AGRICULTURAL HOUSEHOLD MODELS

I. MODEL BASICS

- Ag HH's in LDC's make joint decisions over:
  - Consumption
  - Production
  - Work (labor) allocation ⇔ leisure

AG. HH MODELS PROVIDE A FRAMEWORK FOR ANALYZING HH BEHAVIOR THAT INTEGRATES THESE THREE DECISIONS.

Key distinctions/points addressed by Ag. HH models

- Net selling vs. net buying households (for labor, production)
- Complete vs. incomplete markets
- Backward bending supply curves

Key Assumptions/Stylized Facts

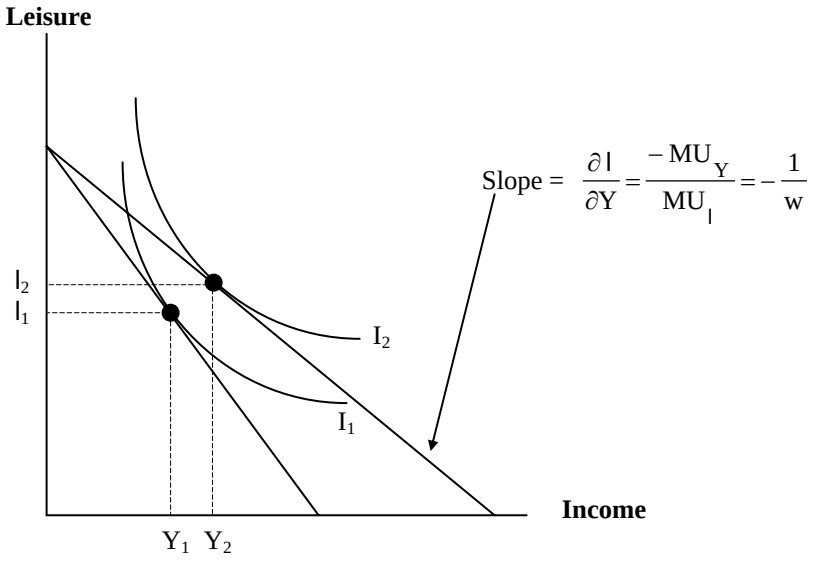
1. Leisure is better termed "home time." It includes:

- Family maintenance (cooking, cleaning)
- Reproduction (kid tending)
- Social obligations (religious, cultural stuff)
- Sleep
- Leisure

2. Unified decision-making (unanimity, consensus or dictatorship)

3. HH generally includes only those living in one "abode"

II. LEISURE-INCOME TRADEOFF



- An increase in returns to a unit of labor (implicit OR explicit wage) causes the income constraint $\overline{AB}$ to swivel out (to $\overline{AC}$).

- The optimum point moves from (l_1, y_1) to (l_2, y_2)

- As drawn, $l_2 > l_1 \Rightarrow$ **income effect** of increased wages **outweighs** the **substitution effect** (change in the opportunity cost of leisure)

$\Rightarrow$ BACKWARD BENDING LABOR SUPPLY

III. CHAYANOV MODEL

A. Features

- **Utility maximization**
- Product market but no labor market

⇒ Implicit wage = marg. rate of subst. between Y and leisure

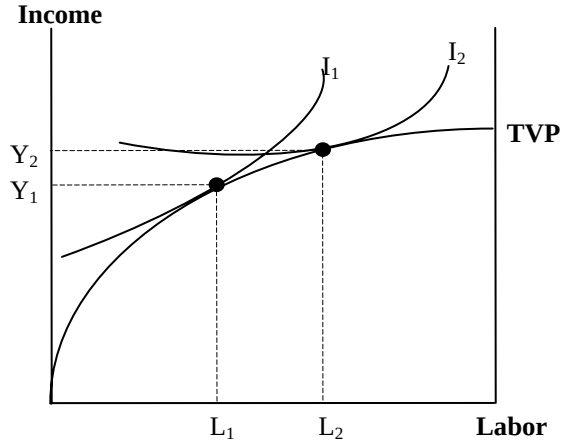
- Household trades off consumption against the disutility of labor (Ellis' "**drudgery averse**" peasant
- **Demographic factors** dominate outcome

