Agricultural Organization in Developing Countries

- Occupies a key place in the economy of developing countries

- According to the UNDP in 1996 agriculture employed
  - 60% of the labour force while contributing 20% of GDP of LDCs
  - 2% of the labour force while contributing 2 % of GDP of DCs

- The first fact implies that in agriculture in LDCs is relatively less productive with respect to non-agriculture (employs 40% of labour, contributes 80% of GDP)

- The two facts together imply that agriculture in LDCs is also relatively less productive with respect to agriculture in DCs

- Yet it provides the livelihood of a majority of people in LDCs

- Backward technology, infrastructure, "bad policies" one sets of reasons (but they afflict other sectors too)

- Missing markets, transactions costs, and inefficiencies of agricultural organization another set.

- Key stylized facts:

  - Small farms are more productive than large farms - inverse farm-size productivity relationship (Berry & Cline, 1979)

  - Sharecropping is an important form of agricultural organization, even though it is less productive than owner-cultivation or fixed rent tenancy

- These two facts would seem to suggest that land reform - other than promoting equity - can also raise productivity

- Indeed, there is some evidence that land reform, tenancy reform policies have improved productivity

- One explanation for the first fact is diminishing returns to land

- But land market should take care of it.
- One explanation for the second fact is agency costs
- But once again, why does not the land market get rid of these inefficiencies?

Endowments Matter only with Market Imperfections - A Simple Demonstration

- Consider a producer
  - Values consumption and leisure $u(c, l)$
  - has some land and labour endowments $\overline{L}, \overline{T}$ and production technology $y = f(L, T)$
- Wage rate is w and rental rate is r
- His profits are $\pi = y - wL - rT$

- His problem is:

$$\max_{c,l} u(c, l)$$

subject to

$$c = \pi + w\left(\overline{L} - l\right) + r\overline{T}$$

or,

$$c + wl = f(L, T) - wL - rT + w\overline{L} + r\overline{T}.$$

- Notice right away that in his choice of L and T his preferences or endowments do not matter

- Could hire in labour or hire out, same for land

- Separation of profit maximizing behaviour as producer, and utility maximizing behaviour as consumer

- If this breaks down, then farms with lower $\overline{T}$ will have different productivity than farms with large $\overline{T}$

- With frictionless markets, factors will be efficiently allocated and farm sizes will adjust endogenously

- What creates frictions in the land or labour markets?
- Agency costs (arising from informational problems) and transactions costs (arising from problem of commitment and enforcement)
- Also, this suggests viewing agricultural organization as a response to deal with these problems
- Key questions
  - What drives choice of agricultural organization/contracts?
  - Does it affect productivity?
  - If it does, why doesn't everyone choose the most efficient organization?

Model 1: Principal-Agent Model with Limited Liability (Banerjee, Gertler, Ghatak, JPE 2002)

- Both landlord and tenant risk neutral
- Output is high ($Y = 1$) or low($Y = 0$) .
- The probability of high output is the effort supplied by tenant, e, at a cost $c(e) = e^2/2$.
- Effort is unobservable and hence non-contractible.
- The tenant has no wealth

- Minimum consumption constraint of $\underline{w} \geq 0$ every period.

- The agent has a reservation payoff $\overline{u} \geq 0$

- The principal must earn a non-negative payoff.

First-best (effort contractible)

- Solve

$$\max_{e} \pi e - \frac{1}{2} e^2.$$

  - effort: $e = \pi$.

– expected joint surplus: $\pi^2 - \frac{1}{2}\pi^2 = \frac{1}{2}\pi^2$.

Second best (effort non-contractible)

- Two outcomes so a contract can be described by two components w (fixed wage) & b (bonus)

- Principal solves:

$$\max_{b,w} u^p = (\pi - b)\, e - w$$

subject to:

– *limited liability constraint* (LLC):

$$b + w \geq \underline{w}, w \geq \underline{w}.$$

– *participation constraint* (PC):

$$u^a = eb + w - \frac{1}{2}e^2 \geq \overline{u}.$$

– *incentive-compatibility constraint* (ICC):

$$e = \arg \max_{e \in [0,1]} \left(eb + w - \frac{1}{2}e^2 \right) = b.$$

- Can achieve first-best by setting $b = \pi$ but that implies non-positive expected profits as $\underline{w} \geq 0$.

- Trade-off between efficiency (setting b high) and rent extraction (setting b low).

- If agent had wealth or limited liability constraint was absent, the principal could have "sold off" the firm to the agent by setting $b = \pi$ & $w = \overline{u} - \frac{1}{2}\pi^2 < 0$.

