



Centre Interuniversitaire sur le Risque,  
les Politiques Économiques et l'Emploi

Cahier de recherche/Working Paper **10-09**

## **Are Foster Children Made Better Off by Informal Fostering Arrangements ?**

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Février/February 2010

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We would thank Arnaud Dellis, Yann Bramoullé, Sabine Kröger for insightful comments. Sylvain Dessy acknowledges financial support by SSHRC under Grant no 410-2007-0413.

**Abstract:**

Research on the effects of informal child fostering arrangements on the welfare of the children involved highlights cross-country disparities. Why may there be differences across countries with regard to the effects of informal child fostering arrangements? If in all countries reporting a high incidence of foster children *Hamilton's rule* applies, then these cross-country differences are puzzling. Our model of child fostering arrangements builds on the fact that a child's school performance is jointly influenced by his nutrition status and the time he has available at home to develop his learning skills and prepare for national school tests. Given this feature of academic performance, fostering out may become a poor parent's best option for enhancing his child's academic excellence, by trading off study time for better nutrition. We show that child fostering arrangements embedding this human capital motive for out-fostering make the foster child better off when nutrition is paramount to a child's ability to achieve academic excellence.

**Keywords:** Child Fostering, Child Nutrition, Foster Child's Welfare

**JEL Classification:** D13, J13, O12, O15

# 1. Introduction

Informal child fostering arrangements are voluntary and reversible transfers of children's residence from parents to non-parents within extended family networks. These arrangements are prevalent in sub-Saharan Africa, though their occurrence is not restricted to this region.<sup>1</sup> If altruistic actions are restricted to beneficiaries that are closely related to actors, as Hamilton's rule suggests, then developing countries' ongoing tolerance of this informal institution need to be explained.

Research on the effects of fostering arrangements on the welfare of the children involved was pioneered by Ainsworth (1990 and 1996) who finds evidence in Cote d'Ivoire that these arrangements adversely affect the welfare of foster children. The validity of this finding, however, was subsequently rejected by Zimmerman (2003) who finds evidence that foster children in South Africa are not at a disadvantage compared to biological children, in terms of enrolment rates. But school enrolment rates by themselves are no hard evidence of fostered children's success at accumulating human capital. How these children perform in national tests at the end of primary and secondary education, for example, may actually matter more than school attendance.

The ensuing debate on the welfare effects of child fostering unfortunately highlights a lack of consensus among scholars seeking to improve our understanding of this informal institution: whereas Fafchamps and Wahba (2006) corroborate Ainsworth's finding in a case study of Nepal, Akresh (2009), by contrast, corroborates Zimmerman's based upon an empirical analysis of child fostering arrangements in Burkina Faso. Arguably, these mixed results suggest the existence of cross-country differences in the effects child fostering arrangements have on the welfare of the children involved. Why may there be differences across countries with regard to the effects of informal child fostering arrangements? If in all countries reporting a high incidence of foster children such arrangements are restricted to a temporary migration of children within extended family networks, and Hamilton's rule equally applies to all these environments, then these cross-country differences are puzzling. This paper is primarily concerned with explaining this puzzle.

We propose a theoretical analysis of adults' decision to participate in child fostering arrangements in the context where parental altruistic actions are restricted to own-children. Several factors can be linked to the decision to foster a child. First, in the absence of a well-functioning market for domestic labor services such as cooking, cleaning, water-fetching, etc., participating in a fostering arrangement may allow a family to improve the welfare of its members by fostering in child domestic labor. On one hand, domestic labor by the foster child (hereafter referred to as in-foster) may partially substitute for

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<sup>1</sup>See Zimmerman 2003 for a review of evidence on the prevalence of this institution in Africa.

the foster parents' labor input in household chores, thus allowing them to achieve a high degree of specialization in market activities that increase family income. On the other hand, the in-foster's labor may also alleviate the biological child's domestic workload, thus allowing the latter to allocate more time to after-school learning activities such as reviewing daily school lessons, studying for national school tests, reading magazines and books to improve his vocabulary.

Observe that since household chores (e.g., water-fetching, cleaning, or running errands) can be undertaken before or after school, they need not preclude school attendance by the in-foster. Therefore, for parents too poor to educate their own children, fostering some of them out to extended family members can become an attracting strategy for enhancing their human capital accumulation. An important contribution of this paper is to highlight the interplay in a child human capital formation between his nutrition status and the time he has available for engaging in after-school learning activities.

There is ample evidence that proper nutrition is key to children's ability to function and learn, as shown within the economics literature by Pitt and Rosenzweig (1990) and Alderman, Behrman, Lavy, and Rekha (1997). In the public health literature, Brown, Beardslee, and Prothrow-Stith (2008) also corroborate these findings based on a review of a large number of research contributions focusing on the effects of child nutrition on academic excellence in school. Likewise, there is also evidence that academic excellence in school begins at home, where parents set a good learning environment for their children, giving them adequate time to organize for national tests, review daily lessons, or put out sustained effort to improve their writing and math skills (Pohlsen 1984). In a case study of school performances in the Thiruvananthapuram District of the Indian State of Kerala, for example, Nair, Mini, and Padmamohan (2003) find that not allocating enough studying time to reviewing daily lessons was an important factor of poor school performance among adolescents. In our model, household chores and after-school learning activities have a competing claim on a child's non-schooling time.

By stressing child's nutrition status and child's time allocated to after-school learning activities as joint determinants of a child's human capital, our theory of child fostering arrangements opens up the possibility that parental out-fostering strategies are affected by the intertwined concerns for both adequate child nutrition and studying time for school. On one hand, domestic child labor by the in-foster directly or indirectly enhances the foster family ability to provide its members with proper nutrition. But, on the other hand, if excessive, the foster child's involvement in household chores may hamper his school performance by reducing the time he has available for after-school learning activities. We argue that this trade-off has implications for the effects non-parent residence has on the human capital of in-fosters.

To explore these effects, we model the optimal child fostering arrangement as the outcome of a cooperative game between a sending household and a receiving household over how much labor time the in-foster is to allocate to household chores. This modeling strategy seems reasonable for two main reasons. First, asymmetric motives for child fostering generate a potential conflict between the receiving household and the sending household, stemming from the trade-off between the immediate benefits of child labor to the former and the future human capital benefits to the latter. It is therefore reasonable to expect the optimal child fostering arrangement to be one that resolves this conflict. Second, as child fostering is restricted to temporary migration of children within extended family networks (Zimmerman 2003, Akresh 2009), and reputation and trust are the cornerstone of such networks, bargaining outcomes are virtually self-enforcing, and thus may need no external provision of enforcement mechanisms. We show that the optimal child fostering arrangement unambiguously improves the in-foster’s nutrition status. We also show that, as a reflection of Hamilton’s rule, there are asymmetries in human capital levels between the in-foster and the biological child, despite equal enrolment in school. Indeed, while they both enjoy the same nutrition status (Serra 2009), and are both enrolled in school (Zimmerman 2003), the in-foster, however, has less study time, and always contributes more time in household chores than does the biological child. Despite this intra-household inequality due to Hamilton’s rule, our model predicts that to the extent that nutrition is paramount to a child’s ability to perform in school, non-parent residence brings about a Pareto-improvement in the in-foster’s human capital relative to own-parent residence.

Numerical simulations of the model indeed highlight necessary and sufficient conditions for the optimal child fostering arrangement to enhance the in-foster’s human capital. We show that when nutrition is relatively more productive than after-school learning activities in a child’s human capital, being fostered out causes a child’s level of human capital to exceed the level that would have obtained under own-parent residence—a situation we refer to as autarky. Only when child’s time allocated to after-school learning activities is relatively more important than nutrition in determining a child’s ability to accumulate human capital can the fostering arrangement become largely an inter-household transfer of domestic labor (Ainsworth 1996), a situation that leaves the in-foster worse off. This situation can occur, for example, in environments where the quality of in-school education is too low. Since in most developing countries school children must take national tests at the end of the primary and secondary education, a poor quality of in-school education (as reflected for example by large pupil-to-teacher ratios, or high incidences of absenteeism among teachers) can put pressure on parents to provide more study time for their school-age children, or, better yet, resort to after-school tutoring to increase their children’s chances of passing the national tests. In such environments, after-school

learning activities can have a much larger contribution in a child's human capital than his nutrition status. Our analysis therefore suggests that in countries where informal child fostering arrangements have been found to adversely affect the in-foster's human capital, the poor quality of the formal education system may be to blame.

This paper draws on the theoretical work of several authors who have previously analyzed the effects of informal child fostering arrangements on the welfare of the children involved. Whereas Zimmerman (2003) studies child fostering arrangements solely from the viewpoint of the receiving household, we extend this analysis to include the sending household as well. This modelling strategy enables us to approach child fostering arrangements as outcomes of cooperative games between sending households and receiving households. In our model, the object of inter-household bargaining is the level of the in-foster's input in domestic labor activities.

Our analysis is closest to Serra (2009), but differs from hers in two important ways. First, Serra's analysis is not explicitly concerned with cross-country differences, and therefore cannot be used to understand such differences. Second, in Serra (2009), foster families with high socioeconomic status though probably aware of the positive externality they generate in their in-fosters' human capital, they make no attempt to extract rents from it. This view, however, is impervious to her maintained assumption that parental altruistic actions are restricted to own-children. Indeed, if Hamilton's rule applies, inter-household differences in socioeconomic status can translate into large asymmetries in bargaining power between the sending, and the receiving, household. These asymmetries, in turn, can affect the foster child's ability to take advantage of the positive externality generated by non-parent residence in a household with high socioeconomic status. In our model, given that Hamilton's rule applies, the optimal fostering arrangement obtains as the outcome of a cooperative game, in which participating households use the level of welfare they derive from enforcing own-parent residence for their respective children as a threat-point. Households with a higher threat-point are more impatient in the negotiation, while those with a low threat-point are more patient. Our numerical simulations show that in-fosters' domestic workload is lower when their biological parents have a sufficiently high bargaining power. The reverse is true when biological parents have a sufficiently low bargaining power. Contrary to Serra (2009) our results are intended (as opposed to unintended) consequences of the actions of all parties involved.

The rest of this paper is structured as follows. Section 2 presents a description of the environment. Section 3 characterizes household welfare and child welfare in autarky corresponding to the enforcement of own-parent residence for all children. This provides a benchmark case against which welfare performances of traditional child fostering arrangements can be compared. Section 4 describes a bargaining game of child fostering

between a sending household and a receiving household. The outcome of this bargaining game is then numerically simulated in section 5 to uncover the welfare properties of the optimal child fostering arrangement. Section 6 provides concluding remarks, while section 7 provides proofs of results presented in the main text.

