Policy brief
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Understanding productivity dispersion

Evidence from a new survey of manufacturing firms in Uganda

In brief

- There are large productivity differences across firms in developing countries, even within the same sector and region. Understanding what contributes to such differences in productivity is important for designing policies to help low productivity firms grow.
- This project implemented a representative survey of over 1,000 manufacturing firms in Uganda to quantify differences in productivity and understand what drives such differences.
- The key results from the survey are that:
    - Mechanisation matters: machine usage is the primary factor associated with profitability;
    - Small firms engage in an active firm-to-firm rental market for machines, which enables them to access high-capacity and expensive machines within semi-formal or informal clusters; and
    - While the rental market partly relieves capital constraints, firms still report access to machines as an important challenge.
- As such, industrial policies facilitating mechanisation seem particularly promising. In particular, this survey suggests that policies should leverage the cooperative nature of firm networks and the existing rental market to increase mechansation, which could include subsidising machines that can be shared by firms in the cluster.

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What drives differences in firm productivity?

While firms in developing countries are on average less productive than firms in high-income countries, high productivity firms do exist even within developing countries. This is encouraging for policy: if we understand what high productivity firms do differently, we can use these insights to design policies that can help the low productivity firms catch up with the more productive ones.

The aim of this project was to collect new survey data to help answer the question of what drives differences in firm productivity, to inform industrial policy in Uganda and other developing countries. In particular, this new survey data allows us to explore the relative importance of mechanisation of the production process, skills of the workers, and managerial quality in driving productivity differences across manufacturing firms in Uganda.

Overview of research design

Together with the NGO BRAC and in collaboration with the Ministry of Trade of Uganda, we designed and implemented a survey of 1,115 manufacturing firms from three sectors that employ a large share of workers in the country: (i) carpentry; (ii) metal fabrication; and (iii) grain milling. The survey was conducted in a representative sample of urban and semi-urban areas across the Central, Western, and Eastern regions of Uganda.

The survey collected detailed information on:

- production processes for key products;
- usage of modern machines (such as thickness planers in carpentry) at each production step;
- skills of the workers involved in the production process; and
- managerial practices of firm owners.

The survey also included questions about the main challenges faced by firm owners in increasing the productivity of their firm, as well as on whether and how firms interact with other firms in the same sector and geographical cluster.

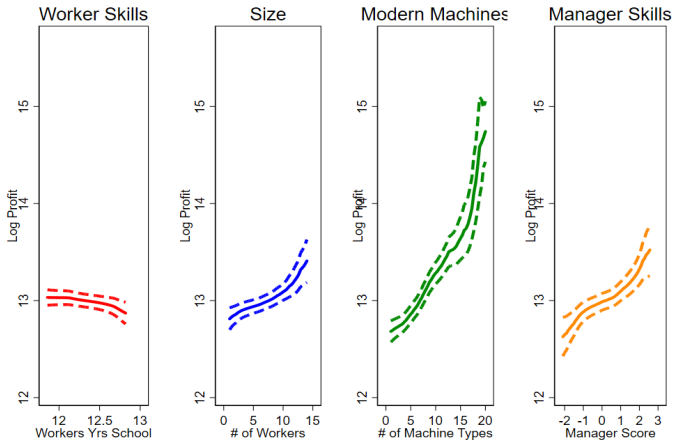
We used this rich data to understand production processes in these firms, and to study why some firms manage to be so much more successful than others, even within the same sector and geographical area.

Key results

The first finding from the firm survey is that **usage of modern machines is the main factor associated with higher profitability.** In particular, our data reveals that mechanisation plays a more important role in explaining

differences in profitability than firm size, skills of the workers, or managerial practices. This is shown in *Figure 1* below for the carpentry sector.

Figure 1: Determinants of profitability



Highly **mechanised firms are twice as profitable** as firms that use mostly manual tools, even after controlling for firm size, skills of the workers, and managerial practices of the owner. By contrast, skills of the workforce play a minimal role in driving productivity differences.

