Trucks

or

The Triple Curse of Remoteness

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How does market power shape the transportation sector?

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    - Falling costs may increase rents of transportation firms, reducing gains to consumers.
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  - *Spatial* impact of transportation policy less clear:
    - Does market power attenuate or exacerbate the costs of remoteness?

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- Show presence of the three curses in Colombia by combining:
  - **Unique data-set** comprising all (non-ag) intra-national shipments & all trucks.
  - **Causal evidence** from large scale infrastructure improvements.

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- Next steps (not for today!):
  - Combine theory+data to quantify how each curse shapes the welfare impacts of infrastructure improvements.
  - Assess how recent (anti) competitive policies shape these welfare impacts.

Related literature

- Endogenous trade costs:
  - Due to imperfect competition: Hummels, Lugovskyy and Skiba (2009), Atkin and Donaldson (2016), Asturias (2019)
  - Due to route planning: Behrens and Picard (2011), Ishikawa and Tarui (2017), Brancaccio, Kalouptsidi, Papageorgiou (2018), Wong (2018)
  - Due to intermediaries: Antras and Costinot (2011), Bardhan et al. (2013), Allen (2014), Mitra et al. (2017), Allen and Atkin (2017), Startz (2018), Chatterjee (2019), Grant and Startz (2019), Bergquist and Dinerstein (2019)
- Imperfect competition and trade more generally:
  - Kreps and Scheinkman (1983), Maggi (1996), Atkeson and Burstein (2008)

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- *In this paper, market power:*
  - Determined simultaneously with trade flows.
  - Shapes the impact of infrastructure improvements on the equilibrium distribution of economic activity.

Outline of Talk

Introduction

Trucking in Colombia

- A tale of two routes
- Three stylized facts
- A unique truck dataset

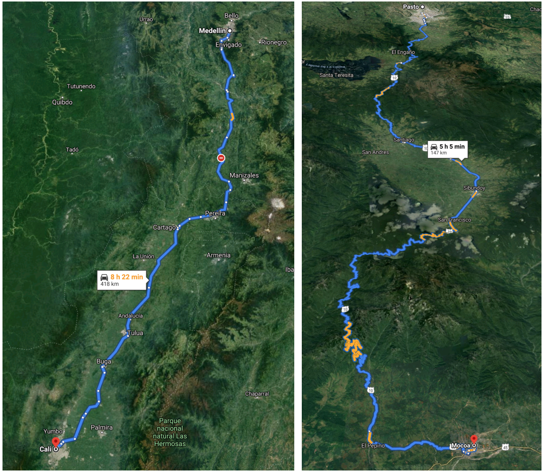
A spatial model with imperfect competition

The Triple Curse of Remoteness

Next Steps and Conclusion

Trucking in Colombia: A tale of two routes

Trucking in Colombia: A tale of two routes



(a) Medellin to Cali (b) Pasto to Mocoa

Trucking in Colombia: A tale of two routes

Medellin to Cali

1. 968 shipments shipments (in Sep. 2016)
2. Shipping price: $0.33 USD per ton-mile
3. Market concentration: .008 (HHI)
4. 4.7 trucks owned per trucker (88 tons)

Pasto to Mocoa

1. 35 shipments (in Sep. 2016)
2. Shipping price: $0.47 per ton-mile
3. Market concentration: 0.07 (HHI)
4. 1.1 trucks owned per trucker (7 tons)

Trucking in Colombia: A tale of two routes

Medellin to Cali

Figure: Coltanques Logistica y Transportes

Pasto to Mocoa

Figure: 1973 Ford F600

Trucking in Colombia: A tale of two routes

Medellin to Cali

Figure: Coltanques owner: Henry

Notes: Henry owns 1,200 trucks and makes 14,000 trips per month. He also owns an airline.

Pasto to Mocoa

Figure: 1973 Ford F600 owner: Jesus

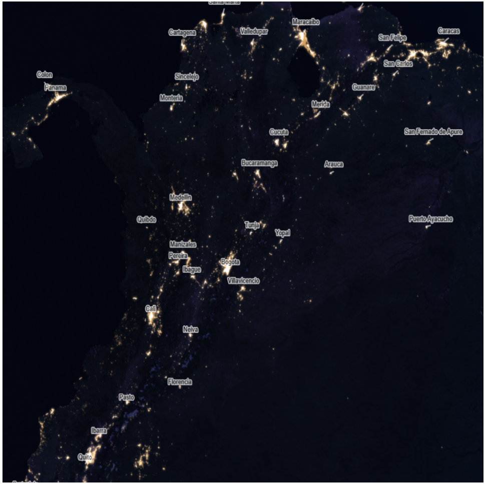
Notes: Owns one truck, 4 trips per month. Drives on the same route since 1968. Source: Uribe (2017)

Trucking in Colombia, Fact #1: Complex geography

- Mountainous.
- Major ports on Pacific and Atlantic Oceans but industrial centers located in the interior.
- Road quality poor, transportation costs high.
- 97% of cargo shipped by truck.

Trucking in Colombia, Fact #1: Complex geography

(a) Topography



(b) Night lights

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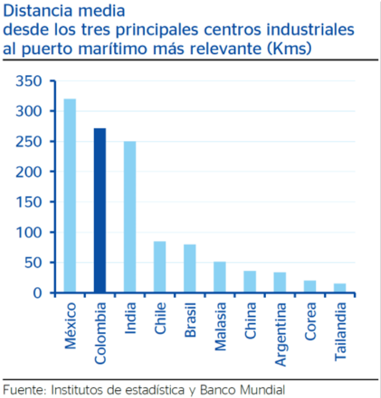
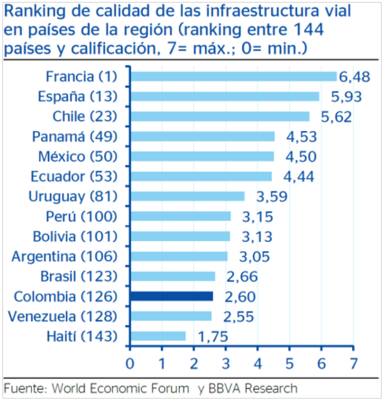
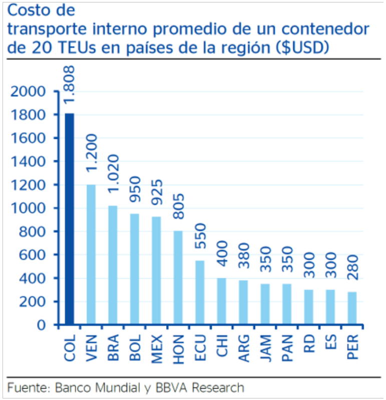


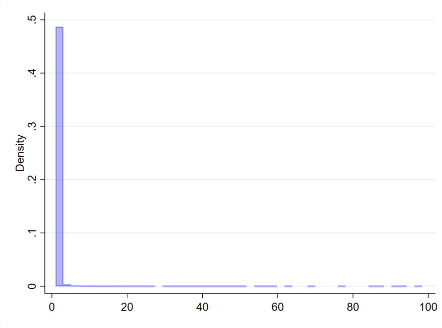




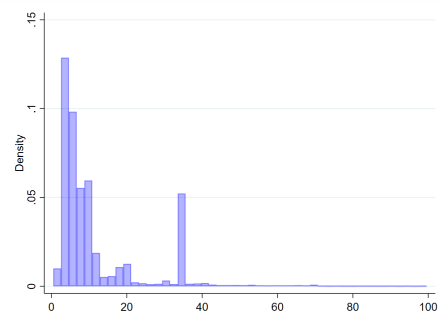
Source: BBVA (2012)

Trucking in Colombia, Fact #2: Heterogeneous truckers

Figure: Distribution across truckers



(a) Number of trucks



(b) Capacity (tons)

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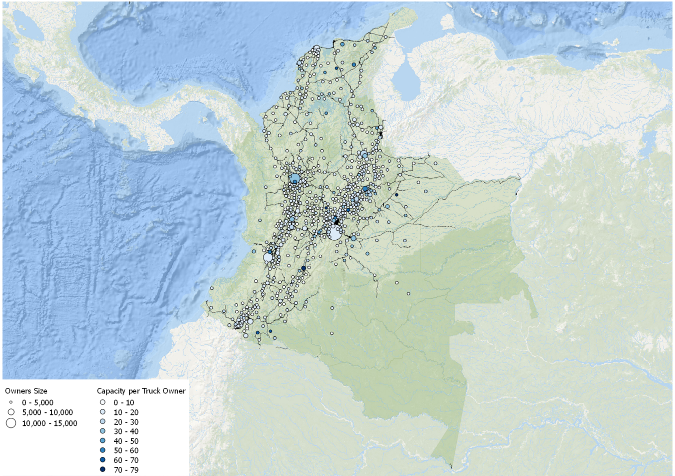
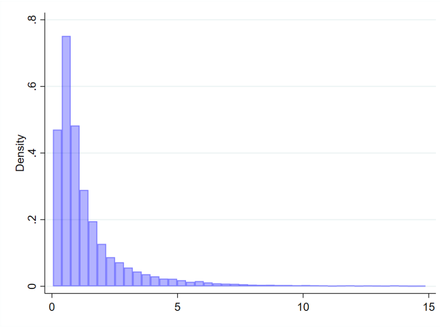
Figure: Residences of truckers

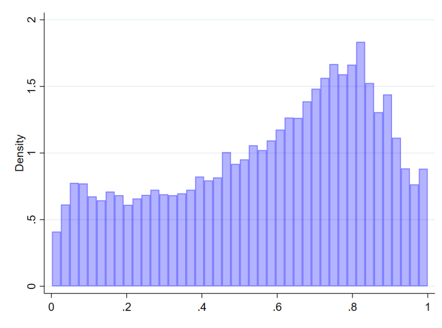


Trucking in Colombia, Fact #3: Imperfect competition?

Figure: Distribution across routes



(a) Price (per ton-mile)



(b) Market concetration (HHI)

Trucking in Colombia, Fact #3: Imperfect competition?

Colombia's truck strike: The truck stops here

By **bogotapost** - August 16, 2016

Why does it cost more to get a container from the coast to Bogotá than to ship it from Beijing? *Gerald Barr* continues his journey through some of the curiosities and contradictions of life in Colombia by demystifying the truck strike.

On Colombia's long and windy roads you get used to being stuck behind slow-moving trucks. But that's put into perspective when they spend more than seven weeks not moving at all, with some actively blocking the road. Yes folks, the country has just seen another truck strike. Wasn't there one last year? And the year before? Turns out there has been a truck strike every year for the past 15 years, as regular as Christmas, you might say, or rather a kind of "anti-Christmas" because nothing gets delivered.

