Secondary Cities and Agricultural Transformation: Evidence from Ethiopia

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World Bank – May 19, 2016
Urbanization

• Urbanization is quickly increasing in SSA
  o Growth and concentration in medium-sized cities
  o Economic development and poverty

• Composition of urbanization
  o Agglomeration in mega cities
  o More dispersed pattern leads to more inclusive growth

• Conference topic
  o Indirect mechanism
  o Broader impacts
Secondary Towns

• Migrants’ outcomes
  o More accessible non-farm sector
  o Migration less costly

• Hinterland effects
  o Remittances, wage effects, etc.
  o Consumption linkage
    • Higher urban demand
    • Agricultural production in rural hinterland

• Rural development
  o Small scale and rural farming
Cities & Agriculture in Ethiopia

• Ethiopia is urbanizing fast
  o Urban share will triple in next decade
  o People are concentrating in cities
    • Addis Ababa
    • Secondary towns

• Teff is major staple crop
  o Produced by 6 million farmers
  o Consumed daily by 2/3 Ethiopians
  o Economically superior good
Cities are growing fast in Ethiopia
Market Access has improved
Conceptual framework
Agriculture and 1 City

\[ P_f = P_1 - \mu(D_f) \]
Agriculture and 2 Cities

- Now: Urban proximity to 2 cities
  - Presence of city 2 (Secondary Town) at $\mu_2$
  - Same price $P_2$ and per unit transport cost
  - $P_{f,1} = P_1 - \mu$ and $P_{f,2} = P_2 - |\mu_2 - \mu|$. 
Prices and 2 cities

\[ P_{f,1}(\mu) \]

\[ P_{f,2}(\mu) \]

Impact of City 1

Impact of City 2
Prices and 2 cities

Teff price

\[ P_{f,1}(\mu) \]

\[ P_{f,2}(\mu) \]

Impact of City 1

Impact of City 2

Transportation cost to City 1
Prices and 2 cities

Teff price

$P_{f,1}(\mu)$

$P_{f,2}(\mu)$

Transportation cost to City 1

$\mu_{f_1}$ $\mu_1$ $\mu_1'$ $\mu_2$ $\mu_{f_2}$

Impact of City 1

Impact of City 2
Prices and many cities

Impact of City 1

Pf,1(μ)

Impact of City 2

Pf,2(μ)

Impact of City 3

Pf,3(μ)

Teff price
Prices and many cities

Teff price

Impact of City 1
Impact of City 2
Impact of City 3

\[ P_{f,1}(\mu) \]

\[ P_{f,2}(\mu) \]

Transportation cost to City 1
Data
Survey Data

• Teff value chain survey in 2012 (cross sectional)
  o 36 randomly selected villages in major teff producing areas
  o 720 randomly selected farmers

• Urban proximity
  o Transport cost
  o Cost of transporting 1 quintal of teff (ETB/quintal)

• Cities in survey area
  o Capital: Addis Ababa
  o Secondary towns: Nazareth and Bahir Dar
  o Select city that maximizes net prices: $P_{f,i} = P_i - \mu$
Teff Transaction Trip

\[ \text{Total Transport Cost } T \]

\[ \text{Self-reported cost } c_f \]

\[ \text{GIS Road Network } \mu \]

\[ \text{Donkey Trip} \]

\[ \text{Truck Trip} \]

\[ m_f, p_f \]

\[ \max(P_f,i) \]
Farmers and cities
Results

Is there an effect of Secondary Towns?
Simulation of model

• Compare model simulation with empirical observation

• Teff price farmers receive in trader markets
  o Predicted: $\hat{P}_{f,i} = P_i - \mu$
  o Observed: $P_{f,i}$

• Truck cost $\mu$ from trader town to Addis Ababa
Predicted vs. Observed teff prices
Other outcomes

- **Use of DAP (kg/ha)**
- **Use of Improved Seeds (kg/ha)**
- **Teff Land Productivity (kg/ha)**
- **Teff Profits (birr/ha)**
Results

Size of effect
Urban proximity & Agricultural Outcomes

• Effect of (total) transport cost $T_i$
  - $Y_i = \alpha_y + \beta_y \times T_i + X_i + P_i + Z_i + \varepsilon_{i,y}$
  - $Y_i$: improved seed usage, productivity and profits
  - $X_i$: controls
  - $P_i$: output and input prices
  - $Z_i$: zone fixed effects

• Effect $\beta_y$ dependent on type of city?
  - $Y_i = \alpha_y + \beta_y \times T_i + \gamma_y \times S_i + \pi_y \times (S_i \times T_i) + X_i + P_i + Z_i + \varepsilon_{i,y}$
  - $S_i$: dummy for Secondary Towns
  - $\beta_y$ is effect for farmers shipping to Addis Ababa
  - $\beta_y + \pi_y$ is effect for farmers shipping to Secondary Town
Endogeneity issues

• Heterogeneity between farmers in $S_i$
  o Household and teff production
  o Double Robust method
    • Estimation of Propensity Score
    • Weighted regression

• Endogenous location of road network
  o Better infrastructure in areas with higher economic potential
  o Instrumental Variable (IV) Approach
    • ‘Natural path’ walking distance
### Preliminary results

<table>
<thead>
<tr>
<th></th>
<th>Secondary Town</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teff price (ETB)</td>
<td>***</td>
</tr>
<tr>
<td>Wages (ETB)</td>
<td>0</td>
</tr>
<tr>
<td>Fertilizer (kg/ha)</td>
<td>0</td>
</tr>
<tr>
<td>Improved Seed (kg/ha)</td>
<td>0</td>
</tr>
<tr>
<td>Labor (days/ha)</td>
<td>0</td>
</tr>
<tr>
<td>Yield (kg/ha)</td>
<td>***</td>
</tr>
<tr>
<td>Labor Productivity (kg/day)</td>
<td>**</td>
</tr>
<tr>
<td>Teff Profits (ETB/ha)</td>
<td>***</td>
</tr>
</tbody>
</table>
Conclusions
Cities & Agricultural transformation in Ethiopia