- So set w as low as possible (no risk-sharing issues), i.e., $w = \underline{w}$ and choose b to balance incentive provision & rent extraction.

- Case 1 (PC does not bind as $\overline{u}$ low)
  - Principal maximizes $(\pi - b)b - \underline{w}$
  - Bonus is $b^* = \frac{\pi}{2}$

- Case 2 (PC binds as $\overline{u}$ high)

- Agent's binding PC: $\frac{1}{2}b^2 + \underline{w} = \overline{u}$.
- Yields $b^* = \sqrt{2\left(\overline{u} - \underline{w}\right)}$

- Figure displays b and expected joint surplus (S) against reservation payoff.

- Bonus first flat (reservation payoff low, PC doesn't bind) and then increases with $\overline{u}$.

- Implications: contractual choice is driven by tenant's outside option (more generally, wealth as well)

- Fixed rent tenancy is associated with highest productivity, but its not in the landlord's interest to choose

- Tension between rent extraction & incentive provision because of the presence of moral hazard & limited liability

- Policy implications: land reform or tenancy reform can improve productivity without any technological change.

Model 2: Principal-Agent Model with Risk-Sharing & Incentive Provision Trade off (Stiglitz, 1974)

- Output q is determined by effort (e) & a random shock (ε) which has zero mean & variance σ^2

$$q = e + \varepsilon.$$

- The landlord is risk-neutral & the tenant is risk-averse with the following mean-variance utility function defined over his income y:

$$U(y) = E(y) - \frac{r_T}{2} Var(y)$$

- As in the previous model the disutility of effort is $\frac{1}{2}ce^2$.

- Also, as before, the landlord cannot observe e but now there are no wealth constraints or limited liability

- Focus on linear contracts: tenant gets paid

$$y = sq - R$$

where s is share of output & R a fixed rent component (if > 0) or a fixed wage component (if < 0)

- The incentive-compatibility constraint:

$$e = \arg\max\{U(y) - \frac{1}{2}ce^2\}.$$

- As $E(y) = E[sq - R] = se - R$ & $Var(y) = Var(sq - R) = s^2 Var(q) = s^2\sigma^2$ we get

$$\begin{aligned} e &= \arg\max_e \left\{ se - R - \frac{r_T}{2} s^2\sigma^2 - \frac{1}{2} ce^2 \right\} \\ &= \frac{s}{c}. \end{aligned}$$

- Knowing this, landlord maximizes

$$E((1-s)q + R) = \frac{s(1-s)}{c} + R$$

subject to the participation constraint (PC) of the tenant

$$se - R - \frac{r_T}{2} s^2\sigma^2 - \frac{1}{2} ce^2 \geq u$$

- Using the ICC we can simplify this to

$$\frac{s^2}{2c} - R - \frac{r_T}{2} s^2 \sigma^2 \geq u.$$

- Since there are no limited liability constraints, the PC will bind & we can substitute

$$R = \frac{s^2}{2c} - \frac{r_T}{2} s^2 \sigma^2 - u$$

into the objective function & maximizes with respect to s

$$\frac{s(1-s)}{c} + \frac{s^2}{2c} - \frac{r_T}{2} s^2 \sigma^2 - u$$

- This yields the first-order condition:

$$\frac{1-2s}{c}+\frac{s}{c}-r_T s\sigma^2=0$$

which yields

$$s^*=\frac{1}{1+cr_T\sigma^2}<1.$$

- **Implication 1**: The higher is the risk-aversion of the tenant the lower is the share. Risk neutral tenants ($r_T=0$) get fixed rent contracts ($s=1$).

- **Implication 2**: More risky crops (high σ^2) are more likely to be cultivated under sharecropping.

- **Implication 3**: As $s < 1$ effort is less than the first-best level. Share-cropped plots of land would be less productive than those under fixed rental tenancy.

- **Corollary to Implication 3**: If due to land or tenancy reform the landlord is eliminated from the scene, productivity will go up. However, note that:

  - If the landlord is eliminated the tenant's welfare will in fact go down since he is effectively buying insurance from the landlord & so if given the opportunity, would want to continue to buy insurance from the landlord or someone else.

  - This is in contrast to the previous model where eliminating the landlord will improve effort (like here) but also make the tenant better off (unlike here)

- More general point: sometimes people loosely say sharecropping is inefficient.

- Economists interpret efficiency in the Pareto-sense: something is inefficient if someone could be made better off without making the other person worse off.

