

"When would we know our financial system is working?"

“Towards The Scientific Theory Of Cities”

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“Measuring Up Cities”
Long Finance Symposium

Towards the Scientific Theory
of Cities

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Institute for
New Economic Thinking
AT THE OXFORD MARTIN SCHOOL



Jan 30 2014

HOW we approach Cities?

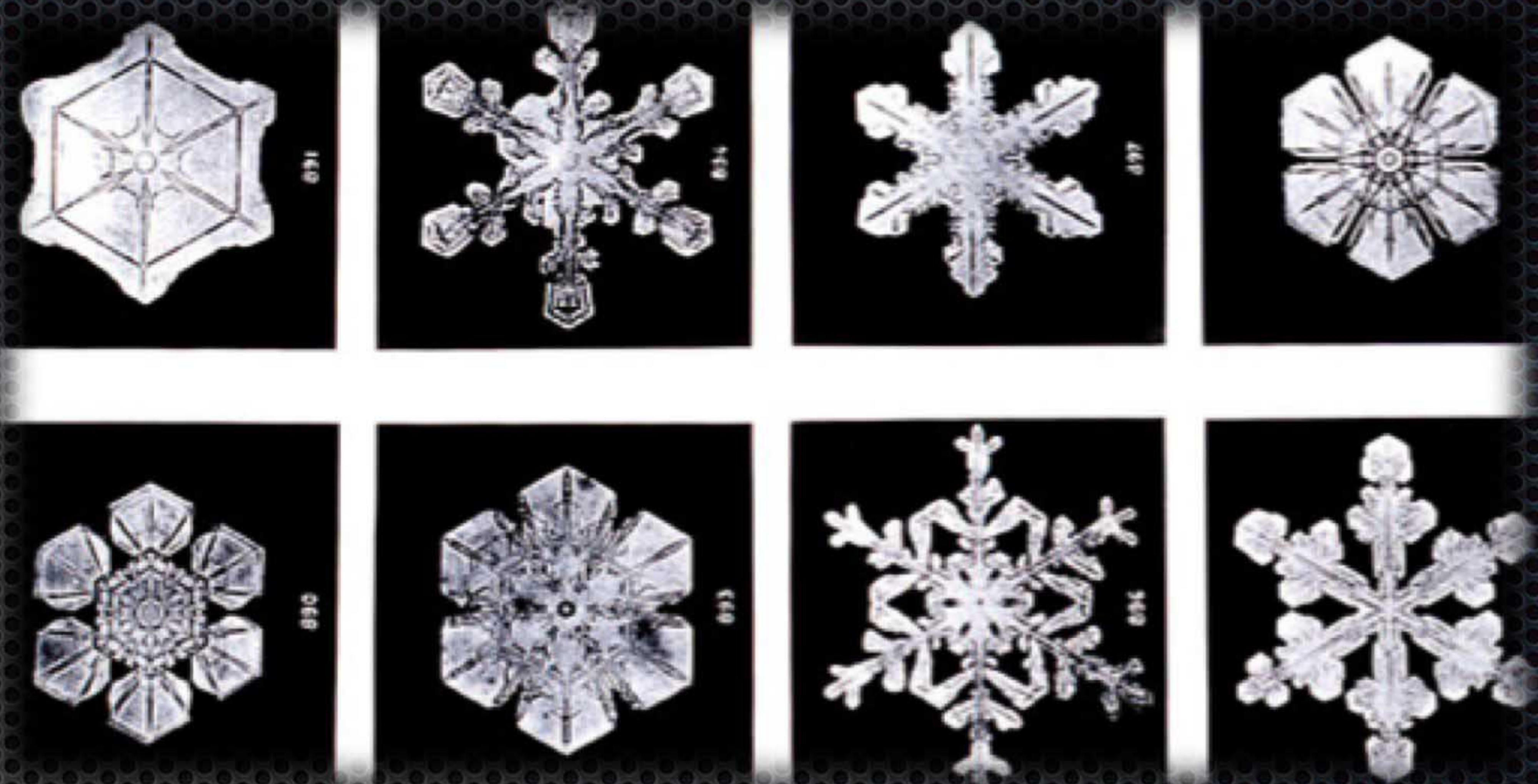
Interconnected and Complex

Problems and Solutions

Emergent pattern through socio-economic interactions.



Emergences



Cities as emergence of order?

If YES,

How we can
observe them?

What are they?



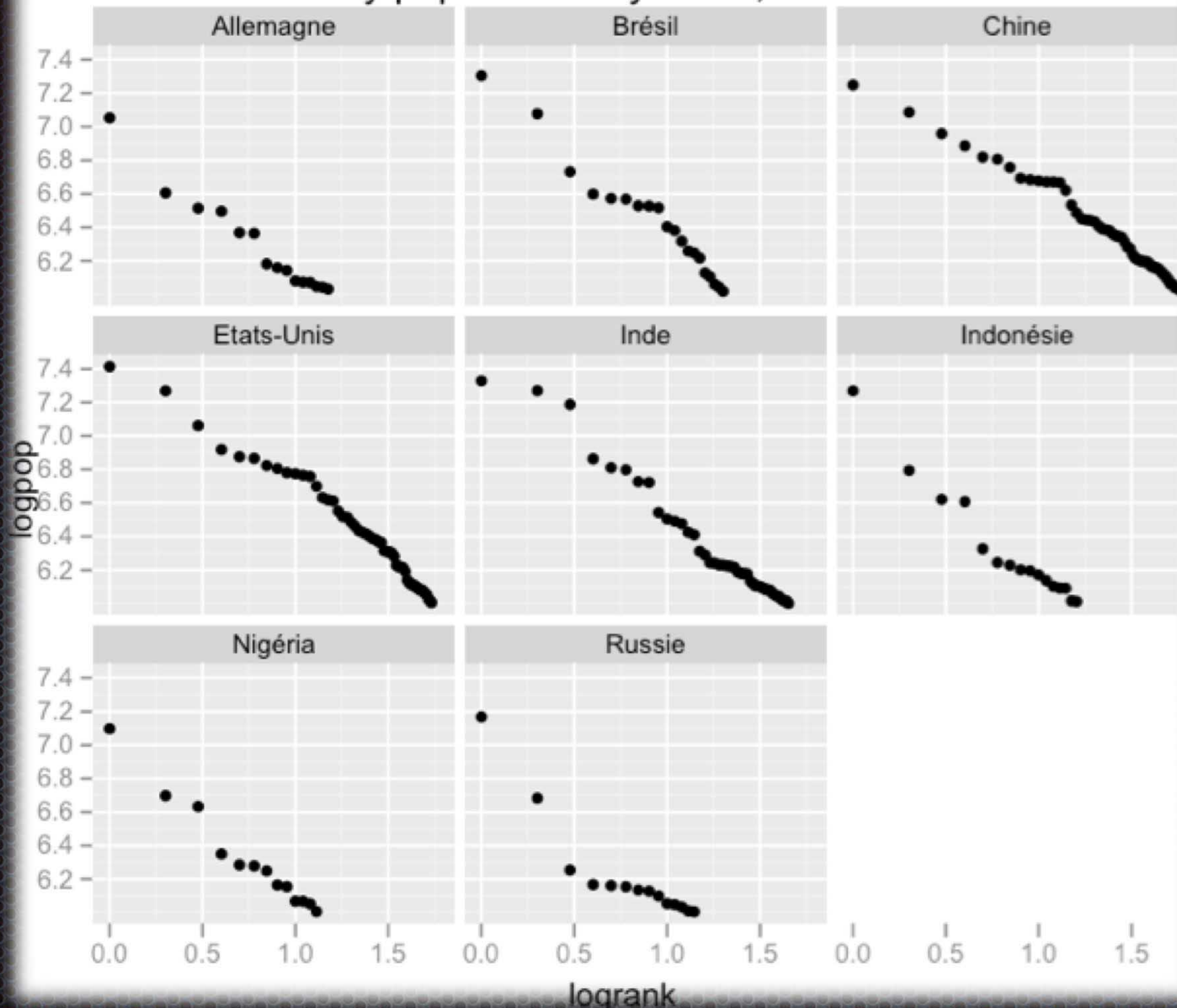
Quantifiable, comparable
regular patterns across
cities, based on which
“Mathematical” theory can
be constructed.
(beyond just cherry pickings)