B. The Model

Max U(Y, ℓ) subject to:

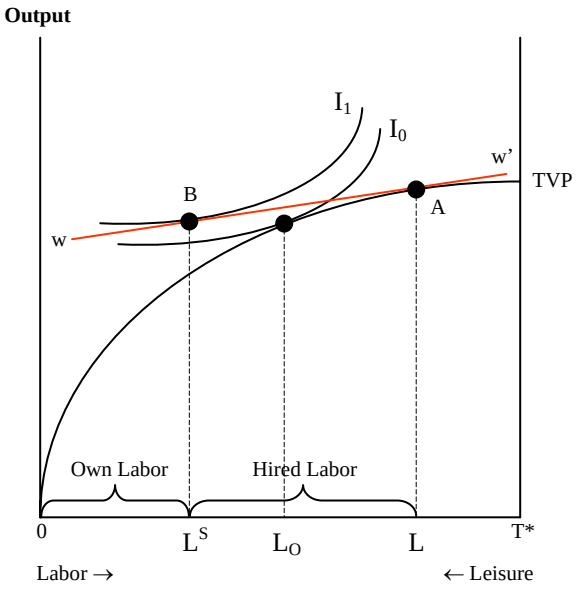
$Y = P \cdot f(L)$; $T^* = L + \ell$; $Y \geq Y_{MIN}$; $L \leq L_{MAX}$

Solution: $\frac{\partial U / \partial \ell}{\partial U / \partial Y} = Pf_L$ **⇔ subjective equilibrium**



$I_1 \rightarrow I_2$ follows from increase in HH size (w/o an increase in the # of workers per HH). That is: Y/cap. ↓⇒MU_Y↑⇒ subj. wage↓.
Need to feed more HH members⇒ HH more willing trade off more ℓ for an extra unit of Y ($I_1 \rightarrow I_2$)

CHAYANOV MODEL WITH LABOR MKT: NET BUYER OF LABOR

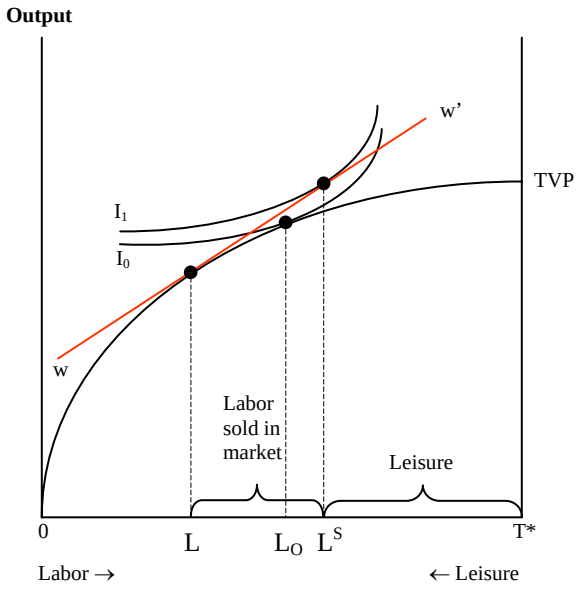


- Wage line (ww') = opportunity cost of family labor
  - The steeper the slope of ww', the higher the wage rate
  - **Here wages are relatively low (flat slope)**

- Production occurs at point A (where **MPL = W/P**), but the household works only at L^S and consumes leisure at point B (where **MRS = W/P**)
  - $L - L^S$ = amount of hired labor
  - $T^* - L^S$ = leisure

- There is an unambiguous improvement in welfare compared to the old situation of no labor market.
  - No labor mkt $\Rightarrow L^S = L_0$ and welfare is given by I_0 ($< I_1$).

CHAYANOV MODEL WITH LABOR MKT: NET SELLER OF LABOR



- Here ww' is relatively steep ⇒ high wage

- Farm production occurs at L (all HH labor)

- Off-farm labor = $L^S - L$.

- Leisure is less than previous situation because the wage is high

  ⇒ ***** **High Opportunity Cost of not working** *****

<u>BOTTOM LINE</u>:

Introducing a labor market renders consumption (of leisure) independent of production decision.

