PROJECT POLICY BRIEF

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Using Digital Technology for Agricultural Mechanisation: Evidence from the Tractor Rental Market

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The small scale of individual producers limits agricultural mechanisation in many developing countries. Tractor sharing via rental markets has the potential to achieve economies of scale, enabling smallholder farmers' access to mechanisation and increasing productivity. This project explores the benefits of and prevalent frictions on rental market for tractors using georeferenced records from a novel digital tractor sharing platform in Kenya and Nigeria.

Introduction

Technology adoption is deemed essential for improving agricultural productivity in low- and middle-income countries. However, access to productive technologies requiring large, fixed investments such as tractors is often limited by the small scale of producers. Most landholdings are too small and fragmented to warrant ownership, essentially preventing farmers from mechanising. Since consolidating land to achieve economies of scale is often not possible, enabling farmers to share tractors via a private rental market may provide a viable solution instead. While a potentially powerful way to expand mechanisation access, there are important challenges these markets need to overcome in practice. Most importantly, the aggregation and coordination of individual plots is complicated by the fact that all farmers in a certain geographic area require the same type of mechanisation service at the same time under rain-fed conditions.

Despite its importance, our understanding of the extent to which tractor sharing can help increase mechanisation and why it is not more prevalent in developing countries is limited. To fill this gap, this project studies the functioning of tractor rental markets using data from a novel digital tractor sharing platform that matches smallholder farmers with tractor owners. How much does a functioning rental market matter? What are the relevant frictions that the platform addresses? How can the market be organised better?

Policy context

The project uses data for Nigeria and Kenya. While there are important differences between these two countries, the following features are common for both and largely representative for many countries in Sub-Saharan Africa (and beyond). First, the agricultural sector represents a large share of GDP and employment. Second, plots are small and fragmented. In Nigeria, over 90% of farm are smaller than 10 acres. Third, agricultural production is largely rain-fed. Finally, the level of mechanisation is low. In Kenya, only 2% own and 10% use tractors for land preparation at baseline. The number of tractors in use in the region did not significantly increase since 1961. Other power sources for land preparation mainly include manual labour (either farm or hired labour, 65%) or animal power (25%). However, it is becoming increasingly expensive to hire on-farm labour due to increasing agricultural wages.

Data and methodology

This project uses administrative records from a novel digital tractor sharing platform to study rental market interactions. Specifically, it obtained access to the universe of geo-referenced tractor service requests and activities for Nigeria and Kenya since the beginning of operations in 2018.

On the demand side, the platform uses a network of intermediaries, who earn a small commission, to locally aggregate plots of smallholder farmers, submit tractor service requests on their behalf on a smartphone application and coordinate service provision with tractor owners and operators. On the supply side, tractor owners can manage service activities in an application and monitor their tractors' activity in real-time thanks to a GPS device that is installed on every tractor on the platform. A unique feature of this data is that it contains detailed information on the actual work done by tractors at any point in time (where they go and when, and whether they work on outstanding requests).

The main purpose of this project so far has been to compile this data. Thus, the methodology has been limited to the exploration and descriptive analysis of the data obtained, in addition to gathering qualitative information from discussions with different stakeholders on the ground. A more rigorous analysis is still in progress. Hence, the results described below are preliminary and should be interpreted with caution.

Results

Platform activities have been expanding across space (with some heterogeneity at the district level) and growing over time, indicating a positive effect on the use of capital. The mechanised area as measured on the platform appears substantial, especially given that mechanisation rates were low at baseline. Thus, the platform may be successful in reducing transaction costs in several dimensions.

First, moral hazard between tractor owners and operators driving the tractors for the provision of services seems to be a key issue that restricts capacity available in the market otherwise. Owners

incur losses because operators underreport the work done and monitoring is costly since many owners do not live close by farms. The GPS devices mounted on tractors and the mobile application allows owners to track their assets in real-time and observe the exact area for which they should receive rental payments.

Second, there may be search and matching frictions that the platform can help solve. Farmers may not know anyone they could rent a tractor from and even if they do, there is congestion at peak times in the season. Similarly, owners may not know where to find demand, sometimes soliciting work by parking at market centres. The centralised matching feature of the platform can create links beyond personal networks and village boundaries.

Third, the intermediaries aggregating farmers requests may improve the coordination and planning of service provision. They bundle plots together into clusters to achieve economies of scale that make up for the costs of moving equipment in space incurred by tractor owners. This is crucial especially when farmers face difficulties coordinating among themselves. These intermediaries also provide tractor owners with important information that reduces uncertainty about job and plot characteristics, which would otherwise deter them from experimenting with new customers. Similarly, they can manage the service provision on-site, making sure farmers are ready to pay owners. In addition, having all information registered digitally on the application helps owners to plan and have a better overview of tractor utilisation.

While the platform may improve on some potential inefficiencies on informal rental markets, its organisation faces its own challenges. As a result, a large share of service requests remains uncompleted, and many tractors work on plots outside the platform instead. Among other things, this may be partially due to unresolved contractual frictions that create hold-up problems. In particular, payments for tractor services are currently not (yet) made through the platform. This means neither farmers nor owners are guaranteed to transact. It also prevents the platform to capture any surplus from making the match. Moreover, it inhibits the platform to retain enough customers on either side to reach sufficient scale for network effects to kick in.

Policy impact

Agricultural mechanisation is a long-standing policy priority in Sub-Saharan Africa. However, early initiatives such as subsidies for the import of tractors and, more recently, the establishment of local tractor hiring centres have largely failed to provide access to mechanisation. This project studies an alternative solution that directly addresses the underlying problem of capital indivisibilities. In particular, the results of this project may speak to the benefits of developing a market that connects supply and demand of tractor services and may provide some guidance on relevant frictions that may require government intervention. Given the context of the study, it may also provide insights into how easily scalable digital tools can be leveraged to reduce transaction costs. Based on the descriptive evidence above, supporting the emergence of marketplaces for tractor rental may be a cost-effective way to increase access to mechanisation and improve productivity among smallholder farmers. Governments may play a role in helping those marketplaces reach a certain scale and providing the appropriate infrastructure and framework for them to function properly.

Moving forward

Work on this project, including its main analysis, is still on-going. Next, the project will collect additional data on mechanisms and outcomes, which mainly implies running a survey among (potential) users as well as processing satellite imagery. Then, the project aims to quantify the impact of the platform and the role of different mechanisms using quasi-experimental variation and a theoretical model. To the extent that the platform successfully induces mechanisation, the project will also investigate broader effects on processes of economic development and structural transformation considering the labour-saving nature of the technology in the future. The project hopefully also lays the foundation for a broader research agenda on the economics of rental markets and agricultural mechanisation given that there are many different interesting patterns in the data that require further analysis.

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