Input Transaction Costs, Mechanization, and the Mis-allocation of Land: The Irrelevance of the IR

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We assess whether and how the redistribution of farmland changes the average return on land (efficiency). We first show that information on output per acre by land size is insufficient to infer how a redistribution of land would change overall farm efficiency, as such a measure ignores inputs costs which can vary by land scale. We then show that information on the variation in profits per unit of land by land size is also insufficient for identifying the gains and losses from increasing or decreasing farm size, as what matters is the relationship between the marginal return to land and land size. Indeed, we show that the existence of an inverse relationship (IR) between profits per acre and farm size can be consistent with an efficiency-enhancing redistribution of land that increases or decreases farm scale.

We use annual, plot-level panel data from the India ICRISAT VLS covering the period 2009-2014 to estimate the marginal returns and input costs by land size. These data display the common features of many agricultural data sets from low-income countries - namely, the IR - the inverse relationships between land or plot size and both output and profits per acre, within and across farmers for the majority of plot sizes, and then a rise in average profitability with plot size among larger plot sizes. Average profitability at the highest plot sizes are lower than those for the lowest plots sizes, however. We show that the IR we observe in the data is neither due to differences in land quality by plot size nor to measurement error that varies with plot size. We also show, however, that the marginal returns to land increase with plot size over the span of the plot distribution in a way that is consistent with per-acre profits being higher at low plot sizes compared with higher plot sizes. That is, we find that despite IR there are evidently positive scale economies, and that the concentration of plot sizes at small scale in the ICRISAT villages lowers agricultural efficiency compared with a land allocation with higher average plot sizes.

The next question we address is why the marginal return to land rises with scale. We focus on two mechanisms: the existence of transaction costs in hiring inputs and technical scale economies in equipment productivity. We show that the existence of both would yield a U-shaped relationship between average profitability and plot size and rising marginal returns with plot size, which is what we observe in the data. The village-specific ICRISAT price schedules for daily wage and rental rates indicate that the average wage per hour falls as hours of work increase as do rental rates for tractors and bullocks. We show that this is consistent with employers and renters having to compensate sellers for the fixed transaction costs they incur in hiring out (search, travel, storage). We also show that starting from small plots, which employ only family labor, as plot sizes increases the total (all family) labor-land ratio declines, so that average profitability declines. As land size further increases it is more profitable to hire labor, but input costs are initially high as more and more operations employ expensive, low-hour employment, further decreasing average profitability. With further increases in land size, more and more farm operations employ inputs at (lower unit-cost) higher daily hours. Thus, average profitability and marginal profitability rises. This upward rise in the marginal returns on land by scale is enhanced as larger, more efficient machinery can be used on large plots.

Our estimates are consistent with the existence of hired input transaction costs: net of village/time fixed effects and large number of measures of productivity-relevant plot characteristics, on larger plots there are less operations employing low-hour inputs (hired labor,

tractors and bullocks) and such plots are characterized by lower average hired input costs. Consistent with this, we show using plot fixed effects, which control fully for inherent plot productivity, that increases in rainfall increase the use of expensive, low-hour inputs on smaller plots. Finally, we examine the use and productivity of manual versus more expensive power sprayers, where we can measure both the amount of spraying and hours of use. We show that power sprayers are more likely to be owned on larger-scale farms, net of wealth effects, and that increasing plot size increases the amount of sprayed material, while lowering the total cost of both hired and family labor used for spraying operations, consistent with the scale economies of mechanized equipment.