“Empowerment and Efficiency: Tenancy Reform in West Bengal”
Banerjee, Gertler and Ghatak, 2002

• Operation Barga (West Bengal)
  → launched by the Left Front in 1978
  → registered tenants given permanent/inheritable tenure if they pay at least 25% of output as rent

• This paper
  → develops a theoretical analysis of potential impacts of reform
  → uses reform as a “natural experiment” to assess effects empirically
The Theoretical Model

Infinitely lived risk–neutral landlord

Large population of infinitely–lived risk–neutral tenants with reservation payoff $m$ per period

Subjective discount factor $\delta$

Output:

$$ y = \begin{cases} 
1 & \text{with probability } e \\
0 & \text{with probability } 1 - e
\end{cases} $$

where $e$ is the tenant’s effort — non-observable

Cost to tenant of supplying effort:

$$ C(e) = \frac{c}{2} e^2. $$
Limited liability: Tenants rent plus sharecropping payment is limited by his wealth, $w$

Contract specifies:

\[
\begin{align*}
  h & = \text{payment to the tenant} \\
  \varphi & = \text{probability of no eviction} \\
  l & = \text{payment to the tenant} \\
  \psi & = \text{probability of no eviction}
\end{align*}
\]

\[
\left\{
\begin{array}{l}
  \text{when } y = 1 \\
  \text{when } y = 0
\end{array}
\right.
\]
Optimal Tenancy Contracts without Eviction

→ one–period contracting problem

• Landlord’s maximization problem

$$\max_{e,h,l} \pi = e - [eh + (1 - e)l]$$

→ subject to

$$h \geq -(1 + w) \text{ and } l \geq -w$$ \hfill (LLC)

$$v = eh + (1 - e)l - \frac{c}{2}e^2 \geq m$$ \hfill (PC)

$$e = \arg \max_e \left\{ eh + (1 - e)l - \frac{c}{2}e^2 \right\}$$ \hfill (ICC)

• The ICC can be written as

$$e = \frac{h - l}{c}$$

← note that it must be that $h > l$
• Substituting for $e$ the problem becomes

$$\max_{h,l} \pi = \frac{h - l}{c} - \frac{(h - l)^2}{c^2} - l$$

subject to

$$\frac{(h - l)^2}{2c} + l \geq m \quad \text{(PC)}$$

$$l \geq -w \quad \text{(LLC)}$$

• The value of $e$ implied by the optimal contract:

$$e^* = \begin{cases} 
\frac{1}{2c} & \text{if } m + w < \frac{1}{8c} \quad \text{(LLC only binds)} \\
\sqrt{\frac{2(m + w)}{c}} & \text{if } \frac{1}{8c} \leq m + w < \frac{1}{2c} \quad \text{(both bind)} \\
\frac{1}{c} & \text{if } \frac{1}{2c} \leq m + w \quad \text{(PC only binds)}
\end{cases}$$

$\Rightarrow$ increase in outside option $m$ (weakly) increases effort (bargaining power effect)
Increasing $m$
\[ \delta \), where, as before, \( m \) is the value of the outside option per period. The hypothesis of history independence implies that the landlord cannot precommit anything beyond the current-period incentive contract, \((h, d)\), and the corresponding probabilities of eviction, \((1 - \phi, 1 - \psi)\). It also implies that the tenant’s lifetime utility from next period onward, \( \bar{V} \), is taken as exogenous in this period by both players.