Make it abstract, quantitative,
and comparative to make a
clear view of the universal law

For example,
size distribution of cities

Zipf's law: tale of many cities

world city populations by ranks, for 8 countries



$$p(r) \sim 1/r$$

Models for
Growth
Dynamics

Within a country
Not for EU

For example,
size distribution of cities
size dependency

Urban Scaling

$$Y \sim N^\beta$$

$$\beta \approx 1.15$$

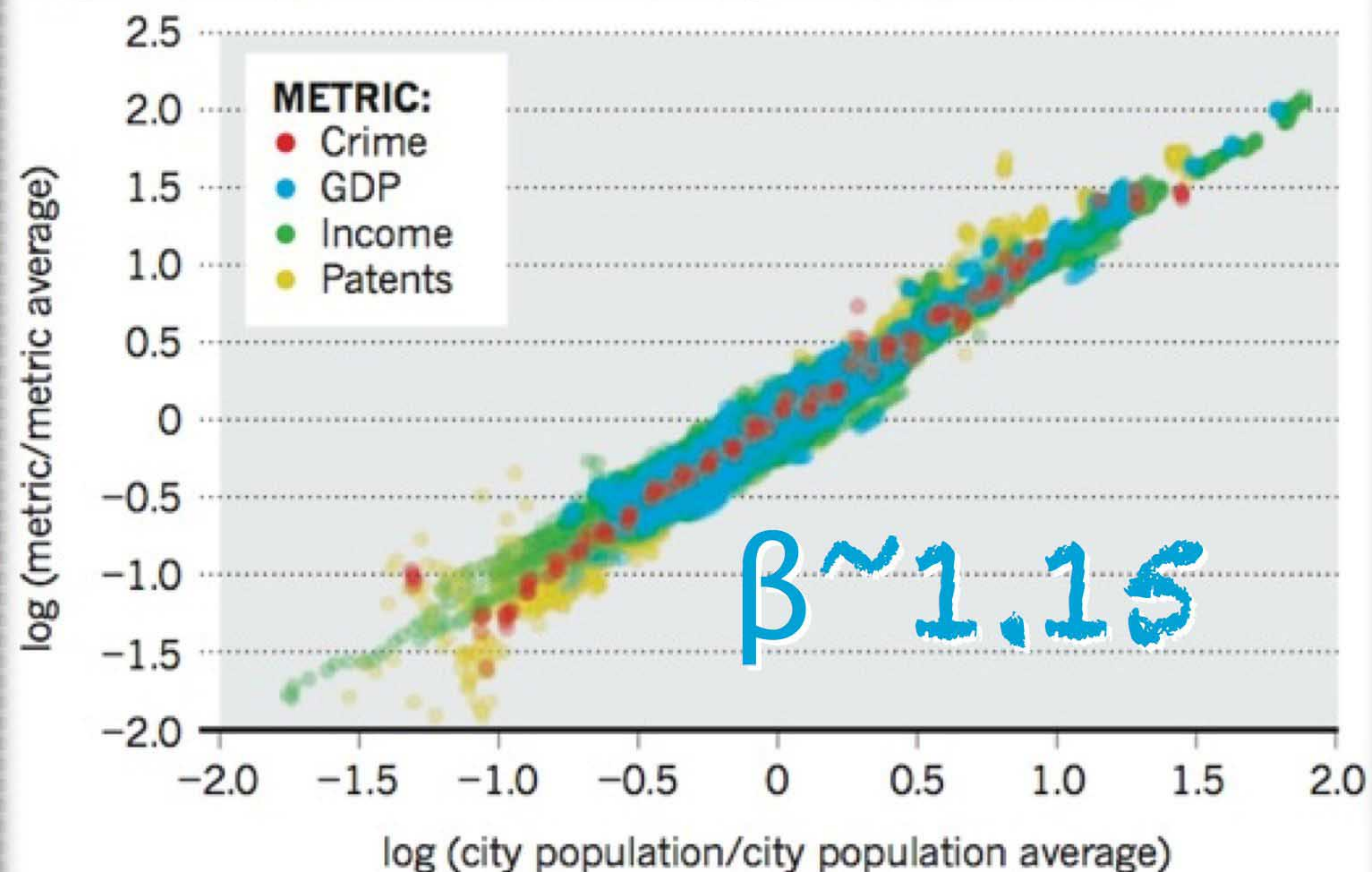
$$\beta \approx 0.85$$

Bettencourt & West, Nature 467 (2010)

Bettencourt, Science (2013)

PREDICTABLE CITIES

Data from 360 US metropolitan areas show that metrics such as wages and crime scale in the same way with population size.



What are the regularities?

