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Research Note 13

Integrating livestock in the CAADP framework: Policy analysis using a dynamic computable general equilibrium model for Ethiopia

Summary of ESSP II Working Paper 34, "Integrating livestock in the CAADP framework"

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This study examines the magnitude of the macro and welfare effects generated by a realistic acceleration in the productivity growth of the Ethiopian livestock sector, as compared to historical trends and to alternative scenarios of productivity expansion in the cereal and cash crop sectors. Results from the dynamic general equilibrium simulations show large aggregate gains from livestock productivity acceleration and effects on poor households' incomes and consumption that are roughly in line with those obtained under cereal growth. This bears important initial implications for the allocation and prioritization of public investment in agriculture in Ethiopia.

Researchers and policy makers increasingly recognize that the livestock sector supports the livelihoods of a large proportion of rural households in Africa and may have an important role to play in rural poverty reduction strategies.

In Ethiopia, the livestock sector is particularly large. It accounts for about one-third of agricultural GDP, approximately the same as total cereals, and 14 percent of overall GDP. Livestock products, including live animals, meat, and leather goods, are a major source of foreign exchange, about 6.4 percent of total exports. Meat, eggs, dairy, and other livestock products together account for about 12 percent of the value of total household consumption. Additionally, farmers rely heavily on oxen draft power to till the land for crop cultivation.

Given its critical role in generating macro flows, accelerated growth in the livestock sector should have the potential to stimulate wider economic growth and reduce poverty significantly. Understanding the magnitude of these effects is an important pre-requisite to appropriately prioritize public resources for the development of the sector, and to strike the right balance for the allocation of public investment between different agricultural sub-sectors.

To adequately analyze growth in the livestock sector and its macro effects, economy-wide models should capture both the biological, dynamic relationships between the stocks and flows of livestock, and the economic linkages between the sector and the rest of the economy. To do so, we extend an existing dynamic recursive general equilibrium model for the Ethiopian economy with the aim of representing substantive features of the sector which were not captured by previous models. We first develop a separate herd dynamics module that enables us to specify stock–flow relationships, distinguishing between the capital role of livestock and the flow of livestock products. In our model, livestock productivity growth in one year increases the stock of the factor, resulting in a flow of benefits that continues in successive years.

The separate module is then coupled with the main general equilibrium model. We also improve the underlying system of economic accounts to better capture the economic importance of draft power and breeding stocks. The data for the model is disaggregated into five agroecological zones.

We use this model to simulate separate, realistic total factor productivity (TFP) shocks to three agricultural

subsectors—cereals, cash crops, and livestock—and compare them with a baseline scenario replicating productivity trends from 1998 to 2007, following Dorosh and Thurlow (2009).

The weighted average of TFP growth across all agricultural activities is similar across the cereal, cash crop, and livestock simulations. However, the composition of this growth differs significantly, driving the differences in simulation results. In the baseline scenario, the cereal sector has a high TFP growth rate, whereas productivity growth for cash crops and livestock is stagnant. Hence the scenario where the cereal sector accelerates is characterized by heavily unbalanced TFP growth across activities, while in the remaining two scenarios productivity gains are more equally distributed.

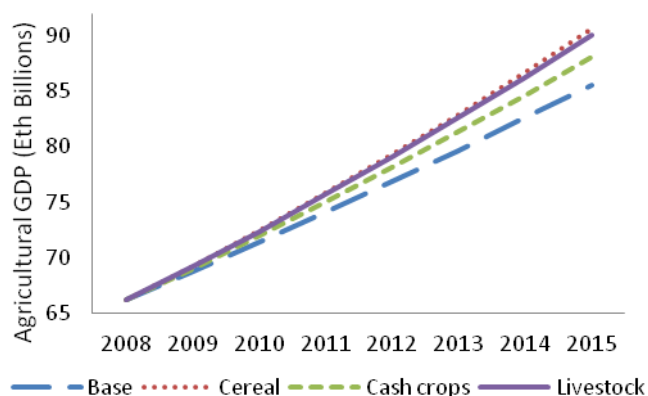
Results

The results we obtained reveal the important role of the livestock sector in increasing various measures of GDP and combating food insecurity. Agricultural GDP and overall GDP growth levels achieved in the livestock TFP shock scenario are very similar to those achieved in the cereal TFP shock scenario, unlike what was previously thought.

In our simulations, factors are dynamically re-allocated between agricultural activities. This highlights the inefficiency of strategies focusing on cereal sector development alone, which result in asymmetric productivity gains and fail to maximize efficiency during the reallocation process. The draft power inter-linkage plays a crucial role here, as it enables the model to capture the re-allocation process of the livestock factor. Livestock TFP growth in fact spurs overall economic growth both by directly promoting livestock GDP and by providing draft power to the large and highly productive cereal sector (see Figure 1).