Given these assumptions, the tenant’s expected lifetime utility in the current period from choosing a level of effort \( e \) today, \( \bar{V}_0 \), must satisfy the Bellman equation:\(^{17}\)

\[
\bar{V}_0 = \max_{\{e \in [0,1]\}} \left\{ eh + \delta [\phi e + (1 - e)\psi] (\bar{V} - M) + \delta M - (1 - e)w - \frac{1}{2}e^2 \right\}.
\]

Differentiating this expression with respect to \( e \) yields the new ICC:

\[
h + w + \delta (\bar{V} - M)(\phi - \psi) = ce.
\]

Comparing this with the ICC in the one-shot game, we see that the

\(^{17}\) Here we assume that the LLC binds, i.e., \( l = -w \). If it does not bind, there will be no rents and the threat of eviction would have no effect.
Optimal Tenancy Contracts with Eviction

→ works like Shapiro–Stiglitz (1986), but with endogenous effort

\[ V = \text{expected lifetime utility of an incumbent tenant} \]
\[ M = m/(1 - \delta) = \text{expected lifetime utility of someone who is not a tenant} \]

Assume the LLC binds (otherwise eviction has no effect)

• Expected lifetime utility from choosing \( e \) today:

\[
V_0 = \max_{e} \sum_{n} eh + \delta [\varphi e + (1 - e)\psi](V - M) + \delta M - (1 - e)w - \frac{c}{2}e^2
\]

→ the first–order condition yields

\[
h + w + \delta (V - M) (\varphi - \psi) = c\hat{e}
\]
• It is optimal for the landlord to set $\varphi = 1$ and $\psi = 0$. Why?

$\rightarrow$ and so

$$h + w + \delta (V - M) = c\hat{e}$$

(ICC)

• In a **stationary equilibrium** $V_0 = V$ and so expected Tenant utility is

$$V = \hat{e}h + \delta \hat{e} (V - M) + \delta M - (1 - \hat{e})w - \frac{c}{2}\hat{e}^2$$

$\rightarrow$ this can be re-written as

$$V - M = \frac{\hat{e}h - (1 - \hat{e})w - \frac{c}{2}\hat{e}^2 - m}{1 - \delta \hat{e}}$$

(AB)

$\rightarrow$ the stationary contract must offer this to be incentive compatible

$\rightarrow V - M$ is increasing convex function of $e$, and decreasing in $w$ and $m$
• The landlord’s problem is

$$\max_{e,h,l} \quad e(1-h) - (1-e)l$$

subject to (ICC) and LLC \((l = -w)\).

$$\rightarrow$$ substituting these in we get

$$\max_e \quad n_{-c} e - \frac{c}{2} e^2 + \delta (V - M) e + w$$

• The FOC implies

$$e^* = \frac{1+\delta (V - M)}{2c} \quad (CD)$$

$$\rightarrow$$ the more surplus the Tenant gets, the more effort is required by the Landlord
which can be rewritten in the form

$$e = \frac{1 + \delta(\bar{V} - M)}{2c}.$$  

(8)

We can find the equilibrium values of $e$ and $\bar{V}$ by solving equations (5) and (8) simultaneously. In figure 2, $AB$ and $CD$ represent equations (5) and (8). These curves intersect at two points, $E_1$ and $E_2$. The curve $AB$ is strictly increasing and convex, whereas $CD$ is a positively sloped straight line. For $e = 1/2c$, $CD$ intersects the horizontal axis. As long as $(1/8c) - m - w > 0$, the curve $AB$ lies above $CD$ at $e = 1/2c$. Also, for $e = 1$, $CD$ lies above $AB$. Hence only the point $E_1$, which corresponds to a value of $e = (1/2c, 1/c)$, is an admissible solution since $E_2$ corresponds to a value of $e > 1$. As $m + w$ increases (but with $[1/8c] - m - w$.

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19 The relevant condition is $(2c - 1)/\delta > w - m$. Since $\delta > 1$ and $w > 0$, $[2 - (\delta/2)] > 1$, which can be rearranged as $(2c - 1)/\delta > c/2$. 

