Technological Change and the Distribution of Schooling:

Evidence from Green-Revolution India

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The case for raising schooling levels in developing countries has traditionally rested on two key assertions: that the returns to education in most developing countries are high and that low levels of schooling are particularly problematic for poor households. Recent investigations into the first of these assertions, however, have argued for a more nuanced view. In particular, evidence has been presented that the returns to education arise primarily from increased skill in decoding information and in decision-making under changing circumstances as hypothesized by Shultz (1976) and Nelson and Phelps (1966) and thus are only likely to be high in circumstances of substantial technological change. Foster and Rosenzweig (1996), in particular, show that rates of return to schooling among farmers in green-revolution India were highest in those regions experiencing substantial agricultural productivity growth. They also show (Foster and Rosenzweig 1994) that for workers engaged exclusively in menial tasks, increased schooling attainment has little effect on productivity.

Sector-specific rates of technological progress are also likely to have important implications for the distributions of schooling and schooling returns. The results from Foster and Rosenzweig (1996), for example, suggest that agricultural technical change is likely to increase inequality in schooling in rural areas because it increases schooling returns for landed households, who make decisions about the adoption and management of new seeds, but not for landless households, who undertake such tasks as weeding or harvesting crops. However, there may be important interactions between these two strata that either attenuate or strengthen this effect. There are two mechanisms. First, children in landed and landless households may compete in the labor market, so that changes in the time landed children allocate to school can have important effects of the demand for the labor supplied by children from landless households. Second, given the public-good nature of schools, increased returns to schooling among only a subset of households, such as farm households, may result in greater school construction, which may affect schooling investments in landless households. Despite increased interest in child labor in developing countries and its interaction with school attendance (e.g., Basu 1999), however, little evidence is available on the likely magnitudes of these effects.

In this paper we develop a two-strata general-equilibrium model of human capital acquisition with endogenous school construction that permits an assessment of the relative impacts of technological change and school availability on schooling investments in landless and landed households and illuminates how these choices interact through the adult and child labor markets. In particular, we consider a model of technical change in agriculture in which higher levels of technology increase the return to schooling among landed households but have no direct impact on the returns to schooling in landless households and in which schools are allocated among localities to fulfill some optimization problem.

The implications of the model are tested using a unique household-level panel data set which constitutes a representative sample of rural India during the peak period of agricultural innovation associated with the green revolution, 1968-1982. In particular, we establish that land prices capitalize expected future technologies and use the spatial and temporal variation in land prices to determine how household schooling decisions by land status are influenced by technological change along with school availability. Consistent with previous work we find that higher expected future technology and increases in the number of schools raise schooling in landed households. While increased school availability also increases schooling in landless households we find that, consistent with the operation of a child labor market, high rates of expected technology for given school availability tends to substantially decrease schooling investment in landless households. We also find, however, that schools are allocated to areas in which agricultural technical change is expected by the local farmers to advance most rapidly, the more so the greater the proportion of households in an area that are farming households. This school building effect attenuates, but does not eliminate, the negative direct effect of advancing agricultural productivity on landless schooling operating through the child labor market. The results thus suggest that schooling-related spillovers between landed and landless households, via labor markets and via the allocation of public goods, can substantially affect the distributional impacts of economic change and social policy.

1. Model

a. Schooling decisions in landless and landed households

We construct a two-period general-equilibrium model with two household types, landless and landed, in which the level of agricultural technology in the second period is stochastic. The two household types are distributed among villages, with distinct labor markets and technologies, with a varying fraction λ_j of households in each village j owning land. In this environment each household in the first period is endowed with T units of adult labor, which earns a village-specific return w_{jt} and T units of child labor. Children participate, when not in school, in a child-intensive activity (e.g., herding) carried out in landed households for which a competitively-determined wage w_{cjt} is paid to hired children[1]. Schooling is valued by parents in both landed and landless households for its own sake.[2] It is assumed that the landless are hired by landed households as workers, and that the schooling of hired adult workers does not augment their productivity. The schooling of landowners, who make input decisions, contributes to productivity in direct relation to the level of agricultural productivity.

All households in the first period earn income, choose how much time to allocate their children to school, and consume. Income in landed households is obtained from the wage labor of both children and adults, the profits from agricultural production using adult labor, and the child-intensive activity.

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[1] We separate the adult and child labor forces to simplify the analysis Allowing substitution would introduce additional income effects arising from the fact that changes in child enrollment would affect adult wages. In Foster and Rosenzweig (2000b) we focus on the labor market for adult wage workers, allow for substitution between children and adults in the labor market and test for its presence. The reason for introducing a labor market for children is to allow for the possibility that children’s time is productive in both landed and landless households and that decreases in participation by landed children impacts the return to child labor of landless households and vice versa. Even in the absence of a market for child labor these conditions would be met if children specialized in the production of a locally marketed good such as firewood.

[2] Alternatively we could allow child schooling to earn a return outside of agriculture that is the same for both landless and landed households. Doing so would not change the main points of the analysis.

Income in landless households arises solely from the wage labor of both adults and children. In the first period a social planner also allocates funds to villages to build schools. Schools are public goods that must accommodate all village children, and all school costs are due to travel time and opportunity costs. In the second period the first-period children are adults, the new technology is realized and the households again earn income and consume, with landed households hiring labor and producing and landless households selling labor.

We assume that the preferences of landless (k=N) and landed (k=A) households are identical and are concave and separable in first and second period consumption and child's human capital:

(1) $$v_{kj}^{*} = v(c_{kj1}, c_{kj2}, h_{kj}) = u(c_{kj1}) + \beta u(c_{kj2}) + z(h_{kj}),$$

where the single-period utility function u is increasing and concave and has a zero third derivative;[3] c_{kj1} and c_{kj2} denote first and second period consumption respectively of households of type k in village j; and h_{kj} denotes child human capital, in units of time, for households of type k in village j. The production function is assumed to have two inputs - land and adult manual labor - and to be multiplicative in the technology level and family human capital so that higher technology increases the returns to family human capital. Hired and family adult farm manual labor are assumed to be perfect substitutes. Agricultural profits in period t in village j are thus

(2) $$\pi_{jt} = \theta_{jt} h_{fAjt} A_j f(l_{jt}) - l_{jt} w_{jt},$$

where θ_{j1} denotes state-t technology in village j, h_{fAjt} summarizes family human capital in landed households in period t,[4] f() is the per-unit of assets agricultural production function for given technology

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[3] Adopting quadratic utility substantially simplifies the treatment of uncertainty about future technology as discussed below.

