Study Protocol: Why do farmers sell immediately after harvest when prices are lowest?

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Motivation

It is often observed that smallholder farmers sell most—if not all—of their marketable surplus immediately after the harvest to itinerant traders at the farm gate. For example, in a survey among maize farmers in Uganda, more than 75 percent of farmers that sold maize sold everything in a single transaction, 77 percent sold to a middlemen and 50 percent immediately after harvest.

Selling immediately after the harvest is not optimal. Thin and poorly integrated markets mean that immediately post harvest, prices in excess supply areas drop. Later, during the lean season when some of the farmers run out of stock, prices have recovered, or even increase further since farmers start to buy back. This lead to the "sell low buy high" puzzle (Stephens and Barrett, 2011). In addition to high supply immediately post harvest, agricultural commodities are often not yet in optimal condition. For instance, in the case of maize, fresh grains are generally not dry enough, requiring further processing and leading to increased risk of rot by the trader. Often, this is used as a reason to further drive down the price paid to the farmer.

There are many reasons for this observed behaviour. Farmers may simply not have the space and infrastructure available to safely store large quantities of maize for extended periods of time (Omotilewa et al., 2018). Farmers may be in urgent need of cash after the lean season (Burke, Bergquist, and Miguel, 2018; Dillon, 2021). Price movements may be unpredictable and farmers may be too risk averse to engage into intertemporal arbitrage (Cardell and Michelson, 2020). It may be that traders only visit villages immediately after harvest,

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and farmers do not have the means to transport maize to markets themselves. Furthermore, issues related to social taxation may mean farmers convert maize to cash, which is easier to hide from friends and family. There may also be behavioural factors, such as present bias, anchoring of prices to past experience where negative experiences are more salient than postive experiences etc.

In this study, we zoom in on two potential explanations for the sell low buy high puzzle. A first is related to budget neglect, whereby farmers underestimate expenses later in the season and as a result sell too much of their harvest too soon. To test this hypothesis, we implement a field experiment in which

Warehousing is a solution to both of these problems. It provides a safe location where agricultural commodities can be aggregated and stored for longer periods. However, even when warehouses are available, farmers seem reluctant to bulk significant amounts of agricultural commodities and store for longer periods.

In this paper, we focus mainly on the question: Why do farmers not store for longer periods?

Literature

Why do farmers sell low and buy high? One of the most obvious, is related to credit constraints. Using observational data, Stephens and Barrett (2011) find that to meet consumption needs later in the year, many farmers end up buying back grain from the market a few months after selling it, in effect using the maize market as a high-interest lender of last resort. Burke, Bergquist, and Miguel (2018) show that in a field experiment in Kenya, credit market imperfections limit farmers' abilities to move grain intertemporally. Providing timely access to credit allows farmers to buy at lower prices and sell at higher prices, increasing farm revenues and generating a return on investment of 29% . Dillon (2021) uses the fact that primary school began 3 months earlier in 2010 than in 2009 to demonstrate that this prompted households with children to sell maize when prices are particularly low. To identify the impacts of liquidity during the lean season, Fink, Jack, and Masiye (2020) offered subsidized loans in randomly selected villages in rural Zambia and conclude that liquidity constraints contribute to inequality in rural economies.

Risk averse farmers may also fail to delay sales if there is considerable uncertainty about the price in the future. A recent article argues that the "sell low buy high" puzzle is not a puzzle at all by arguing that price movements are insufficient for farmers to engage in inter-temporal arbitrage (Cardell and Michelson, 2020). However, their analysis use prices obtained from market centers, which may be a poor proxy for the farm gate prices that farmers face: prices in main markets are generally much better integrated in the wider national, regional and even global economy, and so will be less prone to extreme spikes and slumps.

A reason that is often heard in the field is that farmers have nowhere to store, so they just sell. This could be a lack of space, as farmers often harvest

10-20 bags of 100kg of maize. But there are also risk related to pests and diseases affecting the stored maize. If storage is the main reason why farmers do not engage in intertemporal arbitrage more, then providing storage technology should delay sales Omotilewa et al. (2018) indeed find that households that received PICS bags stored maize for a longer period, reported a substantial drop in storage losses