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**Fig. 2**
Broad Predictions of Theory

• Removing the threat of eviction weakens dynamic incentives to provide effort
  \[ \rightarrow \text{matters when } m + w \text{ is low and LLC is binding} \]

• BUT forbidding eviction increases Tenant’s outside option, \( m \)
  \[ \rightarrow \text{increases the share of the output they receive} \]

\[ \rightarrow \text{increased effort} \]

• also reduces incentive to make long–run investments

\[ \Rightarrow \text{Trade-off between the dynamic and static incentive effects} \]
prereform period, making eviction difficult or impossible must have strengthened the tenant’s bargaining position: in other words, $m$ should have gone up. Our model says that the tenant’s share of the crop should go up, or at least not go down, when $m$ goes up. Our survey (as well as smaller surveys by Kohli [1987] and Chadha and Bhaumik [1992]) confirms that crop shares increased after the reform (see fig. 3). For example, the proportion of tenants in our sample getting more than 50 percent of output increased from 17 percent to 39 percent. Evidence from our survey suggests that while shares rose for both registered and unregistered tenants, the increase was greater for registered tenants. To the extent that unregistered tenants faced some insecurity of tenure, their bargaining power presumably increased less, resulting in a smaller increase in the share.24

24 This begs the question of why these tenants did not register. Unregistered tenants in our sample cited two main reasons for not registering: either they had good relations with the landlord or they were dependent on the landlord for credit or other inputs. We might surmise that for both these groups, though for different reasons, the change in $m$ was more limited than it was for those who registered.
Implications of Operation Barga for Crop Shares

- Significant improvement in tenants’ contracts and more secure tenure
- Tenants receiving >50% of output rose from 17% to 39%
- 1977 — 1995, 30% of cultivated land was sold to sharecroppers, → sharp contrast to other Indian states
did not reflect what was then happening in West Bengal but rather what was happening in the rest of India.

In the period before Operation Barga, agricultural productivity was growing at almost identical rates in the two states. Rice is the main component of agricultural production in West Bengal and Bangladesh and is planted in over 70 percent of cropped area. Between 1969 and 1978, a period covering the decade before Operation Barga, rice yields increased by 9.3 percent in West Bengal and by 11 percent in Bangladesh. In the period after Operation Barga was introduced (1979–93), rice yields in West Bengal increased by 69 percent compared to 44 percent in Bangladesh. This can be seen more clearly in figure 4, which presents rice yields per hectare over time for West Bengal and Bangladesh. Until 1979, the first real year of Operation Barga, rice yields are approximately the same for the two countries. In the post–Operation Barga period, rice yields in West Bengal are substantially higher in all years except for 1981 and 1982, when West Bengal experienced two

28 The average exponential rate of growth per year was 4.1 percent in West Bengal and 2.7 percent in Bangladesh during 1979–93. See Saha and Swaminathan (1994) for a detailed analysis of the growth performance of agriculture in West Bengal during this period.
<table>
<thead>
<tr>
<th></th>
<th>Log(Rice Yield, kg per Hectare)</th>
<th>Proportion of Registered Tenants,\textsuperscript{b}</th>
<th>Log(Area under Public Irrigation, Hectare),\textsuperscript{c}</th>
<th>Log(Road Length, km)\textsuperscript{d}</th>
<th>Log(Rainfall, mm)\textsuperscript{e}</th>
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<tr>
<td>West Bengal (Annual Observations on 14 Districts)</td>
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<td>Overall</td>
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<td>7.51</td>
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<td>11.76</td>
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\textsuperscript{a} Fraction of total rice area devoted to the cultivation of the summer crop, boro.

\textsuperscript{b} Registration data are relevant only for West Bengal and are available for the period 1978–93.

\textsuperscript{c} Public minor irrigation schemes include shallow tube wells, deep tube wells, and river lift irrigation.

\textsuperscript{d} This information is not available as a continuous series for Bangladesh during the period of analysis.

\textsuperscript{e} Information on HYV share for Bangladesh is available up to 1991, so this number pertains to 1991.
models of log rice yield are presented in columns 2 and 3 of table 2 for 1969–93. The key variables are the interactions of an indicator of whether the district is in the treatment area (West Bengal) with indicators of whether the year was in the postreform period. We split the postreform period into three periods of equal length to accommodate variation in the speed at which registration proceeded, as well as lags in the output response to Operation Barga (e.g., because the effect through increased investment would take time to materialize). The last period reflects the full effect of Operation Barga since registration was mostly complete by then and any resulting investments are likely to have already affected productivity. We reestimated the model excluding 1981 and 1982, when West Bengal experienced two successive years of major droughts.