Colombia reaches deal with truckers to lift 45-day strike

"The deal is realistic and fair. To have ceded to the unions which backed the strike would have meant a disproportionate and permanent increase in costs for families and a hard hit to the country's competitiveness," President Juan Manuel Santos said in a statement.

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- Road network (at origin-destination-month level):
    - Distance and travel time.

An example entry in the dataset

An example entry in the dataset

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Outline of Talk

From empirics to theory

Empirical facts

Theory ingredients

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Theory ingredients

1. Complex geography.
2. Heterogeneous truckers (in quality & place of residence).
3. Finite number of truckers competing to supply different routes.

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- Origin o:
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  - Each worker earns wage w_o.
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- Destination d expenditure on goods from o:

$$X_{od} = \frac{\tau_{od}^{1-\sigma} \left(p_o^0\right)^{1-\sigma}}{\sum_{o'} \tau_{o'd}^{1-\sigma} \left(p_{o'}^0\right)^{1-\sigma}} E_d,$$

  where:
  - $\tau_{od} \geq 1$ is the **endogenous** trade cost.
  - E_d is the expenditure (worker + trucker income).

Imperfect competition: Overview

Trucker t plays a three stage game:

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- *Solution*: Trucker t chooses her price to ensure all her capacity is used.

Stage #3: Competition on a route: Implications

- Trucker t's market share *on a route od* is:

$$s_{od,t} = \left(\bar{Q}^{c}_{od,t}\right)^{\frac{\chi-1}{\chi}} / \sum_{t'} \left(\bar{Q}^{c}_{od,t'}\right)^{\frac{\chi-1}{\chi}}$$

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- Origin o's market share *in a destination d* is:

$$s_{d,o} = \left(\left(\sum_{t'} \left(\bar{Q}^{c}_{od,t}\right)^{\frac{\chi-1}{\chi}}\right)^{\frac{\chi}{\chi-1}}\right)^{\frac{\sigma-1}{\sigma}} / \sum_{o'} \left(\left(\sum_{t'} \left(\bar{Q}^{c}_{o'd,t'}\right)^{\frac{\chi-1}{\chi}}\right)^{\frac{\chi}{\chi-1}}\right)^{\frac{\sigma-1}{\sigma}}$$

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- Trucker t's revenue $R_{od,t} \equiv p_{od,t} \bar{Q}^c_{od,t}$ is:

$$R_{od,t} = s_{od,t} \times s_{d,o} \times E_d$$

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- *Solution*: trucker's markup depends on her in-route and in-destination market shares:

$$p_{od,t} = \mu_{od,t} \times c_{od,t} \times p_o^0$$

  where:

$$\mu_{od,t} \equiv \frac{\chi}{\chi - 1}\left(1 - s_{od,t}\left(1 - \frac{\chi}{\chi - 1}\frac{\sigma - 1}{\sigma}\left(1 - s_{d,o}\right)\right)\right)^{-1}$$

Stage #2: Choice of capacity: Implications

- Lower cost truckers capture greater market share, charge higher markups:

$$\frac{s_{od,t}}{s_{od,t'}} = \left(\frac{\mu_{od,t} c_{od,t}}{\mu_{od,t'} c_{od,t'}}\right)^{1-\chi}$$

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- Trucker t's profit on a given route is:

$$\pi_{od,t} = \left(1 - \mu_{od,t}^{-1}\right) R_{od,t},$$

  - Note: log-supermodular in trucker t productivity.

- *Endogenous* trade costs depends on market concentration:

$$\tau_{od} = \left(\frac{\chi}{\chi - 1}\right) \left(\sum_{t'} \left(\mu_{od,t} c_{od,t}\right)^{1-\chi}\right)^{\frac{1}{1-\chi}}$$

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Stage #1: Choice of residence

- Suppose trucker t characterized by her type k and her home h where:

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  - Intuition:
    - $\bar{\tau}_{od}$ is (standard) iceberg trade cost.
    - $\rho_{h,o}$ and $\rho_{d,h}$ capture cost of getting from home to route and back
    - $\phi_k \geq 1$ is a type shifter.

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- Trucker t of type k solves:

$$\max_h \left(\sum_{od} \pi_{od,h,k} \right) \varepsilon_{h,k}(t)$$

where $\varepsilon \sim \mathit{Frechet}(\theta)$ is an idiosyncratic preference shifter.

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- *Solution*: $T_{h,k} \propto \Pi_{h,k}^{\theta}$, where $\Pi_{h,k} \equiv \sum_{od} \pi_{od,h,k}$.

Stage #1: Choice of residence: Implications

- Number of truckers of type k living in home h:

$$T_{h,k} = \frac{\Pi_{h,k}^{\theta}}{\sum_{h'} \Pi_{h',k}^{\theta}} \bar{T}_k$$

  where $\bar{T}_k$ is economy endowment of truckers of type k.

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- More truckers will live near good routes...
  - ... but better truckers (lower ϕ_k) especially so.

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- Labor income equal to sales net of markups:

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- Implication: trucking redistributes income from *od* to *h*.

Outline of Talk

The Triple Curse of Remoteness

1. More remote locations face higher marginal costs.

2. More remote locations face higher markups.

3. More remote locations are served by worse truckers.

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1. **More remote locations face higher marginal costs.**

2. More remote locations face higher markups.

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Curse #1: More remote locations face higher marginal costs.

- Combining expression for endogenous trade cost plus assumed marginal cost of capacity yields:

$$\tau_{od} = \bar{\tau}_{od} \times \left(\frac{\chi}{\chi - 1}\right) \times \underbrace{\left(\sum_{h,k} \left(\boldsymbol{\rho_{h,o}} \times \boldsymbol{\rho_{d,h}} \times \mu_{od,h,k} \times \phi_k \times T_{h,k}\right)^{1-\chi}\right)^{\frac{1}{1-\chi}}}_{\text{"remoteness"}}$$

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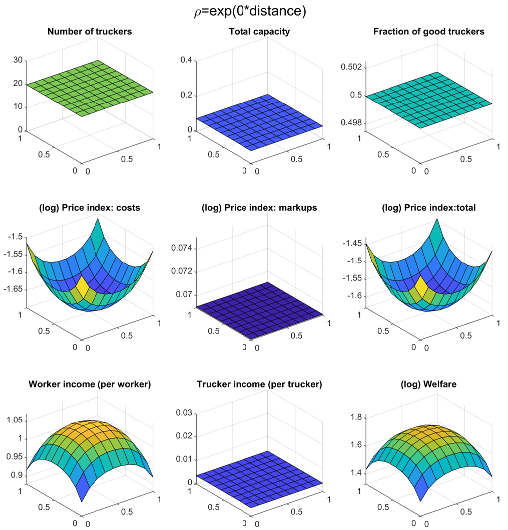
- Recall:
  - More remote locations trade less.
  - Truckers prefer to live near routes with more trade.

- **Curse #1:** More remote locations are further away from truckers' residences, incurring additional costs.

Curse #1: More remote locations face higher marginal costs.



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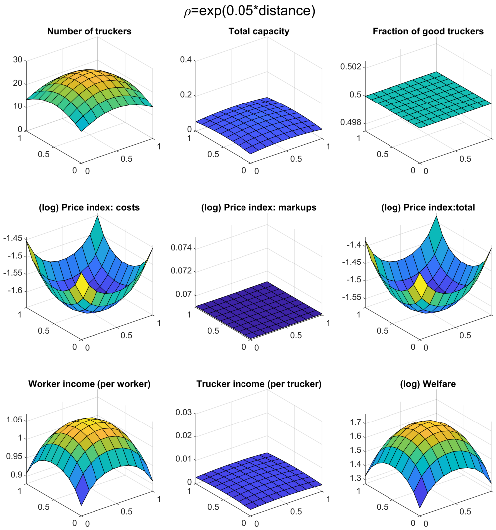

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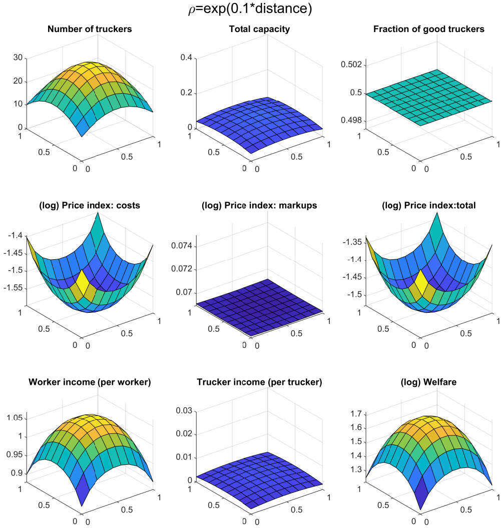

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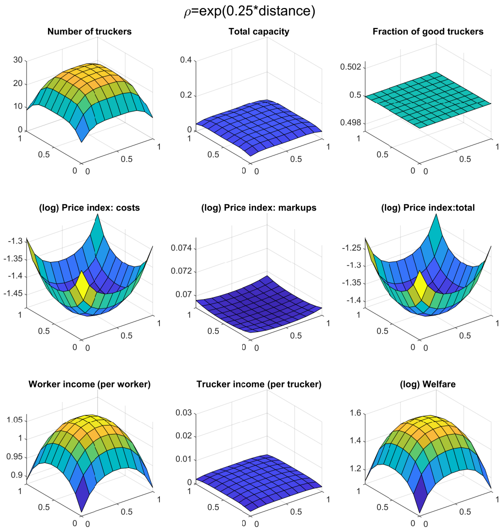

The Triple Curse of Remoteness

1. More remote locations face higher marginal costs.

2. **More remote locations face higher markups.**

3. More remote locations are served by worse truckers.

Curse #2: More remote locations face higher markups.

- Combining expression for endogenous trade cost plus assumed marginal cost of capacity yields:

$$\tau_{od} = \bar{\tau}_{od} \times \left(\frac{\chi}{\chi - 1}\right) \times \underbrace{\left(\sum_{h,k} (\rho_{h,o} \times \rho_{d,h} \times \boldsymbol{\mu_{od,h,k}} \times \phi_k \times T_{h,k})^{1-\chi}\right)^{\frac{1}{1-\chi}}}_{\text{"remoteness"}}$$

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- Recall:
  - More remote locations are further away from (most) truckers' residences.

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  - Markups are increasing in market share.

