Determinants of Deforestation and the Economics of Protection: An Application to Mexico

Denninger and Minten (2002)

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Research Question Addressed by Paper

- Quantify threats to existing forest stands in Mexican states of Chiapas and Oaxaca
- Incorporate both physio-geographic variables and socio-economic data into model
- Goal is to illustrate that the author's deforestation model can help rationalize the delineation of protected areas

Modeling Methodology

- Spatial: States of Chiapas and Oaxaca, Mexico
  - 1 km^2 grid for states in question
  - forested in 1980 (117,000 plots out of a total of 160,000) compared to 1990
- Temporal: two time points: ~1980 and ~1990.
  - Compared forested plots between 1980 and 1990
  - Socio-economic data only from 1990 and 1991
  - Other physio-geographic data time-invariant

Input Data

Physio-geographic

- Rainfall (100 mm)
- Rainfall squared
- Slope (1-9)
- Protection dummy
- Elevation
- Soil data
  - Dummy variables
  - loam, clay, rocky, aluminum toxic, etc.

Socio-economic

- Poverty
- Population density
- % indigenous population
- % crop area under irrigation
- % land under ejido tenure
- % farmers getting free extension
- % farmers with BANRURAL credit
- Distance to paved road

Model Outputs

- Probit regression of deforestation between 1980 and 1990 given that a plot was forested in 1980
- Predicted deforestation of an individual plot at a 70% deforestation probability

Verification

- Model run 3 times:
  - Full model
  - Plot level variables (plot level)
  - Socio-economic variables (aggregated)
- Full model also run with +1 and -1 standard deviation in independent variables

Validation

- Not clear if there was a separation of data used for calibration and data used for validation.
  - ~117,000 forested plots total used to develop model
  - 35,848 deforested plots (1980 to 1990) used for validation
  - Model predicted deforestation on 71% of 35,848 plots

Spatially Explicit

- The invariance test
  - Changing location of towns, roads, etc. would change outcome
- The representation test
  - Geographic features included in model
- The formulation test
  - Distances from roads included
- The outcome test
  - Predicts probability of deforestation

Results

- Increasing elevation, distance from infrastructure, rainfall, and slope all decrease probability of deforestation.
- Protection dummy variable decreases probability of deforestation
- High levels of poverty increase probability of deforestation
- Higher percentages of area under ejido and share of high indigenous populations decrease probability of deforestation
- Government credit subsidies are associated with high levels of deforestation

Input data issues

- Physio-geographic variables the main determinants of deforestation
- Socio-economic variables affects neither overall quality or predictive power of regression
  - Aggregate bias at different levels
  - Socio-economic data alone can lead to erroneous conclusions

Conclusions

- Deforestation the result of multiple physio-geographic and socio-economic variables
  - Omitting critical physio-geographic variables from econometric investigations can invalidate results
- Authors believe that model is more than an academic exercise and has empirical use.
  - Model can help rationalize delineation of protected areas