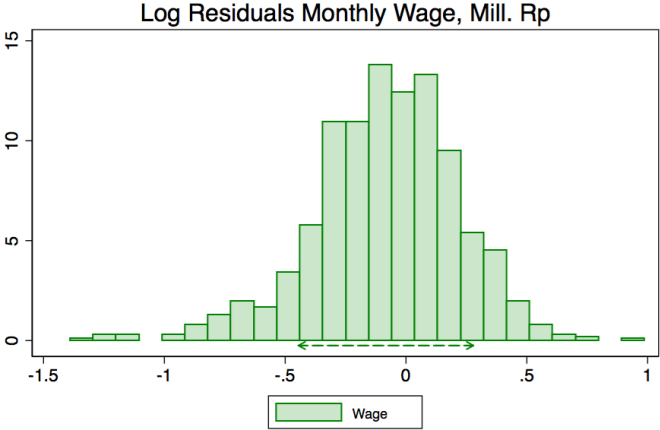


# Economic Development and the Spatial Allocation of Labor: Evidence From Indonesia

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# Gains from Spatial Reallocation of Labor?



Arrow shows 90-10 percentile range.  
Base gap is 2.06.

▶ Remove observables

▶ US?

# Questions

1. Could productivity be increased by moving people?
  - ▶ Not obvious: selection (could go either way).
  - ▶ Quantitatively, how large are the effects?
2. If so, why do people not move?
  - ▶ Amenity differences (traditional in urban economics).
  - ▶ Costs of movement (understudied).

# The Paper

1. Some facts:
  - ▶ Show that selection and movement costs are present.
2. Theory:
  - ▶ Model consistent with facts.
3. Empirical:
  - ▶ Structurally estimate on census data (US and Ind).
4. Quantitative:
  - ▶ How much do movement costs and amenity differences explain?

# Main Results

- ▶ Structural Estimates:
  - ▶ Movement costs have decreased over time in Indonesia.
  - ▶ Movement costs are much higher than in the US.
  - ▶ Amenity is negatively correlated with productivity.
- ▶ Quantitative Results:
  - ▶ Over time 1995-2012:
    - ▶ Reduced movement cost account for about 25% growth.
    - ▶ Changes in amenity account for about 25% growth.
  - ▶ Comparison to the US:
    - ▶ higher movement costs explain about 5% of US-Indonesia gap

## Some Related Literature

- ▶ Rural-urban income gaps  
Young (2014); Lagakos and Waugh (2013); Gollin, Lagakos and Waugh (2011); Restuccia, Yang and Zhu (2008); Caselli (2005)
- ▶ Experimental evidence: large returns to migrating  
Bryan, Chowdhury and Mobarak (2014)
- ▶ Migration costs are large  
Morten and Oliveira (2014); Kennan and Walker (2011); Topel (1986)
- ▶ Large literature on misallocation of factors  
Hsieh, Hurst, Klenow and Jones (2014); Hsieh and Klenow (2009); Hsieh and Moretti (2014), Desmet and Rossi-Hansberg (2014)

(Also, Eaton and Kortum 2002)

# Outline

Reduced Form Facts: Costly Migration and Selection

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# Data

## ▶ Indonesia

- ▶ 1976 SUPAS; 1995 SUPAS; 2011 SUSENAS; 2012 SUSENAS
  - ▶ ~ 27% of hoh do not live in regency of birth.
  - ▶ ~ 60% of these cross a provincial border.
- ▶ Main sample: male hoh who are wage workers, aged 15-65
- ▶ Supplement with IFLS 1993, 1997, 2000, 2007.

## ▶ United States

- ▶ 1990 Census (5% sample) and 2010 ACS
- ▶ 40% do not live in state of birth

▶ Rural-urban migration



# Four motivating facts

1. The gravity equation.
  - ▶ Long history: Ravenstein (1889), Grogger and Hanson (2011)
2. Distance travelled predicts wage.
  - ▶ Distance as proxy for migration cost
  - ▶ We non-parametrically estimate costs later
3. Proportion of migrants moving negatively predicts wage.
4. Distance does not predict wage controlling for proportion.