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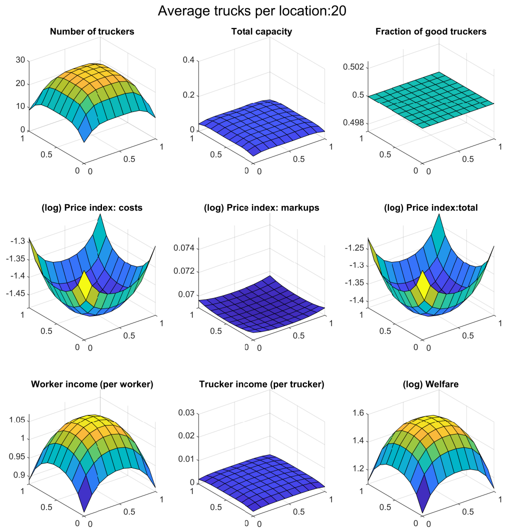
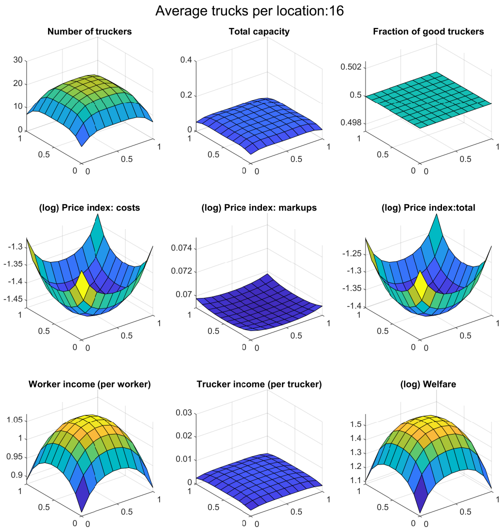
- Recall:
  - More remote locations are further away from (most) truckers' residences.
  - Markups are increasing in market share.

- **Curse #2:** More remote locations have fewer nearby truckers, who are more able to exploit their market power by charging higher markups.

Curse #2: More remote locations face higher markups.



Curse #2: More remote locations face higher markups.



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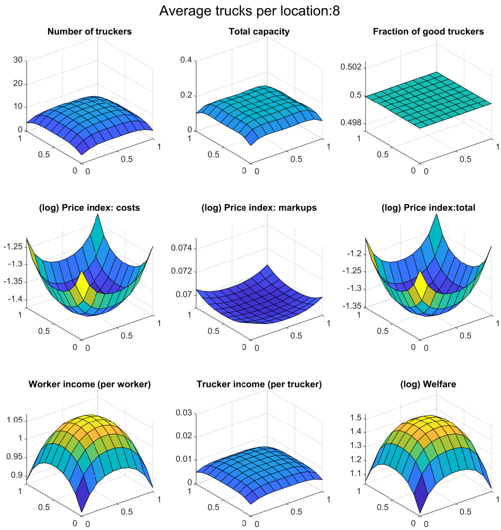

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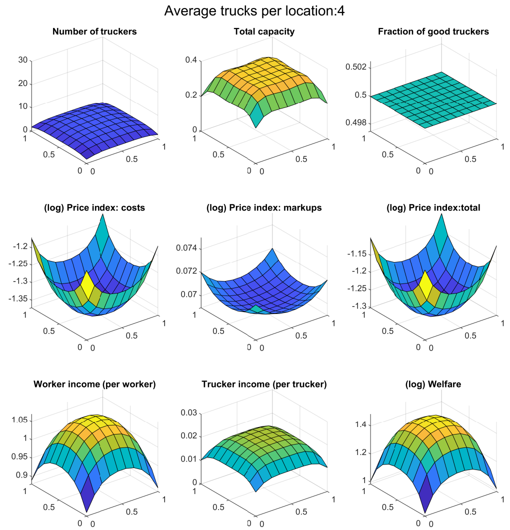

The Triple Curse of Remoteness

1. More remote locations face higher marginal costs.
2. More remote locations face higher markups.
3. **More remote locations are served by worse truckers.**

Curse #3: More remote locations are served by worse truckers.

- Combining expression for endogenous trade cost plus assumed marginal cost of capacity yields:

$$\tau_{od} = \bar{\tau}_{od} \times \left(\frac{\chi}{\chi - 1}\right) \times \underbrace{\left(\sum_{h,k} \left(\rho_{h,o} \times \rho_{d,h} \times \mu_{od,h,k} \times \boldsymbol{\phi_k} \times T_{h,k}\right)^{1-\chi}\right)^{\frac{1}{1-\chi}}}_{\text{"remoteness"}}$$

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- Recall:
  - Profits are log-super modular in trucker productivity.

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- Recall:
  - Profits are log-super modular in trucker productivity.
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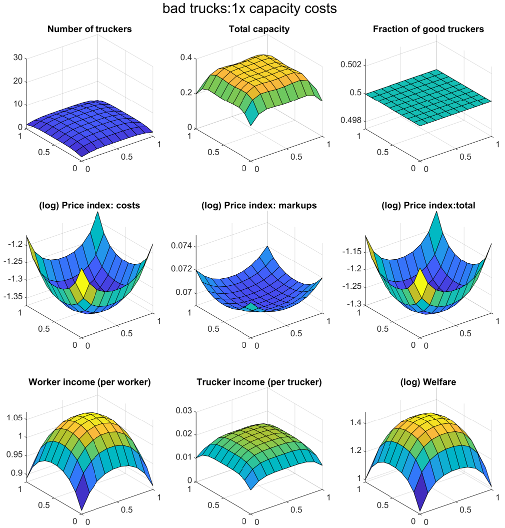
- **Curse #3:** Of the truckers who reside in remote areas, a greater fraction are of worse types.

Curse #3: More remote locations served by worse truckers.



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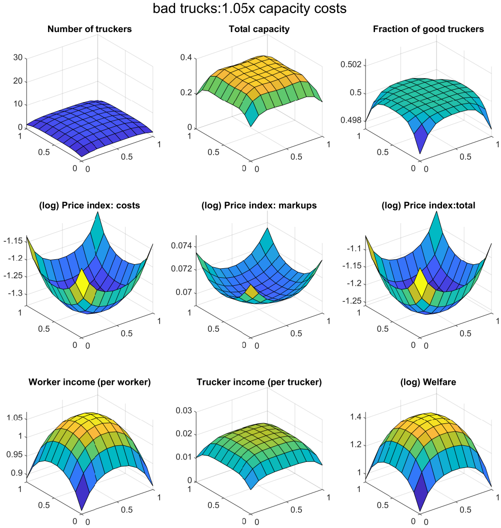

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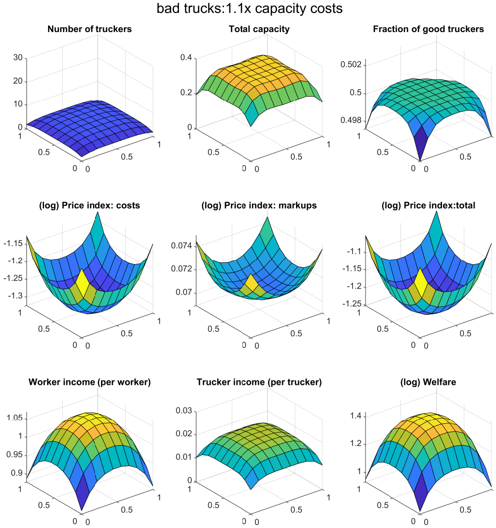

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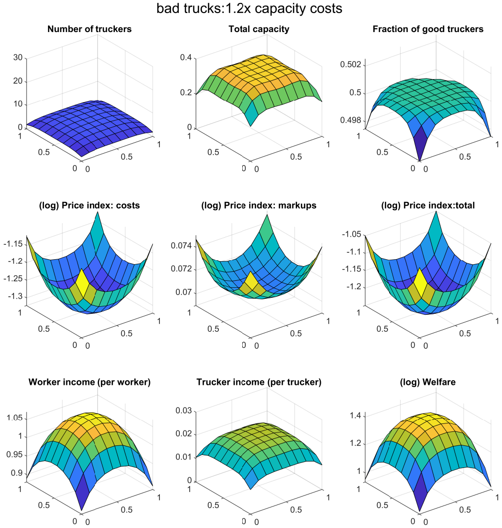
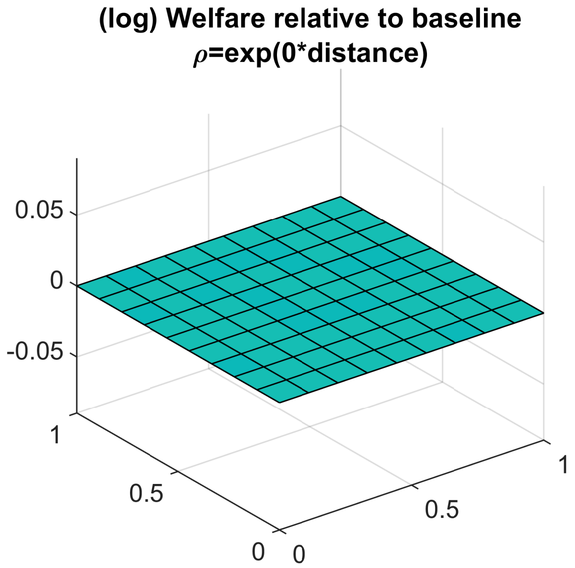


Each curse makes remoteness worse: Curse #1 vs. baseline



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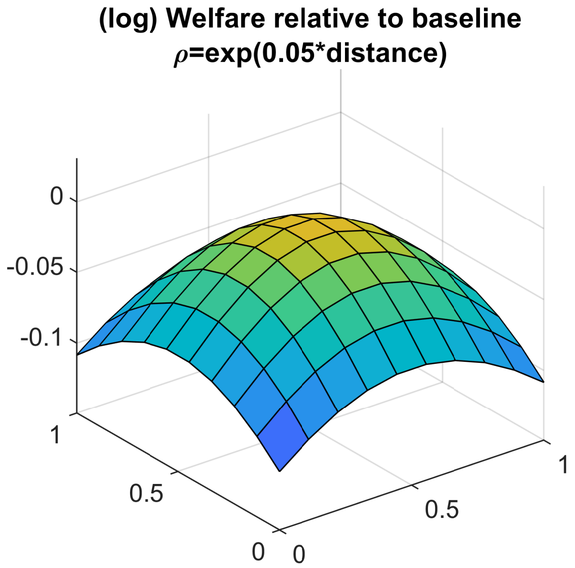

