

Lecture 9

The differences between cities, inequality and generating processes

9.1 The differences between cities: scale independent performance indicators

IUS 4.1

How about the differences **between** cities?

How to measure the effects of **history, agency** and **accident**?

How to build place-specific urban “**performance**” indices?

Per capita Indicators versus Scaling Indicators

Because Properties of Cities are Non-linear on populations size

per capita rates give us a distorted view that
mixes together general urban effects and place specific characteristics

$$Y = Y_0 N^{1+\delta} \rightarrow y = \frac{Y}{N} = Y_0 N^\delta$$

GDP, Wages, Crime, Patents, COVID cases, density ...

tend to increase as per capita rates with city size

$$A_n = A_0 N^{1-\delta} \rightarrow a_n = \frac{A_n}{N} = A_0 N^{-\delta}$$

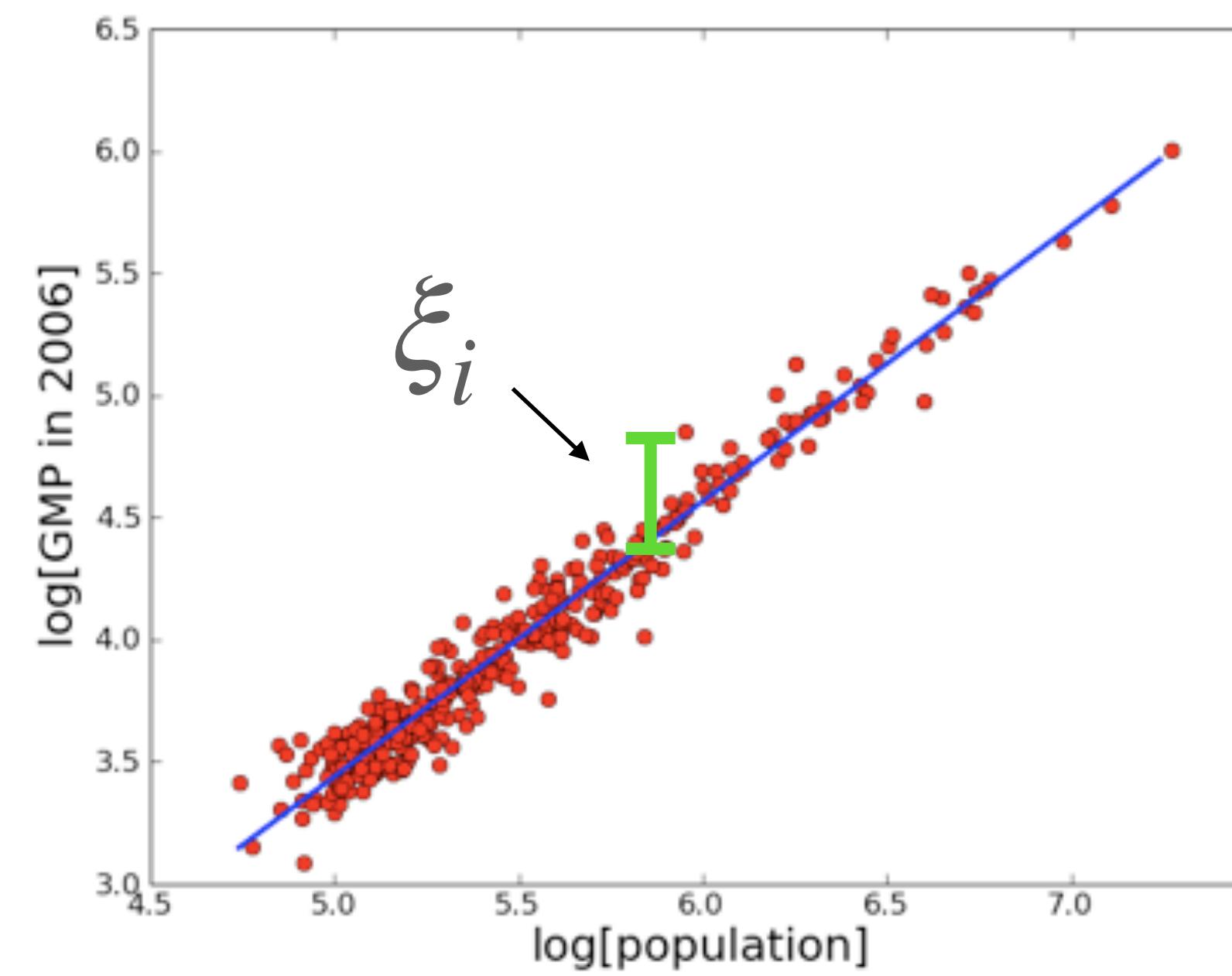
Built ares, area of roads, pipes, infrastructure

tend to decrease as per capita rates with city size

We can use scaling relations to subtract general effects and identify unique properties of each place

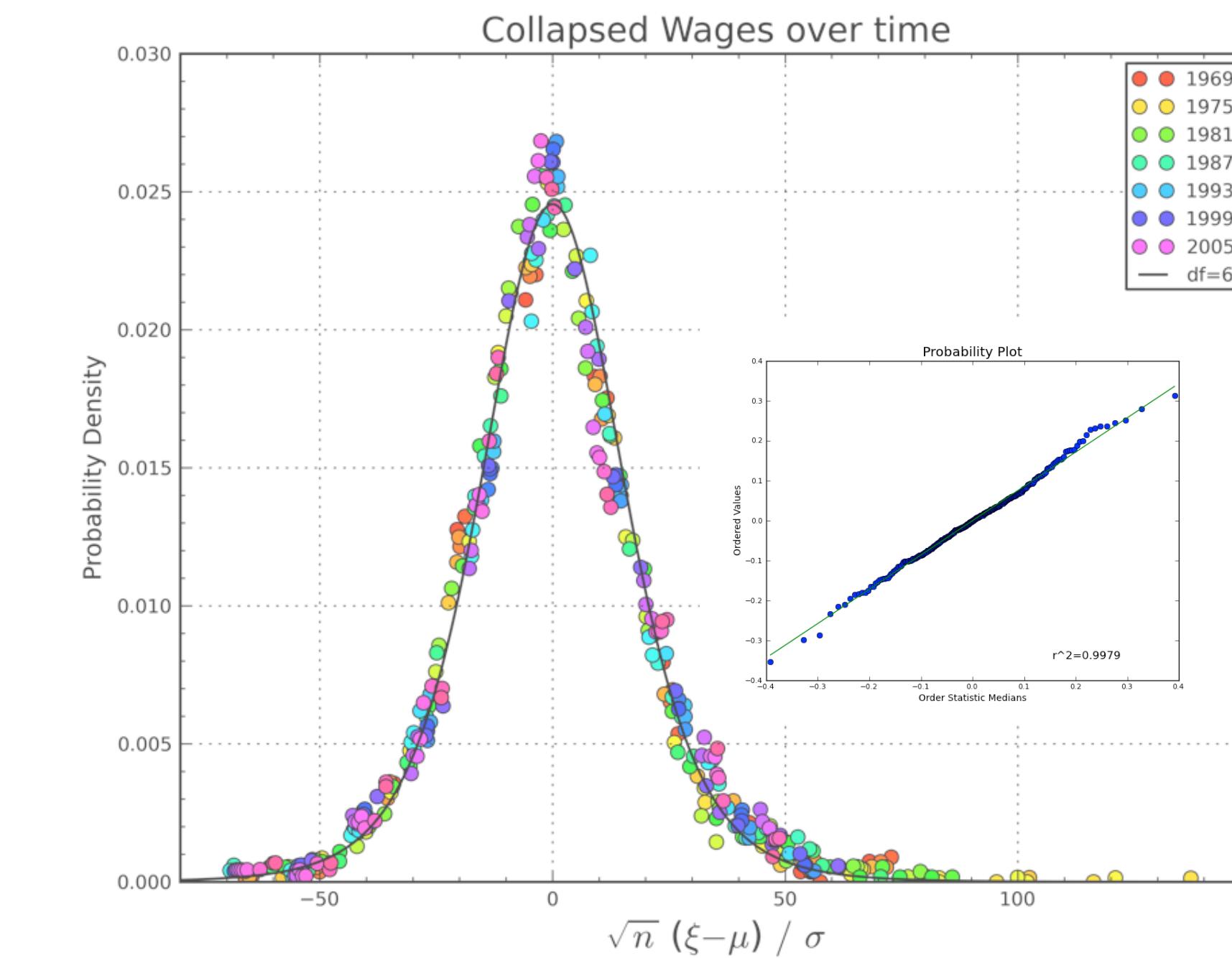
Deviations from Scaling

Scale Adjusted Metropolitan Indicators: SAMIs



$$Y_i = Y_0 N_i^\beta e^{\xi_i}$$

$$\xi_i(t) = \ln \frac{Y_i(t)}{Y_0 N^\beta(t)}$$



What is the structure of each city's deviation?

What is Its “local flavor” of a city?

Centering Data

Take the averages:

$$\langle \ln Y \rangle = \frac{1}{N_c} \sum_{i=1}^{N_c} \ln Y_i$$

$$\langle \ln N \rangle = \frac{1}{N_c} \sum_{i=1}^{N_c} \ln N_i$$

Take the scaling relation:

scaling relation

$$Y_i = Y_0 N_i^\beta e^{\xi_i} \rightarrow \ln Y_i = \ln Y_0 + \beta \ln N_i + \xi_i$$

