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Poverty Traps Driven by Family Bargaining*

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Poverty Traps Driven by Family Bargaining[*]

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Abstract

Poverty traps arise when households remain poor due to insufficient capital assets. While traditional mechanisms emphasize occupational choices, re-analysis of Balboni, Bandiera, Burgess, Ghatak and Heil (2022b) suggests that long-run divergence in household capital may be more closely linked to wives' empowerment. To explore this, I develop a dynamic collective household model incorporating intra-household bargaining, where decisions on capital investment and labor allocation are influenced by husbands' conservative social preferences. This framework demonstrates the existence of interpretable multiple steady states that differ in household capital accumulation and wives' labor supply, even in the absence of market frictions. Empirical data validate a distinctive feature of the model: increases in household capital are proportionally linked to increases in women's labor supply. These findings suggest that women's empowerment can effectively complement "big push" policies aimed at poverty reduction.

Keywords: Poverty Traps; Intra-household Bargaining

JEL codes: O12, D10, J22.

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1 Introduction

Poverty traps describe situations in which households persist in poverty primarily due to insufficient capital assets or cash. Under poverty trap dynamics, otherwise identical households can be either poor or rich solely based on their initial asset levels; the distinction is not due to inherent differences in ability or talent. Recent studies find empirical support for such dynamics. For instance, Balboni et al. (2022b) rigorously validated poverty trap dynamics among poor households in South Asia using a quasi-experimental setting where BRAC in Bangladesh randomly transferred capital assets. Their findings show that households initially endowed with sufficient capital tend to accumulate more, while those without sufficient initial capital decumulate assets and remain poor, exhibiting S-shaped dynamics (Figure 1).[1]

However, the mechanisms explaining poverty traps are often critically debated. In fact, Balboni et al. (2022b) attribute the observed poverty trap dynamics primarily to occupational shifts from wage labor to self-employment among households with sufficient initial capital. They suggest that the underlying mechanism involves lump-sum investment requirements for self-employment (implying non-concave technology) and borrowing constraints. These factors can trap households without sufficient assets in wage labor but enable households with sufficient assets to stay wealthy in self-employment. This explanation aligns with Banerjee and Newman (1993).[2] Despite such empirical studies, the underlying premises of occupational poverty traps remain critically debated, as the lumpy investment may not be frequent (Kraay and McKenzie, 2014). Even Balboni et al. (2022b) acknowledge that alternative explanations may be possible for their findings.

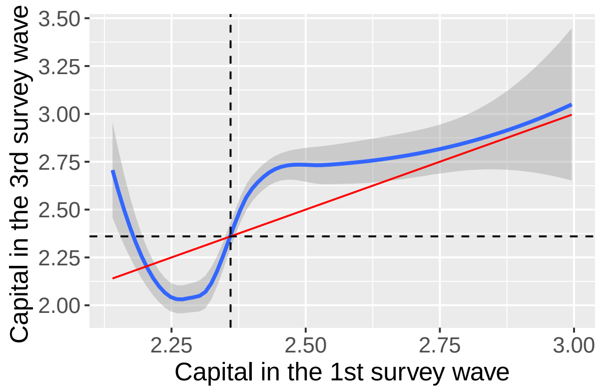
Given recent advances in the empirical literature, this study theoretically and empirically explores a novel mechanism that can create or reinforce poverty traps, focusing on the role of intra-household bargaining. Motivated by my empirical re-analysis of data from Balboni et al. (2022b), I construct a dynamic collective framework in which intra-household bargaining arises as the key determinant of multiple steady states. As part of the empirical investigation, I further demonstrate that the data satisfy a key distinct prediction of my model, suggesting that the bargaining mechanism can be one of the possible driving forces for the observed poverty trap.

The motivation for this bargaining model stems from my re-examination of data from Balboni et al. (2022b). In fact, Balboni et al. (2022b) showed that households with sufficient initial capital (above the threshold in Figure 1) simultaneously accumulate capital and increase self-employment hours. However, my re-analysis reveals a more nuanced occupational dynamic: these same households also increase wage labor

[1] BRAC conducted transfers of cows and job-training for women.

[2] In addition, Banerjee et al. (2019) employs similar mechanisms to explain their observed poverty traps.

Figure 1: Capital Asset Transition (Balboni et al., 2022b)



The graph replicates the estimated transition equation of capital assets from Balboni et al. (2022b) using a local polynomial regression. The x-axis represents initial capital, including the transfer, and the y-axis represents capital after four years. The blue line shows the estimated transition equation, while the gray area indicates the 95 percent confidence bands. The red line marks the 45-degree line, and the dotted line indicates the threshold.

and hours worked outside the home. This suggests a complex, perhaps combinatorial, nature of occupations among the poor, aligning with discussions by Kraay and McKenzie (2014).

Furthermore, my findings suggest that when households have enough initial capital, women in particular increase hours in both wage labor and self-employment. This increased labor participation can signify significant empowerment for these women in conservative South Asian communities. Indeed, female labor supply, particularly where husbands do not directly oversee activities, can improve wives' bargaining power as they can more easily commit to non-cooperative behavior within households (Anderson and Eswaran, 2009). While these findings are suggestive and do not entirely negate the mechanisms proposed by Balboni et al. (2022b), they highlight a more complex dynamic that is not fully captured by a simple occupational shift. This provides the motivation for exploring a new theory of poverty traps rooted in intra-household bargaining, which can act as a key complementary mechanism for understanding these long-run outcomes.

To positively explain the poverty trap dynamics entailing changes in wives' bargaining power, I construct a dynamic collective model of wives and husbands, extending key foundations of dynamic modeling from Basu (2006), Mazzocco (2007), and Lise and Yamada (2018). The model entails three main assumptions. First, households face a standard, concave income-generation mechanism dependent on labor and capital input, and explicit occupational choices are not modeled. This assumption is consistent with the motivating background and discussion by Kraay and McKenzie (2014). Second, husbands experience disutility from their wives' labor supply, reflecting conservative social norms in South Asian society, such as the principle of Purdah. Finally, wives gain more bargaining power as their labor supply increases, as discussed by Anderson and Eswaran (2009).

Together, these assumptions can produce multiple steady states without any market frictions or non-concave technology. When households have higher initial capital, the complementarity between labor input and capital assets implies that the marginal product of labor is high. This incentivizes wives to work more, thereby increasing their bargaining power and reducing their husbands' influence. With diminished opposition from husbands, wives' labor participation remains high, enabling the households to sustain a higher-capital equilibrium. Conversely, in households with lower capital, the marginal product of labor is relatively low, resulting in lower female labor participation and limited bargaining power for wives. Here, husbands are better positioned to discourage wives from working, leading to a lower-capital equilibrium. Thus, the model demonstrates that households can sustain either high or low capital equilibria based on their initial assets and bargaining powers, creating interpretable multiple steady states.

To further confirm that this model is a plausible mechanism, I theoretically derive and empirically verify a distinct prediction of my model using data from Balboni et al. (2022b). This prediction is that the capital-to-labor ratio is equal in both the richer and poorer equilibrium, while it is not in models based on occupational choices and non-concavity in technology. In my model, the difference between richer and poorer steady states lies in wives' bargaining power and labor contribution rather than in the earning technology itself. Thus, a richer equilibrium requires a proportional increase in both wives' labor and capital. By contrast, if occupational choices (e.g., between wage labor and self-employment requiring lump-sum investments) are primary drivers, multiple equilibria would exhibit differing capital intensities. Such differences arise from technological shifts and increasing returns to capital. Since the capital-labor ratios in the data actually converge to a similar value, this suggests that family bargaining is likely at least one of the key drivers in the observed poverty trap.[3]

The mechanism based on intra-household bargaining has an important policy implication: in the presence of poverty traps driven by family bargaining, large capital transfer programs for poor households may not be effective in improving household income without complementary programs that support women's empowerment. This is because a higher-capital equilibrium is sustained by both substantial capital and higher women's labor participation. Thus, large capital transfer programs should ideally be accompanied by measures that facilitate an increase in labor supply, potentially induced by empowerment programs. Empirically, the BRAC program analyzed in Balboni et al. (2022b)'s data included both capital transfers and job training for women, anecdotally supporting my model's implication.

This study's model of poverty traps differs considerably from much of the existing literature. Poverty traps have been broadly discussed based on occupational choices in macroeconomic contexts, with foun-

[3]Moreover, this empirical observation is inconsistent with other types of behavioral poverty traps (e.g. Bernheim et al., 2015; Shah et al., 2012).

dational studies by Banerjee and Newman (1993), Galor and Zeira (1993), and Aghion and Bolton (1997). In addition, many empirical studies (e.g., Banerjee et al., 2019; Balboni et al., 2022a) attributed poverty trap dynamics to borrowing constraints and occupational choices between wage labor and self-employment requiring significant investment, resonating with the micro-foundations of Banerjee and Newman (1993). However, the premises of occupational poverty traps face critical debate. Kraay and McKenzie (2014) suggest that the need for lumpy investment and resulting non-concavity in production may not always be plausible or realistic, as poor households, for example, often combine many different occupations and technologies without lumpy investment (McKenzie and Woodruff, 2006). Without focusing on occupational choices, this study introduces a novel mechanism for poverty traps, joining recent literature on the behavioral or complex nature of such traps (e.g., Shah et al., 2012; Ghatak, 2015; Bernheim et al., 2015; Genicot and Ray, 2017).[4]

Furthermore, this study develops and utilizes a unique ratio test. Notably, this test does not require parametric assumptions on technology to assess potential non-concavity. This is a useful feature compared to many detailed production function estimation techniques (e.g., Olley and Pakes, 1996; Levinsohn and Petrin, 2003). This allows it to distinguish mechanisms of occupational or behavioral poverty traps from poverty traps driven by family bargaining. It thereby contributes to the empirical literature on testing for poverty traps (e.g., Barrett and Carter, 2013; Banerjee et al., 2015; Araujo et al., 2016).