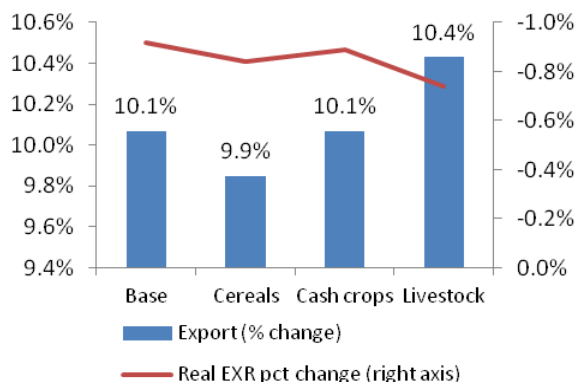
Agricultural commodities constitute the major exports of the Ethiopian economy. Accelerated agricultural TFP expansion hence has substantial effects on the external sector. These are limited by a parallel appreciation of the floating real exchange rate. Appreciation is lowest in the accelerated livestock TFP growth simulation, due to a stronger impact on absorption and demand for imports. As a result, as Figure 2 shows, total export growth is the largest in this simulation.

Figure 1. Evolution of simulated agricultural GDP under various scenarios



Source: Authors' calculations

Figure 2. Percentage change in export value and exchange rate, 2005–2015



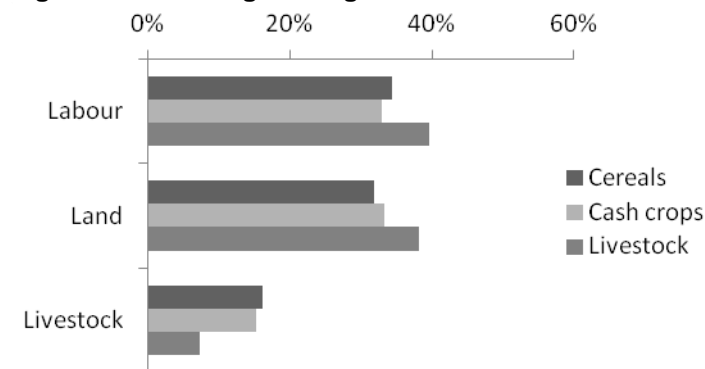
Source: Authors' calculations

There is also a welfare aspect to our results. The factor reallocation process explained above favors diverse factors differently in all the simulations. In the accelerated livestock simulation, livestock-factor intensive activities experience faster productivity growth. Following the strong supply response, the price that these activities command fails to rise much, and the returns to their main factor—livestock—similarly stagnate. The price of labor-intensive activities, on the other hand, rises markedly. Demand for labor, and agricultural labor in particular, is strong, positively affecting wages.

In the cereal simulation, on the other hand, the accelerated cereal activities are intensive in the use of land and labor. As the price for cereal activities falls and the factors are reallocated, returns to labor fail to increase much.

As a result, livestock sector productivity growth leads to greater factor income growth, particularly labor income, than in the other simulations (see Figure 3). Labor is the predominant asset of poor households and hence large income gains and food consumption growth are realized under the livestock-led scenario.

Figure 3. Percentage change in factor income



Source: Authors' calculations

Concluding remarks

In conclusion, simulation results indicate that, compared to accelerated cereal-led growth, improving productivity in the livestock sector has larger aggregate economic efficiency gains measured by value added growth effects and by improvements in the external sector: a smaller real exchange appreciation and larger export earnings. Accelerated livestock growth also results in higher income growth and comparable consumption growth.

As factors are re-allocated across sectors of the economy, and as sectors are intimately interlinked, further expanding TFP growth in the sector with the best baseline productivity performance runs into diminishing returns. A balanced agricultural growth model, where productivity gains are more evenly distributed across sub-sectors, is preferable. In Ethiopia this means investing more in expanding the productivity of livestock.

References

- Dorosh, P., and J. Thurlow. 2009. *Implications of Accelerated Agricultural Growth on Household Incomes and Poverty in Ethiopia: A General Equilibrium Analysis*. ESSP II Working Paper 2. Addis Ababa: International Food Policy Research Institute / Ethiopia Strategy Support Program II.

This research note is intended to promote discussion; it has not been formally peer reviewed but has been reviewed by at least one internal and/or external reviewer. The Ethiopia Strategy Support Program of the International Food Policy Research Institute (IFPRI) works closely with the government of Ethiopia, and other development partners to provide information relevant for the design and implementation of Ethiopia's agricultural and rural development strategies. For more information, see <http://essp.ifpri.info/> or <http://www.edri.org.et/>.

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