

# Finding Poverty in Satellite Images



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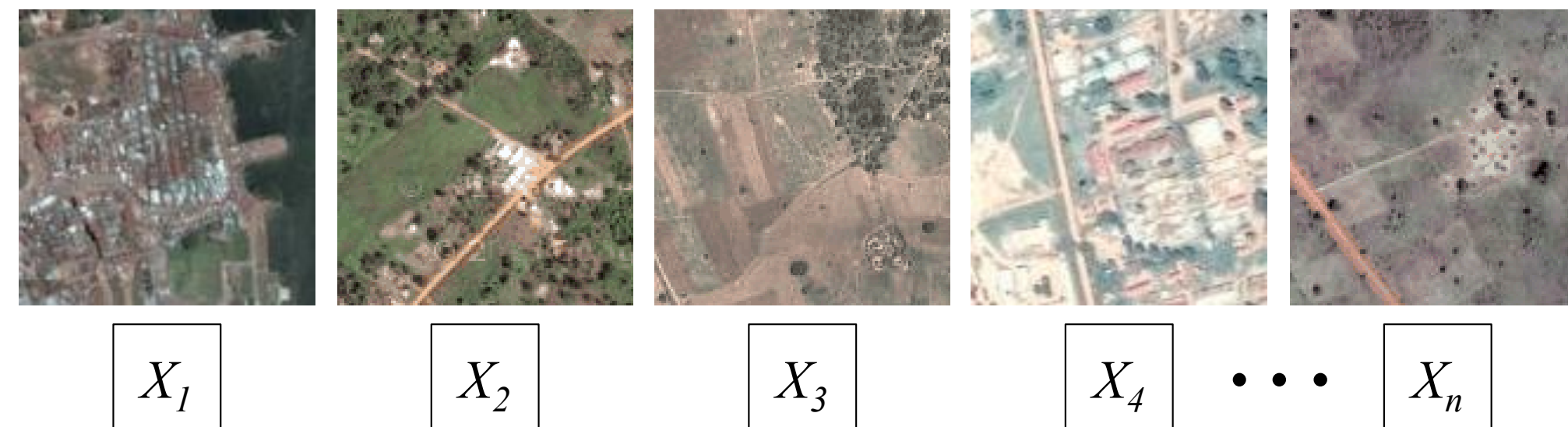
## Motivation

- Lack of reliable poverty data in developing countries poses a major challenge for making informed policy decisions
- Comprehensive surveys are often prohibitively expensive – a cheap, scalable method of producing detailed poverty maps would greatly facilitate economic progress [1]

## High-Level Overview

- Goal:** Accurately predict poverty levels through consumption-based wealth measures and asset-based wealth measures using satellite images

### Daytime Satellite Imagery



### Convolutional Neural Network

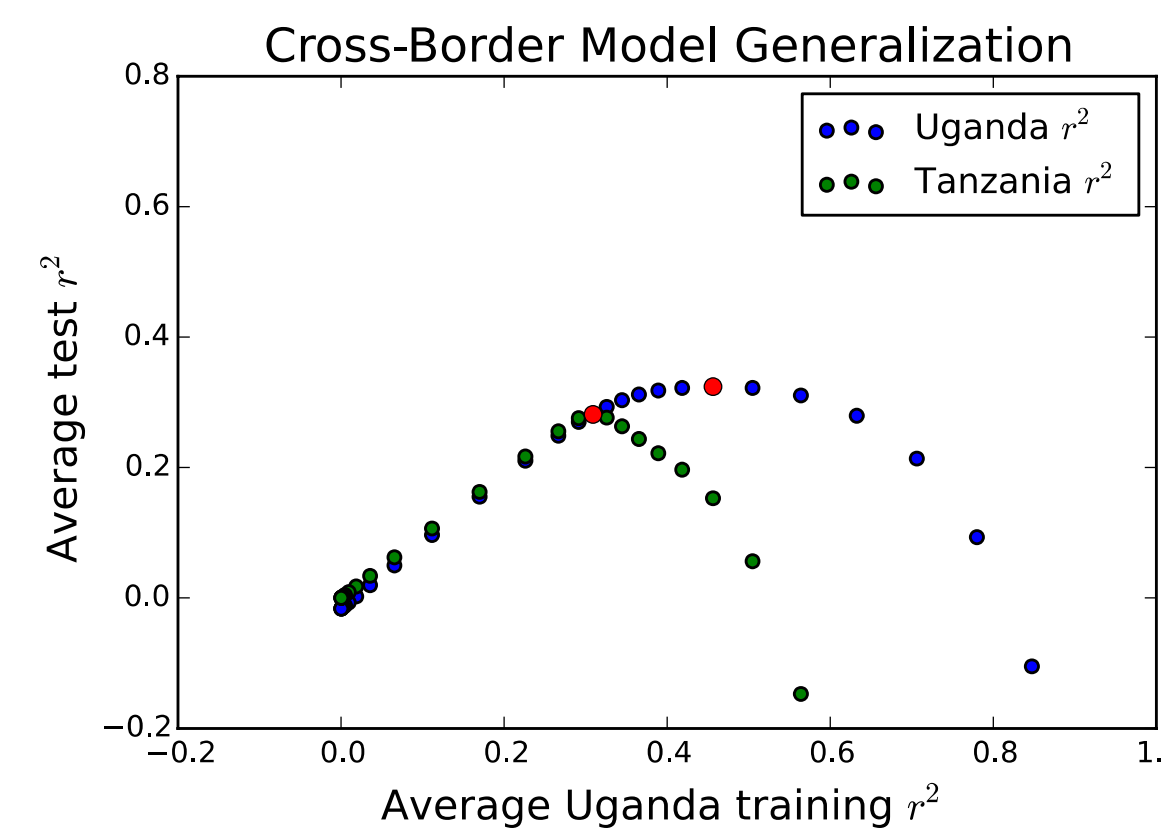
### Low-dimensional Feature Representation



