevant.

from Bangladesh suggests that many women do tend to invest money (not just time) resources on their children, and their daughters in particular (Kabeer 1997; Sultan Ahmed and Bould 2004).

Lemma B.2. *There exist $\overline{\gamma}_m$ and $\underline{\gamma}_m$, such that*

- *If the husband cares sufficiently high for the child's well-being ($\gamma_m \geq \overline{\gamma}_m$), there is an equilibrium in which he pays for the child's entire expense $y_m > 0$ and $y_f = 0$.*

- *If the husband cares sufficiently little for the child's well-being ($\gamma_m \leq \underline{\gamma}_m$), there is an equilibrium in which the wife pays for the child's entire expense $y_f > 0$ and $y_m = 0$.*

Proof of Lemma B.2: When it is a son, the wife has no incentive to invest in the child only when the marginal utility is higher to invest to her own consumption (the equilibrium calculation is in the proof of Proposition B.3):

$$\frac{\beta_f}{x_f^s} \geq \frac{\gamma_f \rho}{y_m^s} \quad \rightarrow \quad \frac{\gamma_m^s \rho}{\beta_m + \gamma_m^s \rho + \delta_m} \geq \frac{x_f^s \gamma_f \rho}{\beta_f(w_m + (1 - a_f^s)(w_f e_f^s))}$$

So there exists an upper bound $\overline{\gamma}_m$, such that when $\gamma_m^s \geq \overline{\gamma}_m$, the husband pays high enough on the son and the wife doesn't find it optimal to spend on the son.

When it is a daughter, the husband have no incentives to invest in the child only when the marginal utility if higher to invest in his own consumption:

$$\frac{\beta_m}{x_m^d} \geq \frac{\gamma_m^d \rho}{y_f^d} \quad \rightarrow \quad \gamma_m^d \leq \frac{\beta_m y_f^d}{\rho x_m^d}$$

So there exists a lower bound $\underline{\gamma}_m$, such that when $\gamma_m^d \leq \underline{\gamma}_m$, the husband cares so little about the child that he doesn't want to contribute when the wife invest into the child. ∎

We remark that $\overline{\gamma}_m$ and $\underline{\gamma}_m$ depends on all the parameters, including γ_f, and we omit this dependence to simplify the notation. We denote the equilibria above as single-financial-contributor equilibria, with the first type as men-contributing equilibria and the second one as women-contributing equilibria.

To study the effect of the child's gender, we consider a husband with high preference for a son ($\gamma_m^s \geq \overline{\gamma}_m$) and low preference for a daughter ($\gamma_m^d \leq \underline{\gamma}_m$). In other words, the change is from a men-contributing equilibrium for a son to a women-contributing equilibrium for a daughter. While it is not entirely impossible to have multiple equilibria, especially when $\underline{\gamma}_m > \overline{\gamma}_m$, we further restrict our attention to the case with unique equilibrium, such that $\gamma_m^s \geq \max(\overline{\gamma}_m, \underline{\gamma}_m)$ and $\gamma_m^d \leq \min(\overline{\gamma}_m, \underline{\gamma}_m)$.

Proposition B.3. *Suppose $\gamma_m^s \geq \max(\overline{\gamma}_m, \underline{\gamma}_m)$ and $\gamma_m^d \leq \min(\overline{\gamma}_m, \underline{\gamma}_m)$. When the child is a daughter (compared to a son):*

- *The wife works more outside the home (e_f), less at home (h_f), gets a higher autonomy (a_f), but a lower overall utility (u_f).*

- *The husband works less (e_m) and consumes more (x_m) as long as the loss of control of his wife's income is not too high.*

Proof of Proposition B.3: When it is a son, the husband pays the child's entire expense. Then in equilibrium,

$$\frac{\beta_f}{a_f} = \frac{\alpha_f}{1 - a_f} \quad \rightarrow \quad a_f^s = \frac{\beta_f}{\alpha_f + \beta_f}$$

$$\frac{\beta_f w_f}{w_f e_f} = \frac{\delta_f}{1 - e_f - h_f}, \quad \frac{\gamma_f \lambda}{h_f} = \frac{\delta_f}{1 - e_f - h_f}$$

So,

$$e_f^s = \frac{\beta_f}{\beta_f + \gamma_f \lambda + \delta_f}, \quad h_f^s = \frac{\gamma_f \lambda}{\beta_f + \gamma_f \lambda + \delta_f}$$

The husband:

$$y_m^s = \frac{\gamma_m^s \rho}{\beta_m + \gamma_m^s \rho} (w_m e_m + (1 - a_f)(w_f e_f))$$

$$e_m^s = \frac{(\beta_m + \gamma_m^s \rho) w_m - \delta_m((1 - a_f)(w_f e_f))}{(\beta_m + \gamma_m^s \rho + \delta_m) w_m}$$

$$p_m x_m^s = \frac{\beta_m}{\beta_m + \gamma_m^s \rho + \delta_m} (w_m + (1 - a_f^s)(w_f e_f^s))$$