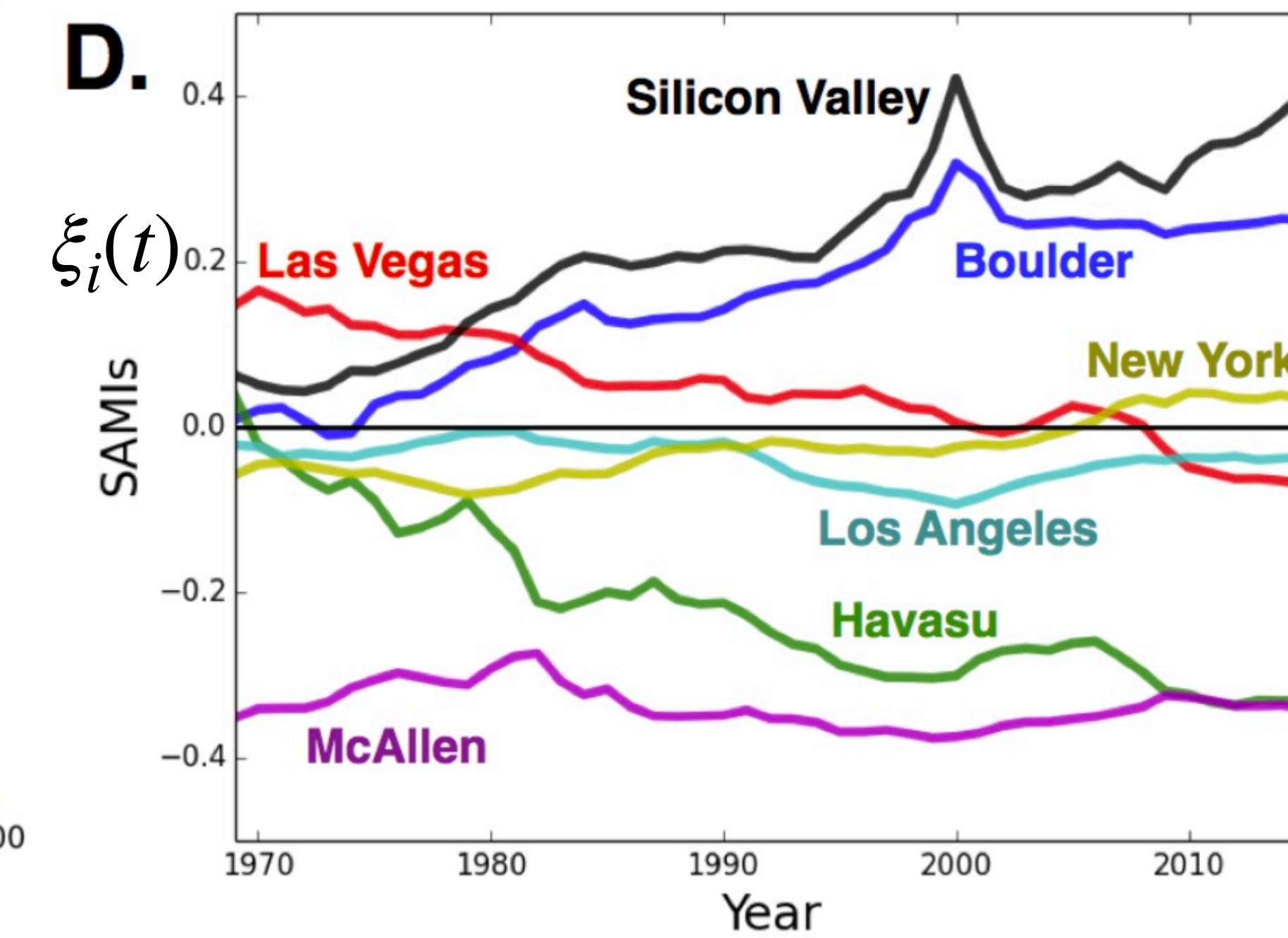
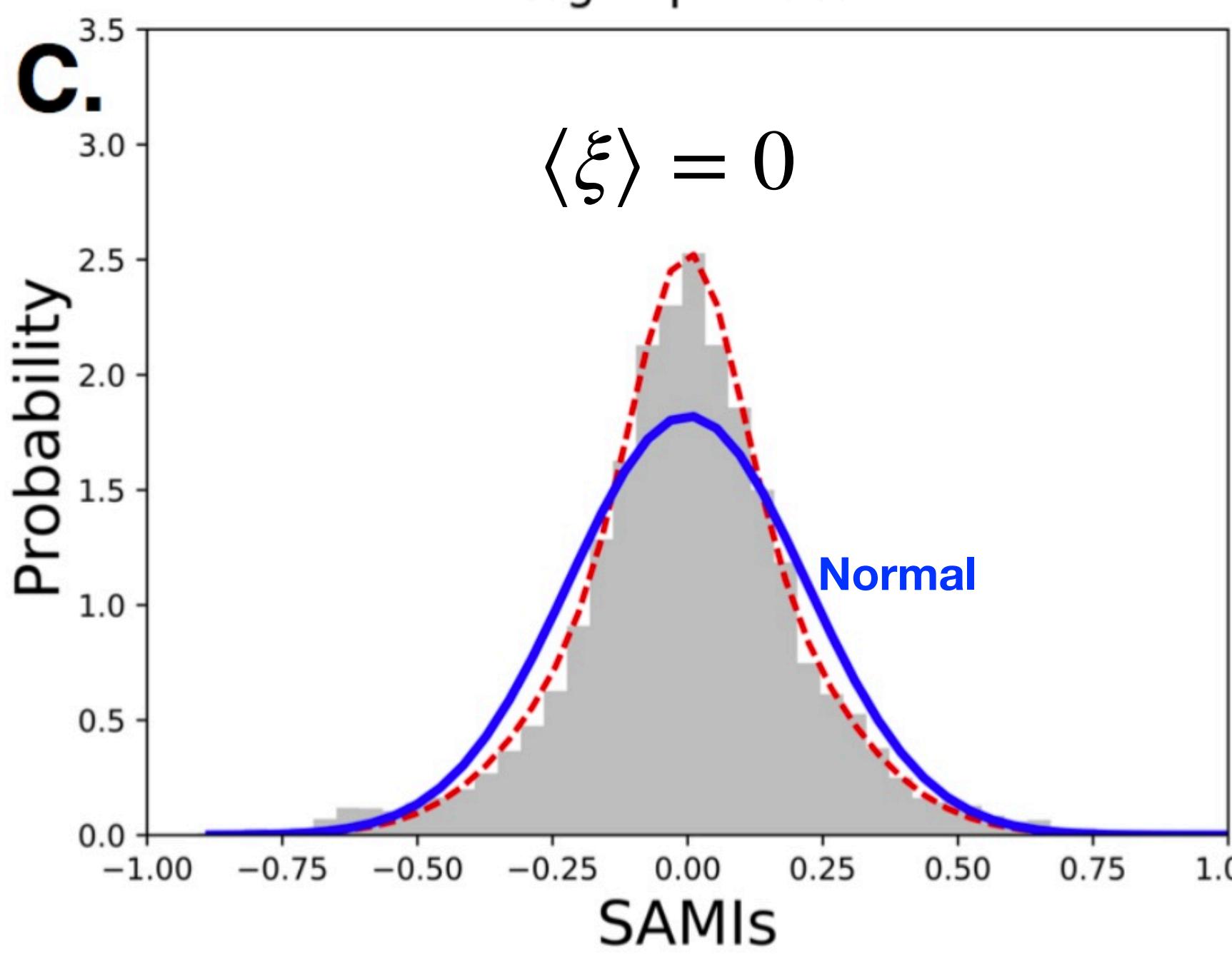
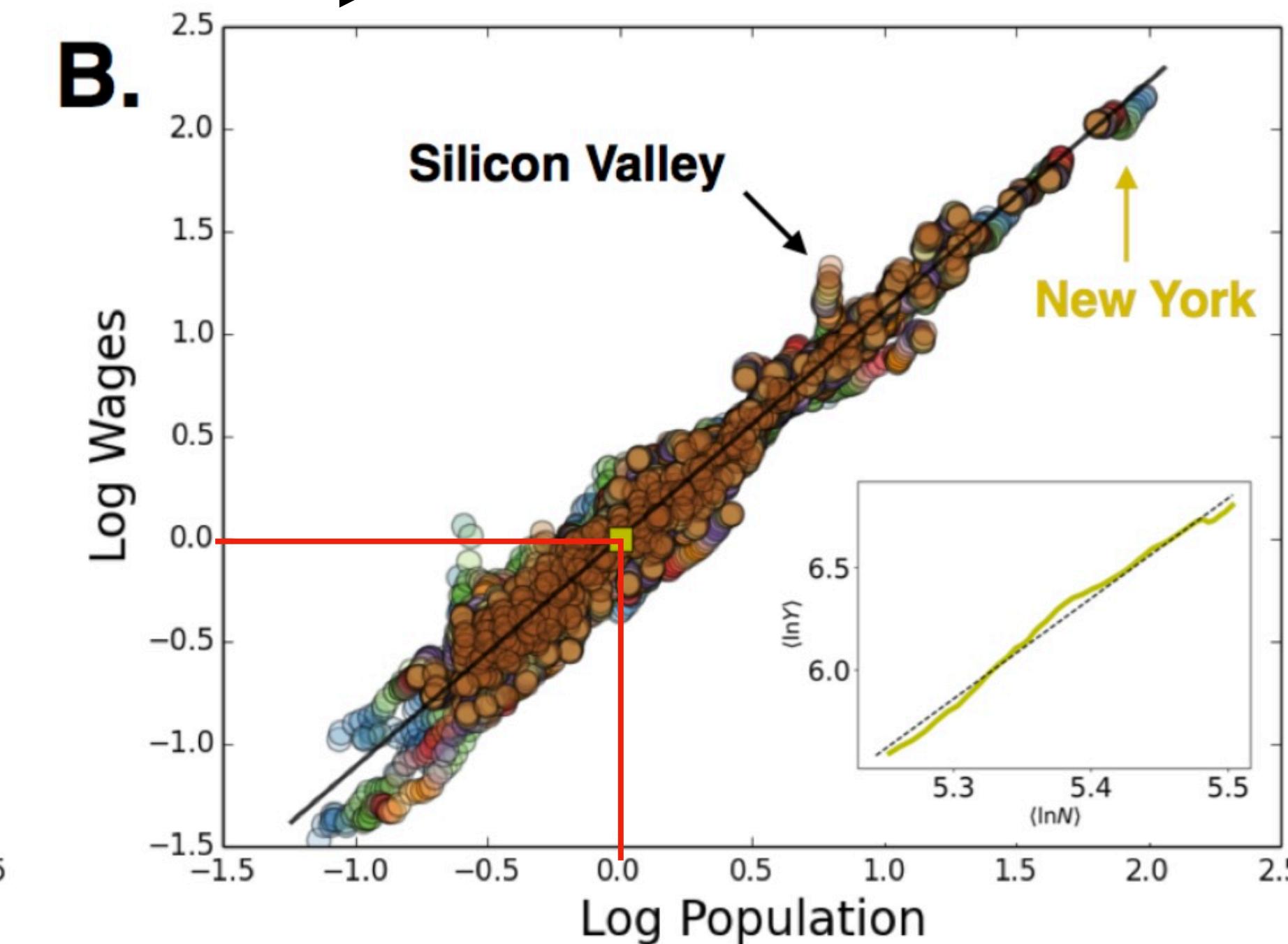
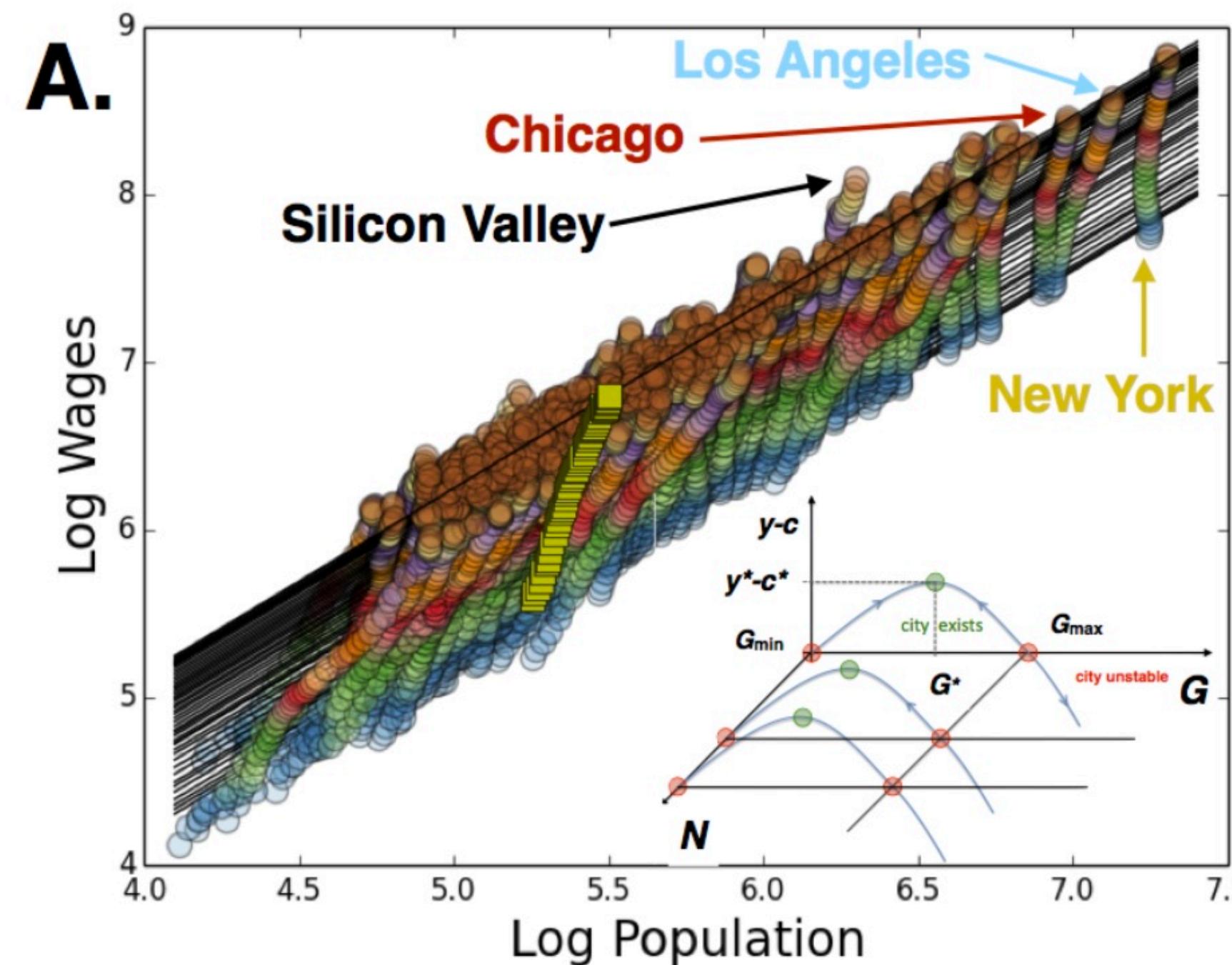
take the logs

take the average

$$\langle \ln Y \rangle = \ln Y_0 + \beta \ln N_i, \quad \langle \xi \rangle = 0$$

$$\ln Y_i - \langle \ln Y \rangle = \beta (\ln N_i - \langle \ln N \rangle) + \xi_i$$

