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Evaluating seasonal food storage and credit programs in east Indonesia ☆

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ABSTRACT

Predictable annual lean seasons occur in many rural areas, including West Timor in Indonesia. Imperfections in savings and credit markets make it difficult for staple farmers to convert harvest season output into lean season consumption. We conduct a randomized evaluation of a seasonal food storage program and a food credit program. By providing improved ways to transfer assets across seasons, each program functions as a subsidy on lean season consumption. We find that neither program had effects on staple food consumption. The storage program increased non-food consumption. The credit program increased reported income and reduced seasonal gaps in consumption. Our results are consistent with positive income effects through the expansion of budget sets, but suggest that the average household could be close to staple food satiation.

1. Introduction

Seasonality is a concern for many households engaged in rain-fed agriculture.[1] Farmers whose incomes vary over the agricultural cycle need access to instruments–savings or credit–to transfer assets across seasons. Imperfections in savings and credit markets can lead to low consumption levels and predictable annual lean seasons.[2] Yet, there is limited evidence on the impacts of programs that address market imperfections related to seasonality.[3]

We conduct a randomized evaluation of two seasonal programs–food storage and food credit–in West Timor. This island in East Indonesia has historically suffered from an annual lean season between November and January. We focus on farmers who produce staples–maize or rice–which serve both as a form of consumption and a tradable asset. Many farmers have difficulty borrowing against future harvests, use poor storage methods, and face seasonal price variation. These features, which we call seasonal frictions, have two effects—they skew consumption away from the lean season and they limit annual consumption possibilities.

We build a stylized model that encapsulates these seasonal frictions in a low harvest-to-lean season marginal rate of transformation (MRT). The lower a household's MRT, the more harvest consumption it must forgo to provide for lean season consumption. The problem of seasonality is therefore framed as a technological one—seasonal frictions lower MRT, increasing the opportunity cost of lean season consumption and making it difficult to transfer assets across seasons.

We address this problem by offering improved access to savings or loans, both of which can raise farmers' MRT. In 2008, we randomly assigned 96 villages to receive a food storage program, a food credit program, or no program. Assignment was stratified by four districts, and

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[1] Seasonal food shortages have been documented in parts of Sub-Saharan Africa, South Asia and Southeast Asia. See Khandker and Mahmud (2012) and Devereux et al. (2012) for an overview.

[2] There is a large literature on the challenges to consumption smoothing in the presence of credit or saving constraints, notably (Deaton, 1991; Townsend, 1994). See Khandker and Mahmud (2012) for a discussion focused on seasonality and Zeller et al. (1997) for an overview that relates food security policies to the consumption smoothing literature.

[3] Seasonal food deprivation has been described as the "cycle of quiet starvation" and the "father of famine" (Devereux et al., 2008) and "one of the most persistent and intractable aspects of global food insecurity" (Khandker and Mahmud, 2012). Yet, according to two surveys on this topic, "of all the dimensions of rural deprivation, the most neglected is seasonality" (Devereux et al., 2008), and, "a focus on seasonality is often missing" in social protection schemes (Khandker and Mahmud, 2012). There is a small but growing literature on policies to mitigate seasonal food shortages. We discuss this later in the introduction.

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two NGOs implemented the programs in two districts each. The storage program offered households free food storage equipment–weather-sealed drums and sacks–with high retention rates. For the credit program, women's microcredit groups were formed and offered loans of staples during the lean season, which were to be repaid in kind after the following harvest. Repaid grain was stored in sealed facilities for disbursement in the following lean season.

Increases in the MRT effectively serve as subsidies that lower the opportunity cost of lean season consumption and thereby expand the overall budget set. As a result, first, substitution effects serve to raise lean season consumption and lower harvest season consumption. Second, income effects from the expansion in the budget set can raise consumption in either season.

Beyond the above-described parallels between the two programs, each operated through different mechanisms and had relative strengths and weaknesses. Storage directly improved MRT by raising the retention rates of stored staple. Furthermore, the program could serve as a commitment device to help households save because the technology reduced visibility of assets and made frequent withdrawals cumbersome. These commitment benefits could apply to both self-control problems and social pressures to share. But it was possible that benefits would be limited within our three-year study—it could take time to accumulate a buffer stock or there might be nothing to store if there were harvest failures.

The credit program improved MRT by allowing households to borrow against future harvests relatively cheaply. It had risk-mitigating features that storage lacked—it provided implicit insurance against harvest risks through limited liability; the group structure encouraged risk-sharing across participants; and unlike storage, it offered a fixed and explicit MRT. This implies that the credit program could have stronger effects on reducing consumption variability, including across seasons. However, by providing an up-front benefit with delayed repayment, it had the potential to increase the debt burden of households if they over-borrowed. The viability of the credit program depended on repayment rates since it was funded with a one-time grant.