## 2. Basics

Consider an environment with two different types of households in equal number. Interactions between households involve the fostering of children. Initially, each household is composed of a father, a mother, and their unique child. In each household of type  $i$ , income consists of a fixed contribution  $\theta_i$  from the father and labor income from the mother. For simplicity, the father does nothing in this environment other than transferring funds to his decision-making wife. Each parent has one period left to live, while her child has two left. A typical mother is endowed with one unit of labor time. She either works at home, or delivers human capital  $h_i^m$  to firms. We denote as  $l_i^m$  the fraction of a mother's time allocated to household chores, with the remainder going to market-labor. A household where the mother has attributes  $(\theta_i, h_i^m)$  is referred to as household  $i$ , with  $i \in \{1, 2\}$ .

There are three main activities in this environment namely, household production of a home-made good ( $z$ ), production of a composite market good ( $x$ ) by perfectly competitive firms, and education. Children may engage in the first and third activities, and mothers in the first and second. The composite market good is the numeraire.

### 2.1. Preferences and Budget Constraint

Household  $i$ 's preferences are defined over parents' consumption of the home-made good ( $c_i^m$ ) and the human capital level of their biological child ( $h_i^b$ ). These preferences are represented by an additively separable utility function:

$$U_i = \ln c_i^m + \gamma_b \ln h_i^b, \tag{1}$$

all  $i$ , where  $\gamma_b \in (0, 1)$  is the utility weight the mother in household  $i$  attributes to its own child's wellbeing as measured by the child human capital level  $h_i^b$ .

Denote by  $s \in \{b, f\}$  the household status of a child. In any household, a child is either a biological child ( $s = b$ ) or a foster child ( $s = f$ ). Assume all children attend school in this environment say, due to a compulsory education law. Each child is endowed with one unit of after school time. There are two competing claims on a child's after school

time. It may be used as labor input in home production ( $l_i^s$ ) or to reviewing daily lessons, studying for school tests, or doing homework. We denote child's time allocated to after-school learning activities by  $1 - l_i^s$ . These activities enhance a child's ability to achieve success in school.

Child's time allocated to after-school learning activities  $1 - l_i^s$  and child's nutrition status as determined by the quantity consumed of the home-made-good  $c_i^s$  are the only private inputs into his human capital. Therefore a child with schooling attributes  $(1 - l_i^s, c_i^s)$  will attain a level of human capital

$$h_i^s = D(e_i^s)^\lambda (c_i^s)^{1-\lambda}, \quad (2)$$

where  $D > 0$  is an education efficiency parameter, and  $\lambda \in (0, 1)$  is a measure of the relative productivity of the time the child spent in after school learning activities.

Let  $a_i \in \{-1, 0, 1\}$  denote the child fostering decision of household  $i$ :  $a_i = -1$  corresponds to child out-fostering,  $a_i = 1$  to child receiving-household, and  $a_i = 0$  means no fostering, which we refer to as the autarky situation. The number of children residing in household  $i$  thus is  $1 + a_i$ . For example, in an in-fostering household ( $a_i = 1$ ), the number of resident children is 2, while the corresponding number is 0 in a sending-household, and 1 in autarky.

Household  $i$ 's disposable income including the fixed transfer and the mother's earned income is  $\theta_i + (1 - l_i^m)h_i^m$ , so that total expenditures on the composite market good satisfy the following budget constraint:

$$x_i \leq \theta_i + (1 - l_i^m)h_i^m, \quad (3)$$

all  $i$ .

## 2.2. Home-Production

The home-made good provides household members with nutritional intakes, and is produced using the composite market good ( $x$ ) and household labor ( $L$ ). For simplicity, assume the production technology for the home-made good is Cobb-Douglas. Then the total quantity produced of the home-made good in household  $i$  is given by:

$$z_i = [\theta_i + (1 - l_i^m)h_i^m]^\sigma (L_i)^{1-\sigma}, \quad (4)$$



all  $i$ , where  $\sigma$  denotes the relative share of the market good in the production of the home-made good.

Also for simplicity, assume each resident child consumes a constant relative share  $\alpha \in (0, 1/2)$  of the home-made good, irrespective of whether he is a biological child ( $s = b$ ) or an in-foster ( $s = f$ ). Therefore,  $\alpha(1 + a_i)$  denotes the fraction of the home-made good allocated to children residing in household  $i$ , with the parents claiming the remaining fraction,  $1 - \alpha(1 + a_i)$ . Combining (3) and (4), we obtain parents' own-consumption of the home-made good as follows:

$$c_i^m = [1 - \alpha(1 + a_i)] [\theta_i + (1 - l_i^m)h_i^m]^\sigma (L_i)^{1-\sigma}, \quad (5)$$

while a resident child with status  $s \in \{b, f\}$  consumes

$$c_i^s = \alpha [\theta_i + (1 - l_i^m)h_i^m]^\sigma (L_i)^{1-\sigma}, \quad (6)$$

all  $s$  and all  $i$ .

Given the fostering decision taken by household  $i$ , the labor requirement for the production of the home-made good satisfies the following constraint:  $L_i = L^i(a_i)$ , where

$$L^i(a_i) = l_i^m + \frac{(1 + a_i) [1 + a_i(1 - a_i)]}{1 + a_i^2} l_i^b + \frac{a_i(1 + a_i)}{2} l_i^f, \quad (7)$$

is household  $i$ 's total supply of labor given the fostering decision  $a_i$ , all  $i$ . In other words, if household  $i$  chooses to remain in autarky (i.e.,  $a_i = 0$ ), total labor input in home-production is  $L^i(0) = l_i^m + l_i^b$ . In a sending household (i.e.,  $a_i = -1$ ), total labor input in home-production reduces to  $L^i(-1) = l_i^m$ ; the comparative figure for a receiving household is  $L^i(1) = l_i^m + l_i^b + l_i^f$ . Therefore, if household  $i$  follows a fostering strategy  $a_i \in \{-1, 0, 1\}$ , its consumption profile will look as follows:

$$C_i^m(a_i) = [1 - \alpha(1 + a_i)] [\theta_i + (1 - l_i^m)h_i^m]^\sigma [L_i(a_i)]^{1-\sigma}, \quad (8)$$

$$C_i^s(a_i) = \alpha [\theta_i + (1 - l_i^m)h_i^m]^\sigma [L_i(a_i)]^{1-\sigma}. \quad (9)$$

### 3. Household and Child Welfare in Autarky: A Benchmark

In this section, we characterize a household socioeconomic outcomes, when there is no child fostering. We want to formalize the motives driving child fostering arrangements. In particular we ask what forces may cause the emergence of asymmetric motives for child fostering documented by the empirical literature (e.g., Akresh 2009).

#### 3.1. The Child Labor Motive for In-Fostering

In this subsection, we explore the nature of socioeconomic forces that provide households with the incentive to foster in children. We start by computing household  $i$ 's payoff in autarky. Define a real valued function  $V^i : [0, 1]^2 \times H \times \Theta \rightarrow \mathbb{R}$ , by:

$$\forall (l_i^m, l_i^b, h_i^m, \theta_i) \in [0, 1]^2 \times H \times \Theta, U_i = V^i(l_i^m, l_i^b, h_i^m, \theta_i),$$

where  $V^i(l_i^m, l_i^b, h_i^m, \theta_i)$  denotes household  $i$ 's utility from choosing autarky (i.e.,  $a_i = 0$ ) when household total labor input in home-production is  $L^i(0) = l_i^m + l_i^b$ . From (1), substituting in (2), (7), (8), and (9) and re-arranging terms yields

$$V^i(l_i^m, l_i^b, h_i^m, \theta_i) = [1 + \gamma_b(1 - \lambda)] [\sigma \ln[\theta_i + (1 - l_i^m)h_i^m] + (1 - \sigma) \ln(l_i^m + l_i^b)] + B_0 + \gamma_b \lambda \ln(1 - l_i^b), \quad (10)$$

where

$$B_0 = \ln(1 - \alpha) + \gamma_b [\ln D + (1 - \lambda) \ln \alpha].$$

Clearly, the level of this utility payoff depends on the household choice of the vector  $(l_i^m, l_i^b)$ . In autarky, each household chooses  $(l_i^m, l_i^b)$  so as to maximize (10). In other words, letting  $(\hat{l}_i^m, \hat{l}_i^b)$  denote household  $i$ 's optimal allocation of labor input in home-production, we have that

$$(\hat{l}_i^m, \hat{l}_i^b) = \arg \max_{\langle l_i^m, l_i^b \rangle} V^i(l_i^m, l_i^b, h_i^m, \theta_i). \quad (11)$$

For each household  $i$ , define  $\eta_i = h_i^m / \theta_i$  as a measure of the mother's opportunity cost of labor input in home-production. The higher  $\eta_i$ , the higher mother  $i$ 's forgone income from trading market-labor for household chores. Using (10), it can be shown that the

optimal household time-allocation is given by:

$$\hat{l}_i^b = \frac{[1 + \gamma_b(1 - 2\lambda)] - \gamma_b\lambda\eta_i^{-1}}{1 + \gamma_b}, \quad (12)$$

$$\hat{e}_i^b = 1 - \hat{l}_i^b = \frac{\gamma_b\lambda}{1 + \gamma_b} (2 + \eta_i^{-1}), \quad (13)$$

$$\hat{l}_i^m = \frac{[(1 - \sigma)(1 + \gamma_b) + \sigma\gamma_b\lambda] (1 + \eta_i^{-1}) - \sigma [1 + \gamma_b(1 - \lambda)]}{1 + \gamma_b}. \quad (14)$$

The following proposition can thus be derived from this optimal allocation:

**Proposition 1.** *In a household where the mother faces a high opportunity cost of labor input in home-production, the child will supply more labor input in home-production and spend less time in after-school learning activities:*

$$(i) \quad \frac{\partial \hat{l}_i^b}{\partial \eta_i} > 0; \quad (ii) \quad \frac{\partial \hat{e}_i^b}{\partial \eta_i} < 0.$$

Proposition 1 obtains because of the substitutability between the mother's labor input and the child labor input in home-production. When the mother has a high opportunity cost of labor input in home-production, this puts more pressure on her child to reduce time allocated to after school learning activities so as to help produce the home-made good. Concerns for the child wellbeing may thus provide a household with a high-opportunity cost mother with the incentive to foster in a child for labor purposes, so as to boost the biological child's educational attainment. In other words, in the absence of a well-functioning market for domestic labor, a mother's high opportunity cost of labor input in home-production generates a child labor motive for fostering in a child.

### 3.2. A Human Capital Motive for Out-Fostering

Why may there be a human capital motive for out-fostering a child? In this subsection, we characterize the determinants of a child's human capital level in autarky. Recall that a child's human capital is jointly determined by his nutrition status and his after-school's time allocated to learning activities. We highlight the role played by nutrition in generating a human capital motive for fostering out a child.