The first three coefficients in columns 2 and 3 are the difference-in-difference estimates. In the early years of Operation Barga (1979–83), West Bengal grew slower than Bangladesh, but this effect seems to be entirely driven by the presence of the two drought years that disproportionately affected West Bengal. In the next two periods (1984–88 and 1988–93), rice yields were about 5 percent higher. These results are consistent with the hypothesis that Operation Barga had a positive impact on productivity.

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<tr>
<td>West Bengal</td>
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<tr>
<td>West Bengal ×</td>
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<td>-.09***</td>
<td>-.01</td>
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<tr>
<td>(1979–83)*</td>
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<td>(3.75)</td>
<td>(.38)</td>
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<tr>
<td>West Bengal ×</td>
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<td>(1984–88)</td>
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<td>West Bengal ×</td>
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<td>(1988–93)</td>
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<td>(1.77)</td>
<td>(1.78)</td>
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<td>29.75***</td>
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<tr>
<td>Sample size</td>
<td>256</td>
<td>717</td>
<td>659</td>
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</table>

Note.—t-statistics are in parentheses.

* These variables are obtained by interacting a dummy variable that takes the value one if a district is in West Bengal and zero if it is in Bangladesh with another dummy variable that takes the value one if the observation is in the indicated time period (1979–83 in this case) and zero otherwise.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

R : .12 .80 .81

TABLE 2
DIFFERENCE-IN-DIFFERENCE MODELS OF LOG OF RICE YIELD PER HECTARE (1969–93)
on owner-cultivator productivity, we can estimate the effect of Operation Barga on sharecropper productivity using the formula

$$\frac{1}{A} \frac{dA}{dt} = s \frac{1}{1 - sA^*} \frac{dA^*}{dt},$$

where $A$ is average productivity, $A^*$ is the average productivity of owner-cultivators who are not affected by the reform, $A^\circ$ is the average productivity of sharecroppers, and $s$ is the average area under sharecropping.\(^{35}\)

There is unfortunately some controversy about the amount of land under sharecropping in West Bengal. The main reasons are lack of reliable land records, the presence of concealed tenancy to evade tenancy laws, and problems of definition of tenancy. Estimates of total cultivated area under sharecropping in West Bengal before the reform were introduced, provided by various rounds of surveys conducted by

\(^{35}\) This formula follows from taking logs of the equation $A = sA^* + (1 - s)A^\circ$ using the approximation $\ln (1 + x) \approx x$ when $x$ is small to obtain

$$\log A_j = \frac{sA^*}{(1 - s)A^\circ} + \log [(1 - s)A^\circ]$$

and then differentiating with respect to $t$. Notice that these percentage changes occur with respect to productivity in owned land (i.e., $A^\circ$). Hence the changes with respect to productivity in sharecropped land (i.e., $A^*$) would be larger.
Empirical Results

• Between 1979 and 1993 rice yields in West Bengal rose by 69%, compared to 44% in Bangladesh

• “Differences–in–differences” approach using districts in West Bengal and Bangladesh

\[
\ln y_{dt} = \alpha_d + \psi_t + \beta \times \text{treatment}_d \times \text{post}_t + \sum \phi_j X_{jdt} + \epsilon_{dt}
\]

\(\alpha_d\) = district fixed effects
\(\psi_t\) = year dummy
\(\text{treatment}_d\) = dummy for whether district is in West Bengal
\(\text{post}_t\) = post-reform year dummy
\(X_{jdt}\) = control variables

\(\beta\) is the difference-indifference estimate of the impact of reform

⇒ Operation Barga accounted for 28% of additional growth