Time and Income Allocation in Non-cooperative and Cooperative Families *

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Abstract

This paper studies time and income allocation in a two-agent family with altruistic preferences, home production of a public good, and voluntary transfers. We first characterize the Nash equilibrium of the non-cooperative game and compare it to the set of Pareto efficient allocations. Then, we analyze a cooperative family in which agents bargain over income shares using the non-cooperative outcome as the disagreement point. Existing non-cooperative household models (Anderberg and Rainer, 2013; Bertrand et al., 2021) show that an increase in one partner's earning capacity can reduce the other's welfare for a non-empty set of parameters. The central result of this paper shows that such welfare conflicts can arise even when the household cooperates. Moreover, cooperation enlarges the parameter region generating welfare conflicts. Although cooperation benefits both agents when earning capacities are fixed, it may amplify welfare conflicts when earning capacities change. These welfare conflicts may create incentives for economic sabotage within the marriage and affect marital stability.

Keywords: household decision-making; intrahousehold allocation; Nash bargaining; non-cooperative game; welfare

JEL Classification: C72, C78, D13, J12, J22

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1 Introduction

Household decisions about the allocation of time and income are central to many economic and social outcomes, including education, marriage, fertility, labor supply, gender inequality, and public policy. The allocation of paid and unpaid work remains highly unequal. Across OECD countries, women perform almost twice as much unpaid work as men each day (OECD, 2025). However, treating the household as a collection of independent decision-makers can be misleading. For example, accounting for household decision-making changes measures of poverty among the elderly, estimates of gender inequality in the labor market, and predictions of female labor supply (Cherchye et al., 2012a; Flabbi and Mabli, 2018; Heath and Tan, 2020). These findings highlight the importance of modeling household decision-making.

There are at least three approaches to modeling household decision-making: unitary, non-cooperative, and cooperative. The unitary model treats the household as a single decision maker (Becker, 1974). Non-cooperative models allow members to act strategically and typically use Nash equilibrium as the solution concept. Cooperative models instead assume Pareto efficient outcomes generated by bargaining. Our paper follows Konrad and Lommerud (2000) in combining the non-cooperative and cooperative approaches.

This paper analyzes a household with two decision-makers. The agents enjoy a household public good (housework) and private consumption. They also care about each other's well-being through a common degree of altruism. With heterogeneous abilities to produce housework and earn income, they allocate their time between housework and market work, and may transfer income to their partner. In a non-cooperative family, agents simultaneously choose time allocations and voluntary transfers. In a cooperative family, agents adopt a Pareto efficient time allocation. They negotiate the income allocation through symmetric Nash bargaining, with the non-cooperative Nash equilibrium as the disagreement point.

The central contribution of this paper is the welfare analysis of the cooperative family. There exists a non-empty set of parameters such that an increase in an agent's wage rate strictly reduces the other's welfare. The underlying intuition is as follows. An increase in one agent's wage rate has two opposing effects on the welfare of the other (the partner). First, it weakly expands the Pareto frontier and benefits both family members. Second, it shifts the cooperative income allocation in favor of the agent whose wage rate increases, reducing the partner's welfare. When an agent has both comparative and absolute disadvantages in earnings, a small increase in the agent's wage rate does not change the Pareto frontier. However, it affects the Nash equilibrium and the resulting income division. The partner receives a smaller income share and becomes worse off. A similar logic applies when altruism is sufficiently low and the agent has only a comparative disadvantage in earnings. Although a higher wage slightly expands the Pareto frontier, the efficiency gain is relatively small, and the redistribution effect dominates. As a result, the partner again becomes worse off.

Our cooperative welfare result is closely related to Anderberg and Rainer (2013) and Bertrand et al. (2021). They show a set of parameter values in which the husband's equilibrium utility decreases in the wife's wage rate in a non-cooperative family. One might attribute this result to a lack of negotiation within the household and expect it to disappear once family members cooperate. Our paper complements these studies by demonstrating that such outcomes can also arise in cooperative families and that cooperation may even amplify them. More precisely, we show that the set of parameter values generating this phenomenon under non-cooperation is a proper subset of the corresponding set under cooperation.

These welfare conflicts have implications for both economic abuse and marital stability. In Australia, 15 percent of adult women and 6.7 percent of adult men reported having experienced economic abuse by a previous cohabiting partner. Among them, 31 percent of women and 18.8 percent of men reported interference with work or earnings, while 20 percent and 2.9 percent, respectively, reported interference with

their studies (Australian Bureau of Statistics, 2023). Existing literature explains such abuse as a means of weakening a partner's outside option, extracting resources, or controlling household behavior (Bloch and Rao, 2002; Bobonis et al., 2013; Adams et al., 2024). Anderberg and Rainer (2013) model economic abuse as instrumental sabotage of a partner's earning capacity in a non-cooperative household. Accordingly, we consider an extension of our model that offers a distinct explanation. Section 6.1 introduces costly sabotage of a training program that can improve one agent's wage rate. The partner may sabotage this program because the resulting intrahousehold allocation directly reduces their welfare. Such sabotage can arise in both non-cooperative and cooperative families, and the parameter region in which it occurs may be larger under cooperation.

Empirical evidence suggests that improvements in women's career prospects or relative earnings can destabilize marriage (Bertrand et al., 2015; Folke and Rickne, 2020; Lippmann et al., 2020). A second extension in Section 6.2 considers stochastic divorce. Changes in earning capacity affect divorce probability through both marital surplus and the value of being single. We show that the divorce probability is lower in a cooperative family than in a non-cooperative family. Consistent with the empirical evidence, our numerical exercises indicate that an increase in one agent's wage rate can raise the divorce probability. In addition, the two family types can respond differently to a wage shock, particularly when a welfare conflict arises only under cooperation.

The analysis also yields a few additional insights. In a non-cooperative family, the Nash equilibrium is unique except at specific parameter values.[1] Whenever an agent has a sufficiently strong comparative advantage in earnings, this agent transfers income to the other in the Nash equilibrium. Equilibrium welfare is non-monotonic in agents' earning capacities. The transfer incentivizes the receiver to specialize in housework. Specialization exploits comparative advantage and moves the allocation closer to the Pareto efficient allocation. However, under certain parameter values, an increase in the receiver's wage rate reduces or eliminates transfers. The resulting reduction in specialization reduces the welfare of both agents.[2]

The Pareto efficient allocations depend on the agents' abilities and the degree of altruism. Both comparative and absolute advantages shape the time allocation, while higher altruism leads to a more balanced income distribution. The Nash equilibrium is Pareto efficient when the wage gap between agents is sufficiently large. In this case, the wage gap induces sufficient transfers and leads to full specialization, aligning individual incentives with efficient production. Moreover, higher altruism reduces the wage gap required for Pareto efficiency of the Nash equilibrium. As a result, the set of parameters for which the non-cooperative allocation is Pareto efficient expands as the degree of altruism increases.

When the non-cooperative outcome is inefficient, cooperation brings the income allocation closer to equal sharing of consumption and improves both agents' welfare. Agents' cooperative welfare is weakly increasing in their own wage rate, but as explained before, is non-monotonic in the partner's wage rate.

There is a large literature on non-cooperative models of household decision-making. Leuthold (1968) provides an early analysis of family members' work-leisure decisions under equal income sharing. Following the non-cooperative approach, Konrad and Lommerud (1995) study labor supply and the production of a public good. In recent years, economists have adopted this approach to analyze the provision of multiple public goods (Browning et al., 2010), consumption (Lechene and Preston, 2011; Cherchye et al., 2011;

[1]For each agent, there exists a threshold of comparative advantage in earnings above which they transfer income to their partner. Multiple Nash equilibria exist whenever one agent's comparative advantage in earnings is exactly equal to this threshold.

[2]There are two cases. (1) When the transferor's comparative advantage in earnings is relatively near the threshold, a sufficiently large increase in the receiver's wage rate eliminates the transfer and reduces the transferor's welfare. (2) For the agent less productive in housework, there exists a non-empty interval of the partner's wage rate over which the agent's welfare decreases as the partner's wage rate rises.

Chiappori and Naidoo, 2020), marriage (Eckstein and Lifshitz, 2015; Bertrand et al., 2021), fertility (Obara and Ogawa, 2024), children's education (Doepke and Tertilt, 2019), economic abuse (Anderberg and Rainer, 2013), taxation (Meier and Rainer, 2015), and the effect of unearned income on labor supply (Heath and Tan, 2020). The Nash equilibria in these models are typically Pareto inefficient. An exception is Cremer and Roeder (2017). They show that anticipated transfers from altruistic parents can, under suitable conditions, induce selfish spouses to provide a household public good efficiently. In our model with altruism and voluntary transfers between spouses, a Pareto efficient Nash equilibrium exists for some parameter values.

In reality, family members interact in a long-term relationship, making cooperation possible. Del Boca and Flinn (2012) provide a framework that models household interaction as an infinitely repeated game. The Nash equilibrium of the stage game is Pareto inefficient. A grim trigger strategy yields cooperation along the equilibrium path when the discount factor is sufficiently high. Following this framework, Del Boca and Flinn (2014) and Flinn et al. (2018) study marriage market sorting and the gender wage gap, respectively. Our model is static, but Pareto efficiency may hold due to altruism. For a family with an inefficient allocation, we characterize the Nash bargaining solution that improves both agents' welfare. Although we do not explicitly model an infinitely repeated game, a grim trigger strategy may support an equilibrium path implementing the Nash bargaining outcome if agents repeatedly play the static game.

Cooperative models assume that household decisions are Pareto efficient. One approach to cooperative decision-making is Nash bargaining with a disagreement point. We adopt the symmetric Nash bargaining solution for cooperative families. As shown in Binmore et al. (1986), the subgame-perfect equilibrium of the alternating-offer game converges to the Nash bargaining solution when the length of the bargaining period is negligible. For a family whose members interact non-cooperatively at the beginning of their relationship, the Nash bargaining solution provides a tractable approximation to the subgame-perfect equilibrium of within-household bargaining.

There are two natural choices of the disagreement point: divorce and the non-cooperative Nash equilibrium. Using divorce as the disagreement point, Manser and Brown (1980) and McElroy and Horney (1981) explore household decisions on private and public consumption, labor supply, and leisure. Further applications include household consumption (Cherchye et al., 2013), agents' attitudes toward government policy (Cohen and Glazer, 2017), preference transitions over intergenerational care (Cigno et al., 2017), and fertility and education (Yakita, 2018).

An alternative disagreement point is the non-cooperative Nash equilibrium. The seminal work is the separate spheres model by Lundberg and Pollak (1993), where each family member controls one public good. They show that control over family resources matters and explore the effect of child allowances. Konrad and Lommerud (2000) analyze the education decision before marriage and Chen and Woolley (2001) study expenditure on a single public good and intrahousehold transfers. Empirical evidence documents the existence of non-cooperative families,[3] suggesting that a failure to cooperate does not necessarily lead to divorce. Accordingly, we adopt the non-cooperative Nash equilibrium as the disagreement point.

In the models of Lundberg and Pollak (1993) and Chen and Woolley (2001), agents purchase public goods from the market, implying identical opportunity costs of public goods. By contrast, we follow Konrad and Lommerud (2000) by assuming that public goods are produced using agents' time endowments, thereby generating heterogeneous opportunity costs due to differences in abilities. We show in Appendix B that welfare conflicts are already implicit in their model when time allocations are interior, although they do

[3] Choukhmane et al. (2025) find that nearly 20% of couples in the U.S. fail to allocate their retirement-saving contributions efficiently. Additional evidence is provided by Buettner et al. (2019); Walther (2018); Del Boca and Flinn (2012); McPeak and Doss (2006).

not derive these comparative statics. Our baseline model departs from theirs by incorporating altruism and diminishing marginal utility from private consumption. Together, these features generate endogenous voluntary transfers and specialization in a non-cooperative family. This richer structure allows us to identify parameter regions in which welfare conflicts arise, relate these regions to agents' comparative and absolute advantages, and show how these regions vary with altruism.

Another approach to cooperative household models is the collective approach (Chiappori, 1988, 1992, 1997; Apps and Rees, 1997; Chiappori, 2011; Cherchye et al., 2012b; Chiappori et al., 2018; Theloudis et al., 2025), which provides a framework for deriving testable implications of household behavior without specifying a particular bargaining protocol.[4] Pareto weights determine the intrahousehold allocation and may therefore shape other economic outcomes. For example, Cremer et al. (2016) show that these weights affect the design of income taxation. In the spirit of this approach, we solve the cooperative family's problem by first characterizing Pareto efficient allocations and then applying the Nash bargaining solution.