## Fact 1: Gravity Equation for Migration

	(1)	(2)	(3)	(4)
	1976	1995	2011	2012
Dep var: Log Prop. Mig.	b/se	b/se	b/se	b/se
Log Distance	-0.47*** (0.0041)	-0.60*** (0.0017)	-0.61*** (0.0016)	-0.61*** (0.0016)
Destination FE	Yes	Yes	Yes	Yes
N	43160	166899	210373	210491

$$\ln \pi_{do} = \alpha_d + \gamma_o + \beta \ln dist_{do} + \epsilon_{do}$$

## Fact 2: Migration Distance Predicts Wages

	(1)
Dep var: Log Wage	b/se
Log Distance	0.038*** (0.0018)
Destination FE	Yes
Origin FE	Yes
N	58882
Correlation	

Year is 1995; Regency; Everyone.

$$\ln w_{ido} = \alpha_d + \beta \ln dist_{do} + \epsilon_{ido}$$

### Fact 3: Migration Proportion Negatively Corr with Wage

	(1)	(2)
Dep var: Log Wage	b/se	b/se
Log Distance	0.038*** (0.0018)	
Log Proportion		-0.064*** (0.0018)
Destination FE	Yes	Yes
Origin FE	Yes	No
N	58882	58882
Correlation		

Year is 1995; Regency; Everyone.

$$\ln w_{ido} = \alpha_d + \beta \pi_{do} + \epsilon_{ido}$$

## Fact 4: Distance only through Proportion Migrating

	(1)	(2)	(3)
Dep var: Log Wage	b/se	b/se	b/se
Log Distance	0.038*** (0.0018)		-0.0044** (0.0021)
Log Proportion		-0.064*** (0.0018)	-0.068*** (0.0024)
Destination FE	Yes	Yes	Yes
Origin FE	Yes	No	No
N	58882	58882	58882
Correlation			-0.750

Year is 1995; Regency; Everyone.

$$\ln w_{ido} = \alpha_d + \beta^1 dist_{do} + \beta^2 \pi_{do} + \epsilon_{ido}$$

▶ Table: 1976

▶ Table: 2011

▶ Table: Urban 1995

▶ Table: Mig Only 1995

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# Human Capital and Wages

- ▶  $N$  locations.
- ▶ Location specific human capital  $h_d$  drawn from

$$F(h_1, \dots, h_N) = \exp \left\{ \left[ \sum_{i=1}^N h_d^{-\frac{\tilde{\theta}}{1-\rho}} \right]^{1-\rho} \right\}$$

- ▶  $\rho \uparrow$ : people are good at everything.
  - ▶  $\tilde{\theta} \downarrow$ : more dispersion within each destination ( $\theta = \frac{\tilde{\theta}}{1-\rho}$ )
- 
- ▶ Wage earned at location  $d$

$$wage_d = w_d h_d$$



# Utility Maximization

- ▶ Utility: location amenity, consumption and time with family:

$$U_{do} = \alpha_d c^\beta t^{1-\beta}$$

- ▶ Maximize subject to

$$\hat{t} \leq T, \quad c = w_d h_d (T - \hat{t}), \quad t = \hat{t}(1 - \tau_{do})$$

- ▶  $\hat{t}$ : time away from work
- ▶  $T$ : total hours available.
- ▶  $\tau_{do}$ : time to travel  $o$  to  $d$  (symmetric).
- ▶ (specific interpretation here, but could be more general)

- ▶ Solution:

$$U_d = \left( \beta T (\alpha_d^{\frac{1}{\beta}} ((1 - \beta)(1 - \tau_{do}))^{\frac{1-\beta}{\beta}} w_d h_d) \right)^\beta = (\tilde{w}_{do} h_d)^\beta$$

# Selection

- ▶ Results on Fréchet distribution imply:

1. Migration:  $\pi_{do} = \frac{\tilde{w}_{do}^\theta}{\sum_{s=1}^N \tilde{w}_{so}^\theta}$

2. Sorting:  $E(h_{do}) = \Gamma\left(1 - \frac{1}{\theta(1-\rho)}\right) \pi_{do}^{-\frac{1}{\theta}}$

## Relation to Motivational Evidence

- ▶ From the above equations we get

$$\ln(\pi_{do}) = \theta \ln w_d + \frac{\theta}{\beta} \log \alpha_d - \gamma_o + \frac{\theta(1-\beta)}{\beta} \log(1 - \tau_{do}) \quad \text{gravity}$$

$$\ln \overline{wage}_{do} = \ln \Gamma - \frac{1}{\beta} \ln \alpha_d + \frac{1}{\theta} \gamma_o - \frac{1-\beta}{\beta} \ln(1 - \tau_{do}) \quad \text{dist wage}$$

$$\ln \overline{wage}_{do} = \ln \Gamma + \ln w_d - \frac{1}{\theta} \ln \pi_{do} \quad \text{prop wage}$$

- ▶ Consistent with the motivational evidence.