[4] Evidence suggests that, for the purpose of determining household productivity, family schooling is best summarized by maximal schooling within the household (e.g., Berhman et al 1999). We also assume for simplicity that children have lower schooling than parents in period one (while the children are being educated) and have higher schooling than parents in period two. That is h_{fAjt} is parental schooling h_{pAj} in period one and child schooling h_{Aj} in period two.

and family human capital, A_j denotes productive household assets, and l_{jt} is the amount of adult manual labor used in the period.

The first-period budget constraint for a representative landed households in village j is thus

$$c_{Aj1} = \pi_{j1} + A_j g(l_{jc}) - l_{jc} w_{jc} + Tw_{j1} + Tw_{jc} - (w_{jc} + d(S_{j1}))h_{Aj}, \tag{3}$$

where $g(l_{jc})$, with $g''(l_{jc})<0$, is the production function for the child-intensive good; l_{jc} is total child labor used; S_{j1} is the number of schools in village j at time 1; and $d(S_{j1})$ with $d'(S_{j1})<0$ denotes the per unit cost of human capital h_{Aj}, which is assumed to depend on the number of schools.[5] The first-period budget constraint for landless households, which do not undertake own production, is

$$c_{Nj1} = Tw_{j1} + w_{jc}T - (w_{jc}+d(S_{j1}))h_{Nj}. \tag{4}$$

At the start of the second period, second-period technology θ_{j2} is realized. It is assumed that second-period technology is drawn from a distribution that is characterized by a village-specific mean $E\theta_{j2}$ and an additional parameter vector σ_θ that is fixed across villages. Children become adults in the second period and join their parents in the labor force. The human capital of landed children is assumed to augment productivity in landed households. The second-period budget constraint for landed households is thus

$$c_{Aj2} = \pi_{j2} + 2Tw_{j2}. \tag{5}$$

By contrast, because the human capital of the children of the landless, who are hired as wage workers, does not augment productivity the budget constraint for landless households in the second period is just

$$c_{Nj2}=2Tw_{j2}. \tag{6}$$

The partial-equilibrium decision rules for landless households in this model are quite simple - school enrollment decisions depend only on the child wage, the adult wage in the first period and on the

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[5] To simplify the analysis we assume that child labor supply is not influenced by school construction except through its effect on human capital. A more sophisticated model would assume that school construction can increase child labor supply given human capital by reducing travel time.

stock (proximity) of local schools. There are no effects of variation in expected second-period wages or technology on the human capital investment made by landless because there is no capital market and no second period labor-market return to human capital investment for the landless. Thus there is no opportunity for these households to transfer resources across time through human capital investment. In particular, maximizing expected utility over consumption and human capital investment for landless households subject to (4) and (6) yields a landless-household human capital demand function given by

$$(7) \qquad h_{Nj} = h_N^*(w_{j1}, w_{jc}, S_{j1}).$$

The partial-equilibrium effect of increasing the stock of schools on child human capital investment in landless households is given by,

$$(8) \qquad \frac{\partial h_N^*}{\partial S} = d^{\prime}(S)\left(\frac{\partial h_k^{*c}}{\partial p_h} - \frac{\partial h_k^*}{\partial r_1} h_N\right),$$

where $\frac{\partial h_A^{*c}}{\partial p_h} < 0$ is the compensated own-price effect on human capital demand (i.e., the effect of a compensated increase in the monetary cost of schooling given wages and technology) and $\frac{\partial h_A^*}{\partial r_1} > 0$ is the first-period income effect. Assuming income effects are non-negative, both the income and price effects operate in the same direction so that (unsurprisingly) building schools would increase landless schooling investment if wage rates were unaffected by school building. The effect of an increase in the child wage on the amount of schooling among the landless households is also straightforward, and is given by

$$(9) \qquad \frac{\partial h_N^*}{\partial w_c} = \frac{\partial h_N^{*c}}{\partial p_h} + \frac{\partial h_N^*}{\partial r_1}(T - h_N).$$

Whether an increase in the child wage increases or decreases child human capital in landless households thus depends on whether the higher opportunity cost of child time is offset by the higher earnings per child. If income effects are weak, increases in the demand for child labor reduces child schooling for landless households.

b. General-equilibrium effects

Because changes in agricultural technology have no direct effect on the returns to hired-worker schooling investments, whether and how a change in expected technology affects landless schooling decisions depends on how such changes affect child wages and the stock of schools, which will in turn depend on the decisions of the landed households that employ labor and decisions by the school authority. To assess the spillover effects of agricultural technical change on landless-household schooling investment thus requires assessing general-equilibrium effects, in particular the operation of child and adult labor markets. In order to determine the general-equilibrium effects of increasing the number of schools and the level of agricultural technology on schooling investment, by land status, it is necessary to solve for equilibrium wages. In particular, the demand for labor, which is obtained by equating the marginal product of labor on landed households to the wage, must equal the supply. As there is one adult per household in the first period, the total supply of labor per landed household in period 1 is T/λ_j and first-period adult wages must thus solve

$$(10) \qquad w_{j1} = \theta_{j1} h_{pAj} A_j \frac{\partial f}{\partial l}(T/\lambda_j)$$

The first-period children’s wage, however, reflects the total supply of child labor, which is endogenously determined by the schooling decisions (time allocation) in landless and landed households, so that

$$(11) \qquad w_{cj1} = A_j g'((T - (1-\lambda_j)h_{Nj} - \lambda_j h_{A_j})/\lambda_j)$$

In the second period, total (adult) labor supply - the sum of parents in the first period and their grown children - is totally inelastic. The second-period equilibrium wage is thus:

$$(12) \qquad w_{j2} = \theta_{j2} h_{Aj} A_j \frac{\partial f}{\partial l}(2T/\lambda_j).$$

We first solve the general-equilibrium model taking as given the supply of schools. Because adult labor supply (demand) in the second period is also fixed and thus deterministic, even though the second-period technology level and wage is stochastic, it turns out that the wage-constant partial-equilibrium demand equations for the landed households that also condition on the fixed second-period labor supply are useful for understanding the general-equilibrium effects of changes in technology on landless households. The relevant equation describing the schooling investment decision rules for landed households, conditional on first-period wages, the expected second-period wage and technology, the stock of schools and second-period labor usage (2T/λ) is given by

$$(13)\qquad h_{Aj} = h_A^*(w_{j1}, Ew_{j2}, w_{jc}, \theta_{j1}, E\theta_{j2}, S_{j1}, A_j, h_{pAj}, 2T/\lambda, \sigma_\theta),$$

where Ew_{j2} denotes the expected second-period wage.