As this study extends bargaining models to the context of poverty traps, it draws on extensive research on them. For example, empirical studies such as Mazzocco (2007) use UK data to demonstrate that households may not be able to commit to a single level of bargaining power when faced with exogenous shocks to distribution factors. Lise and Yamada (2018) also empirically address limited commitment issues. Theoretically, Basu (2006) explores endogenously changing bargaining power and the potential for multiple equilibria, defining stability conditions that explain persistent patterns in women's bargaining power and resource allocation. This study adopts Basu (2006)'s stability notion to analyze the model equilibria. In addition, Anderson and Eswaran (2009) and Heath and Tan (2020) offer insights into how wives' autonomy may relate to labor force participation in South Asia, providing a solid foundation for this study's theoretical and empirical analyses.[5]

[4] There is theoretical discussion on poverty traps based on calorie intake (Dasgupta and Ray, 1986). However, such situations may not be highly plausible, as high-calorie cheap foods are often available in developing societies.

[5] Bloom et al. (2009) and Doepke et al. (2012) deal with issues of labor participation and female empowerment in more general contexts or from a macroeconomic perspective.

2 Motivating Background

To motivate my theoretical models, I introduce several new empirical findings by extending the analysis of Balboni et al. (2022b).[6] These facts suggest that family bargaining, rather than occupational choice between wage labor and self-employment, may be a key factor determining poverty trap dynamics in the long run. It is important to note that all work-related variables in the Balboni et al. (2022b) dataset pertain to women due to data availability. I will discuss the insights and limitations arising from this later.

First, I present the Difference-in-Differences (DiD) analysis by Balboni et al. (2022b). They used the following specification:

$$Y_{i,t} = \beta_0 I(k_{i,1} > \hat{k}) + \sum_t \beta_{1,t} I(k_{i,1} > \hat{k}) S_t + \sum_t \beta_{2,t} S_t + \eta_{i,t} \tag{1}$$

where S_t are indicators for the 2nd, 3rd, 4th, and 5th survey waves after capital transfers occurred in the 1st survey wave.[7] Here, treated households are those with initial capital higher than the threshold $\hat{k}$ (as shown in Figure 1), and control households are those with initial capital below this threshold.[8] The $\beta_{1,t}$ coefficients for $t \geq 2$ are the DiD estimates. Regarding the model's validity, Balboni et al. (2022b) extensively demonstrated that initial capital, defined as the sum of transferred and existing capital, is as-if randomly determined.

The first graph in Figure 2 shows the DiD coefficients from Equation (1), where $Y_{i,t}$ represents self-employment hours. It replicates the findings of Balboni et al. (2022b), using their strict definition of self-employment, which excludes all forms other than livestock rearing and land cultivation hours. Balboni et al. (2022b) interpret this as evidence that households with sufficient initial capital increase their self-employment hours, indicating an occupation-based poverty trap.

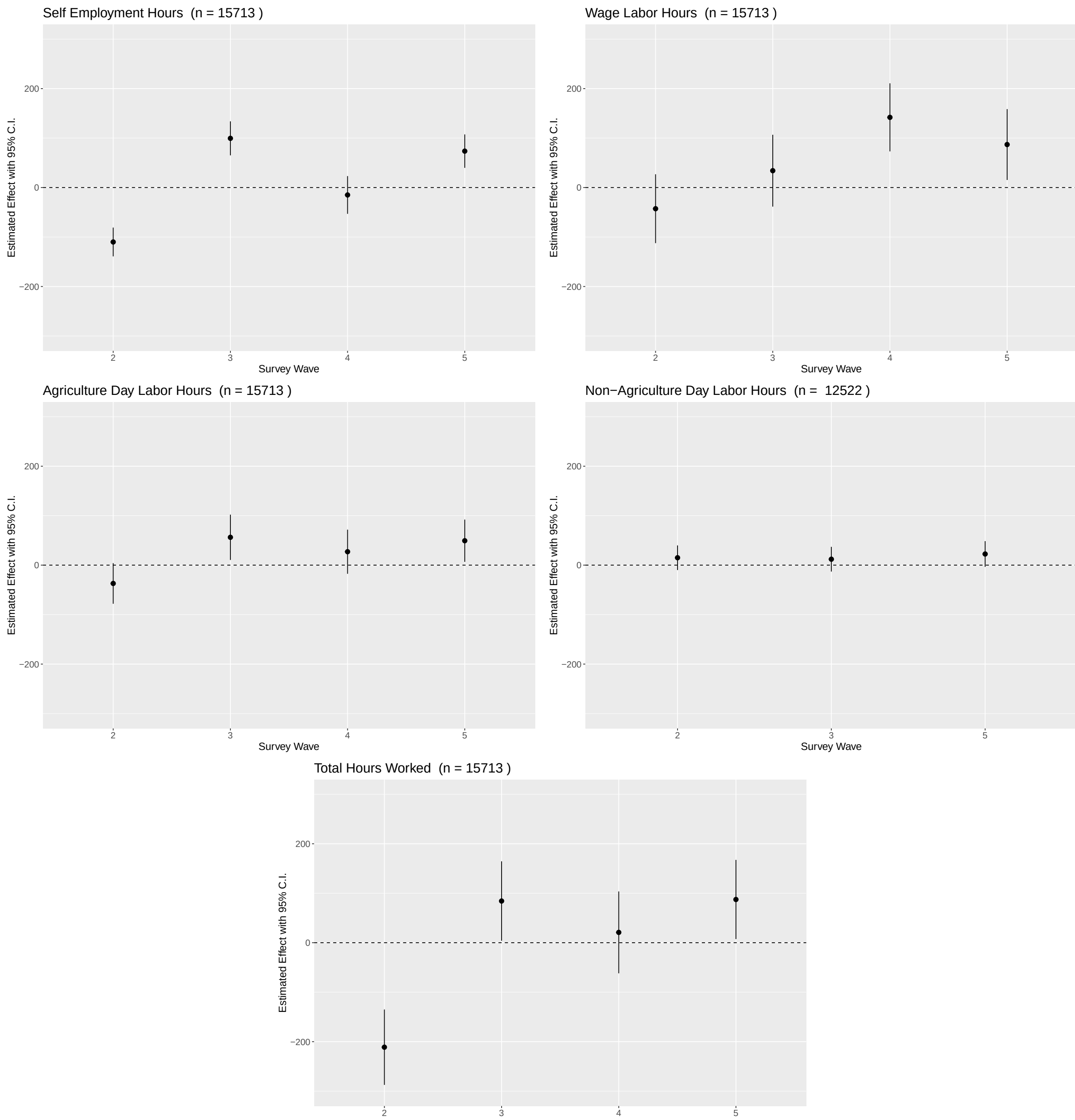
However, the households with sufficient initial capital appear to increase worked hours outside of their households as well. In the second, third, and fourth graphs of Figure 2, $Y_{i,t}$ represents worked hours in wage labor, agriculture day labor, and non-agriculture day labor, respectively. They show a constant increase in wage labor in the long term, and the increase is driven by both agricultural and non-agricultural day labor hours. The magnitude of this total increase in wage labor is comparable to the increase in self-employment. This observed increase in wage labor is difficult to reconcile with a simple occupational poverty trap mechanism discussed by Balboni et al. (2022b). Indeed, it aligns with the more complex nature of the occupations of the poor, as suggested by Kraay and McKenzie (2014).

[6]The dataset is accessible in the online appendix of Balboni, Bandiera, Burgess, Ghatak and Heil (2022b), and I thank the authors for making this well-organized and insightful dataset publicly accessible. The analysis code is accessible on my website (password: uenoyotaroPTFB@).

[7]Each survey wave corresponds to those conducted in 2007, 2009, 2011, 2014, and 2018.

[8]Note that all households in this analysis received some amount of capital transfers.

Figure 2: DiD Coefficients: Self-employment Hours, Wage Work Hours, and Total Hours Worked Conditional on the Subdistrict F.E.



The graphs show the DiD estimation for households with higher initial capital (treated) and lower initial capital (control) with regard to self-employment hours, and hours worked in wage labor. The baseline is the data from the first survey wave, and this estimation also includes subdistrict fixed effects. The samples are selected satisfying the criteria in DiD analysis of Balboni et al. (2022b). For the non-agricultural day labor hours, the data are not available for the survey wave 4.

While these observations cast doubts on occupational poverty traps, they strongly suggest a role for women's empowerment. As Anderson and Eswaran (2009) empirically demonstrate, in South Asian contexts, women's bargaining power within households increases when they work more, especially in environments not directly overseen by their husbands. This is because having substantial work hours outside the household can enhance their ability to commit to non-cooperative behaviors within the household. Therefore, the observed increase in hours worked outside the household strongly suggests a potential rise in women's empowerment.

This interpretation has one important limitation. As the dataset does not contain information on men's work hours, the analysis here could be misleading. Specifically, husbands might be strongly shifting their work hours from wage labor to self-employment, a pattern consistent with occupational poverty traps. Although the data cannot confirm or refute this, the empirical patterns observed for women's labor provide motivation for the theoretical exploration that follows.

3 Theoretical Analysis

In this section, building on the empirical findings presented earlier, I formalize the mechanisms by which households with insufficient initial capital may fail to increase female work hours and accumulate more capital, whereas households with adequate initial capital can sustain higher-capital levels. I develop a dynamic collective framework for household decision-making involving wives and husbands, proposing that these dynamics arise from intra-household bargaining and specific preference structures. This model extends the household bargaining approach of Basu (2006) and related literature on limited commitment to the context of poverty trap dynamics.

In this model, I assume a concave income-generation mechanism and focus on total household income rather than distinguishing between income sources. Empirically, as shown in Section 2, there was no clear shift from wage labor to self-employment for women; rather, their participation in wage labor increased. This increase is significant for understanding wives' empowerment in South Asian villages. However, for the purpose of modeling income generation, the distinction between these two labor sources can be less critical, as discussed by Kraay and McKenzie (2014). Therefore, in the model, I treat both as part of an optimal combination of household labor supply, following the discussion by Kraay and McKenzie (2014).