For example,

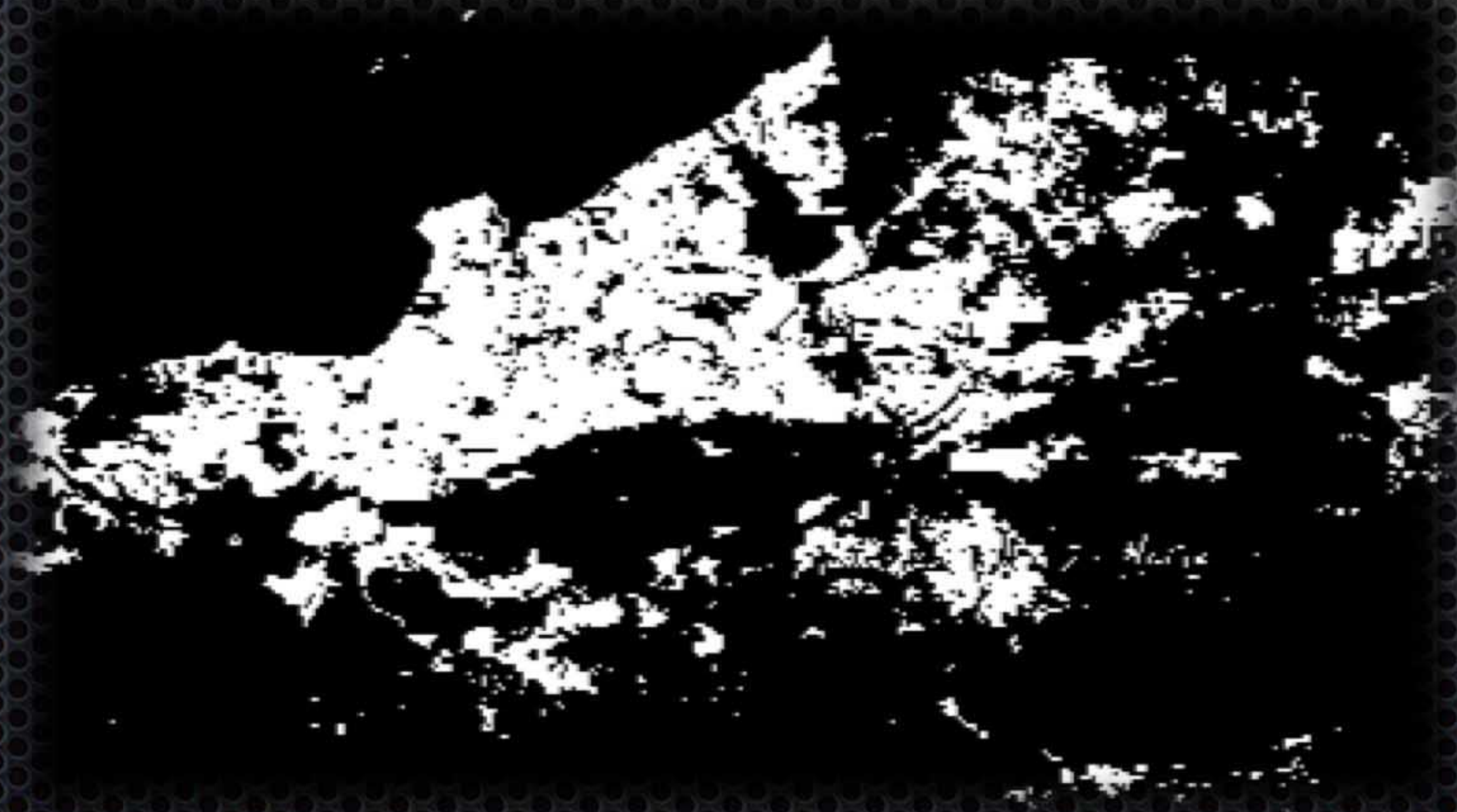
size distribution of cities

size dependency

spatial distribution

internal fabric of economics

Fractal Structure of Population



For example,

size distribution of cities

size dependency

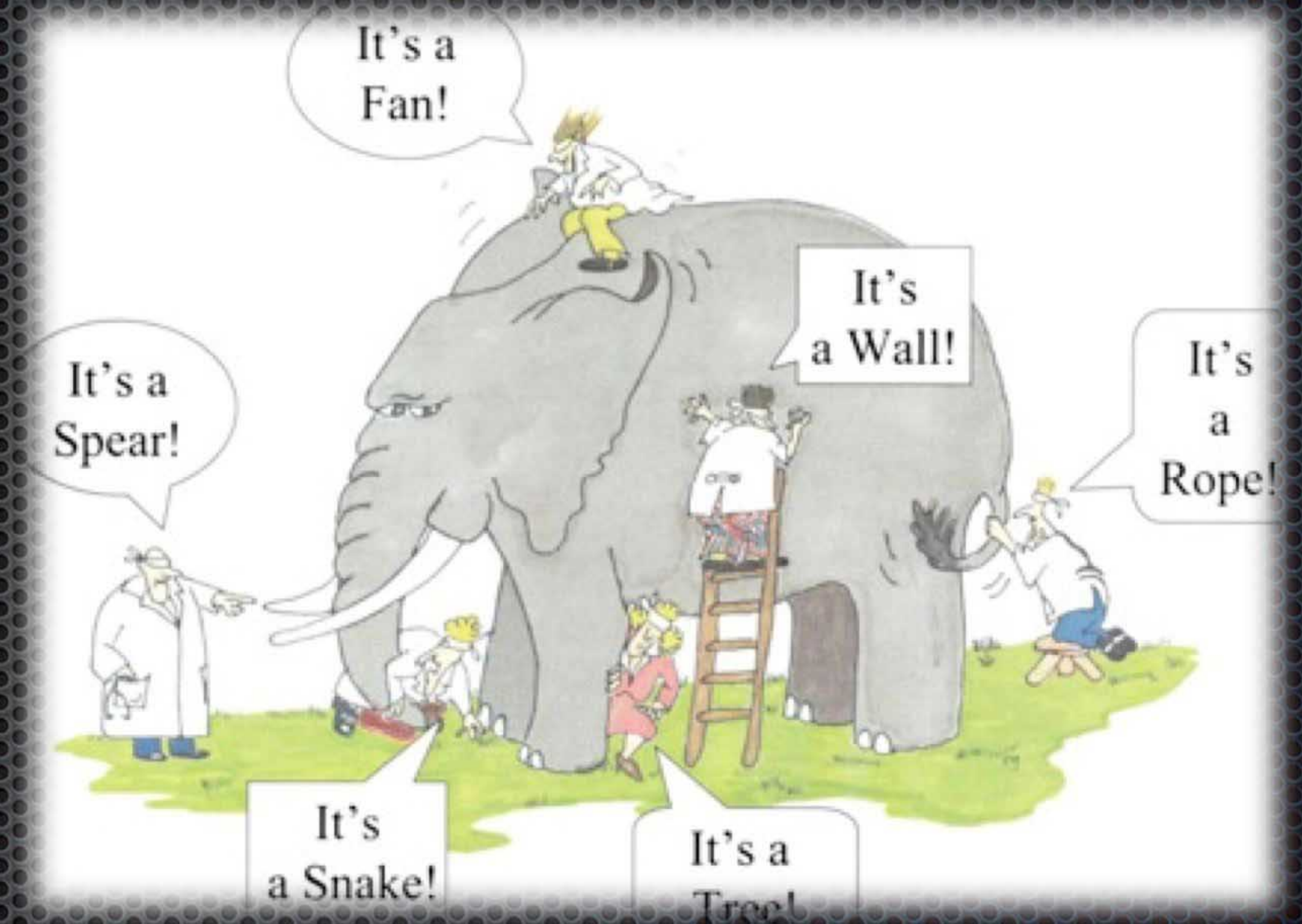
spatial distribution

internal fabric of economics