## Other Implications

- ▶ Wage ratio does not depend on productivity!

$$\frac{\overline{wage}_{do}}{\overline{wage}_{d'o}} = \frac{\alpha_{d'}(1 - \tau_{d'o})}{\alpha_d(1 - \tau_{do})}$$

- ▶ Why? Three effects of  $w \uparrow$ :
  - ▶ Increase in wages of those already there.
  - ▶ Movement of migrants in – less selected
  - ▶ Other home becomes more selected.
- ▶ Without amenity differences or movement costs, no spatial variation in average wages.
  - ▶ Seems a natural benchmark.
- ▶ Productivity still important because migrants more productive.

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# Closing the Model: Demand Side and Agglomeration

- ▶ Location decisions (labor supply) determined by:
  - ▶ Base wages:  $w_d$ .
  - ▶ Amenity:  $\alpha_d$ .
  
- ▶ Demand side: Wages

$$\Pi_d = p_d A_d h_d - w_d h_d$$

$$w_d = p_d A_d$$

$$A_d = \bar{A}_d H_d^\gamma$$

- ▶  $\bar{A}_d$ : natural advantage of location  $d$ .
- ▶  $\gamma \geq 0$ : agglomeration externalities.
- ▶  $p_d$ : prices (from next slide).

## Closing the Model: Prices

- ▶ Prices, from Armington Assumption:

$$Y = \left( \sum_{i=1}^N q_d^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$
$$q_d = A_d H_d$$

- ▶ First order condition for maximisation gives

$$p_d = \left( \frac{Y}{q_d} \right)^{\frac{1}{\sigma}}$$

- ▶ So:

- ▶ High wage  $w_d$  leads people to move to  $d$ .
- ▶ Increases production from  $d$ .
- ▶ Pushes down wage.
- ▶ Reduces migration into  $d$ .

# Closing the Model: Amenities and Congestion

- ▶ We assume

$$\alpha_d = \bar{\alpha}_d L_d^\lambda$$

- ▶  $\lambda \leq 0$ .
  - ▶  $\bar{\alpha}$  “natural amenity”.
- ▶ Amenities are subject to a congestion cost:
  - ▶ More people chasing little land.
  - ▶ Need for institutions in dense cities.
  - ▶ Pollution.



# General Equilibrium

## Definition

An equilibrium consists of:

- ▶ Prices  $p_d$ .
- ▶ Base wages  $w_d$ .
- ▶ Labor supply  $L_d$  (from selection equations).
- ▶ Human capital  $H_d$  (from selection equations).

Such that:

1. Consumers maximize utility
2. Producers maximize profit
3. Labor markets clear
4. Goods markets clear

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# Estimating the Spatial Model

## 1. Estimation from sorting equations:

- ▶ Base wages (endogenous)  $w_d$  ,
- ▶ Amenities (endogenous)  $\alpha_d$
- ▶ Exogenous migration costs  $\tau_{do}$
- ▶ Fréchet parameters:  $\theta, \rho$

## 2. GE solution yields exogenous amenity and productivity:

- ▶ GE solution gives us prices
- ▶  $w_d = f(p_d, \bar{A}_d, H_d)$
- ▶  $\alpha_d = f(\bar{\alpha}_d, L_d)$

Parameters set exogenously:

- ▶ Spillover parameters: amenities ( $\lambda$ ) and productivity ( $\gamma$ )
- ▶ CES parameter  $\sigma$

# How do the Equations Identify the Model (1)?

- ▶ Identify Fréchet parameter:

$$\log(\overline{wage}_{do}) = \gamma_d - \frac{1}{\theta} \log(\pi_{do})$$

- ▶ The Economics:
  - ▶ Small increase in proportion moving leads to large drop in wage implies a lot of heterogeneity in skill.