### Continuous Wealth Measures

Figure 1. Focus of our project in dotted box

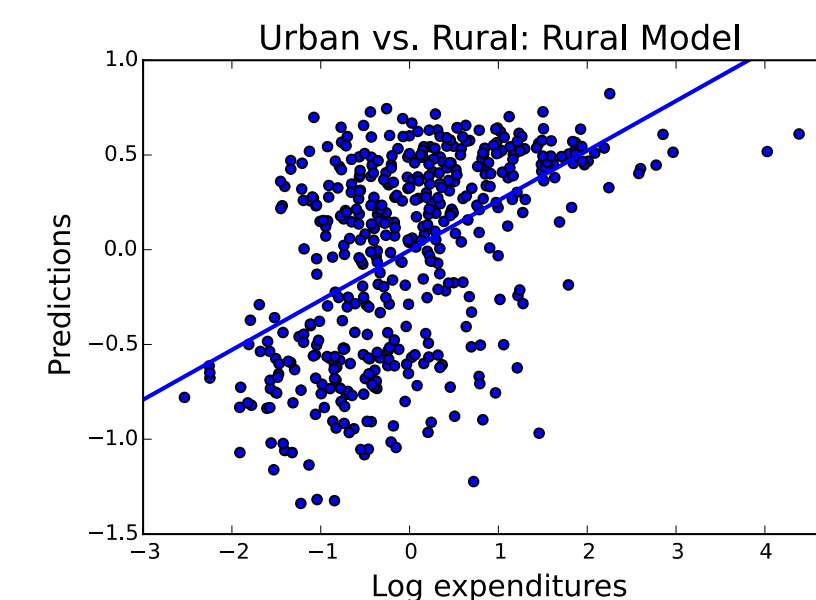
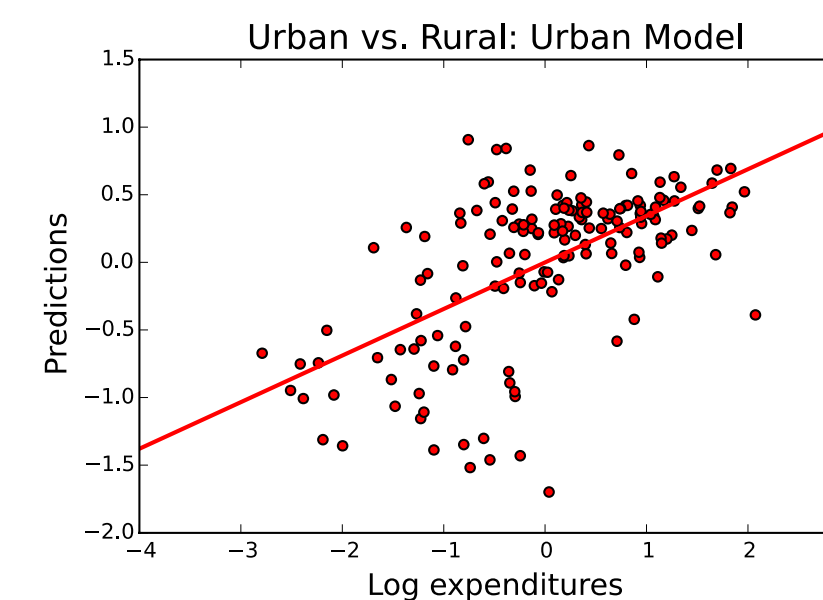
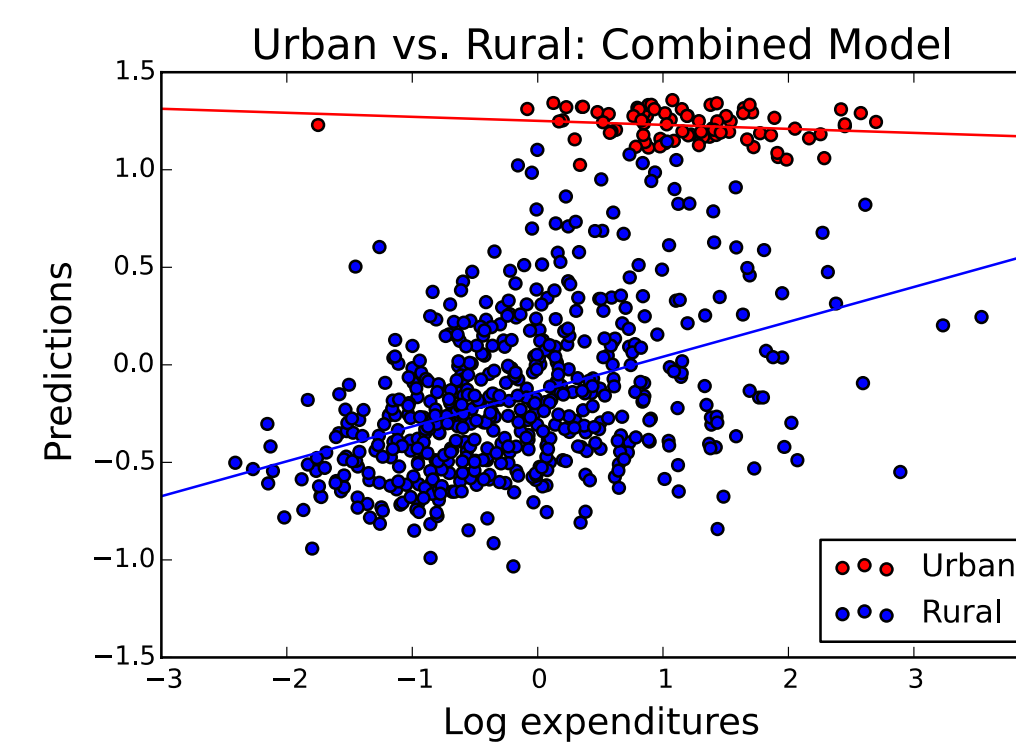
## Predicting Consumption



- The Living Standards Measurement Study collects consumption expenditure data at the household level
- Consumption is often a better indicator of well-being among the poor than income [2]

Features	OLS		Lasso (L1)		Ridge (L2)	
	Survey	Satellite	Survey	Satellite	Survey	Satellite
Training $r^2$	0.407	1.000	0.403	0.383	0.396	0.461
Test $r^2$	0.327	-1.007	0.339	0.187	0.331	0.296

Table 1. Linear regression models predicting consumption expenditures in Tanzania