When it is a daughter, the wife the child's entire expense. Then in equilibrium,

$$y_f^d = \frac{\gamma_f \rho}{\beta_f + \gamma_f \rho} a_f (w_f e_f)$$

$$\frac{\beta_f + \gamma_f \rho}{a_f} = \frac{\alpha_f}{1 - a_f} \quad \rightarrow \quad a_f^d = \frac{\beta_f + \gamma_f \rho}{\alpha_f + \beta_f + \gamma_f \rho}$$

Similarly,

$$e_f^d = \frac{\beta_f + \gamma_f \rho}{\beta_f + \gamma_f (\lambda + \rho) + \delta_f}, \quad h_f^d = \frac{\gamma_f \lambda}{\beta_f + \gamma_f (\lambda + \rho) + \delta_f}$$

The husband:

$$e_m^d = \frac{\beta_m w_m - \delta_m((1 - a_f)(w_f e_f))}{(\beta_m + \delta_m) w_m}$$

56

$$p_m x_m^d = \frac{\beta_m}{\beta_m + \delta_m}(w_m + (1 - a_f^d)(w_f e_f^d))$$

Her consumption change is unclear.

$$p_f x_f^s = \frac{\beta_f}{\alpha_f + \beta_f} \frac{\beta_f}{\beta_f + \gamma_f \lambda + \delta_f} w_f$$

$$p_f x_f^d = \frac{\beta_f}{\beta_f + \gamma_f \rho} \frac{\beta_f + \gamma_f \rho}{\alpha_f + \beta_f + \gamma_f \rho} \frac{\beta_f + \gamma_f \rho}{\beta_f + \gamma_f(\lambda + \rho) + \delta_f} w_f$$

Lastly, it is easy to check that the wife's overall utility is lower when it is a girl. When it is a girl, the wife's choices are $(x_f^d, e_f^d, h_f^d, y_f^d, a_f^d)$. When it is a son, using the same set of choices plus $y_m^d > 0$ must give the wife is a strictly higher utility. $\blacksquare$

B.3 Autonomy as control of time

Alternatively, we can think of autonomy as the wife's control of her time. In many traditional and conservative societies, the husband may dislike his wife working outside (Basu, 2006). In a simple model, we assume the husband controls h_f, the time the wife has to spend on the household public good (i.e. taking care of the child). And the wife allocates her free time $1 - h_f$ to working outside and leisure. Her autonomy is her free time $a_f = 1 - h_f$.

In the husband's utility,

$$\max_{x_m, h_f, e_m, y_m} \beta_m ln x_m + \gamma_m^{s,d}(\lambda ln h_f + \rho ln(y_f + y_m)) + \delta_m ln(1 - e_m) + \alpha_m ln(1 - h_f)$$

$$s.t.\ e_m, h_f \in [0,1],\ x_m, y_m > 0,\ p_m x_m \leq w_m e_m - y_m$$

where $\alpha_m ln(1 - h_f)$ is the cost for the husband to supervise the wife.

In the wife's utility,

$$\max_{x_f, e_f, y_f} \beta_f ln x_f + \gamma_f(\lambda ln h_f + \rho ln(y_f + y_m)) + \delta_f ln(1 - e_f - h_f)$$

$$s.t.\ e_f \in [0, 1 - h_f],\ x_f, y_f > 0,\ p_f x_f \leq w_f e_f - y_f$$

Proposition B.4. *Suppose the autonomy is control of time and Nash equilibrium is interior. If the husband's preference for the public good decreases when it is a girl ($\gamma_m^s > \gamma_m^d$),*

- *The wife works more outside (e_f), less at home (h_f), and gets a higher autonomy (a_f).*

- *The husband works less outside (e_m).*

- *The monetary investment to the household public good may increase or decrease ($y_f + y_m$).*

Proof of Proposition B.4: Take first-order conditions:

$$[h_f]: \quad \frac{\lambda \gamma_m}{h_f} - \frac{\alpha_m}{1 - h_f} = 0 \rightarrow h_f = \frac{\lambda \gamma_m}{\lambda \gamma_m + \alpha_m}$$

So as γ_m decreases when it is a girl, h_f decreases and $a_f = 1 - h_f$ increases.

$$[e_f, y_f]: \quad \frac{\beta_f w_f}{w_f e_f - y_f} = \frac{\delta_f}{1 - e_f - h_f} = \frac{\gamma_f \rho w_f}{y}$$

$$[e_m, y_m]: \quad \frac{\beta_m w_m}{w_m e_m - y_m} = \frac{\delta_m}{1 - e_m} = \frac{\gamma_m \rho w_m}{y}$$

So we have,

$$\rho(w_f e_f + w_m e_m - y) = (\frac{\beta_f}{\gamma_f} + \frac{\beta_m}{\gamma_m})y \tag{22}$$

$$e_f = 1 - h_f - \frac{\delta_f}{\gamma_f \rho w_f}y, \quad e_m = 1 - \frac{\delta_m}{\gamma_m \rho w_m}y \tag{23}$$

Putting e_f and e_m into the equation (22),

$$\rho(w_f(1 - h_f) + w_m) = (\frac{\beta_f + \delta_f}{\gamma_f} + \frac{\beta_m + \delta_m}{\gamma_m} + \rho)y$$

As h_f decreases, y/γ_m must increases, so e_m decreases. Lastly, if y decreases, by the expression of e_f in (23), it increases; otherwise if y increases, by equation (22), e_f must increases. So regardless, e_f increases. ∎

As the husband cares less about a girl, he demands less control of the wife's time, so she works less at home, works more outside and gets a higher autonomy. With both the less care of the household public good and the wife's higher earning, the husband works less. The monetary contribution to the household public good is ambiguous, since on one hand the husband contributes less because he cares less, while on the other hand, the wife contributes more because she earns more.