• Impact of urban proximity on teff production decisions

• Difference between type of cities
  o Effect on prices is similar
  o Strong effect on input use in Secondary Towns
  o Strong effect on labor productivity in Capital

• Way forward
  o Improve empirical results
  o Welfare implications
  o Other mechanisms
Thank you!
### Propensity Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Secondary town (Yes=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of head (years)</td>
<td>0.00</td>
</tr>
<tr>
<td>Gender of head (male=1)</td>
<td>0.03</td>
</tr>
<tr>
<td>Educated head (years=1)</td>
<td>0.14</td>
</tr>
<tr>
<td>Head is from Oromia (yes=1)</td>
<td>-0.67***</td>
</tr>
<tr>
<td>Size of the household (number)</td>
<td>0.02</td>
</tr>
<tr>
<td>Children in the household (number)</td>
<td>0.05</td>
</tr>
<tr>
<td>Household owns radio (yes=1)</td>
<td>-0.10</td>
</tr>
<tr>
<td>Household owns tv (yes=1)</td>
<td>-0.55**</td>
</tr>
<tr>
<td>Household owns mobile phone (yes=1)</td>
<td>-0.53***</td>
</tr>
<tr>
<td>Farm assets (ln of ETB)</td>
<td>0.16***</td>
</tr>
<tr>
<td>Wealth index (PCA of household assets)</td>
<td>-0.29***</td>
</tr>
<tr>
<td>Farming Ability (.)</td>
<td>0.06</td>
</tr>
<tr>
<td>Land owned (ha)</td>
<td>-0.09***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.82</td>
</tr>
</tbody>
</table>

*Note: Standard errors are in parentheses.*
Balancedness of matching

![Graph showing balancedness of matching](image)

- **Propensity Score**
  - Untreated: Off support
  - Untreated: On support
  - Treated
Natural Path
First Stage result

<table>
<thead>
<tr>
<th>First stage</th>
<th>Transportation Cost (ETB/quintal)</th>
<th>Transportation Cost * Secondary Town</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Path (hours)</td>
<td>1.38***</td>
<td>0.81***</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Natural Path * Secondary Town</td>
<td>0.36</td>
<td>1.27***</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>Secondary Town</td>
<td>-2.15</td>
<td>25.12***</td>
</tr>
<tr>
<td></td>
<td>(5.79)</td>
<td>(5.36)</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Prices</td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.590</td>
<td>0.890</td>
</tr>
<tr>
<td>Shea's Adjusted Partial $R^2$</td>
<td>0.244</td>
<td>0.330</td>
</tr>
</tbody>
</table>
Preliminary results

• Teff outcomes are lower in Secondary Towns

• Effect of distance
  o Teff price and fertilizer use: similar
  
  o Fertilizer and labor use: larger for farmers shipping to a Secondary Town

  o Improved seed use, teff yield, labor productivity and profits: larger for farmers shipping to Addis
## Urban proximity and prices

<table>
<thead>
<tr>
<th>Prices</th>
<th>log of teff prices (ETB/quintal)</th>
<th>log of wage (ETB/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
</tr>
<tr>
<td><strong>Urban proximity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck Cost (ETB/quintal)</td>
<td>-4.52***</td>
<td>-3.35**</td>
</tr>
<tr>
<td></td>
<td>(0.92)</td>
<td>(1.33)</td>
</tr>
<tr>
<td>Wu-Hausman F(3,715)</td>
<td>10.49***</td>
<td></td>
</tr>
</tbody>
</table>
## Urban Proximity and Inputs

<table>
<thead>
<tr>
<th>Inputs</th>
<th>DAP (kg/ha)</th>
<th>Improved Seed (kg/ha)</th>
<th>Labor (days/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
<td>OLS</td>
</tr>
<tr>
<td>Transportation Cost (ETB/quintal)</td>
<td>-1.80***</td>
<td>-2.30***</td>
<td>-0.36**</td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td>(0.64)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Wu-Hausman F(3,715)</td>
<td>4.30**</td>
<td>2.84**</td>
<td>3.55**</td>
</tr>
</tbody>
</table>

*Urban Proximity*
### Urban proximity and productivity

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Yield (kg/ha)</th>
<th>Labor Productivity (kg/day)</th>
<th>Teff Profits (ETB/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
<td>OLS</td>
</tr>
<tr>
<td>Transportation Cost (ETB/quintal)</td>
<td>-14.63***</td>
<td>-10.62**</td>
<td>-0.06***</td>
</tr>
<tr>
<td></td>
<td>(1.89)</td>
<td>(4.73)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Wu-Hausman F(3,715)</td>
<td>3.80*</td>
<td>0.39</td>
<td></td>
</tr>
</tbody>
</table>
## Urban proximity and welfare

<table>
<thead>
<tr>
<th>Welfare</th>
<th>log of Wage income (ETB)</th>
<th>log of Commerce income (ETB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
</tr>
<tr>
<td><strong>Urban proximity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Cost (ETB/quintal)</td>
<td>-0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Wu-Hausman F(3,1177)</td>
<td>0.10</td>
<td></td>
</tr>
</tbody>
</table>

- **OLS**: Ordinary Least Squares
- **IV**: Instrumental Variables
- **F**: Wald F-statistic