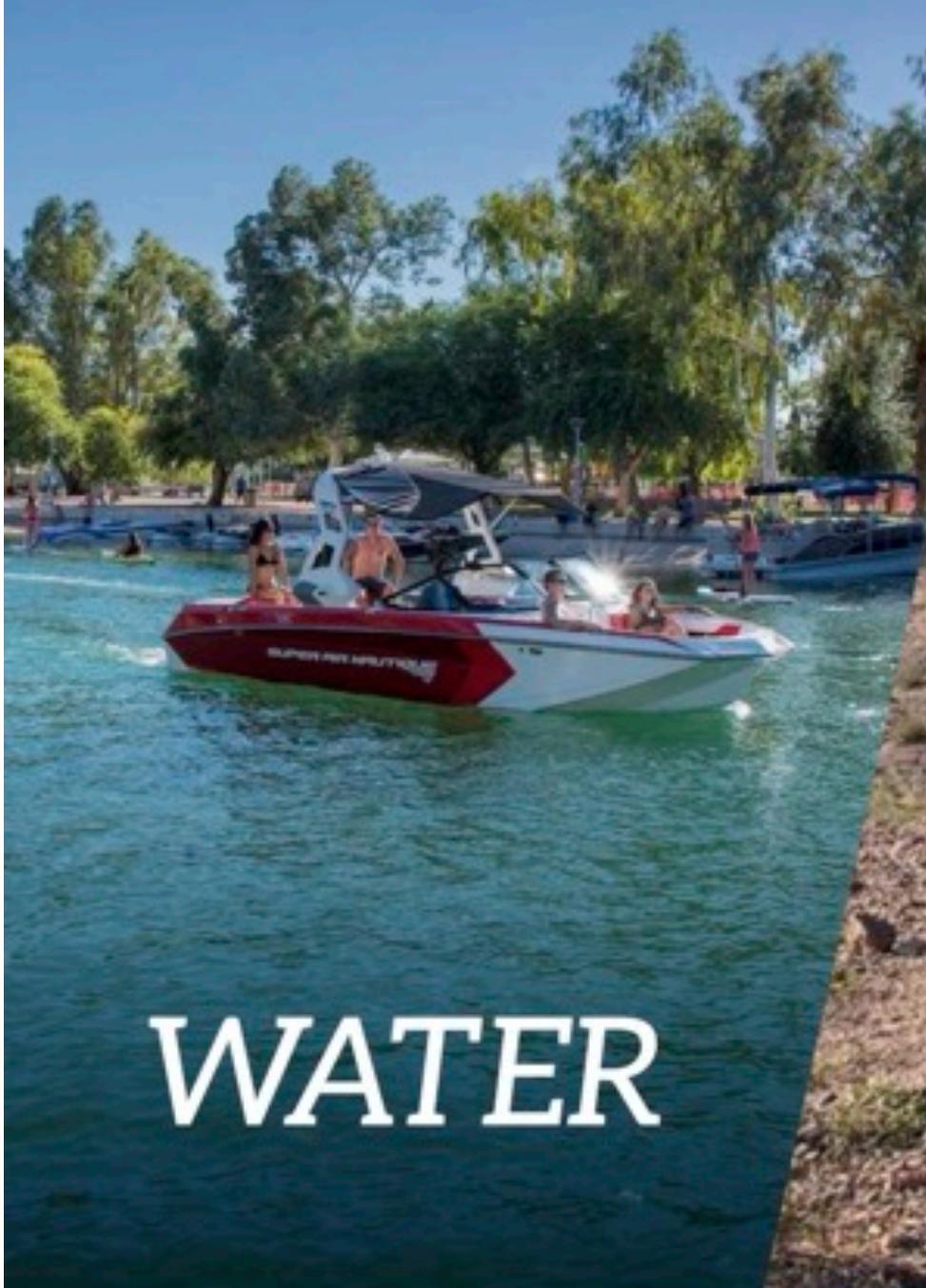
Centered Variables





PLAY STAY DINE EVENTS PLAN

Find Your *Element* in Arizona's Playground



WATER



EARTH



AIR



FUN

HOTELS

Book online or call 1-800-559-2391 for assistance



HOTELS

Book online or call 1-800-559-2391 for assistance

CHECK IN

CHECK OUT

ROOMS

ADULTS

KIDS

10/26/2021

10/27/2021

1



1



0



SEARCH

[Share](#) [Print Page](#)

Home / Play / Attractions / London Bridge

PLAY

[Top Ways to Play](#)[Attractions](#)[London Bridge](#)

Tour

London Bridge Fun Facts

The English Village

Beaches & Swimming

Parks

Aquatic Center

Birding

Havasu 95 Speedway

Lighthouses

Museum of History

Rockhounding

Meteorite Hunting

Stargazing

Vortex Sites

Cool & Unusual

Boating

Tours & Getaways

Entertainment

Fishing

Golfing

Hiking

The London Bridge



Take a [London Bridge virtual tour](#) and watch live streaming video of the bridge and Bridgewater Channel from our [Lake Havasu Weather WebCam](#).

How did the world-famous London Bridge come to make its home in a remote Arizona desert city? The story began centuries earlier, over 5,400 miles away in London, England.

[BOOK YOUR STAY NOW](#)[DISCOVER ARIZONA'S WEST COAST](#)