The next section describes the model. Section 3 analyzes a non-cooperative family. Section 4 explores Pareto efficient allocations. Section 5 solves the cooperative allocation generated by Nash bargaining. Section 6 applies the welfare results to economic sabotage and marital stability. Section 7 concludes. Appendix A examines the Kalai-Smorodinsky bargaining, Appendix B revisits the model of Konrad and Lommerud (2000), and Appendix C considers the separate spheres model. These appendices show that our central result is robust to the choice of bargaining protocol and models of household production and time allocation. All proofs are in Appendix D.

2 Setup

There are two married partners, agents 1 and 2. Each agent, $i \in \{1, 2\}$, benefits directly from a home-produced household public good (housework) $H > 0$ and private consumption $c_i > 0$. To simplify the analysis, we assume the direct benefit of agent i is additively separable, and the utilities from H and c_i take logarithmic forms. Define $u_i(H, c_i)$ by

$$u_i(H, c_i) = \ln H + \ln c_i.$$

In addition, agents have altruistic preferences. They care about their partners and derive utility from their partners' well-being. The degree of altruism is denoted by α, with $\alpha \in [0, 1]$. The utility function of agent $i \in \{1, 2\}$ is

$$U_i = u_i + \alpha u_{-i} = (1 + \alpha) \ln H + \ln c_i + \alpha \ln c_{-i}$$

where $-i$ is the partner of agent i, i.e., $-i \in \{1, 2\}$ and $-i \neq i$. When $\alpha = 1$, agents care about their partner as much as they care about themselves. When $\alpha \in (0, 1)$, agents put a positive weight on their partner's well-being but care about themselves more than their partner. When $\alpha = 0$, agents are entirely selfish and do not care about their partner.

Each agent has one unit of time endowment. The time can be allocated to housework or market work.

[4] The collective approach has been widely applied in empirical studies, including analysis of education returns from marriage (Bruze, 2015), labor supply (Bredemeier and Juessen, 2013; Fehr et al., 2016; Bredemeier et al., 2023), job choice (Bredemeier et al., 2025), the wage gap in labor market (Angelov et al., 2016; Eckstein et al., 2019; Andresen and Nix, 2022), consumption (Bruyneel et al., 2012; Cherchye et al., 2017), intrahousehold allocation (Zhuge and Lang, 2025), savings (Voena, 2015), fertility (Fahn et al., 2016; Brown et al., 2025), the elderly's well-being (Cherchye et al., 2012a; Guo et al., 2022), children's education (Del Boca et al., 2026), domestic violence (Bulte and Lensink, 2021), social security policy (Lise and Yamada, 2019; Groneck and Wallenius, 2021), marriage sorting (Reynoso, 2024) and its relationship to labor market sorting (Calvo et al., 2024).

Housework produces the household public good, while market work generates income. Let $x_i \in [0,1]$ be the time that agent i allocates to housework. The rest, $1 - x_i \in [0,1]$, is agent i's labor supply. As the time for housework and labor supply of agent i can be described by x_i, we will refer to x_i as agent i's time allocation, and $x = (x_1, x_2)$ as the family's time allocation.

The housework production is perfectly substitutive. Let $a_i > 0$ be agent i's housework productivity. Given the time allocation $x = (x_1, x_2)$, the amount of household public good is

$$H(x) = a_1 x_1 + a_2 x_2. \tag{1}$$

We assume agent 1 is at least as productive in housework as agent 2 and that the productivity gap is sufficiently small, as specified below:

Assumption 1. $\frac{a_2}{a_1} \in \left[\frac{1}{2+\alpha}, 1\right]$.

The upper bound $\frac{a_2}{a_1} \leq 1$ is a normalization without loss of generality. By contrast, the lower bound $\frac{a_2}{a_1} \geq \frac{1}{2+\alpha}$ is substantive. It rules out a strong asymmetry in agents' housework productivity. By excluding several Nash equilibria, it allows for a concise characterization of the Nash equilibrium and cooperative comparative statics. The restriction is relevant for some of the comparative statics results, but not for the paper's central result regarding welfare conflicts. In particular, if $\frac{a_2}{a_1} < \frac{1}{2+\alpha}$, then for each agent, there is a non-empty set of parameters such that a marginal improvement of the agent's wage rate reduces the partner's cooperative utility.[5]

Let $w_i > 0$ be the wage rate of agent i. With labor supply $1 - x_i$, agent i earns wage income $m_i(x_i) = w_i(1 - x_i)$. The family's total income is

$$M(x) = m_1(x_1) + m_2(x_2) = w_1(1 - x_1) + w_2(1 - x_2). \tag{2}$$

The parameters a_1, w_1, a_2, w_2, and α are common knowledge.

Each agent can transfer part of their wage income to the partner. Let τ_i be the amount of money that agent i transfers to the partner $-i$. The private consumption of agent i is the income after transfer:

$$c_i(x, \tau) = m_i(x_i) - \tau_i + \tau_{-i} = w_i(1 - x_i) - \tau_i + \tau_{-i}$$

where $\tau = (\tau_1, \tau_2)$ and $0 \leq \tau_i \leq m_i(x_i)$ for both $i \in \{1, 2\}$. It is clear that $M(x) = c_1(x, \tau) + c_2(x, \tau)$, which means the total private consumption is always equal to the total income.

Let $\rho = (\rho_1, \rho_2)$ be the income allocation defined by

$$\rho_i = \frac{c_i(x, \tau)}{M(x)}, \qquad \text{for } i \in \{1, 2\}.$$

Here ρ_i is agent i's consumption share of total income. Clearly, $\rho_1 + \rho_2 = 1$. We will refer to (x, ρ) as an allocation.

Given a pair of time allocation and transfers (x, τ), the utility of agent i is

$$U_i(x, \tau) = (1 + \alpha) \ln (H(x)) + \ln (c_i(x, \tau)) + \alpha \ln (c_{-i}(x, \tau)). \tag{3}$$

Equivalently, given an allocation (x, ρ), the utility of agent i is

$$U_i(x, \rho) = (1 + \alpha) \ln [H(x)M(x)] + \ln(\rho_i) + \alpha \ln(1 - \rho_i).$$

[5] Appendix D.1 characterizes the Nash equilibria without this lower bound and shows that cooperative welfare conflicts persist.

A family may be non-cooperative or cooperative. We analyze a non-cooperative family with time allocations and transfers, (x, τ), as transfers are voluntary and made without any agreement. For a fixed time allocation x, different transfer combinations can generate the same income allocation and thus yield identical utilities. In a cooperative family, agents can directly negotiate over income allocations rather than specific transfers. Therefore, it is without loss of generality to focus on allocations (x, ρ) when analyzing cooperation.

3 Non-cooperative Family

This section studies a non-cooperative household. Agents simultaneously decide their time allocation and voluntary transfers, taking their partner's actions as given. We first characterize the Nash equilibrium. Then, we analyze the implied allocation and welfare properties.

3.1 Nash Equilibrium

This subsection characterizes the Nash equilibrium. In this non-cooperative game, each agent $i \in \{1, 2\}$ chooses a strategy $s_i = (x_i, \tau_i)$, where x_i is the time allocation and τ_i is the transfer to the partner. Each agent maximizes their own utility by choosing s_i, taking the partner's behavior s_{-i} as given. Agent i's utility is

$$U_i(s_i; s_{-i}) = (1 + \alpha) \ln \left(H(s_i; s_{-i})\right) + \ln \left(c_i(s_i; s_{-i})\right) + \alpha \ln \left(c_{-i}(s_i; s_{-i})\right).$$

Agent i's optimization problem is to choose s_i, subject to $0 \leq x_i \leq 1$ and $0 \leq \tau_i \leq m_i(x_i)$, to maximize utility $U_i(s_i; s_{-i})$. A strategy profile $s^{NE} = \left(s_1^{NE}, s_2^{NE}\right)$ is a Nash equilibrium if for both $i \in \{1, 2\}$,

$$s_i^{NE} \in \arg\max_{s_i} U_i\left(s_i; s_{-i}^{NE}\right). \tag{4}$$

Solving optimization problem (4) for both $i \in \{1, 2\}$ simultaneously yields the Nash equilibrium.

We first derive the necessary conditions on transfers at any Nash equilibrium, if one exists. Then, Propositions 1 and 2 establish the existence of Nash equilibria and characterize them. A positive transfer from agent i to the partner $-i$ increases the partner's private consumption but reduces agent i 's private consumption. An agent has an incentive to transfer whenever the marginal benefit from improving the partner's private consumption outweighs the marginal cost of reducing their own consumption.

Lemma 1. *Suppose $s^{NE} = \left(x_1^{NE}, \tau_1^{NE}, x_2^{NE}, \tau_2^{NE}\right)$ is a Nash equilibrium. Let $m_i^{NE} = m_i\left(x_i^{NE}\right)$ be the wage income of agent i for $i \in \{1, 2\}$ in the equilibrium s^{NE}.*

(1) Positive transfer. If the gap in wage incomes is sufficiently large, $\alpha m_i^{NE} > m_{-i}^{NE}$ for some $i \in \{1, 2\}$, then agent i transfers $\tau_i^{NE} = \frac{1}{1+\alpha}\left(\alpha m_i^{NE} - m_{-i}^{NE}\right) > 0$ to agent $-i$, and agent $-i$ makes no transfer, $\tau_{-i}^{NE} = 0$.

(2) No transfer. If the two wage incomes are sufficiently close, $m_1^{NE} \geq \alpha m_2^{NE}$ and $m_2^{NE} \geq \alpha m_1^{NE}$, then neither agent makes a transfer, $\tau_i^{NE} = 0$ for both $i \in \{1, 2\}$.

In any Nash equilibrium, there is at most one agent who transfers to the partner. When the gap in wage income is sufficiently large, the high-income agent transfers just enough to equalize marginal utilities of private consumption, given altruism. The resulting income allocation is

$$\left(\rho_i^{NE}, \rho_{-i}^{NE}\right) = \left(\frac{1}{1+\alpha}, \frac{\alpha}{1+\alpha}\right).$$

The high-income agent transfers income to the low-income agent until the former consumes $\frac{1}{1+\alpha}$ of total income.

When the gap between wage incomes is small, neither agent is willing to sacrifice own consumption to increase the partner's consumption. In this case, each agent consumes their own wage income. Therefore, each agent consumes exactly their own wage income. Consequently,

$$\frac{\alpha}{1+\alpha} \leq \rho_i\big(s^{NE}\big) \leq \frac{1}{1+\alpha}, \qquad \text{for } i \in \{1,2\}.$$

When $\alpha = 0$, altruism vanishes and no agent has an incentive to transfer income. When $\alpha = 1$, we have $\frac{1}{1+\alpha} = \frac{\alpha}{1+\alpha} = \frac{1}{2}$, so agents share their total income equally in every Nash equilibrium.

Now we characterize the Nash equilibrium. There are two types: equilibrium without transfers, characterized in Proposition 1, and equilibrium with a positive transfer, characterized in Proposition 2.

Proposition 1 (No-transfer Nash equilibrium)**.** *Assume Assumption 1 holds. Suppose agents' opportunity costs of housework are sufficiently close, that is, neither agent has a sufficiently strong comparative advantage in earnings. Precisely,* $\frac{w_1}{a_1} \geq \alpha\frac{w_2}{a_2}$ *and* $\frac{w_2}{a_2} \geq \alpha\frac{w_1}{a_1}$*. Then there exists a Nash equilibrium* $s^{NE} = \big(x_1^{NE}, \tau_1^{NE}, x_2^{NE}, \tau_2^{NE}\big)$ *where* $\tau_1^{NE} = \tau_2^{NE} = 0$*, and* $x_i^{NE} = \frac{2+\alpha}{3+\alpha} - \frac{a_{-i}}{(3+\alpha)a_i}$ *for each* $i \in \{1,2\}$*.*

In the equilibrium, greater altruism leads to more time allocated to housework. For each agent, the time devoted to housework increases in the agent's own productivity but decreases in the partner's productivity. Because agent 1 has higher housework productivity, agent 1 spends more time on housework and contributes more to the household public good than agent 2. In particular, $x_2^{NE} \to 0$ as $\frac{a_2}{a_1} \to \frac{1}{2+\alpha}$. Thus, when the productivity gap is sufficiently large, agent 2 contributes very little to housework.

The following proposition characterizes the Nash equilibrium when an agent has a relatively strong comparative advantage in earnings.

