Welfare effects of smallholder farmers’ participation in livestock markets in Zambia

Mary Lubungu

Presentation outline

- Introduction
- Data sources
- Estimation technique
- Results and discussions
- Conclusions
Introduction

- Demand for livestock/products is increasingly rapidly in developing countries
  - trend expected to continue due to
    - Human population growth, rising incomes, increasing urbanization
- Ideally urban-rural synergies can create markets for smallholder livestock producers thus,
  - Contributing to rural poverty reduction
- Especially that rural poverty rates in Zambia have remained stubbornly high (80%) for more than a decade (CSO, 2009, 2011)
Introduction

Questions

- Does participation in livestock markets improve the smallholder household welfare?
- Are there any biases in the distribution of benefits between poor and better off households?

Conflicting evidence exist about who derives more income from livestock sales – “better off households or poor households”

- In Pakistan, Malawi, India, Asia, Latin America, and Philippines - poorer households’ benefit more (Pica-Ciamarra et al., 2011)
- In Burkina Faso - better off households’ benefit more (Wouterse and Taylor, 2008)
Introduction

- While these studies present valuable information,
  - none of them has employed econometric techniques
  - their finding are based on bivariate analysis
    - which fails to control for other factors that may affect incomes
  - Failure to control for other factors could potentially lead to biased estimates

- This study provides useful empirical evidence on the potential for livestock market participation
  - to contribute to raising incomes and reducing poverty among smallholder farmers in general
  - and among poor households in particular
Zambia

- Landlocked
- Population: 13.9 million (64% rural)
- GDP/cap: US$1,600 (26/47 in SSA)
- Rural poverty rate: 80%
- Agriculture contributes
  - 20% to GDP
  - 85% to labor force
- Single rainy season (Oct.-Apr.)

Source: CIA World Factbook
Data

- Nationally representative HH survey
  - 394 standard enumeration areas (map)
  - Smallholder HHs (cultivate <20 ha)
  - Farm & non-farm activities, demographics, assets
  - Wave 1: 2001 (6,922 HHs)
  - Wave 2: 2004 (5,358 HHs)
  - Wave 3: 2008 (8,094)
  - Treat each survey wave as separate pooled cross sectional data
  - 20,435 pooled HHs
  - 4,261 (20.8%) HHs owned cattle
Welfare indicators

- Traditionally, household income or expenditure is used as a measure of welfare
  - In developing countries, expenditure is preferred (Meyer and Sullian, 2003; Ravallion, 1992)
    - Due to under reporting of income
    - However, collection of consumption data is costly and datasets are often much smaller
- Accurate estimated income is an important indicator
  - Provide more information about income strategies and inequality (Covarrubias, de la O Campos, and Zezza, 2009)
Welfare indicator used

- Total household income which includes
  - Crop, livestock and off farm
- Income for 2001 and 2004 were adjusted for inflation using the consumer price index
  - The base period for real income is 2008
- To ensure intra-household comparisons, we adjust the household income by adult equivalent

Indaba Agricultural Policy Research Institute
Estimation of welfare

- Employed Roy’s self selection model (Roy, 1951)
  - Individuals select alternatives that provides greatest utility
- Gain from participation (average treatment effect on the treated)
  \[ ATT = E(Y_{1i} - Y_{0i}|w_i = 1) \]
- ATT estimated on a sample exhibiting common support
- Matching Techniques
  - Nearest neighbor
  - Stratification
  - Kernel
  - Radius
Estimation the income gap between the poverty class

- Employed the Blinder-Oaxaca three ford decomposition technique (Jann, 2008)

\[ Y^a - Y^b = \left( \bar{X}^a - \bar{X}^b \right) \hat{\beta} + \bar{X}^b \left( \hat{\beta}^a + \hat{\beta}^b \right) + \left( \bar{X}^a - \bar{X}^b \right) \left( \hat{\beta}^a + \hat{\beta}^b \right) \]

- The first part of the right hand side is the expected change in the group of poor households mean income if they had endowments of non-poor households
- The second component measures the expected change in the group of poor households’ mean income if they had coefficients of non-poor households
- The third component accounts for measures in the differences in endowments and coefficients simultaneously
- Selection bias corrected via inverse mills ratio
Results
## Summary statistics of selected variables