Lake Havasu City VISITORS GUIDE



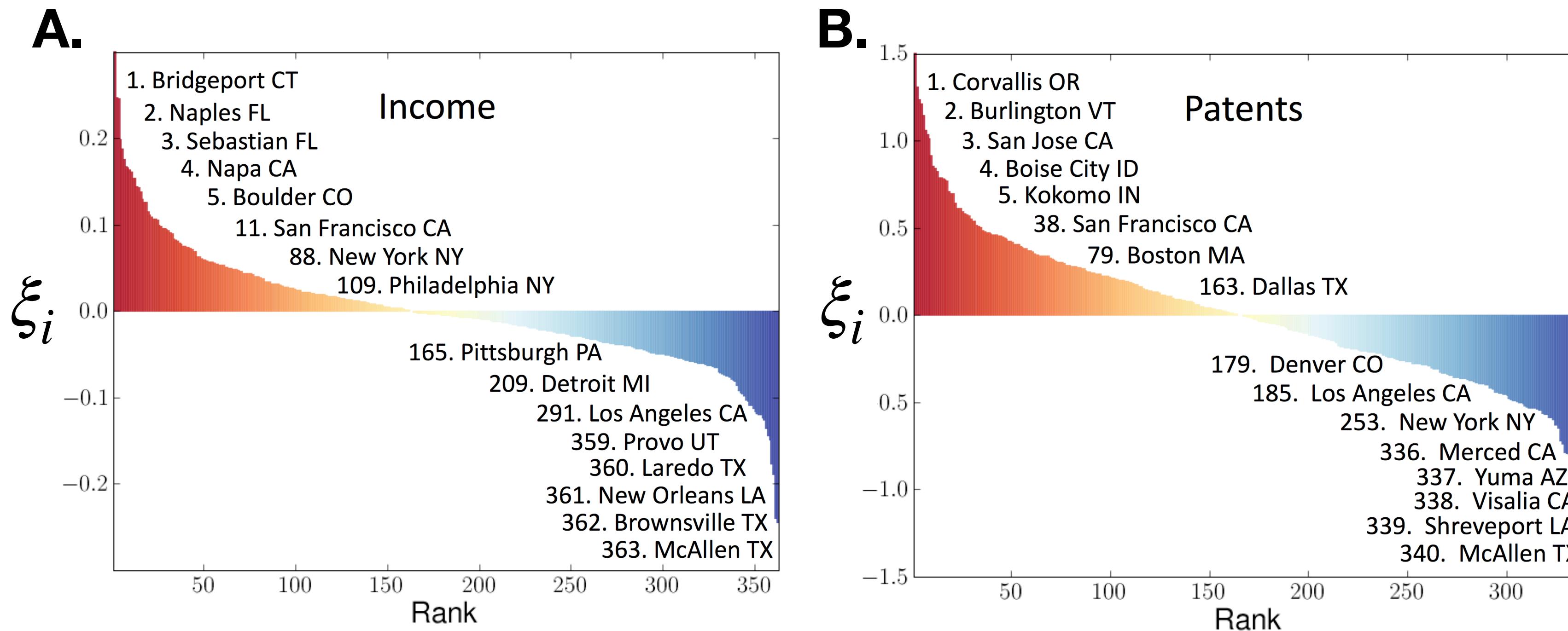
The London Bridge in Lake Havasu City



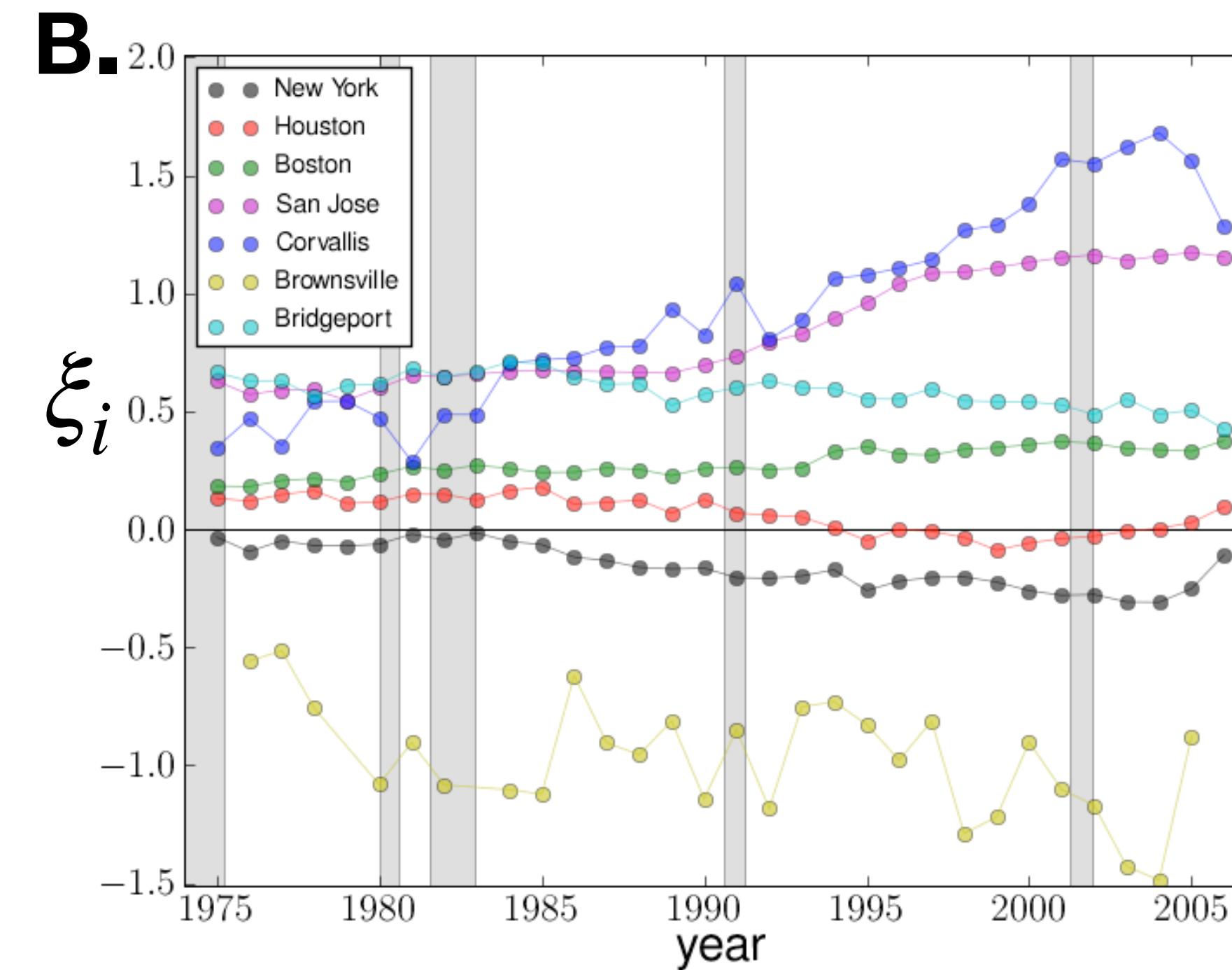
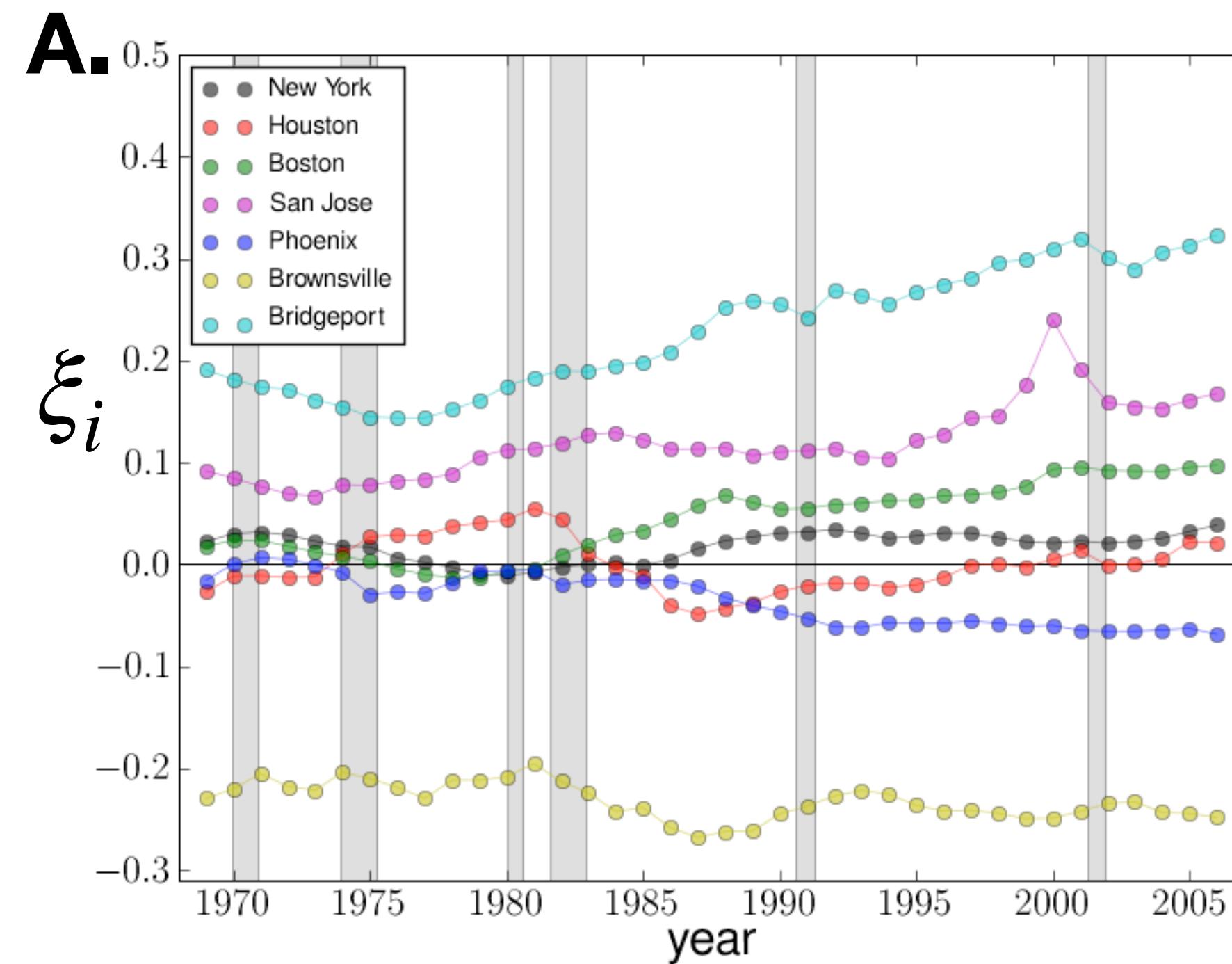
In 1967, the Common Council of the City of London began to look for potential buyers for the London Bridge. As Lake Havasu City's founder, chainsaw magnate [Robert P. McCulloch, Sr.](#) saw a once-in-a-lifetime opportunity. He believed--correctly, as history shows us--that reconstructing this massive icon in his new city would attract tourists and prospective buyers of residential lots.

McCulloch placed the winning bid of \$2.4 million on April 18, 1968 (over \$17 million in today's dollars). McCulloch arrived at this figure by doubling the estimated cost of dismantling the structure (\$1.2 million), bringing the price to \$2.4 million. He then added on \$60,000, a thousand dollars for each year of his age at the time he estimated the bridge would be reconstructed in Arizona. Contrary to popular belief, McCulloch was not under the impression that he was purchasing the Tower Bridge of London.

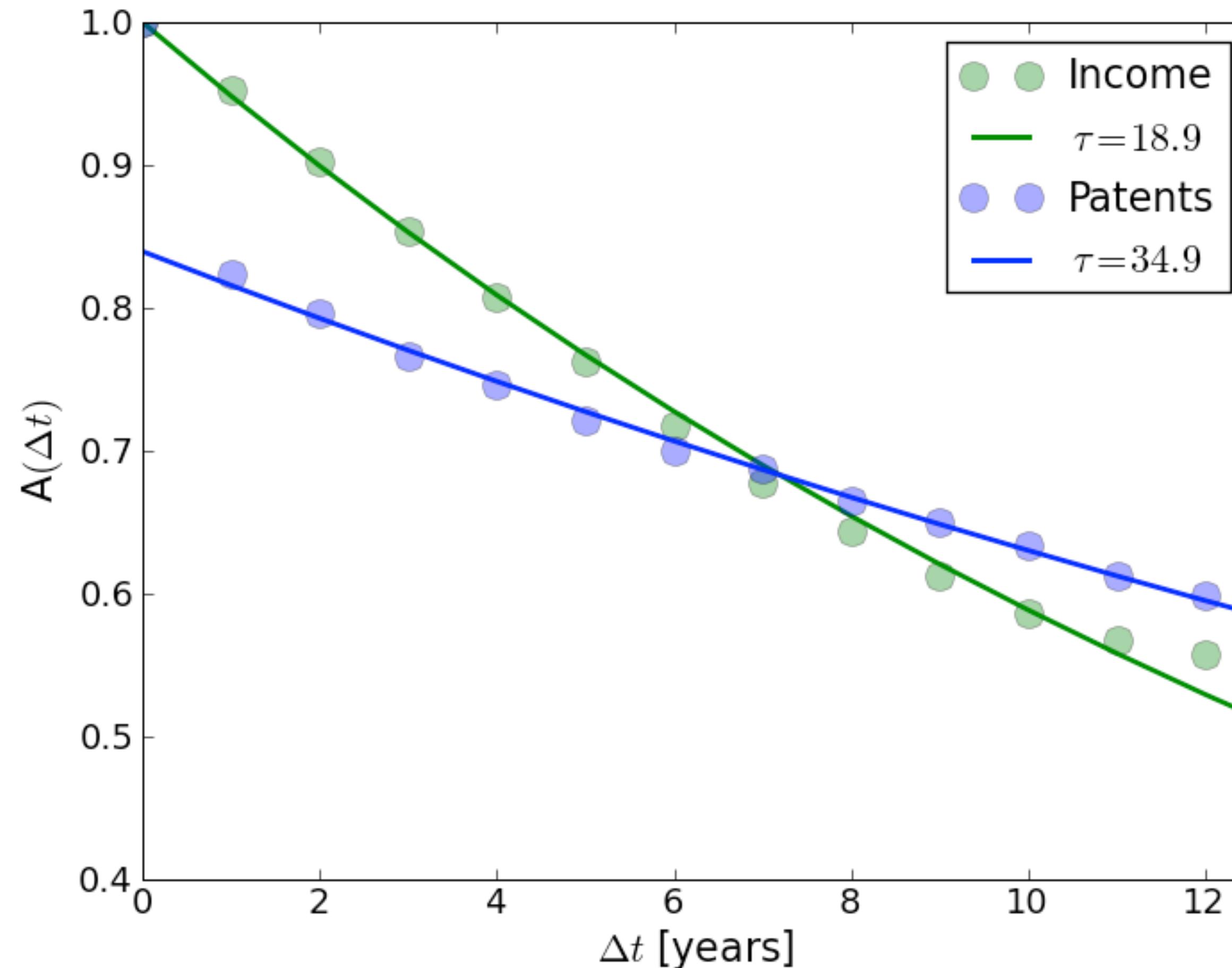
Ranking US Metropolitan Areas by Deviations from Scaling