B.4   A collective model

In a collective model, a social planner, representing the wife and the husband, maximizes the weighted total utility: $U = a_f u_f + (1 - a_f)u_m$. Recall the wife and the husband's

utilities are ($y = y_f + y_m$):

$$u_f = \beta_f lnx_f + \gamma_f(\lambda lnh_f + \rho lny) + \delta_f ln(1 - e_f - h_f)$$

$$u_m = \beta_m lnx_m + \gamma_m^{s,d}(\lambda lnh_f + \rho lny) + \delta_m ln(1 - e_m)$$

In India, husbands are in dominant positions, so we maintain the assumption that $u_m > u_f$ in equilibrium. Thus, the social planner has incentives to give the husband a higher weight once a_f is endogenous. In particular, suppose a_f^0 is the baseline autonomy determined by spouses' outside options, and the social planner can costly move autonomy away from its baseline value. Let $\triangle a_f$ be the distortion towards the husbands from baseline value, s.t. $a_f = a_f^0 - \triangle a_f$. The cost to do so is $\alpha \ln(1 - \triangle a_f)$, such that there is no cost if there is no distortion. Overall, the social planer's utility is

$$U = (a_f^0 - \triangle a_f)u_f + (1 - a_f^0 + \triangle a_f)u_m + \alpha \ln(1 - \triangle a_f)$$

Suppose when it is a son, the social planner's optimal choice is $\triangle a_f^s$, u_f^s and u_m^s. Note that by assumption, $u_f^s < u_m^s$, and thus the optimal $\triangle a_f^s > 0$. When it is a daughter, the husband cares less of the household public good (the well-being of the child), $\gamma_m^d < \gamma_m^s$. The direct effect of a daughter is decreasing the husband's utility while keeping the wife's utility constant. To fix the idea, suppose the decrease of the husband's preference $\gamma_m^s - \gamma_m^d$ is sufficiently high, such that the equilibrium adjustment doesn't alter the direct effect. Then the gap of spouses' utilities is smaller when it is a daughter, $u_m^d - u_f^d < u_m^s - u_f^s$. The FOC suggests that

$$u_m - u_f = \frac{\alpha}{1 - \triangle a_f}$$

So $\triangle a_f^d < \triangle a_f^s$. The wife gets a higher autonomy with a daughter, because of a lower distortion.

C Appendix: Estimating labor supply on the intensive margin

To estimate the effects of daughters on labor supply including both the extensive and the intensive margin, we use the 1993 National Sample Survey, which contains information on the number of days (between 0 and 7) a respondent worked in the previous week. We use tobits to estimate analagous equations to 4 and 5; results are qualitatively similar if

we use an ordered logit.

$$DaysWorked_i = \beta_1 ChildrenPresent_i + \beta_2 FemaleChildrenPresent_i + x_i'\delta + \epsilon_i \quad (24)$$

$$DaysWorked_i = \beta_3 OldestChildPresentisFemale_i + x_i'\delta + \epsilon_i \quad (25)$$

A caveat to interpretting these results is that rather than using all children ever born to estimate $Children_i$, $Daughters_i$, and $FirstBornDaughter_i$, which we argue in section 3.2 is important to avoid reversal causality concerns, we only see children present in the household. To create a sample of parents and children, we use adults who identify as the head of the household or spouse and consider children listed as children of the head. There are two levels of selection one may be concerned about in this sample: selection into remaining alive and selection into remaining in the household, conditional on being alive.

We try to minimize the latter by considering children who are less likely to be married. However, given that figures 3 and 4 indicate the daughters begin affecting their mothers autonomy and labor supply at approximately age 10, we also would not expect to see a sample of young children generating the results we see. We thus consider maximum age cutoffs ranging from age 10 to 16, the median age at marriage of women interviewed in the 1993 Demographic and Health Survey. The results in table A2 do indeed get stronger as the maximum age cutoff increases.

While the mechanism between these results could be a mixture of true causal effects of daughters and selection effects that increase with age (having a 16-year-old daughter still present in the household signifies a greater degree of liberalness than having a ten-year-old daughter still present in the house), note that the most clear selection story suggests that mothers with enough bargaining power to keep her daughter alive and present in the household may also be more likely to work. By contrast, it is less clear to us which way the selection of having a daughter present in the household would affect men's labor supply. But since we cannot rule out that selection effects are driving the male labor supply results, we view them as suggestive evidence, in accordance with Rose (2000), that support our main model.