

# Intermediated Trade and Rural Road Infrastructure

Regression Discontinuity Evidence from Sierra Leone

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## Research Questions

**How does improvement in rural road infrastructure affect market prices in developing countries, particularly Sub-Saharan Africa?**

- Large share of foreign aid
- Identification challenges (van de Walle, 2009)

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**How does improvement in rural road infrastructure affect market prices in developing countries, particularly Sub-Saharan Africa?**

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**Can price responses to road improvements shed light on trading market structure?**

- Recent theoretical focus on “intermediated trade”
- Still limited empirical evidence

# Contributions

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- 2. Impact of road improvement on transport costs and crop prices**
- 3. Use empirical results to test trader competitions theories**

## Literature

- Impact of highways and railroads on prices, growth, and welfare: Michaels, 2008; Donaldson, 2010; Banerjee et al. 2012
  - Focus on feeder roads, as opposed to highways and railroads.
- Theoretical Literature on traders: Antrás and Costinot (2011); **Chau, Goto, and Kanbur (2009)**; Bardhan, Mookherjee, and Tsumagari (2009)
  - Empirical Tests
- Empirical Literature on Intranational Pass-Through: Li et al. (2011); Burstein and Jaimovich (2009); Atkin and Donaldson (2012)
  - Focus on infrastructure projects: “supply” and “demand” effects

# EU Feeder Roads Program

Feeder road rehabilitation program

- 9.5 million euros (16K euros/km; 336K euros/road)

In four districts, list of roads eligible for rehabilitation

- 47 roads (avg. 21 km)

Roads ranked according to score based on baseline data

- Economic production, density, road assessment, social value, length

Rehabilitation of road up to 150km in each district (31 vs. 16)

- RDD: roads just below cutoff vs. roads just above

## Control Roads



# Treatment Roads



# Outline

- ① Theory: Trader Competition and Responses to Road Improvements
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### Producers in Rural Villages:

- Travel to local market using rural roads
- Vary across villages in:
  - Productivity (output per farmer)
  - Distance to “cities”, where urban consumers located
- Sell in local rural market to “city traders” or local traders

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### City Traders:

- Travel from city to buy in rural market
  - *Major Road* transport cost
  - *Rural Road* transport cost
- Resell in the city at given price (SOE)

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## 3. Cournot Oligopsony (with trader entry)

- Road improvement increases price by
  - reducing trader costs
  - increasing supply elasticity (trader mark-down  $\searrow$ )
- Price increase smaller in more productive villages

## Trader Competition Models (cont'd)

### 4. Search Frictions (Mortensen, 2003)

- Producers have imperfect info on prices and trader availability
  - Waiting costs and uncertainty (Fafchamps and Hill, 2008)
  - Trader-farmer relationships (Casaburi and Reed, 2013)
- Search frictions+trader entry costs  $\Rightarrow$  market power
- Departure from competition stronger when:
  - Isolated markets (far from cities)
  - Low volumes produced ("thin markets")
- Price responses to road improvement also depend on these features

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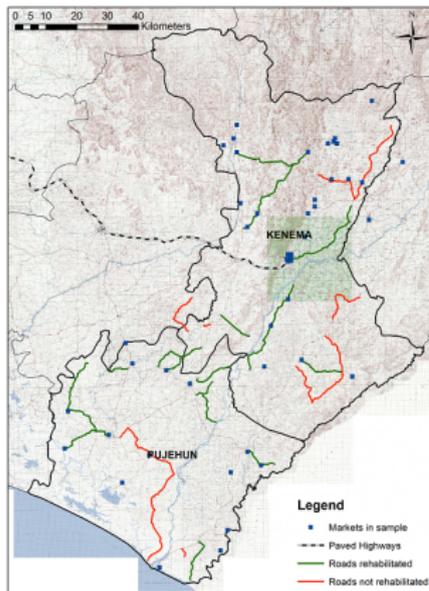
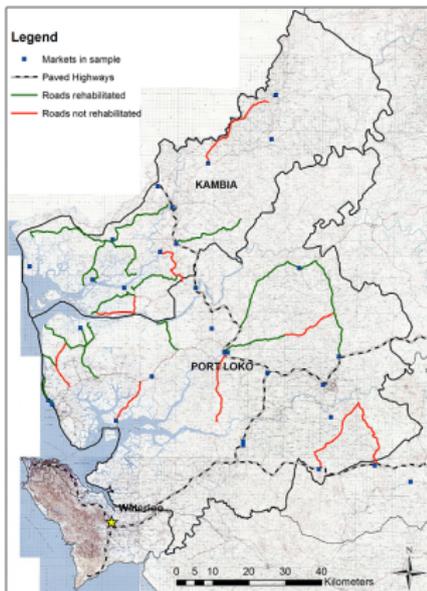
## **Heterogeneity in price responses by market characteristics**