The comparative statics from the partial-equilibrium problem for landed households are straightforward. In particular, it can be shown that the effect of an increase in child wages on landed household human capital investment, given expected second-period technology, wages, schools, and second-period labor usage, is given by

$$(14)\qquad \frac{\partial h_A^*}{\partial w_c} = \frac{\partial h_A^{*c}}{\partial p_h} - \frac{\partial h_A^*}{\partial r_1}(l_c - (T - h_A)),$$

Expression (14) is unambiguously negative, reflecting the negative effect of a higher opportunity cost of child time and the fact that increases in child wages reduce the income of landed households, who are net hirers of child labor. In contrast, increases in expected second period adult wages given technology, schooling, and second-period labor usage unambiguously increase human capital investment in landed households

$$(15)\qquad \frac{\partial h_A^*}{\partial Ew_2} = -\frac{\partial h_A^*}{\partial r_2}(T/\lambda)(2 - \lambda).$$

This is because landed households, who are also net hirers of adult labor, expect to suffer a loss in the second period if second-period wages rise. This induces them to shift resources from the first to the second period. Given the absence of credit markets such a transfer of resources can only be accomplished by increasing human capital investment. Finally, the wage-constant effect of an increase in expected second-period technology on human capital investments in landed households is given by

$$(16)\qquad \frac{\partial h_A^*}{\partial E\theta_2} = f(2T/\lambda)\left(-\frac{\partial h_A^{*c}}{\partial p_h}E\mu + h_A\frac{\partial h_A^*}{\partial r_2}\right),$$

where $E\mu$ is the ratio of the expected second to first period marginal utilities of income. An increase in $E\theta_2$ raises the return to schooling investment, which induces more schooling, but also increases second-period income, which induces households to want to increase their consumption in the first-period by cutting back on schooling.

Expressions (14) through (16), which characterize wage and technology effects on landed-household schooling decisions, are relevant to the schooling decisions of the landless. This is because changes in the allocation of children's time in school h_A in landed households affect the demand for hired landless children as substitute child workers and thus the opportunity cost of schooling for the landless. To assess how changes in expected agricultural technology affect schooling decisions in both landed and landless households gross of wage effects, we combine the human capital demand functions for the two types of households (7) and (13), the three wage equations (10), (11) and (12), and expressions for labor supply to derive human capital demand functions that condition only on aggregate village-level conditions, inclusive of the number of local schools:

$$(17) \qquad h_{kj} = h_k^{**}(\lambda_j, T_j, S_{j1}, \theta_{j1}, E\theta_{j2}, A_j, h_{pAj}, \sigma_\theta), \quad \text{k=A,N.}$$

Substituting (17) and the corresponding equations for consumption into the utility function (1) also yields expressions for equilibrium expected utility conditional on the level of schools

$$(18) \qquad v_{kj} = v_k^{**}(\lambda_j, S_{j1}, \theta_{j1}, E\theta_{j2}, A_j, h_{pAj}, \sigma_\theta).$$

Implicit differentiation of the human capital equations (17), the wage equations, and labor supply yields the general-equilibrium effect of a change in expected agricultural technology on the schooling decisions of the landed:

$$(19) \qquad \frac{\partial h_A^{**}}{\partial E\theta_2} = \frac{1}{D}(A(1-\lambda)g^{\prime\prime}\frac{\partial h_N^*}{\partial w_c} + \lambda)(\frac{\partial h_A^*}{\partial Ew_2}h_A f^{\prime}(2T/\lambda) + \frac{\partial h_A^*}{\partial E\theta_2}),$$

where

$$(20) \qquad D = \lambda(1 - \frac{\partial h_A^*}{\partial Ew_2}Ew_2/h_A) + (\lambda\frac{\partial h_A^*}{\partial w_c} + \frac{\partial h_N^*}{\partial w_c}(1-\lambda)(1 - \frac{\partial h_A^*}{\partial Ew_2}Ew_2/h_A))Ag^{\prime\prime},$$

with D>0, as required for a stable equilibrium. Expression (19) is positive as long as the partial-equilibrium effect of expected technology change on landed schooling investment is non-negative. Moreover, comparison of the general-equilibrium effect (19) with the partial-equilibrium effect (16) suggests that the general-equilibrium effect of an increase in expected technology on the schooling investments in landed households is more positive than the partial-equilibrium effect because the general-equilibrium effect contains both the direct partial-equilibrium technology effect (16) and the second-period wage effect, which is positive. The intuition is that if technology is expected to improve, second-period wages will also be expected to increase (given the fixity of labor supply), which will further induce landed households to transfer resources to the second period. Expression (19) also indicates that the more responsive is schooling investment in landless households to the child wage, the greater is the responsiveness of landed schooling investment to anticipated technical change. This is because the higher the responsiveness of child labor in landless households to wage changes, the smaller is the increase in the child wage induced by the reduction in the supply of landed children to the child-intensive employment activity.

The general-equilibrium effect of a change in expected agricultural technology on the schooling decisions of the landless is given by:

$$(21) \qquad \frac{\partial h_N^{**}}{\partial E\theta_2} = -\frac{1}{D}\lambda A g^{\prime\prime}\frac{\partial h_N^{*}}{\partial w_c}\left(\frac{\partial h_A^{*}}{\partial Ew_2}h_A f^{\prime}(2T/\lambda) + \frac{\partial h_A^{*}}{\partial E\theta_2}\right).$$

Comparison of (19) and (21) indicates that the effects of a change in expected future agricultural technology on schooling investment in landless households is not only not zero, as suggested by the partial-equilibrium analysis, but rather is opposite in sign to the general-equilibrium effect in landed households. The reason is that if higher future technology induces greater human capital investment on the part of landed households this raises the equilibrium child wage which increases the opportunity cost of schooling in landless households and thus lowers their human capital investments.

In general, because of the operation of the child and adult labor markets all of the characteristics of landed households, inclusive of the level of agricultural technology, affect the schooling decisions in landless households. Indeed, in the partial-equilibrium model of the landless households, the schooling of parents has no effect on either income or preferences and therefore increases in parental schooling in landless households have no effect on landless schooling investment. However, taking into account the operation of the labor market, the schooling of parents in landed households affects the schooling of landless children because the schooling of landed-household parents in the first period affects the demand for both adult and child laborers.