Urban Economic Activities

- 32 million Establishments:
Work places in USA

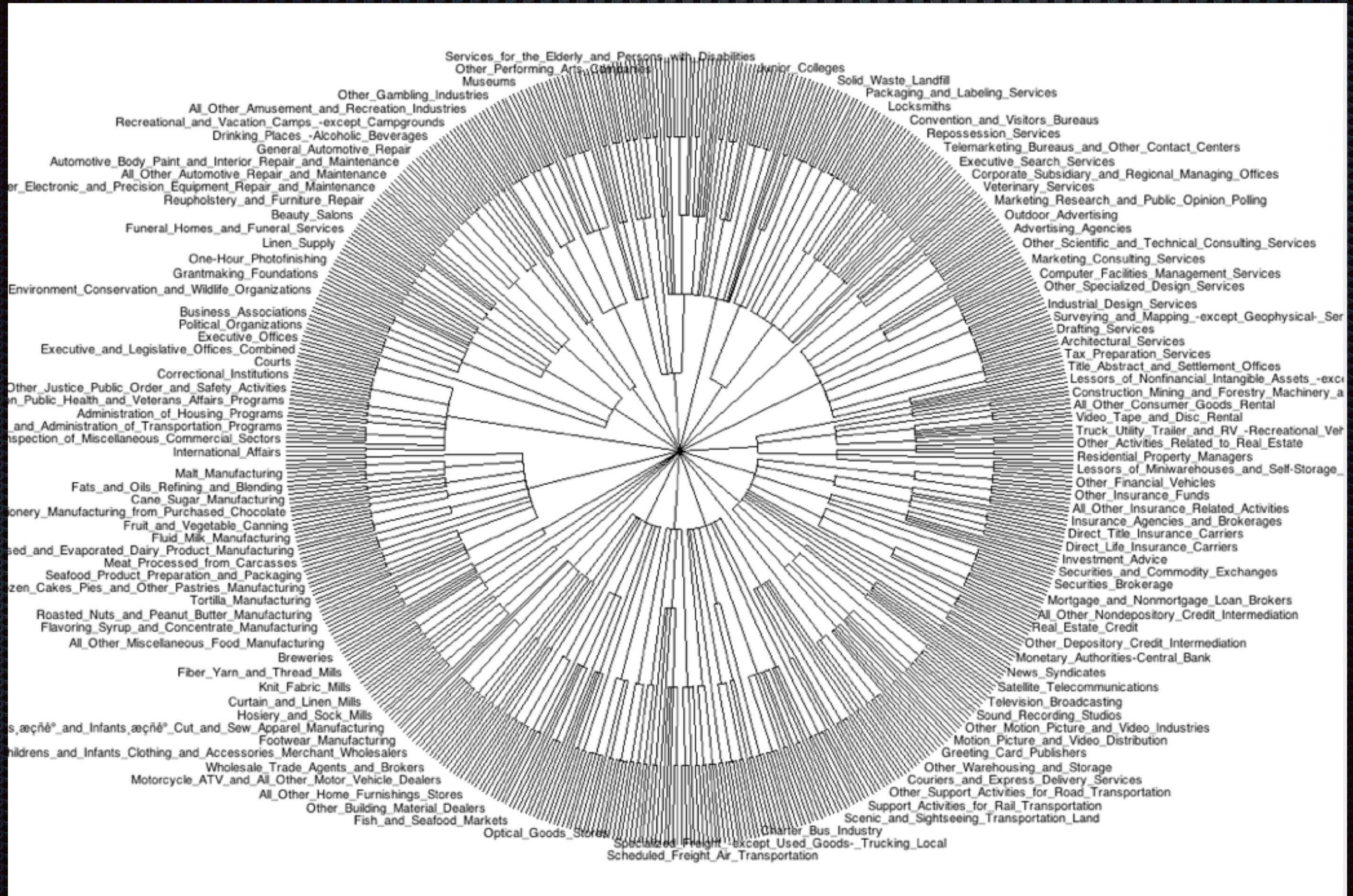
- **Industrial Types (NAICS):**
Restaurants, Religious organizations, Lawyers, Physicians...



- **Specialization vs. Diversification**
 - Silicon Valley, Detroit, Phoenix, New York...
 - More diverse: More product, restaurants, services