Proposition 2 (Positive-transfer Nash equilibrium)**.** *Assume Assumption 1 holds. Suppose agent* i *has a relatively strong comparative advantage in earnings for some* $i \in \{1,2\}$*. Precisely,* $\alpha\frac{w_i}{a_i} \geq \frac{w_{-i}}{a_{-i}}$*. Then, there exists a Nash equilibrium* $s^{NE} = \big(x_1^{NE}, \tau_1^{NE}, x_2^{NE}, \tau_2^{NE}\big)$ *where agent* i *transfers*

$$\tau_i^{NE} = \frac{1}{1+\alpha}\left[\alpha w_i\big(1 - x_i^{NE}\big) - w_{-i}\big(1 - x_{-i}^{NE}\big)\right] > 0$$

to agent $-i$*, while agent* $-i$ *makes no transfer,* $\tau_{-i}^{NE} = 0$*. The equilibrium time allocation is as follows.*
(1) If agent 1 has a sufficiently strong comparative advantage in earnings, $\alpha\frac{w_1}{a_1} \geq \frac{w_2}{a_2}$*, then*

$$x_1^{NE} = \frac{1}{2}\left(1 - \frac{a_2}{a_1}\right) \quad \text{and} \quad x_2^{NE} = 1.$$

(2) If agent 2 has a sufficiently strong comparative advantage in earnings, $\alpha\frac{w_2}{a_2} \geq \frac{w_1}{a_1}$*, then*

$$x_1^{NE} = \min\left\{\frac{\alpha}{1+\alpha}\left(1 + \frac{w_2}{w_1}\right), 1\right\} \quad \text{and} \quad x_2^{NE} = 0.$$

(3) If the relevant condition on the comparative advantage holds with equality, $\alpha\frac{w_i}{a_i} = \frac{w_{-i}}{a_{-i}}$*, then*

$$x_i^{NE} = \frac{1}{2}\left[\left(1 - \frac{1+\alpha}{\alpha}x_{-i}^{NE}\right)\frac{w_{-i}}{w_i} + 1\right] \quad \text{and} \quad x_{-i}^{NE} > \frac{2+\alpha}{3+\alpha} - \frac{a_{-i}}{(3+\alpha)a_i}.$$

Moreover, the Nash equilibrium is unique if $\alpha\frac{w_1}{a_1} > \frac{w_2}{a_2}$ *or* $\alpha\frac{w_2}{a_2} > \frac{w_1}{a_1}$*.*

Proposition 2 shows that transfers arise precisely when one agent has a sufficiently strong comparative advantage in earnings. Specialization emerges endogenously. The transferor works more in the market, while

the transfer recipient allocates more time to housework.

In part (1), agent 1 has a strong comparative advantage in earnings. Together with the assumption $a_1 \geq a_2 > 0$, this condition implies $\alpha w_1 \geq w_2$, which means agent 1 has an absolute advantage in earnings as well. In the equilibrium, agent 1 allocates most of their time to the labor market and transfers money to agent 2, given that agent 2 has no wage income. As agent 2's housework productivity is relatively low, agent 1 spends some time in housework, with $x_1^{NE} \to 0$ as $\frac{a_2}{a_1} \to 1$. Given the transfer from agent 1 and agent 2's comparative disadvantage in earnings, agent 2 exits the labor market and allocates all of their time to housework.

In part (2), agent 2 has a strong comparative advantage in earnings. In addition, if $\alpha w_2 \geq w_1$, agent 2 has an absolute advantage in earnings, and then $x_1^{NE} = 1$. This is symmetric to part (1), except that agent 2 contributes nothing to the public good because agent 2 is less productive in housework. If $\alpha w_2 < w_1$, then agent 1 has an absolute advantage in earnings. The transfer from agent 2 is insufficient to incentivize agent 1 to drop out of the labor market.

In part (3), there exists a continuum of equilibria. Let i be the agent who has the comparative advantage in earnings. The transfer is

$$\tau_i^{NE} = \frac{\alpha w_i - (2+\alpha) w_{-i}}{2(1+\alpha)} + \frac{(3+\alpha) w_{-i}}{2(1+\alpha)} x_{-i}^{NE}.$$

Hence the transfer τ_i^{NE} increases in agent $-i$'s housework time x_{-i}^{NE}. Moreover, the public good and private consumption in an equilibrium s^{NE} are

$$\begin{aligned} H\left(s^{NE}\right) &= \frac{1}{2}(1-\alpha) a_i x_{-i}^{NE} + \frac{1}{2}(\alpha a_i + a_{-i}), \\ c_{-i}\left(s^{NE}\right) &= \frac{\alpha}{2(1+\alpha)} \left(w_{-i} + w_i + \frac{1-\alpha}{\alpha} w_i x_{-i}^{NE} \right), \text{ and} \\ c_i\left(s^{NE}\right) &= \frac{1}{2(1+\alpha)} \left(w_{-i} + w_i + \frac{1-\alpha}{\alpha} w_i x_{-i}^{NE} \right). \end{aligned}$$

As $0 < \alpha < 1$, all of $H\left(s^{NE}\right)$, $c_1\left(s^{NE}\right)$, and $c_2\left(s^{NE}\right)$ are increasing with x_{-i}^{NE}. Therefore, in the continuum of equilibria, both agents enjoy more public good and more private consumption when agent $-i$ allocates more time to housework and agent i transfers more money to agent $-i$. As $\tau_i^{NE} \to 0$, $x_j^{NE} \to \frac{2+\alpha}{3+\alpha} - \frac{a_{-j}}{a_j}$ for $j \in \{i, -i\}$. Thus, the equilibrium without transfer described in Proposition 1 constitutes the lower boundary of the continuum of equilibria, featuring the lowest transfer and being the least desirable for both agents. On the other hand, subject to the restriction $\left(x_1^{NE}, x_2^{NE}\right) \in [0,1]^2$, the equilibrium described in Proposition 2(1) forms the upper boundary of the continuum of equilibria when $\alpha \frac{w_1}{a_1} = \frac{w_2}{a_2}$, yielding the highest amounts of public good and private consumption, and thus is the most desirable equilibrium. Similarly, the equilibrium described in Proposition 2(2) is the most desirable equilibrium when $\alpha \frac{w_2}{a_2} = \frac{w_1}{a_1}$.

The degree of altruism matters for the existence of a positive transfer in the Nash equilibrium. For any fixed (a_1, w_1, a_2, w_2), there exists a unique $\underline{\alpha} \in (0,1]$ such that the conditions $\frac{w_1}{a_1} \leq \alpha \frac{w_2}{a_2}$ or $\frac{w_2}{a_2} \leq \alpha \frac{w_1}{a_1}$ hold if and only if $\alpha \in [\underline{\alpha}, 1]$. If the family members' degree of altruism is higher than the critical value $\underline{\alpha}$, then there is a positive transfer in the Nash equilibrium. If their degree of altruism is lower than the critical value $\underline{\alpha}$, then there is no transfer in the Nash equilibrium. The critical value $\underline{\alpha}$ is determined by the ratio of opportunity costs. The closer the ratio $\frac{w_1}{a_1} \Big/ \frac{w_2}{a_2}$ is to 1, the higher the critical value $\underline{\alpha}$. In particular, $\underline{\alpha} = 1$ if the opportunity costs are the same.

3.2 Non-cooperative Allocation and Welfare

This subsection derives equilibrium allocations and studies welfare implications, focusing on how wage changes affect consumption, specialization, and utility.

From now on, we focus on the Nash equilibrium that is Pareto dominant within the equilibrium set whenever multiple equilibria exist. Suppose $\alpha < 1$, s^{NE} is given by Proposition 2 (1) and (2) if $\alpha\frac{w_2}{a_2} = \frac{w_1}{a_1}$ or $\alpha\frac{w_1}{a_1} = \frac{w_2}{a_2}$. For $\alpha\frac{w_2}{a_2} \neq \frac{w_1}{a_1}$ and $\alpha\frac{w_1}{a_1} \neq \frac{w_2}{a_2}$, the Nash equilibrium is unique. Then, $(a_1, w_1, a_2, w_2, \alpha) \mapsto s^{NE}$ is a well-defined function. When $\alpha = 1$, multiple Nash equilibria exist if and only if $\frac{w_1}{a_1} = \frac{w_2}{a_2}$, in which case

$$H\big(s^{NE}\big) = \frac{a_1}{2}\left(1 + \frac{w_2}{w_1}\right) \text{ and } c_1\big(s^{NE}\big) = c_2\big(s^{NE}\big) = \frac{1}{4}(w_1 + w_2),$$

in every Nash equilibrium. As the outcome is uniquely determined by agents' abilities (a_1, a_2, w_1, w_2), the allocation and welfare are uniquely determined.

With the unique Nash equilibrium s^{NE}, we can derive the non-cooperative allocation and the equilibrium utilities. Let $H^{NE} = H\big(s^{NE}\big)$ and $c_i^{NE} = c_i\big(s^{NE}\big)$ be the household public good and the private consumption of agent i given by the Nash equilibrium s^{NE}, for $i \in \{1, 2\}$. Let $\rho^{NE} = \big(\rho_1^{NE}, \rho_2^{NE}\big)$ be the corresponding income allocation. Let $V_i^{NE} = U_i\big(x^{NE}, \rho^{NE}\big)$ be the utility in the Nash equilibrium. We illustrate the Nash equilibrium outcome in Figure 1. The following corollary summarizes the non-cooperative allocation.

Corollary 2.1. *In a non-cooperative family with $\alpha > 0$, the profile of household public good and private consumption $\big(H^{NE}, c_1^{NE}, c_2^{NE}\big)$ is*

$$\big(H^{NE}, c_1^{NE}, c_2^{NE}\big) = \begin{cases} \left(a_1, \frac{\alpha w_2}{1+\alpha}, \frac{w_2}{1+\alpha}\right) & \text{if } w_1 \leq \alpha w_2, \\ \left(\frac{\alpha a_1(w_1+w_2)}{(1+\alpha)w_1}, \frac{\alpha(w_1+w_2)}{(1+\alpha)^2}, \frac{w_1+w_2}{(1+\alpha)^2}\right) & \text{if } w_1 > \alpha w_2 \text{ and } \alpha\frac{w_2}{a_2} \geq \frac{w_1}{a_1}, \\ \left(\frac{(1+\alpha)(a_1+a_2)}{3+\alpha}, \frac{(a_1+a_2)w_1}{(3+\alpha)a_1}, \frac{(a_1+a_2)w_2}{(3+\alpha)a_2}\right) & \text{if } \frac{w_1}{a_1} > \alpha\frac{w_2}{a_2} \text{ and } \frac{w_2}{a_2} > \alpha\frac{w_1}{a_1}, \\ \left(\frac{a_1+a_2}{2}, \frac{w_1(a_1+a_2)}{2(1+\alpha)a_1}, \frac{\alpha w_1(a_1+a_2)}{2(1+\alpha)a_1}\right) & \text{if } \alpha\frac{w_1}{a_1} \geq \frac{w_2}{a_2}. \end{cases}$$

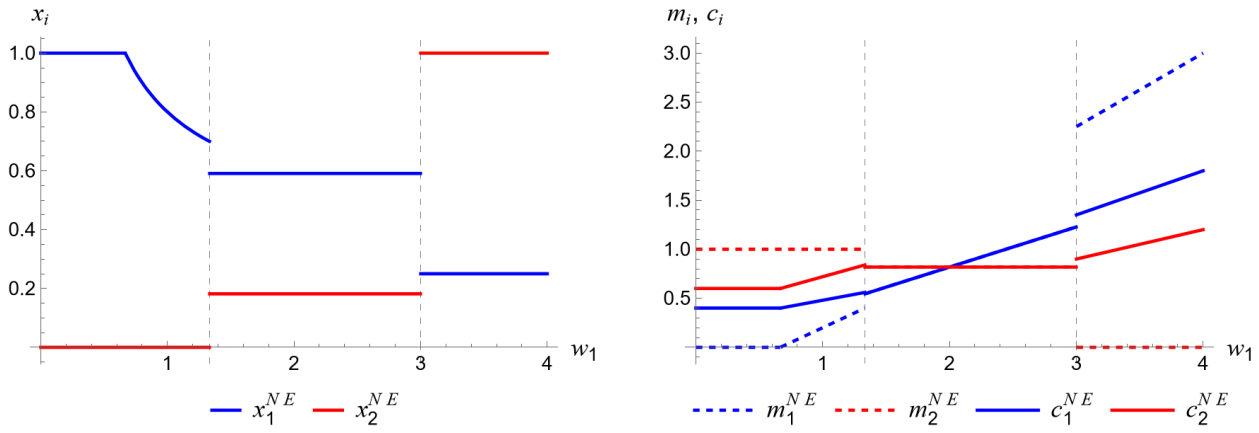
The non-cooperative income allocation ρ^{NE} is

$$\rho^{NE} = \begin{cases} \left(\frac{\alpha}{1+\alpha}, \frac{1}{1+\alpha}\right) & \text{if } \alpha\frac{w_2}{a_2} \geq \frac{w_1}{a_1}, \\ \left(\frac{\frac{w_1}{a_1}}{\frac{w_1}{a_1}+\frac{w_2}{a_2}}, \frac{\frac{w_2}{a_2}}{\frac{w_1}{a_1}+\frac{w_2}{a_2}}\right) & \text{if } \frac{w_1}{a_1} > \alpha\frac{w_2}{a_2} \text{ and } \frac{w_2}{a_2} > \alpha\frac{w_1}{a_1}, \\ \left(\frac{1}{1+\alpha}, \frac{\alpha}{1+\alpha}\right) & \text{if } \alpha\frac{w_1}{a_1} \geq \frac{w_2}{a_2}. \end{cases}$$

For fixed $\frac{a_2}{a_1}$ and $\alpha > 0$, if the wage gap between agents is sufficiently high, i.e., $w_1 < \alpha w_2$ or $\alpha\frac{w_1}{a_1} \geq \frac{w_2}{a_2}$, then the low-wage agent exits the labor market. In this case, marginal wage changes for that agent have no effect because labor supply is already at a corner. In contrast, wage changes for the working agent affect total income and both agents' consumption.