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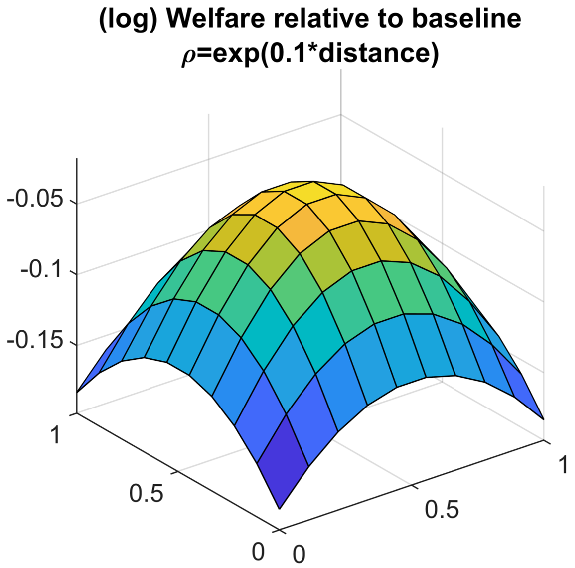

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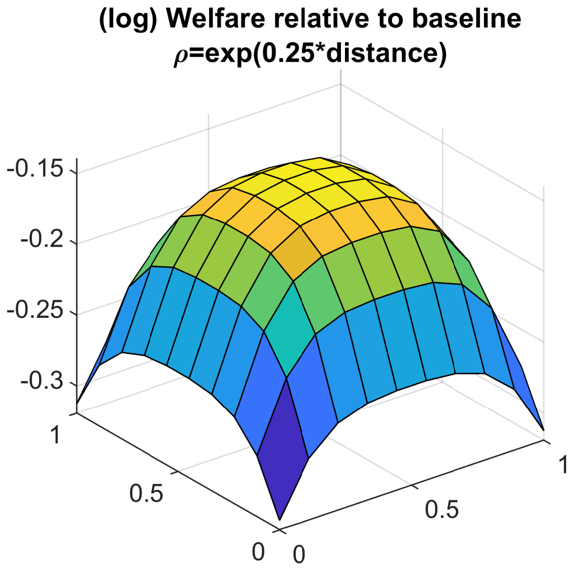
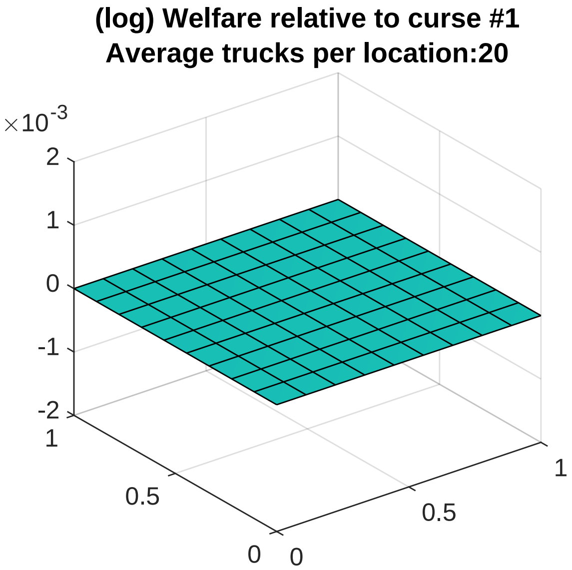


Each curse makes remoteness worse: Curse #2 vs. Curse #1



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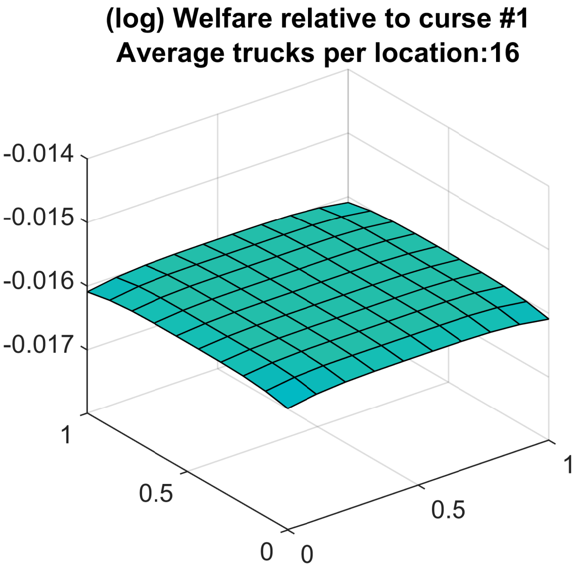

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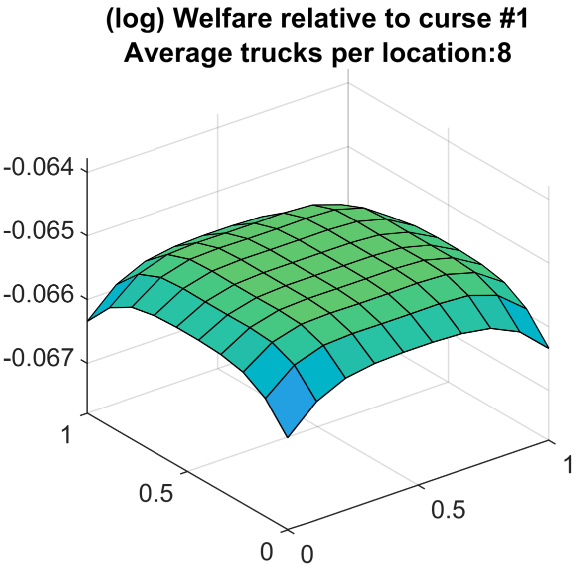

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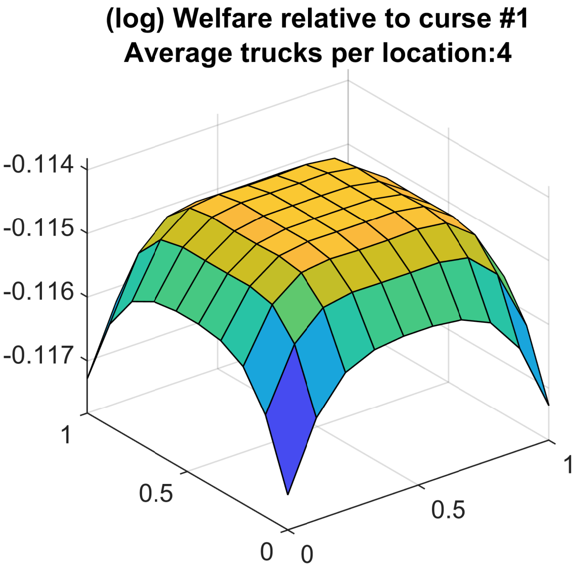
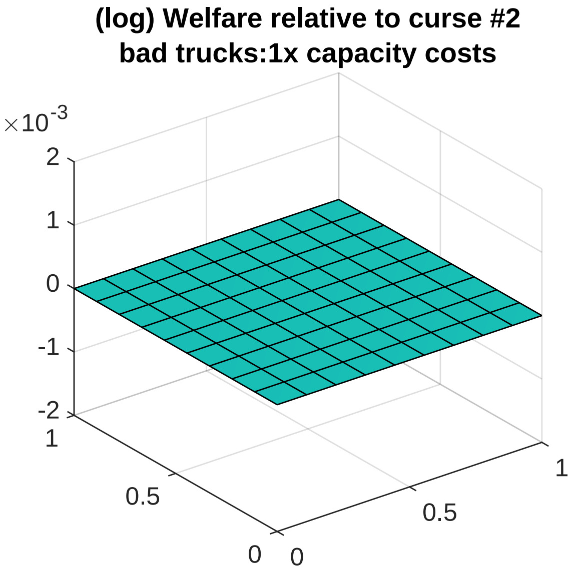


Each curse makes remoteness worse: Curse #3 vs. Curse #2



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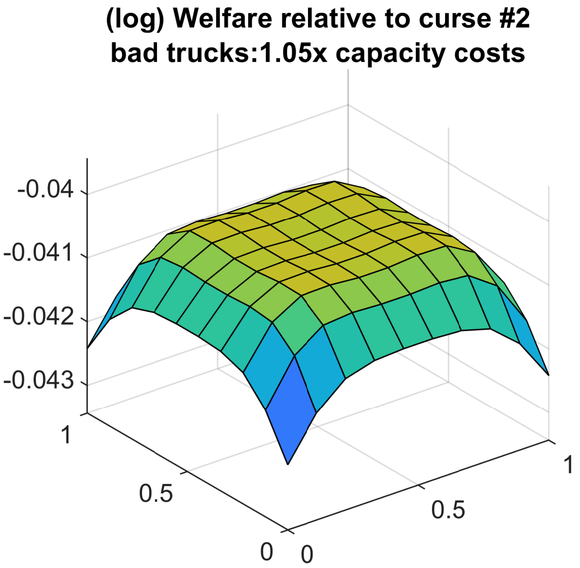

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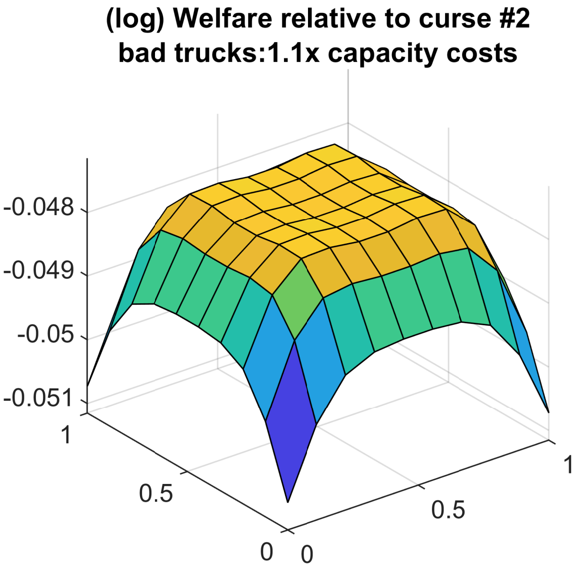

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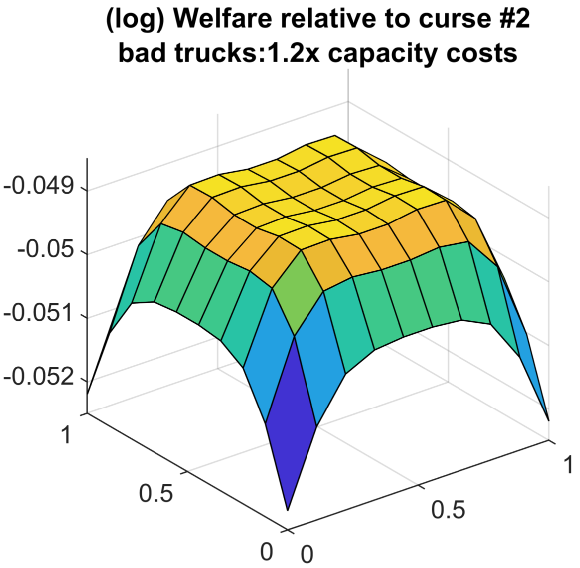

The Triple Curse of Remoteness: Empirical evidence

Fact 1a: Truckers travel further from home to serve more remote routes (Curse 1)

Fact 1b: Truckers market shares are declining with distance from home (Curse 1)

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Fact 1a: Truckers travel further from home to serve more remote routes (Curse 1)

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And...