- social taxing: if I have a lot of maize in my house, this is visible for family and neighbours and it will be very hard to deny if they come and ask for it. Therefore, I sell everything now; I can hide the money. and it also seems seems to be a reason why households do not buy in bulk "paying more for less" paper. You find that
  - I would be particularly interested in individuals that are frequently taxed by friends and relatives. In this context, Dupas and Robinson (2013) find that adding an earmarking feature was effective.
  - lack of self control: seems less plausible as it is money is probably burning a bigger hole in your pocket than the bags of maize you have stored. You can only eat so much. This includes failure to resist temptation to extract themselves or social taxation. There is a solid literature on this for savings (Ashraf, Karlan, and Yin, 2006; Dupas and Robinson, 2013),
  - budget neglect (which leads to an overoptimistic view of the future) - how does this fit in the sell low buy high puzzle? But do people really see the future better than it is? I think the term overoptimistic future is very misleading in this article. Towards the end, they speculate on why budget neglect persists. They find that rosy memories dampen ability to learn from the past. This seems to contradict research that claim bad experiences (rejections) tend to stick much more than positive outcomes (acceptance) .
  - But are they using appropriate prices (regional market prices are not a good proxy for farm gate prices)? Also, if farmers are indeed rational to sell everything immediately post harvest, then I am still surprised to see the predictable and recurrent consumption cycles (Kaur).
  - trust issues: I think this is a big reason why farmers do not want to aggregate. It requires one to have sufficient trust in the store manager.

model

$$\underset{c_1,c_2,e_3}{max}\ U_1(c_1) + \delta U_2(c_2, e_2) \tag{1}$$

$$st\ c_1 + c_2 + \gamma e_2 = p.h_1 + (p+\theta).(H - h_1)$$

What is left is sold at time 2, when the price has changed by θ.

Hypotheses and Interventions

In a first hypothesis, we assume that farmers suffer from budget neglect—the left side of the budget constraint—which may lead to an overoptimistic view of the future. Budget neglect is also found to be a main contributing factor to recurrent hungry seasons in Zambia.

A second intervention is related to the right side of the budget constraint. Here, the hypothesis is that farmers are too pessimistic about the future price. Farmers typically rely on experience an anchoring to attach probabilities to the price distribution. There is some evidence that people provide more weight to negative experiences in the past than to positive experiences.

Marketing can be approached in a similar way as technology adoption. Can we use the insights from budget neglect here, like Brian and Jenny think that inability of farmers to incorporate all costs and benefits leads farmers to choose an inferior storage technology?

In one treatment, we can show farmers a video that details all costs involved? But this seems somewhat lame.

Here is another explanation that uses the budget neglect idea: Consider a very simple 2 period model where a farmer gets two opportunities to sell. Once immediately after the harvest and once during the lean season. The farmer has a total harvest of H<=q1 + q2 and so needs to decide in period 1 how much to sell, given his price expectation for p2 and how much they expect to need in the future.

Budget neglect leads farmers to sell too much immediately after harvest. In a first intervention, we do something similar to Kaur et al based on segmentation and recall, but in the context of intertemporal arbitrage. For instance, we ask the farmer to give the expected price

Pessimistic price expectations also lead to higher sales immediately post harvest. A second intervention looks at anchoring/framing where we ask some farmers to give the lowest/ highest expected price. We can than look at a quadratic loss function compared to the control group the was asked about the expected price, but also look at asymmetry.

Experimental design and power calculations

The proportion of farmers that sold immediately after the harvest. We use the IHS 2019/2020 to run power simulations.

Context and study area

The study focuses on the Central and Northern Region of Malawi (Kasungu, Mzimba, Ntchisi, Rumphi, Dowa and Mchinji). These areas are characterized by rained agriculture with a single season. The resulting seasonal price movements is illustrated in Figure 1 that shows maize price in kwatcha per Kg in Rumpi over 2020. Planting of maize starts in December, and maize becomes increasingly