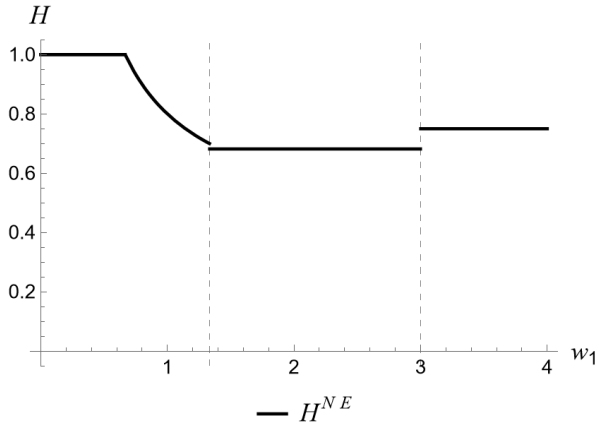
If $\frac{w_1}{a_1} > \alpha\frac{w_2}{a_2}$ and $\frac{w_2}{a_2} > \alpha\frac{w_1}{a_1}$, there is no transfer in the Nash equilibrium. A marginal increase in the wage rate w_i increases agent i's private consumption. As agents care about each other, this change benefits the partner as well.

If $w_1 > \alpha w_2$ and $\alpha\frac{w_2}{a_2} \geq \frac{w_1}{a_1}$, agent 1 participates in the labor market and receives a transfer from agent 2. The transfer in the Nash equilibrium supports agent 1's private consumption and pushes agent 1 away from the labor market. A marginal increase in agent 2's wage rate improves the welfare of both agents. In contrast, a marginal increase in agent 1's wage rate induces agent 1 to put less time into housework but more time in the labor market. Then, both agents enjoy less household public good but more private consumption.

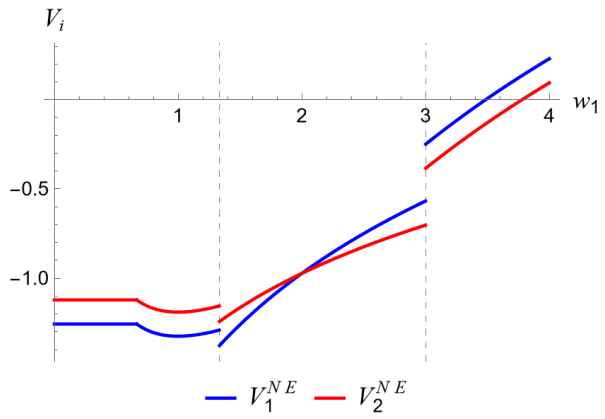


(a) Time allocation

(b) Wage income and private consumption



(c) Household public good



(d) Utility

Figure 1: Non-cooperative family when $a_1 = 1, a_2 = \frac{1}{2}, w_2 = 1$ and $\alpha = \frac{2}{3}$

The vertical dashed lines in each panel indicate parameter values at which there is a continuum of Nash equilibria connecting the no-transfer and positive-transfer equilibria. Because only the two endpoint equilibria are plotted, the displayed curves are discontinuous at these boundaries.

As shown in Figure 1, both agents' utilities may decrease with w_1. Regarding the effect of w_1 on the utilities, we have

$$\frac{\partial V_1^{NE}}{\partial w_1} = \frac{\partial V_2^{NE}}{\partial w_1} = (1+\alpha)\left(\frac{2}{w_1+w_2} - \frac{1}{w_1}\right) < 0 \quad \Leftrightarrow \quad w_1 < w_2.$$

When $w_1 < w_2$ and $0 < \alpha < 1$, agent 1 has both absolute and comparative advantages in housework, while agent 2 has both absolute and comparative advantages in earnings. Pareto efficiency requires complete specialization.[6] In a non-cooperative family, a marginal increase in agent 1's wage rate pushes the time allocation away from the efficient specialization, and hence, reduces both agents' utilities. In particular, for any fixed $w_2 > 0$, both agents' utilities in the Nash equilibrium are decreasing in agent 1's wage rate if $w_1 \in \left(\alpha w_2, \min\left\{w_2, \frac{\alpha a_1 w_2}{a_2}\right\}\right)$, which is a non-empty interval for all $\alpha < 1$. This result is consistent with Anderberg and Rainer (2013). Furthermore, if $\alpha < \frac{a_2}{a_1}$, then $w_1 > w_2$ is impossible. When agents care little about each other, an increase in agent 1's wage rate will never be desirable for a non-cooperative family in this case.

The non-cooperative allocation may fail to be Pareto efficient. For example, in the no-transfer Nash

[6] We show this in Proposition 3 in Section 4.

equilibrium, both agents allocate $x_i^{NE} > 0$ to housework and $1 - x_i^{NE} > 0$ to the labor market. Suppose that the agent with a comparative advantage in earnings, say i, increases the labor supply to $1 - x_i^{NE} + \epsilon$ for some small $\epsilon > 0$, while the other agent $-i$ allocates $x_{-i}^{NE} + \frac{a_i}{a_{-i}}\epsilon$ to housework and the rest to the labor market. Compared with the non-cooperative allocation, this alternative time allocation produces the same amount of the household public good and a higher total income. With a suitable transfer from agent i to agent $-i$, both agents are better off.

4 Pareto Efficient Allocation

This section finds the Pareto efficient allocations. Define $\eta(x) = (1+\alpha)\ln[H(x)M(x)]$ as the utility from the household's total output given the time allocation x, and $\phi(\rho_i) = \ln\rho_i + \alpha\ln(1-\rho_i)$ as the utility from the income allocation ρ. Then, agent i's utility can be written in an additively separable form,

$$U_i(x,\rho) = \eta(x) + \phi(\rho_i). \tag{5}$$

For a fixed income allocation ρ, both agents benefit from increasing $\eta(x)$. Hence, in any Pareto efficient allocation $\left(x^{PE},\rho\right)$, x^{PE} must maximize $\eta(x)$. We say that x^{PE} is a *Pareto efficient time allocation* if $x^{PE} \in \arg\max_{x\in[0,1]^2}\eta(x)$.

For a fixed time allocation x, each agent i's utility increases in ρ_i for $\rho_i \leq \frac{1}{1+\alpha}$ and decreases in ρ_i for $\rho_i > \frac{1}{1+\alpha}$. That is, each agent prefers a larger consumption share whenever their share is below $\frac{1}{1+\alpha}$. However, they wish to increase their partner $-i$'s private consumption when the partner consumes less than $\frac{\alpha}{1+\alpha}$ of the total income. Hence, in any Pareto efficient allocation $\left(x^{PE},\rho\right)$, we have $\rho_i \leq \frac{1}{1+\alpha}$ for both $i \in \{1,2\}$. As $\rho_1 + \rho_2 = 1$, Pareto efficiency also requires $\rho_i \geq \frac{\alpha}{1+\alpha}$ for both $i \in \{1,2\}$. Hence, we say that ρ is a *Pareto efficient income allocation* if $\rho_i \in \left[\frac{\alpha}{1+\alpha}, \frac{1}{1+\alpha}\right]$ for both $i \in \{1,2\}$. Combining these two steps, Proposition 3 describes the Pareto efficient allocations.

Proposition 3 (Pareto efficient allocation)**.** *For every $(a_1, w_1, a_2, w_2, \alpha)$, there exists a Pareto efficient allocation. An allocation (x,ρ) is Pareto efficient if and only if the income allocation ρ is balanced in the sense that $\frac{\alpha}{1+\alpha} \leq \rho_i \leq \frac{1}{1+\alpha}$ for both $i \in \{1,2\}$, and the time allocation x maximizes the utility from the household's total output, $x \in \arg\max_{x'\in[0,1]^2}\eta(x')$. The Pareto efficient time allocations x^{PE} are characterized as follows.*

(1) If agent 2 has a comparative advantage in earnings, $\frac{w_2}{a_2} > \frac{w_1}{a_1}$, then $x_1^{PE} = \min\left\{\frac{1}{2}\left(1+\frac{w_2}{w_1}\right), 1\right\}$ and $x_2^{PE} = 0$.

(2) If neither agent has a comparative advantage in earnings, $\frac{w_2}{a_2} = \frac{w_1}{a_1}$, then $x_1^{PE} + \frac{w_2}{w_1}x_2^{PE} = \frac{1}{2}\left(1+\frac{w_2}{w_1}\right)$.

(3) If agent 1 has a comparative advantage in earnings, $\frac{w_2}{a_2} < \frac{w_1}{a_1}$, then $x_1^{PE} = \frac{1}{2}\left(1-\frac{a_2}{a_1}\right)$ and $x_2^{PE} = 1$.

When $\frac{w_2}{a_2} \neq \frac{w_1}{a_1}$, the Pareto efficient time allocation is unique. When $\frac{w_2}{w_1} = \frac{a_2}{a_1}$, the two agents have the same opportunity cost in the labor market. Therefore, there are multiple time allocations that yield the same optimal amounts of household public good and total income.

The Pareto efficient time allocations depend on agents' comparative and absolute advantages. Agent 1 always contributes a positive amount of household public good because of the higher housework productivity relative to agent 2. When agent 2 has a comparative advantage in housework, $\frac{w_2}{a_2} < \frac{w_1}{a_1}$, agent 2 allocates all the time to housework. However, once agent 2 has a comparative advantage in earnings, $\frac{w_2}{a_2} > \frac{w_1}{a_1}$, there is a sharp change in which agent 2 allocates all the time to the market work, even if agent 2's wage rate is lower than agent 1's. Furthermore, when $w_2 < w_1$, agent 1 also works in labor market.

If both agents place a positive weight on the partner's well-being, i.e., $\alpha > 0$, then, $\frac{\partial U_i}{\partial \rho_i} < 0$ and $\frac{\partial U_{-i}}{\partial \rho_i} > 0$ for $\rho_i > \frac{1}{1+\alpha}$. This means that if agent i consumes more than $\frac{1}{1+\alpha}$ of total income and agent $-i$ consumes less than $\frac{\alpha}{1+\alpha}$ of total income, then decreasing agent i's consumption and increasing agent $-i$'s consumption benefit both agents. The interval $\left[\frac{\alpha}{1+\alpha}, \frac{1}{1+\alpha}\right]$ shrinks as altruism increases, reflecting that stronger caring for the partner's well-being requires a more balanced income allocation. In particular, $\rho = \left(\frac{1}{2}, \frac{1}{2}\right)$ is the unique Pareto efficient income allocation when $\alpha = 1$. On the other extreme, any income allocation is Pareto efficient when $\alpha = 0$.

This characterization of Pareto-efficient income allocations is consistent with the fact that $\rho_i^{NE} \in \left[\frac{\alpha}{1+\alpha}, \frac{1}{1+\alpha}\right]$ in any non-cooperative family. Even without negotiation, when the gap between wage incomes is sufficiently large, the high-income agent chooses their preferred income allocation, which is Pareto efficient, by transferring money to the low-income agent. Otherwise, their wage incomes are close and neither agent makes a transfer. The corresponding income allocation is also Pareto efficient.

Let $H^{PE} = H\left(x^{PE}\right)$ and $M^{PE} = M\left(x^{PE}\right)$ be the household public good and total income generated by a Pareto efficient time allocation x^{PE}. The next corollary calculates H^{PE} and M^{PE}.

Corollary 3.1. *The mapping $(a_1, w_1, a_2, w_2) \mapsto \left(H^{PE}, M^{PE}\right)$ is well-defined and continuous. It is given by*

$$\left(H^{PE}, M^{PE}\right) = \begin{cases} \left(\frac{1}{2}(a_1 + a_2), \frac{w_1}{2}\left(1 + \frac{a_2}{a_1}\right)\right) & \text{if } \frac{w_2}{w_1} < \frac{a_2}{a_1}, \\ \left(\frac{a_1}{2}\left(1 + \frac{w_2}{w_1}\right), \frac{1}{2}(w_1 + w_2)\right) & \text{if } \frac{a_2}{a_1} \leq \frac{w_2}{w_1} \leq 1, \\ (a_1, w_2) & \text{if } \frac{w_2}{w_1} > 1. \end{cases} \tag{6}$$

Furthermore, the mapping $(a_1, w_1, a_2, w_2) \mapsto \eta^{PE} = \eta\left(x^{PE}\right)$ is well-defined and continuous.