Fact 2a: There is less competition on more remote routes (Curse 2)

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Fact 3b: Better truckers expand relatively more when competition increases (Curse 3)

The Triple Curse of Remoteness: Empirical implications

Resulting in:

Fact 4a: Lower costs of transit on less remote routes

Fact 4b: Decreased costs of transit on routes with more and better truckers

The Triple Curse of Remoteness: Empirical implications

Resulting in:

Fact 4a: Lower costs of transit on less remote routes

Fact 4b: Decreased costs of transit on routes with more and better truckers

And...

Fact 5a: Higher trade flows on less remote routes

Fact 5b: Increased trade flows on routes with more and better truckers

Measuring Remoteness

- Theory:

$$\ln \tau_{od} = c + \ln \bar{\tau}_{od} + \underbrace{\ln \left(\sum_{h,k} \left(\rho_{h,o} \times \rho_{d,h} \times \mu_{od,h,k} \times \phi_k \times T_{h,k} \right)^{1-\chi} \right)^{\frac{1}{1-\chi}}}_{\text{"remoteness"}}$$

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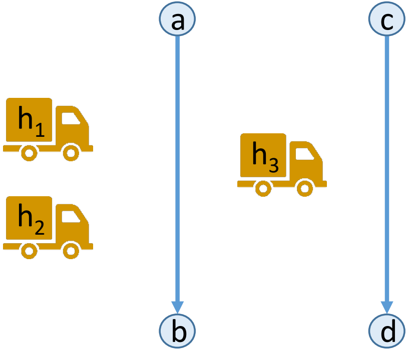
- Empirical proxy:

$$Remote_{od} \equiv - \ln \sum_{h} \left(\frac{1}{dist_{ho} \times dist_{dh}} \times T_h \right)$$

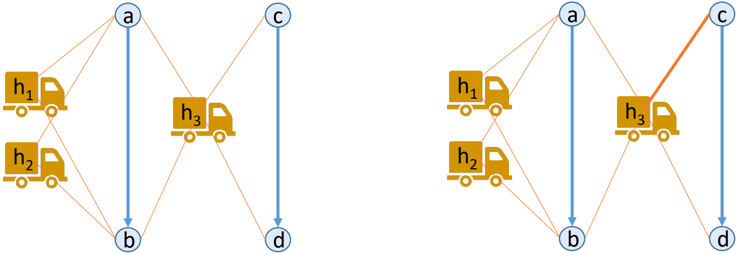
  - Assumes $\phi_k = \mu_{od,h,k} = 1$, $\rho_{h,o}^{1-\chi} = \frac{1}{dist_{ho}}$
  - $dist_{ho}$ is travel time between h and o [Alternatively: great circle distance].
  - T_h is total number of truckers in h (regardless of type) [Alternatively: total population].

Identification in the cross section: Suggestive evidence



- Intuition: Comparing routes that are equally far from *o* and *d*, do routes which truckers live further from have less competition.

Identification in the panel: Causal evidence



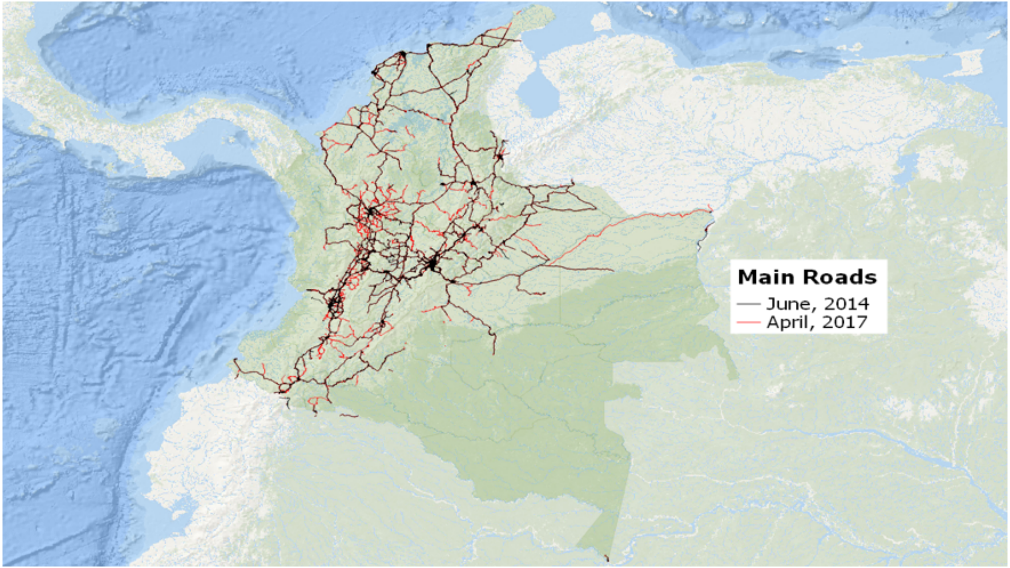
Period 0

Period 1

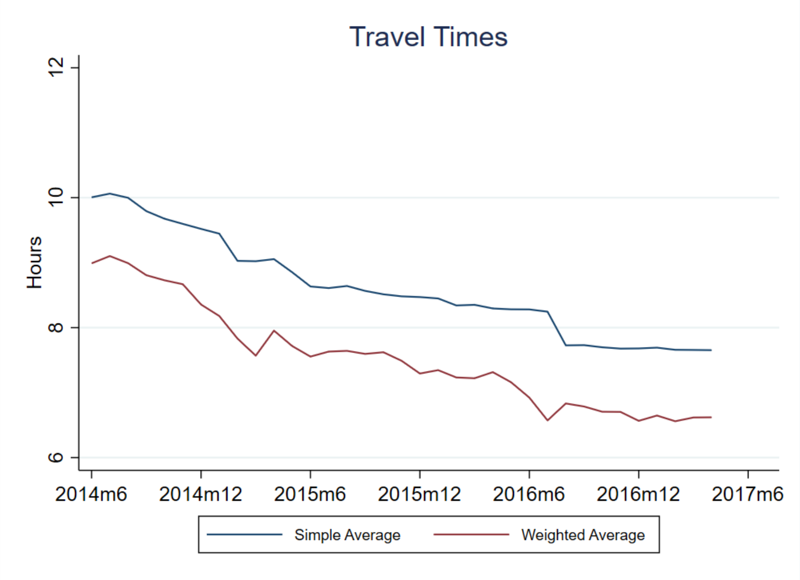
- Intuition: generate exogenous shocks to *od* competition from infrastructure improvements elsewhere, conditioning on *od* infrastructure improvements

Evolution of the Colombian Infrastructure Network

Evolution of the Colombian Infrastructure Network



Evolution of the Colombian Infrastructure Network



The Triple Curse of Remoteness: Empirical evidence

Fact 1a: Truckers travel further from home to serve more remote routes (Curse 1)

Fact 1b: Truckers market shares are declining with distance from home (Curse 1)

Fact 2a: There is less competition on more remote routes (Curse 2)

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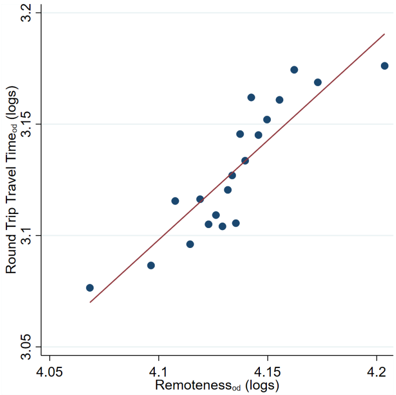
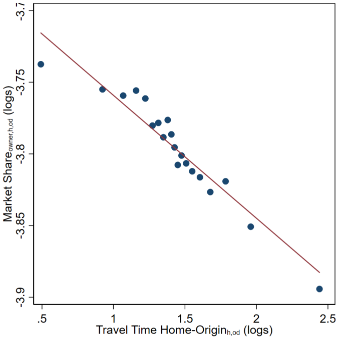
Fact 1a: Truckers travel further from home to serve more remote routes



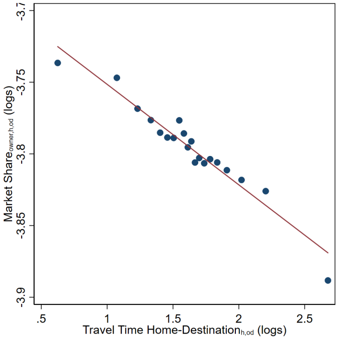
$$\ln roundtrip\_distance_{od} = \beta \ln Remote_{od} + \sum_k \delta_{ok} + \sum_k \delta_{dk} + \varepsilon_{od}$$

Table

Fact 1b: Truckers market shares are declining with distance from home



(e) Distance to route origin



(f) Distance to route destination

$$\ln MarketShare_{Owner,od} = \beta_1 \ln TravelTimeHomeOrigin_{h,o} + \beta_2 \ln TravelTimeHomeDestination_{h,d} + \delta_{Owner} + \delta_{od} + \varepsilon_{Owner,od}$$

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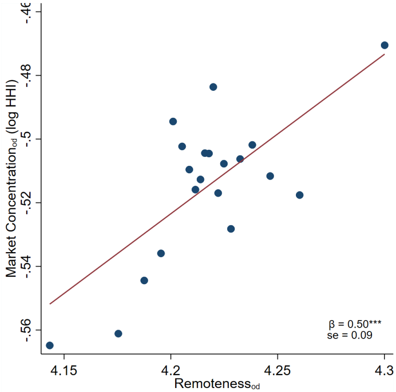


$$\ln HHI_{od} = \beta \ln Remote_{od} + \sum_k \delta_{ok} + \sum_k \delta_{dk} + \varepsilon_{od}$$

Table

Fact 2b: Routes that became more accessible became more competitive

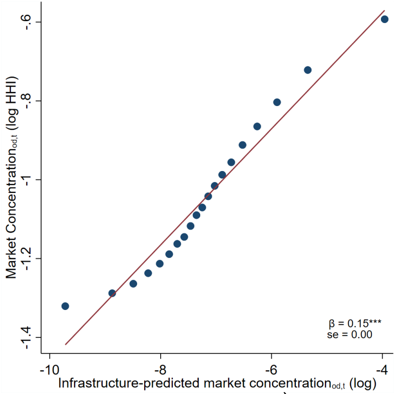
$$\ln HHI_{od,t} = \beta_1 \ln \left(\sum_h \left(\frac{\hat{Q}_{od,h,t}}{\sum_{h'} \hat{Q}_{od,h',t} \times T_{h',t}} \right)^2 \times T_{h,t} \right) + \beta_2 \ln dist_{od,t} + \delta_{od} + \delta_{ot} + \delta_{dt} + \varepsilon_{odt}$$

- where $\hat{Q}_{od,h,t}$ comes from estimating trucker's capacity:

$$\ln Q_{od,h,t} = \alpha_1 \ln dist_{h,o,t} + \alpha_2 \ln dist_{h,d,t} + \delta_{od,t} + \delta_{h,t} + \varepsilon_{h,od,t}$$

where we exclude FE and use $T_{h,pre}$.