- In both the models we saw, sharecropping emerges when we maximize the landlord's expected payoff subject to providing the tenant with a given level of payoff

- But then by construction they are Pareto-efficient

- However, because of incentive problems due to lack of perfect monitoring, the allocation is *constrained* Pareto-efficient

- Still, no policy maker can make one party better off without making the other worse off.

- However, you can raise productivity & make one party better off (model 1) - we know the other party must be worse off in this case

Other Theoretical Issues

- Dynamic issues
  - It is possible to improve efficiency using dynamic contracting
  - One simple story (see Banerjee, Gertler, Ghatak, 2002) is an efficiency-wage like story
  - If the tenant's reservation payoff is very low, he earns rents
  - That means firing threats if output is low can be added as an incentive device

- Investment Incentives
  - Suppose investment is contractible, i.e., something like an irrigation equipment
  - To the extent it is complementary with e, it will be under-supplied (even if the landlord has enough money) because e is undersupplied
  - Suppose investment is non-contractible (say, care & maintenance of land)
  - Then an additional argument in favour of sharecropping - under fixed rent, tenant will over-exploit the land (multi-tasking argument - otherwise fixed wage the best)
  - Also, now eviction threats can harm investment incentives by raising the tenant's effective discount rate

- Alternative Models of Agricultural Organization:
  - Pure risk sharing: both landlord & tenant are risk averse & there is no moral hazard (Cheung, 1969)
  - No direct implication for productivity under sharecropping but other predictions similar to model 2
  - Partnership or double moral hazard: both landlord & tenant provide unobservable inputs & sharecropping gives both parties incentives as opposed to just one (Eswaran & Kotwal, 1984)

Evidence

Key Empirical Questions

- How much does contractual structure affect productivity?
  - E.g. if we see sharecropping instead of owner cultivation, how much of output is potentially lost due to the agency problems?
- What drives contractual choice? Is it the need to share risk, or to give incentives? Which form of transactions costs drives this?
  - E.g. is it true that riskier crops are associated with sharecropping, or that wealthier tenants receive a higher crop share?

Some Empirical Issues

- "Productivity in plot A owned by landlord 1, cultivated by tenant 1 under a fixed rent contract is higher than that of plot B owned by landlord 2, cultivated by tenant 2 under a sharecropping contract" tells us little about the productivity loss associated with sharecropping.

- If we make a comparison such as above, unobserved heterogeneity is important.
  - Need to control for type of farmer (better farmers may choose fixed rent contracts & worse farmers sharecropping).
  - Control for land quality - better quality lands are likely to be owner-cultivated.

- Think in terms of program evaluation:
  - sharecropping is the program, sharecroppers are the treatment group & farmers under fixed rent or owner cultivation are the control group.
  - Endogenous program placement & self-selection of individuals into programs are the key issues.

- Endogenous matching of landlord & tenant.
- More risk averse tenants are likely to match with landlords whose plots are good for safe crops
- Then share of tenant will be found to be increasing in the riskiness of the crop,
- Seemingly contradicts the risk-sharing or risk-sharing vs. incentives model (Dean & Lueck, 1992)
- Biases estimates. Need good instruments.

Shaban (JPE 1987)

- Compares the productivity of sharecropped land with that of the same tenant's self-cultivated land for the same crop, in the same village.
- This controls for ability of the tenant, the technology & the weather as well as forms the right benchmark for comparing efficiency.
- An important issue here is to control for land quality as well.
- Study of 8 Indian villages from the ICRISSAT Dataset

- From each village 40 households selected over several years (30 cultivating & 10 labor households).

- Cropwise information on

  - (a) inputs : family male/female labor, hired male/female labor, bullock pair labor, seed, fertilizer, other inputs (value of pesticide, manure, cost of fuel for irrigation equipment). Labor inputs are measured as hours per acre. The rest are measured as Rs. per acre.

  - (b) output : Measured as Rs. per acre

  - (c) plot characteristics : irrigated area, plot value (100 Rs. per acre), shallow/medium & deep/poor/other soil).

- He does not have data on contracts.
  - Notes that contracts are the same within the village but vary across villages.
  - In all villages landlord provides land only & tenant provides all bullock & family labor.
  - In all villages output is shared equally.
  - In some villages, cost of all other inputs is borne fully by tenant (villages A,C,F), in some it is shared equally (village B) , in some villages costs of some items are shared (fertilizer, seed, hired labor) & not others (other) (Villages D,E).
- Tenancy is not that widespread - more than 75% of households are owner-cultivators. About 15% of them are mixed sharecroppers-owner cultivators.

