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Linking agricultural investments to growth and poverty: An economywide approach applied to Mozambique

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ABSTRACT

National agricultural investment plans in developing countries are expected to be evidence-based, reflect broad development processes, and measure contributions to high-level outcomes, such as economic growth and poverty reduction. We propose an economywide systems-approach that combines *ex post* household econometric analysis (using propensity score matching) of investment impacts with *ex ante* modeling of growth and poverty linkages (using a spatially-disaggregated dynamic computable general equilibrium model). We apply this approach retrospectively to Mozambique. Simulation results indicate that the country's investment plan from 2012 to 2017 would not achieve national growth targets, despite doubling public spending on agriculture. Rather than increasing spending, the government should have reallocated resources towards agricultural research and extension, instead of irrigation and fertilizer subsidies. Providing extension services to smallholders is most effective at raising growth and reducing poverty in all regions of the country. Investing in irrigation was more likely benefit growth in the country's southern region due to less favorable agroecological conditions. These conclusions are robust across assumptions about investment efficiency. As demonstrated in Mozambique, our approach provides a consistent framework for evaluating *ex ante* sector-wide agricultural investment plans based on growth, poverty and regional equity considerations. Our approach complements household-level evaluations by enhancing their relevance for national planning.

1. Introduction

National agricultural investment plans should ideally be designed using evidence on the *relative* effectiveness and efficiency of different interventions in order to optimize the allocation of public resources within the sector. In developing countries, where agriculture is a major economic sector, agricultural investment plans are expected to consider not only impacts on farming and food security, but also indicate contributions to high-level outcomes (e.g., economic growth, job creation, and poverty reduction) and reflect national development processes and objectives (e.g., urbanization and industrialization). Agricultural policymakers in these countries are asked to adopt a "systems approach" that situates farm-level investments and policies within sector-wide strategies and programs, and quantifies economywide impacts and trade-offs. Demand for this approach is particularly evident in Africa, where many governments have committed to the African Union's Comprehensive African Agricultural Development Program (CAADP), which promotes sector-wide planning and sets spending commitments and national growth and poverty targets.

Adopting sector-wide approaches and measuring economywide outcomes is technically challenging, and the existing literature provides only limited guidance. Despite advances in impact evaluation techniques, the evidence generated by most studies is derived from small-scale (often donor-funded) pilot projects involving specific interventions. Policymakers must therefore consolidate evidence from multiple studies, and consider externalities arising from scaling-up (and financing) investments. Most impact evaluation studies focus on household-level outcomes and overlook other parts of the agriculture-food system, such as downstream processing and trading. Evidence suggests that the economywide spillovers associated with agricultural investments can be substantial (see, for example, Arndt et al., 2016; and Taylor and Filipski, 2014).

An alternative approach is to directly evaluate the effects of sector-wide spending. Fan et al. (2000), for example, use district panel data to estimate the impact of different investments on total agricultural revenues. A similar approach is proposed by Elbers et al. (2009), albeit for the education sector. These studies provide information on the marginal returns to investments that can be used to prioritize sectoral budgets.

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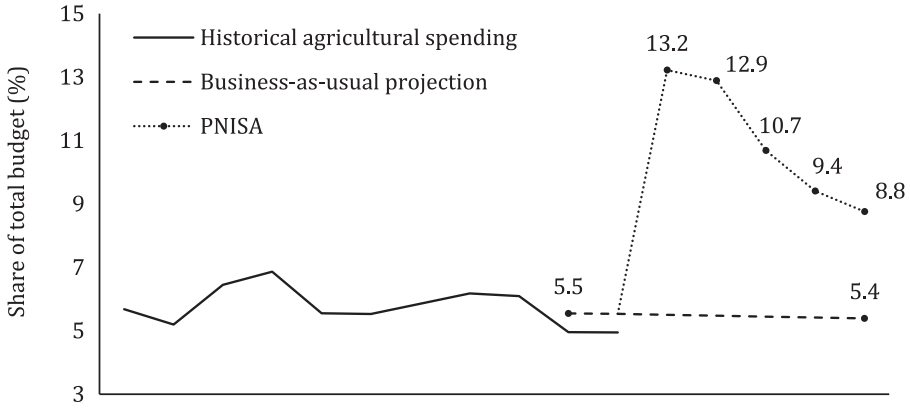

Fig. 1. Public Agricultural Spending, 2002–2017.
Notes: The "business-as-usual projection" maintains the 2007–12 average annual agricultural budget share.
Source: Own calculations using World Bank (2011), Mogues and Benin (2012), GOM (2012) and MAFAP (2017).