Fact 2b: Routes that became more accessible became more competitive



$$\ln HHI_{od,t} = \beta_1 \ln \left(\sum_h \left(\frac{\hat{Q}_{od,h,t}}{\sum_{h'} \hat{Q}_{od,h',t} \times T_{h',t}} \right)^2 \times T_{h,t} \right) + \beta_2 \ln dist_{od,t} + \delta_{od} + \delta_{ot} + \delta_{dt} + \varepsilon_{odt}$$

Table

The Triple Curse of Remoteness: Empirical evidence

Fact 1a: Truckers travel further from home to serve more remote routes (Curse 1)

Fact 1b: Truckers market shares are declining with distance from home (Curse 1)

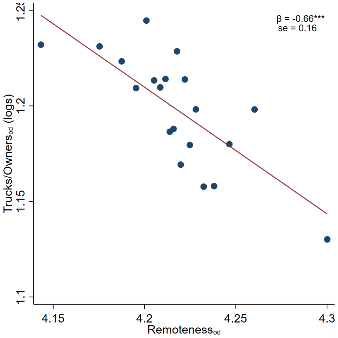
Fact 2a: There is less competition on more remote routes (Curse 2)

Fact 2b: Routes that became more accessible became more competitive (Curse 2)

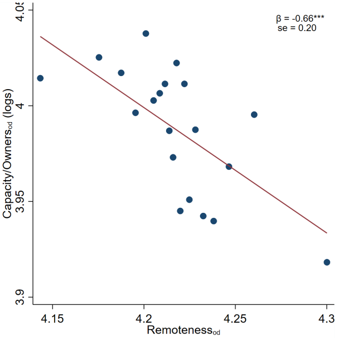
Fact 3a: Truckers that supply more remote routes are worse (Curse 3)

Fact 3b: Better truckers expand relatively more when competition increases (Curse 3)

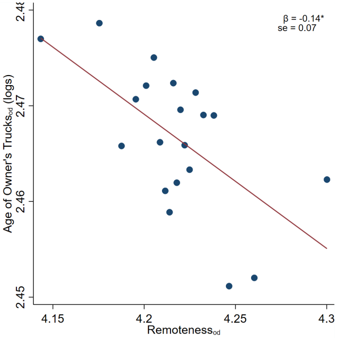
Fact 3a: Truckers serving more remote routes are worse



(g) Trucks / owner



(h) Capacity / owner



(i) Age of Trucks

$$\ln \mathit{Truckerquality}_{od} = \beta \ln \mathit{Remote}_{od} + \sum_k \delta_{ok} + \sum_k \delta_{dk} + \varepsilon_{od}$$

Tables

Fact 3b: Better truckers expand their operations more when competition increases

- Can also explore differential sorting of truckers based on profits

$$T_{h,t}^{owners,type} = \gamma_1 \Pi_{h,t}^{proxy,type} + \delta_{ht} + \delta_{h,type} + \delta_{t,type} + \varepsilon_{h,t}$$

  - where $T_{h,t}^{owners,type}$ is number of truckers of given type (good, bad) residing in h at t
  - δ_{ht} ensures we are exploiting variation across trucker types within ht
  - $\Pi_{h,t}^{proxy,type} = \sum_{od} \frac{\left(\frac{1}{T_{od,t}^{type}} \times \left(\frac{Shipments_{od,t}^{type}}{Shipments_{od,t}}\right)\right)^2 \times Shipments_{od,t}}{dist_{ho,t} \times dist_{dh,t}}$
  - with $\Pi_{ht}^{IV,type,proxy} = \sum_{od} \frac{\left(\frac{1}{\hat{T}_{od,t}^{type,-h}} \times \left(\frac{Shipments_{od,pre}^{type,-h}}{Shipments_{od,pre}^{-h}}\right)\right)^2 \times Shipments_{od,pre}^{-h}}{dist_{ho,pre} \times dist_{dh,pre}}$ and $\widehat{T_{od,t}^{type}}$ as before (excluding truckers from h)

Table: Fact 3b: Better truckers expand their operations more when competition increases

	Number of Owners$_{h,t}$^{Type}		Number of Trucks$_{h,t}$^{Type}		Trucks/Owners$_{h,t}$^{Type}	
	Logs	Inv. Hyp. Sine	Logs	Inv. Hyp. Sine	Logs	Inv. Hyp. Sine
Profit$_{h,t}$^{Type} (logs)	0.504**	0.067	0.752***	0.185	0.249***	0.237***
	(0.250)	(0.142)	(0.269)	(0.151)	(0.094)	(0.079)
Fixed Effects						
- homeXmonth	X	X	X	X	X	X
- monthXtype	X	X	X	X	X	X
- homeXtype	X	X	X	X	X	X
SW/Cragg-Donald F-stat	186***	669***	186***	669***	186***	186***
N	30,900	73,780	30,900	73,780	30,900	30,900

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

The Triple Curse of Remoteness: Implications

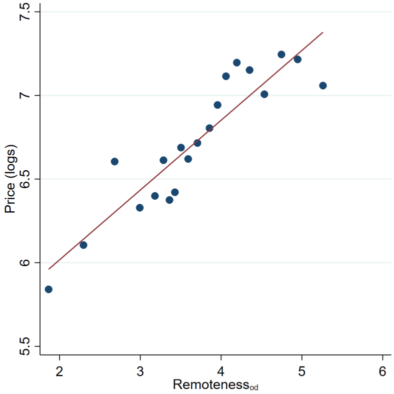
Fact 4a: Lower costs of transit on less remote routes

Fact 4b: Decreased costs of transit on routes with more and better truckers

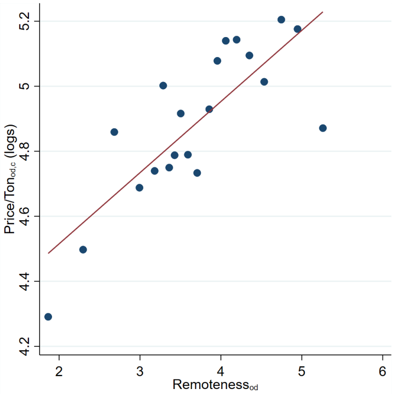
Fact 5a: Higher trade flows on less remote routes

Fact 5b: Increased trade flows on routes with more and better truckers

Fact 4a: Lower costs of transit on less remote routes



(j) Price / trip



(k) Price / ton

$$\ln Price_{odc} = \beta \ln Remote_{od} + \sum_k \delta_{okc} + \sum_k \delta_{dkc} + \varepsilon_{odc}$$

Tables

Fact 4b: Decreased costs of transit on routes with more and better truckers

$$\ln p_{od,t,c} = \beta_1 \ln dist_{od,t} + \beta_2 \ln HHI_{od,t} + \beta_3 \ln wtd.avg.capacity_{od,t} + \delta_{od} + \delta_t + \delta_c + \varepsilon_{od,t},$$

- where $\ln HHI_{od,t}$ instrumented with $\ln \left(\sum_h \frac{(dist_{ho,t})^{\hat{\alpha}_1} (dist_{hd,t})^{\hat{\alpha}_2}}{\sum_{\tilde{o}\tilde{d}} (dist_{h\tilde{o},t})^{\hat{\alpha}_1} \left(dist_{h\tilde{d},t} \right)^{\hat{\alpha}_2}} \times TruckOwners_{h,pre} \right)$

- and $\ln wtd.avg.capacity_{od,t}$ instrumented with $\ln \sum_{type} \left(\frac{\widehat{N_{od,t}^{type}}}{\sum_{\tilde{type}} \widehat{N_{od,t}^{\tilde{type}}}} \right) \times capacity_{od,pre}^{type}$

Table: Fact 4b: Decreased costs of transit on routes with more and better truckers

	IV 1st stage: Market concentration$_{od,t}$ (log HHI)	OLS: Price$_{od,t,c}$ (log)	IV 2nd Stage: Price$_{od,t,c}$ (log)
Infrastructure-predicted market concentration$_{od,t}$ (log)	2.51***		
	(0.33)		
Market concentration$_{od,t}$ (log HHI)		-0.00***	0.29**
		(0.00)	(0.12)
Travel Time$_{od,t}$ (log)	0.03	-0.00	-0.03
	(0.02)	(0.02)	(0.02)
Fixed Effects			
origin X destination X commodity	X	X	X
origin X month X commodity	X	X	X
destination X month X commodity	X	X	X
SW F-stat: Market Concentration	59.3***		59.3***
Cragg-Donald F-stat			59.3*
N	715,206	715,206	715,206
Adjusted within-R^2		0.00	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

t=month, o=origin, d=destination, k = travel time bins

Table: Fact 4b: Decreased costs of transit on routes with more and better truckers