The general notation is as follows. The equilibrium capital and female labor supply in the higher steady state are denoted by k^{**} and h^{a**} respectively, and those in the lower steady state are k^{*} and h^{a*}, respectively. Conceptually, k^{**} and k^{*} correspond to the higher and lower intersections of the transition equation with the 45-degree line in Figure 1. The superscripts a and b represent wives and husbands, respectively. h_t

is the labor supply at time t, and c_t is consumption at time t. T denotes the maximum labor supply available to wives. $\bar{h^b}$ denotes the fixed labor supply by husbands. The parameter μ indicates the bargaining power of the wife, and U represents utility. The income-generation function f takes h (total labor) and k (capital) as inputs. Households may also experience variations in bargaining power over time.

3.1 Model Settings for Bargaining and Individual Preferences

I begin by assuming that wives possess greater bargaining power (or equivalently, a higher reservation utility) when they have engaged in more work in the previous period:

$$h_t^a > h_t^{a'} \Rightarrow \boldsymbol{\mu}(h_t^a) \geq \boldsymbol{\mu}(h_t^{a'})$$
$$\mu_{t+1} = \boldsymbol{\mu}(h_t^a)$$

where $\boldsymbol{\mu}(h^a)$ is the wife's bargaining power as an increasing function of her working hours h^a. This assumption is realistic: when women have employment or work experience, they can more credibly commit to noncooperative behavior within the household or even sustain their lives independently. This perspective is consistent with Anderson and Eswaran (2009).

Regarding preferences, I assume that wives gain utility from their own consumption and leisure, while husbands gain utility from their own consumption but experience disutility from their wives' labor supply, all within a discounted utility framework:

$$U^a(\{c_t^a, h_t^a\}_{t\geq 0}) \equiv \sum_{t=0}^{\infty} \beta^t u^a(c_t^a, T - h_t^a), \quad U^b(\{c_t^b, h_t^a\}_{t\geq 0}) \equiv \sum_{t=0}^{\infty} \beta^t u^b(c_t^b, T - h_t^a),$$

where $u^a(c_t^a, T - h_t^a) \equiv \ln(c_t^a) + v^a(T - h_t^a)$ and $u^b(c_t^b, T - h_t^a) \equiv \ln(c_t^b) + v^b(T - h_t^a)$. This assumption regarding husbands' utility is reasonable given the cultural context of rural South Asian villages and is supported by empirical literature (Heath and Tan, 2020). Furthermore, I assume that husbands provide a constant labor supply $\bar{h^b}$, consistent with empirical contexts in rural South Asian settings where husbands are often the primary, and relatively stable, income earners.[9]

[9]Note that I could also assume that husbands experience disutility from their own labor. However, this factor is less significant for the core mechanism as long as husbands' labor supply remains relatively stable compared to their wives'. Therefore, for simplicity, I assume a constant labor input by husbands, denoted by $\bar{h^b}$.

3.2 Equilibrium with Fixed Power

I start the analysis with a fixed bargaining power $\mu \in (0,1)$. The household's problem is framed as follows:

$$\max_{\{c_t^a, c_t^b, h_t^a\}_{t\geq 0}} \mu \sum_{t=0}^{\infty} \beta^t u^a(c_t^a, \underbrace{T - h_t^a}_{\text{Wife's Leisure}}) + (1-\mu) \sum_{t=0}^{\infty} \beta^t u^b(c_t^b, \underbrace{T - h_t^a}_{\text{Wife's Leisure}})$$

$$s.t.\ \lambda_t : c_t^a + c_t^b + k_{t+1} \leq f(k_t, \underbrace{h_t^a}_{\text{Wife's Labor}} + \underbrace{\bar{h^b}}_{\text{Husband's Constant Labor}}) + (1-\delta)k_t,\ \forall t$$

where λ_t is the Lagrangian multiplier associated with the budget constraint at time t, and δ is the depreciation rate of household capital. The income-generation function $f \in C^2$ is assumed to be strictly concave and to exhibit Constant-Returns-to-Scale (CRS).[10] This function satisfies the Inada conditions, implying that as labor or capital approaches zero, its marginal product approaches infinity. The felicity functions u^a and u^b also satisfy Inada conditions for consumption and leisure, ensuring that the marginal utility of consumption or leisure approaches infinity as either approaches zero. See the footnote for the specific conditions.[11]

The first-order conditions (FOCs), budget constraint, and transversality condition are as follows:

$$\begin{cases} \mu \dfrac{\beta^t}{c_t^a} = (1-\mu)\dfrac{\beta^t}{c_t^b} = \lambda_t,\ \forall t \\ \mu\beta^t v^{a'}(T - h_t^a) + (1-\mu)\beta^t v^{b'}(T - h_t^a) = \lambda_t f_2(k_t, h_t^a + \bar{h^b}),\ \forall t \\ \lambda_t(f_1(k_t, h_t^a + \bar{h^b}) - \delta) + \lambda_t - \lambda_{t-1} = 0,\ \forall t \\ \lim\limits_{\tau\to\infty} \lambda_\tau k_{\tau+1} = 0 \\ c_t^a + c_t^b + k_{t+1} = f(k_t, h_t^a + \bar{h^b}) + (1-\delta)k_t,\ \forall t \\ k_0 = \hat{k_0} \quad \text{(given initial capital)} \end{cases} \tag{2}$$

In this setting, global convergence to a unique steady state, given any initial capital level, is assured.[12]

Lemma 1 *The first-order conditions (Equation (2)) are sufficient for an optimal allocation. For any initial capital k_0, this optimal allocation sequence $(\{k_t(k_0)\}_{t=0}^{\infty})$ converges globally to a unique steady state, k^{ss}.*

$$\exists k^{ss} > 0, \forall k_0 > 0,\ \lim_{t\to\infty} k_t(k_0) = k^{ss}$$

[10]While the technology could loosely be assumed to be CRS or Decreasing-Returns-to-Scale, I follow the standard in macroeconomic literature and assume CRS for simplicity. Furthermore, as shown by the ratio test in Section 4, the data are empirically consistent with CRS.

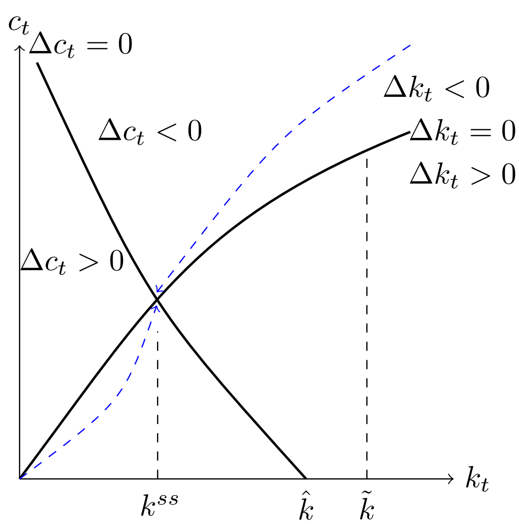
[11]f and v^s for $s = a, b$ satisfy: $f(0, L) = 0$ for all $L > 0$, $f(K, 0) = 0$ for all $K > 0$ (where L is total labor); $v^{a'}, v^{b'}, f_1, f_2, f_{12}(= f_{21}) > 0$; $v^{a''}, v^{b''}, f_{11}, f_{22} < 0$; $\lim_{H\to T_{total}} f_2(K, H) = 0$ for all K (where $H = h^a + \bar{h^b}$ is total labor and T_{total} would be $T + \bar{h^b}$ if h^a can go to T), $\lim_{H\to T \text{ (from } h^a\to 0)} f_2(K, H) = \infty$ for all $K > 0$; $\lim_{K\to\infty} f_1(K, H) = 0$ for all $H > 0$, $\lim_{K\to 0} f_1(K, H) = \infty$ for all $H > 0$; $\lim_{h_t^a\to T} v'^a(T - h_t^a) = \infty$; $\lim_{h_t^a\to T} v^{b'}(T - h_t^a) = \infty$ (assuming v^b is about $T - h_t^a$ implying he values her leisure, or if $v^{b'}$ is on h_t^a directly for disutility from her work, the limit would be as $h_t^a \to 0$ or T depending on the functional form); and $f_{11}f_{22} - f_{12}^2 > 0$ for strict concavity.

[12]Note that I now fix the bargaining power.

The proof is provided in the appendix. □

The phase diagram in Figure 3 illustrates the dynamic system, where the x-axis represents current capital and the y-axis shows current total consumption. The blue line is the saddle path leading to a unique steady-state point, k^{ss}, for a given fixed bargaining power. The variables $\hat{k}$ and $\tilde{k}$, which appear in the proof of Lemma 1, are shown for reference but are not central to the main analysis. Importantly, this optimal path depends on the fixed bargaining power, implying that changes in bargaining power could alter the trajectory and steady-state outcomes.

Figure 3: Phase Diagram



Phase diagram of the dynamic system resulting from the optimal conditions (Equation (2)). The x-axis represents current capital, and the y-axis represents current total consumption. The blue line depicts the saddle path. $\Delta c_t \equiv c_t - c_{t-1}$ and $\Delta k_t \equiv k_{t+1} - k_t$.

Given the proof of global convergence to a steady state, I next focus on the steady-state analysis. Since the dataset does not provide consumption data disaggregated by household members, my primary focus is on labor and capital. Importantly, steady-state consumption is uniquely determined by steady-state levels of labor and capital. The steady-state conditions satisfy:

$$\begin{cases} c^a + c^b = f(k, h^a + \bar{h^b}) - \delta k \\ f_1(k, h^a + \bar{h^b}) + 1 - \delta = \dfrac{1}{\beta} \\ \mu {v^a}'(T - h^a) + (1-\mu){v^b}'(T - h^a) = \dfrac{f_2(k, h^a + \bar{h^b})}{f(k, h^a + \bar{h^b}) - \delta k} \end{cases}, \tag{3}$$

where c^a, c^b, k and h^a denote the steady-state variables.