## How do Equations Identify Model (2)?

- ▶ Separate absolute from comparative advantage

- ▶ Fréchet distribution:  $\frac{\text{var}(w_{do})}{\text{mean}(w_{do})^2} = \frac{\Gamma(1 - \frac{2}{\theta(1-\rho)})}{\Gamma(1 - \frac{1}{\theta(1-\rho)})} - 1.$

## How do the Equations Identify the Model (3)?

- Identify migration costs, amenity and base wage.

$$\log(\pi_{do}) = \underbrace{\theta \ln w_d + \frac{\theta}{\beta} \ln \alpha_d}_{\tilde{\gamma}_d} + \underbrace{\frac{\theta(1-\beta)}{\beta} \ln(1-\tau_{do})}_{\tilde{\gamma}_{do}} - \gamma_o$$

$$\log(\overline{wage}_{do}) = \underbrace{\ln \gamma - \frac{1}{\beta} \ln \alpha_d}_{\tilde{\gamma}_d} - \underbrace{\frac{1-\beta}{\beta} \ln(1-\tau_{do})}_{\tilde{\gamma}_{do}} + \frac{1}{\theta} \gamma_o$$

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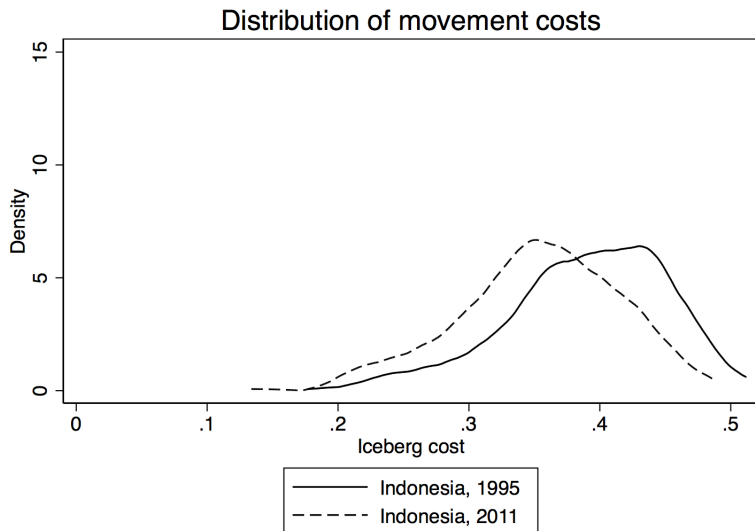
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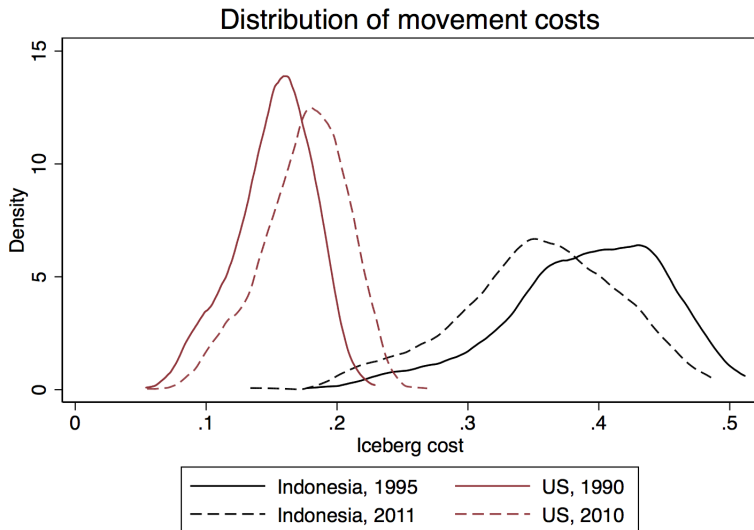
GE Counterfactuals: Reduce Migration Costs