	IV 1st stage: Market concentration$_{od,t}$ (log HHI)	IV 1st stage: Quality$_{od,t}$ (log owner avg. capacity)	OLS: Price$_{od,t,c}$ (log)	IV 2nd Stage: Price$_{od,t,c}$ (log)
Infrastructure-predicted market concentration$_{od,t}$ (log)	2.52***	3.28***		
	(0.33)	(0.63)		
Infrastructure-predicted change in quality	-0.05***	0.61***		
	(0.00)	(0.01)		
Market concentration$_{od,t}$ (log HHI)			-0.01***	0.19*
			(0.00)	(0.11)
Quality$_{od,t}$ (log owner avg. capacity)			0.00***	0.08***
			(0.00)	(0.01)
Travel Time$_{od,t}$ (log)	0.03	0.23***	-0.00	-0.05**
	(0.02)	(0.04)	(0.02)	(0.02)
Fixed Effects				
origin X destination X commodity	X	X	X	X
origin X month X commodity	X	X	X	X
destination X month X commodity	X	X	X	X
SW F-stat: Market Concentration	68.2***			68.2***
SW F-stat: Quality		102***		102***
Cragg-Donald F-stat				34*
N	715,206	715,206	715,206	715,206
Adjusted within-R^2			0.00	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

t=month, o=origin, d=destination, k = travel time bins

The Triple Curse of Remoteness: Implications

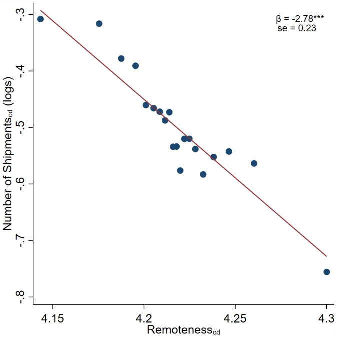
Fact 4a: Lower costs of transit on less remote routes

Fact 4b: Decreased costs of transit on routes with more and better truckers

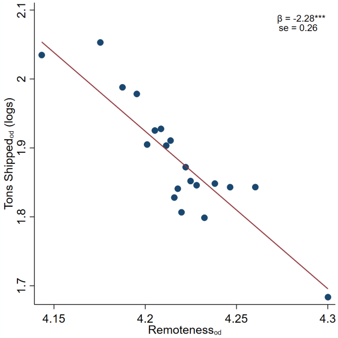
Fact 5a: Higher trade flows on less remote routes

Fact 5b: Increased trade flows on routes with more and better truckers

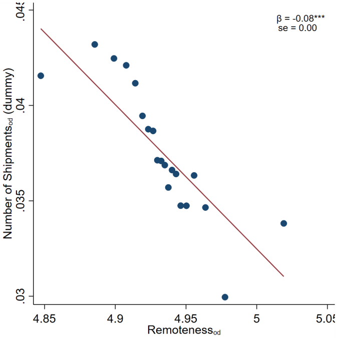
Fact 5a: Higher trade flows on less remote routes



(l) Number of shipments



(m) Tons



(n) Extensive margin

$$\ln Q_{od} = \beta \ln Remote_{od} + \sum_k \delta_{ok} + \sum_k \delta_{dk} + \varepsilon_{od}$$

Table

Table: Fact 5b: Increased trade flows on routes with better truckers

	IV 1st stage: Market concentration$_{od,t}$ (log HHI)	IV 1st stage: Quality$_{od,t}$ (log owner avg. capacity)	OLS: Tons Shipped$_{od,t,c}$ (log)	IV 2nd Stage: Tons Shipped$_{od,t,c}$ (log)
Infrastructure-predicted market concentration$_{od,t}$ (log)	2.52***	3.28***		
	(0.33)	(0.63)		
Infrastructure-predicted change in quality	-0.05***	0.61***		
	(0.00)	(0.01)		
Market concentration$_{od,t}$ (log HHI)			-0.00	0.14
			(0.00)	(0.18)
Quality$_{od,t}$ (log owner avg. capacity)			0.01***	0.12***
			(0.00)	(0.02)
Travel Time$_{od,t}$ (log)	0.03	0.23***	0.02	-0.03
	(0.02)	(0.04)	(0.03)	(0.04)
Fixed Effects				
origin X destination X commodity	X	X	X	X
origin X month X commodity	X	X	X	X
destination X month X commodity	X	X	X	X
SW F-stat: Market Concentration	68.2***			68.2***
SW F-stat: Quality		102***		102***
Cragg-Donald F-stat				34*
N	715,206	715,206	715,206	715,206
Adjusted within-R^2			0.00	

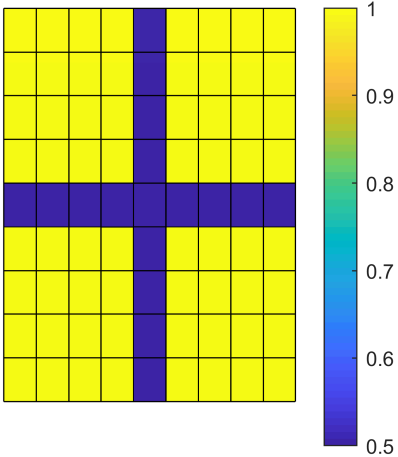
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.
t=month, o=origin, d=destination, k = travel time bins

$$\ln Shipments_{odt} = \beta_1 \ln dist_{od,t} + \beta_2 \ln HHI_{od,t} + \beta_3 \ln wtd.avg.capacity_{od,t} + \delta_{od} + \delta_t + \delta_c + \varepsilon_{od,t},$$

Outline of Talk

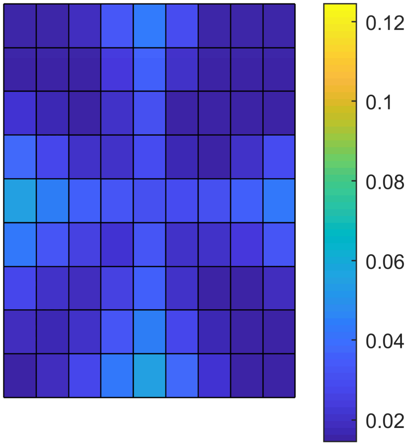
Next Step: Quantify impact of infrastructure improvements

Figure: An example infrastructure improvement



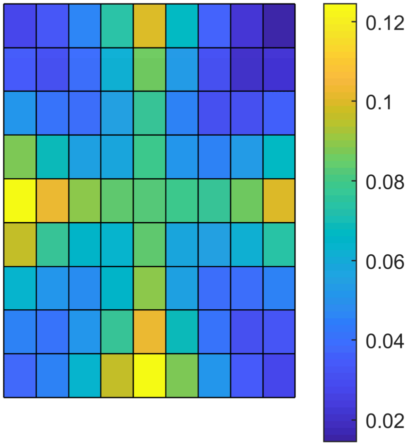
Next Step: Quantify impact of infrastructure improvements

Figure: An example infrastructure improvement: Welfare gains *without* market power



Next Step: Quantify impact of infrastructure improvements

Figure: An example infrastructure improvement: Welfare gains *with* market power



Next Step: How does competition policy shape these impacts?

La Línea (Road Pass)

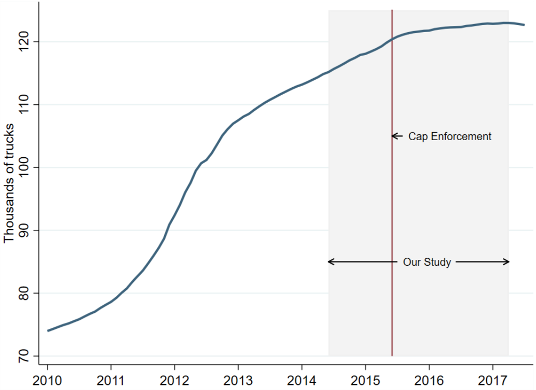
From Wikipedia, the free encyclopedia

For other uses, see La Linea (disambiguation).

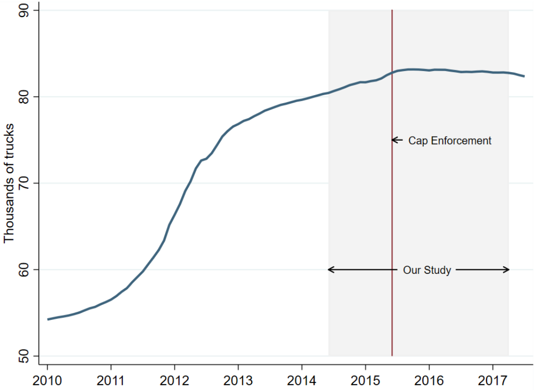
La Línea (English: The Line) is a highway tunnel currently under construction between the cities of Calarcá, Quindío and Cajamarca, Tolima in Colombia. It will cross beneath the locally famous "Alto de La Línea" in the Cordillera Central or central range of the Andes mountains, easing traffic on one of Colombia's main east-west road connections (the National Route 40) which links Bogotá with Cali and the Pacific port of Buenaventura. It will be the 2nd longest road tunnel in Latin America.[1] The total length of the tunnel will be 8,652 metres, its western entrance being at 2,420 metres above msl, 19 kilometres east of the city of Armenia and the eastern one at 2,505 metres above msl, at 37.8 kilometres west of Ibagué.[2] Constructions of the pilot tunnel started on 30 September 2004 and both sides of the pilot met on 2 August 2008.[3] In September 2007 Ministry of Transport launched the tender process for the construction of tunnel and connecting roads.[4] Construction work started in December 2008 and was expected to finish in 2016.[5][6] As of May 2016, opening is delayed to 2018.[7] As of January 2019, opening is delayed to December 2020.[8]

Next Step: How does competition policy shape these impacts?

Figure: Colombia's new(ly enforced) 1:1 truck scrapping scheme



(a) All Trucks



(b) Big Trucks (Weight>10.5 tons)

Conclusion

- New **spatial imperfect competition model, cross-sectional patterns from shipment-level trucking data**, and plausibly causal **estimates from infrastructure changes** highlight the *triple curse of remoteness*:

1. Remoteness $\implies$ higher physical transportation costs
2. Remoteness $\implies$ less competition in transportation sector, higher markups
3. Remoteness $\implies$ transportation services provided by worse firms

Conclusion

- New **spatial imperfect competition model, cross-sectional patterns from shipment-level trucking data**, and plausibly causal **estimates from infrastructure changes** highlight the *triple curse of remoteness*:
  1. Remoteness $\implies$ higher physical transportation costs
  2. Remoteness $\implies$ less competition in transportation sector, higher markups
  3. Remoteness $\implies$ transportation services provided by worse firms

- Much still to do:
  - Quantifying the the welfare impacts of existing infrastructure improvements in the presence of market power.
  - Quantify the impact of (anti) competitive policies on gains from future infrastructure improvements.

