

Mechanising Agriculture: Impacts for Labour and Agricultural Productivity

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The measurement of the returns to adoption of mechanised practices is of first order relevance to understanding the effect of policies directed towards capital intensification on overall productivity. Using a randomised controlled trial, we measure the impact of mechanisation on farmers' income and labour supply decisions, as well as on labour demand. Family labour supply and hired labour declines both during land preparation, when mechanisation use increases, and other stages, when treatment has no effect on mechanisation. The magnitude of the effects is quite different by types of labour, with the greatest effect on hired labour. The experiment induced no changes in agricultural labour wages, the price of capital from private providers, and the price of output. Our results provide novel estimates of the impact of mechanisation access on agriculture.

Introduction

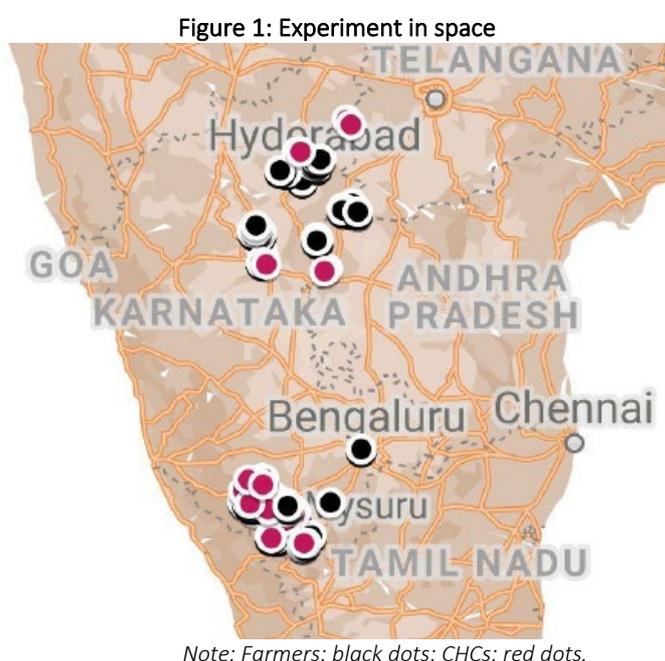
The mechanisation of production has become a primary feature of modern agriculture and is central to agricultural labour productivity. However, modern agricultural equipment is likely more profitable on larger farms and most agricultural production in poor economies is done by smallholder farmers. Mechanisation is potentially transformative of the production process through its effects on labour and productivity. Indeed, governments in the developing world are increasingly intervening in the agricultural sector to subsidise mechanisation and modernise the sector. However, there is little evidence of the magnitude of the returns to mechanisation and the channels through which mechanisation shifts labour and productivity. This project sought to better understand these impacts through an experiment providing subsidies to farmers in order to access mechanisation via rental markets.

An Experiment with Rental Markets

In partnership with one of the biggest providers of rental agricultural equipment in India, we conducted a large randomised controlled trial to increase access to rental markets for mechanisation. Rental markets are a potentially powerful way to increase access to mechanisation for small and medium-sized farmers. Evidence on the path to mechanisation of now-rich economies suggests that equipment rental markets were a steppingstone to that process. To the extent that these rental markets overcome indivisibilities in the purchase

of equipment that prevent the adoption of mechanised practices by smallholder farmers, they may be of first order relevance to the transformation of rural economies.

The randomised controlled trial covered 7,100 farmers across nearly 200 villages in the state of Karnataka in South India (see Figure 1). The average farmer cultivates about 3.5 acres and ownership of heavy capital equipment is relatively low. Less than 3% of the sample reports owning tractors. Farmers were given a lottery for subsidy vouchers to access approximately two hours-worth of agricultural equipment rental services per voucher from a nearby custom hiring centre (CHC). Farmers could rent any equipment available at the CHC including tractors, rotavators, and cultivators. In addition to these vouchers, a subset of treatment farmers was given cash transfers worth half of the voucher amount. Vouchers were valid for redemption throughout the agricultural season, allowing farmers to optimally allocate the use of equipment across agricultural processes and request multiple services at different points in the season.



Returns to Mechanisation

During the intervention, we find that treatment farmers are 30 percentage points more likely than control farmers to rent agricultural equipment from the CHCs. These effects are heterogeneous by operational landholdings, with larger farmers being more likely to take up the mechanisation rental. Once the vouchers expire, the treatment effects on CHC rental use fall to less than one percentage point, indicating that the price subsidies are responsible for higher take-up. Importantly, the voucher treatment increases overall mechanisation hours, by approximately 0.8 hours per farm on average over the season, approximately a 10% increase relative to the mean.

Both take-up and overall mechanisation hours are not affected by cash transfers suggesting that liquidity constraints may not be a primary barrier to mechanisation in our set up.