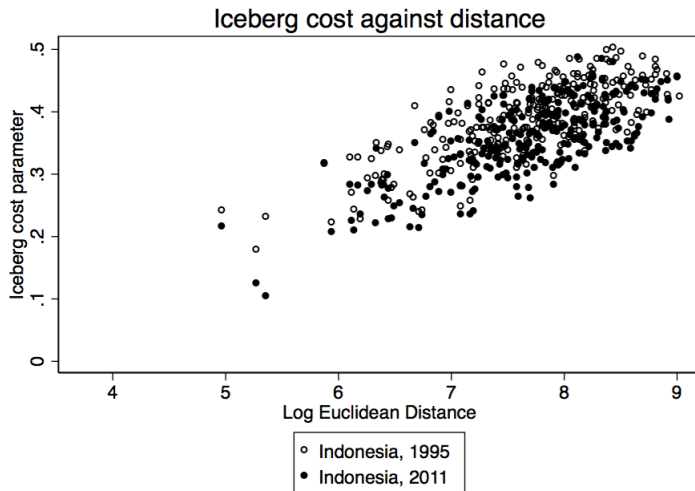
# 1a. Migration Costs Reduced over Time



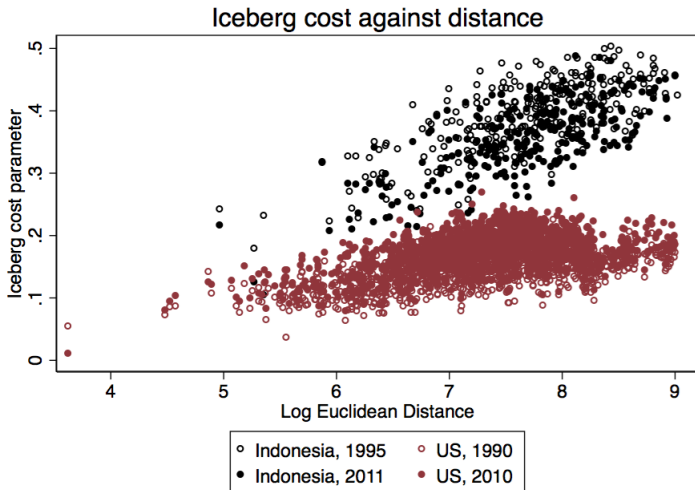
## 1b. US Has Lower Movement Costs



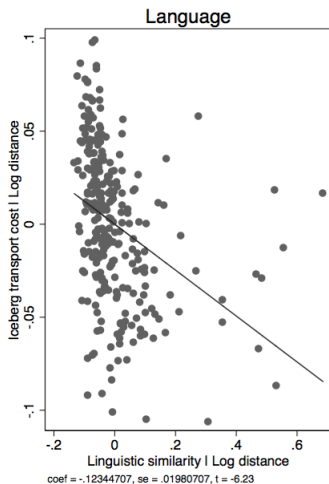
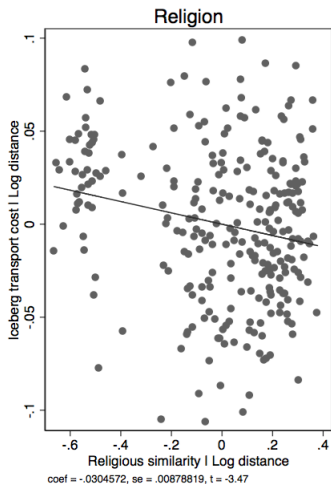
# 1c. Migration Costs Correlated with Distance



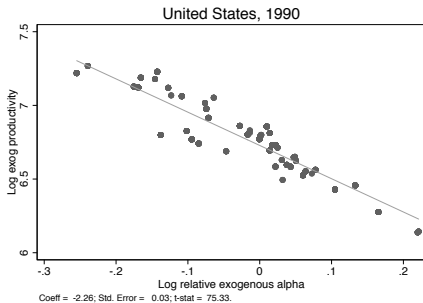
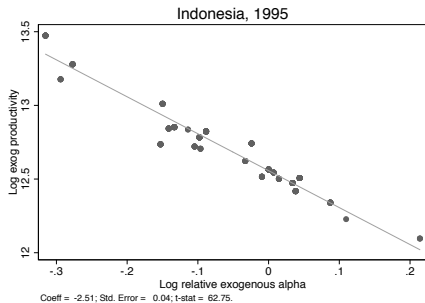
## 1d. Less Correlation in the US



## 2e. Costs Correlate with Language and Religion Differences

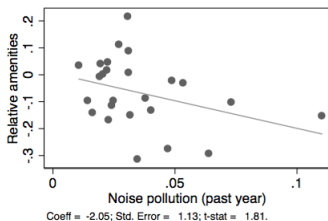
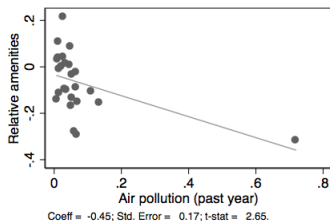
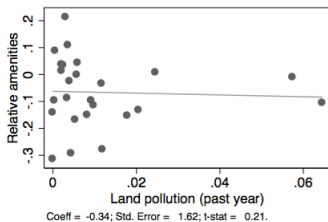
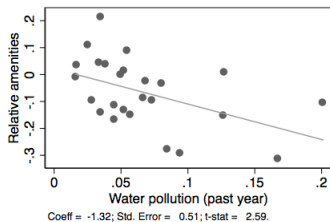


## 2a. Amenities and productivity negatively correlated



▶ All years

## 2b. Amenity negatively correlated with pollution



Data from 1995.