The general-equilibrium effect of the schooling level of parents in landed households on the schooling of children in landed and landless households, respectively, is given by

$$(22) \qquad \frac{\partial h_A^{**}}{\partial h_{pA}} = \frac{\lambda}{h_{pA}D}\left[(\pi_1 + w_1 T)\frac{\partial h_A^*}{\partial r_1} + \frac{1-\lambda}{\lambda}\left(\pi_1 \frac{\partial h_A^*}{\partial r_1}\frac{\partial h_N^*}{\partial w_c} + w_1 T(\frac{\partial h_A^*}{\partial r_1}\frac{\partial h_N^*}{\partial w_c} - \frac{\partial h_N^*}{\partial r_1}\frac{\partial h_A^*}{\partial w_c})\right) Ag^{//}\right] \text{ and}$$

$$(23) \qquad \frac{\partial h_N^{**}}{\partial h_{pA}} = \frac{\lambda}{h_{pA}D}\left[(1 - \frac{\partial h_A^*}{\partial Ew_2}\frac{Ew_2}{h_A})w_1 T\frac{\partial h_N^*}{\partial r_1} - \left(\pi_1 \frac{\partial h_A^*}{\partial r_1}\frac{\partial h_N^*}{\partial w_c} + w_1 T(\frac{\partial h_A^*}{\partial r_1}\frac{\partial h_N^*}{\partial w_c} - \frac{\partial h_N^*}{\partial r_1}\frac{\partial h_A^*}{\partial w_c})\right) Ag^{//}\right].$$

Expressions (22) and (23) indicate (i) if schooling investment does not respond to changes in income, then variation in parental schooling in landed households has no effect on schooling investment in children for either landless or landed households,[6] and (ii) if income effects are positive for both types of households and neither the income nor child-wage effects on child schooling are very different across landed and landless households then increases in parental schooling in landed households will be unambiguously associated with increased schooling investment in landed households but the increase will be less in landless households and landless-household schooling investment may decrease. The intuition is that an increase in the schooling of adults in landed households increases landed-household income which leads to more time being allocated to schooling among landed children. The latter effect raises the demand for substitute child labor and thus increases the child wage, which increases the opportunity cost of schooling for landless children. Offsetting this is the fact that if landed farmers are more schooled, manual labor is also more productive so that the demand for adult hired labor also increases, leading to higher incomes in landless households. It is thus an empirical question whether on net the effect of the schooling of landed-household adults affects landless schooling investment negatively or positively.

Finally, the variation in the production assets of the landed household affects the schooling

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[6] This is because we have assumed that the adult and child labor are separable.

decisions in both landed and landless households. The effect of a change in the level of the landed household asset on landed schooling investment is given by

$$(24)\qquad \frac{\partial h_A^{**}}{\partial A} = \frac{\lambda}{AD}\left[w_c\frac{\partial h_A^*}{\partial w_c} + H_A + \frac{1-\lambda}{\lambda}(H_A\frac{\partial h_N^*}{\partial w_c} - w_1T\frac{\partial h_N^*}{\partial r_1}\frac{\partial h_A^*}{\partial w_c})g^{//}A\right],$$

where $H_A = -\frac{\partial h_A^{c*}}{\partial p_h}E\mu E\theta_2 Af(l_2) + (\pi_1 + w_1T)\frac{\partial h_A^*}{\partial r_1} + (\pi_2 + 2Ew_2T)\frac{\partial h_A^*}{\partial r_2}$.

There are three effects, corresponding to the three terms in (24). First, an increase in productive assets raises the return to first-period child labor, given child wage rates, and thus reduces child time allocated to schooling. Second, as given by the second term H $_{A,}$ an increase in the size of the asset stock increases the return to schooling in the second period, which raises schooling if the difference between the first- and second-period income effects is small. Finally there is a general-equilibrium effect which partly offsets any change in schooling via its feedback on child wages.

Variation in the productive assets of the landed affects the schooling in landless households according to:

$$(25)\qquad \frac{\partial h_N^{**}}{\partial A} = \frac{\lambda}{AD}\left[(1-\frac{\partial h_A^*}{\partial Ew_2}\frac{Ew_2}{h_A})(w_c\frac{\partial h_N^*}{\partial w_c} + w_1T\frac{\partial h_N^*}{\partial r_1}) - \frac{1-\lambda}{\lambda}(H_A\frac{\partial h_N^*}{\partial w_c} - w_1T\frac{\partial h_N^*}{\partial r_1}\frac{\partial h_A^*}{\partial w_c})g^{//}A\right].$$

Here, there are only two effects because changes in landed-household assets do not change the second-period return to schooling for the landless. Thus, increasing the assets in landed households unambiguously reduces landless schooling, because it raises the demand for child labor in the first period and because landed children may reduce their time spent in the non-school activity, with this only partly offset by the general-equilibrium effect of the rise in child wages.

c. Endogenous school allocations and schooling investment

With endogenous school allocations, the effects of expected improvements in agricultural technology or landed assets on the schooling of landless-household children will also depend on how changes in expectations about future technology or changes in asset holdings also affect the allocation of schools. Increased schooling availability can offset the reduction in landless-household schooling investment that is induced by an increase in the demand for child labor when future agricultural technology is expected to advance. The general-equilibrium effect of an exogenous increase in the stock of schools on school investment in landless households incorporates a direct effect operating through the reduced cost of schooling and an indirect effect that operates through the child labor market::

$$(26)\qquad \frac{\partial h_N^{**}}{\partial S} = \frac{1}{D}\lambda\left(\left(1 - \frac{\partial h_A^*}{\partial Ew_2}Ew_2/h_A\right)\frac{\partial h_N^*}{\partial S} - \left(\frac{\partial h_N^*}{\partial w_c}\frac{\partial h_A^*}{\partial S} - \frac{\partial h_A^*}{\partial w_c}\frac{\partial h_N^*}{\partial S}\right)Ag''\right)$$

Assuming that the second component, which reflects the differential responsiveness of children in landed and landless households to school availability, is not too large, more schools will result in higher schooling of the landless. This effect might be offset, however, if withdrawals of landed households from the labor market to attend school lead to a sufficiently large increase in the child wage to draw landless households out of the labor market. The general-equilibrium effect of school building is less than the partial-equilibrium effect (8).

Whether an increase in anticipated future agricultural technology in a locality does in fact increase school allocations to that locality is not obvious. This will depend in part on the objective function of the planner. One alternative is that the planner maximizes the weighted sum of expected utilities across localities, given by

$$(27)\qquad E_t\sum_j \lambda_j v_{Aj} + (1-\lambda_j)v_{Nj}$$

where v_{kj}, for k=A,N, denotes equilibrium utility for landed and landless households, respectively. The social planner can only influence welfare through the distribution of resources for the purpose of building schools and is given a fixed set of schools to allocate that is financed outside of the set of villages.[7] In particular, the social budget constraint is:

$$(28)\qquad \sum_j s_{j1} = S_1^*,$$

where $s_{j1}=S_{j1}-S_{j0}$ denotes the number of new schools built in village j at time 1 and S_1^* denotes the

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[7] In India the farm sector is exempt from income taxes, and most revenue is generated from Federal tariffs on imports and exports.

maximum number of schools across all villages that may be built at time 1.[8]