Other Notable Triple Curses

“I stand a wretch, in birth, in wedlock cursed, A parricide, incestuously, triply cursed!” - Oedipus

Other Notable Triple Curses

THE TRIPLE CURSE;

OR, THE

EVILS OF THE OPIUM TRADE

ON

INDIA, CHINA, AND ENGLAND.

BEING THE REPORT OF A SPEECH DELIVERED AT THE GUILDHALL, BATH,

BY

J. PASSMORE EDWARDS.

LONDON: JUDD AND GLASS, NEW BRIDGE STREET, AND GRAY'S INN ROAD.

Price 3d.

Other Notable Triple Curses

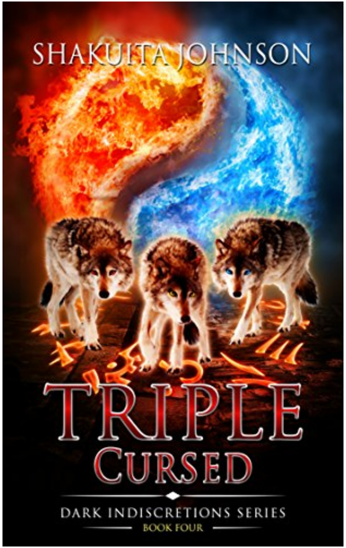


Table: Fact 1a: Truckers travel further from home to serve more remote routes

Dep. var: Round Trip Travel Time$_{\mathrm{od}}$ (log)	(1)	(2)	(3)
Remoteness$_{\mathrm{od}}$	1.543***	0.892***	0.692***
	(0.013)	(0.094)	(0.166)
Fixed Effects			
- origin X destination	X		
- origin X distnace bins, destination X distnace bins (K=10)		X	
- origin X distnace bins, destination X distnace bins (K=25)			X
Observations	9,754	7,431	5,029
Adjusted within-R^2	0.63	0.02	0.01

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses. *o*=origin, *d*=destination, *k* = bins of travel times, *h*=home.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*=travel times and *L*=truck truckers. *o*=origin, *d*=destination, *k* = bins of travel times, *h*=home.

Back

Table: Fact 2a: There is less competition on more remote routes

Dep. var: Market Concentration$_{od}$ (log HHI)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	0.53***	0.69***	0.56***
	(0.01)	(0.05)	(0.10)
Observations	34,819	34,602	34,744
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	0.60***	0.66***	0.50***
	(0.01)	(0.05)	(0.09)
Observations	34,819	34,602	34,744
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	0.33***	0.35***	0.11**
	(0.01)	(0.03)	(0.06)
Observations	33,818	33,530	33,726
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	0.33***	0.26***	0.06
	(0.01)	(0.03)	(0.05)
Observations	33,818	33,530	33,726
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where $dist$={travel times, straight line distance} and L={population, truck owner share}. o=origin, d=destination, k = bins of travel times or straight line distances, h=home.

Note: If od had 0 trips, HHI was not calculated. Back

Table: Fact 2b: Routes that became more accessible became more competitive

Market Concentration$_{od,t}$ (log HHI)	(1)	(2)
Infrastructure-predicted market concentration$_{od,t}$ (log)	0.15***	0.15***
	(0.00)	(0.00)
Travel Time$_{od,t}$ (log)		-0.09***
		(0.02)
Fixed Effects		
- origin X destination	X	X
- origin X month	X	X
- destination X month	X	X
Observations	548,776	548,776
Adjusted within-R^2	0.16	0.16

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where $dist$={travel times, straight line distance} and L={population, truck owner share}. o=origin, d=destination, k = bins of travel times or straight line distances, h=home.

Note: If od had 0 trips, HHI was not calculated. Back

Table: Fact 3a: There are worse truck owners on more remote routes

Dep. var: Trucks/Owners$_{od}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-0.26***	-0.86***	-0.73***
	(0.02)	(0.09)	(0.16)
Observations	34,819	34,602	34,744
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-0.31***	-0.86***	-0.66***
	(0.02)	(0.09)	(0.16)
Observations	34,819	34,602	34,744
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-0.17***	-0.19***	-0.03
	(0.01)	(0.05)	(0.09)
Observations	33,818	33,530	33,726
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-0.17***	-0.18***	-0.03
	(0.01)	(0.05)	(0.08)
Observations	33,818	33,530	33,726
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.
$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home.

Table: Fact 3a: There are worse truck owners on more remote routes

Dep. var: Capacity/Owners$_{od}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-0.15***	-0.90***	-0.72***
	(0.03)	(0.11)	(0.21)
Observations	34,819	34,602	34,744
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-0.17***	-0.91***	-0.66***
	(0.03)	(0.12)	(0.20)
Observations	34,819	34,602	34,744
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-0.12***	-0.23***	-0.01
	(0.02)	(0.07)	(0.12)
Observations	33,818	33,530	33,726
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-0.12***	-0.20***	0.02
	(0.02)	(0.06)	(0.10)
Observations	33,818	33,530	33,726
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and L={population, truck owner share}. o=origin, d=destination, k = bins of travel times or straight line distances, h=home.

Table: Fact 3a: There are worse truck owners on more remote routes

Dep. var: Age of Owner's Trucks$_{od}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-0.44***	-0.34***	-0.30***
	(0.01)	(0.04)	(0.08)
Observations	34,815	34,598	34,740
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-0.49***	-0.24***	-0.14*
	(0.01)	(0.04)	(0.07)
Observations	34,815	34,598	34,740
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-0.25***	-0.22***	-0.26***
	(0.01)	(0.02)	(0.04)
Observations	33,814	33,526	33,721
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-0.25***	-0.16***	-0.17***
	(0.01)	(0.02)	(0.04)
Observations	33,814	33,526	33,721
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home. Back

Table: Fact 4a: Prices are higher on more remote routes

Dep. var: Price (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness_{od}	1.29***	2.15***	2.69***
	(0.01)	(0.03)	(0.05)
Observations	106,009	104,466	105,026
Remoteness measured using travel times & truck owner shares			
Remoteness_{od}	1.36***	2.02***	2.64***
	(0.01)	(0.03)	(0.05)
Observations	106,009	104,466	105,026
Remoteness measured using straight line distance & population shares			
Remoteness_{od}	0.71***	0.78***	0.64***
	(0.00)	(0.02)	(0.03)
Observations	79,978	77,475	78,558
Remoteness measured using straight line distance & truck owner shares			
Remoteness_{od}	0.70***	0.66***	0.53***
	(0.00)	(0.02)	(0.03)
Observations	79,978	77,475	78,558
Fixed Effects			
origin X destination X commodity	X	X	X
origin X commodity X distance bins, destination X commodity X distance bins (K=10)		X	
origin X commodity X distance bins, destination X commodity X distance bins (K=25)			X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.
$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}.
o=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home.

Table: Fact 4a: Prices are higher on more remote routes

Dep. var: Price/Ton$_{od,c}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	0.93***	1.64***	2.13***
	(0.01)	(0.04)	(0.06)
Observations	106,009	104,466	105,026
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	0.98***	1.49***	2.01***
	(0.01)	(0.04)	(0.07)
Observations	106,009	104,466	105,026
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	0.53***	0.69***	0.62***
	(0.01)	(0.03)	(0.05)
Observations	79,978	77,475	78,558
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	0.52***	0.55***	0.46***
	(0.01)	(0.03)	(0.05)
Observations	79,978	77,475	78,558
Fixed Effects			
origin X destination X commodity	X	X	X
origin X commodity X distance bins, destination X commodity X distance bins (K=10)		X	
origin X commodity X distance bins, destination X commodity X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home. Back

Table: Fact 5a: Trade is lower on more remote routes

Dep. var: Number of Shipments$_{od}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-2.34***	-3.75***	-3.35***
	(0.03)	(0.13)	(0.25)
Observations	34,819	34,602	34,744
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-2.69***	-3.51***	-2.78***
	(0.04)	(0.14)	(0.23)
Observations	34,819	34,602	34,744
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-1.43***	-1.58***	-0.73***
	(0.02)	(0.08)	(0.14)
Observations	33,818	33,530	33,726
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-1.44***	-1.26***	-0.48***
	(0.02)	(0.08)	(0.12)
Observations	33,818	33,530	33,726
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home.

Table: Fact 5a: Trade is lower on more remote routes

Dep. var: Tons Shipped$_{od,c}$ (logs)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-0.23***	-0.78***	-0.62***
	(0.01)	(0.07)	(0.10)
Observations	112,150	111,023	111,481
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-0.24***	-0.75***	-0.55***
	(0.01)	(0.08)	(0.10)
Observations	112,150	111,023	111,481
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-0.20***	-0.29***	-0.13*
	(0.01)	(0.05)	(0.08)
Observations	78,666	76,181	77,264
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-0.19***	-0.25***	-0.11
	(0.01)	(0.05)	(0.07)
Observations	78,666	76,181	77,264
Fixed Effects			
origin X destination X commodity	X	X	X
origin X commodity X distance bins, destination X commodity X distance bins (K=10)		X	
origin X commodity X distance bins, destination X commodity X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home.

Table: Fact 5a: Trade is lower on more remote routes

Dep. var: Number of Shipments$_{od}$ (dummy)	(1)	(2)	(3)
Remoteness measured using travel times & population shares			
Remoteness$_{od}$	-0.14***	-0.12***	-0.02***
	(0.00)	(0.00)	(0.00)
Observations	1,110,916	1,110,863	1,110,691
Remoteness measured using travel times & truck owner shares			
Remoteness$_{od}$	-0.17***	-0.16***	-0.08***
	(0.00)	(0.00)	(0.00)
Observations	1,110,916	1,110,863	1,110,691
Remoteness measured using straight line distance & population shares			
Remoteness$_{od}$	-0.08***	-0.11***	-0.05***
	(0.00)	(0.00)	(0.00)
Observations	1,110,916	1,110,840	1,110,477
Remoteness measured using straight line distance & truck owner shares			
Remoteness$_{od}$	-0.09***	-0.10***	-0.06***
	(0.00)	(0.00)	(0.00)
Observations	1,110,916	1,110,840	1,110,477
Fixed Effects			
origin X destination	X	X	X
origin X distance bins, destination X distance bins (K=10)		X	
origin X distance bins, destination X distance bins (K=25)			X

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

$Remoteness_{od} \approx -\ln \sum_h \left(\frac{1}{dist_{ho} \times dist_{dh}} \times \left(\frac{L_h}{\sum_h L_h} \right) \right)$, where *dist*={travel times, straight line distance} and *L*={population, truck owner share}. *o*=origin, *d*=destination, *k* = bins of travel times or straight line distances, *h*=home.

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