- Econometric specification
  - For simplicity assume each household has one sharecropped plot & one owner-operated plot.
  - In practice they could have several of each, & Shaban takes a weighted average with the weights reflecting relative plot size.
  - Also, assume that the data are for one year only. In practice it is for several years, & Shaban averages this.

- For the sharecropped plot the specification for the variable x of interest (input intensity or productivity) is

$$x_h^s = \alpha_h + \sum_j \beta_j D_{hj}^s + \gamma_s E_h + \eta_h$$

  - α_h is household specific intercept & E_h is a village dummy
  - D_{hj}^s capture various land quality measures relating to the sharecropped plot such as plot value, soil quality, irrigation status.
  - If data were for one period only, having both a village and a household intercept would be superfluous.
  - Shaban puts in both since he observes the same household over time & this allows him to control for the average (over time) productivity of a household as well as village fixed effects

- For the owner-operated plot the specification for the variable x of interest (input intensity or productivity) is

$$x_h^o = \alpha_h + \sum_j \beta_j D_{hj} + \gamma_o E_h + \varepsilon_h$$

  - α_h & E_h as before

  - D_{hj}^o capture various land quality measures relating to the owned plot such as plot value, soil quality, irrigation status.

- Taking differences,

$$x_h^o - x_h^s = \sum_j \beta_j (D_{hj}^o - D_{hj}^s) + \theta E_h + \upsilon_h.$$

- Common household specific term taken out.

- Common village-specific term that affect both sharecropped & owner operated plots (e.g. quality of land, public goods) taken out.

- Coefficient $\theta \equiv \gamma_o - \gamma_s$: degree to which average productivity differences between sharecropped & owned plots of villagers in village A differ from the corresponding thing for village B.

- Difference in Differences.

- The idea is: contracts vary across villages but not within. Also they are fixed over time. Therefore, θ is picking up this contract specific effect.

- Ideally we would want plot-wise contract information here.

Results

1. First the sample is restricted to owned & sharecropped plots of 352 households who are mixed sharecroppers.

    - Vector of mean differences are significantly different from 0.
    - With land quality & tenant quality held constant, village dummies capture the pure effect of sharecropping.
    - These effects explain 16% of output differences.
    - Among other factors, irrigation status is important (40%).
    - Among inputs, the effect of tenancy on family & bullock labor is particularly significant - these are the inputs whose costs are fully borne by sharecroppers in all villages.

2. Mixed sharecropper for single crop (sorghum) - 76 households.

   - One problem with the previous analysis is that it does not control for the type of the crop
   - Mixed tenants could be growing different crops in plots that also vary in tenure status.
   - Runs the same regression with respect to a single crop (sorghum).
   - Again the vector of mean differences is significantly positive except for hired female labor.
   - Their decomposition shows that tenure status is responsible for 27% of the output difference.

3. Mixed tenant - 90 households.

   - Could argue that the previous results are not due to sharecropping per se, but tenancy in general.

   - In particular, given tenancy legislation all contracts are short-term & these could lead to lower investment & due to complementarity, lower input-intensity.

   - To test this Shaban takes owner cum fixed rent tenants only.

   - The results show that mean differences are not significantly different from zero & the effect of tenancy is not significantly different from zero in seven out of eight inputs & output.

Criticisms

- Tenant ability is taken care of in a linear additive way.
  - Suppose tenant ability affects not only intercept but also slopes of production functions in owned & sharecropped plots.
  - Will cause a greater dispersion in productivity between own land & sharecropped land (compared to if we could measure & control for ability)
  - Now it is possible a village dummy is partly capturing the average ability of tenants there & so what it is picking up in the regressions is not the pure effect of moral hazard but also the effect of tenant ability on first-differences (as ability is hard to measure, this too is a valid but not devastating criticism).

- There could be fixed village characteristics other than contractual structure which could explain the difference in productivity between a person's own land and sharecropped land.
  - For instance it could reflect lower *unmeasured* land-quality of sharecropped lands (again, he since he does use several measures of land quality, this is not a very strong criticism)

Tenancy Reform in West Bengal, India (Banerjee, Gertler & Ghatak, JPE 2002)

- Quasi Natural Experiment
  - A Left-Wing administration came to power in the Indian state of West Bengal in 1977
  - Decided to implement existing tenancy laws rigorously - Operation Barga (OB)
  - Offers opportunity to directly measure productivity effect of tenancy reform
- Not land redistribution.

  - Instead, increased tenant bargaining power (improves outside option) & limited eviction rights of landlord.