First, from (9), substituting in (12) and (14) and re-arranging terms yields the child's nutrition level as follows:

$$\hat{c}_i^s = \alpha\sigma^\sigma(1 - \sigma)^{1-\sigma} \frac{[1 + \gamma_b(1 - \lambda)]}{1 + \gamma_b} (2 + \eta_i^{-1}) \eta_i^\sigma \theta_i^\sigma, \quad (15)$$

all  $i$ . Likewise, from (2), substituting in (13) and (15) and re-arranging terms yields the child human capital level as follows:

$$\hat{h}_i^b = \phi(\lambda) (2 + \eta_i^{-1}) \eta_i^{\sigma(1-\lambda)} \theta_i^{\sigma(1-\lambda)}, \quad (16)$$

all  $i$ , where

$$\phi(\lambda) \equiv \frac{([\alpha\sigma^\sigma(1-\sigma)^{1-\sigma}][1 + \gamma_b(1-\lambda)]^{1-\lambda} (\gamma_b\lambda)^\lambda D}{1 + \gamma_b}.$$

The main observation from Eq. (16) is that the opportunity cost of mother  $i$ 's labor input in home-production has two opposite effects on her child's human capital. One is a negative effect due to the substitutability between mother's labor and child labor in home-production. The other is a positive effect owing to the contribution of the home-made good to the child's nutrition— an input in the child's human capital.

Observe that if nutrition were not an input in a child's human capital (i.e.,  $\lambda = 1$ ), Eq. (16) would reduce to

$$\hat{h}_i^b = \phi(1) (2 + \eta_i^{-1}),$$

all  $i$ . In that case, a child born of a mother with a high-opportunity cost of labor input in home-production accumulates less human capital:

$$\frac{\partial \hat{h}_i^b}{\partial \eta_i} < 0.$$

But to the extent that a child's ability to achieve academic excellence in school is jointly determined by his learning activities at home and his nutrition status, living in a household where the mother has a high opportunity cost of non-market labor therefore need not adversely affect the child's human capital. Indeed, a necessary condition for a child born of a mother with a high-opportunity cost of labor input in home-production to accumulate more human capital is that nutrition be contributive to the child's human capital (i.e.,  $0 < \lambda < 1$ ).

To the extent that the composite market good is sufficiently contributive in the home-production of nutrition, households where the mother supplies more market-labor may provide better nutrition for their members. The opportunity to take advantage of the human capital effects of adequate nutrition may therefore provide a low-opportunity cost mother with the incentive to foster out her child to a high-opportunity cost mother.

We have argued above that inter-household differences in the mother's opportunity cost

of labor input in home-production combine with the productivity of nutrition as an input in a child's human capital to generate potential asymmetric motives for child fostering. However households will not act upon these motives unless the resulting welfare level is no less than its autarky level. Therefore, as a benchmark, we compute below each household's autarky welfare.

### 3.3. Household Welfare In Autarky

Define a real-valued function  $\bar{V} : \Gamma \rightarrow \mathbb{R}$ , by  $\forall \eta_i \in \Gamma$ ,

$$\bar{V}(\eta_i) \equiv \max_{\langle l_i^m, l_i^b \rangle} V^i(l_i^m, l_i^b, h_i^m, \theta_i).$$

We interpret  $\bar{V}(\eta_i)$  as a measure of household  $i$ 's autarky welfare when the mother faces a level of opportunity cost  $\eta_i$  of labor input in home-production. From (10), substituting in (12) and (14), re-arranging terms yields mother  $i$ 's autarky welfare level as follows:

$$\bar{V}(\eta_i) = \bar{B}_0 + (1 + \gamma_b) \ln(2 + \eta_i^{-1}) + \sigma [1 + \gamma_b(1 - \lambda)] \ln \eta_i \theta_i, \quad (17)$$

all  $i$ , where

$$\begin{aligned} \bar{B}_0 = B_0 + [1 + \gamma_b(1 - \lambda)] & \left[ \ln [\sigma^\sigma (1 - \sigma)^{1-\sigma}] + \ln \left( \frac{1 + \gamma_b(1 - \lambda)}{1 + \gamma_b} \right) \right] \\ & + \gamma_b \lambda \ln \left( \frac{\gamma_b \lambda}{1 + \gamma_b} \right). \end{aligned} \quad (18)$$

As was the case for the child's human capital, the mother's opportunity cost of labor input in home-production has an ambiguous effect on household's welfare. We use this autarky welfare as a basis for exploring the gains from child fostering.

## 4. A Bargaining Game of Child Fostering

Note that child fostering involves the determination of the fraction of time  $l^f \in [0, 1]$  the foster child will contribute to home-production of nutrition. Since by assumption foster parents only cares about the human capital level of their own child, there is a conflict between the immediate benefits of child labor to the receiving household and the future benefits of child's human capital to the sending household. It is therefore reasonable, as a first approximation, to approach a traditional child fostering arrangement as a cooperative game between the sending household and the receiving household. Indeed, if the receiving household were to uncooperatively determine  $l^f$ , it will set its level at

unity, implying that the foster child will have no time for after-school learning activities such as reading books, reviewing class notes, studying for exams, or doing homework assignments. Were this situation to materialize, no altruistic mother will voluntarily send her child out for fostering. Therefore in order for there to be child fostering in this environment, the biological mother and the foster mother must cooperate to determine  $l^f$ .

In deciding whether or not to cooperate, mothers will balance the payoff from cooperation against the payoff from no cooperation. When there is no cooperation, both mothers play the strategy  $a_i = 0$ . We referred to this situation as the autarky. To study the implications of informal child fostering arrangements for the foster child's welfare, we first characterize the cooperative game that determines the foster child's time allocated to home-production of nutrition in the receiving household. Since this game is played between a mother who wants to foster her child out and another who want to foster the child in, it is important to outline the characteristics of the household who gains from fostering out as well as those of the household who gains from fostering in.

#### 4.1. Who Gains from In-Fostering?

Suppose any household  $i$  would consider fostering in a child. Let  $l^f$  denote the labor input of the foster child in home-production. For the receiving household  $i$ , non-cooperative choice of the pair  $(l_i^m, l_i^b)$  yields the following payoff:

$$V^I(\eta_i, l^f) = \max_{\langle l_i^m, l_i^b \rangle} V(l_i^m, l_i^b, h_i^m, \theta_i, l^f), \quad (19)$$

where

$$\begin{aligned} V(l_i^m, l_i^b, h_i^m, \theta_i, l^f) &= \gamma_b \lambda \ln(1 - l_i^b) + \sigma [1 + \gamma_b(1 - \lambda)] \ln [\theta_i + h_i^m(1 - l_i^m)] \\ &\quad + B_1 + (1 - \sigma) [1 + \gamma_b(1 - \lambda)] \ln (l_i^m + l_i^b + l_i^f), \quad (20) \\ B_1 &= \ln(1 - 2\alpha) + \gamma_b [\ln D + (1 - \lambda) \ln \alpha], \end{aligned}$$

and  $\eta_i = h_i^m/\theta_i$  denotes the opportunity cost of the mother in household  $i$ . Denote as  $(\tilde{l}_i^m, \tilde{l}_i^b)$  the interior solution to the maximization problem in (19):

$$(\tilde{l}_i^m, \tilde{l}_i^b) = \arg \max_{\langle l_i^m, l_i^b \rangle} V(l_i^m, l_i^b, h_i^m, \theta_i, l^f), \quad (21)$$

all  $i$ . We prove the following Lemma in Appendix 7.1.

**Lemma 1.** *Given  $l^f$ , household  $i$ 's labor inputs allocation in home-production is given as follows:*

$$\tilde{l}_i^b = \hat{l}_i^b - \frac{\gamma_b \lambda}{1 + \gamma_b} l^f, \quad (22)$$

$$\tilde{l}_i^m = \hat{l}_i^m - \frac{\sigma [1 + \gamma_b (1 - \lambda)]}{1 + \gamma_b} l^f, \quad (23)$$

where  $(\hat{l}_i^b, \hat{l}_i^m)$  denotes the vector of time allocation in autarky, all  $i$ .

Lemma 1 states that child fostering partially relieves the mother and her biological child from participation in home-production. Indeed, as long as  $l^f > 0$ , we have that

$$\tilde{l}_i^b < \hat{l}_i^b \quad \text{and} \quad \tilde{l}_i^m < \hat{l}_i^m$$

all  $i$ . From (20), substituting in (23) and (22), re-arranging terms yields

$$V^I(\eta_i, l^f) = \bar{B}_1 + (1 + \gamma_b) \ln(2 + l^f + \eta_i^{-1}) + \sigma [1 + \gamma_b (1 - \lambda)] \ln \eta_i \theta_i, \quad (24)$$

all  $i$ , where

$$\bar{B}_1 = B_1 + \gamma_b \lambda \ln \left( \frac{\gamma_b \lambda}{1 + \gamma_b} \right) + [1 + \gamma_b (1 - 2\lambda)] \left( \ln [\sigma^\sigma (1 - \sigma)^{1-\sigma}] + \ln \left[ \frac{1 + \gamma_b (1 - \lambda)}{1 + \gamma_b} \right] \right).$$

Given  $(\eta_i, l^f)$ , it is important to ask which household  $i$  gains from in-fostering. We propose the following definition of gains from in-fostering:

**Definition 1.** Household  $i$  gains from in-fostering if and only if, given  $(\eta_i, l^f)$ , its welfare from in-fostering is no less than its autarky level:

$$V^I(\eta_i, l^f) - \bar{V}(\eta_i) \geq 0, \quad (25)$$

all  $i$ .

According to the above definition, a household that stands to lose from in-fostering has a level of opportunity cost  $\eta_i$  such that given  $l^f$ ,

$$V^I(\eta_i, l^f) - \bar{V}(\eta_i) < 0.$$

Define the net gain from in-fostering by  $\vartheta^I(\eta_i, l^f) \equiv V^I(\eta_i, l^f) - \bar{V}(\eta_i)$ , all  $i$ . Then, using (17) and (24) as well as the definition of  $\bar{B}_0$  and  $\bar{B}_1$  respectively, yields this net gain as follows:

$$\vartheta^I(\eta_i, l^f) = (1 + \gamma_b) \ln \left[ \frac{1 + (2 + l^f) \eta_i}{1 + 2\eta_i} \right] - \ln \left( \frac{1 - \alpha}{1 - 2\alpha} \right), \quad (26)$$

all  $i$ . Proposition 2 below summarizes the characteristics of a household who gains from in-fostering:

**Proposition 2.** *Suppose*

$$l^f > 2(\beta - 1), \quad (27)$$

where

$$\beta = \left( \frac{1 - \alpha}{1 - 2\alpha} \right)^{\frac{1}{1 + \gamma_b}} > 1.$$

If  $\eta_i > \bar{\eta}$ , where

$$\bar{\eta} = \frac{\beta - 1}{l_i^f - 2(\beta - 1)},$$

then,

$$\vartheta^I(\eta_i, l^f) \geq 0.$$

The interested reader can check that unless the foster child's labor input in home production  $l^f$  is sufficiently large in the sense of condition (27), no household gains from in-fostering in this environment. Therefore condition (27) implies that child labor is an essential feature of informal child fostering arrangements. It states that no household will foster in a child who can not commit a sufficiently high labor input in home-production. This is because adult time and child's time are substitutes in home-production, and parents in each household only care about the human capital level of their biological child.