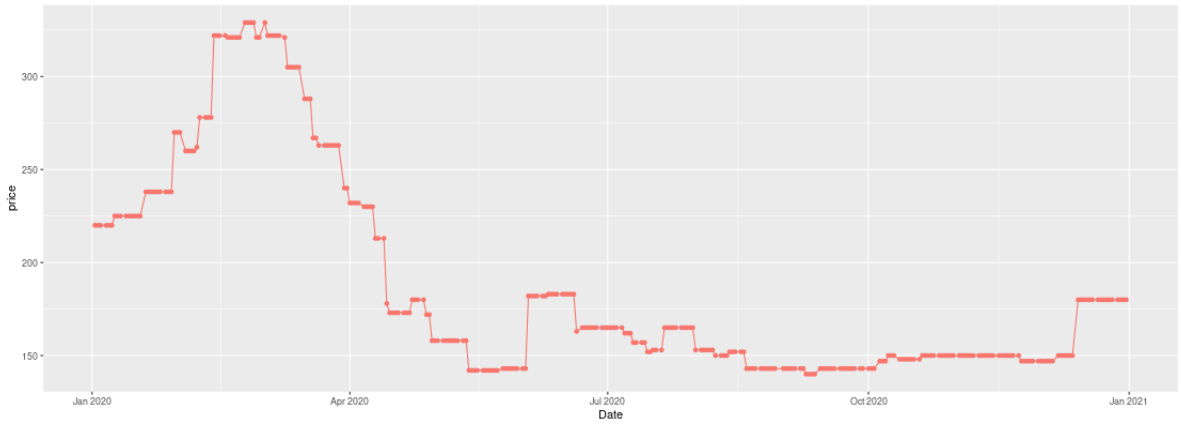

Figure 1: Price of maize in Rumphi

scarce during the growing season. Harvesting starts around April 2020, which takes the pressure off the prices when farmers start consuming from their own maize. However, farm gate sales are still low as traders wait for maize to dry. This results in a relatively long period of low prices all the way to the start of the planting season towards the end to the year.

The aim of the study is to encourage farmers to wait just a few months longer and sell

Outcomes

The proportion of farmers that sold immediately after the harvest.

In this section, we register the outcomes that will be used to assess impact and investigate impact pathways.

Key outcomes: - sales of commodity (proportion, quantities) - prices fetched - aggregation (sales to warehouse) - disrespecting contract/side selling - farmer welfare - time between harvest and sales

-anchoring: ask the farmer to write down what the price was last season and stick it on the bag.

-self-serving bias in how people interpret their past performance: rosy experience?

References

Stephens, Emma C. and Christopher B. Barrett (2011). "Incomplete Credit Markets and Commodity Marketing Behaviour". In: *Journal of Agricultural Economics* 62.1, pp. 1–24. DOI: https://doi.org/10.1111/j.1477-9552.2010.00274.x. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.

1111/j.1477-9552.2010.00274.x. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1477-9552.2010.00274.x.

Omotilewa, Oluwatoba J. et al. (2018). "Does improved storage technology promote modern input use and food security? Evidence from a randomized trial in Uganda". In: *Journal of Development Economics* 135, pp. 176–198. ISSN: 0304-3878. DOI: https://doi.org/10.1016/j.jdeveco.2018.07.006. URL: https://www.sciencedirect.com/science/article/pii/S030438781830926X.

Fink, GuÌnther, B. Kelsey Jack, and Felix Masiye (2020). "Seasonal Liquidity, Rural Labor Markets, and Agricultural Production". In: *American Economic Review* 110.11, pp. 3351–92. DOI: 10.1257/aer.20180607. URL: https://www.aeaweb.org/articles?id=10.1257/aer.20180607.

Dillon, Brian (2021). "Selling Crops Early to Pay for School: A Large-Scale Natural Experiment in Malawi". In: *Journal of Human Resources* 56.4, pp. 1296–1325. DOI: 10.3368/jhr.56.4.0617-8899R1. eprint: http://jhr.uwpress.org/content/56/4/1296.full.pdf+html. URL: http://jhr.uwpress.org/content/56/4/1296.abstract.

Burke, Marshall, Lauren Falcao Bergquist, and Edward Miguel (Dec. 2018). "Sell Low and Buy High: Arbitrage and Local Price Effects in Kenyan Markets*". In: *The Quarterly Journal of Economics* 134.2, pp. 785–842. ISSN: 0033-5533. DOI: 10.1093/qje/qjy034. eprint: https://academic.oup.com/qje/article-pdf/134/2/785/28289352/qjy034.pdf. URL: https://doi.org/10.1093/qje/qjy034.

Cardell, Lila and Hope Michelson (July 2020). *âSell Low, Buy High?â - A New Explanation for a Persistent Puzzle*. 2020 Annual Meeting, July 26-28, Kansas City, Missouri 304448. Agricultural and Applied Economics Association. DOI: 10.22004/ag.econ.304448. URL: https://ideas.repec.org/p/ags/aaea20/304448.html.

Dupas, Pascaline and Jonathan Robinson (2013). "Why Don't the Poor Save More? Evidence from Health Savings Experiments". In: *American Economic Review* 103.4, pp. 1138–71. DOI: 10.1257/aer.103.4.1138. URL: https://www.aeaweb.org/articles?id=10.1257/aer.103.4.1138.

Ashraf, Nava, Dean Karlan, and Wesley Yin (May 2006). "Tying Odysseus to the Mast: Evidence From a Commitment Savings Product in the Philippines*". In: *The Quarterly Journal of Economics* 121.2, pp. 635–672. ISSN: 0033-5533. DOI: 10.1162/qjec.2006.121.2.635. eprint: https://academic.oup.com/qje/article-pdf/121/2/635/5324429/121-2-635.pdf. URL: https://doi.org/10.1162/qjec.2006.121.2.635.