THE SEPARABLE AG. HOUSEHOLD MODEL (COMPLETE MARKETS)

NOTATION

C_F	=	Food consumption
C_{NF}	=	Non-food consumption
ℓ	=	Leisure
Q_F	=	Output
L	=	Labor used in production (both household labor and hired labor)
X	=	Other input used
T*	=	Total time available to the household
W	=	Wage rate
H	=	Household labor
P_i	=	Price of commodity i (i = F, NF, X)

I. The Constrained Utility Maximization Problem

Max $U(C_F, C_{NF}, \ell)$, subject to three constraints:

1. Production: $Q = f(L, X)$

2. Time: $T^* = H + \ell$

3. Full Income: $\underbrace{P_F(Q_F - C_F)}_{\text{mkt'd surplus}} + \underbrace{W(H - L)}_{\text{mkt'd labor}} = P_X X + P_{NF} C_{NF}$

mkt'd surplus: (+ if net seller, - if net buyer)

mkt'd labor: (+ if net seller, - if net buyer)

These three constraints can be combined into one "full income" constraint:

$$\underbrace{(P_F f(L, X) - P_X X - WL)}_{\text{Farm profit } (\pi^*)} + \underbrace{W \times T^*}_{\text{Full value of time}} = \pi^* + W \times T^* = P_F C_F + P_{NF} C_{NF} + W\ell$$

II. First Order Conditions

1. $\frac{\partial U}{\partial C_F} - \lambda P_F = 0$

2. $\frac{\partial U}{\partial C_{NF}} - \lambda P_{NF} = 0$

3. $\frac{\partial U}{\partial 1} - \lambda W = 0$

} **Marg. rate of subst. = price ratio for any two goods**

4. $\lambda\left[P_F \frac{\partial Q_F}{\partial L} - W\right] = 0$ $\Rightarrow$ **Value marginal product of labor = wage**

5. $\lambda\left[P_F \frac{\partial Q_F}{\partial X} - P_X\right] = 0$ $\Rightarrow$ **Value marginal product of input x = P_X**

6. $\pi^* + WT^* = P_F C_F + P_{NF} C_{NF} + W\ell$: **Full income constraint**

Key Points

1. Production decisions over X and L affect consumption decisions via farm profits (π^*) in the full income constraint.
2. Consumption decisions **do not affect** production decisions. In other words, production is independent of (**separable** from) household preferences and income.
3. In the Chayanov model, effect of income on production was ambiguous – HH might choose more leisure/less output when returns ↑. The **key difference** here is that the **existence of a labor market** means the household can now maximize profit using hired labor while still taking increased leisure.

III. Comparative Statics

A. Food Demand

At the optimum, $C_F = C_F(P_F, P_{NF}, W, P_X, Y^*)$

where $Y^* = P_F Q_F^* - P_X X^* - WL^* + WT^*$

*** DEMAND DEPENDS ON PRICES AND INCOME AS USUAL, BUT PRICES NOW HAVE AN ADDED EFFECT ON INCOME VIA PROFITS**

To see this, totally differentiate C_F w.r.t. P_F:

$$\frac{\partial C_F}{\partial P_F} = \underbrace{\left.\frac{\partial C_F}{\partial P_F}\right|_{\pi^* \text{ constant}}}_{\text{Standard Slutsky Equation}} + \underbrace{\frac{\partial C_F}{\partial Y^*} \cdot \frac{\partial Y^*}{\partial P_F}}_{\text{“Profit Effect”}}$$

$$= \underbrace{\left.\frac{\partial C_F}{\partial P_F}\right|_{U \text{ constant}}}_{<\,0} + \underbrace{(Q_F - C_F)}_{\text{MS (+ or -)}} \underbrace{\frac{\partial C_F}{\partial Y^*}}_{>0}$$

Elasticity form: $\varepsilon_P = \varepsilon^{HICKS} + [P_F(Q_F - C_F)/Y^*]\eta_F$

Points

(1) If HH is net buyer of food, then dC/dP is always negative.

(2) **Profit effect** at least **reduces** the usual **negative relationship**.