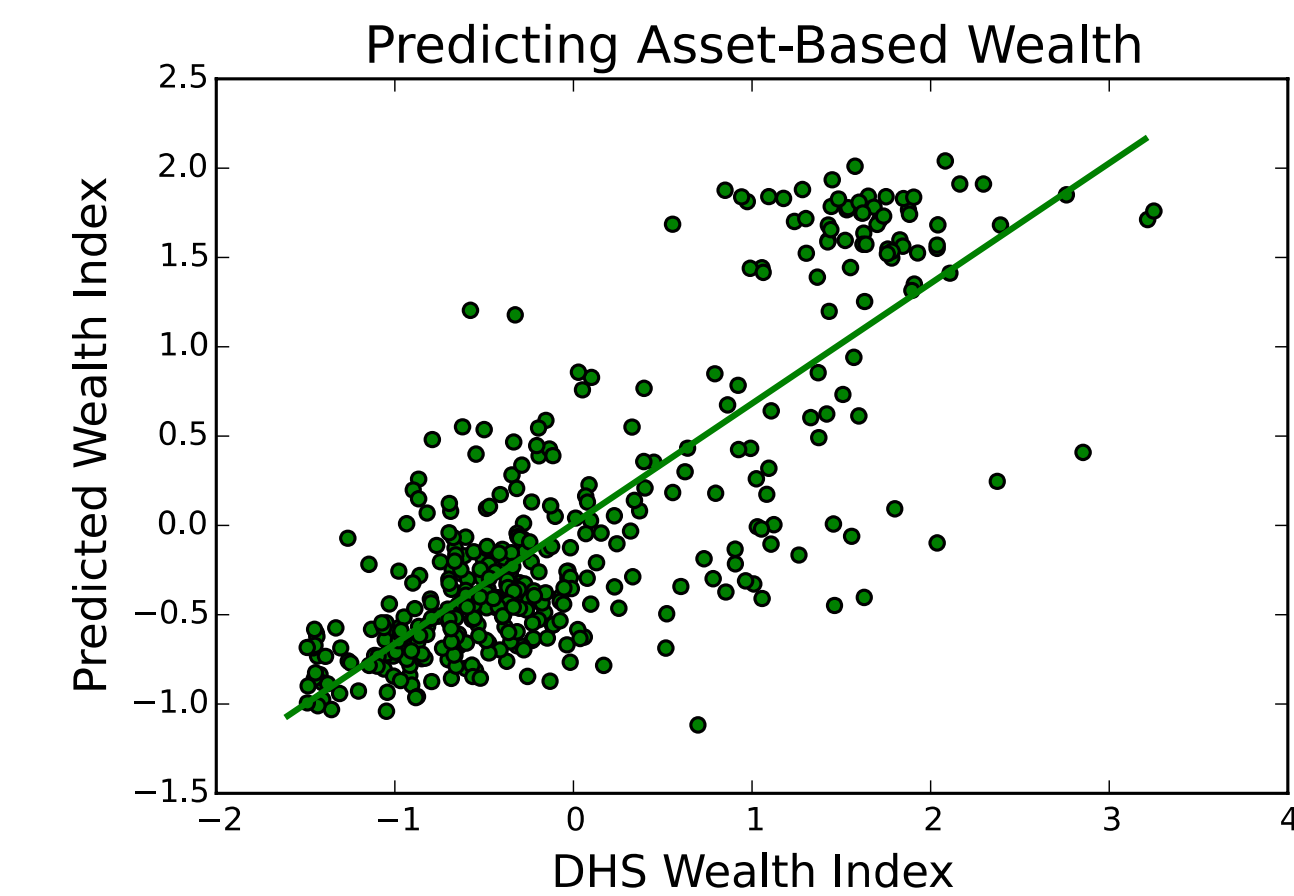


	Urban		Rural		Overall	
	Training	Test	Training	Test	Training	Test
Combined	0.043	-0.227	0.324	0.145	0.442	0.303
Separate	0.439	0.303	0.294	0.212	-	-

Table 2. Combined vs. separate urban and rural regression models

## Predicting Assets

- The Demographic and Health Surveys (DHS) record asset-based wealth measures in developing countries



	OLS		Lasso (L1)		Ridge (L2)	
	Training	Test	Training	Test	Training	Test
Our model	0.978	0.000	0.676	0.634	0.795	0.653

Table 3. Linear regression models predicting asset-based wealth in Uganda

- A paper published recently in *Science* used mobile phone call record data to predict asset-based wealth and reported  $r^2 = 0.46$  [3]

## Conclusion

- Our predictions for consumption expenditures approach survey accuracy; our predictions for asset-based wealth measures improved upon recent state-of-the-art results
- Poverty estimation techniques based on remote sensing and machine learning can be applied on a global scale at a fraction of the cost of traditional survey-based methods

## References

- M. Xie, N. Jean, et al., *CoRR* **1510.00098** (2015), <http://arxiv.org/abs/1510.00098>.
- B. Meyer and J. Sullivan, *National Bureau of Economic Research*, w9760 (2003).
- J. Blumenstock, G. Cadamuro, and R. On, *Science* **350**, 6264 (2015).

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