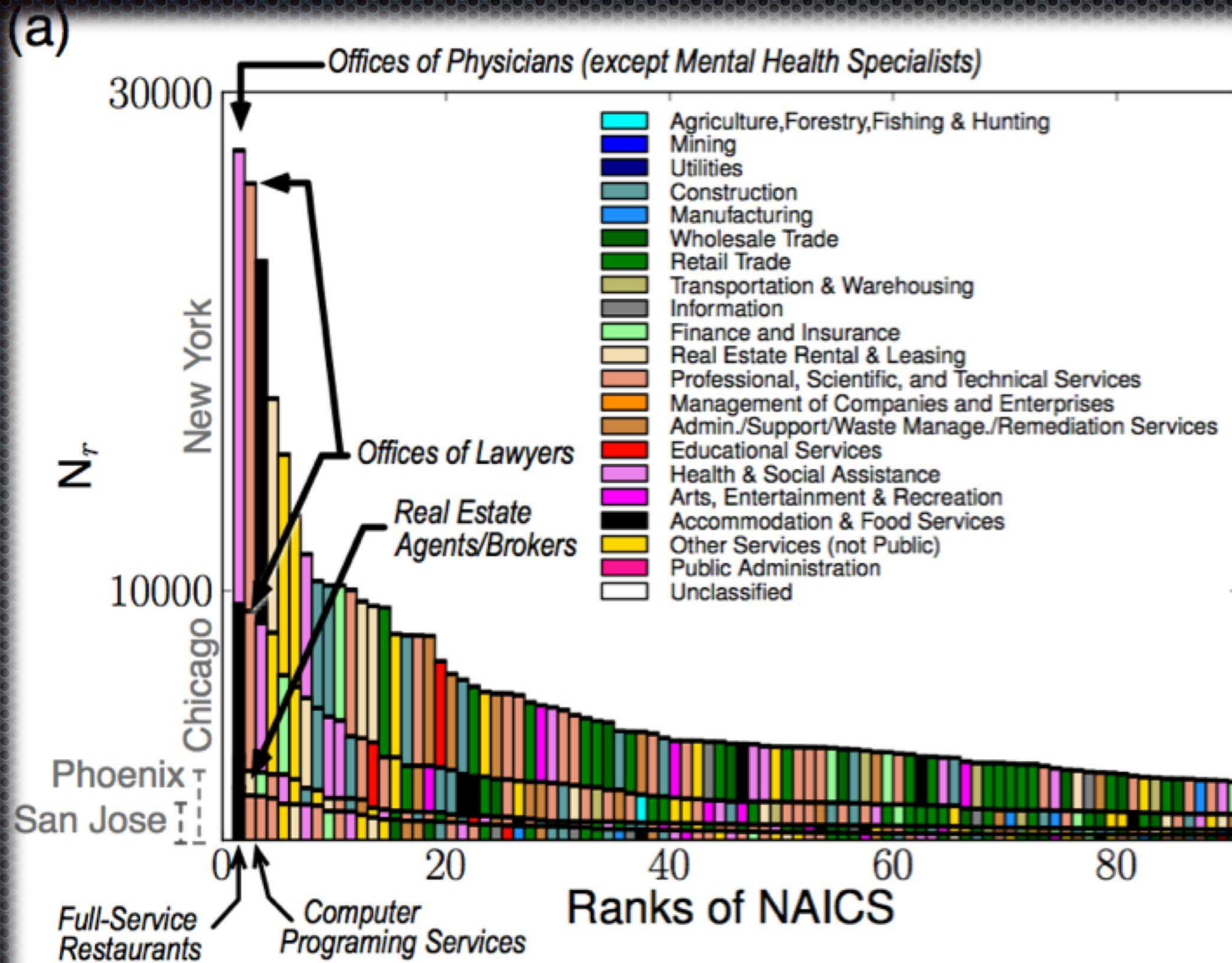
How they manifest themselves?

Like species in ecosystem...



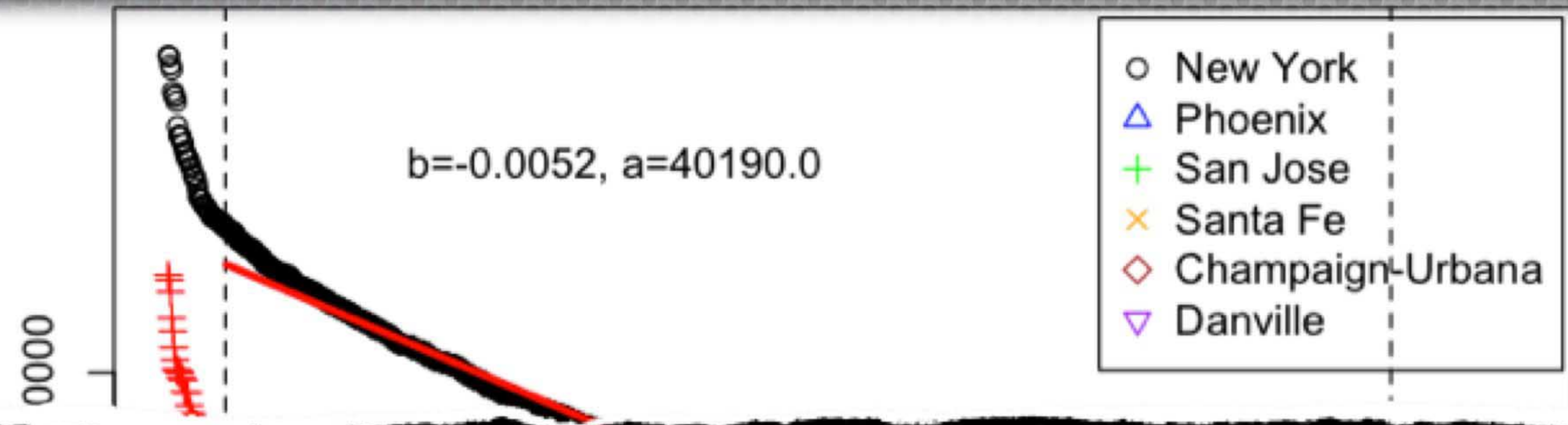
Fingerprints of Cities

Number of Firms of given Industry



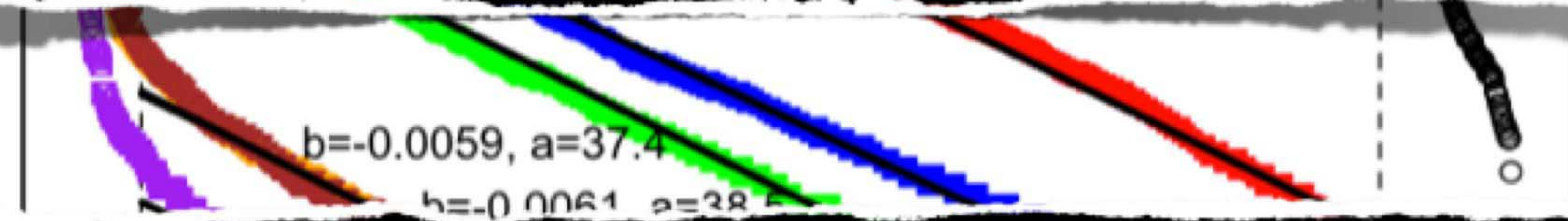
Abundance Shapes

Industry



Universal Shape?