3.3 Equilibria with Endogenous Power: Static Properties

In this section, I endogenize the bargaining power, denoted by $\mu = \boldsymbol{\mu}(h^a)$.[13] For this analysis, I make the following assumption:

Assumption 1 *The husband has a stronger marginal disutility from the wife's labor (or stronger marginal utility from her leisure) than the wife herself:*

$$\forall h^a \in (0, T) \text{ s.t. } h^a \text{ is a steady state for some } \mu \in (0, 1),\ v_a'(T - h^a) < v_b'(T - h^a)$$

This assumption implies that the husband experiences greater marginal disutility from an additional hour of the wife's labor than the wife herself does. This aligns well with the cultural context in South Asian villages (Heath and Tan, 2020). Accordingly, the steady-state labor supply h^a and capital k under Equation (3) must satisfy the following conditions:

Proposition 1 *If the wife is empowered (i.e., μ increases), she will work more in the steady state, resulting in higher steady-state capital.*

$$\frac{\partial h^a}{\partial \mu} > 0, \quad \frac{\partial k}{\partial \mu} > 0$$

The proof is provided in the appendix.[14] □

Assuming that husbands experience greater disutility from their wives' labor supply than the wives themselves, an increase in wives' bargaining power (empowerment) implies that husbands are less able to prevent their wives from working. This, in turn, leads to an increase in wives' labor supply. Given the complementarity between labor and capital inputs, this increase in labor supply contributes to higher levels of capital.[15]

In Figure 4, I illustrate the steady-state values for capital (k), wife's labor (h^a), and the endogenous bargaining power (μ) as described by Equation (3) and the function $\mu = \boldsymbol{\mu}(h^a)$. As Figure 4 illustrates, the model can produce multiple steady states without technological non-concavity or market frictions, a feature that contrasts with standard Ramsey-type models, which typically yield a unique steady state. To align with the S-shaped dynamics suggested by Figure 1, I depict a common scenario with three intersections, implying two stable steady states (and one unstable).

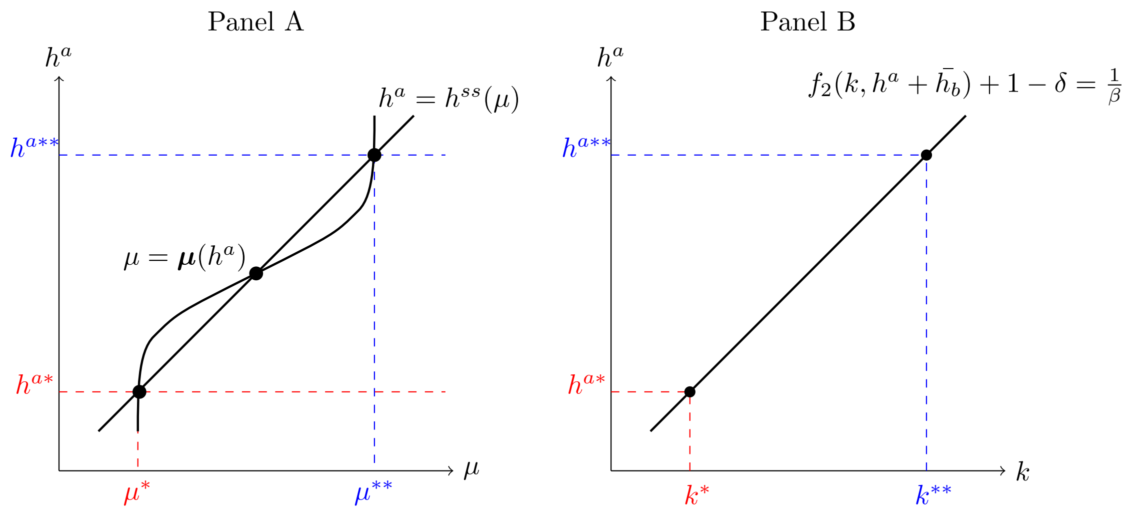
The intuition behind Figure 4 is as follows. On the left side of Figure 4, $h^a = h^{ss}(\mu)$ represents the steady-state wife's labor supply, which depends on her bargaining power μ. Given Assumption 1 ($v_a'(T - h^a) < v_b'(T - h^a)$), $h^{ss}(\mu)$ increases with μ (Proposition 1). This implies that if the wife's bargaining

[13] Here, I focus on the static properties, temporarily setting aside the dynamic perspective.

[14] The same implication holds even if husbands' work hours are considered, under some moderate assumptions.

[15] These assumptions and the proposition are extensions of the analysis by Basu (2006).

Figure 4: Graphical Representation of the Steady States



Graphical representation of the steady states satisfying Equation (3) and the power function $\mu = \boldsymbol{\mu}(h^a)$.

power is substantial, husbands cannot effectively curtail her labor participation. The curve $\mu = \boldsymbol{\mu}(h^a)$ represents the wife's bargaining power as an increasing function of her labor supply h^a. The intersections of these two functions determine the steady-state labor supply and bargaining power. The right side of the figure illustrates the relationship between capital and total labor. According to Proposition 1, a positive relationship exists between capital changes and total labor changes due to the complementarity between labor and capital in the income-generation function. Thus, k^{**} and h^{a**} represent the higher steady-state capital and wife's labor, while k^* and h^{a*} represent the lower steady-state values.

The intersections on the left side of Figure 4 and the corresponding capital levels on the right side represent the following situations.[16]

- In the higher-capital steady state (k^{**}, Panel B), the wife's labor supply must be large (h^{a**}, Panel B) due to labor-capital complementarity. This leads to higher bargaining power for the wife ($\mu^{**} = \boldsymbol{\mu}(h^{a**})$, Panel A). This increased bargaining power prevents her husband from significantly hindering her labor supply, allowing her to continue working longer hours ($h^{ss}(\boldsymbol{\mu}(h^{a**}))$, Panel A). The increased labor supply, in turn, supports a higher level of capital (k^{**}, Panel B) in the steady state. Therefore, the higher-capital steady state is self-sustaining.

- In the lower-capital steady state (k^*, Panel B), the wife's labor supply is small (h^{a*}, Panel B) due to labor-capital complementarity. This results in lower bargaining power for the wife ($\mu^* = \boldsymbol{\mu}(h^{a*})$, Panel A). This diminished bargaining power allows her husband to effectively hinder her labor supply

[16] The stability of the intermediate steady state is discussed in the subsequent subsection.

($h^{ss}(\boldsymbol{\mu}(h^{a*}))$, Panel A). The reduced labor supply supports a lower level of capital (k^*, Panel B) in the steady state. Therefore, the lower-capital steady state is also self-sustaining.[17]

Briefly, I examine the number of intersections for h^a and μ under alternative assumptions for $h^{ss}(\mu)$ and $\boldsymbol{\mu}(h^a)$:

- If $h^{ss}(\mu)$ is increasing in μ and $\boldsymbol{\mu}(h^a)$ is increasing in h^a (the case in this section), multiple intersections are possible.
- If $h^{ss}(\mu)$ is increasing in μ and $\boldsymbol{\mu}(h^a)$ is strictly decreasing in h^a, there is at most one intersection.
- If $h^{ss}(\mu)$ is decreasing in μ and $\boldsymbol{\mu}(h^a)$ is decreasing in h^a, multiple intersections are possible.
- If $h^{ss}(\mu)$ is decreasing in μ and $\boldsymbol{\mu}(h^a)$ is strictly increasing in h^a, there is at most one intersection.

While one might suspect that multiple intersections occur only if $\boldsymbol{\mu}(h^a)$ exhibits strong non-linearities (e.g., being highly sensitive to changes in labor supply), I demonstrate in Appendix D through a numerical example that this is not necessarily the case.

3.4 Equilibria with Endogenous Power: Stability and Dynamics

The previous subsection offered interpretable analytical insights into multiple steady states. This section discusses general dynamics, although explicitly characterizing them and obtaining analytical implications is challenging due to the complexity of the maximization problems.[18] To explicitly discuss dynamics in a manner similar to Basu (2006), I introduce a simplifying assumption regarding the power function $\boldsymbol{\mu}(h^a)$.

Assumption 2 *Local constancy of bargaining power around each steady state: For all* $\{h^a, \mu\}$ *satisfying Equation* (3) *(the steady-state conditions),*

$$\exists \delta > 0, \textit{ such that } \forall h' \in (0, T) \textit{ with } |h^a - h'| < \delta, \textit{ we have } \mu = \boldsymbol{\mu}(h^a) = \boldsymbol{\mu}(h').$$

A potential justification is that, if this assumption holds, the dynamic allocation will be Pareto-optimal locally around each steady state. This might be plausible for poor households who may be keen not to miss opportunities to improve their welfare.[19] However, I acknowledge that this is a technical assumption made to facilitate the analytical discussion.

[17] The steady state in the middle may not be stable. See the next subsection.

[18] Additionally, Section 4 includes a discussion of the model's dynamic application to the context of Balboni et al. (2022b).

[19] The Pareto optimality of household allocations is debated. Studies in Mexico have found evidence consistent with Pareto efficiency (Attanasio and Lechene, 2014; Bobonis, 2009). In contrast, Udry (1996) and Mazzocco (2007) reject Pareto optimality in West Africa and the U.K., respectively.

To discuss stability in a specific sense, I adopt the stability definition from Basu (2006). Basu (2006) conceptualizes each level of bargaining power μ, an endogenous variable, as a "player" in a repeated game centered on the static allocation of household resources. The game in this model is defined similarly:

- Players (distinct levels of bargaining power): $P = (\mu, \mu', \mu'', \ ...)$
- μ's Behavior Strategy at time t: Considering the history up to $t-1$, μ chooses a feasible allocation $(c_t^a, c_t^b, h_t^a, k_{t+1})$, denoted by $x_t(\mu)$.
- μ's Payoff:

$$V(\{x(\mu'); \mu' \in P\}, k_0; \mu) = \sum_{t=0}^{\infty} \beta^t \sum_{\mu' \in P} \underbrace{\mathbb{1}(\mu_t = \mu')}_{\text{If current power } \mu_t \text{ is } \mu'} \cdot \underbrace{\Big[\mu u^a(x_t(\mu')) + (1-\mu)u^b(x_t(\mu'))\Big]}_{\text{Payoff if allocation } x_t(\mu') \text{ occurs, evaluated by } \mu},$$

  where μ_t is the bargaining power determined by the actual realization of h_{t-1}^a via $\boldsymbol{\mu}(h_{t-1}^a)$.