  - So long as tenant pays 25% rent to landlord, cannot be evicted (earlier share was mostly 50%)

- Bargaining power effect - should raise share & effort

- Security of tenure effect

  - To the extent landlord uses eviction to enforce higher output, this could decrease effort

  - But investment incentives better (also because share & effort is higher)

- Survey done by authors indicates crop shares went up significantly

- Eviction threats were not widely used (only 12% of all tenants said yes)

- Two main empirical approaches based on district-wise data

1. Difference in difference approach using districts from neighboring country Bangladesh

    - Experienced similar agroclimatic/technological/market shocks but not this institutional reform

    - Controlling for year dummies & district fixed effects, did WB districts experience higher growth in the post OB period? See figure.

- Estimate:

$$\ln y_{dt} = \alpha_d + \psi_t + \beta * treatment_d * post_t + \sum_j \phi_j X_{jdt} + \varepsilon_{dt}.$$

- Adjusted difference in difference: control for as many observables as possible (irrigation, rainfall)

- Estimated productivity effect of OB is 52%

2. Exploiting inter-district variation in programme intensity within West Bengal

   - Registration rate

   - Assumption: these were driven bureaucratic factors uncorrelated with productivity

- However, could be partly driven by demand: areas that experiences positive productivity shock also experienced large demand for registration

- Also, the variation in registration rate could be correlated with other programmes (e.g., decentralization)

- Do not have good instruments (anything you can think of that drives registration, is also likely to be correlated with productivity shocks)

- Control for as many time-varying factors as possible (other than year dummies & district fixed effects) - public irrigation, roads, rainfall etc

- Estimate

$$\ln y_{dt} = \alpha_d + \psi_t + \gamma * r_{dt-1} + \sum_k \beta_k X_{kdt} + \varepsilon_{dt}.$$

- Estimated productivity effect of OB is 62%

- Productivity effects obtained are much larger than that of Shaban
  - Indirect effects of tenancy reform: land sales from landlords to tenants went up (landlordism became unprofitable)
  - Shaban does not take into account investment effect (after all he controls for land quality & if that is taken out his effect goes up to 33%)
  - Possibly capturing effect of some other omitted programmes

Ackerberg-Botticini (JPE, 2002)

- Motivation: matching of landlords characteristics and tenant characteristics endogenous
- For example, less risk averse tenants will prefer farming riskier crops
- Given this, correlation between crop type becomes hard to interpret
- For example, in many studies, it was found that riskier crops are farmed under fixed rent as opposed to sharecropping

- This was interpreted to mean that tenant risk aversion is not very important to explain contracts

- Could well be driven by endogenous matching

- Want to explain what drives variation of contractual form.

- Estimate

$$y = \alpha + \beta_1 x_l + \beta_2 x_t + \sum_k \gamma_k z_k + \varepsilon$$

  - y (contractual form)

  - x_l is characteristic of landlord/crop

- x_t is characteristic of tenant
- z_k : other factors such as land quality, village effect (e.g., land is scarce or not)

- They have data on 902 plots owned by 128 landlords from three towns in Tuscany based on census & property survey archives of the 15th century.

- The data is on the nature of contracts (share & fixed rent), the crop type (vines, cereals, & mixed), & tenant wealth.

- An important fact to note is that vines are more sensitive to weather variability (riskier)

- Also, care & maintenance efforts are important as well (incentive problems)

- Their main findings: if one runs contract choice (0 =share & 1 =fixed rent) on town dummies, tenant wealth & crop dummy (0 =cereals, 0.5 =mixed, & 1 =vines) then
  - higher wealth makes fixed rent more likely
  - a shift in crop type towards vines decrease the likelihood of fixed rent contracts.

- These results are consistent across various specifications : linear probability, probit & (town) fixed effects models.

- Consistent with moral hazard with limited liability or risk vs. incentives explanations.

- For vines there is more aggregate risk, but also greater monitoring problems, so its not clear whether shares should be higher or lower.

- However, when they run crop types on town dummies & tenant wealth then they get a negative & very significant relationship - poorer tenants appear to work on vines.

- If risk aversion important we would expect the opposite.

- A multi-tasking story: for vines multi-tasking issues would cause landlords to favor share contracts, & for risk sharing reasons, this is attractive to poorer tenants.

- Due to endogenous matching of tenants to crop we are getting a biased estimate

- If we could perfectly observe all relevant characteristics of tenants & crops then putting them on the right hand side will solve the problem.

- For example, we should put both crop riskiness & tenant risk aversion on the right hand side to test for risk sharing.