Ranking US Metropolitan Areas by Deviations from Scaling over time

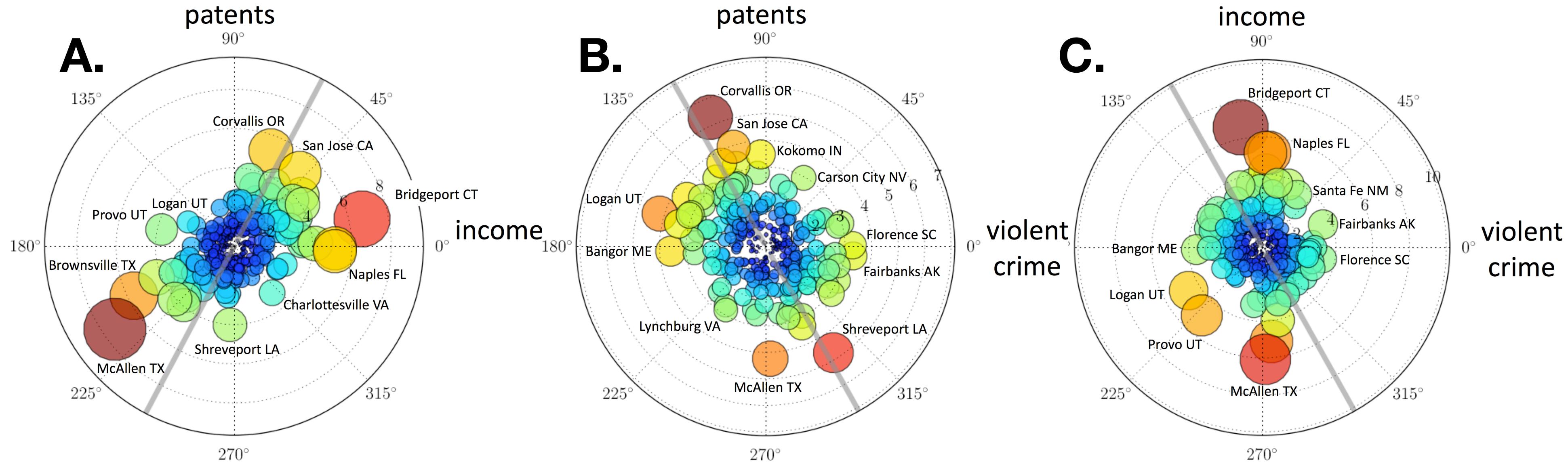


Temporal persistence of scaling deviations

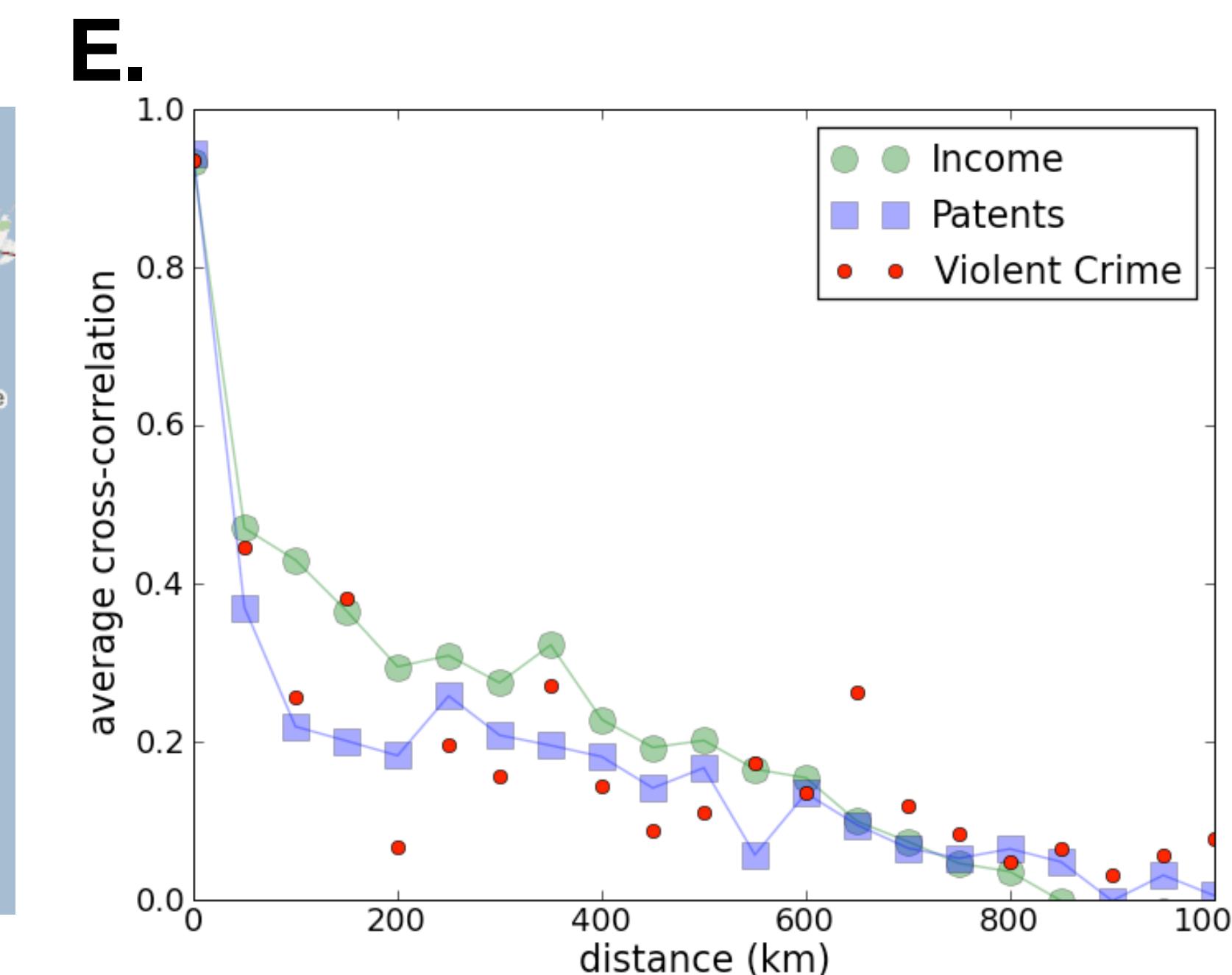
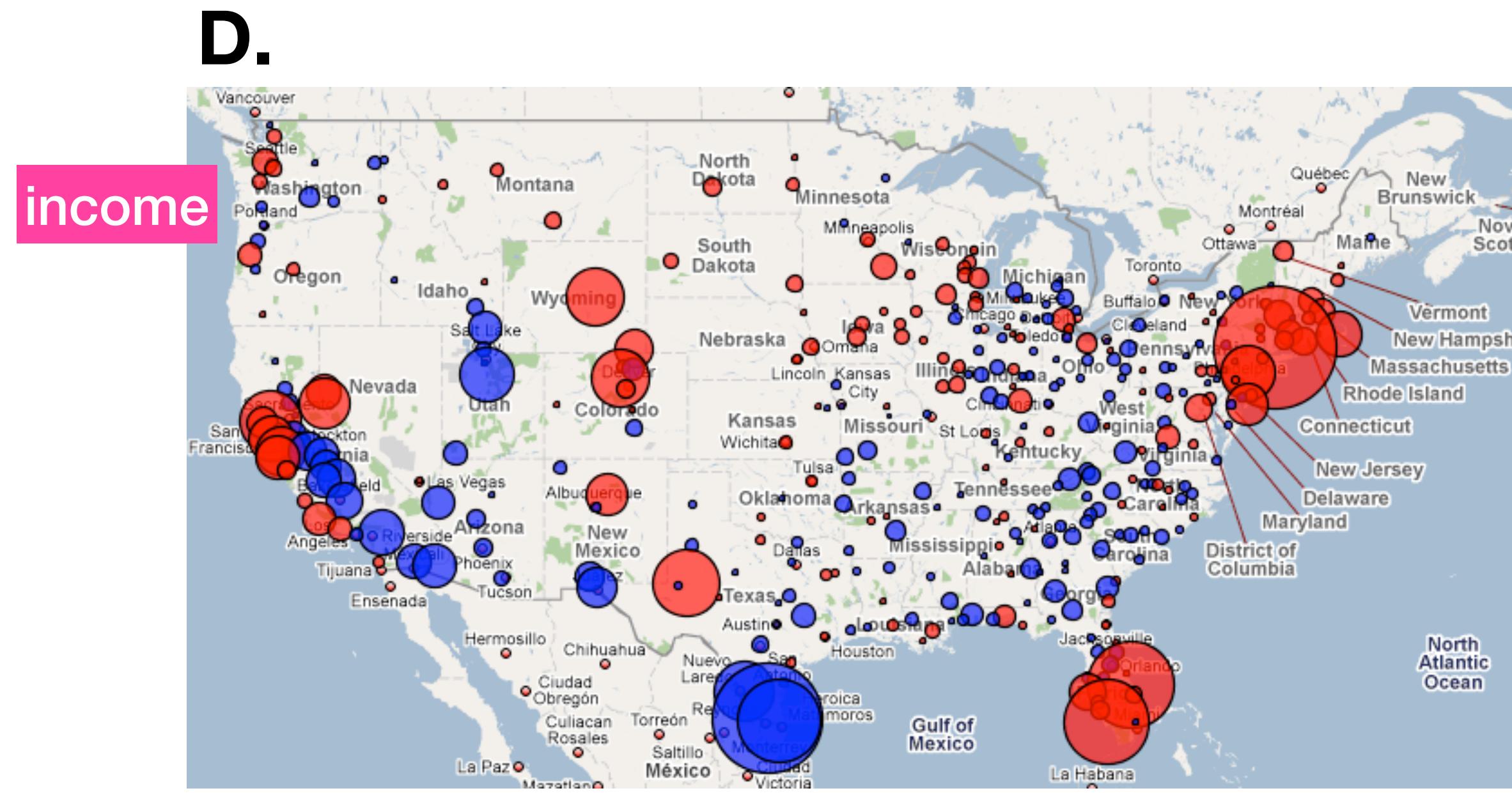


Persistence times are in the order of a **few decades !**

Correlations between deviations and spatial structure



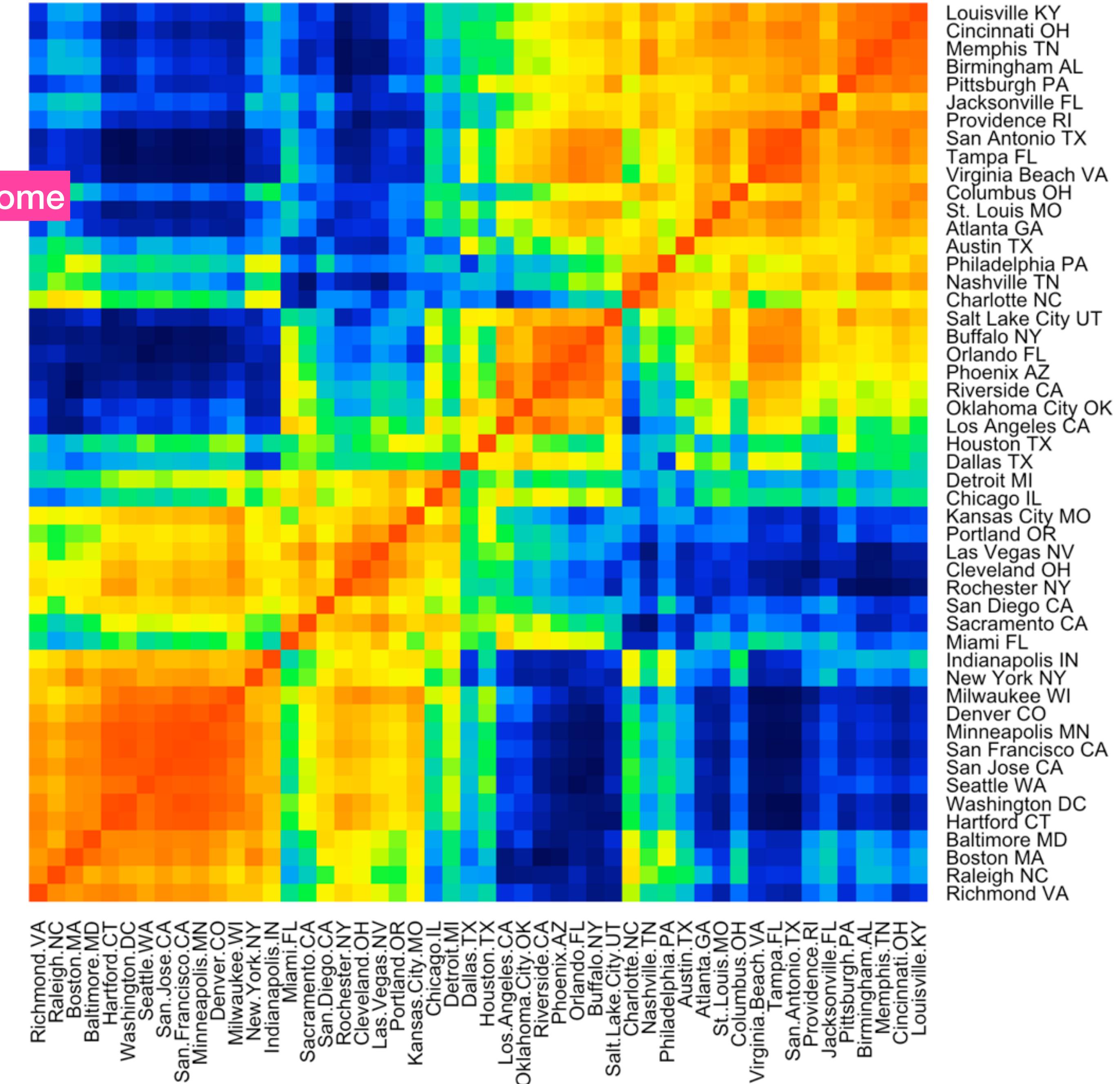
Cross correlations explain only **5-15%** of the variation.