The initial capital k_0 and bargaining power μ_0 are given. In this framework, the current household resource allocation is determined by the household's current bargaining power. Each potential bargaining power level $\mu \in P$ evaluates outcomes based on its own weighted sum of utilities.

Let $s(\mu) = \{s_t(\mu)\}_{t=0}^{\infty}$ be the sequence of resource allocation along the saddle path associated with a fixed bargaining power μ, given some initial capital k_0. The local stability of the steady states is then satisfied under certain conditions.

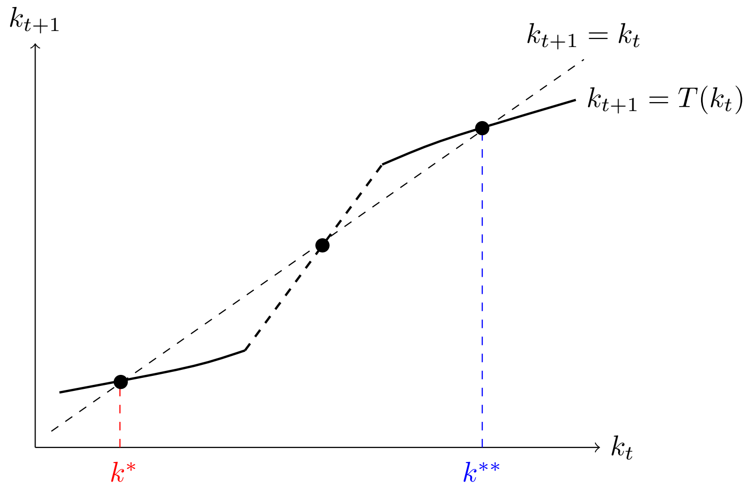
Proposition 2 *Local Stability of a Steady State: The saddle path $s(\mu^{ss})$ corresponding to a steady-state bargaining power μ^{ss} is a weakly dominant strategy for μ^{ss} if, along this path, the wife's labor supply $s_t(\mu^{ss})$ consistently regenerates the same bargaining power: $\boldsymbol{\mu}(s_t(\mu^{ss})) = \mu^{ss}$ for all $t \geq z$ (where z is some initial period).*[20]

The proof is straightforward. If $\boldsymbol{\mu}(s_{t-1}(\mu^{ss})) = \mu^{ss}$ for all $t \geq z$, then the bargaining power remains at μ^{ss}, and other potential bargaining power levels $\mu' \neq \mu^{ss}$ do not influence the allocation as long as μ^{ss} follows its optimal path $s(\mu^{ss})$. Given the optimality of $s(\mu^{ss})$ (from Lemma 1, for a fixed μ^{ss}), μ^{ss} cannot achieve a strictly better outcome by choosing a different allocation. □

Figure 5 shows the transition equation $k_{t+1} = T(k_t)$ derived from the preceding analysis (conceptually from Figure 4). There are two steady states, k^* and k^{**}, which are locally stable due to the properties of $\boldsymbol{\mu}(\cdot)$ around these points (Assumption 2). A steady state between them exists, which lacks the assumption and may not be stable. Since explicitly deriving the optimal path when the system is far from any steady state is difficult, the transition in the intermediate region is depicted by a dashed line.

[20] I use the simplified notation, in which $\boldsymbol{\mu}()$ is a function of all the resource. This is just for simplicity in the notation.

Figure 5: Transition Equation $k_{t+1} = T(k_t)$



The transition equation ($k_{t+1} = T(k_t)$) implied by the model's assumptions and analysis. Multiple steady states (k^* and k^{**}) exist with local stability. Since characterizing the optimal strategy when far from a steady state is complex, the transition dynamics in the intermediate region are depicted as a dashed line, indicating opacity.

3.5 Empirical Implication

I derive a testable implication that distinguishes this model from those featuring non-concavity in production. Let (k^{**}, h^{a**}) and (k^*, h^{a*}) denote capital and wife's labor inputs in the higher and lower steady states, respectively. The two steady states in this model satisfy:

$$f_1(k^*, h^{a*} + \bar{h^b}) + 1 - \delta = f_1(k^{**}, h^{a**} + \bar{h^b}) + 1 - \delta = \frac{1}{\beta}$$

This implies that the marginal product of capital is equal in both steady states, determined by the time preference β and depreciation δ. Given Euler's theorem for homogeneous functions, the CRS property of the income-generation function, and the strict concavity with respect to capital ($f_{11} < 0$), I can deduce the following relationship for the capital-to-total labor ratio:

Proposition 3 *Under the model with a concave, CRS income-generation function, the capital-to-total labor ratio is the same across steady states.*

$$\frac{k^*}{h^{a*} + \bar{h^b}} = \frac{k^{**}}{h^{a**} + \bar{h^b}} \tag{4}$$

As long as households face a concave, CRS income-generation function, they cannot "miraculously" achieve access to a more productive technology (characterized by a higher capital-labor ratio at the same marginal product of capital) simply by accumulating sufficient capital.[21] Therefore, to sustain a higher-capital steady

[21] If the technology were Decreasing-Returns-to-Scale (DRS), then for the same f_1, a higher k would imply a lower k/H ratio, so $\frac{k^*}{h^{a*}+\bar{h^b}} > \frac{k^{**}}{h^{a**}+\bar{h^b}}$ would be expected. However, the empirical analysis in Section 4 is consistent with CRS. For simplicity and

state, households must increase their total labor supply (primarily through female labor in this model) proportionally to the increase in capital to maintain the profitability of capital investment.

This relationship typically does not hold in models with non-concavity, such as those alluded to by Balboni et al. (2022b) or formalized by Banerjee and Newman (1993). In such models, households may face a poverty trap in wage labor due to non-concave production functions for alternative activities (e.g., self-employment) that exhibit local increasing returns to capital.[22] In that context, the lower-capital equilibrium corresponds to a less capital-intensive, less profitable technology, whereas the higher-capital equilibrium involves a shift to a more capital-intensive, more profitable technology. Consequently, households with sufficient initial capital have a strong incentive to increase their capital-to-labor ratio. Therefore, the relationship in such models is typically:

$$\frac{k^*}{h^{a*}+\bar{h^b}} < \frac{k^{**}}{h^{a**}+\bar{h^b}} \tag{5}$$

To illustrate further with a tractable example of technological switching: consider that a low-productivity technology $f_L(k,H) = A_L k^\alpha H^{1-\alpha}$ is available to all, but a high-productivity technology $f_H(k,H) = A_H k^\alpha H^{1-\alpha}$ (with $A_H > A_L$) becomes accessible or optimal only if capital k surpasses some threshold. If both steady states satisfy the same Euler equation for capital ($f_1 = r+\delta$), then for $f_1(k,H) = A\alpha(k/H)^{\alpha-1}$, we would have $A_L\alpha(k^*/(h^{a*}+\bar{h^b}))^{\alpha-1} = A_H\alpha(k^{**}/(h^{a**}+\bar{h^b}))^{\alpha-1} = r+\delta$. Since $A_H > A_L$, it must be that $(k^*/(h^{a*}+\bar{h^b}))^{\alpha-1} > (k^{**}/(h^{a**}+\bar{h^b}))^{\alpha-1}$. Given $\alpha - 1 < 0$, this implies $k^*/(h^{a*}+\bar{h^b}) < k^{**}/(h^{a**}+\bar{h^b})$.[23] This logic leads to the same prediction as Equation (5).[24]

Furthermore, other common types of behavioral poverty traps would also likely predict Equation (5) rather than Equation (4). Such models often posit that behavioral frictions, like present bias or a focus on immediate scarcity, cause poor individuals to forgo profitable investments (e.g., Bernheim et al., 2015; Shah et al., 2012). Consequently, under these theories, a lower-capital (poorer) equilibrium would be characterized by a high marginal product of capital (MPK), reflecting these missed opportunities. Conversely, a higher-capital (richer) equilibrium, achieved if households overcome these behavioral hurdles and increase their capital stock, would exhibit a lower MPK, assuming a standard concave production technology. This declining MPK with increasing capital generally implies that the capital-labor ratio would be lower in the

following standard macroeconomic literature, I assume CRS.

[22] Balboni et al. (2022b) discuss a production function for self-employment like $(ak+bk^2)h^\beta$, where k is capital and h is labor in self-employment. This exhibits an increasing return feature with respect to capital if $b > 0$.

[23] At a glance, this A_H/A_L difference represents Hicks-neutral technical change. However, with a Cobb-Douglas production function, this is equivalent to Harrod-neutral (labor-augmenting) and Solow-neutral (capital-augmenting) technical change as well.

[24] Furthermore, Equation (4) contradicts a poverty trap mechanism in which large capital transfer makes people more patient to invest. This is because, if households decrease their discount rate, then they should increase their capital-labor ratio, aligning with Equation 5.

poorer equilibrium than in the richer one, consistent with Equation (5).

Notably, a key advantage of using this ratio test (Equations (4) and (5)) is its ability to assess implications of technological non-concavity without requiring specific parametric assumptions on the production function itself. This contrasts with many conventional approaches to production function analysis that often rely on detailed parametric or semi-parametric specifications to identify technological features (e.g., Olley and Pakes, 1996; Levinsohn and Petrin, 2003).

4 Empirical Analysis: Theory to Data

4.1 Empirical Test

As shown in the theory section, the key distinction between the model in this study, which employs a concave income-generation function, and models like those of Balboni et al. (2022b), which rely on non-concave production functions or behavioral frictions, lies in the predicted capital-to-labor ratios across different equilibria. In this study's model, these ratios are predicted to remain constant, whereas they would typically differ in models emphasizing non-concave production (e.g., due to occupational shifts involving different technologies). I test this distinction by empirically comparing the implications of Equations (4) and (5).