However, these studies have limitations. Spatial and time-series expenditure data is often unavailable, and even where data exists, it only provides information on past investments. New types of investments have little or no historical precedence on which to base current decisions. Nor is it obvious that long-run average returns are a good indicator of future impacts, due to changes in policy design and implementation practices. Finally, these studies measure sector-level rather than economywide outcomes.

Linking agricultural investments to national growth and poverty presents a further challenge. A well-established literature confirms the importance of agricultural growth for economic development and poverty reduction (see Christiaensen et al., 2011; Dorosh and Thurlow, 2016). However, different sources of agricultural growth lead to different growth multipliers and poverty linkages. Diao et al. (2010), for example, find that agricultural growth led by staple food crops is more effective at reducing national poverty than growth from export-oriented crops. Similar differences exist for growth led by smallholder outgrower schemes versus large-scale plantation farms (see, for example, Arndt et al., 2010). However, while the existing literature provides general guidance on the distributional effects of different sources of agricultural growth, it lacks the specificity required for evidence-based planning. It also does not consider the costs associated with achieving growth and poverty outcomes.

We present a mixed-method, systems-oriented approach to prioritizing investment plans – one that combines the strengths of *ex post* survey-based evaluations and *ex ante* economywide models. This allows for explicit, albeit somewhat stylized, analysis of sector-wide expenditures, as opposed to detailed analysis of specific interventions or sector-wide assessments lacking flexibility or sufficient empirical grounding. We demonstrate our integrated approach in Mozambique. At the household-level, we econometrically estimate the direct impact of on-farm interventions, including access to extension services and the use of irrigation and chemical fertilizers. This analysis is done for subnational regions that have different agroecological, socioeconomic, and market conditions. Results are used to parametrize a public agricultural investment module that measures direct outcomes at the sector-wide level. The investment module is linked to a computable general equilibrium (CGE) model, which measures the direct and indirect impacts of investments on national and regional growth and poverty.

Our approach addresses some of the above-mentioned limitations. It provides a consistent framework for prioritizing investments based on household-level data and models that track high-level outcomes. Although we focus on growth and poverty, the approach can be used to track food security and nutrition, as well as environmental outcomes, such as water resource depletion and emissions from land-use change (see Pauw and Thurlow, 2011; Schuenemann et al., 2016).

The paper is structured as follows: Section 2 describes Mozambique's agricultural sector and its investment plan, and Section 3 outlines our methods and evaluation procedure. Section 4 estimates the investment functions' parameters, and Section 5 presents results from simulating different combinations of agricultural investments. The final section summarizes our findings and identifies areas where the approach could be extended or improved.

2. Agriculture in Mozambique

2.1. National agricultural investment plan

We evaluate Mozambique's agricultural investment plan known as the Programa Nacional de Investimento do Sector Agrário (PNISA) (GOM, 2012). PNISA established ambitious targets for the 2013–2017, including doubling agriculture's share of public spending and achieving 6% annual growth in agricultural gross domestic product (GDP). This ambition reflected concerns about the slow pace of poverty reduction in the country in recent years. Mozambique's economy grew rapidly at 7% per year during the 2000s, but the national poverty headcount rate remained virtually unchanged.[1] This is partly attributed to the timing of weather shocks and higher world food and energy prices (Arndt et al., 2008). However, the longer-term failure of domestic policy to promote rapid agricultural growth was a significant factor (Cunguara and Hanlon, 2010). Arndt et al. (2012) found that slower-than-expected agricultural growth was a major factor explaining the slow pace of poverty reduction.

Mozambique's government signed the CAADP agreement in late-2010, thereby committing itself to allocating at least 10% of the total budget to agriculture. On average, during 2007–2012, only 5.5% of the budget was for agriculture, and this share would have remained unchanged if prevailing trends had continued after 2012 (see Fig. 1). PNISA's aim was to increase agriculture's budget share to an average of 10.2% per year during 2013–2017.[2] PNISA's five-year budget was $2.5 billion, thus implying $1.2 billion additional spending beyond what was expected based on past trends. We evaluate the impact of this planned increase.

Table 1 shows the allocation of funds across investment areas in the agricultural sector. PNISA planned to spend, on average, $39.7 per rural inhabitant per year (measured in constant 2012 dollars and accounting

[1] The poverty headcount rate is the share of the population with per capita consumption below the official poverty line.

[2] The most recent data indicates that agriculture's actual budget share averaged 14.3% during 2012–2015, which exceeded PNISA's planned 12.3% budget share (IFPRI, 2017).

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