To investigate the impacts of food storage and credit, we built a large scale seasonal household panel that tracked 2870 households during each harvest and lean season over three years. We test for two categories of treatment effects. First, we look at the mean effects on consumption-related outcomes, which could also have consequences on health. Second, we look at seasonal gaps between harvest and lean season consumption. We report Intent-to-Treat (ITT) effects below.

The storage program raised the *Consumption and Income Index* by 0.097 units. This is driven by a 13.4% and a 14.2% increase in non-food expenditure in the lean and harvest seasons, respectively. We find a null effect on staple food consumption (0.6% effect, s.e. 2.9%), with a 95% confidence interval on calories consumed per capita per day of −18 to 23 cal. Further analysis shows that the positive effects on the index are strongest for individuals who we identify as the most savings constrained; i.e. those who face relatively low initial MRTs.

For storage, we find no effects on consumption smoothing across seasons. This is consistent with the discussion above on its relative lack of risk protection mechanisms compared to credit. Storage also had no effects on health.

The credit program raised the *Consumption and Income Index* by 0.087 units, but only in the harvest season. This is driven by a 26.8% rise in reported income in the harvest season, with no detectable changes in consumption levels. Since our measure of consumption is incomplete, this increased income might translate into higher consumption in categories that we do not measure. Again, we estimate null effects on staple food consumption (2.4%, s.e. 3.6%), with a 95% confidence interval of −95 to 196 cal per capita per day.

Additionally, the seasonal gap in monthly non-food expenditure narrowed by 0.066 units, with significant reductions in the overall *Seasonal Gap Index* for districts administered by one NGO. However, there were moderately negative health effects in the harvest season. The *Health Index* is 0.075 units higher in the lean season and is 0.130 units lower in the harvest season. Health effects are statistically insignificant in the lean season and when we pool both seasons.

The null effects on staple food consumption are striking considering our focus on raising the MRT of these goods. The positive effects on non-food consumption and reported income suggest that each program did raise household assets for staple farmers. But this rise in assets did not translate into greater staple consumption, which implies that the average household in our study could be close to staple food satiation. This is consistent with preferences where the marginal utility of staples drops rapidly relative to the marginal utility of other consumption (see Banerjee and Duflo, 2007; Jensen and Miller, 2008 for related discussions of preferences).

This finding is also notable in the light of transaction costs associated with the buying and selling of staples, which are relevant given our focus on remote rural households. Under standard food subsidy programs, transaction costs of converting cash (or vouchers) to staples might incentivize households against raising staple consumption. In contrast, our programs directly expand in-kind income, so households could have minimized transaction costs by raising staple consumption instead of converting it to other goods.

This paper demonstrates some ways in which staple programs can affect outcomes for staple farmers despite leaving staple consumption unchanged. This has implications for the design and interpretation of staple food policy, which plays a major role in many developing countries.[4] Increases in harvest season consumption are consistent with dominant income effects from budget set expansions, and a consequent rise in welfare.

To better understand the mechanisms, we analyze how each program affects intermediate outcomes. In Sections 4.1 and 4.2, we extend our stylized model to develop hypotheses for the programs' effects on "first-stage" outcomes that precede consumption—staple inventory and staple sales. In Section 4.3, we discuss how the programs might interact with risks, social pressures and behavioral biases. We also consider other budget set effects that could counteract the effects of the programs.

In Section 7, we discuss first-stage effects on staple sales and inventory. While each program affects sales, we do not detect effects on inventory. The latter has two explanations. First, stocks are difficult to measure precisely and are highly sensitive to timing. Second, some of our theoretical predictions on sales and inventory are themselves ambiguous. In particular, for both storage and credit programs, the signs of first-stage effects in the harvest season depend on the household's initial method of saving.[5]

Despite the fact that we do not observe effects on inventory, the following patterns shed some light on mechanisms. For storage, we find increases in income from staple sales in districts under one NGO. In particular, higher lean season staple sales are consistent with expanded inventory. Also, since consumption effects are stronger for savings-constrained households, it appears likely that the storage program facilitated

[4] In the Philippines, the rice subsidy program accounts for 70% of public social protection expenditures (Jha and Ramaswami, 2010). Indonesia and India too have large and expensive staple subsidy programs.

[5] While our model makes clear predictions on first-stage effects in the lean season, harvest season effects are theoretically ambiguous. Under the storage program, in the lean season both sales and inventory should rise—more inventory due to the higher retention rate and more sales to fund other consumption. However, harvest season predictions depend on initial methods of saving—when income effects dominate, effects on intermediate steps are opposite-signed for cash savers versus in-kind savers. As we explain in Section 4.3, in-kind savers should store less and sell more to fund greater non-food consumption in the harvest season, but cash savers who switch to saving in-kind should store more and sell less.

Under credit, in the lean season, sales should rise as under storage. In the harvest season, again, predictions for staple sales are ambiguous. Staple sales for consumption increase but sales for savings drop for cash savers, since they now have to repay in kind. But in contrast to storage, inventory in both seasons should fall since credit reduces the need to maintain one's own stock.