Comparing the non-cooperative allocation and the Pareto efficient allocation, there are some families whose non-cooperative allocations are Pareto inefficient. The following corollary provides the condition under which the non-cooperative allocation is Pareto efficient.

Corollary 3.2. *Assume Assumption 1 holds. If $\alpha = 1$, the non-cooperative allocation is always Pareto efficient. If $\alpha < 1$, then the non-cooperative allocation $\left(x^{NE}, \rho^{NE}\right)$ is Pareto efficient if and only if $\alpha w_2 \geq w_1$ or $\alpha \frac{w_1}{a_1} \geq \frac{w_2}{a_2}$. Otherwise, there exists at least one Pareto efficient allocation $\left(x^{PE}, \rho\right)$ such that $U_i\left(x^{PE}, \rho\right) > V_i^{NE}$ for both $i \in \{1, 2\}$.*

Pareto efficiency arises when one agent has sufficiently strong absolute and comparative advantages in earnings. We assume agent 1 has the absolute advantage in housework, $a_1 \geq a_2$. Under this assumption, the condition $\alpha w_2 \geq w_1$ implies $\alpha \frac{w_2}{a_2} \geq \frac{w_1}{a_1}$, while $\alpha \frac{w_1}{a_1} \geq \frac{w_2}{a_2}$ implies $\alpha w_1 \geq w_2$. In either case, the high-wage agent transfers sufficient income to the low-wage agent in the non-cooperative Nash equilibrium, inducing specialization and thereby achieving Pareto efficiency. Otherwise, the transfer is insufficient or even zero, and inefficiency arises. In this case, there exist Pareto efficient allocations that make both agents strictly better off, as illustrated in Figure 2.

The set of parameters such that the non-cooperative allocation is Pareto efficient expands as α increases. If $\alpha = 0$, then neither $\alpha w_2 \geq w_1$ nor $\alpha \frac{w_1}{a_1} \geq \frac{w_2}{a_2}$ is possible. Thus, a Pareto-efficient non-cooperative allocation can arise if family members care about each other. At the other extreme, when agents care about their partners as much as they care about themselves, $\alpha = 1$, the non-cooperative allocation achieves Pareto efficiency.

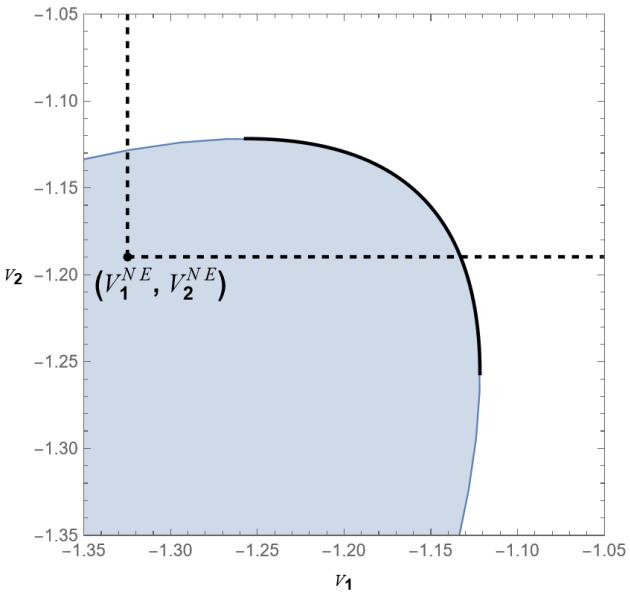


Figure 2: Pareto frontier and Nash equilibrium utilities when $a_1 = 1, a_2 = \frac{1}{2}, w_1 = 1, w_2 = 1$ and $\alpha = \frac{2}{3}$ The shaded area represents the feasible utility set, and the black curve is the Pareto frontier. The dashed lines pass through the Nash equilibrium utility pair (V_1^{NE}, V_2^{NE}).

5 Cooperative Family

As discussed in Sections 3 and 4, the non-cooperative allocation may fail to be Pareto efficient. Hence, negotiation and cooperation may improve both agents' welfare. In this section, we consider a cooperative family. The two agents negotiate over an allocation (x, ρ) through symmetric Nash bargaining. The symmetry here means agents have the same bargaining power. The disagreement point is the non-cooperative Nash equilibrium. After reaching an agreement, they follow it and receive their payoffs.

This section first solves the Nash bargaining problem to characterize the cooperative allocations. Then, we calculate the effects of small changes in each agent's earning capacity on the cooperative income allocation and the indirect utilities.

5.1 Cooperative Allocation

This subsection solves the Nash bargaining problem and characterizes the resulting cooperative income allocation. Following Corollary 3.1, the household public good and total income generated by any Pareto efficient allocation are unique. Thus, the two agents bargain only over the income allocation.

Let $U_i^C(\rho) = \eta^{PE} + \phi(\rho_i)$ be the utility of agent i when the time allocation is Pareto efficient and the income allocation is $\rho = (\rho_i, \rho_{-i})$, where η^{PE} is described by Corollary 3.1. Given an income allocation where agent 1's consumption share is ρ_1, the Nash product is

$$W(\rho_1) = \big(U_1^C(\rho) - V_1^{NE}\big)\big(U_2^C(\rho) - V_2^{NE}\big).$$

where $\rho = (\rho_1, 1 - \rho_1)$, and V_i^{NE} is the utility of agent i in the non-cooperative Nash equilibrium.

The cooperative family's problem is to choose agent 1's consumption share ρ_1 subject to Pareto efficiency and individual rationality:

$$\max_{\rho_1 \in \left[\frac{\alpha}{1+\alpha}, \frac{1}{1+\alpha}\right]} \quad W(\rho_1) \tag{7}$$

$$\text{s.t.} \quad U_i^C(\rho) \geq V_i^{NE} \text{ for both } i \in \{1,2\}.$$

The following proposition characterizes the unique cooperative income allocation.

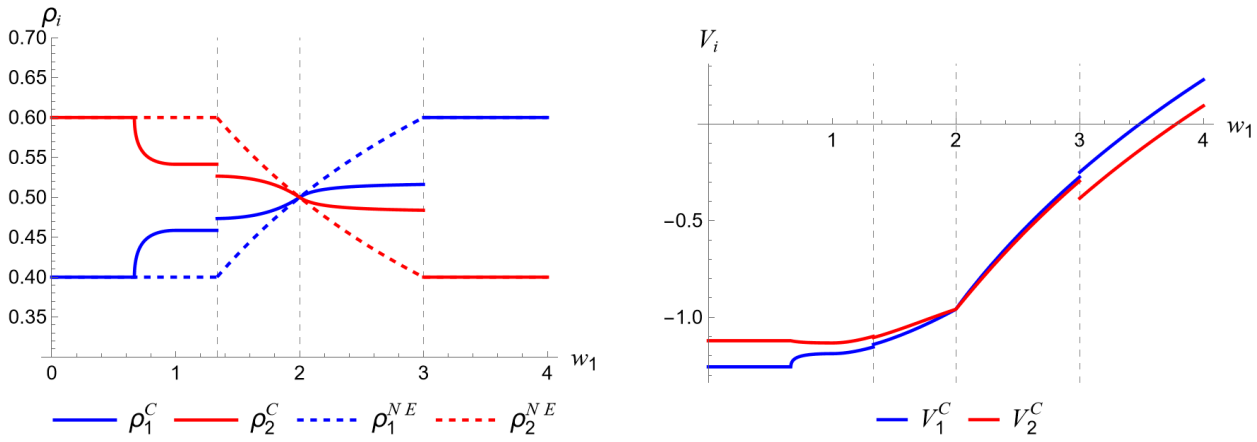
Proposition 4 (Cooperative income allocation)**.** *For every $(a_1, w_1, a_2, w_2, \alpha)$, the cooperative family's problem (7) has a unique solution ρ_1^C. Let $\rho^C = \left(\rho_1^C, 1-\rho_1^C\right)$ denote the cooperative income allocation, and let $V_i^C = U_i^C\left(\rho^C\right)$ denote agent i's cooperative utility.*

(1) If the non-cooperative allocation is Pareto efficient, then $\rho_i^C = \rho_i^{NE}$ and $V_i^C = V_i^{NE}$ for both $i \in \{1,2\}$.

(2) Otherwise, ρ_1^C is characterized by $\frac{\mathrm{d}W}{\mathrm{d}\rho_1}\left(\rho_1^C\right) = 0$ and $V_i^C > V_i^{NE}$ for both $i \in \{1,2\}$. Moreover, for each $i \in \{1,2\}$

(a) if $\rho_i^{NE} = \frac{1}{2}$, then $\rho_i^C = \frac{1}{2}$;

(b) if $\rho_i^{NE} \neq \frac{1}{2}$, then ρ_i^C lies strictly between ρ_i^{NE} and $\frac{1}{2}$, that is, $\min\left\{\rho_i^{NE}, \frac{1}{2}\right\} < \rho_i^C < \max\left\{\rho_i^{NE}, \frac{1}{2}\right\}$.



(a) Income allocation

(b) Utility

Figure 3: Income allocation and utilities in a cooperative family when $a_1 = 1, a_2 = \frac{1}{2}, w_2 = 1$ and $\alpha = \frac{2}{3}$
In each panel, the left and right vertical dashed lines indicate the threshold values between the no-transfer and positive-transfer Nash-equilibrium regimes. The middle dashed line indicates the parameter value at which the two agents have identical opportunity costs of household production.

Whenever the non-cooperative allocation is Pareto efficient, any income allocation other than ρ^{NE} would make at least one agent strictly worse off. Then, the cooperative income allocation coincides with the non-cooperative one, and both agents receive the same utilities as under non-cooperation. Otherwise, Nash bargaining strictly benefits both agents and shifts the income allocation toward equal sharing. Figure 3 (a) illustrates the cooperative income allocation with w_1 varying and other parameters fixed. Exact equal sharing occurs if and only if the non-cooperative income allocation is $\left(\rho_1^{NE}, \rho_2^{NE}\right) = \left(\frac{1}{2}, \frac{1}{2}\right)$, which requires agents to have identical opportunity costs, i.e., $\frac{w_1}{a_1} = \frac{w_2}{a_2}$.

5.2 Comparative Statics and Welfare

Empirical evidence suggests that shifts in relative earning capacities can affect both intrahousehold allocation and marital welfare. Favorable wage shocks may shift bargaining weights and resource allocation toward the recipient (Lise and Yamada, 2019), while gender-specific labor-market shocks can redirect household spending toward the spouse whose relative economic position improves (Gihleb et al., 2026). Relative earning positions are also associated with marital satisfaction and conflict (Bertrand et al., 2015). This

subsection studies how changes in wage rates affect income allocation and agents' welfare in a cooperative family.

Using the decomposition $V_i^C = \eta^{PE} + \phi(\rho_i^C)$, a marginal improvement of one agent's wage rate, say w_i, has two effects: the production effect, which is the effect on utility from the total output η^{PE}; and the allocation effect, which is the effect on utility from the income allocation ρ^C. A higher wage rate implies more possible combinations of the public good H and the total income M, which means η^{PE} is weakly increasing in w_i and the production effect is nonnegative for both agents. The allocation effect depends on how the cooperative income allocation ρ^C changes with w_i. As shown in Figure 3, ρ_1^C is weakly increasing in w_1. Thus, V_1^C is weakly increasing in w_1. In contrast, ρ_2^C is weakly decreasing in w_1, and V_2^C is non-monotonic with w_1. In general, a marginal improvement in one agent's wage rate has the following properties.

Proposition 5 (Comparative statics)**.** *Assume Assumption 1 holds. Then, the cooperative income allocation and utilities satisfy the following properties:*

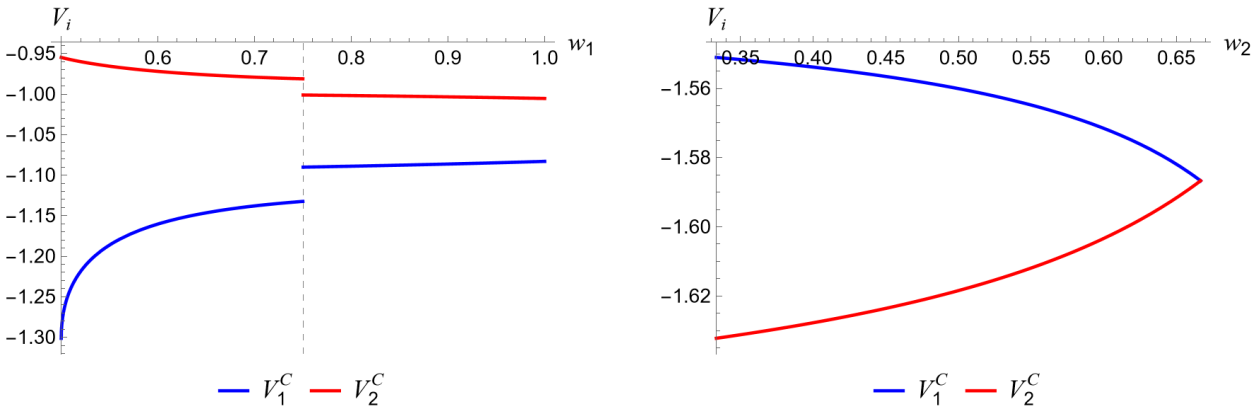
(1) For each agent i, the cooperative consumption share ρ_i^C is weakly increasing in their own wage rate w_i, and weakly decreasing in their partner's wage rate w_{-i}.