The concept of kindred cities

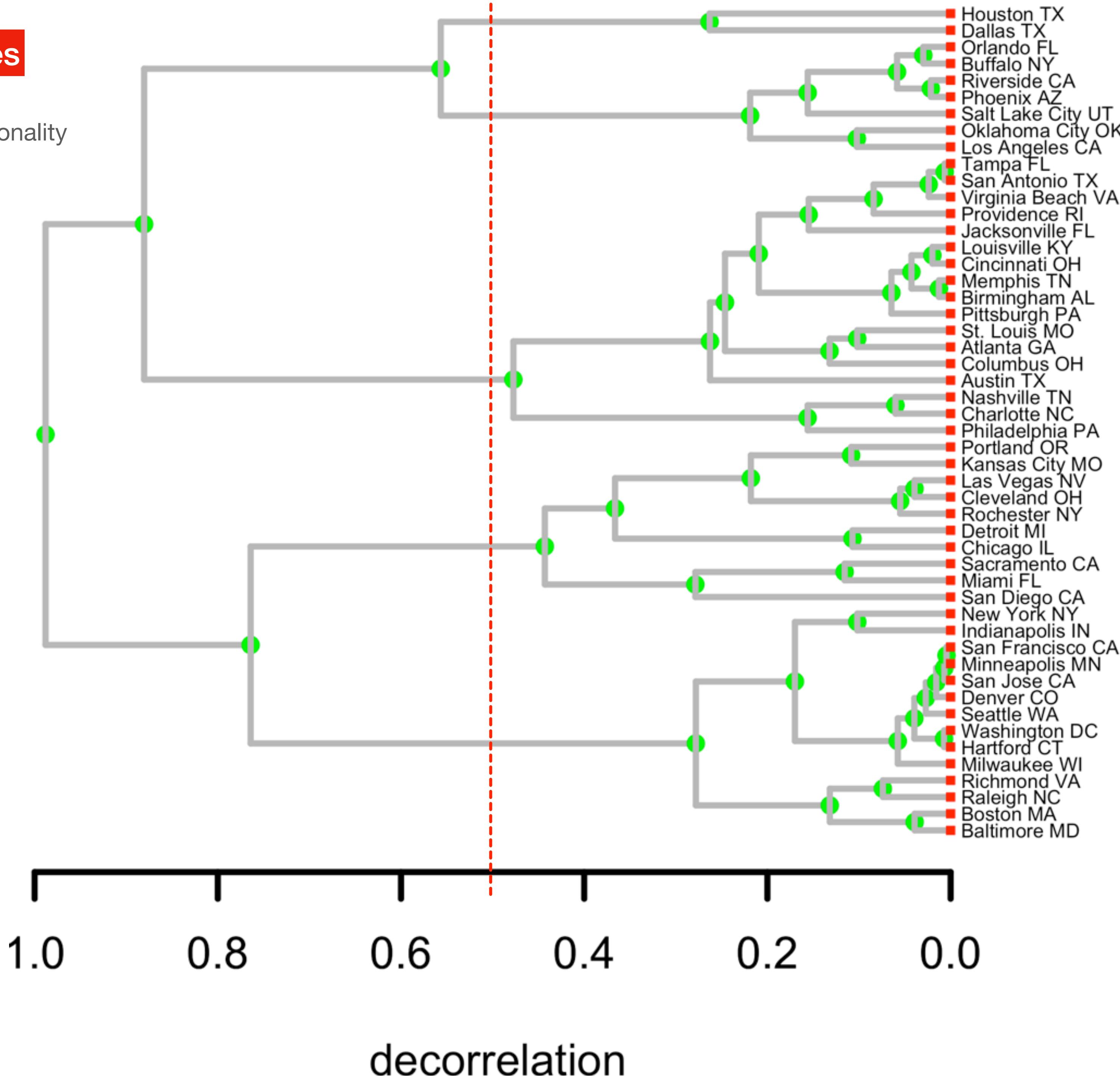
cities with similar histories of exceptionality

Heat maps from Urban History Clustering Analysis



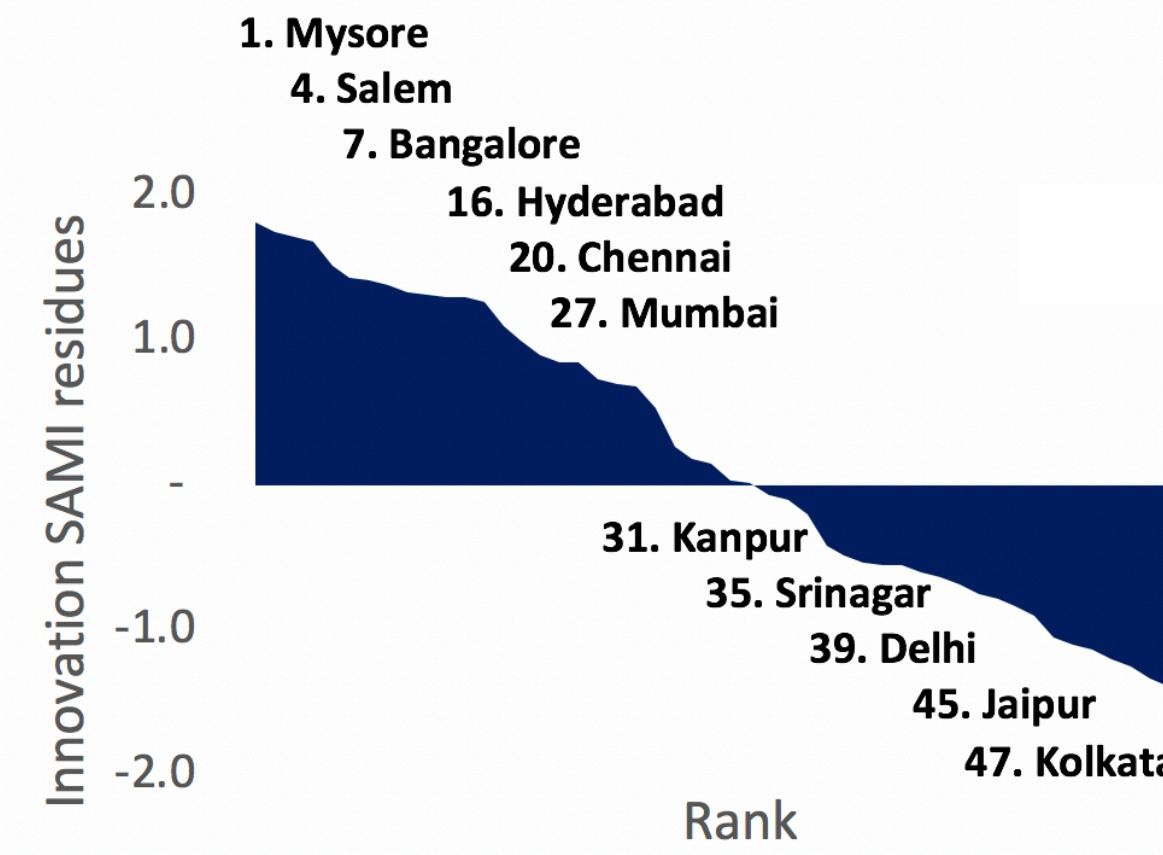
The concept of kindred cities

cities with similar histories of exceptionality

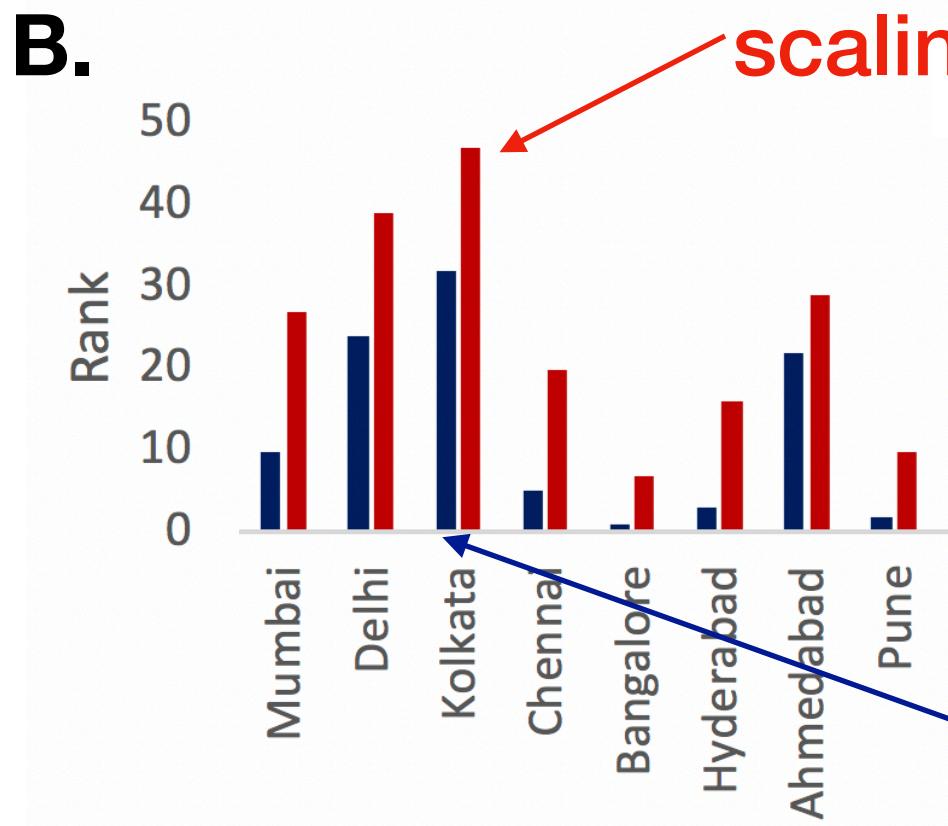


Patents in Indian Cities

A.