of Fil



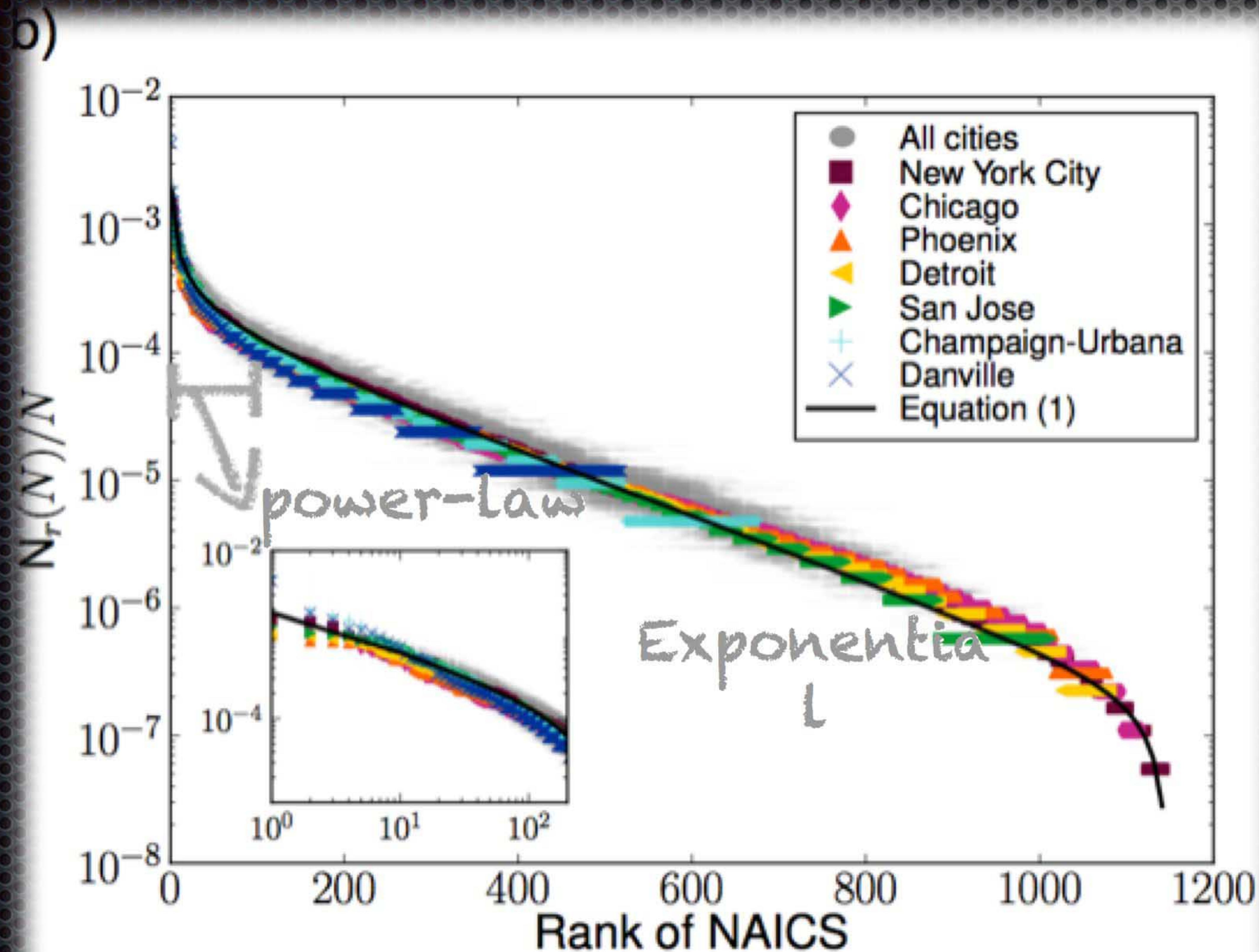
Normalize by Population Size

N

0 200 400 600 800 1000 1200

Rank of NAICS by n_i

Universal Distribution

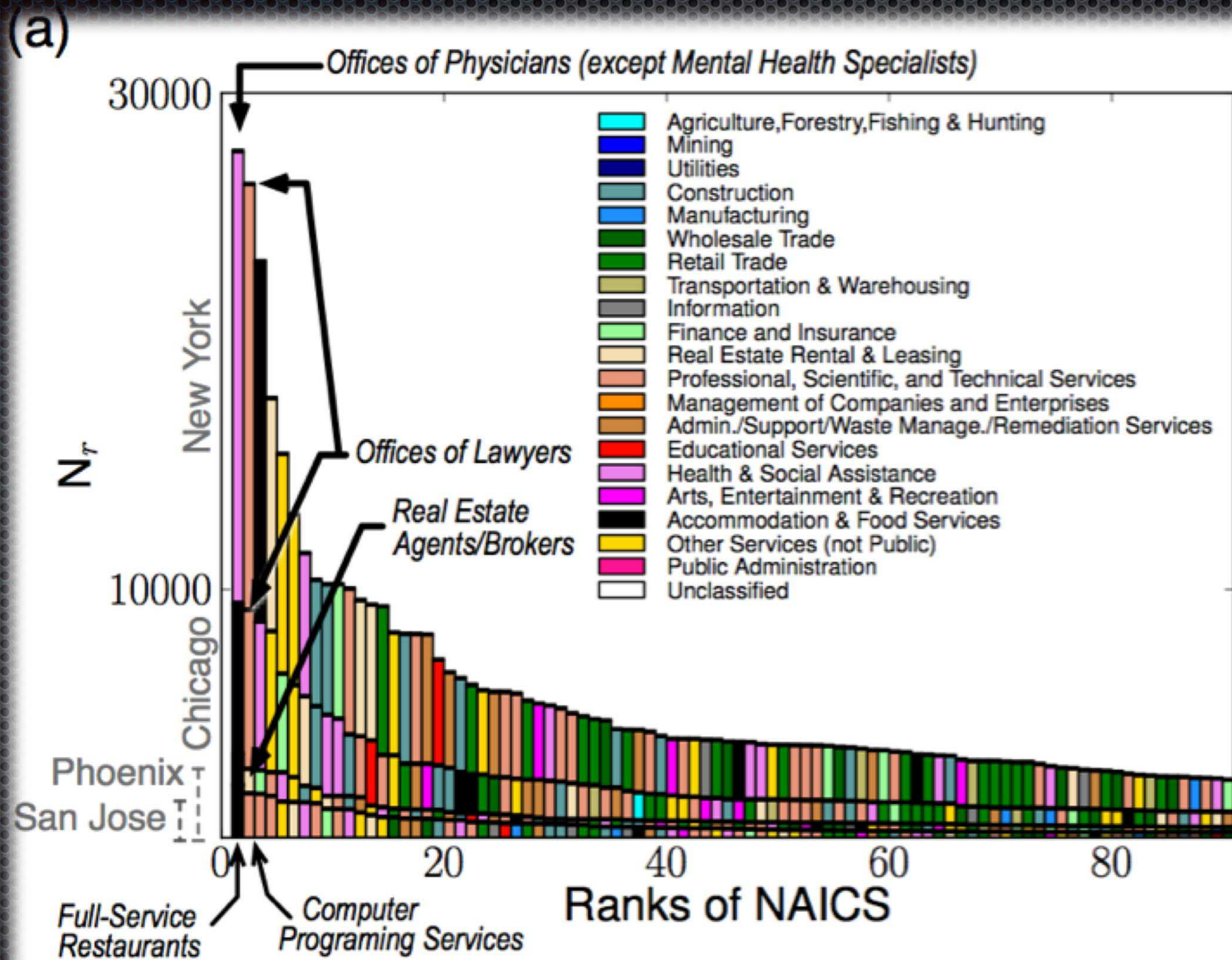


- Regardless of **Density** and **Wealth**
- **Common Niche** structures across all cities
- SAME underlying models for interactions of businesses
- Generalized Simon-Yule Model