(3) If marketed surplus is large enough, then $\frac{\partial C_F}{\partial P_F}$ may actually turn positive (**especially if income elasticity is large**)

B. Leisure Demand

At the optimum, $\ell = \ell(P_F, P_{NF}, W, P_X, Y^*)$

Totally differentiating C_F w.r.t. P_F:

$$\frac{\partial \ell}{\partial W} = \underbrace{\frac{\partial \ell}{\partial W}\bigg|_{\Delta\pi^* = 0}}_{\text{Standard Slutsky Equation}} + \underbrace{\frac{\partial \ell}{\partial Y^*} \cdot \frac{\partial Y^*}{\partial W}}_{\text{"Profit Effect"}} = \frac{\partial \ell}{\partial W}\bigg|_{\Delta\pi^* = 0} + \frac{\partial \ell}{\partial Y^*} \cdot (T^* - L)$$

$$= \frac{\partial \ell}{\partial W}\bigg|_{\Delta U = 0} - \frac{\partial \ell}{\partial Y^*} \cdot \ell + \frac{\partial \ell}{\partial Y^*} \cdot (T^* - L)$$

$$= \underbrace{\frac{\partial \ell}{\partial W}\bigg|_{\Delta U = 0}}_{< 0} + \underbrace{(H - L) \cdot \frac{\partial \ell}{\partial Y^*}}_{\substack{\text{mkt'd surplus} \\ (+ \text{ or } -)}} \underbrace{\quad}_{>0} \quad \textbf{[Note: } T^* = H + \ell \Rightarrow T^* - \ell = H\textbf{]}$$

<u>Points</u>

1. $H - L < 0 \Rightarrow$ Net purchaser of labor

   $\Rightarrow \frac{\partial \ell}{\partial W}$ is unambiguously negative.

2. However, if $H - L > 0 \Rightarrow$ Net seller of labor (e.g., landless)

   $\Rightarrow \frac{\partial \ell}{\partial W}$ **may be positive (depends on the size of income elast., m.s)**

C. Marketed Surplus

Start with the basic identity:

$$\mathbf{M = Q_F - C_F}$$

Totally differentiating:

$$\frac{dM}{dP_F} = \frac{dQ_F}{dP_F} - \frac{dC_F}{dP_F}$$

$$= \underbrace{\frac{dQ_F}{dP_F} - \left.\frac{\partial C_F}{\partial P_F}\right|_{\Delta U=0}}_{>0} - \underbrace{(Q_F - C_F)}_{+ \text{ or } -} \underbrace{\frac{\partial C_F}{\partial Y^*}}_{>0}$$

- **If M (= $Q_F - C_F$) is large enough, then the household's consumption response may outweigh its output response**

⇒ marketed surplus may actually <u>fall</u> when price increases

IV. Advantages of Ag. Household Models

1. **Key empirical distinction** of agricultural household models is that they **account for the profit effect**

- Affects demands for all sorts of commodities (including non-agricultural ones) and labor supply via **cross price effects**.

- Potentially important for **policy** design and assessing the impact of policies (e.g., price policies)

- **Where profit effects are greatest**

➢ When profits are a **large share of total income**

➢ For commodities having relatively **large income elasticities**.

2. **Explicit linkage of production and consumption** points out relationships ignored in standard models

- Ag. household model $\Rightarrow$ **W, price of inputs should be in the demand functions.**

3. **Ag household models are best used when:**

- Profit effects expected to be large
- Profits are large share of income
- Income elasticities are relatively high
- No market failures (or limited ones)

V. Extensions

A. Multiple crops

- Accommodates policy questions regarding export vs. food crop interventions (e.g., taxes, price policies).

- Accommodates differences in input usage across crops (e.g., fertilizer)

- Note that price policies for one crop will affect production of other crops

B. Nutrition

- Modify model by adding set of relationships between consumption goods (foods) and nutrients or calories

  $\Rightarrow$ **Response of nutrients or calorie intake to price changes**

C. Health

- Related to nutrition
- Health production function: $H = H(C_F, C_{NF}, \ell$, other stuff)
- May affect production function (e.g., efficiency wages)

D. Intertemporal models

- Storage (e.g, my stuff, Saha's extension)
- Borrowing

EMPIRICAL RESULTS OF INTEREST TO POLICY MAKERS

1. Lower market supply response when profit effects are considered

2. Price policy (or technological change) boosts Labor demand AND tends to lessen labor supply (Singh, Squire, and Strauss, Table 1.5), which is good for landless and smallholders (since it puts upward pressure on wages)

3. Demand for non-agricultural goods more strongly affected by an increase in the price of food (because the income elasticity of nonfood is usually greater than that of food).