- But typically proxy variables for risk aversion are used, such as his wealth level since risk aversion is hard to measure

- The proxy error term will be added to the error term in the above equation

- But the proxy error is likely to be correlated with crop type
- This will bias the estimates.
- Ackerberg & Botticini (AB) use instruments that affect the matching equation that describes how tenants are matched with crops but do not affect the contractual choice equations.
- The three towns differ in terms of the importance of crop type
- If the effect of risk aversion on contracts & the effect of wealth on tenant's risk aversion are similar across these towns, then using town dummies as instruments for vines provides "exogenous" variation in crop type

- Exogenous supply side variation in land suitable for different types of crops
- Puts similar tenants (i.t.o. risk aversion) on different types of land just because they happened to be in a given area (assumption: there is little migration)
- Hence the effect of vines is identified correctly.
- With this, the vines coefficient becomes smaller & much less significant, while the wealth coefficient becomes larger & more significant.
- Suggests that both risk-sharing & multi-tasking important considerations for choice of sharecropping.

Table 2: Difference-in-Difference Models of Log of Rice Yield (1969-93)[6]

Log (Rice Yield Per Hectare)	Difference	Level	
	1969-78	1969-93	Exclude 1981-82
West Bengal (=1)	0.004 (0.17)	--	--
West Bengal × (1979-83)[7]	--	- 0.09*** (3.75)	- 0.01 (0.38)
West Bengal × (1984-88)	--	0.05** (1.99)	0.05** (2.00)
West Bengal × (1988-93)	--	0.05* (1.77)	0.05* (1.78)
District FE[8] F-Statistic	--	44.55	42.61
Year FE F-Statistic	4.26***	29.75***	31.81***
R-Squared	0.12	0.80	0.81
Sample Size	256	717	659

Table 3: Difference in Difference Models of Log of Rice Yield (1977-91)

	Whole Sample			Exclude Drought Yr.s 1981-82		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
West Bengal × (1979-83)	- 0.08*** (-2.43)	-0.07** (-2.05)	- 0.05 (-1.58)	0.001 (0.01)	0.002 (0.06)	0.015 (0.47)
West Bengal × (1984-87)	0.04 (1.17)	0.05 (1.47)	0.07** (2.04)	0.04 (1.24)	0.04 (1.26)	0.06** (1.93)
West Bengal × (1988-91)	0.08** (2.20)	0.12*** (3.28)	0.18*** (5.11)	0.07** (2.33)	0.11*** (2.97)	0.17*** (4.95)
Log (Rainfall)	---	0.01 (0.40)	0.007 (0.32)	---	0.019 (0.70)	0.01 (0.46)
Log (Public Irrigation)	---	0.122*** (7.22)	0.07*** (4.27)	---	0.103 (5.77)	0.04*** (2.69)
HYV Share of GC Area	---	---	1.04*** (8.18)	---	---	1.05*** (8.21)
District FE F-Statistic	40.02***	20.14***	14.76***	41.43***	18.8***	14.64***
Year FE F-Statistic	20.18***	12.14***	7.73***	21.67***	12.41***	6.04***
R-Squared	0.82	0.85	0.87	0.83	0.85	0.88
Sample Size	424	424	424	367	367	367

[6] In all the tables t-statistics are in parentheses. Also, ***,**, and * denote significance at 1%, 5% and 10% level respectively.

[7] These variables are obtained by interacting a dummy variable which takes the value 1 if a district is in West Bengal and 0 if it is in Bangladesh with another dummy variable which takes the value 1 if the observation is in the indicated time period (1979-83 in this case) and 0 otherwise.

[8] FE stands for fixed effects.

Table 5: The Effect of Registration on the Log of Rice Yield in West Bengal (1979-93)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sharecropper Registration (One Year Lagged)	0.43*** (3.46)	0.42*** (3.44)	0.43*** (3.55)	0.35*** (2.69)	0.36*** (2.64)	0.36*** (2.63)
Log (Rainfall)	---	- 0.07*	- 0.08*	- 0.07	- 0.08*	- 0.08*
		(-1.67)	(-1.82)	(-1.59)	(-1.74)	(-1.77)
Log (Public Irrigation)	---	0.02	0.01	0.01	0.02	0.02
		(1.01)	(0.70)	(0.60)	(0.83)	(0.79)
Log (Roads)	---	0.28***	0.25**	0.21**	0.19	0.22
		(2.75)	(2.46)	(1.99)	(1.55)	(1.54)
HYV Share of Rice Area	---	---	0.57***	0.45**	0.47**	0.47**
			(2.85)	(2.10)	(2.16)	(2.16)
South × Year[9] F-Statistic	---	---	---	4.73***	4.36***	4.38***
Left Front × Year[10] F-Statistic	---	---	---	---	2.64**	2.65**
Sharecrop. × Year[11] F-Statistic	---	---	---	---	2.64**	0.12
District FE F-Statistic	72.23***	15.10***	8.99***	9.01***	8.47***	7.68***
Year FE F-Statistic	28.31***	27.67***	21.60***	17.63***	17.83***	12.17***
R-Squared	0.91	0.92	0.92	0.92	0.92	0.92
Sample Size	210	210	210	210	210	210