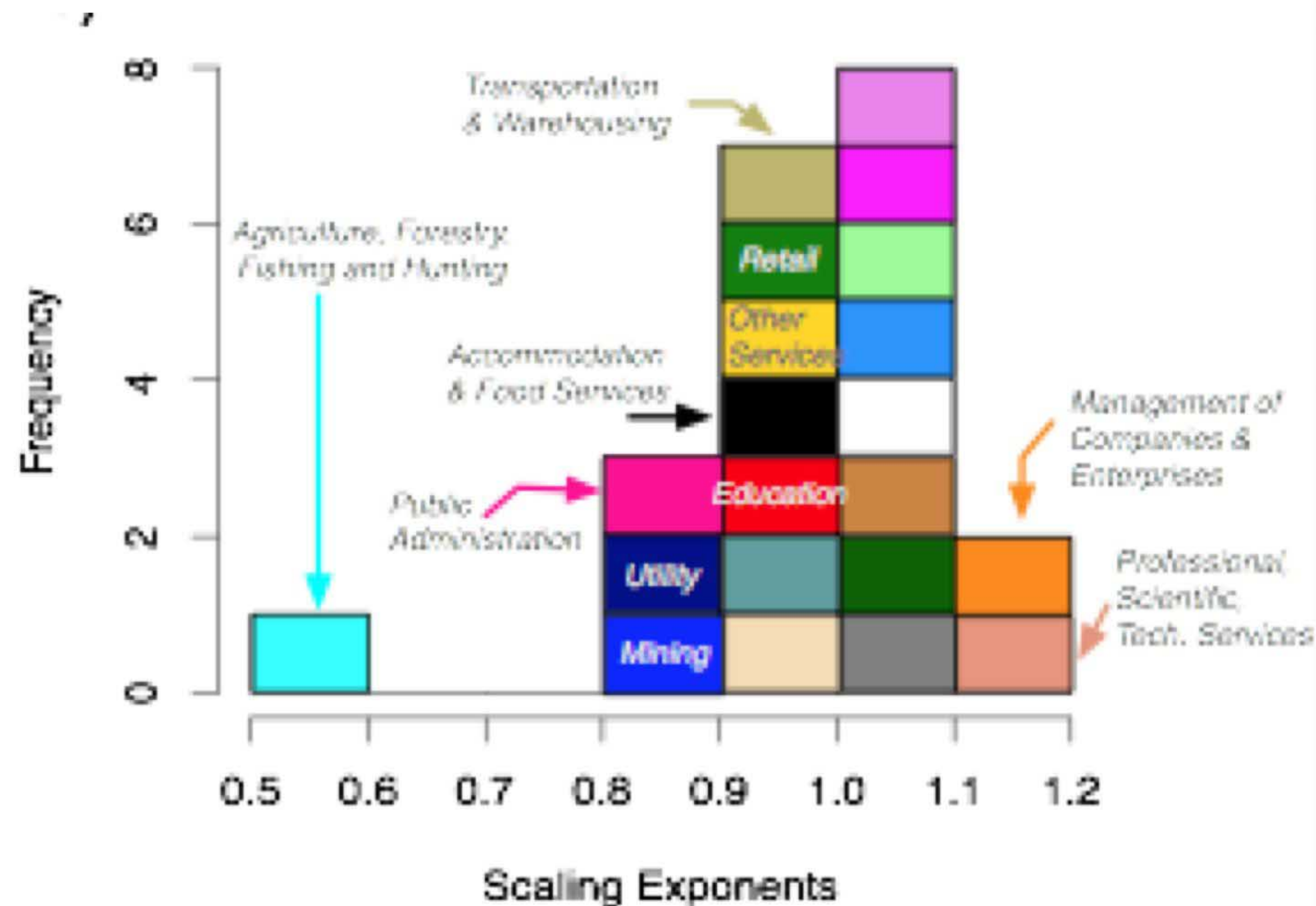
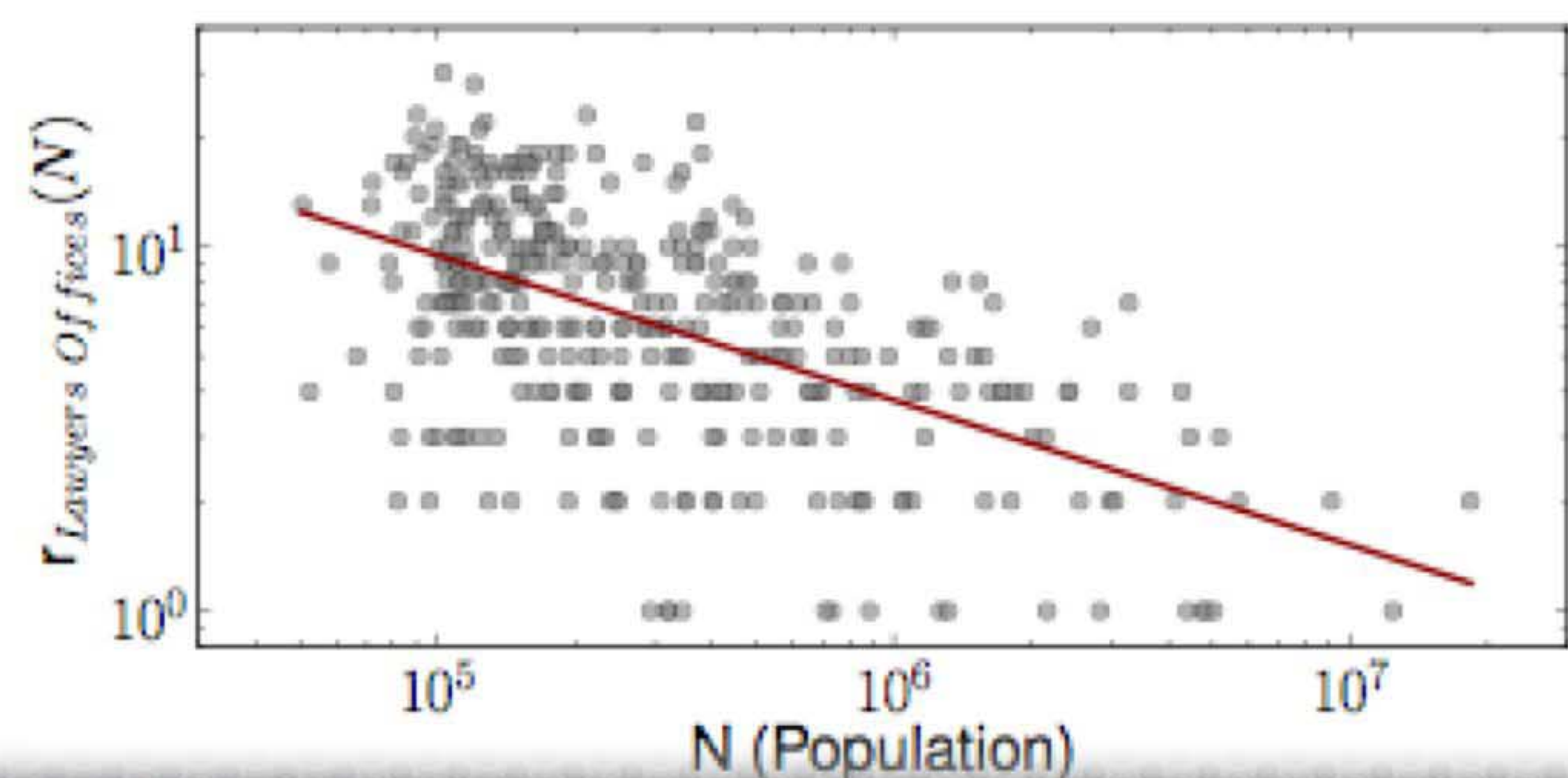
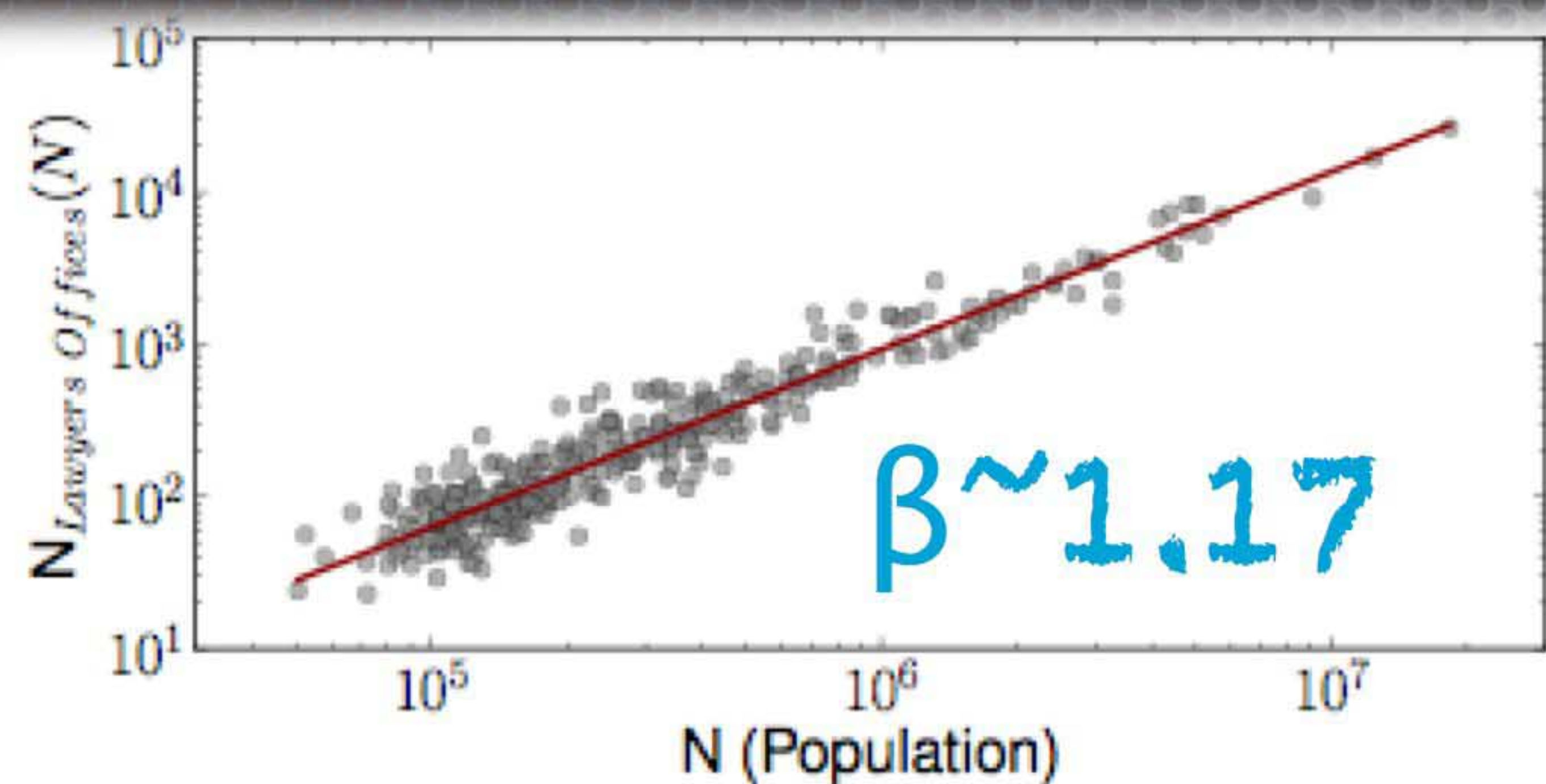
$$p(r) \sim r^{0.6} e^{-r/170}$$

Dissimilarity of Cities

Number of Firms of given Industry



Systematic Shift of Sectors



$$\text{rank } i = \begin{cases} N^{(1-\alpha)/\gamma} & \text{for small } i < i_0 \\ i_0 (1 - \alpha) \log(A/N) & \text{for large } i > i_0 \end{cases}$$

Increases in Productivity, Consumer demand

Why we observe the universal patterns?

Existence of an underlying mathematical mechanism

Generic city that includes all the universal properties

Prediction

Thank you