Condition (27) has implications for the net gain from in-fostering. Indeed, Proposition 2 implies that in any household, parents' opportunity cost of labor input in home-production is the main determinant of the gains from in-fostering. This opportunity cost is defined by  $\eta_i = h_i^m / \theta_i$ , all  $i$ . In particular, Proposition 2 states that the household that gains from in-fostering is one where the parents (in this case the mother) faces a sufficiently high opportunity cost of labor input in home-production.

## 4.2. Who Gains from Out-Fostering?

Suppose that parents in household  $i$  decides to foster out their child. In this case, the mother will be left alone to supply labor in home-production (i.e.,  $l_i^b = 0$  and  $l_i^m > 0$ ), in addition to delivering her human capital to firms. In other words, the only variable



household  $i$  can choose non-cooperatively is the mother time allocation between home-production and market labor. Therefore define household  $i$ 's welfare from out-fostering as

$$V^O(l^f, \eta_i, \eta_j) = \max_{\langle l_i^m \rangle} V(x), \quad (28)$$

where  $x = (l_i^m, l^f, h_i^m, h_j^m, \theta_i, \theta_j)$  and

$$\begin{aligned} V(x) = & B_{-1} + \sigma \ln [\theta_i + (1 - l_i^m)h_i^m] + (1 - \sigma)\gamma_b(1 - \lambda) \ln (\tilde{l}_j^m + \tilde{l}_j^b + l^f) \\ & + \gamma_b\lambda \ln (1 - l^f) + \sigma\gamma_b(1 - \lambda) \ln [\theta_j + (1 - \tilde{l}_j^m)h_j^m] + (1 - \sigma) \ln(l_i^m) \end{aligned} \quad (29)$$

$$B_{-1} = \gamma_b [\ln D + (1 - \lambda) \ln \alpha]$$

and

$$(\tilde{l}_j^m, \tilde{l}_j^b) = \arg \max_{\langle l_j^m, l_j^b \rangle} V(l_j^m, l_j^b, h_j^m, \theta_j, l^f)$$

all  $j$ . Letting  $\bar{l}_i^m = \arg \max_{\langle l_i^m \rangle} V(l_i^m, l^f, h_i^m, h_j^m, \theta_i, \theta_j)$ , it can be shown that

$$\bar{l}_i^m = (1 - \sigma) (1 + \eta_i^{-1}), \quad (30)$$

all  $i$ . Therefore, from (29), substituting in (23), (22), (30) and re-arranging terms yields:

$$\begin{aligned} V^O(l^f, \eta_i, \eta_j) = & \bar{B}_{-1} + \ln (1 + \eta_i^{-1}) + \sigma [\ln(\eta_i\theta_i) + \gamma_b(1 - \lambda) \ln(\eta_j\theta_j)] \\ & + \gamma_b\lambda \ln (1 - l^f) + \gamma_b(1 - \lambda) \ln (2 + l^f + \eta_j^{-1}), \end{aligned} \quad (31)$$

all  $i$ , where

$$\bar{B}_{-1} = B_{-1} + [1 + \gamma_b(1 - \lambda)] \ln [\sigma^\sigma(1 - \sigma)^{1-\sigma}] + \gamma_b(1 - \lambda) \ln \left( \frac{1 + \gamma_b(1 - \lambda)}{1 + \gamma_b} \right).$$

We propose the following definition of gains from fostering out a child.

**Definition 2.** A household  $i$  gains from fostering out its child if and only if the welfare level from following this strategy is no less than its autarky level:

$$V^O(l^f, \eta_i, \eta_j) - \bar{V}(\eta_i) \geq 0. \quad (32)$$

Let's define household  $i$ 's net gain from out-fostering by:

$$\vartheta^O(l^f, \eta_i, \eta_j) \equiv V^O(l^f, \eta_i, \eta_j) - \bar{V}(\eta_i).$$

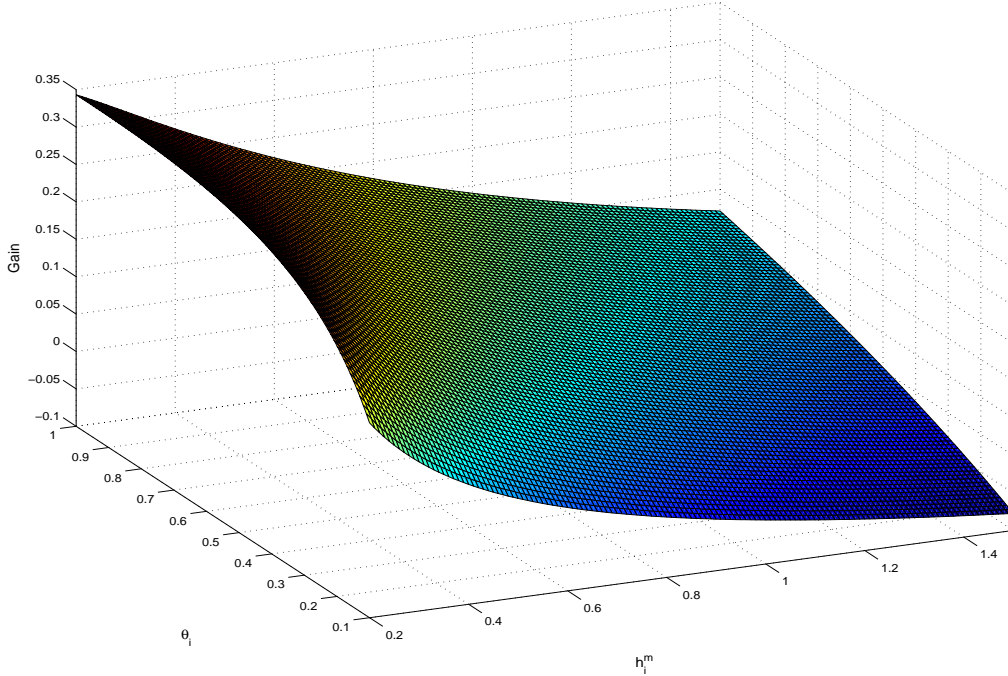
Then using (17) and (31) as well as the definition of  $\bar{B}_0$  and  $\bar{B}_{-1}$  respectively, we obtain this net gain as follows:

$$\begin{aligned} \vartheta^O(l^f, \eta_i, \eta_j) = & \bar{B} + \gamma_b \lambda \ln(1 - l^f) - \sigma \gamma_b (1 - \lambda) \ln h_i^m + \sigma \gamma_b (1 - \lambda) \ln h_j^m \\ & + \ln(1 + \eta_i^{-1}) - (1 + \gamma_b) \ln(2 + \eta_i^{-1}) + \gamma_b (1 - \lambda) \ln(2 + l^f + \eta_i^{-1}) \end{aligned} \quad (33)$$

where

$$\bar{B} = -\ln(1 - \alpha) - \left[ \gamma_b \lambda \ln \left( \frac{\gamma_b \lambda}{1 + \gamma_b} \right) + \ln \left( \frac{1 + \gamma_b (1 - \lambda)}{1 + \gamma_b} \right) \right].$$

Unlike expression (26) in sub-section 3.2 above, the net gain from out-fostering (33) is very complex, and thus does not offer a clear picture of who gains from out-fostering. To clarify this picture, we proceed by numerical simulation.



**Figure 1.** Gain from Out-Fostering as Function of  $h_i^m$  and  $\theta_i$  See Appendix 7.4

Figure 1 plots the net gain from fostering out a child against the constituents of the household bargaining power ( $h_i^m \theta_i$ ). Three main observations can be drawn from Figure 1:

- i) For any pair  $(i, j)$  of mothers with equal earning power (i.e.,  $h_i^m = h_j^m$ ), the mother who receives the highest transfer from her husband will be more likely to foster out, other things being equal. This result is illustrated by the observation that the net gain from out-fostering is an increasing function of  $\theta_i$ .

- ii) For any pair  $(i,j)$  of mothers with equal transfers (i.e.,  $\theta_i = \theta_j$ ), the mother with the lowest earning power will obtain a higher net gain from fostering out a child. This result is illustrated by the negative relationship between a mother's level of human capital  $h_i^m$  and the level of the net gain from fostering out a child.
- iii) Therefore, Figure 1 suggests that for any pair  $(i,j)$  of households such that  $\theta_i \neq \theta_j$  and  $h_i^m \neq h_j^m$ , the household that gain from fostering out a child is one where the mother has a sufficiently low opportunity cost labor input in home-production  $\eta_i = h_i^m/\theta_i$ .

### 4.3. Bargaining over Foster Child's Labor Input in Home-Production.

Since bargaining involves two different households, we adopt the convention that household  $i = 1$  is the sending household and household  $i = 2$  is the receiving household. The object of the bargaining is  $l^f$ . We want to determine the optimal level,  $\hat{l}^f$ , of the fostered child's labor input in home-production that is agreeable to both the sending and the receiving household. Let us show that child fostering involves a conflict between the immediate benefits of child labor to the receiving household, and the future benefits of human capital to the sending household. We prove the following lemma in Appendix 7.2.

**Lemma 2.** *The following statements are all true:*

- i) *the net gain from fostering in a child  $\vartheta^I$  is increasing in  $l^f$ ;*
- ii) *if  $\eta_2$  satisfies*

$$(1 - 3\lambda) - \frac{\lambda}{\eta_2} < 2(\beta - 1), \quad (34)$$

*then the net gain from fostering out a child  $\vartheta^O$  is decreasing in  $l^f$ ;*

- iii) *in addition,  $\vartheta^I$  and  $\vartheta^O$  are concave function of  $l^f$ :*

$$\frac{\partial^2 \vartheta^I}{\partial l^f{}^2} < 0 \quad \text{and} \quad \frac{\partial^2 \vartheta^O}{\partial l^f{}^2} < 0.$$

This lemma states that child fostering generates a conflict between the sending household and the receiving household. Therefore we can approach the determination of the foster child's labor input in home-production as a cooperative game between the two

types of households. We structure this cooperative game below.

Define

$$\Gamma(l^f; h_1^m, h_2^m, \theta_1, \theta_2) \equiv \vartheta^I(h_2^m, \theta_2, l^f) \times \vartheta^O(l^f, h_1^m, h_2^m, \theta_1, \theta_2),$$

where  $\vartheta^I(h_2^m, \theta_2, l^f)$  and  $\vartheta^O(l^f, h_1^m, h_2^m, \theta_1, \theta_2)$  denote respectively the net gains from fostering in and fostering out, a child and  $(h_1^m, h_2^m, \theta_1, \theta_2)$  is the allocation of bargaining powers between the two types of households.