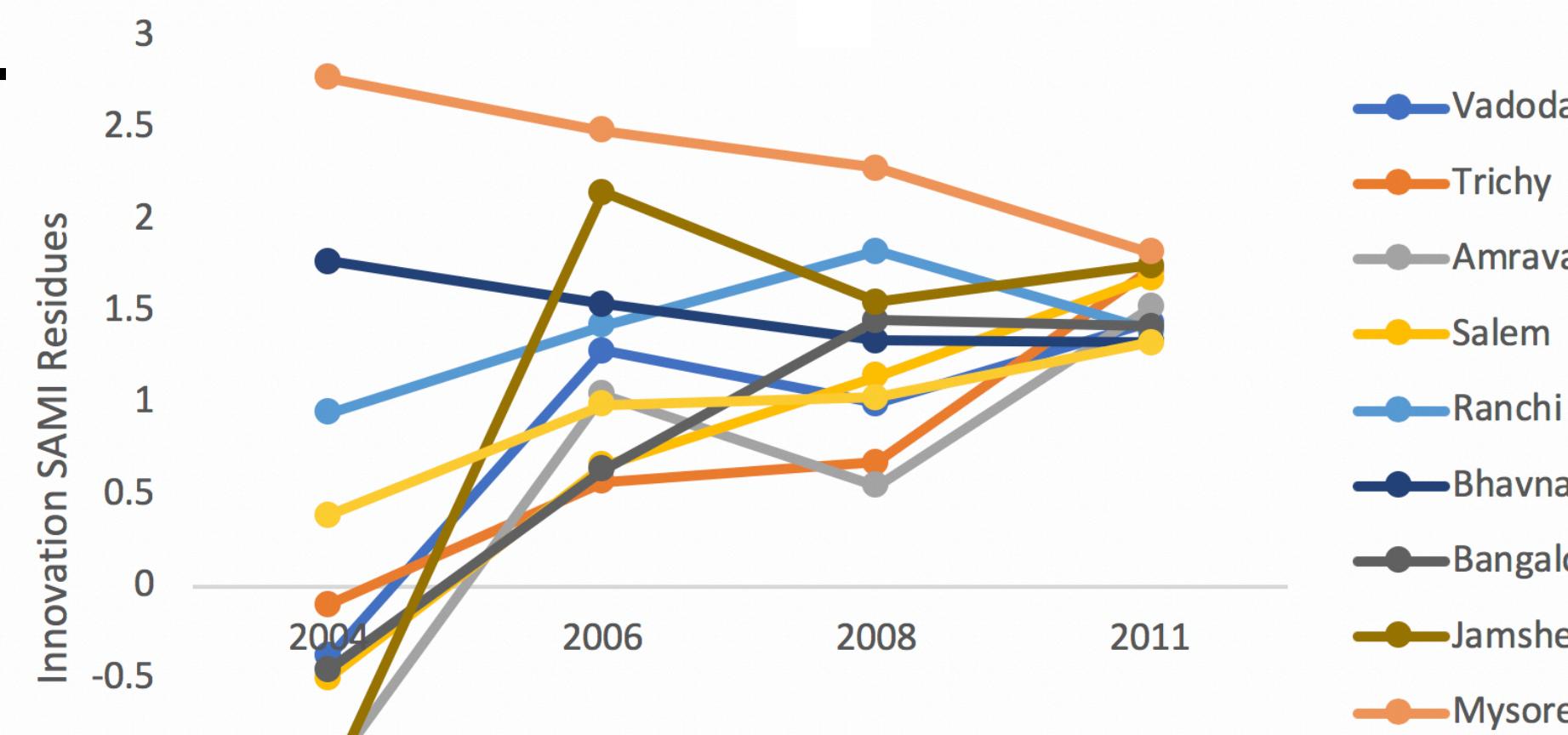


B.



discovery of small innovative cities

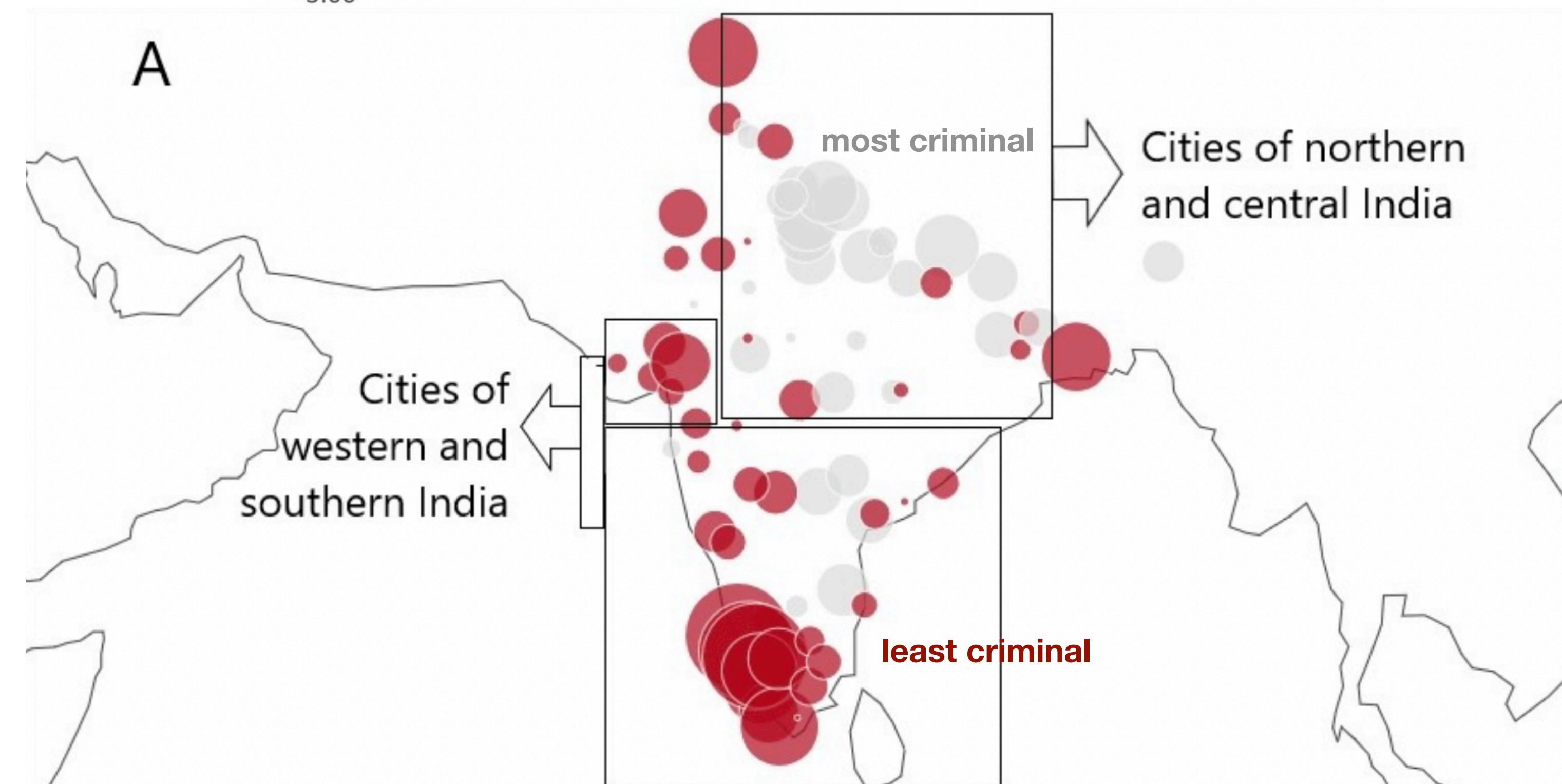
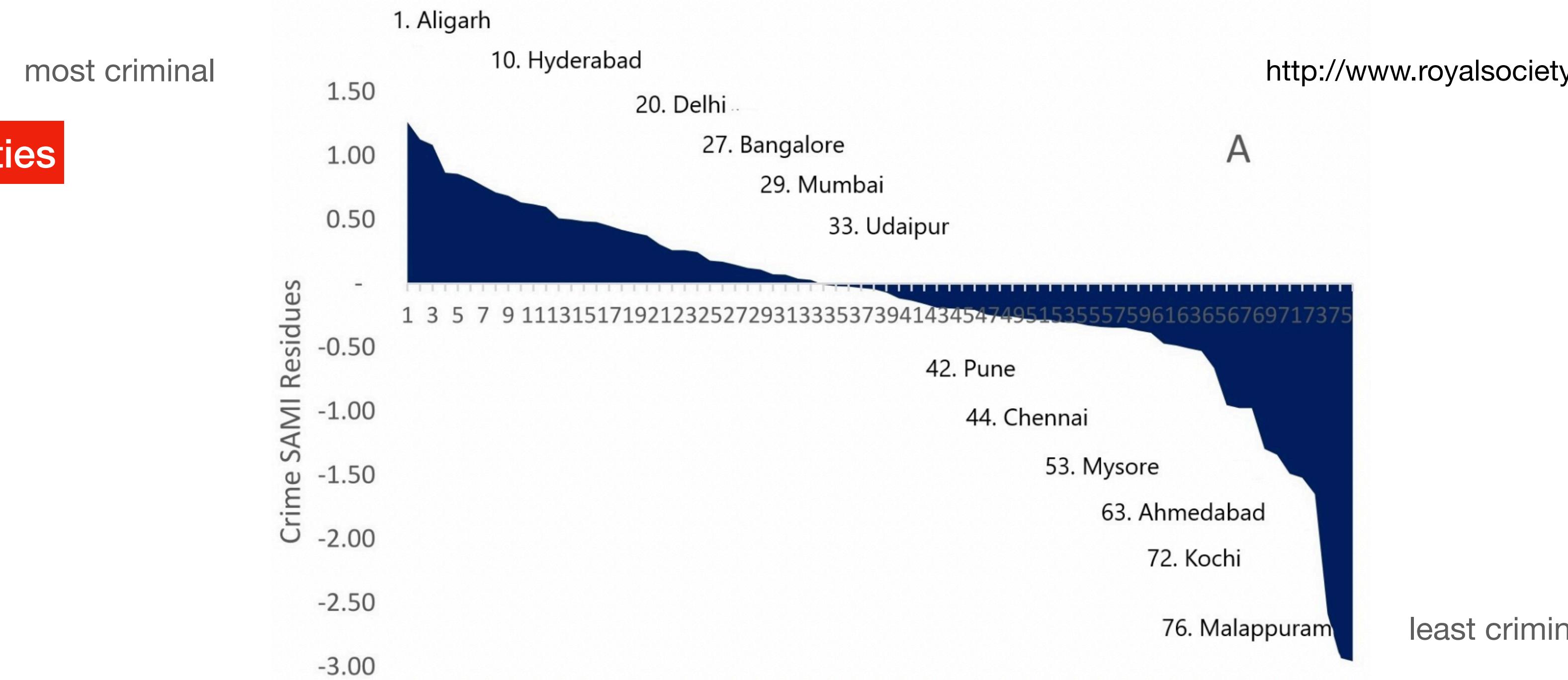
C.

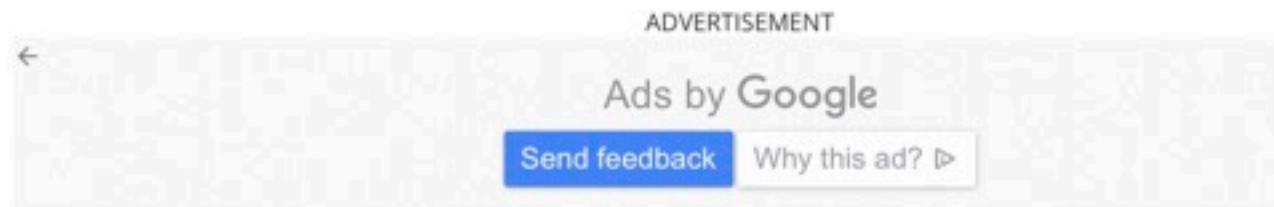


D.



Crime in Indian Cities



[india](#) [cities](#) [opinion](#) [world](#) [HTLS 2020](#) [ipl](#) [entertainment](#) [bihar election](#) [trending](#) [videos](#) [tech](#) [podcasts](#) [web stories](#) [lifestyle](#) •••[Home](#) / [Lucknow](#) / Smart city in making: Aligarh gets a chance to unlock its potential

Smart city in making: Aligarh gets a chance to unlock its potential

To tap the potential of the traditional lock industry, Aligarh will be made an International Lock City.

LUCKNOW Updated: Jul 26, 2017, 16:29 IST S Raju/ Pradeep Saxena
Hindustan Times, Aligarh

The officials have allocated Rs 2,566 crore for the smart city project.(HT Photo)



Kerala: Malappuram tops list of world's fastest-growing urban areas

T P Nijeesh / TNN / Updated: Jan 9, 2020, 10:22 IST

TIMESPOINTS

FACEBOOK

TWITTER

LINKEDIN

EMAIL

AA

safest

UP NEXT

1

Kerala: Malappuram tops list of world's fastest-growing urba...