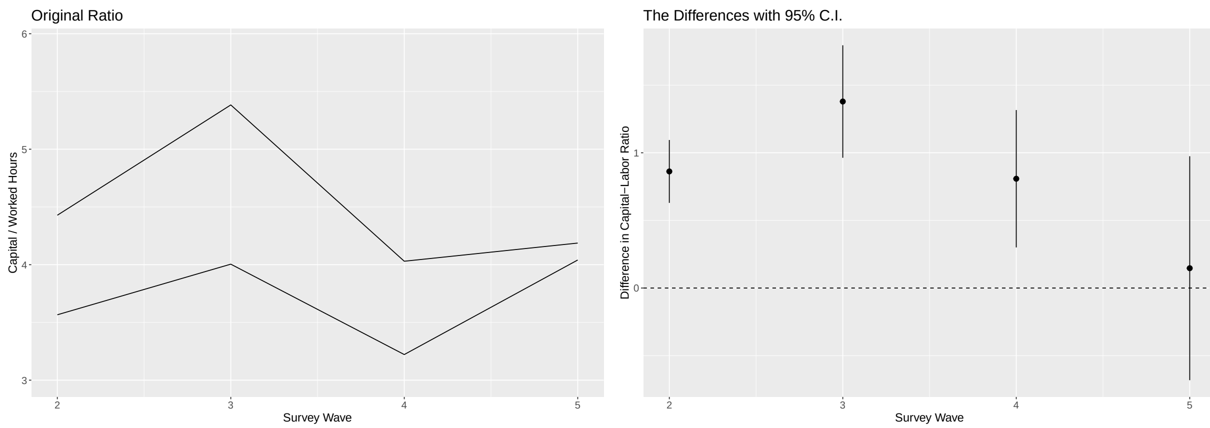
The left-hand side of Figure 6 displays the average capital-to-labor ratios for each survey wave. Total worked hours (women's observed hours plus assumed constant hours for men) are used as the measure of labor input. Observations were separated into two groups based on whether household initial capital in the first survey wave was above or below the threshold. The upper line represents households with higher initial capital, while the lower line represents those with lower initial capital. This graph indicates that the capital-to-labor ratios for both groups converge to similar values in the long run, irrespective of their initial capital levels.[25]

Next, I statistically test whether the differences in these ratios between households with different initial capital levels are significant. The null hypothesis is that the capital-to-labor ratios are the same for both types of households (those with and without sufficient initial capital). The results are shown on the right-hand side of Figure 6. In the 5th survey wave, the p-value for the difference is 0.72, suggesting that, in the long run, the ratios are statistically indistinguishable between two groups. Although this failure to reject the null could be interpreted as weak evidence due to the wide confidence intervals in later waves, this result reflects an actual convergence of the point estimates for the ratios (4.04 and 4.19, as shown in the left-hand panel).

[25] As data on men's work hours are not available, I assume that they work a constant 2400 hours per year.

The long-run convergence of these ratios to a single value contradicts the prediction of multiple equilibria driven by non-concave technology (which would imply different capital-labor ratios). Instead, this finding is consistent with the prediction of multiple equilibria arising from differing bargaining powers under a concave, CRS income-generation function.[26]

Figure 6: Capital-Labor Ratios: Households Above vs. Below the Capital Threshold in the 1st Survey Wave (n = 15713)



The left-hand graph shows average capital-to-total labor input ratios for each survey wave, for households with higher and lower initial capital, respectively. Observations are separated by whether initial capital (1st survey wave) was above or below the threshold. The upper line is for households with higher initial capital; the lower line is for those with lower initial capital. The right-hand graph presents confidence intervals for the differences in these ratios. Sample selection criteria follow Balboni et al. (2022b). Analyses using alternative definitions of labor or stricter sample selection are available in Appendix C.

As discussed in Section 2, the lack of data on husbands' work allocation is a potential issue, and I have assumed constant work hours for husbands. If, for instance, husbands in households with initially higher capital significantly decreased their work hours as capital accumulated, the true capital-labor ratio for this group might be higher, potentially aligning more with Equation (5). However, for such a scenario to lead to a statistically significant rejection of the null hypothesis (that the ratios are equal), husbands in the higher-initial-capital group would need to have worked approximately 510 fewer hours in the 5th survey wave (see Figure 10 in Appendix C). This represents a considerable reduction in labor supply, especially given the cultural context of South Asia where husbands are typically the main income earners.

4.2 Theory to the Context and Policy

I argue that the findings of Balboni et al. (2022b) can be well explained by a combination of mechanisms: occupational shift and training influencing outcomes in the short to medium term, and poverty traps driven

[26] In addition, Appendix C shows a similar convergence when using an alternative definition of worked hours (worked hours only in self-employment).

by family bargaining becoming more salient in the long term.[27] The BRAC program in Bangladesh, as described in their study, involved not only capital transfers (cows) but also job training in livestock rearing specifically for women. The table below shows the average hours women spent on livestock rearing, for households grouped by their initial capital.

Figure 7: Average hours worked in livestock-rearing

Household type \Survey wave	2nd	3rd	4th	5th
Initial capital less than the threshold	716	529	425	253
Initial capital more than the threshold	683	697	481	384

The transfer and training initially led to an increase in female hours worked in livestock. However, these hours gradually reduced over time for both groups. Notably, for households starting with capital below the threshold (”Initial capital less than the threshold”), there is a marked reduction in livestock hours from the 2nd to the 3rd survey wave (from 716 to 529 hours).[28] This earlier or sharper decline for the initially poorer group might be because, as Balboni et al. (2022b) discuss, these households may have had to sell transferred cows sooner due to insufficient complementary inputs or pressing consumption needs. Conversely, households that started with capital above the threshold (”Initial capital more than the threshold”) maintained a higher level of female labor in livestock rearing in the 3rd, 4th, and 5th survey waves compared to the other group. If BRAC’s program successfully directed these cow-rearing activities primarily to women, and if Anderson and Eswaran (2009)’s mechanism (whereby increased external work enhances bargaining power) is operative, then these sustained work hours could have helped wives with sufficient initial capital maintain or increase their bargaining power. This, in turn, may have supported the higher-capital equilibrium, as predicted by the model in the previous section. Households that started with insufficient capital, unable to sustain this engagement (and thus the associated bargaining power), may have converged to the lower-capital equilibrium.

This interpretation of the dynamics within the Balboni et al. (2022b) data suggests that large capital transfers intended as a ”big push” may require complementary programs that stimulate women’s labor supply and empowerment, especially if poverty traps are partly driven by family bargaining. Without such job training or similar empowerment-focused interventions, households might not achieve a higher-capital equilibrium, as these multiple steady states are theorized to be sustained by differing levels of both capital and women’s bargaining power.

[27] Please refer to the Introduction and Motivating Background sections for detailed information on Balboni et al. (2022b).

[28] The 3rd survey wave is four years after the initial capital transfer.

5 Conclusion

Drawing on empirical motivation from a re-analysis of data from Balboni et al. (2022b), this study developed a theoretical model demonstrating that poverty traps with multiple steady states can arise from intra-household bargaining. This framework yielded a distinct prediction regarding capital-labor ratios—that they would remain constant across steady states—which was subsequently supported by the data, offering an alternative lens to existing models. A key policy implication is that where family bargaining drives poverty traps, 'big-push' policies may only be effective if they are accompanied by programs promoting female empowerment. This type of situation may be applicable to any context involving social norms or husbands' preferences against female labor participation.

It is important to acknowledge that this analysis offers a possible interpretation of the long-term poverty trap results observed in Balboni et al. (2022b) and should be viewed not as a definitive refutation of occupation-based models, but rather as a crucial complementary mechanism. This is particularly true because the evidence for women's empowerment in this study is indirect, primarily due to data limitations. Hence, further empirical research should involve detailed investigation into intra-household resource allocation and bargaining power when considering poverty traps.

Furthermore, data limitations hinder a detailed welfare analysis for individual household members based on the proposed bargaining model. While "big-push" policies incorporating women's empowerment can transition households to a higher-capital equilibrium with greater total income, it is ambiguous whether husbands' welfare improves. This ambiguity arises because, in such a scenario, husbands may lose bargaining power and must accept increased female labor hours, from which they derive disutility. This perspective represents a crucial difference from classic poverty trap models based on occupational shifts, where "big-push" policies leading to higher household income are generally considered Pareto-improving or at least preferable for all members. Therefore, a comprehensive welfare analysis would require more detailed data to accurately estimate each member's consumption, leisure, and preference parameters.

6 Declaration of generative AI and AI-assisted technologies in the writing process.

During the preparation of this work the author used Gemini and ChatGPT in order to enhance the readability and quality of writings. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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A Proof of Lemma 1

Sufficiency of the Condition for Optimality

I referred to Stokey (1989) in this section. I start with the simplified notation.

$$x_t \equiv (c_t^a, c_t^b, h_t^a)^\mathsf{T}$$
$$f(x_t) \equiv \mu u^a(c_t^a, h_t^a) + (1-\mu)u^b(c_t^b, h_t^a)$$
$$(k_{t+1} =)\ g(x_t, k_t) \equiv f(k_t, h_t^a + \bar{h^b}) + (1-\delta)k_t - c_t^a - c_t^b$$