<table>
<thead>
<tr>
<th>Participation status in cattle markets</th>
<th>Poverty class among participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>non-participants</td>
</tr>
<tr>
<td>Value of assets (ZWK)</td>
<td>5,632</td>
</tr>
<tr>
<td>Household income (ZWK)</td>
<td>1,616</td>
</tr>
<tr>
<td>Crop share of total income</td>
<td>70.63</td>
</tr>
<tr>
<td>Livestock share of total income</td>
<td>6.99</td>
</tr>
<tr>
<td>Off-farm share of total income</td>
<td>22.22</td>
</tr>
<tr>
<td>HCI (%)</td>
<td>31.66</td>
</tr>
</tbody>
</table>

Note: *p<0.10, **p<0.05, ***p<0.01; HCI=household crop commercialization index (gross value of crop sales/gross value of crop production)*100; The 2008 Zambia Kwacha to US$ exchange rate was 3.829
Source: CSO/MACO/FSRP Supplemental Survey
Estimation of propensity score and balancing tests

- PS-only covariates significantly correlated with income were included
- Common support requirement satisfied within [0.08191682, 0.92294961]
- Balancing test results (next slide) confirm the existence of strong bias for most covariates
- PS matching successfully eliminated this bias as evidenced by the
  - Insignificant t-test after matching
  - Insignificant likelihood ratio test (Ho: all covariates jointly equal to zero) after matching (10.56, p-value=0.957)
  - Which was significant prior to matching (198.11, p-value=0.000)
### Balancing Properties of Covariates in Treated and Control Groups (selected vars)

| Covariates                           | Sample      | Mean treated units | Mean control units | % bias between treated and controls | % reduction in bias | H0: Mean(treated) = Mean(control) | t       | p>|t| |
|--------------------------------------|-------------|--------------------|--------------------|------------------------------------|---------------------|-----------------------------------|--------|-----|
| Number of HH members                 | Unmatched   | 8.168              | 7.290              | 21.3                               | 85.3                | 6.39                              | 0.000  |
|                                      | Matched     | 8.168              | 8.297              | -3.1                               | 85.3                | -0.64                             | 0.523  |
| Age of household head                | Unmatched   | 51.864             | 50.163             | 11.3                               | 97.5                | 3.20                              | 0.001  |
|                                      | Matched     | 51.864             | 51.906             | -0.3                               | 97.5                | -0.07                             | 0.946  |
| Years of schooling of HH head        | Unmatched   | 6.731              | 5.949              | 20.1                               | 91.7                | 5.87                              | 0.000  |
|                                      | Matched     | 6.731              | 6.795              | -1.7                               | 91.7                | -0.39                             | 0.695  |
| Number of goats owned                | Unmatched   | 5.245              | 3.470              | 20.7                               | 86.9                | 6.58                              | 0.000  |
|                                      | Matched     | 5.245              | 5.012              | 2.7                                | 86.9                | 0.57                              | 0.567  |
| Landholding size (ha)                | Unmatched   | 5.047              | 3.995              | 20.6                               | 89.9                | 6.48                              | 0.000  |
|                                      | Matched     | 5.047              | 5.154              | -2.1                               | 89.9                | -0.43                             | 0.669  |
| HH reporting non-farm income (=1)    | Unmatched   | 0.666              | 0.591              | 15.6                               | 81.9                | 4.42                              | 0.000  |
|                                      | Matched     | 0.666              | 0.680              | -2.8                               | 81.9                | -0.68                             | 0.495  |
## Estimates of Average Treatment Effect of Cattle Market Participation on log of Per Capita Household Income

<table>
<thead>
<tr>
<th>Matching technique</th>
<th>Number of households.</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participating group</td>
<td>control group</td>
<td>ATE</td>
<td>Bootstrapped Standard error</td>
<td>t-stat</td>
</tr>
<tr>
<td>Nearest neighbor</td>
<td>1,099</td>
<td>806</td>
<td>0.524</td>
<td>0.062</td>
<td>8.516</td>
</tr>
<tr>
<td>Stratification</td>
<td>1,096</td>
<td>3,160</td>
<td>0.549</td>
<td>0.038</td>
<td>14.373</td>
</tr>
<tr>
<td>Kernel</td>
<td>1,099</td>
<td>3,137</td>
<td>0.574</td>
<td>0.029</td>
<td>19.865</td>
</tr>
<tr>
<td>Radius</td>
<td>1,099</td>
<td>3,157</td>
<td>0.640</td>
<td>0.036</td>
<td>17.540</td>
</tr>
</tbody>
</table>