- Distance from urban centers and agricultural productivity affect supply elasticity and intensity of search frictions

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# Map of Roads and Markets



# RDD Specifications

## Local Linear Regression (IK: $h=0.15$ )

$$y_{midt} = \alpha + \beta * T_i + \gamma * Score_i + \delta T_i * Score_i + \eta_d + \eta_t + \epsilon_{it}$$

## Regression Details

- Outcomes:
  - Transport costs (road-level)
  - Rice and cassava prices (market-level: 82 markets)
- Matching between chiefdoms, markets and roads
  - Multiple matches: twoway clustering (roads, markets)
  - Markets weighted by distance to road
- Verify RDD validity (McCrary and balance check)
- Robustness (RDD specification, sample, weights, inference)

## Transport Costs

	Average Speed (kph)		Log Fare/km	
	(1)	(2)	(3)	(4)
<b>Preferred LLR (h=.15)</b>				
Treatment	12.085** [5.345]	12.769** [5.282]	-0.594** [0.236]	-0.610*** [0.203]
Mean for Control	26.196	26.196	6.729	6.729
Heterogeneity Controls		X		X
Observations	31	31	31	31

## Agricultural Prices

	Log Local Rice Price		Log Local Rice Price		Log Cassava Price	
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Preferred LLR (h=.15)</b>						
Treatment	-0.116** [0.058]	-0.105*** [0.029]	0.006 [0.029]	0.005 [0.016]	-0.178** [0.086]	-0.141** [0.058]
Mean for Control	6.831	6.831	6.889	6.889	5.703	5.703
Heterogeneity Controls		X		X		X
Observations	190	188	896	883	918	906

- Market crop prices *decrease* after road rehabilitation

## Agricultural Prices: Heterogeneity

	Distance		Harvest		Seller Density	
	(1) Log Rice Price	(2) Log Cassava Price	(3) Log Rice Price	(4) Log Cassava Price	(5) Log Rice Price	(6) Log Cassava Price
<b>Preferred LLR (h=.15)</b>						
Treatment	0.085*** [0.024]	0.002 [0.033]	-0.022 [0.036]	-0.115 [0.071]	-0.040 [0.040]	-0.275** [0.108]
Treat * Above Median	-0.162*** [0.047]	-0.345*** [0.104]	0.065* [0.039]	0.064 [0.080]	0.095** [0.039]	0.236** [0.113]
One-sided p-value	0.000	0.000	0.048	0.212	0.008	0.018
Mean for Control	6.889	5.703	6.889	5.703	6.889	5.703
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- Crop prices response “more positive” in markets close to cities and in more productive areas

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**Results consistent with search frictions model of trader competition**

## Additional Results: Cell Phone Penetration

	(1) Log Rice Price	(2) Log Cassava Price
<b>Preferred LLR (h=.15)</b>		
Treatment	-0.038 [0.033]	-0.233** [0.091]
Treat * Above Median	0.084** [0.040]	0.242** [0.106]
One-sided p-value	0.019	0.011
Mean for Control	6.889	5.703
Observations	883	906

- Price responses are closer to the competitive case (“more positive”) in markets with larger cell phone penetration

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# Policy Implications

## **1. Impact of road improvement on prices depends on market structure**

- Rural roads can have effects on producer supply and trader demand
- Depending on whether supply or demand effect is stronger, road improvements will drive prices in the markets up or down
- In our setting: supply channel dominates

## Policy Implications (cont'd)

### **2. The impact of road improvements varies by road location**

Impact on trader demand stronger (and thus prices  $\nearrow$ ):

- In markets close to urban areas
- In markets in more productive areas

## Policy Implications (cont'd)

### **3. The presence of search frictions is relevant for other policies**

- Example: incentivizing traders to visit markets regularly
- Agricultural export promotion programs “pass-through”
  - Impact on farmers' prices lower than in competitive setting

## Policy Implications (cont'd)

### **4. Complementarity between infrastructure investments and policies that reduce search frictions**

Rationale for other investments at the same time of road improvement:

- Cell phone networks
- Price information systems

Thanks