(2) For each agent i, the cooperative utility V_i^C is weakly increasing in their own wage rate w_i.

(3) If $\alpha w_2 < w_1 < w_2$, then agent 2's cooperative utility V_2^C is strictly decreasing in agent 1's wage rate, w_1.

(4) If $\alpha \frac{w_1}{a_1} < \frac{w_2}{a_2} < \frac{w_1}{a_1}$, then agent 1's cooperative utility V_1^C is strictly decreasing in agent 2's wage rate w_2.

(5) If $w_2 < w_1$, $\alpha \frac{w_2}{a_2} < \frac{w_1}{a_1} < \frac{w_2}{a_2}$, and α is sufficiently close to zero, then agent 2's cooperative utility V_2^C is strictly decreasing in agent 1's wage rate w_1.



(a) $\frac{1}{2} < w_1 < 1$ and $w_2 = 1$ (b) $w_1 = 1$ and $\frac{1}{3} < w_2 < \frac{2}{3}$

Figure 4: Cooperative utilities when $a_1 = 1, a_2 = \frac{2}{3}$ and $\alpha = \frac{1}{2}$

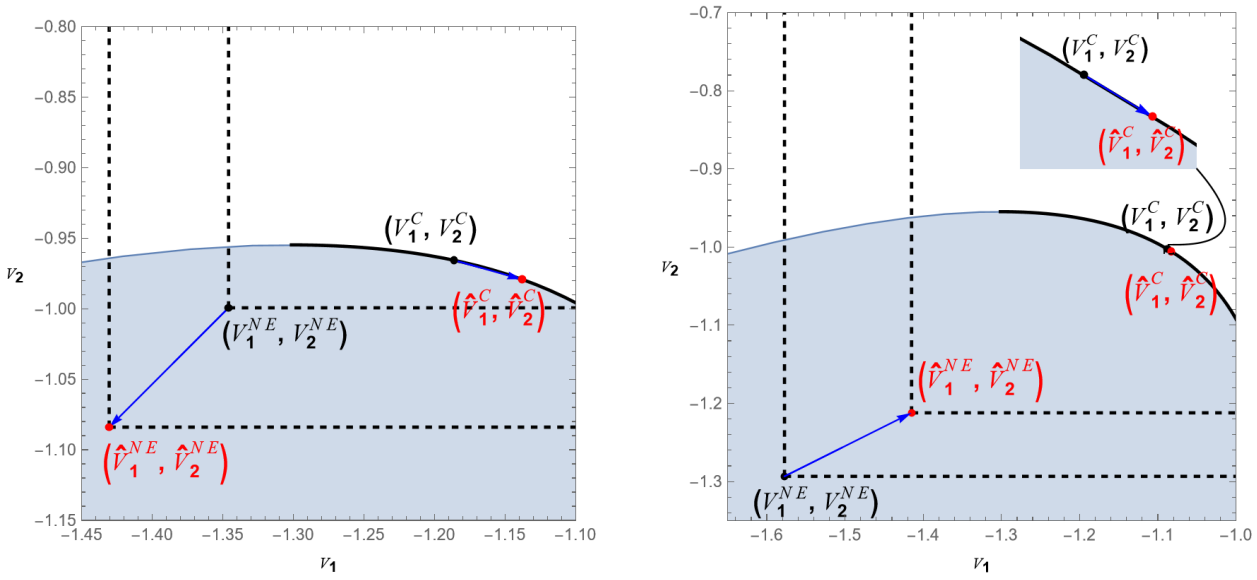
In panel (a), the vertical dashed line indicates the threshold between the positive-transfer and no-transfer Nash equilibrium. To the left of the threshold, the disagreement point is the Nash equilibrium where agent 1 transfers to agent 2; to the right, it is the no-transfer Nash equilibrium. In panel (b), the disagreement point is the no-transfer Nash equilibrium.

Proposition 5(1) shows that a wage improvement shifts the cooperative income allocation weakly in favor of the agent whose wage increases. Thus, the allocation effect weakly benefits that agent. Together with the nonnegative production effect, this implies that each agent's cooperative utility is weakly increasing in their own wage, as stated in 5(2). By contrast, when the partner's wage increases, the production and allocation effects operate in opposite directions, and the overall effect depends on their relative magnitudes.

Under the conditions in Proposition 5(3)-(4), the Pareto efficient time allocation is independent of the partner's wage rate. Therefore, the production effect is zero, while the allocation effect, and then the net effect, is strictly negative. Figure 4(a) illustrates the welfare conflict described in 5(3) where V_1^C strictly

increases in w_1, while V_2^C strictly decreases in w_1. Figure 4(b) illustrates the welfare conflict described in Proposition 5(4) where V_1^C strictly decreases in w_2, while V_2^C strictly increases in w_2. In Proposition 5(5), the Pareto frontier expands as w_1 increases, but when altruism is sufficiently low, the adverse allocation effect dominates the positive production effect.

The condition in Proposition 5(3) is that agent 2 has both absolute and comparative advantages in earnings, but the advantages are not strong enough to induce a Pareto efficient Nash equilibrium. Suppose a small improvement of w_1 occurs, then the Pareto frontier is unchanged as $\left(x_1^{PE}, x_2^{PE}\right) = (1, 0)$. If $\alpha w_2 < w_1 < \min\left\{\alpha \frac{a_1}{a_2} w_2, w_2\right\}$, both agents' utilities in the Nash equilibrium decrease equally, as shown in Figure 5(1). This means a higher surplus for both agents from cooperation, which pushes the cooperative income allocation toward the equal share. As agent 2 is the high-wage agent, this change harms agent 2 and benefits agent 1. In the second case, if $\alpha \frac{a_2}{a_1} w_2 < w_1 < w_2$, V_1^{NE} increases more than V_2^{NE}, as shown in Figure 5(2). This change pushes the cooperative income allocation toward the outcome in favor of agent 1. In both cases, agent 1 consumes more and agent 2 consumes less, with the household public good and the total income unchanged.



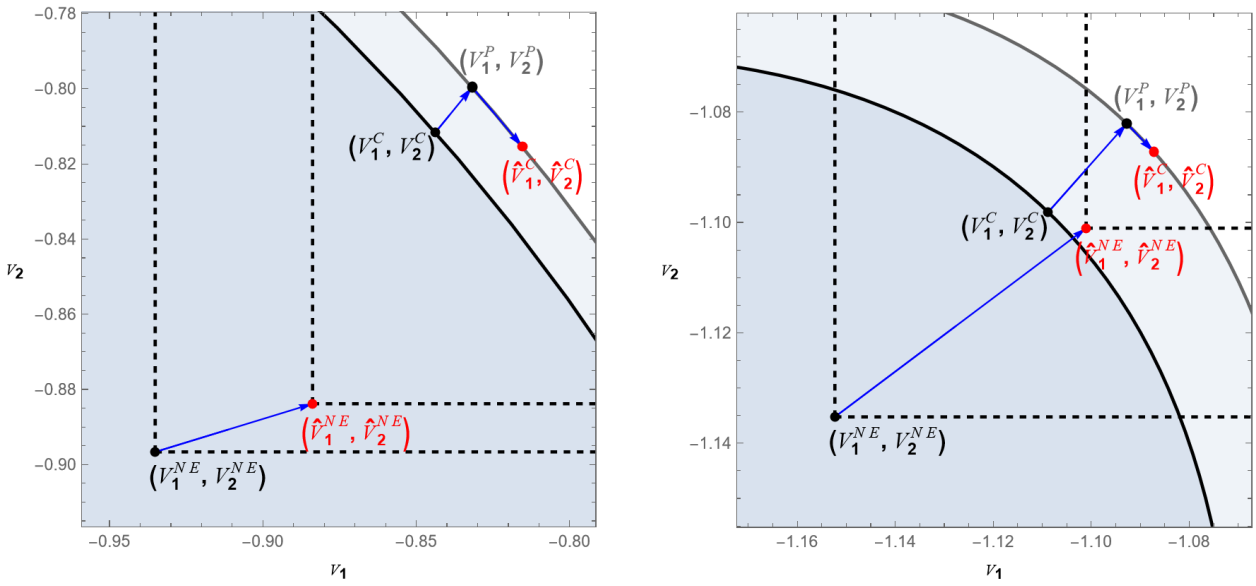
(a) $w_1 = 0.55$ and $\hat{w}_1 = 0.7$ (b) $w_1 = 0.85$ and $\hat{w}_1 = 1$

Figure 5: Nash bargaining as w_1 increases to $\hat{w}_1$
when $a_1 = 1, a_2 = \frac{2}{3}, w_2 = 1$ and $\alpha = \frac{1}{2}$

In each panel, the black curve is the Pareto frontier at both w_1 and $\hat{w}_1$. The points (V_1^{NE}, V_2^{NE}) and (V_1^C, V_2^C) are the non-cooperative and cooperative utility pairs at w_1, respectively, while the points $(\hat{V}_1^{NE}, \hat{V}_2^{NE})$ and $(\hat{V}_1^C, \hat{V}_2^C)$ are the corresponding utility pair at $\hat{w}_1$. In panel (b), the upper-right inset magnifies the movement between the cooperative outcomes.

Proposition 5(4) is symmetric to the second case of the above paragraph. The condition means agent 1 has both absolute and comparative advantages in earnings, but the advantages are not strong enough to induce a Pareto efficient Nash equilibrium. Suppose a small improvement of w_2 occurs, V_2^{NE} increases more than V_1^{NE} in the non-cooperative allocation. Then agent 2 can ask for a higher consumption share in the bargaining. However, the Pareto efficient time allocation, x^{PE}, is independent of w_2, and then the utility from the total output, η^{PE}, also remains unchanged. Therefore, agent 2 consumes more and agent 1 consumes less, which means agent 2 is better off and agent 1 is worse off.

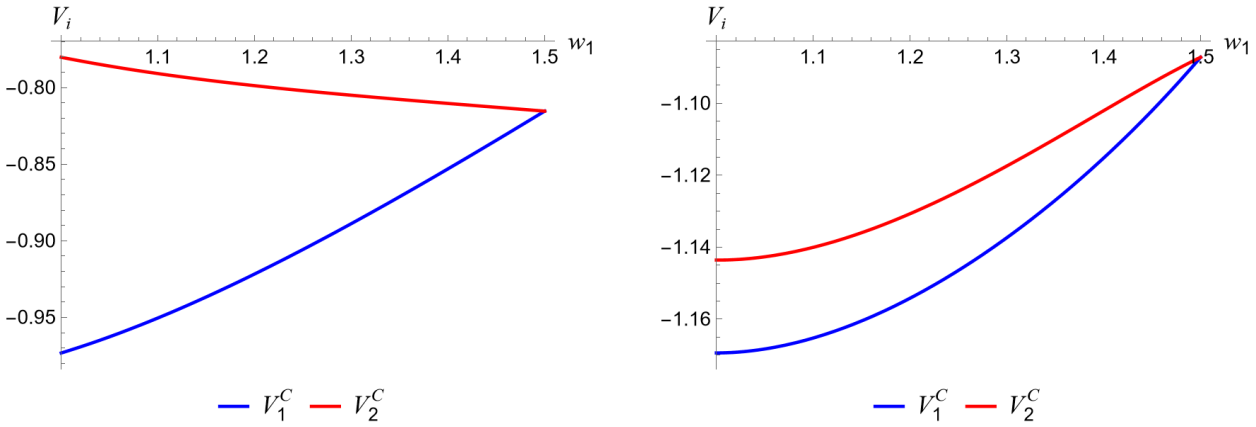
The situation is subtle when $w_2 < w_1$ and $\alpha \frac{w_2}{a_2} < \frac{w_1}{a_1} < \frac{w_2}{a_2}$. In this case, agent 1 has the absolute



(a) $\alpha = \frac{1}{4}$ (b) $\alpha = \frac{2}{3}$

Figure 6: Nash bargaining with an expanding Pareto frontier as $w_1 = 1.45$ increases to $\hat{w}_1 = 1.5$ when $a_1 = 1, a_2 = \frac{2}{3}$ and $w_2 = 1$

In each panel, the black curve is the Pareto frontier when $w_1 = 1.45$, while the gray curve is the Pareto frontier when w_1 increases to $\hat{w}_1 = 1.5$. The points (V_1^{NE}, V_2^{NE}) and (V_1^C, V_2^C) are the non-cooperative and cooperative utility pairs at w_1, respectively, while the points $(\hat{V}_1^{NE}, \hat{V}_2^{NE})$ and $(\hat{V}_1^C, \hat{V}_2^C)$ are the corresponding utility pairs at $\hat{w}_1$. The point (V_1^P, V_2^P) is the utility pair on the new Pareto frontier obtained by holding the initial cooperative income allocation fixed.