Maximizing the planner objective function (25) taking into account the behavior of the landless and landed and the constraint (26) yields the first-order condition

$$(29) \qquad \lambda_j \frac{\partial v_A^{**}}{\partial S_j} + (1-\lambda_j)\frac{\partial v_N^{**}}{\partial S_j} - \zeta = 0,$$

where ζ is the Lagrange multiplier on the school construction constraint (26). Equation (27) may then be solved implicitly obtain schooling investment decision rules

$$(30) \qquad S_j = S^{(3)}(\lambda_j, \theta_{j1}, E\theta_{j2}, A_j, h_{pAj}, S_{0j}, \sigma_\theta, \zeta).$$

In this problem it is not possible to predict how school building will respond to anticipated region-specific changes in technology. Although the allocation of schools to those regions with the highest technology tends to yield the highest increases in total income across villages, this effect will be offset at least in part by the diminishing marginal utility of income: a given increase in consumption or human capital induced by schooling subsidies may yield a higher welfare gain in low technology relative to high technology areas even if it results in a higher income gain in the latter. It is clear, however, that the effect of technology on schooling investment will differ importantly according to village landholding composition. Because technology only has a direct impact on income and returns to schooling for landed households, the magnitude of the response of schools to technology should be decreasing to zero in the share of landless households. This is most clear in the case where the planner is maximizing the sum of second-period village incomes. In that case, schools will be allocated to where technology is expected to be the most advanced, because schooling has the highest return in those localities, but the positive expected technology effect in a village will be smaller the higher the proportion of landless households located there This is because advancing agricultural technology always benefits the income of the landed more than the landless.

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[8] Note that, as is common in the theoretical literature examining the interaction between social planners and household fertility and human capital choices (Nerlove *et al.*1987), we assume that the social planner only cares about welfare from the standpoint of the current generation.

d. Agricultural technology expectations and land prices

An important feature of the model is that it incorporates expectations about future technology as a key determinant of schooling investment. Given that data on expectations are not in general available, it is important to reformulate the model in terms of observables that reflect these expectations. Because land prices capitalize the expected discounted stream of future returns on land and land rents are increasing in technology, land prices reflect both current and expected future technology. We posit in particular that land prices are determined by the price that an individual with a high level of schooling h* would be willing to pay for land.[9] In particular, if p_{At} denotes the price of land at time t, then using the notation of the model

$$(31) \qquad p_{Ajt} = E_t \sum_{s=0} \delta^s \theta_{jt+s} h^* f_A(A, T/\lambda_j),$$

where δ is the discount factor. To simplify, we assume further that technological innovation takes place only once such that at t=τ and for all s>1,

$$(32) \qquad E_\tau \theta_{j\tau+1} h_{j\tau+1} f(A, T/\lambda_j) = E_\tau \theta_{j\tau+s} h_{j\tau+s} f(A, T/\lambda_j)$$

Thus for period t=τ,

$$(33) \qquad p_{Aj\tau} = \theta_{j\tau} h^* f_A(A, T/\lambda_j) + \frac{\delta}{1-\delta} E_\tau \theta_{j\tau+1} h^* f_A(A, T/\lambda_j)$$

With estimates of the production technology and information on land inputs, so that the marginal product of land can be computed, (31) can be solved for $E\theta_{jt+1}$ in terms of current land prices. However, if it assumed that production is Cobb-Douglas it is possible to identify future technology effects using information only on current land prices and yields. In particular in that case, land yields y_{jt} in j at time t are

$$(34) \qquad y_{jt} = \theta_{jt} h_{jt} f(A_j, T/\lambda_j)/A_j = \theta_{jt} h_{jt} f_A(A_j, T/\lambda_j)/\alpha,$$

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[9] Suppose, for example, that a primary educated individual can achieve the maximal yields given technology. Then land prices would reflect the expected yields that could be achieved by primary educated individuals rather than the yields obtained given the actual and expected actual schooling levels in that village. The underlying assumption is that educated individuals have sufficient access to capital that they could in principle enter the market and bid up the price of land.

where α is the Cobb-Douglas land-share parameter. Substituting and solving implicitly yields a function of the form

(35) $$E_\tau\theta_{j\tau+1} = E\theta(p_{Aj\tau}, y_{j\tau}, h_j, A_j, T/\lambda_j, h^*)$$

where

(36) $$\frac{\partial \ln E\theta}{\partial \ln p_{Aj\tau}} = p_{Aj\tau}h_{j\tau}/(p_{Aj\tau}h_{j\tau} - \alpha y h^*) > 0$$

(37) $$\frac{\partial \ln E\theta}{\partial \ln y_{j\tau}} = -\alpha y_{j\tau}h^*/(p_{Aj\tau}h_{j\tau} - \alpha y_{j\tau}h^*) < 0$$

Substitution of (33) into (17) and (18) then yields the general-equilibrium relationships for school allocations and child schooling expressed in terms of contemporaneous village-specific yields and land prices, as:

(38) $$S_j = S^{(4)}(\lambda_j, y_{j1}, p_{Aj1}, A_j, h_{pAj}, S_{0j}, \sigma_\theta, \zeta)$$

and

(39) $$h_{kj} = h_k^{(3)}(\lambda_j, S_{j1}, y_{j1}, p_{Aj1}, A_j, h_{pAj}, \sigma_\theta),$$

respectively, where

$$\frac{\partial S^{(4)}}{\partial p_{Aj1}} = \frac{\partial S^{(3)}/\partial E\theta_2}{\partial p_A/\partial E\theta_2}$$

and so forth.

3. Data

Our main objective in the empirical analysis is to identify how agricultural technical change affects the schooling decisions of rural households by land ownership status. We do this by estimating approximations to the general-equilibrium relationships (38) and (39) relating (i) school enrollment in landed and landless households, conditional on local school availability, and (ii) school building to expected local agricultural technology, as reflected in local land prices conditional on yields. We use information constructed from data files produced by the National Council of Applied Economic Research (NCAER) from six rural surveys carried out in the crop years 1968-69, 1969-70,1970-71, 1981-82, and

1999-2000. The first set of three survey rounds from the Additional Rural Incomes Survey (ARIS) provides information on over 4500 households located in 261 villages in 100 districts. These sample households are meant to be representative of all households residing in rural areas of India in the initial year of the survey excluding households residing in Andaman and Nicobar and Lakshadwip Islands. The most detailed information from the initial set of three surveys is available for the 1970-71 crop year and covers 4,27 households in 259 villages. The 1981-82 survey, the Rural Economic and Demographic Survey (REDS), was of a subset of the households in the 1970-71 ARIS survey plus a randomly-chosen set of households in the same set of villages, excluding the state of Assam, providing information on 4,596 households in 250 villages. 248 of these are the same villages as in the ARIS. Finally, in1999 a village-level survey (REDS99) was carried out in the same set of original ARIS villages, this time excluding villages in the states of Jammu and Kashmir. Among other data, the survey obtained information on the schools in each of the villages, including information on when they were constructed.