[9] Represents a set of variables obtained by interacting a dummy variable that takes the value 1 if that district is in southern West Bengal with each year.

[10] Represents a set of variables obtained by interacting a dummy variable that takes the value 1 if that district had left-front majority at the local level government in 1977 with each year.

[11] Represents a set of variables obtained by interacting the initial extent of sharecropping in a district with each year.

Figure 3: Crop share of tenants before and after the reform

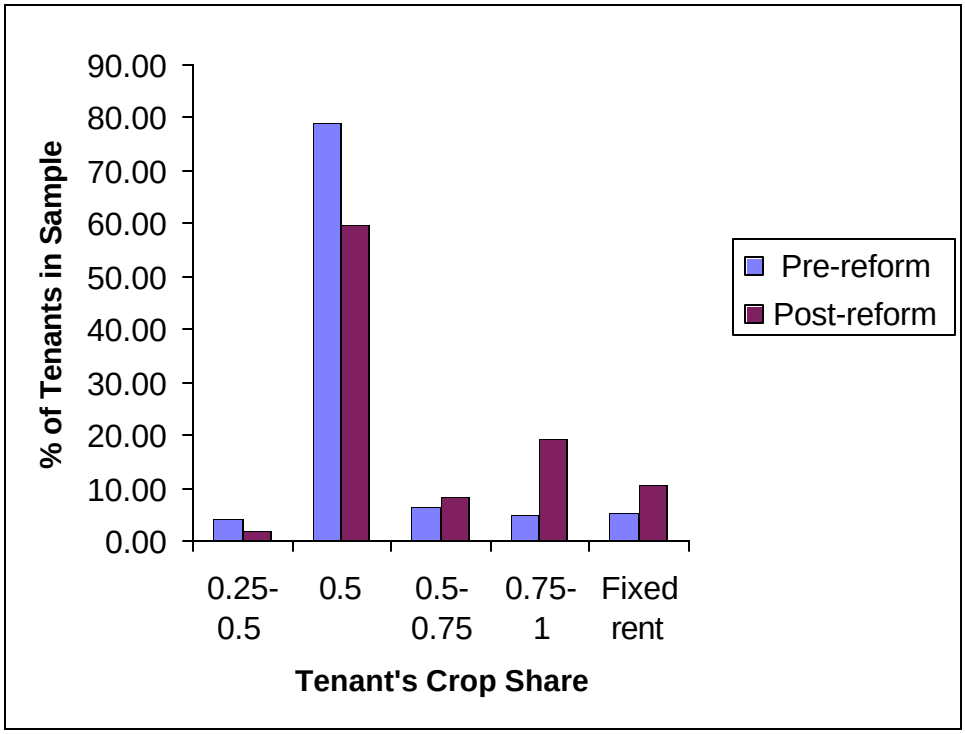
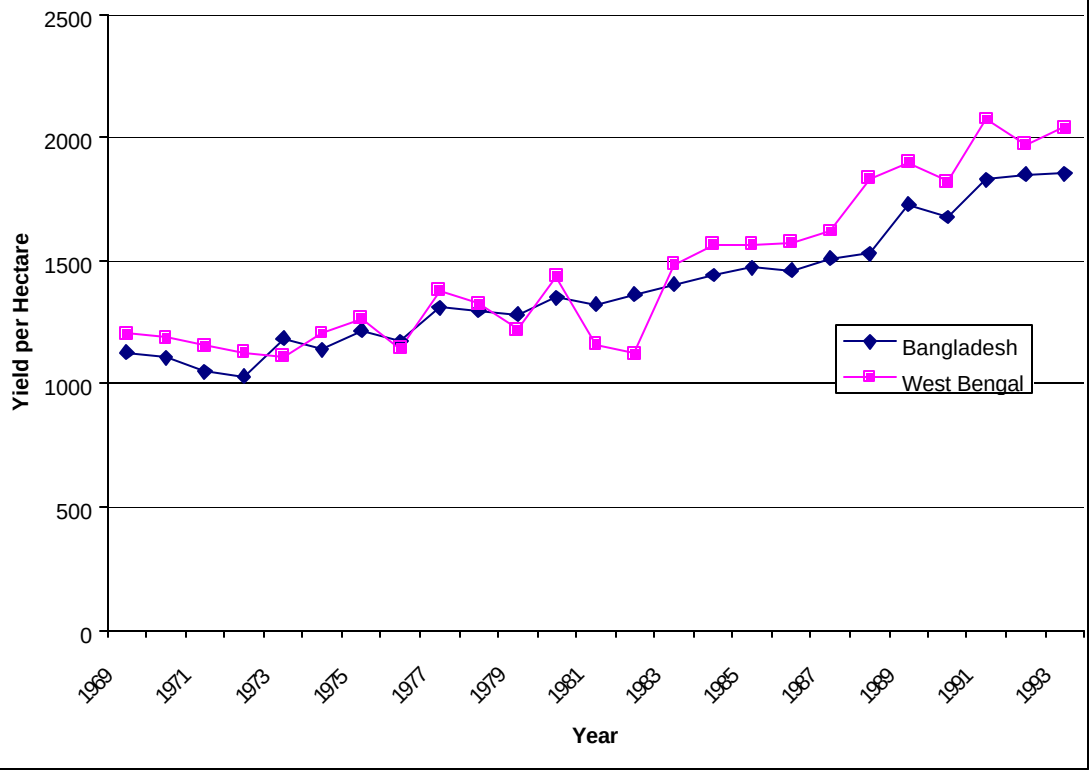