(a) $\alpha = \frac{1}{4}$ (b) $\alpha = \frac{2}{3}$

Figure 7: Cooperative utilities as w_1 varies over $1 < w_1 < \frac{3}{2}$ when $a_1 = 1, a_2 = \frac{2}{3}$ and $w_2 = 1$

advantage in earnings, while agent 2 has comparative advantage. Suppose that the wage rate w_1 increases to $\hat{w}_1$. This increase generates two opposing effects on agent 2's cooperative utility, as illustrated in Figure 6, which decomposes the change into a production effect and an allocation effect. First, it raises Pareto-efficient total output and shifts the Pareto frontier northeast. Holding the initial cooperative income allocation fixed, this production effect moves the cooperative outcome from (V_1^C, V_2^C) to the intermediate point (V_1^P, V_2^P), benefiting both agents. Second, the wage increase changes the disagreement point and shifts the bargaining outcome along the new Pareto frontier toward an allocation more favorable to agent 1. This allocation effect moves the outcome from (V_1^P, V_2^P) to $(\hat{V}_1^C, \hat{V}_2^C)$, reducing agent 2's utility relative to the intermediate point. When α is low, as shown in Figures 6(a) and 7(a), the negative allocation effect dominates the positive

production effect and then $\hat{V}_2^C < V_2^C$. When α is high, as shown in Figures 6(b) and 7(b), the production effect dominates, and hence $\hat{V}_2^C > V_2^C$. Higher altruism strengthens the production effect because total household output receives a larger weight in utility. It also weakens the adverse allocation effect because agent 2 places greater weight on agent 1's consumption and therefore suffers less from a reduction in agent 2's own consumption share.

Comparing the cooperative and non-cooperative families shows that cooperation does not eliminate welfare conflicts: an improvement in one agent's wage can still reduce the partner's welfare. In the non-cooperative family, agent 2's welfare V_2^{NE} strictly decreases in w_1 only when $w_1 \in \left(\alpha w_2, \min\left\{w_2, \alpha\frac{a_1}{a_2}w_2\right\}\right)$, as shown in Section 3. By contrast, under cooperation, agent 2's welfare V_2^C strictly decreases in w_1 for all $w_1 \in (\alpha w_2, w_2)$, which is a strictly wider interval whenever $\alpha\frac{a_1}{a_2} < 1$. Moreover, agent 1's non-cooperative welfare V_1^{NE} is non-decreasing in w_2, whereas agent 1's cooperative welfare V_1^C strictly decreases in w_2 when $w_2 \in \left(\alpha\frac{a_2}{a_1}w_1, \frac{a_2}{a_1}w_1\right)$. Therefore, cooperation can amplify the welfare conflicts between agents in response to wage changes.

6 Implications for Household Behavior

The welfare conflicts identified above may have broader implications for household behavior. We consider two simple extensions. First, an agent may have an incentive to prevent an improvement in the other agent's earning capacity. Second, changes in earning capacity may affect marital stability through their effects on both marital surplus and the value of being single.

6.1 Economic Sabotage

Programs designed to improve women's earning capacity have increased domestic abuse (Bulte and Lensink, 2019; Blair and Mvukiyehe, 2025), while Gazeaud et al. (2023) find weaker effects when male partners were involved. Motivated by this evidence, this section extends the model to allow for labor-market sabotage before the household allocation stage. Next, we formalize the decisions concerning participation in and sabotage of a training program.

Consider a family with parameters $(a_1, a_2, w_1, w_2, \alpha)$ and type $T \in \{NE, C\}$. Suppose the government offers agent i a training program that increases the agent's wage rate by $\delta_i > 0$. After observing δ_i, the partner $-i$ decides whether to sabotage agent i's participation in the program by incurring a private fixed cost $e > 0$. If the partner $-i$ does not sabotage, agent i decides whether to participate. Agent i's wage rate increases to $w_i + \delta_i$ from participation. Otherwise, it remains w_i. If partner $-i$ sabotages, then agent i cannot participate in the program. After these stages, the household allocation is determined according to the family type. In a non-cooperative family, continuation payoffs are given by the Nash equilibrium. In a cooperative family, the household adopts a Pareto-efficient time allocation and divides income through Nash bargaining. Thus, a cooperative family should be understood as cooperative only at the subsequent allocation stage. The sabotage decision is unilateral and non-contractible.

Assume that agent i participates when indifferent and that agent $-i$ does not sabotage when indifferent. Conditional on family type $T \in \{NE, C\}$, agent $-i$ anticipates agent i's participation decision. Agent i participates if

$$V_i^T(w_i + \delta_i, w_{-i}) - V_i^T(w_i, w_{-i}) \geq 0. \tag{8}$$

If $V_i^T(w_i + \delta_i, w_{-i}) - V_i^T(w_i, w_{-i}) < 0$, agent $-i$ does not sabotage because sabotage leaves the household outcome unchanged while incurring the private cost e. When condition (8) holds, agent $-i$ sabotages if and only if the utility loss caused by agent i's participation exceeds the cost of sabotage

$$V_{-i}^T(w_i, w_{-i}) - V_{-i}^T(w_i + \delta_i, w_{-i}) > e. \tag{9}$$

Thus, sabotage occurs in a subgame-perfect equilibrium if and only if both conditions (8) and (9) hold. That is, the training program benefits the recipient but the partner's gain from preventing participation exceeds the sabotage cost. The next proposition applies these conditions to characterize local sabotage under cooperation and non-cooperation.

Proposition 6 (Local sabotage)**.** *Suppose $\alpha < 1$ and Assumption 1 holds. Suppose the potential wage improvement, δ_i, and the relative sabotage cost, e/δ_i, are sufficiently small. Then, sabotage occurs in a cooperative family if*

(1) agent 1 is offered the training program and one of the following conditions holds:

(a) $\alpha w_2 < w_1 < w_2$;

(b) $w_2 < w_1$, $\alpha \frac{w_2}{a_2} < \frac{w_1}{a_1} < \frac{w_2}{a_2}$ and α is sufficiently close to zero.

(2) agent 2 is offered the training program and $\alpha \frac{w_1}{a_1} < \frac{w_2}{a_2} < \frac{w_1}{a_1}$.

By contrast, sabotage does not occur in a non-cooperative family.

In a cooperative family, sabotage against either agent may arise. As shown in Proposition 5(2), each agent's cooperative utility is weakly increasing in their own wage rate. Hence, whenever offered a training program, the agent accepts it. Part (1) gives sufficient conditions under which agent 2 sabotages agent 1's training program. Cases (a) and (b) follow directly from Proposition 5(3) and (5), respectively. In these cases, a marginal increase in agent 1's wage rate strictly reduces agent 2's utility. In particular, case (b) shows that sabotage may occur even when agent 1 has an absolute advantage in earnings, provided that agent 2 has a comparative advantage in earnings and altruism is sufficiently low. Similarly, part (2) follows from Proposition 5(4). Agent 1 sabotages agent 2's training program when the latter's wage improvement reduces agent 1's cooperative utility.

Under non-cooperation, both agents' utilities move in the same direction following a sufficiently small wage change. Thus, whenever a marginal wage increase harms the partner, it also harms the recipient, who then rejects the program. However, this local result does not rule out sabotage following a discrete wage increase that crosses an equilibrium boundary. In particular, after a transition from a positive-transfer Nash equilibrium to a no-transfer equilibrium, the recipient's utility may recover above its initial level before the partner's utility does. The recipient then participates, while the partner may prefer to sabotage if the resulting utility loss exceeds the sabotage cost e.

Remark 1. The closest theoretical comparison is Anderberg and Rainer (2013), who model the deliberate sabotage of a partner's earning capacity. Our analysis differs from theirs in two respects. First, they consider a sequential game in which agents choose transfers before allocating time, whereas we model transfers and time allocation as simultaneous decisions. This difference may lead to different welfare responses to wage changes. Second, they identify sabotage incentives through a local decline in the partner's equilibrium utility, while we explicitly model program participation and costly sabotage. In our setting, sabotage additionally requires that the recipient would benefit from participating in the training program.

Figure 8 illustrates the equilibrium sabotage regions on the (w_1, w_2) plane for different training gains δ_1 for agent 1. Economic abuse can arise in both family types, but the corresponding regions differ substantially.

The cooperative sabotage region is generally broader. However, a local welfare conflict is not necessary to induce a sabotage because the wage increase has a discrete size and sabotage is costly. When δ_1 is small relative to e, the sabotage cost may exceed agent 2's utility loss, $e \geq V_2^T(w_1, w_2) - V_2^T(w_1 + \delta_1, w_2)$, and then sabotage does not occur. This observation suggests that gradual improvements in the lower-wage agent's earning capacity may be preferable to a single large increase. A relatively large training gain may create strong incentives for sabotage. By contrast, smaller gains may keep the partner's loss below the sabotage cost. They may therefore be less likely to trigger sabotage at each stage.

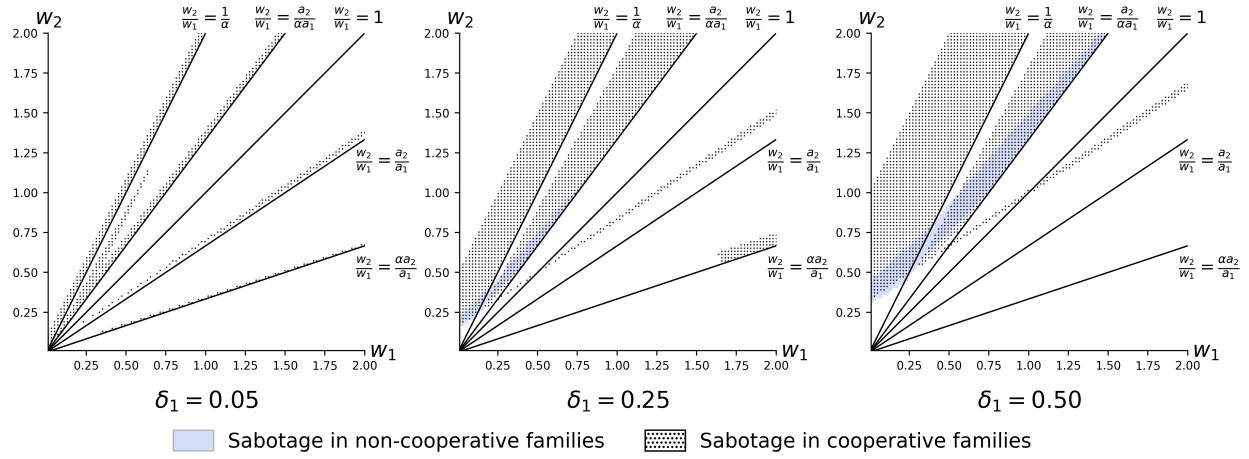


Figure 8: Sabotage regions when agent 1 is offered a training program with $a_1 = 1$, $a_2 = \frac{2}{3}$, $\alpha = \frac{1}{2}$ and $e = 0.005$.

The analysis is closely related to the literature on instrumental economic abuse. Adams et al. (2024) document declines in women's employment and earnings after entering abusive relationships and argue that such economic control can make it harder for victims to leave. A broader literature studies violence or threats as tools for extracting transfers, controlling household resources, or preventing relationship exit (Bloch and Rao, 2002; Bobonis et al., 2013; García-Ramos, 2021). The explanation by our model is complementary but distinct. An earning opportunity may be blocked not to weaken the recipient's future outside option or extract resources, but because its realization directly lowers the partner's utility within marriage through the induced reallocation. This motive can arise even when the subsequent household allocation is cooperative and Pareto efficient at the new wage vector. Cooperation may enlarge the set of opportunities that the other spouse prefers to sabotage.

6.2 Marital Stability

Welfare conflicts may affect marital stability. We introduce stochastic divorce decisions after the household allocation is determined. Divorce is probabilistic because each agent's decision also depends on an idiosyncratic utility shock.