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# Quantifying the “why we care”

With our model, interesting counterfactuals:

1. Changing over time:
  - ▶ Movement costs
  - ▶ Amenities.
2. Comparison to US:
  - ▶ Movement cost.

# Exogenous agglomeration parameters

- ▶ Amenity spillover: set to 0  
Albouy (2012)
- ▶ Productivity spillover: set to 0.05  
Rosenthal and Strange (2004): 0.03-0.08; Redding and Sturm (2014): 0.07; Kline and Moretti (2014): 0.2
- ▶ Sigma (CES production function): set to 8  
Allen and Arkolakis (2014)
- ▶ Beta (share consumption in utility function) : set to 0.6  
Hsieh, Hurst, Klenow and Jones (2014)

## 1a. Change migration costs

	(1) Cut by 50%	(2) Cut by 100%	(3) 2012 costs
1976	1.316	1.434	1.172
1995	1.366	1.462	1.088
2011	1.396	1.512	0.981
2012	1.408	1.525	1.000
Share cons. utility	0.600	0.600	0.600
Amenity spillover	0.000	0.000	0.000
Prod spillover	0.050	0.050	0.050
CES parameter	8.000	8.000	8.000

Within model per capita GDP growth:

- ▶ 1976-1995: 118%
- ▶ 1995-2012: 38%

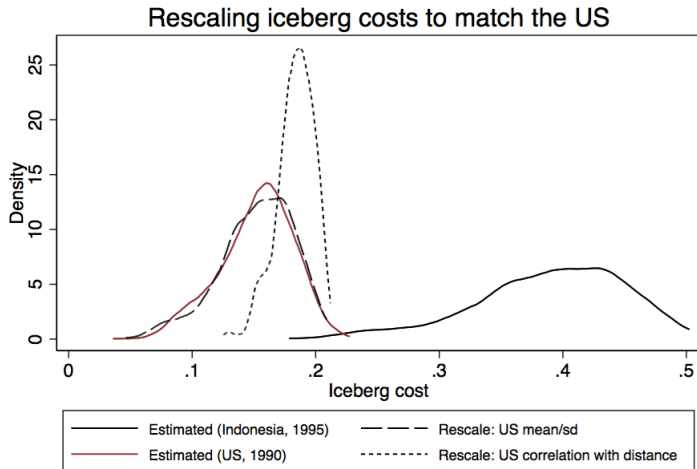
## 1b. Change amenities

	(1) Equalize amenities	(2) 2012 amenities
1976	1.168	1.314
1995	1.076	1.102
2011	1.083	1.033
2012	1.086	1.000
Share cons. utility	0.600	0.600
Amenity spillover	0.000	0.000
Prod. spillover	0.050	0.050
CES parameter	8.000	8.000

Within model per capita GDP growth:

- ▶ 1976-1995: 118%
- ▶ 1995-2012: 38%

## 2. Rescale to United States



Graph shows distribution of 1995 iceberg costs for Indonesia.

## 2. Indonesia productivity if had US migration costs

	(1) Rescaling	(2) Parametric
1995	1.542	1.531
2011	1.529	1.511
2012	1.558	1.535
Share cons. utility	0.600	0.600
Amenity spillover	0.000	0.000
Productivity spillover	0.050	0.050
CES parameter	8.000	8.000

- ▶ 1995 Indonesia-US per cap GDP gap: 15.2

# Conclusion

- ▶ Wages are heterogeneous across space
- ▶ If due to costly migration or amenity difference may represent opportunity.
- ▶ Tractable spatial equilibrium model
  - ▶ Wages
  - ▶ Amenities
  - ▶ Comparative advantage
  - ▶ Agglomeration and congestion spillovers
- ▶ Migration costs quantitatively important:
  - ▶ If had 2012 costs in 1976: GDP 20% higher
  - ▶ 4% of US-Indonesia gap