We find no evidence of higher output per acre, although output per worker increases as a reflection of the labour-saving effect that mechanisation had on farming activities. We structurally estimate the return to mechanisable tasks to be 36% on average per season across farms, and total factor productivity gains of 3% on average.

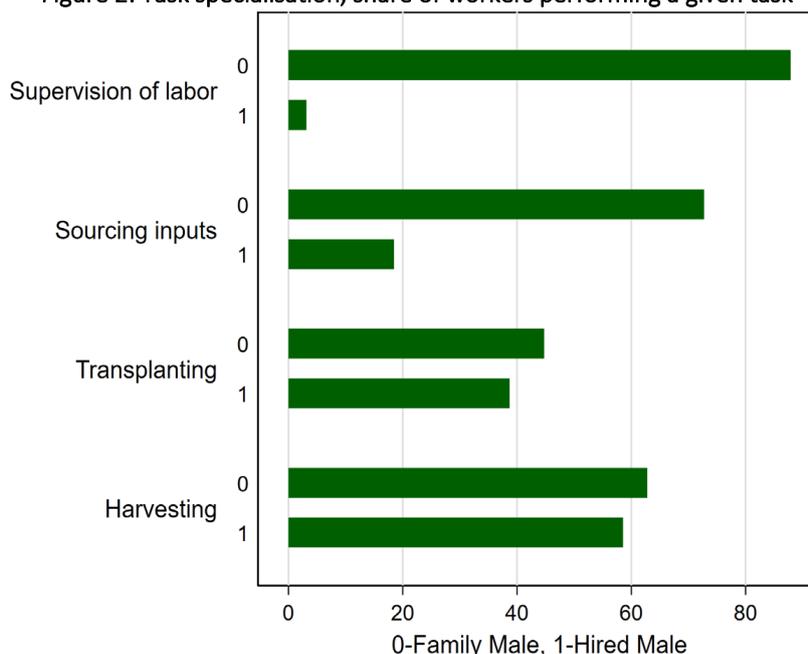
Effects on Labour and Household Income

Our results indicate that farmers hire fewer workers for production by about eight percentage points, a little over six days of hired labour per acre over the season.

Family labour supply and hired labour decline both during land preparation, when mechanisation use increases, and other stages, when treatment has no effect on mechanisation. The magnitude of the effects is quite different by types of labour, with the greatest effect on hired labour. Mechanisation reduces male family labour use by about 0.13 workers per acre over the season, whereas for hired male workers, the impact is much larger, about 0.43 workers per acre.

Since family labour is mostly occupied in supervision activities, we interpret the decline in supervision labour and the persistent effect of mechanisation on hired labour as evidence of output standardisation, which is beneficial in the presence of contracting frictions. Indeed, tasks in our setting are highly specialised, especially for tasks that are vulnerable to contracting frictions. For instance, male family labour engages in supervision of farm labour 88% of the time, whereas male hired labour engages in supervision only about 3% of the time (see Figure 2). Moral hazard problems are ubiquitous in agricultural labour and therefore, by increasing output observability, mechanisation eases these problems. The role of mechanisation in easing moral hazard problems to free up managerial resources is a novel channel for the transformative role of capital intensification in rural economies.

Figure 2: Task specialisation, share of workers performing a given task



Indeed, we find that while family labour pulls back from their supervision role, non-agricultural income for treatment households increases by 41% relative to control. This is consistent with labour reallocation in response to capital-deepening in agriculture, as stressed by an extensive literature studying country's paths towards economic development.

Policy Implications

The measurement of the returns to adoption of mechanised practices is of first order relevance to understanding the effect of policies directed towards capital intensification on overall productivity.

This is even more important when governments in the developing world are increasingly intervening to subsidise equipment purchases at large scale or the development of capital rental markets altogether. The return on our subsidies averaged 28% in terms of labour savings and additional agricultural income. This return is even higher when we additionally account for savings in intermediate inputs.

While these positive returns show promise for the introduction of subsidies to access mechanisation services, the experiment induced no changes in agricultural labour wages, the price of capital from private providers, and the price of output.

It is unlikely that policy interventions at scale would not generate shifts in these prices. Future research shall explore and quantify these channels.

Moving Forward

While the experimental design could have allowed mechanisation impact throughout the agricultural season, responses are concentrated at land preparation. Yet, mechanisation of other processes of production is widespread in more developed economies and richer agricultural regions in India. Hence, we view our estimates as a lower bound to the marginal returns to mechanisation in agriculture. Importantly, these returns as well as the effects on labour supply and demand are likely not invariant to the scale of operation. Our results provide novel estimates of the impact of mechanisation access on agriculture. However, many questions remain for future work, such as the impact of long-term mechanisation access on land consolidation, and the movement of labour into non-agricultural work.

This note is based on research conducted as a part of PEDL [ERG 6308](#).