**Lemma 3.** *Under condition (34), the Nash bargaining function  $\Gamma$  is strictly concave in  $l^f$ .*

**Proof.** See appendix 7.3.

Therefore, we can characterize the Nash bargaining solution,  $\chi(\cdot)$ , as follows:  $l^f = \chi(h_1^m, h_2^m, \theta_1, \theta_2)$ , where

$$\chi(h_1^m, h_2^m, \theta_1, \theta_2) = \arg \max_{\langle l^f \rangle} \Gamma(l^f; h_1^m, h_2^m, \theta_1, \theta_2) \quad (35)$$

The Nash solution  $\chi(\cdot)$  to the bargaining problem, if it exists, satisfies the following first order necessary and sufficient condition:

$$\frac{\vartheta^I(h_2^m, \theta_2, l^f)}{\vartheta^O(l^f, h_1^m, h_2^m, \theta_1, \theta_2)} = \frac{(1 - l^f) [(2 + l^f)h_1^m + \theta_1] (1 + \gamma_b)h_2^m}{\gamma_b [h_1^m l^f + \lambda\theta_1 - (1 - 3\lambda)h_1^m] [(2 + l^f)h_2^m + \theta_2]}. \quad (36)$$

Since this first order condition is non-linear, there is no hope of obtaining a closed form solution. Therefore to characterize the welfare effects of traditional child fostering arrangements, we simulate the model using specified parameters.

## 5. Numerical Simulations of the Model

In this section, we simulate the model to characterize the outcomes of the bargaining game between the sending household (whose variables are indexed by  $i = 1$ ) and the receiving household (whose variable are indexed by  $i = 2$ ). In all simulation exercises summarized below, we normalize the receiving household's socioeconomic status to  $(\theta_2, h_2^m) = (40, 4)$ . Another maintained assumption is that household's time input and the composite market good have equal shares in the production of the home-made good:  $\sigma = 0.5$ . This is purely a simplifying assumption made without loss of generality. It allows us to focus exclusively on the effect of the introduction of a child's level of nutrition intake as an input into his human capital. We set the level of parental altruism toward own-child at  $\gamma_b = 0.169$ , as in de la Croix and Doepke (2004). The other important exogenous variables are the

constituents of the sending household’s socioeconomic status  $(\theta_1, h_1^m)$  and the relative share of child’s schooling time in his human capital  $\lambda$ .

To highlight the role played by nutrition as an input into a child’s human capital level, we consider three cases. In the first case,  $\lambda = 0.3$ , meaning that a child’s level of nutrition intake is relatively more contributive to his human capital formation than the fraction of his time allocated to after-school learning activities, such as reviewing daily lessons, studying for school tests, or doing homework. In the second case  $\lambda = 0.5$  implying that child’s nutrition status and time allocated to after-school learning activities have equal shares in the child’s human capital. Finally, in the third case,  $\lambda = 0.7$ , meaning that a child’s time allocated to after-school learning activities is relatively more contributive to his school performance than is his level of nutrition intake.

For each of the three cases above, we also highlight the role played by the sending household’s relative bargaining power as determined by its socioeconomic status  $(\theta_1, h_1^m)$ . We show how these variables affect the outcomes of the bargaining game. For  $\theta_1$ , we consider three different levels:  $\theta_1 < \theta_2$ ,  $\theta_1 = \theta_2$ , and  $\theta_1 > \theta_2$ . For each of these levels, we plot all bargaining outcomes as a function of  $h_1^m$ —which is the human capital level of the mother in the sending-household. Results of all simulation exercises are shown in Appendix 7.4

## 5.1. Case 1: $\lambda = 0.3$

Case 1 corresponds to an environment where a child’s level of nutrition intake is paramount to his ability to achieve academic excellence in school. In this environment, we ask how informal child fostering arrangements affect the in-foster’s and household’s outcomes.

### 5.1.1. Foster Child’s Labor Input and Nutrition Intake

In this subsection, we explore the implications of the optimal child fostering arrangement for children’s human capital inputs. We first ask how this optimal arrangement affects the supply of child labor by the in-foster. To address this question, we compare the level of the child’s labor input under the fostering arrangement  $(l^f)$  and in absence of it  $(l_1^b)$ —the autarky situation. Since the receiving household has two residents children, the in-foster and the biological child, we also compare the former’s labor input to the latter’s in home-production.

We next ask how the optimal fostering arrangement affects the foster child’s level of nutrition intake. We address this question by comparing the child’s nutrition level under the fostering arrangement  $(\hat{c}^f)$  and in absence of it  $(\hat{c}_1^b)$ .

Recall that in autarky, the child labor input in home-production  $l_1^b$  is given analytically by (12). Under child fostering, the biological child labor input  $l_2^b$  is given analytically by (23) while the in-foster's, i.e.,  $\hat{l}^f = \chi(h_1^m, h_2^m, \theta_1, \theta_2)$ , is solution to (36). Likewise, in autarky the child nutrition status as determined by the quantity consumed of the home-made good  $c_1^b$  is given analytically by (15), while the in-foster's nutrition status as proxied by  $c^f$  is given by

$$\hat{c}^f = \alpha [\theta_2 + (1 - l_2^m)h_2^m]^\sigma (L_2(a_2))^{1-\sigma}$$

Results of this numerical simulation are shown in Appendix 7.4.1 under Figure 2. Figure 2 shows that compared to the autarky situation where there is no inter-household migration of children, informal fostering arrangements increase the incidence of child labor among in-fosters, causing them to contribute more of their time to household chores than do biological children. In other words, Figure 2 suggests that, compared to autarky and to the biological child of the foster family, an in-foster will have less time to allocate to scholastic activities that enhance academic excellence in school. But it also suggests that these arrangements raise the level of child's nutrition compared to autarky. In other words, informal fostering arrangements help improve the nutrition status of in-fosters, thus helping them become more alert, and pay more attention in the classroom. How the in-foster's level of human capital is affected by these two opposite effects becomes an important issue to address if one is to gain a better understanding of the effects of informal fostering arrangements.

### 5.1.2. Foster Child's Human Capital and Household's Welfare

In this subsection, we discuss the implications of the optimal child fostering arrangements for the in-foster's level of human capital level, and on household welfare. Observe that under the child fostering arrangement, the foster child human capital level  $\hat{h}^f$  is given as:

$$\hat{h}^f = D (1 - \hat{l}^f)^\lambda \left( \frac{\bar{\alpha} [1 + \gamma_b(1 - \lambda)] [\theta_2 + h_2^m(2 + \hat{l}^f)]}{1 + \gamma_b} \right)^{1-\lambda} \left( \frac{1}{h_2^m} \right)^{(1-\sigma)(1-\lambda)}$$

where  $\bar{\alpha} = \alpha \sigma^\sigma (1 - \sigma)^{1-\sigma}$  and  $l^f = \chi(h_1^m, h_2^m, \theta_1, \theta_2)$ . In autarky where each child resides with his biological parents, a child's human capital level is given by (16) above.

Results of this numerical simulation are shown in Appendix 7.4.2 under Figure 3 in the case where  $\lambda = 0.3$ , which, again is taken to mean that a child's level of nutrition intake is paramount to his ability to accumulate human capital. Indeed, a child who is more alert

in class because of better nutrition may need less studying time in order to pass school tests. Thus having less time to study or to do one's homework may not be as strong an impediment to achievement of good school results when a child has better nutrition status.

Figure 3 reports the implications of the optimal child fostering arrangement on household and in-foster's welfare levels. It shows that both the sending, and the receiving, household are benefited by this arrangement, with the former arguably more better-off than the latter. Indeed the sending household's net gain from out-fostering their child always exceeds the corresponding figure for the receiving household (see left-hand side graphs in Figure 3).

More importantly, Figure 3 shows that compared to autarky, the in-foster's human capital level is higher, though always lower than, the corresponding figure for the foster family's biological child. This result is a direct consequence of the important role nutrition plays as an input into child's human capital. Figure 3 also shows that the beneficial effects informal child fostering arrangements have on the in-foster's human capital rise with the sending household bargaining power. Note that an increase in  $\theta_1$  ceteris paribus lowers the sending household bargaining power, while an increase in  $h_1^m$  raises it.

## 5.2. Case 2: $\lambda = 0.5$

Case 2 corresponds to an environment where a child's level of nutrition intake and a child's time allocated to after-school learning activities have equal shares in his human capital formation. In this environment, and as in Case 1 above, we ask how informal child fostering arrangements affect child's outcomes and household outcomes.

Results of this numerical simulation are shown in Appendix 7.4.3 under Figure 4 which is the analog of Figure 2 for Case 2. It shows that the relative role of nutrition in the child's human capital accumulation technology has no bearing on the effects informal child fostering arrangements have on the in-foster's labor input and nutrition. As in Case 1, the optimal fostering arrangement raises the incidence of child labor for the in-foster, causing him to contribute more of his time to household chores than does the biological child. The persistence of this child labor outcome despite a change in the relative contribution of nutrition in the child's human capital leads us to conclude that the receiving household's child labor motive for in-fostering is the main driver of the in-foster's level of labor supply, resulting in asymmetric status between the in-foster and the biological child.

Results of the numerical simulation summarizing the implications of the child labor mo-

tive for in-fostering for the in-foster's level of human capital are shown in Appendix 7.4.4 under Figure 5.

Compared to Case 1, the child labor motive for in-fostering still causes an asymmetry between the in-foster's and the biological child's human capital outcomes. The latter still accumulates more human capital than the former. In this case however, and unlike in Case 1, the sending household's bargaining power becomes more determinant in ensuring that placing one's child under the temporary care of non-parents enhances his human capital compared to autarky. This is because fostering out a child entails a trade-off between after-school learning activities and nutrition. And because after-school learning activities and nutrition have equal shares in the child's human capital, parental bargaining power becomes crucial in ensuring that their child is not made worse off by being placed under the temporary care of non-parents. Graphs on the right-hand-side of Figure 5 indeed illustrate the crucial role played by the sending household bargaining power. When that bargaining power is weak, less time for after-school learning activities and more nutrition than in autarky result in the in-foster accumulating less human capital compared to autarky, which leaves him worse off. Yet, compared to autarky, the sending household is made better off as illustrated by graphs in the left-hand-side of Figure 5. This result implies that when the sending household has a low bargaining power, fostering out a child simply becomes a way to buffer the costs of raising children, thus making the parents better off, albeit at the expense of their own child's welfare.

### 5.3. Case 3. $\lambda = 0.7$

In this case, having enough time to review lessons, to study for school tests, do homework is paramount to a child's ability to achieve academic excellence in school. This is likely to be the case in environment where the quality of in-school education too low, that additional private learning activities are necessary, for example to allow the child to have a better preparation for national tests. Nutrition in this case becomes relatively less important. So what, in this case, are the implications of the optimal child fostering arrangement?