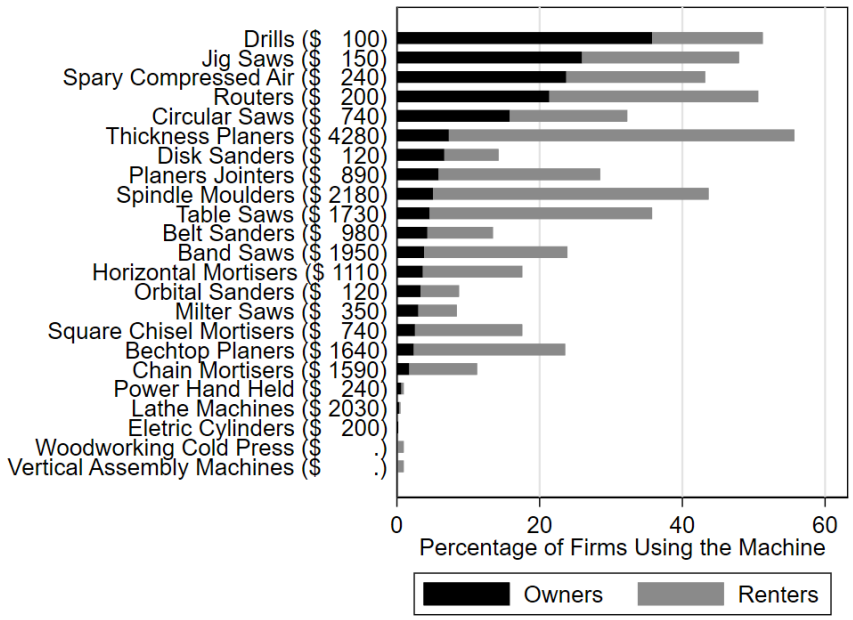
Focusing in on machine usage, our second key finding is that modern **machines in carpentry** are typically **high production capacity and expensive**, and so most firms need at most one of each type. This is not surprising given the small size of most firms. For example, thickness planers are a very important and common type of machine used, but they cost $4,280 on average – more than 30 times the median monthly profit in carpentry ($125). In addition, most firms in carpentry need to use a machine only for a few hours per week, and so machines spend some time idle.

As a result of the fact that machines are expensive and have excess capacity, we see that an **active inter-firm rental market for machines** has emerged in the carpentry sector. *Figure 2* shows the extent of the rental market across typical machines. To get a sense of the importance of the rental market, note that while less than 7% of firms surveyed own a thickness planer, as many as 60% use one; the difference is explained by the rental market. In the majority of cases, firms rent their machines directly from other firms operating in the same geographic cluster. This inter-firm rental market enables small firms to access large and expensive machines without having to pay the fixed cost of purchase, thus alleviating capital constraints and effectively allowing firms to **produce at scale collectively.**

In line with the presence of these rental markets, we further document that production is organised in **clusters,** and that firms tend to engage in

cooperative behaviour with other firms in the same cluster. It is common for firms not only to share machines with other firms in their network, but also to share information and even workers. Clusters are very common in carpentry and metal fabrication: these are sectors characterised by a large number of firms that tend to locate nearby each other. Clustering is less common in grain milling instead, as this is a sector with fewer and more geographically dispersed firms.

Figure 2: Usage of modern machines by ownership vs rental



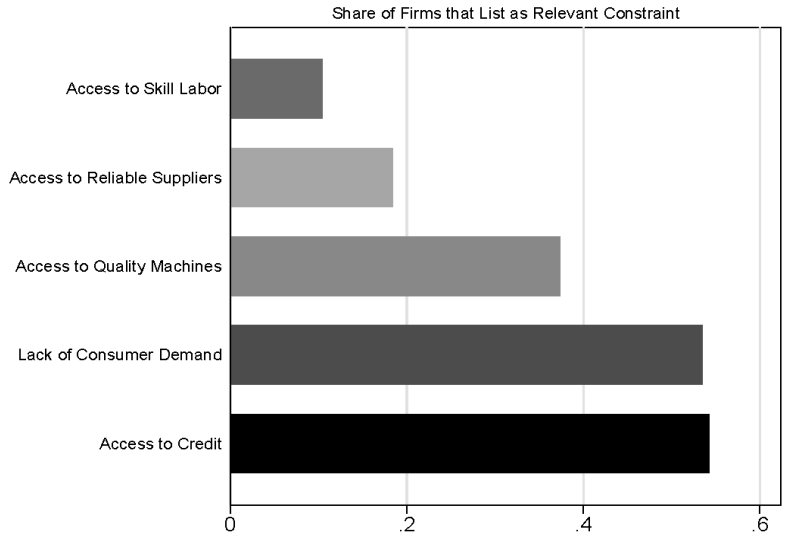
We note that while the rental market is very active in carpentry, it is much less developed in the other two sectors of metal fabrication and grain milling: in metal fabrication machines are cheaper so firms mostly own them; in grain milling instead machines are expensive but firms use them more intensively, so that there is less scope for renting out the excess capacity.