- All else constant, participation in cattle markets raises per capita household income by about 52-64% on average
## Results of Linear Decomposition of Log of Household Income: poor vs. non-poor households

### Panel A: mean predications

<table>
<thead>
<tr>
<th></th>
<th>Bias unadjusted</th>
<th></th>
<th>Bias adjusted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Robust standard error</td>
<td>Mean</td>
<td>Robust standard error</td>
</tr>
<tr>
<td>Non-poor households</td>
<td>8.302</td>
<td>0.037</td>
<td>** ***</td>
<td>8.307</td>
</tr>
<tr>
<td>Poor households</td>
<td>6.614</td>
<td>0.021</td>
<td>** ***</td>
<td>6.616</td>
</tr>
<tr>
<td>non-poor-poor differential</td>
<td>1.688</td>
<td>0.043</td>
<td></td>
<td>1.691</td>
</tr>
</tbody>
</table>

### Panel B: Simultaneous change in endowment and coefficient

<table>
<thead>
<tr>
<th></th>
<th>Bias unadjusted</th>
<th></th>
<th>Bias adjusted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Robust standard error</td>
<td>Mean</td>
<td>Robust standard error</td>
</tr>
<tr>
<td>Three-fold endowment</td>
<td>0.455</td>
<td>0.042</td>
<td>** ***</td>
<td>0.453</td>
</tr>
<tr>
<td>Coefficients</td>
<td>1.356</td>
<td>0.053</td>
<td>** ***</td>
<td>1.360</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.123</td>
<td>0.057</td>
<td>**</td>
<td>-0.123</td>
</tr>
</tbody>
</table>

Note: the difference is between the predicated log of household income of the non-poor and poor households among the participating households only. Significance level *p<0.10, **p<0.05, ***p<0.01
Results of Linear Decomposition of Log of Household Income: poor vs. non-poor households

Panel A:
- absolute value for the antilog of predicated average incomes are poor-ZMK4031.44 (US$1293.14) and non-poor ZMK 1293.14 (US$337.68) yielding a difference of ZMK2738.30 (US$715.18)

Panel B
- endowment and coefficients are positive and significant suggesting that
  - poor HHs would statistically earn more than non-poor HHs if poor HHs retained their coefficients but had endowments comparable to those of non-poor HHs
  - Similarly, poor HHs would earn significantly more than non-poor HHs if poor HHs retained their endowment but had the coefficients of the non-poor HHs
## Summary of the Decomposition Results (as percentages)

<table>
<thead>
<tr>
<th>Amount attributable:</th>
<th>Bias unadjusted</th>
<th>Bias adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>- due to endowments (E):</td>
<td>-203.7</td>
<td>-123.9</td>
</tr>
<tr>
<td>- due to coefficients (C):</td>
<td>33.2</td>
<td>33.2</td>
</tr>
<tr>
<td>Shift coefficient (U):</td>
<td>-236.8</td>
<td>-157.1</td>
</tr>
<tr>
<td>Raw differential (R) (E+C+U):</td>
<td>372.4</td>
<td>292.7</td>
</tr>
<tr>
<td>Adjusted differential (D) (C+U):</td>
<td>168.8</td>
<td>168.8</td>
</tr>
<tr>
<td>Endowments as % total (E/R):</td>
<td>19.7</td>
<td>19.7</td>
</tr>
<tr>
<td>Discrimination as % total (D/R):</td>
<td>80.3</td>
<td>80.3</td>
</tr>
</tbody>
</table>

Note: U = unexplained portion of differential (difference between model constants); D = portion due to discrimination (C+U). Positive number indicates advantage to non-poor group; negative number indicates advantage to poor group.

- Inter group differences in characteristics or productive differences accounts for 123.9% in favor of poor HHs.
- However, productivity difference is not enough to offset the 292.7% advantage in shift coefficient (U).
- Overall, statistical discrimination accounts for 80.3% of the income differential in favor of non-poor households.
Conclusion

- Article determines welfare effects of participation in cattle markets
- Employ propensity score matching and decomposition techniques on nationally representative household survey data from smallholder farmers
- After correction for selection bias, we find that participation in cattle markets raises household income by over 50%
- decomposition results suggest that poor households derive relatively smaller benefits from participation than their non-poor counterparts due to 80.3% of the inter-group income differential
Conclusion

- The results suggest that with appropriate interventions, participation in livestock markets can
  - enhance the welfare of smallholder households and
  - contribute to poverty reduction
Thank you for your attention