Figure 6 in Appendix 7.4.5 summarizes our answer to this question. It shows that as the previous two cases, the child labor motive for in-fostering still causes the foster child to contribute more time in home-production than does the biological child, thus leaving the former with less time to allocate to after-school learning activities. As in this case, schooling time is paramount to the child's ability to accumulate human capital compared to nutrition, an important question is whether the sending household has enough bar-



gaining power to prevent its child being made worse off by the fostering arrangement.

Appendix 7.4.6 under Figure 7 provides the answer to this question. Expectedly, Figure 7 shows that the sending household's bargaining power can do nothing to prevent the foster child being made worse off by the fostering arrangement.

## 6. Conclusion

The results presented in this paper suggest that in the absence of well-functioning market for domestic labor, households enter child fostering arrangements to allow parents to take advantage of gains from specialization in market activities, by adjusting household size. Gains from specialization exist when there are inter-household differences with respect to parents' opportunity cost of labor input in home-production. We derived necessary and sufficient conditions for all parties involved to gain from the optimal child fostering arrangement. We show that placing children under the care of non-parents need not make these children worse off, even when adults' altruistic actions are restricted to own-children.

The innovative feature of our model responsible for this conclusion is the inclusion of a child's nutrition status as a determinant of his ability to achieve academic excellence in school. Better nutrition, for example, by making the child more alert in school, and by enhancing his ability to retain more information, can reduce the amount of time needed to review daily lessons, study for school tests, or do homework. A child with a low nutrition status, in contrast, may take more time to study and review due to low alertness and inability to concentrate. We argued that when nutrition is paramount to a child school performance, parents can take advantage of the fostering institution to improve their children academic achievements by fostering them out to households that can offer them a better nutrition status.

We obtained these results in a context where Hamilton's rule applies, causing altruistic actions by parents to be restricted to own-children. We also implicitly assumed that school enrolment is mandatory, an institution increasingly adopted by all countries including poorer ones. This assumption only serves the purpose of establishing the fact that

asymmetry in human capital outcomes between a biological child and an in-foster may still exist despite equal enrolment. Indeed we show that when such asymmetries exist, they are fully explained by differences in time allocated to after-school learning activities, such as studying for school tests, reading books and magazines to improve communications skills, etc. Because of the operation of Hamilton's rule, our model predicts that a biological child will always accumulate a higher level of human capital than the in-foster. Yet under certain conditions, the in-foster accumulates more human capital compared to the autarky situation where there is own-parent residence for all children. Our analysis therefore suggests that Hamilton's rule need not provide a motive for public policy action to regulate informal child fostering arrangements.

Consistent with reported cross-country disparities in the welfare effects of informal child fostering arrangements (Ainsworth 1996, Zimmerman 2003, Fafchamps and Wahba 2006, and Akresh 2009), our analysis suggests that these disparities can be explained by differences in the quality of the formal education system. In general, our analysis reinforces the growing consensus in the existing literature (Zimmerman 2003; Akresh 2009; Serra 2009) that informal child fostering arrangements enhance, rather than impede, development.

## 7. Appendix

In this section, we provide proofs for most of the results obtained in the main text.

### 7.1. Proof of Lemma 1

We know that  $(\tilde{l}_i^m, \tilde{l}_i^b)$  are solution to the maximisation problem (21):

$$(\tilde{l}_i^m, \tilde{l}_i^b) = \arg \max_{\langle l_i^m, l_i^b \rangle} V(l_i^m, l_i^b, h_i^m, \theta_i, l^f).$$

By solving the first order condition of this problem, it can be shown that  $\tilde{l}_i^m$  and  $\tilde{l}_i^b$  are respectively given by:

$$\tilde{l}_i^b = \frac{[1 + \gamma_b(1 - 2\lambda)] - \gamma_b\lambda(\eta_i^{-1} + l^f)}{1 + \gamma_b},$$

$$\tilde{l}_i^m = \frac{[(1 - \sigma)(1 + \gamma_b) + \sigma\gamma_b\lambda](1 + \eta_i^{-1}) - \sigma[1 + \gamma_b(1 - \lambda)](1 + l^f)}{1 + \gamma_b},$$

Therefore it obvious appears that

$$\tilde{l}_i^b = \hat{l}_i^b - \frac{\gamma_b\lambda}{1 + \gamma_b}l^f,$$

$$\tilde{l}_i^m = \hat{l}_i^m - \frac{\sigma[1 + \gamma_b(1 - \lambda)]}{1 + \gamma_b}l^f,$$

## 7.2. Proof of Lemma 2

- i) The result of this statement is obtained by differentiating the net gain from foster in a child with respect to  $l^f$ . Indeed, the net gain from foster in a child is given by:

$$\vartheta^I(\eta_i, l^f) = (1 + \gamma_b) \ln \left[ \frac{1 + (2 + l^f)\eta_i}{1 + 2\eta_i} \right] - \ln \left( \frac{1 - \alpha}{1 - 2\alpha} \right).$$

Therefore, differentiating with respect to  $l^f$  yields:

$$\frac{\partial \vartheta^I(\eta_i, l^f)}{\partial l^f} = \frac{(1 + \gamma_b)\eta_i}{1 + (2 + l^f)\eta_i} > 0.$$

- ii) the net gain from foster out a child is given by the following relation:

$$\begin{aligned} \vartheta^O(l^f, \eta_i, \eta_j) &= \bar{B} - \sigma\gamma_b(1 - \lambda) \ln h_i^m + \sigma\gamma_b(1 - \lambda) \ln h_j^m + \ln(1 + \eta_i^{-1}) \\ &\quad + \gamma_b\lambda \ln(1 - l^f) - (1 + \gamma_b) \ln(2 + \eta_i^{-1}) + \gamma_b(1 - \lambda) \ln(2 + l^f + \eta_i^{-1}). \end{aligned}$$

Therefore, differentiating with respect to  $l^f$  yields:

$$\frac{\partial \vartheta^O(l^f, \eta_1, \eta_2)}{\partial l^f} = -\gamma_b \left[ \frac{l^f - (1 - 3\lambda) + \lambda\eta_2^{-1}}{(1 - l^f)(2 + l^f + \eta_2^{-1})} \right].$$

Let us assume that

$$(1 - 3\lambda) - \frac{\lambda}{\eta_2} < 2(\beta - 1).$$

This inequality is also equivalent to

$$(1 - 3\lambda) - \frac{\lambda}{\eta_2} < l^f,$$

since  $l^f > 2(\beta - 1)$  according to (27). In other words, the numerator of the fraction

containing in the above expression of the first derivative of the net gain from foster out a child is a positive one. It therefore appears obvious to remark that this last inequality implies that:

$$\frac{\partial \vartheta^O(l^f, \eta_1, \eta_2)}{\partial l^f} < 0.$$

iii) The second derivative respectively of  $\vartheta^O$  and  $\vartheta^I$  with respect to  $l^f$  are:

$$\begin{aligned} \frac{\partial^2 \vartheta^O(l^f, \eta_1, \eta_2)}{\partial l^{f2}} &= -\gamma_b \left[ \frac{\lambda}{(1-l^f)^2} + \frac{1-\lambda}{(2+l^f+\eta_2^{-1})^2} \right] < 0, \\ \frac{\partial^2 \vartheta^I(\eta_2, l^f)}{\partial l^{f2}} &= -\frac{(1+\gamma_b)\eta_2^2}{1+(2+l^f)\eta_2} < 0. \end{aligned}$$

These results imply that  $\vartheta^O$  and  $\vartheta^I$  are concave function of  $l^f$

### 7.3. Proof of Lemma 3

The Nash Bargaining function is defined by

$$\Gamma(l^f; h_1^m, h_2^m, \theta_1, \theta_2) \equiv \vartheta^I(h_2^m, \theta_2, l^f) \times \vartheta^O(l^f, h_1^m, h_2^m, \theta_1, \theta_2),$$

Its second derivative with respect to  $l^f$  is given by the following relation:

$$\frac{\partial^2 \Gamma}{\partial l^{f2}} = \frac{\partial^2 \vartheta^I}{\partial l^{f2}} \times \vartheta^O(l^f, \theta_1, \theta_2) + \frac{\partial^2 \vartheta^O}{\partial l^{f2}} \vartheta^I(\eta_2, l^f) + \frac{\partial \vartheta^O}{\partial l^f} \times \frac{\partial \vartheta^I}{\partial l^f}.$$

Since  $\vartheta^O$  and  $\vartheta^I$  are positive values, the quantity

$$\frac{\partial^2 \Gamma}{\partial l^{f2}} = \frac{\partial^2 \vartheta^I}{\partial l^{f2}} \times \vartheta^O(l^f, \theta_1, \theta_2) + \frac{\partial^2 \vartheta^O}{\partial l^{f2}} \vartheta^I(\eta_2, l^f)$$

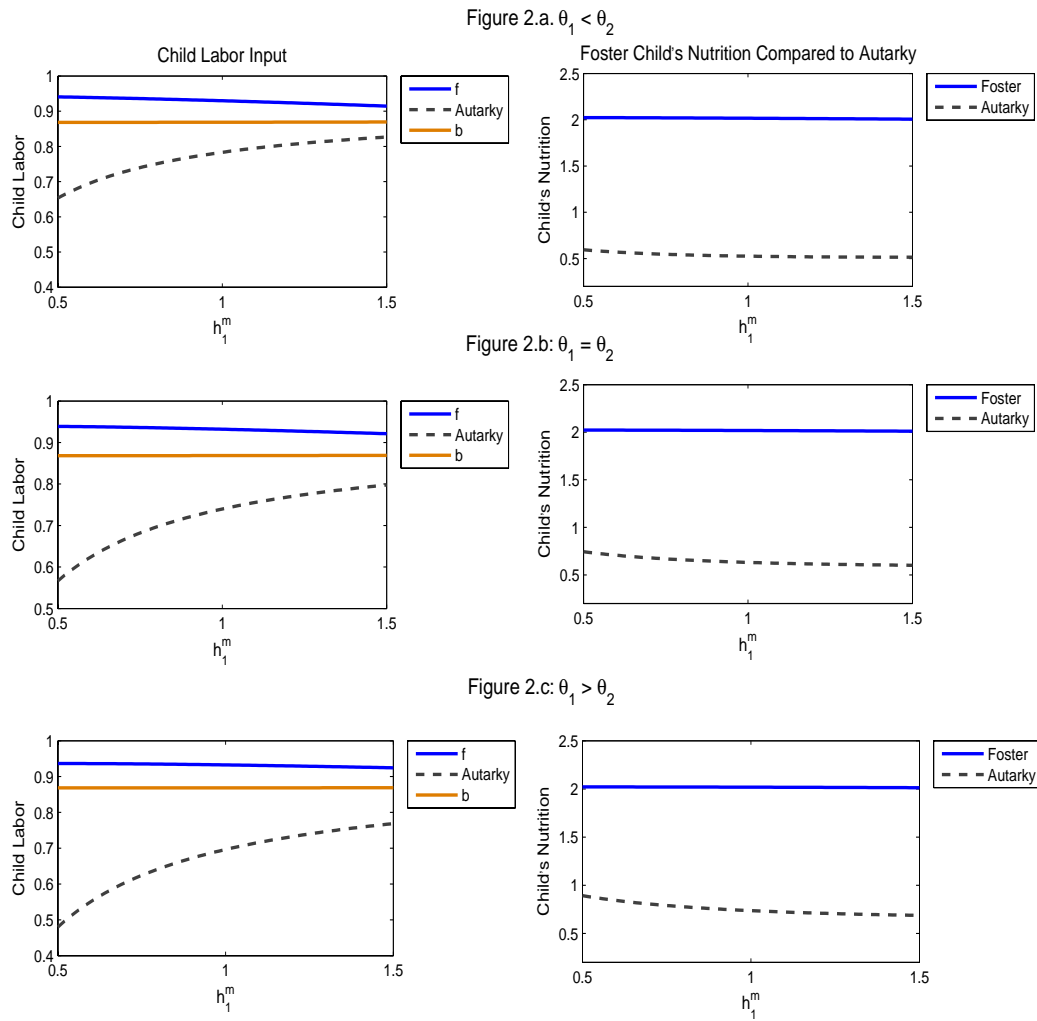
is therefore a negative one according the result (iii) of Lemma 2. Elsewhere, we know that under (34), the first derivative of  $\vartheta^O$  with respect to  $l^f$  is negative. These result lead us to conclude that