The existence of comparable household surveys at two points in time separated by 11 years enables the construction of a panel data set at the lowest administrative level, the village, for 245 villages that can be used to assess the effects of the changing economic circumstances on household and school allocations. There are three other key features of the data: First, the first survey took place in the initial years of the Indian green revolution, when rates of agricultural productivity growth began to increase substantially in many areas of India. Second, two-thirds of the households surveyed in 1981-82 were the same as those in 1970-71. This merged household panel, the original 1968-71 panel and information on profits, inputs and capital stocks were used by Behrman *et al*. (1999) based on methodology developed in Foster and Rosenzweig (1996) to estimate rates of technical change for each of the villages between the two survey dates and between 1968 and 1971. Third, in each survey there is information provided on the prices of irrigated and unirrigated land, as well as information on crop prices, crop- and seed-specific output and planted area by land type that permit the construction of yield rates for high-yielding variety crops on the two types of land.

We aggregated the household survey data at the village level by landownership status to form two panel data sets in order to estimate the determinants of changes in school enrollment rates in landed and landless households. In particular, we chose households with children aged 10 through 14 years of age and constructed the proportions of children in that age group who were attending school in each village separately for households owning land and for landless households in the two survey years using sample weights. We also constructed weighted, village-level aggregates of the schooling and wealth of the parents of the children in this age group for each of the two land groups at each survey date. Slightly over 30% of children 10-14 resided in landless households in 1971. 37% of the children in this age group in the landless households were attending school, compared with 41% in landless households in that year.

The data indicate that in both 1971 and 1982 a significant proportion of the primary school-age children who were not attending school participated in the labor market. In landless households 34.9% of the non-attendee children aged 10-14 worked for wages. Although only 8.3% of the non-attending 10-14 year-olds in landed households worked for wages off the farm, an additional 28% of these landed children worked as “family” workers. In 1982, 30.3% of landless children aged 10-14 who were not attending school worked as wage workers, compared with 22.4% in landed households. In the latter, however, 38.6% of the children not in school worked as family laborers.

Crop yields and land prices play a prominent role in our model. We computed village-specific yield rates for the high-yielding seed varieties of the four major green revolution crops - wheat, rice, corn and sorghum - on irrigated land for 1971 and 1982. We aggregated the total output in each of the years for these crop/seeds using 1971 prices and sample weights and divided by the weighted sum of the irrigated area devoted to these crops for each village and survey year. The 1982 survey data provides information at the village level on the prices of irrigated and unirrigated land. The 1971 survey provides information on the value and quantity of owned land, by irrigation status, for each household. We constructed the village median price of irrigated land for 1971 from the weighted household-level data, and deflated the 1982 village-level irrigated land prices to 1971 equivalents using the rural consumer price index. The measures of the village-specific rates of technical change over the period 1971-82 and the land price and yield data were appended to the two village-specific data sets describing schooling investments in landless and landed households.

The 1999 REDS school building histories provide the dates of establishment for all schools located within10 kilometers of the villages classified by whether they were public, private, aided, or parochial and by schooling level - primary, middle, secondary, and upper secondary. It is thus possible to examine the determinants of school building over the 1971-82 survey span as well as for the decade subsequent to the 1981-82 survey round, relating comparable intervals of school investment to initial village conditions. In Foster and Rosenzweig (2000a) we carried out investigations of the accuracy of recall data pertaining to village infrastructure based on comparisons of the overlapping years for the histories of electrification that were obtained in the 1970-71 and 1981-82 surveys. The results, to the extent that they carry over to the similarly-obtained school histories, suggest that the school building histories accurately reflect the true changes in school availability over the survey period.[10]

For the analyses here, we look at the determinants of changes in the spatial allocation of secondary, inclusive of upper secondary, schools. We do this because even in the 1960's primary schools were nearly universal - by 1971 primary schools were located within 90% of the sample villages. The relevant margin is at the secondary school level. In 1971, only 41% of villages were proximate to a secondary school. However there was considerable school building - by 1981 secondary school village coverage had reached 57% and coverage increased to 73% by 1991. As documented in detail in Foster

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[10] There is one caveat - if there are schools that have been destroyed over the period these would not be reflected in a school-building history based on schools in existence in the villages in 1999.

and Rosenzweig (2000a), the school establishment histories also indicate that there were large inter-state disparities in the presence of rural secondary schools 1971, but show as well that there have been substantial variations in state-wide school investments since then.

Table 1 provides the means and standard deviations for the constructed village-level variables for the 1970-71 and 1981-82 survey rounds. As noted, in 1971 the average primary school enrollment rate among children in landed households was about 11% higher than that in landless households. In the subsequent 11 years, enrollment rates for both sets of households increased, but at a faster rate in landed households, so that by 1982 the disparity in enrollment rates between landed and landless households had increased to over 25%. Over the same period output per acre of HYV crops approximately doubled and the real price of irrigated land increased by a factor of 2.4, suggesting that expectations of future growth rose more than did real output. And, the number of secondary schools built between 1971 and 1982 represented a 38% increase in the stock of secondary schools, with school building continuing in the next 11 years at similar rate.

4. Land Prices and Expected Future Yields

We first investigate whether land price variation captures, in accordance with economic theory, variation in expectations about future productivity that are assumed to condition the current decisions of the forward-looking households. In particular, we estimate a log-log approximation to (33) using data on land prices and HYV yields from the 1971 round of the data and “future” yields from the 1982 data using OLS and instrumental variables, the latter to deal with possible measurement error in the land price and yield measure. We instrument the log price of land in 1971 using the estimated village-level technical change measure for the interval 1968-71. In addition to this variable, we make use of the fact that the Indian government made a forecast “announcement” at the initial stages of the green revolution. In the late 1960's, two programs - the Intensive Agricultural District Program (IADP) and the Intensive Agricultural Advancement District Program (IAADP) - were introduced in selected districts, roughly one in each state. These programs were purposively placed in areas the government had identified as having substantial potential for agricultural productivity growth due to the newly-available high-yielding seed varieties. The programs were designed to provide more assured supplies of credit and fertilizer. As part of the ARIS sampling design, moreover, households residing in these program districts were oversampled (as reflected in the sample weights), so that roughly a third of the households (villages) are represented in each program area. We assume that the existence of these well-publicized programs affected positively farmer's expectations about future growth in addition to augmenting yields.