THE NON-SEPARABLE AG HOUSEHOLD MODEL (MISSING MARKETS)

I. NON-SEPARABLE MODELS

When one or more market is "incomplete" then **recursiveness breaks down ⇒ consumption variables determine production**

Sources of non-separability

- **Transactions costs**
  - Distance to market
  - High transport costs
  - Excessive mkting margins (e.g., traders w/ monopoly power)

- **Thin markets**
  - Covariate production,
  - Isolated or remote markets
  - Not alot of buyers and sellers

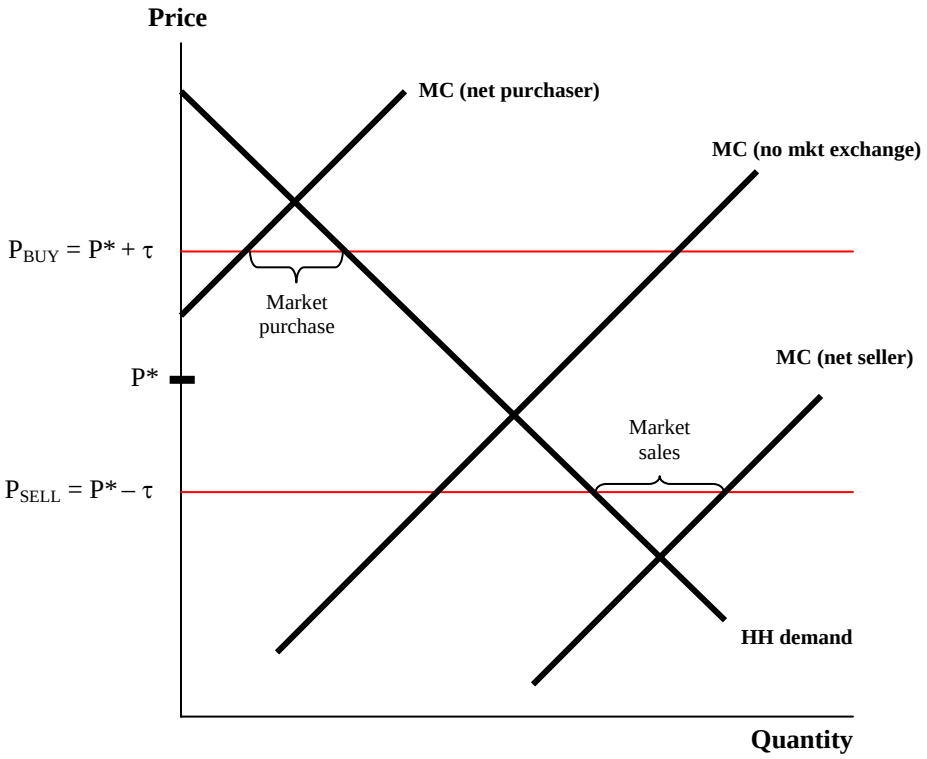
- **Risk & risk aversion**

Market Failure (deJanvry, Fafchamps & Sadoulet)

Definition: **A market fails when the cost of a transaction through market exchange creates disutility greater than the utility gain that it produces, such that no market transaction occurs**

- Non-existence of a market is an extreme case of mkt failure
- More commonly, a market exists but some households won't participate (because gains < cost)
- **Market failure is household specific** (not commodity specific)

The Price Band Picture



- P_{BUY} and P_{SELL} are the boundaries of the household's **price band** (depicted by the red lines).

- If the households marginal cost (supply) curve crosses its demand curve within the price band, then the household does not participate in the market.

- If the households marginal cost (supply) curve crosses its demand curve above the price band, then the household is a net purchaser.

- If the households marginal cost (supply) curve crosses its demand curve above the price band, then the household is a net purchaser.