$$\frac{\partial^2 \Gamma}{\partial l^{f2}} < 0.$$

## 7.4. Results of the numerical simulation

In this sub-section we present the graphs pertaining to the numerical simulation of the model. There are three cases: (i)  $\lambda = 0.3$ ; (ii)  $\lambda = 0.5$ ; (iii)  $\lambda = 0.7$ .

### 7.4.1. Incidence of Child Labor and Child's Nutrition for $\lambda = 0.3$

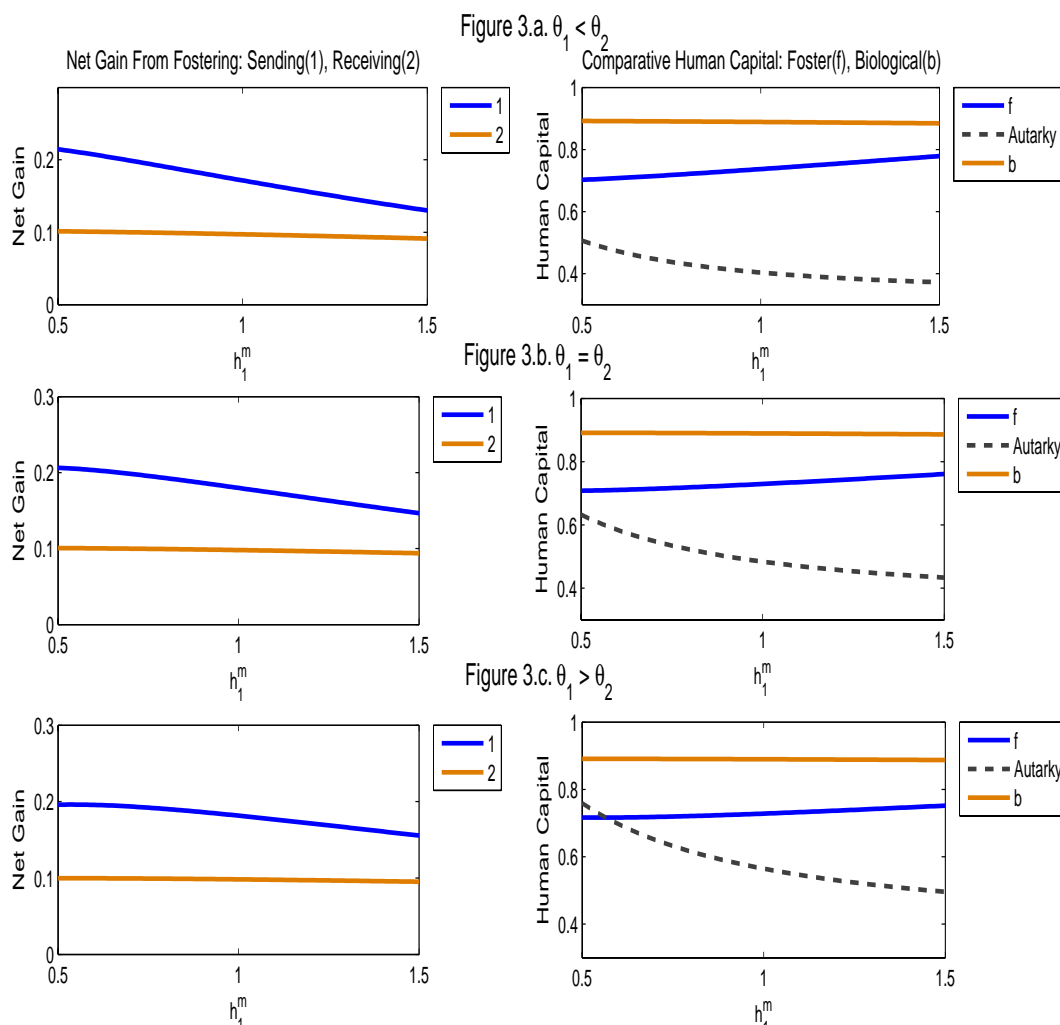


**Figure 2.** Foster child's labor supply and nutrition status for  $\lambda = 0.3$

The blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables. In all graphs, the black-colored dotted curve represents the foster child's variables in autarky corresponding to own-parent residence. To uncover the effects of fostering arrangements on the foster child's welfare, we contrast the fostering

outcomes with the autarky outcomes.

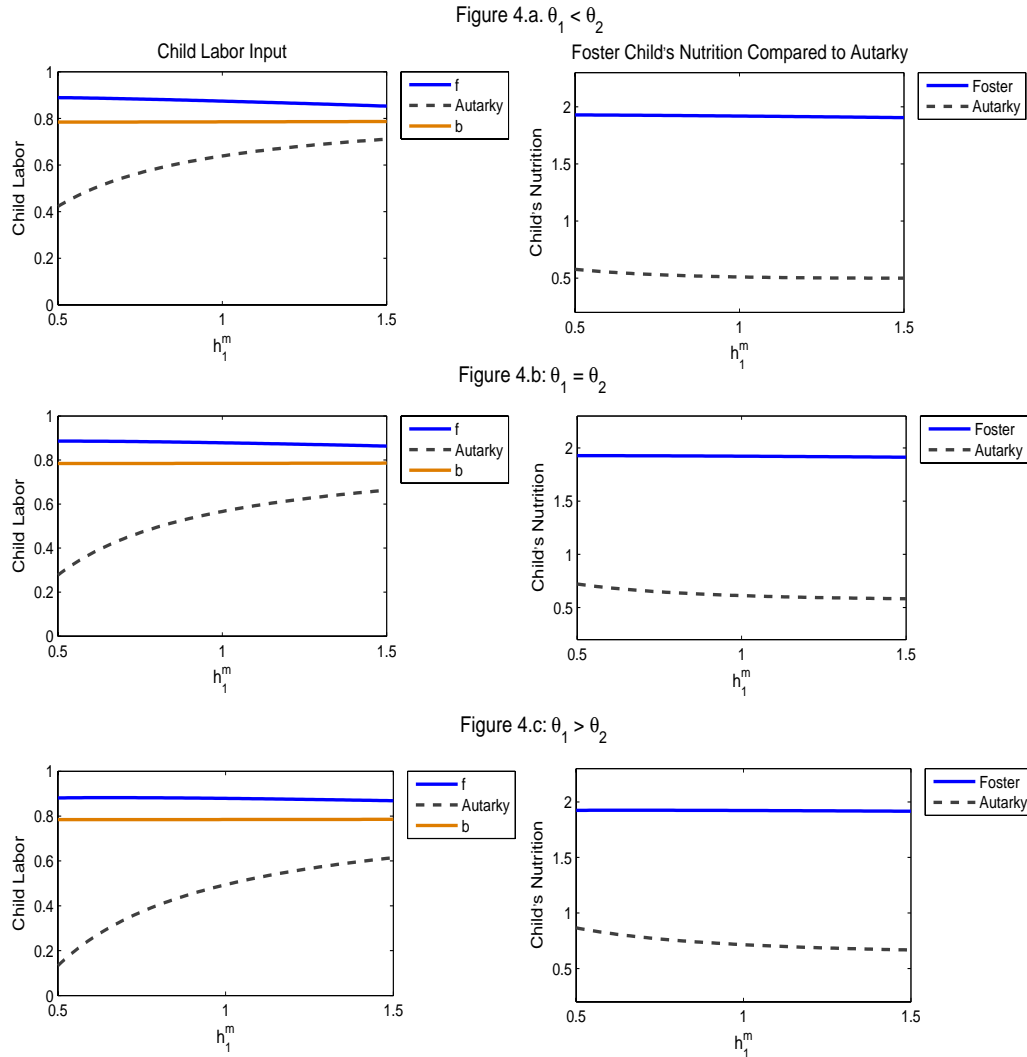
### 7.4.2. Gains from the Fostering Arrangement for $\lambda = 0.3$



**Figure 3.** Foster child's human capital and household's welfare when  $\lambda = 0.3$ .

The blue-colored curve of the left-hand side graphs represents the sending household's variables, and the orange-colored curve, the receiving household's variables. As for the right-hand side graphs, the blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables, and the black-colored dotted curve, the foster child's variables in autarky corresponding to own-parent residence.