The first and second columns report OLS and two-stage least squares (2SLS) estimates, respectively, of the relationship between the log of HYV crop yields in 1982 and the log of HYV crop-yields and land prices in 1971. In both columns 1971 yields are negatively related to 1982 yields, controlling for 1971 land prices, while 1971 land prices and 1982 yields are positively and significantly related, in accordance with expressions (36) and (37). The two variables, plus the initial stock of schools and the schooling of farmers, together explain 14% of the variation in the actual variation in crop yields 11 years in the future. As expected, moreover, relative to the 2SLS estimates the OLS estimates of the yield and price effects are biased towards zero, due presumably to measurement error.[11]

5. The Determinants of School Enrollment

We estimate a linear approximation to equation (39) determining the school enrollment rates of 10-14 year-olds in landless and landed households. In particular, the equations we estimate (for k= A,N) are

$$h_{kjt}=\alpha_{k1}y_{jt}+\alpha_{k2}p_{Ajt}+\alpha_{k3}A_{jt}+\alpha_{k4}h_{hjt}+\alpha_{k5}S_{jt}+\alpha_{k6}\lambda_{jt}+\mu_{j}+\varepsilon_{kjt}, \tag{40}$$

where the subscript t denotes time; μ_i captures unobserved time-invariant characteristics of villages, including second moments of the technology distribution (σ_θ) and preferences for schooling; and ε_{jt}

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[11] Inspection of equations (36) and (37) suggests that the sum of the log land price and yield coefficients should be unity if the technology is Cobb-Douglas and technology improves in a discrete jump. Our estimates clearly reject this combination of assumptions.

denotes an i.i.d. mean-zero taste shock.

Because parental human capital reflects investments made in the village in previous periods, OLS estimation of (40) given the unobservability of the fixed preference factors embedded in μ will in general yield biased estimates of the coefficients. Moreover, cross-sectional variation in land prices may reflect variations in such permanent qualities as location, inclusive of proximity to cities or even attractiveness, rather than just expectations of future changes in agricultural technology and current yields. These problems may be addressed in part by estimating (40) in cross-time differences:

$$(41) \qquad \Delta h_{kjt} = \alpha_{k1}\Delta y_{jt} + \alpha_{k2}\Delta p_{Ajt} + \alpha_{k3}\Delta A_{jt} + \alpha_{k4}\Delta h_{hjt} + \alpha_{k5}\Delta S_{jt} + \Delta\varepsilon_{kjt}$$

so that the fixed unobservables are swept out.

There are two additional problems, however. First, because an exogenous (say, taste- or income-driven) shock to the demand for schooling in period t will, given the model, result in, among other things a higher level of parental schooling and possibly a higher level of wealth A in period t+1, there will be a correlation between the differenced regressors in (41) and the differenced residual. To eliminate this correlation, we employ instrumental variables, using the initial values of the variables in (40), including the survey information on pre-1971inherited assets and the period-t adult schooling, which will be uncorrelated with the differenced residuals given the assumption of i.i.d. taste shocks, as instruments.[12]

A second problem is that land prices, as noted, may measure expectations of future profitability with error and the yield variables may be error-ridden, as we have seen in the estimation of the yield forecast equations. We also use instrumental-variables estimation to deal with these problems, adding to the list of instruments the technical change and pre-1971 program variables used to estimate the yield forecast equation.

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[12] We use the information on inherited assets rather than the 1971 wealth level as an instrument because it is likely that wealth, as in most surveys, is measured with error. We assume that the correlation between the measurement error in the inherited wealth variable and the measurement error in the 1971-82 wealth change variable is substantially less than that between the error in the initial wealth level and the change in wealth.

The first column of Table 3 reports the fixed-effects instrumental-variables (FE-IV) estimates of the determinants of school enrollment in the landed households. The estimates indicate that, for given current yields, in villages in which land prices are higher, school enrollment rates in landed households are also higher, consistent with the hypothesis that expectations of future higher levels of technology raise the returns to landed schooling investments. In addition, adding a secondary school increases school enrollment for 10-14 year-olds in the landed households, for given expectations and yield levels. The point estimates indicate that increasing expectations of future productivity such that land prices doubled would raise the school enrollment rates in landed households by 14%. This would imply, given expression (33) and a discount rate of 3%, a rate of growth in agricultural technology over the next 11 years of 7.4% per year. Adding a school raises enrollment by 68%, although that estimate is not very precise. Finally, increases in the total wealth of the landed households appears on net to depress landed child school enrollment, consistent with most wealth being land wealth and with the opportunity cost effect outweighing the second-period schooling gains as seen in expression (24).

The estimates of the determinants of schooling enrollment for landless households, based on the same specification, are given in the second column. As expected given the operation of a child labor market and the effects of anticipated technical change on landed schooling seen in column one, increases in expected future productivity reduce schooling enrollment in the landless households, and the effect is strong - the same doubling of land prices induced by an expected rise in agricultural productivity reduces landless schooling enrollment by over 90%.. For given expectations about future productivity, increases in current yields also lower landless schooling. These effects, however, are more than offset by building a school, which evidently would more than double landless enrollment in the same technology regime.

Finally, given yields and land prices, an increase in the schooling of farmers appears to also reduce the schooling investment made by landless households. This effect also operates through the child labor market, but requires care in interpretation given the inclusion of the yield and land price variables in the specification - among farm households with the same yields, assets and land prices, those with more productive (schooled) farmers must have poorer land quality and thus must expect higher future levels of technology growth. If so, we should expect to observe more schooling investment in the farm households and less in the landless households, which is what the columns one and two estimates indicate, although the effects are imprecise. In contrast, the schooling of the landless household adults should have no effect, given our assumption of the absence of schooling returns for the landless, on landless schooling investment. This is confirmed in the column-three specification, in which the schooling of the landless adults is included in the landless enrollment equation - the coefficient for landless adult schooling is less than half of that of the schooling of the landed-household adults, is small in magnitude and not statistically significantly different from zero by any conventional standard.

6. The Determinants of School Building

The estimates in Table 3 suggest that the gap between landless and landed schooling widens with increased agricultural technical change and that there is an absolute decline in landless schooling investment where the landed are increasing their schooling in response to technological advances, in the absence of offsetting forces. One offsetting factor is school building. The net effect of technical change on schooling investment in landless households depends therefore on how changes in expected technology impact on school construction. The first column of Table 4 reports estimates of the school building equation (38), using the same estimation procedure as was used to estimate the enrollment equations. The estimates indicate that schools are built where agricultural productivity is expected to increase in the future. On average, a doubling of land prices, for given current productivity, results in .16 schools being built in the subsequent 11 years, which represents more than a doubling in the average rate at which schools were built between 1971 and 1982.

The responsiveness of school building in a village to changes in expectations about future farm productivity appears to be significantly related to the proportion of landless in the village, as seen in the estimates reported in the second column of Table 4 in which the log of the land price is interacted with the proportion of landless households. In particular, as is consistent with school allocation rules that maximize total incomes, more schools are evidently built in response to an increase in anticipated productivity in villages with few landless households compared with villages with many households who have no land. The point estimates suggest that if almost all of the households in a village are landless, school building is almost totally unresponsive to agricultural change. In contrast, if almost all households are farm households, an increase in expected local increases in future agricultural productivity that results in a doubling of land prices would increase the number of schools built over the next 11 years by almost one-half of a school on average, which is 2.5 times the average rate.