The optimal condition implies that the allocation $((x_t^*, k_{t+1}^*))$ satisfies $\beta^t \frac{\partial f(x_t^*)}{\partial x_t} + \lambda \frac{\partial g(x_t^*, k_t^*)}{\partial x_t} = \mathbf{0}$, under the inada conditions. $-\lambda_{t-1} + \lambda_t \frac{\partial g(x_t^*, k_t^*)}{\partial k_t} = 0$ and $\lim_{T\to\infty} \lambda_T k_{T+1}^* = 0$. Also, the assumptions of concavity implies that $\beta^t f(x_t) + \lambda[g(x_t, k_t) - k_{t+1}]$ is strictly concave in (x_t, k_t, k_{t+1}). Then, for any other feasible allocation $((x_t, k_{t+1}))$, the objective function satisfies the following

$$\begin{aligned}
\lim_{T\to\infty}\sum_{t=0}^{T}\beta^t f(x_t) &\leq \lim_{T\to\infty}\sum_{t=0}^{T}\{\beta^t f(x_t) + \lambda_t[g(x_t,k_t) - k_{t+1}]\} \\
&< \lim_{T\to\infty}\sum_{t=0}^{T}\beta^t\left\{\frac{\partial f(x_t^*)}{\partial x_t^\mathsf{T}} + \lambda_t \frac{\partial g(x_t^*, k_t^*)}{\partial x_t^\mathsf{T}}\right\}(x_t - x_t^*) \\
&\quad + \lim_{T\to\infty}\sum_{t=0}^{T}\left\{-\lambda_{t-1} + \lambda_t \frac{\partial g(x_t^*, k_t^*)}{\partial k_t}\right\}(k_t - k_t^*) \\
&\quad + \lim_{T\to\infty}(-\lambda_T)(k_{T+1} - k_{T+1}^*) \\
&\quad + \lim_{T\to\infty}\sum_{t=0}^{T}\left\{\beta^t f(x_t^*) + \lambda_t[g(x_t^*, k_t^*) - k_{t+1}^*]\right\} \\
&\leq \lim_{T\to\infty}\sum_{t=0}^{T}\left\{\beta^t f(x_t^*) + \lambda_t[g(x_t^*, k_t^*) - k_{t+1}^*]\right\} \\
&= \lim_{T\to\infty}\sum_{t=0}^{T}\beta^t f(x_t^*)
\end{aligned}$$

The first inequality comes from the resource constraint. The second inequality uses the property for strictly concave function, and the fact that $\lambda_T k_{T+1} \geq 0$. The third inequality uses the conditions (Eular equation and transversality condition). The forth equality comes from the resource constraint and the strictly monotone preference. □

Global Convergence

Strictly monotone preference and inada conditions ensure the problem is reduced to the one determining the total consumption c_t. Note that the husband's labor supply is $\bar{h^b}$ and the time endowment of the wife is T. Thus $c_t^a = \mu c_t, c_t^b = (1-\mu)c_t$. I redefine $h_t \equiv h_t^a$, $v'(T - h_t) \equiv \mu v^{a'}(T - h_t^a) + (1-\mu)v^{b'}(T - h_t^a)$,

$\Delta c_t = c_t - c_{t-1}$ and $\Delta k_t = k_{t+1} - k_t$. Also $v' > 0$,$v'' < 0$ and $\lim_{h_t \to T} v'(T - h_t) = \infty$. Then the reduced conditions are as follows.

$$\begin{cases} v'(T-h_t) = \dfrac{1}{c_t} f_2(k_t, h_t + \bar{h^b}),\ \forall t \\ f_1(k_t, h_t) + 1 - \delta = \dfrac{c_t}{\beta c_{t-1}},\ \forall t \\ \lim\limits_{\tau \to \infty} \dfrac{\beta^t k_{\tau+1}}{c_\tau} = 0 \\ k_{t+1} - k_t = f(k_t, h_t + \bar{h^b}) - \delta k_t - c_t,\ \forall t \\ k_0 = \hat{k_0} \end{cases}$$

The first equation and the inada conditions ensure that in any feasible path of $\{k_t, c_t\}$ h_t is uniquely determined and is dependent only on the current c_t and k_t. Therefore I can define $h_t = h(k_t, c_t)$. $h(,)$ satisfies

$$h_1(k,c) = \frac{-f_{21}}{v''c + f_{22}} > 0,\ h_2(k,c) = \frac{v'c}{v''c + f_{22}} < 0,\ \lim_{c \to \infty} h(k,c) = 0.\ \lim_{c \to 0} h(k,c) = T$$

I illustrate the phase diagram. Note that, as I assume the strictly concave income-generation, $f_{11}f_{22} - f_{12}f_{21} > 0$. The following relationships regarding $\Delta c_t = 0$ and $\Delta k_t = 0$ are satisfied as long as $f_1 - \delta > 0$.

$$\Delta c_t = 0 \Rightarrow f_1 + 1 - \delta - \frac{1}{\beta} = 0,\ \Delta k_t = 0 \Rightarrow f - \delta k_t - c_t = 0$$

$$\left.\frac{dc_t}{dk_t}\right|_{\Delta c_t = 0} = \frac{-f_{11}v^{''}c_t - f_{11}f_{22} + f_{21}f_{12}}{f_{12}v'} < 0,\quad \left.\frac{dc_t}{dk_t}\right|_{\Delta k_t = 0} = \frac{f_2 f_{21} - (f_1 - \delta)(v^{''}c_t + f_{22})}{f_2 v' - v'' c_t - f_{22}} > 0$$

I define $\dot{k}$ as the (unique) value satisfying $f_1(\dot{k}, 0) = \delta + \frac{1}{\beta} - 1$. I also define $\hat{k}$ as the unique one satisfying $f_1(\hat{k}, T + \bar{h^b}) = \delta + \frac{1}{\beta} - 1$. You can easily check $\hat{k} > \dot{k}$ since $f_{12} > 0$.

Regarding $\{k_t, c_t\}$ $s.t. \Delta c_t = 0$,

$$\lim_{k_t \to \dot{k}+0} c_t = \infty,\ \lim_{k_t \to \hat{k}-0} c_t = 0$$

Regarding $\{k_t, c_t\}$ $s.t. \Delta k_t = 0$,

$$\lim_{k_t \to 0+0} c_t = 0$$

Also, I define $(\tilde{k}, c_t)$ as the (unique) one satisfying $\Delta k_t = 0$ and $f_1(\tilde{k}, h(\tilde{k}, c_t) + \bar{h^b}) = \delta$. Since $f_{12} > 0$ and $h(k_t, c_t) < T$, the following is satisfied:

$$\tilde{k} > \hat{k}$$

Thus I can characterize the phase diagram like Figure 3. A saddle path exists to any initial capital, and no path other than the saddle path can satisfy the transversality condition or the positive capital value condition. Consumption allocation is uniquely determined by $c_t^a = \mu c_t$ and $c_t^b = (1 - \mu)c_t$. □

B Proof of Proposition 1

Applying the implicit function theorem to the steady state yields

$$\begin{pmatrix} f_{11} & f_{12} \\ (\mu v^{a'} + (1-\mu)v^{b'})(f_1 - \delta) - f_{21} & (\mu v^{a''} + (1-\mu)v^{b''})(f - \delta k) + (\mu v^{a'} + (1-\mu)v^{b'})f_2 - f_{22} \end{pmatrix}$$

$$\begin{pmatrix} \frac{\partial k}{\partial \mu} \\ \frac{\partial h^a}{\partial \mu} \end{pmatrix} = \mathbf{0}$$

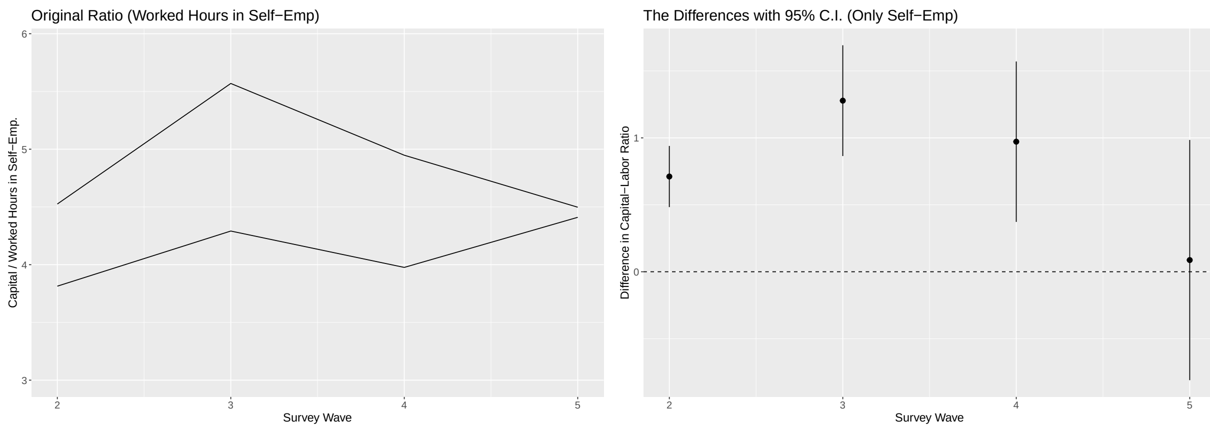
Then this is reduced to

$$\begin{aligned} \frac{\partial h^a}{\partial \mu}\frac{1}{f_{11}}\{f_{11}f_{22} - f_{12}f_{21} + f_{12}(f_1 - \delta)(\mu v_a' + (1-\mu)v_b') \\ -f_{11}f_2(\mu v_a' + (1-\mu)v_b') + f_{11}(f - \delta k)(\mu v_a'' + (1-\mu)v_b'')\} = (f - \delta k)(v_a' - v_b') \\ \frac{\partial h^a}{\partial \mu}C = (f - \delta k)(v_a' - v_b') \end{aligned}$$