Figure 4: Rice Yield in West Bengal and Bangladesh 1969-93.



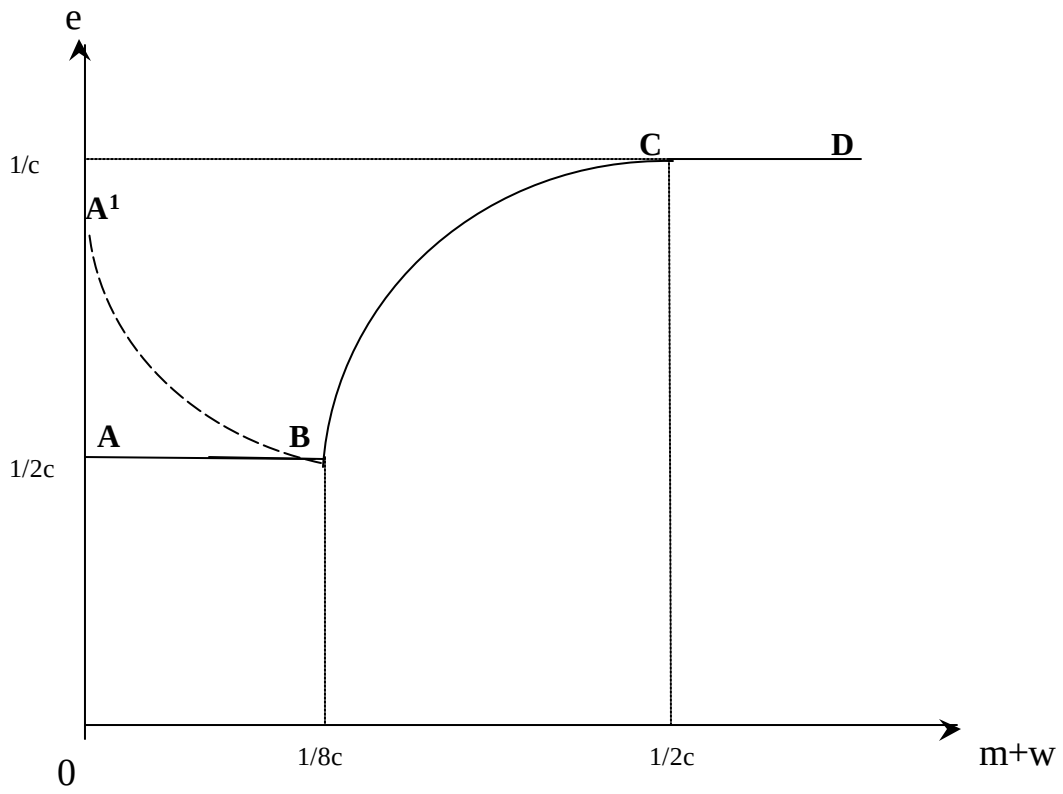


Figure 1