The estimate in column three suggest that for the average village in which 30% of the households dot not own land, the number of schools built in response to a doubling of land prices associated with increased expectations of improved agricultural technology is .32. The estimates from column three of Table 3 suggest that this increase in school availability would raise landless schooling enrollments by almost 41% (.15/.367). This would cut the direct negative effect of the rising land price on landless school enrollment by almost half. Put another way, ignoring the endogenous response of school building to spatial differences in expectations about future agricultural technical change would lead to a substantial overestimate of the negative impact of agricultural technical change on the disparities between landless and landed schooling investment.

7. Conclusion

While it has long been argued that the process of economic growth importantly affects inequality, few micro-level empirical studies have explored the underlying mechanisms of this relationship. This fact is likely due not only to the limited availability of longitudinal data that permits one to examine these relationships at units of analysis below that of the country or state, but also to the methodological difficulties that arise in attempts to account for general-equilibrium effects that are likely to importantly influence the growth-inequality relationship.

By focusing on inequality in school attendance in a setting for which the nature of technical change, the operation of labor markets, and the extent of schooling returns are well understood, we have in this paper provided one example of how individual responses interact in the market place to importantly alter the distributional consequences of economic growth. The partial equilibrium-responses in this paper are straightforward. Because there is no market return to schooling for landless households, expected agricultural technological change increases schooling in landed but not landless households thus increasing school inequality. From a general-equilibrium perspective, however, two additional factors come into play: the market for child labor and school construction. The operation of the market for child labor worsens the distributional impact of agricultural productivity on school investment across landless and landed households, as landless child labor is used to replace landed child labor lost due to increased child school attendance in landed households. Our results suggest, however, that school construction increases in areas in which there are expectations of greater future productivity increases and that the closer proximity of schools differentially benefits landless households. Thus endogenous school building tends to offset the adverse distributional consequences of agricultural technological change.

These additional general-equilibrium effects may have significant implications for policies directed at increasing the level and equality of schooling. If technical change increases the returns to schooling then a partial-equilibrium approach would suggest that there is a tradeoff between directing educational resources towards high technical change areas, which maximizes productivity gain, and allocating them towards low-technical change areas, which will reduce schooling and income inequality. The results from this paper suggest that the inequality effects are more complex. Because, for given school availability, technical change has opposite effects on schooling for landed and landless households, differential technical change will have a diminished impact, relative to the partial-equilibrium case, on inter-regional average schooling differentials. Moreover, because schooling differentials between the landed and landless will be higher in high relative to low technical change areas, intra-regional inequality is likely to be lower if schools are targeted towards high technical change areas. There may, in fact, not be a tradeoff between productivity gains and overall schooling inequality in decisions about the allocation of schools.

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Table 1
Means and Standard Deviations of Key Variables, by Survey Year

Variable	1971	1982
Primary school enrollment rate, children 10-14 - landed	.408 (.302)	.503 (.359)
Primary school enrollment rate, children 10-14 - landless	.367 (.373)	.401 (.385)
Number of secondary schools built in subsequent 11 years	.157 (.371)	.170 (.382)
Number of secondary schools	.410 (.630)	.568 (.703)
Price of irrigated land, 1971 rupees	4405 (3581)	10848 (9713)
Per-acre yield index using 1971 prices, HYV crops	289.3 (257.0)	586.0 (348.5)
Wealth, 1971 rupees	13647 (12947)	12091 (10060)
Proportion of landed households with a primary-schooled male	.449 (.326)	.421 (.365)
Proportion of landless households with a primary-schooled male	.171 (.321)	.269 (.383)
Proportion children 10-14 who are boys - landed households	.541 (.231)	.533 (.285)
Proportion children 10-14 who are boys - landless households	.575 (.316)	.506 (.378)

Table 2
Land Prices in 1971 and Future (1982) Yields

	OLS	2SLS
Log irrigated land price, 1971[a]	.223 (3.48)[b]	.762 (2.20)
Log yields, 1971[a]	-.0553 (1.00)	-.581 (1.68)
Number of secondary schools in village, 1971	.167 (2.04)	.299 (2.37)
Proportion of farm households with a primary schooled male, 1971	.191 (1.30)	.227 (0.91)
Adverse weather in 1971	.217 (1.91)	.0311 (0.16)
Constant	3.83 (8.21)	2.80 (1.15
R^2	.140	-
N	229	229

[a] Instrumented variable. Instruments are: estimated technical change, 1968-71; presence of IADP program; presence of IAADP program. See text.
[b] Absolute value of t-ratio in parentheses.

Table 3
FE-IV Estimates: Determinants of School Enrollment Among 10-14 Year-Olds, by Land Ownership

	Landed	Landless	
Log of land price	.143 (2.52)[a]	-.342 (2.40)	-.330 (2.26)
Log of yield	.0441 (1.02)	-.168 (2.66)	-.168 (2.64)
Number of secondary schools	.278 (1.46)	.455 (2.03)	.472 (2.05)
Total wealth	-.104 (1.75)	-.0324 (0.57)	-.0301 (0.52)
Proportion of landed households with a primary-schooled male	.0918 (0.93)	-.184 (1.42)	-.170 (1.27)
Proportion of landless households with a primary-schooled male	-	-	-.0766 (0.43)
Proportion of 10-14 year olds male	.0732 (0.95)	.348 (3.62)	.343 (3.50)
N	382	222	222

[a] Absolute value of asymptotic t-ratio in parentheses.

Table 4
FE-IV Estimates: Determinants of School Building

	(1)	(2)	(3)
Log of land price[a]	.163 (2.37)[b]	.439 (2.53)	.387 (2.56)
Log of land price x proportion of households landless[a]	-	-.388 (1.92)	-.320 (1.70)
Log of yield[a]	.00790 (0.17)	-.227 (1.59)	-.196 (1.45)
Log of yield x proportion of households landless[a]	-	.527 (2.00)	.439 (1.70)
Number of secondary schools[a]	-.779 (3.12)	-.665 (2.03)	-571 (1.75)
Total wealth[a]	-.00357 (0.07)	-.141 (1.10)	-.102 (0.96)
Proportion of landed households with a primary-schooled male[a]	-.439 (4.07)	-.571 (2.99)	-.503 (2.75)
Proportion of landless households with a primary-schooled male[a]	-	-	-.407 (1.59)
N	410	410	410

[a] Instrumented variable. See text.

[b] Absolute value of asymptotic t-ratio in parentheses.