Because $C < 0$, the proposition is proved. □

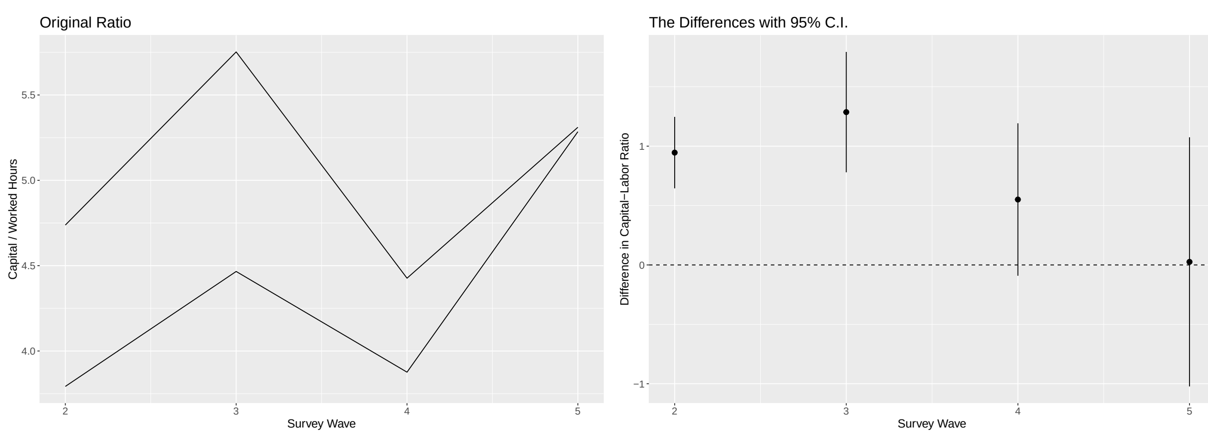
C Additional Graphs

Figure 8: Capital-Labor Ratios: Households Above vs. Below the Capital Threshold in the 1st S.W. (worked hours only in self-employment)



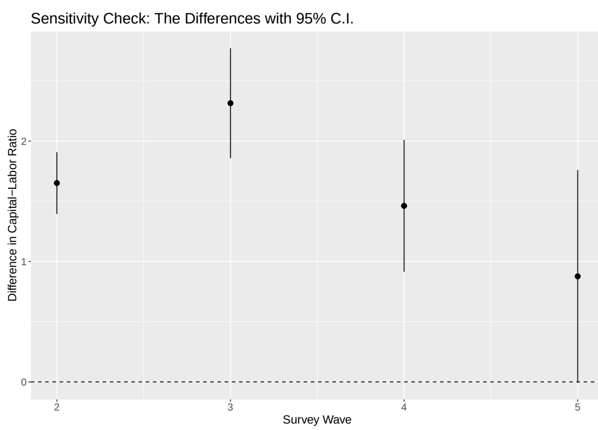
The left-hand side graph shows the average capital-to-labor input ratios for each survey wave, for households with higher and lower initial capital, respectively. The observations are separated by households above and below the capital threshold in the first survey wave. The upper line represents households with higher initial capital, while the lower line represents households with lower initial capital. The right-hand side graph presents the p-value for the differences in the ratios under the null hypothesis that the ratios are the same for the two types of households. I followed the same sample selection criteria as Balboni et al. (2022b).

Figure 9: Capital-Labor Ratios: Households Above vs. Below the Capital Threshold in the 1st S.W. (only households with strictly positive capital assets in the 5th survey wave.)



The left-hand side graph shows the average capital-to-labor input ratios for each survey wave, for households with higher and lower initial capital, respectively. The observations are separated by households above and below the capital threshold in the first survey wave. The upper line represents households with higher initial capital, while the lower line represents households with lower initial capital. The right-hand side graph presents the p-value for the differences in the ratios under the null hypothesis that the ratios are the same for the two types of households. I followed the same sample selection criteria as Balboni et al. (2022b). In addition, I removed households without strictly positive capital assets in the 5th survey wave.

Figure 10: Sensitivity Check in Capital-Labor Ratios: Households Above vs. Below the Capital Threshold in the 1st S.W. (510 hours are reduced for households above the capital threshold.)



The graph present the p-value for the differences in the ratios under the null hypothesis that the ratios are the same for the two types of households. For households with enough initial capital, 510 hours are reduced from worked hours. I followed the same sample selection criteria as Balboni et al. (2022b).

D Numerical Example

This appendix presents a numerical example to illustrate that the model's framework can rationalize observed differences in steady-state capital and labor as outcomes of differing bargaining power. The calibration exercise uses data corresponding to the 5th survey waves, assuming these represent steady states for two groups of households with and without sufficient initial capital. I utilized Quant Econ Julia textbook (Perla et al., 2023) to improve the Julia coding.

D.0.1 Simple Calibration

The utility functions are specified as:

$$v^a(T-h^a) = \gamma^a ln(T-h^a), v^b(T-h^a) = \gamma^b ln(T-h^a),\ (\gamma^a < \gamma^b \in (0,\infty))$$
$$f(k, h^a + \bar{h^b}) = Ak^\alpha (h^a + \bar{h^b})^{1-\alpha}$$

Utilizing the FOCs, the Bellman equation can be simplified as follows.

$$\begin{aligned} V(k_t) = \max_{h_t^a \geq 0} \Bigg\{ & ln\left(\frac{f_2(k_t, \bar{h^b} + h_t^a)(T-h_t^a)}{\mu\gamma^a + (1-\mu)\gamma^b}\right) + (\mu\gamma^a(1-\mu)\gamma^b) ln(T-h_t^a) \\ & +\beta V\left(f(k_t, \bar{h^b} + h_t^a) + (1-\delta)k_t - \frac{f_2(k_t, h_t^a + \bar{h^b})(T-h_t^a)}{\mu\gamma^a + (1-\mu)\gamma^b}\right)\Bigg\} \end{aligned}$$

The calibration procedures are outlined next. The goal is to show that the observed multiple steady states can be consistent with a change in the female bargaining power μ. To this end, all parameters other than μ are held constant for households with and without sufficient initial capital. This aligns with the poverty trap mechanism where households differ primarily in capital and bargaining powers.

First, the chosen parameter values are introduced as follows.

Table 1: Calibrated Parameter Values

Parameter	Value	Note
β	0.626	Annual discount factor. Implies a high annual discount rate ($\approx 59.7\%$).
A	1	Total factor productivity (normalization).
δ	0	Capital depreciation rate. Zero depreciation is assumed for this calibration.
α	0.333	Capital share in production.
T	2400	Wife's total time endowment (hours per year).
$\bar{h^b}$	2400	Husband's fixed labor supply (hours per year).

Then, by assuming that the 5th survey wave data represent steady states, FOCs in the steady state are utilized to determine the preference parameters γ^a and γ^b for given bargaining powers μ^* and μ^{**}.

$$\begin{cases} \mu^{**}\gamma^a + (1-\mu^{**})\gamma^b = \dfrac{(1-\alpha)(k^{**})^{\alpha}(h^{a**}+\bar{h^b})^{-\alpha}(T-h^{a**})}{k^{**\alpha}(h^{a**}+\bar{h^b})^{1-\alpha}} \\ \mu^{*}\gamma^a + (1-\mu^{*})\gamma^b = \dfrac{(1-\alpha)(k^{*})^{\alpha}(h^{a*}+\bar{h^b})^{-\alpha}(T-h^{a*})}{k^{*\alpha}(h^{a*}+\bar{h^b})^{1-\alpha}} \end{cases}$$

Note that variables with one star $(*)$ denote the lower steady state, and those with two stars $(**)$ denote the higher steady state.

It is further assumed that $\mu^* = 0.4$ and $\mu^{**} = 0.6$. These values are comparable to estimations by Calvi (2020). Replacing k^{**}, h^{a**}, k^*, and h^{a*} with the average capital and labor supply for households with and without sufficient initial capital (from the 5th survey wave), the conditions above yield $\gamma^a = 0.181$ and $\gamma^b = 0.341$. This implies that the husband's utility weight for the wife's leisure is almost twice that of the wife's ($\gamma^b/\gamma^a \approx 1.88$), consistent with Assumption 1. The results are summarized as follows.

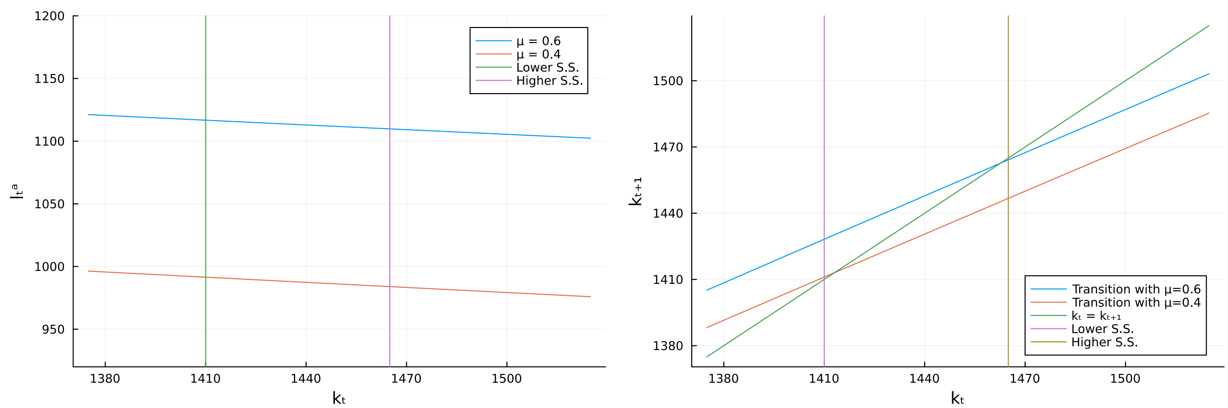
Table 2: Steady-State Values and Calibrated Parameters

Household Group (Initial Capital)	Mean k_5	Mean h_5^a	μ	γ^a	γ^b
Below Threshold (Lower S.S.)	1378.38	991.04	0.4	0.181	0.341
Above Threshold (Higher S.S.)	1501.13	1110.88	0.6	0.181	0.341

The numerical solution is illustrated in Figure 11. The left panel shows the wife's labor supply as a function of capital, and the right panel shows the capital transition equation, for each of the two specified bargaining power levels.

This difference in bargaining power ($\mu = 0.4$ vs. $\mu = 0.6$) is shown to be consistent with the two distinct steady states observed in the data. This exercise illustrates that the model can rationalize divergent long-run outcomes based on variations in intra-household bargaining power.

Figure 11: Numerical Calculation: Labor Input of Women (Left Panel) and Capital Transition Equation (Right Panel) for Fixed Bargaining Powers



The left panel shows the calibrated wife's labor supply as a function of current capital for $\mu = 0.4$ and $\mu = 0.6$. The right panel shows the corresponding capital transition equations. These illustrate how different fixed bargaining powers lead to different steady states (intersections with the 45-degree line).