Estimation of Spillover Effects from Large Scale Adoption of Transgenic (Bt) Corn in the Philippines

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Theoretical Framework

We first invoke a theoretical model that permits large scale adoption to affect farmer behavior. Define the following variables:

Area-wide adoption: \( C \)

Expected profits per ha of Bt & non-Bt varieties: \( \Pi_{Bt} - \Pi_{Non-Bt} \)

Bt seed price premium: \( w \)

Own-farm Asian corn borer densities: \( d \)

Then an individual grower will adopt Bt if:

\[
\Delta \Pi = \frac{\partial \Pi_{Bt}}{\partial d} - \frac{\partial \Pi_{Non-Bt}}{\partial d} + \frac{\partial w}{\partial d} \frac{\partial w}{\partial d} < 0
\]

This says that greater area-level adoption reduces individual incentives to adopt Bt, suggesting a negative spillover.

Empirical Framework: Random Utility Modeling

\[
\Pr \left[ U_{ijk} \geq U_{ikh} \forall k \right] = \frac{\exp(\beta x_{ijk} + \alpha C_{ijh} - \eta_{ijh})}{\sum_{k} \exp(\beta x_{ijk} + \alpha C_{ikh} - \eta_{ikh})}
\]

Individual-level endogeneity: \( E \left( C_{ijkh} | s_{ijh} \right) \neq 0 \)

Instrumental variables strategy from Bayer & Timmins (2007):

\[
\hat{C}_{ijh} = \frac{1}{n_{ij}} \sum_{k=1}^{n_{ij}} \exp(\hat{\beta} x_{ijk} + \hat{\delta}_j - \hat{\eta}_{ijh})
\]

This creates predicted area-level adoption shares based on exogenous variables, using inter-area variation to exogenous characteristics determining adoption.

Discussion and Conclusion

- Significant spillover effect found to be associated with the use of Bt corn in the Philippines.
- This spillover, as pointed out in the literature, is expected to accrue primarily to non-adopting farmers.
- This positive externality should be accounted for in cost benefit analyses of the effects of Bt technology as ignoring them likely underestimates the value to farmers.
- Further work involves using this approach on US data and performing yield regressions that account for this effect.

Econometric Results

<table>
<thead>
<tr>
<th>IV model</th>
<th>Unweighted</th>
<th>Area-weighted</th>
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<tbody>
<tr>
<td>Tobit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed price (PHP)</td>
<td>-0.01</td>
<td>-0.020</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.018)</td>
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<tr>
<td>Bt single-trait</td>
<td>0.86</td>
<td>1.28</td>
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<td></td>
<td>(1.00)</td>
<td>(2.81)</td>
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<td>Stacked-trait</td>
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<td>(3.51)</td>
<td>(4.33)</td>
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<tr>
<td>Spillover</td>
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<td></td>
<td>(3.69)</td>
<td>(4.72)</td>
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<tr>
<td>Constant</td>
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<td>(2.78)</td>
<td>(5.80)</td>
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<tr>
<td>Observations</td>
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</tr>
</tbody>
</table>

Standard errors in parentheses

*p < 0.05, **p < 0.01, ***p < 0.001

References