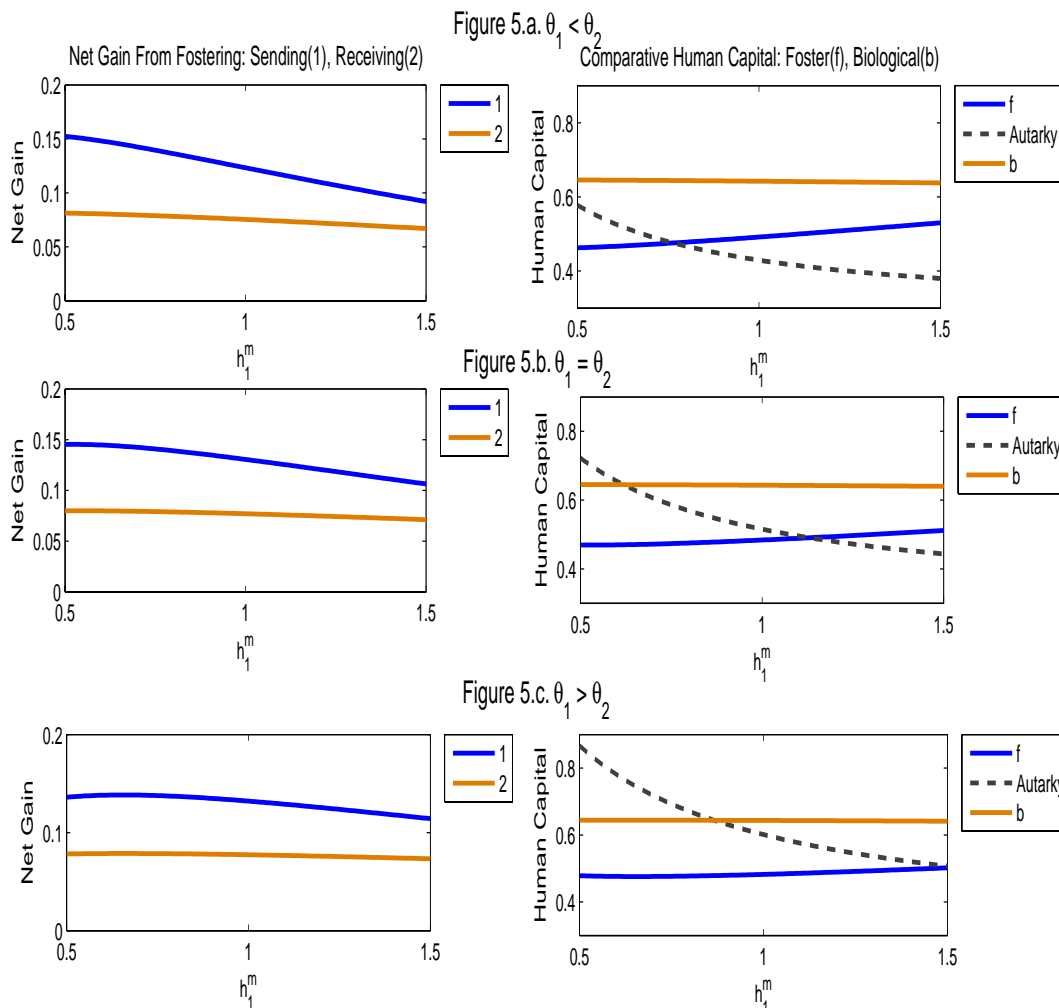
### 7.4.3. Incidence of Child Labor and Child's Nutrition for $\lambda = 0.5$



**Figure 4.** Foster child's labor supply and nutrition status when  $\lambda = 0.5$ .

The blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables. In all graphs, the black-colored dotted curve represents the foster child's variables in autarky corresponding to own-parent residence. To uncover the effects of fostering arrangements on the foster child's welfare, we contrast the fostering outcomes with the autarky outcomes.

### 7.4.4. Gains from the Fostering Arrangement for $\lambda = 0.5$

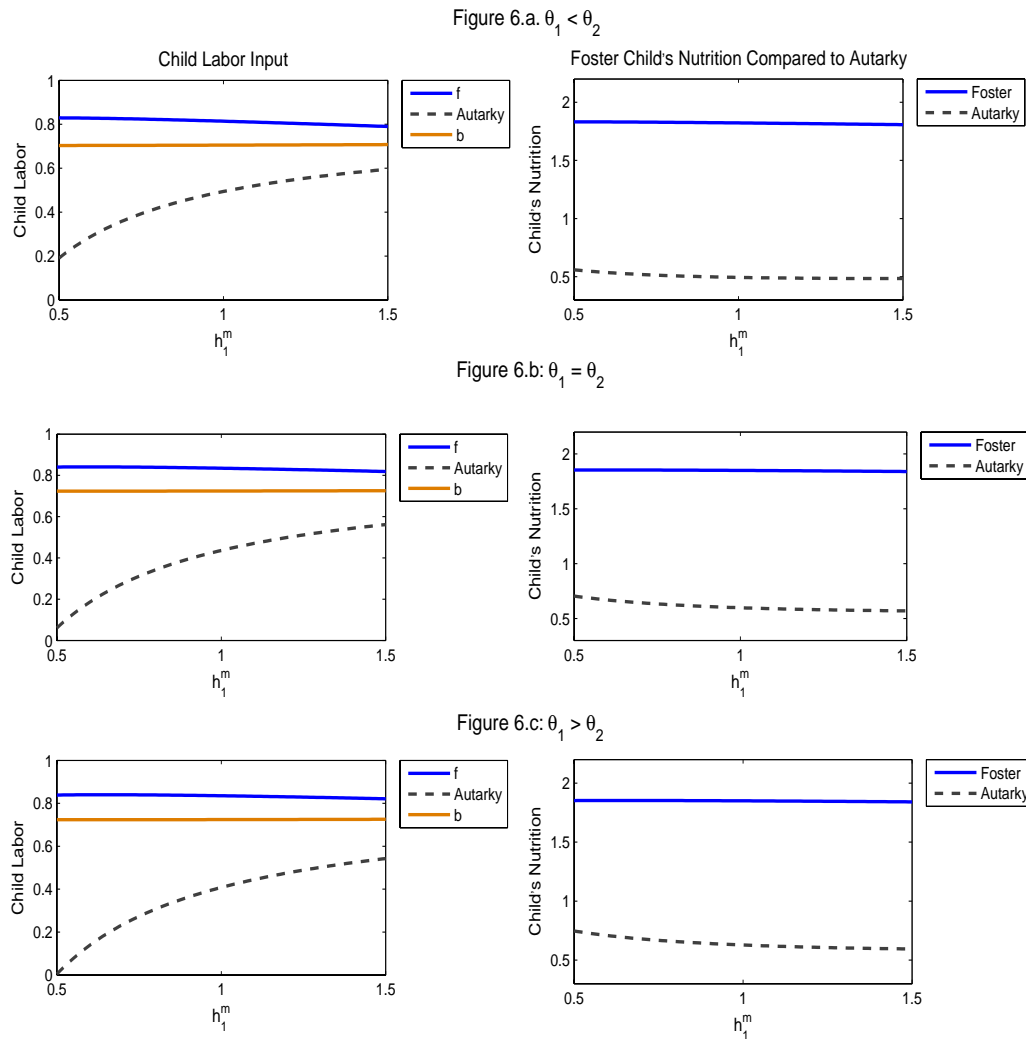


**Figure 5.** Foster child's human capital and household's welfare when  $\lambda = 0.5$ .

The blue-colored curve of the left-hand side graphs represents the sending household's variables, and the orange-colored curve, the receiving household's variables. As for the right-hand side graphs, the blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables, and the black-colored dotted curve, the foster child's variables in autarky corresponding to own-parent residence.



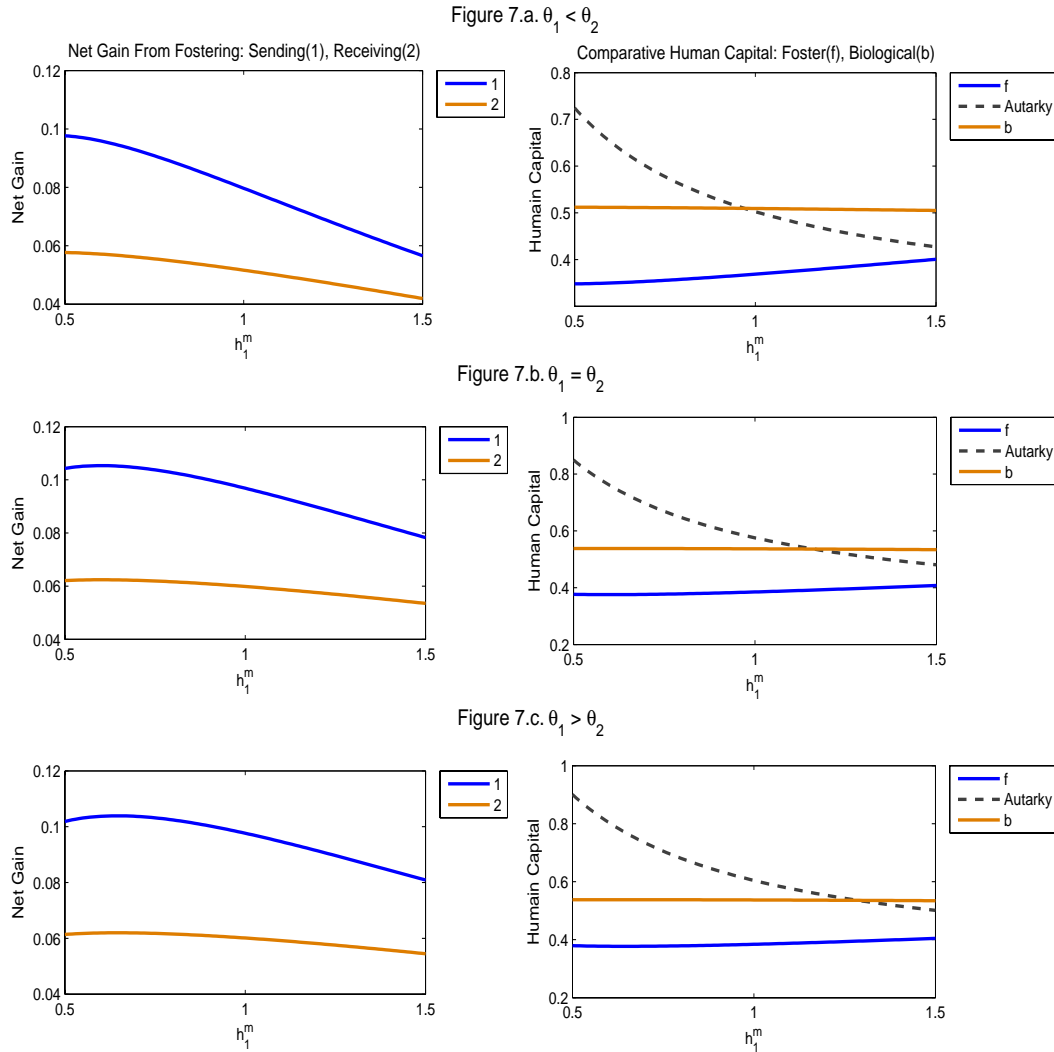
### 7.4.5. Incidence of Child Labor and Child's Nutrition for $\lambda = 0.7$



**Figure 6.** Foster child's labor supply and nutrition when  $\lambda = 0.7$ .

The blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables. In all graphs, the black-colored dotted curve represents the foster child's variables in autarky corresponding to own-parent residence. To uncover the effects of fostering arrangements on the foster child's welfare, we contrast the fostering outcomes with the autarky outcomes.

### 7.4.6. Gains from the Fostering Arrangement for $\lambda = 0.7$



**Figure 7.** Foster child's human capital and household welfare when  $\lambda = 0.7$ .

The blue-colored curve of the left-hand side graphs represents the sending household's variables, and the orange-colored curve, the receiving household's variables. As for the right-hand side graphs, the blue-colored curve represents the foster child's variables, the orange-colored curve, the biological child's variables, and the black-colored dotted curve, the foster child's variables in autarky corresponding to own-parent residence.

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