Profitable cropland available in sub-Saharan Africa

Jing Liu\textsuperscript{1*} and Nelson Villoria\textsuperscript{2}

\textsuperscript{1}Purdue University
\textsuperscript{2}Kansas State University
\textsuperscript{*Email: liu207@purdue.edu

Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

Copyright 2016 by Jing Liu and Nelson Villoria. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.
Profitable Cropland Supply in Africa
Jing Liu¹ and Nelson Villoria²
¹Purdue University, ²Kansas State University

Africa is in lack of profitable land despite its abundance in arable land
- 400 Million ha of arable land in Guinea Savannah
- Less than 10% is cultivated
- Much of the remaining land is not readily usable due to developmental challenges

Disagreement on how much profitable land is available in Africa
- 451 Mha (Alexandros and Bruinsma, 2012)
- 365 Mha (Deininger and Byerlee, 2011)
- 242-384 Mha (Chamberlin et al., 2014)
- The obstacle to measuring profitability is the unknown site-specific prices and land returns

Research objectives
- Model and empirically test the effect of market access on cultivation decisions at the grid-cell level
- Estimate cropland supply elasticity
- Estimate a cropland supply schedule as a function of market access increase

Finding 1: Remarkable variation in cropland supply elasticity within sub-Saharan Africa
- Transition elasticity =1 indicates +1% in market access increases the probability of observing cultivation by 1%
- Market access is an index [0,100] of traveling time to the nearest central market (sourced from Verburg et al., 2011)

Finding 2: Market access needs to increase by more than ten folds to reach the lower bound of previous estimation
- Current Africa has much less profitable land than arable land
- Observed cropland expansion according to FAOSTAT:
  - 20 Mha (2011 vs. 2005)
  - 56 Mha (2010 vs. 1990)

Finding 3: A two-decade TFP growth in Africa can improve food security
- Improved food security in Africa
- Borlaug hypothesis vs. Jevons’ paradox
- TFP growth is land-sparing conditional on the inelastic food demand.
- If food demand is price elastic, the inelastic cropland supply means a smaller cropland expansion.

Data and empirical strategies
- Estimate a spatial Durbin (logit) model to correct for autoregressive errors and alleviate omitted variable bias
  \[ P(Z = 1|X) = \frac{e^{\beta_0 + \beta_1 X + \phi W P}}{1 + e^{\beta_0 + \beta_1 X + \phi W P}} \]
- Y: a binary based on the fraction of harvested area
- X: market access, land features (precip, irrigation, etc), region dummies, agro-ecological zone dummies

Application: Economic and environmental impacts of TFP growth
- Experiment: Faster crop TFP growth in SSA, 2004-2025
  - Exp1: TFP +18.3% everywhere
  - Exp2: TFP +38.4% in SSA, +18.3% everywhere else

Conclusions
- The evolving market access bridges two contradictory views on Africa’s cropland expansion: land abundance (Deininger and Byerlee, 2011) and scarcity (Chamberlin et al., 2014).
- Given the current low land supply elasticity in SSA, barring major investments in market access, the broad-based ag-technological progress is unlikely to incentivize land major expansion.

Corresponding author: Jing Liu
liu207@purdue.edu