While the rental market effectively helps firms in carpentry to reduce capital constraints and to achieve scale, this has not succeeded in removing barriers to machine access for all firms. As shown in *Figure 3*, the average firm still reports **access to machines as an important constraint**. Renters are more likely to report access to machines as their primary constraint, and in over 70% of cases, firms that are renting machines report that they are doing so as a second-best alternative, and would prefer to buy the machines if they could access enough money to do so. Renters also have significantly lower profits per worker than firms who own machines. These findings suggest that renters still face significant challenges in accessing the machines they need in production.

This may be due to the rental market being subject to imperfections such as transportation, coordination, and monitoring costs that limit

its effectiveness. For example, firms that want to rent a machine need to transport their wood to the premises of the firm that owns the machine, in order to use the machine there. They then need to bring their wood back to their firm in order to finish the operations. This likely creates substantial transportation costs. In addition, firms that want to rent a machine need to wait until the machine is free, thus leading to coordination costs. Such transportation and coordination costs can limit the benefits from the rental market. Finally, machine owners usually supervise the work being done with their machine by other firms, to make sure the machine is used properly. These types of monitoring costs can lead to higher prices and lower utilisation again limiting the effectiveness of the rental market in helping firms produce at scale.

Figure 3: Perceived constraints to productivity growth



Policy recommendations

While our analysis is not causal, our results do show that the main factor that differentiates productive and unproductive firms is mechanisation. Modern machines are faster, more accurate and produce higher quality work. Therefore, our results suggest that **policies stimulating mechanisation** are likely to be particularly promising in increasing productivity.

However, in practice, what can governments do to help firms mechanise in a cost-effective way? The main lesson from our study is that policy-makers can leverage **the cooperative nature of firm clusters** to increase mechanisation and spur productivity. This means that in areas where at least some firms own modern machines and where the rental market for machines is already operating, attention should be given to improving the functioning of the existing rental market. One initiative that seems promising in this respect is to facilitate interactions and communication among firm owners, for instance by helping firms form **business groups or associations.** Increasing

interactions among firm owners can lead to more information flows about who owns machines and who needs machines, as well as to more trust among firm owners. Information and trust can be very important to reduce coordination and monitoring costs, thus potentially improving the functioning of the rental market.

Another initiative that seems promising is to help firm owners access the credit they need to purchase machines, for example by providing subsidies to purchase capital equipment. The key implication of our study here is that helping one firm purchase machines likely benefits other firms in the cluster as well through the rental market. In other words, the new capital generates **positive spillovers** to other firms. Because part of the excess capacity of large machines can be rented out to other firms, even just helping a few key firms buy machines can lead to many other firms also being able to use the new machines. This means that **targeted credit subsidies** to purchase machines can potentially be a highly cost-effective policy tool.

Credit subsidies can be even more important in areas where no firms currently own modern machines, so that a rental market for machines is absent. Subsidising key members of the cluster has the potential to be highly cost effective in these areas, as it can lead to the emergence of a rental market for the newly purchased machines, which can then benefit the cluster at large.

In fact, the Ministry of Trade of Uganda, together with the Office of the President, has for some time been providing machines to clusters of firms around Uganda. The decision of the Ministry and the President to engage in this kind of intervention was a response to the demands of local producers for help in accessing modern technology. This is an interesting initiative, and it would be very useful to collect data and conduct an evaluation of its impacts on mechanisation and productivity.

More generally, evaluating interventions such as incentives to create business groups or targeted credit subsidies to purchase machines through rigorous randomised control trials seems a promising way forward for better design of industrial policy in Uganda and other developing countries.