Let $T \in \{NE, C\}$ index the family type. We refer to V_i^T as agent i's marital value. If the marriage ends in divorce, agent i allocates time between market work and home production. The value of being single is

$$V_i^S(w_i) = \max_{x_i \in (0,1)} \ln(a_i x_i) + \ln\big[w_i(1 - x_i)\big].$$

For a single agent, the optimum is $x_i^S = 1/2$, and then $V_i^S(w_i) = \ln\left(\frac{a_i w_i}{4}\right)$. Thus, the value of being single

increases in the agent's own wage and is independent of the partner's wage.

Let ε_i be agent i's idiosyncratic utility shock associated with divorce. We assume that the utility shocks are mutually independent and exogenous to all model primitives and household decisions. After the household determines its allocation, the shocks are realized. Each agent then observes ε_i and decides whether to divorce.

Conditional on the family type T, agent i prefers divorce whenever the value of being single, including the utility shock, exceeds the marital value. Formally, $V_i^S + \varepsilon_i > V_i^T$, or equivalently, $\varepsilon_i > V_i^T - V_i^S$. Let p_i^T denote the probability that agent i prefers divorce to remaining married. We assume ε_i has a logistic probability distribution with mean $\mu = \mathbb{E}[\varepsilon_i]$ and scale parameter $\sigma > 0$. It follows that $p_i^T = \Lambda\left(\frac{V_i^S - V_i^T + \mu}{\sigma}\right)$ where $\Lambda(z) = 1/(1+\exp(-z))$.

The marriage continues if and only if neither agent prefers divorce. Independence of the shocks implies that the marriage continues with probability $(1-p_1^T)(1-p_2^T)$. Therefore, the family divorce probability is

$$D^T = 1 - (1-p_1^T)(1-p_2^T).$$

The welfare comparison between cooperative and non-cooperative families immediately yields the following result on marital stability.

Proposition 7 (Cooperation and divorce probability)**.** *For every $(a_1, w_1, a_2, w_2, \alpha)$, the divorce probability under cooperation is weakly lower than under non-cooperation, $D^C \leq D^{NE}$. The inequality holds strictly if and only if the non-cooperative allocation is Pareto inefficient.*

For each agent i, the cooperative utility is weakly higher than the non-cooperative utility, $V_i^C \geq V_i^{NE}$. Hence, the probability that agent i prefers divorce is weakly lower, $p_i^C \leq p_i^{NE}$. By definition of D^T, we have $D^C \leq D^{NE}$. Cooperation weakly stabilizes marriage, although it need not make divorce less responsive to wage changes.

Suppose agent i experiences an exogenous wage shock $\delta_i > 0$ such that the wage increases from w_i to $w_i + \delta_i$. The wage shock may arise from a public policy that directly raises effective earnings, such as a wage subsidy. It may also result from non-policy developments, such as a promotion, technological change, or an improvement in labor market conditions. Such shocks are empirically relevant for marital dissolution. Weiss and Willis (1997) find that an unexpected increase in the husband's earning capacity reduces the divorce hazard, whereas an unexpected increase in the wife's earning capacity raises it. Relatedly, Lise and Yamada (2019) show that wage shocks shift intrahousehold allocations, particularly near divorce.

We assume that the wage shock is independent of household decisions and cannot be strategically accepted or rejected. For a family of type T, its effect on divorce probability is $D^T(w_i+\delta_i, w_{-i}) - D^T(w_i, w_{-i})$. For a sufficiently small shock $\delta_i > 0$, the effect $D^T(w_i+\delta_i, w_{-i}) - D^T(w_i, w_{-i})$ has the same sign as $\frac{\partial D^T}{\partial w_i}$.

A wage shock on agent i affects divorce probability through two channels. The first is agent i's relative gain from being single rather than remaining married. The second is the change in the partner $-i$'s marital value. Mathematically, differentiating D^T with respect to agent i's wage gives

$$\frac{\partial D^T}{\partial w_i} = \frac{(1-p_1^T)(1-p_2^T)}{\sigma}\left[-p_i^T\left(\frac{\partial V_i^T}{\partial w_i} - \frac{\partial V_i^S}{\partial w_i}\right) - p_{-i}^T \frac{\partial V_{-i}^T}{\partial w_i}\right].$$

The term $\frac{\partial V_i^T}{\partial w_i} - \frac{\partial V_i^S}{\partial w_i}$ is agent i's relative gain from remaining married rather than being single. This channel increases divorce risk when the value of being single rises faster than marital value. For example, suppose $w_1 < \alpha w_2$. In this case, the non-cooperative allocation is Pareto efficient and coincides with the cooperative allocation, with agent 1 fully specialized in housework. A sufficiently small increase in w_1 leaves agent 1's

marital value unchanged, but improves their value of being single. Therefore, $\frac{\partial V_1^T}{\partial w_1} - \frac{\partial V_1^S}{\partial w_1} < 0$ for both $T \in \{NE, C\}$, and this channel raises divorce risk.

The second term $\frac{\partial V_{-i}^T}{\partial w_i}$ captures the effect on the partner $-i$'s marital value. An increase in the partner's marital value stabilizes the marriage, whereas a decrease raises the partner's incentive to divorce. As shown in Proposition 5(3)–(5), the latter case can arise under cooperation when an increase in agent i's wage rate reduces the partner's cooperative utility.

Divorce probability is not a welfare criterion. A policy that raises an agent's wage may improve that agent's welfare even if it also increases the probability of divorce. However, such effects on marital stability may be unintended and should be taken into account when evaluating the broader consequences of the policy.

The two family types may respond differently to the same wage shock to agent i. This difference is especially important when the Nash equilibrium involves no transfer and agent $-i$ has a comparative advantage in earnings. In this region, cooperation may generate a welfare conflict absent under non-cooperation, leading to different effects on marital stability. Figure 9 illustrates this pattern by varying w_1 while holding other parameters fixed. Divorce probability is weakly lower under cooperation, with equality whenever the non-cooperative allocation is Pareto efficient. The responses differ in the shaded region of the figure. In this region, agent 2 has a comparative advantage in earnings and the Nash equilibrium involves no transfer, that is, when $\alpha \frac{a_1}{a_2} w_2 < w_1 < \frac{a_1}{a_2} w_2$.

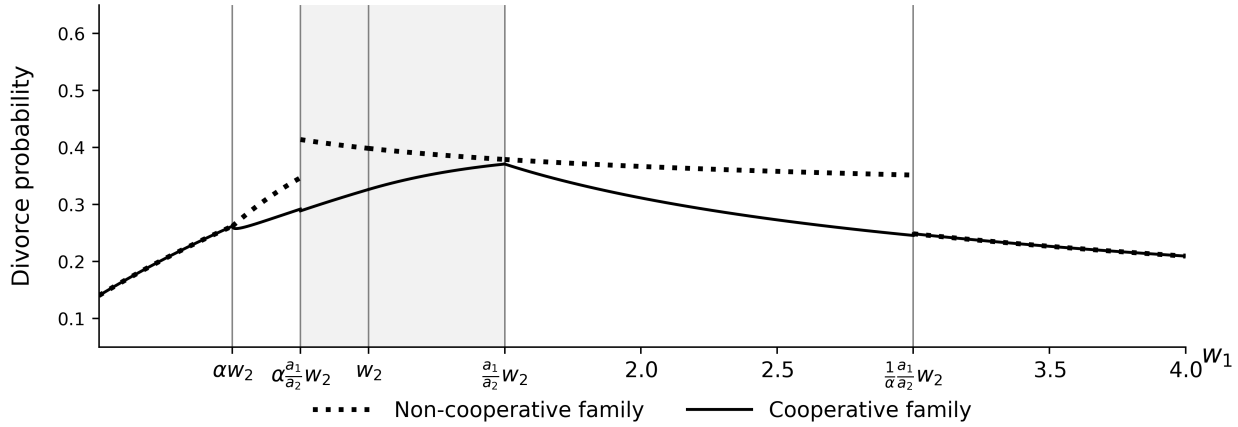


Figure 9: Divorce probabilities under non-cooperation and cooperation as functions of agent 1's wage rate when $a_1 = 1$, $a_2 = \frac{2}{3}$, $\alpha = \frac{1}{2}$, $w_2 = 1$, $\mu = -1$, and $\sigma = 1$

The shaded region indicates the parameter values for which the Nash equilibrium involves no transfer and agent 2 has a comparative advantage in earnings.

Suppose agent 2 has a comparative advantage in earnings and the Nash equilibrium involves no transfer, that is. $\alpha \frac{a_1}{a_2} w_2 < w_1 < \frac{a_1}{a_2} w_2$. In a non-cooperative family, both agents' marital values increase with w_1. These welfare gains dominate the destabilizing effect of the improvement in agent 1's value of being single. Thus, a sufficiently small positive wage shock $\delta_1 > 0$ reduces the divorce probability D^{NE}.

The intuition is different under cooperation. Consider the same parameter region $\alpha \frac{a_1}{a_2} w_2 < w_1 < \frac{a_1}{a_2} w_2$. When $w_1 < w_2$, agent 1's marital value V_1^C increases with w_1, whereas agent 2's marital value V_2^C decreases, as shown in Proposition 5. When altruism is sufficiently low, this welfare conflict may persist even after w_1 exceeds w_2.[7] For a sufficiently small positive wage shock $\delta_1 > 0$, the increase in agent 1's marital value stabilizes the marriage. By contrast, the increase in agent 1's value of being single and the decline in agent

[7] Figure 7(a) plots both agents' marital value using the same parameter values as Figure 9 and illustrates this welfare conflict.

2's marital value are destabilizing. Therefore, the net effect on the divorce probability D^C is generally ambiguous. In the numerical example in Figure 9, the destabilizing effects dominate the stabilizing effect. In particular, D^C continues to increase after agent 1 acquires an absolute advantage in earnings, as long as agent 2 retains the comparative advantage, that is, when $w_2 < w_1 < \frac{a_1}{a_2} w_2$.

The literature shows that improvements in women's career prospects or relative earnings can destabilize marriage. Female promotions increase divorce, particularly in gender-traditional couples (Folke and Rickne, 2020). The divorce response when a wife begins to out-earn her husband depends on social norms (Lippmann et al., 2020). Our analysis provides a welfare-based mechanism linking these findings. A wage increase may raise the recipient's marital utility while lowering the partner's, and it simultaneously raises the recipient's value of being single. This distinction also reveals a new role for cooperation. Although cooperation lowers divorce risk at any given wage vector, it can make marital stability more responsive to changes in relative earnings.

7 Conclusion

This paper presents a model of time and income allocation in a two-agent family with altruistic preferences, a public good, and private consumption. We solve the Nash equilibrium for the non-cooperative family in Propositions 1 and 2, and the Nash bargaining solution for the cooperative family in Propositions 3 and 4. It is possible to achieve Pareto efficiency in a non-cooperative family, as shown in Corollary 3.2. For the family whose non-cooperative allocation is Pareto inefficient, cooperation pushes the income allocation toward equal sharing. Proposition 5 provides the comparative statics and welfare analysis.

We emphasize the welfare implications in Proposition 5. An improvement in one agent's wage rate weakly benefits that agent but may reduce the partner's welfare. This feature also appears under Kalai–Smorodinsky bargaining and in the separate spheres model, as shown in Appendices A and C. These welfare patterns are closely related to economic abuse and marital stability, as shown in our applications. From a policy perspective, our results highlight that interventions affecting individuals' earning capacities can have unintended consequences within households. Policies that raise one family member's wage, such as targeted training programs or wage subsidies, may improve aggregate household resources while worsening the other family member's welfare, even under cooperation.

The two extensions are intended to illustrate the broader relevance of intrahousehold welfare conflicts rather than to provide a comprehensive evaluation of any specific policy. Like many models of household decision-making, our model leaves the nature of the household public good unspecified. If this public good represents care for children or elderly family members, policy evaluation should account not only for decision-making family members but also for that of dependents. A careful analysis of these additional welfare considerations lies beyond the scope of this paper.

The welfare conflicts may also shape other economic outcomes, including marriage market behavior, as shown by Bertrand et al. (2021) in a non-cooperative model. Extending our model to endogenize premarital investment and marital matching is a promising direction.

This paper focuses on families with symmetric altruism and bargaining power. Analyzing asymmetric altruism or bargaining power is a potential direction for future research. Moreover, we adopt simplifying assumptions regarding the functional forms of the utility and household production. The utility function is additively separable in housework and private consumption, with logarithmic components. Extensions could consider alternative forms for the utility and household production functions.

Finally, current labor supply may affect future wages through the accumulation of experience and human capital. Employment interruptions and unemployment may lead to foregone learning-by-doing, skill depreciation, and persistent wage losses (see, e.g. Blundell et al., 2016; Adda et al., 2017). Future research could extend the static model to a dynamic setting in which current labor supply affects future earning capacity. Such an extension could examine how this intertemporal link shapes labor supply and intrahousehold allocation.

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