Price Bands

Width depends on:

1. Transport costs
2. Markups by merchants
3. Opp. costs of time involved in transactions (e.g., search)
4. Risks associated with uncertain prices/availability of goods (i.e., **certainty equivalent prices less than mkt price**).

⇒ Price band widens with:

1. Poorer infrastructure
2. Less competitive marketing system
3. Poorer information flow
4. Greater price risk.

For a given width price band

- **Net Buyer Household** is more likely to stay **above** the price band as supply fluctuates the more elastic its demand.

- **Net Seller Household** is more likely to stay **below** the price band as demand fluctuates the more elastic its supply.

In remote markets with covariate production risk, price bands move w/ supply shift such that HHs tend to stay self-sufficient

- Positive supply shift ⇒ band moves down ⇒ HH doesn't become net seller
- Negative supply shift ⇒ band moves up ⇒ HH doesn't become net seller

THE WORLD ACCORDING TO OMAMO

Maximization problem:

Max $U(C_F, C_{NF}, \ell)$

s.t. $(P_F \pm \tau)M_F + W(H - L) = (P_{NF} \pm \tau)C_{NF} + P_X X$

Solution for net seller:

$$U_F = \lambda\left[P_F - \tau\right] \quad \Rightarrow \text{ if } \tau\uparrow \text{ then } U_F\downarrow \Rightarrow C_F\uparrow$$

$$\left[P_F - \tau\right]\frac{\partial Q_F}{\partial L} = w \quad \Rightarrow \text{ if } \tau\uparrow \text{ then } \frac{\partial Q_F}{\partial L}\uparrow \Rightarrow Q_F\downarrow$$

Solution for net buyer:

$$U_F = \lambda\left[P_F + \tau\right] \quad \Rightarrow \text{ if } \tau\uparrow \text{ then } U_F\uparrow \Rightarrow C_F\downarrow$$

$$\left[P_F + \tau\right]\frac{\partial Q_F}{\partial L} = w \quad \Rightarrow \text{ if } \tau\uparrow \text{ then } \frac{\partial Q_F}{\partial L}\downarrow \Rightarrow Q_F\uparrow$$

BOTTOM LINES

1. **In both instances, increased transactions costs drive household toward autarky**

2. **Given no changes in production technology or land available, increasing food production means de-emphasizing cash crop production**

DEJANVRY, FAFCHAMPS, AND SADOULET: "MISSING MARKETS AND PEASANT BEHAVIOR: SOME PARADOXES EXPLAINED"

I. MOTIVATION

Peasant gripe: Scarcities of either household labor and food are the norm ➔ "Labor is short when weather is good"

➔ "Food is scarce when weather is bad"

Gov't gripe: Peasants are unresponsive to price incentives and to technological opportunities in cash crop production

[*Note:* This issue is framed so that it is more relevant to Africa than Asia**]**

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EXPLANATION = "MARKET FAILURE"
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II. Simulation Results (assumes 2 goods, food and other)

A. Change in the price of cash crops

- Small increase in cash crop output if no markets for food because household has to maintain its own food supply (***Evidence:*** low cash crop supply elasticities in Africa)

- Increases in spending on manufactured goods and fertilizer in the "no markets" case because there's nothing else to spend money on.

- shadow prices of food and labor increase alot without markets because farmers perceive more serious labor & food scarcities than external (e.g., government) viewers

B. Increase in the price of manufactured good

- With market failure there's less incentive to generate cash ➔ grow more food, less cash crop

- "Devalorises" cash income

C. Monetary head tax

- Much more severe negative impact on monetized (mkt) goods consumption

- Production of cash crop increases when no food or labor markets exist

D. Productivity gains in food crops (i.e., technical change)

(1) No market failure

- Substitute from cash crop to food crop production
- MPL ↑ ➔ more labor used
- Y ↑ ➔ more leisure, more hiring in of labor, more consumption

(2) Market failure

- Less resources (esp. labor) needed to produce food for the family
- This frees up resources for cash crop production

E. Conclusion

- Opening markets for food will lead to more emphasis on food crop production
- Interplay between market access, technology adoption and cash crop production.