2

Business incubators at IIM-K and NID Ahmedabad...

3

Do you have what it takes to go #FullOn like Neha Kakkar an...

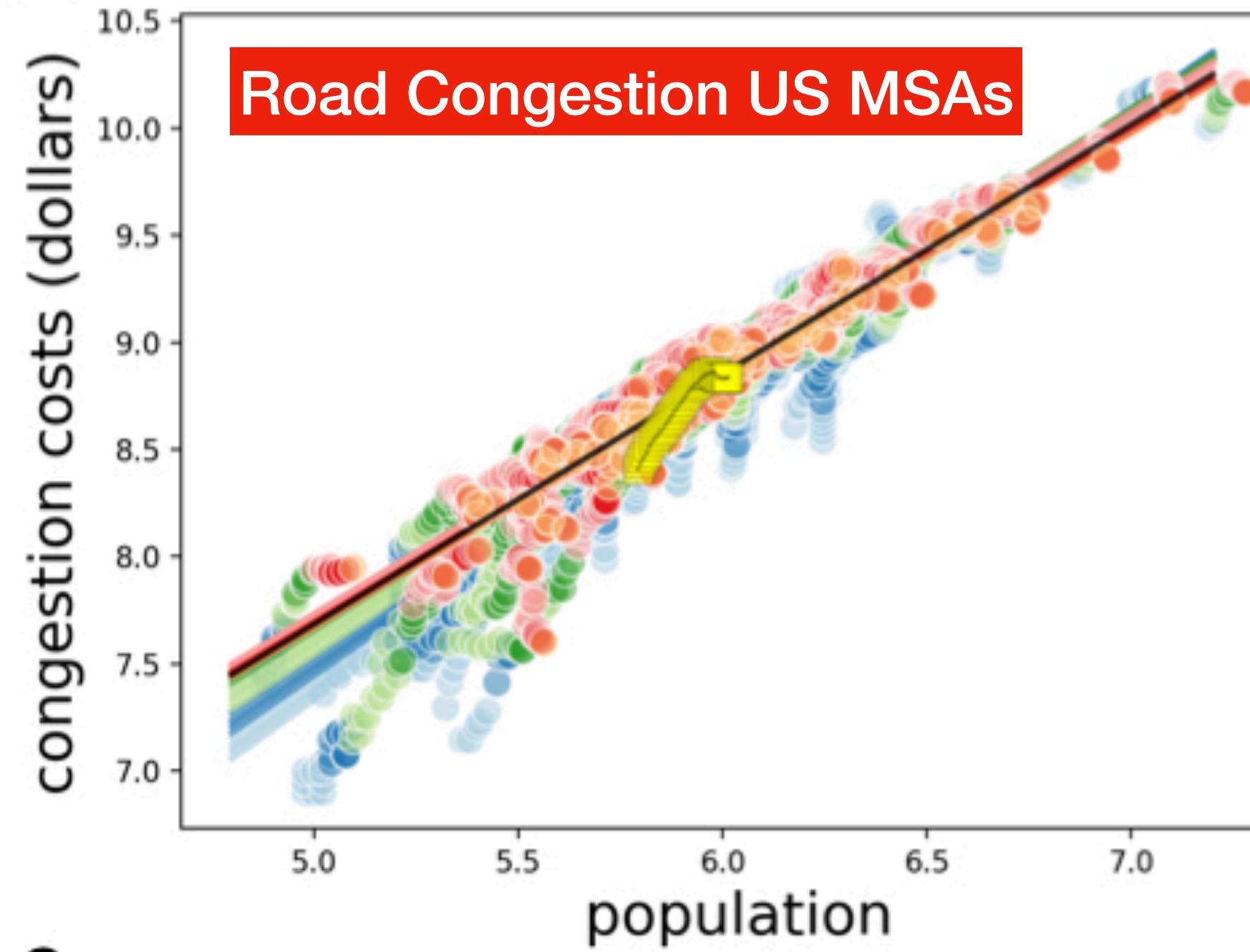
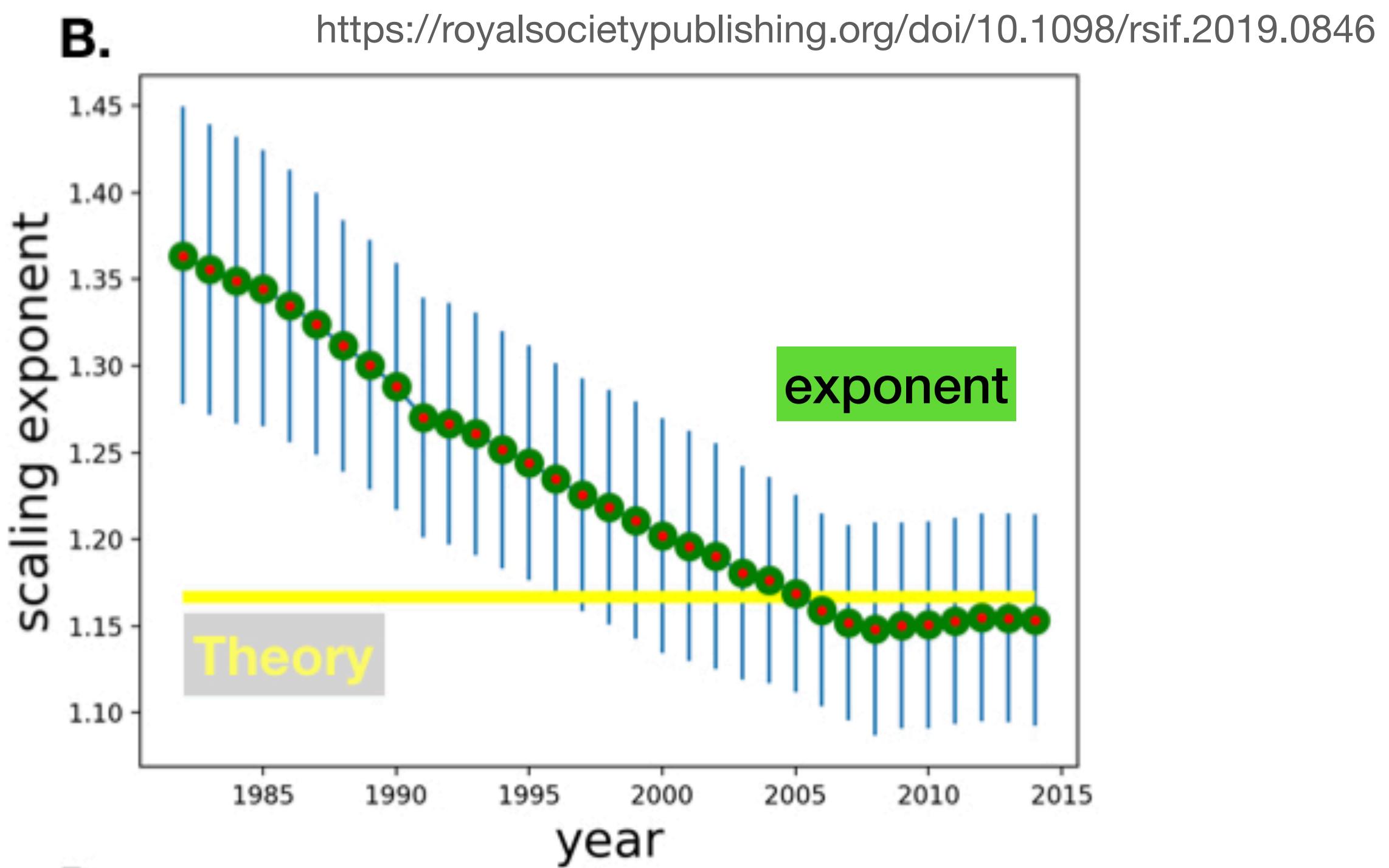
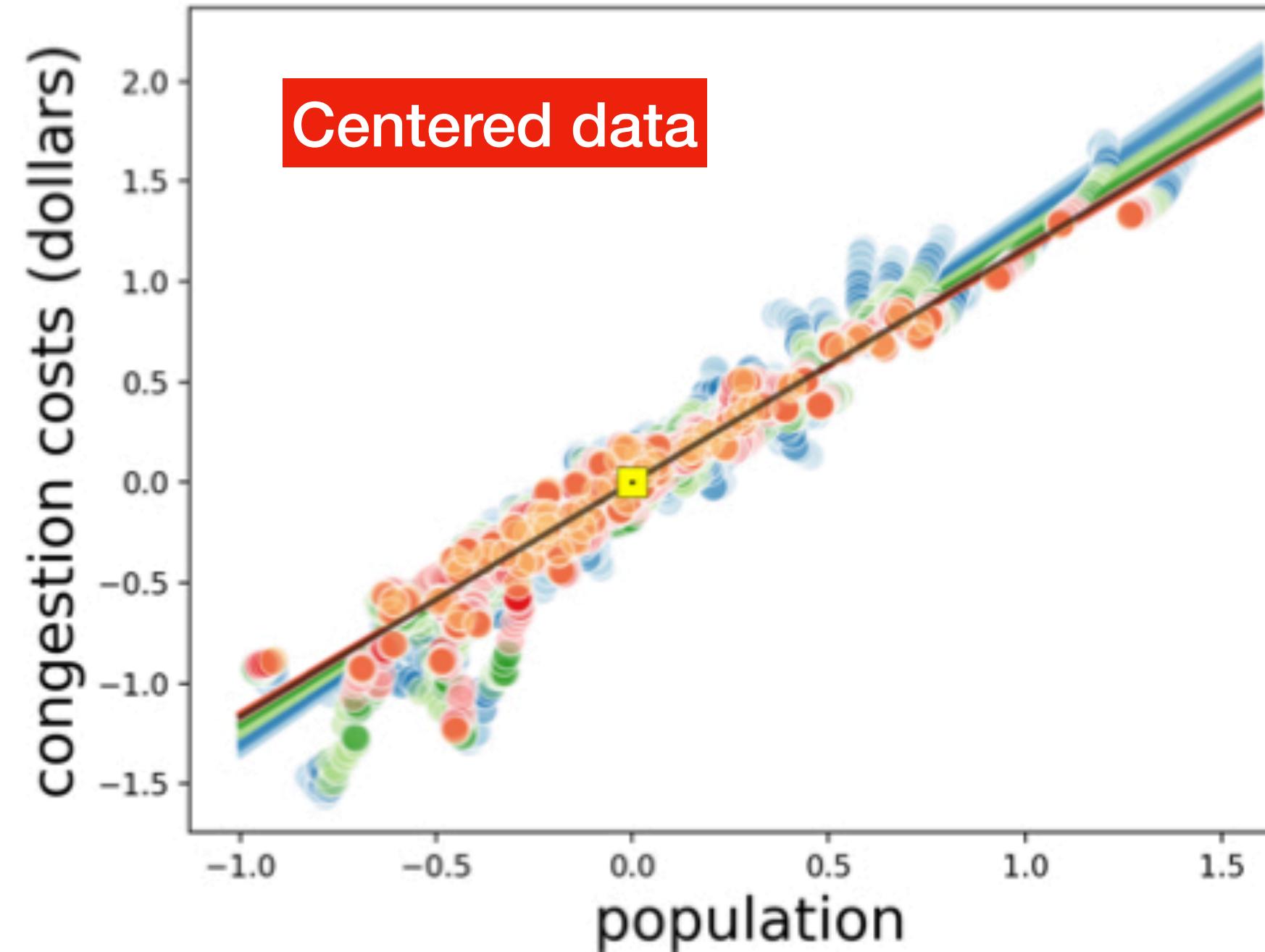
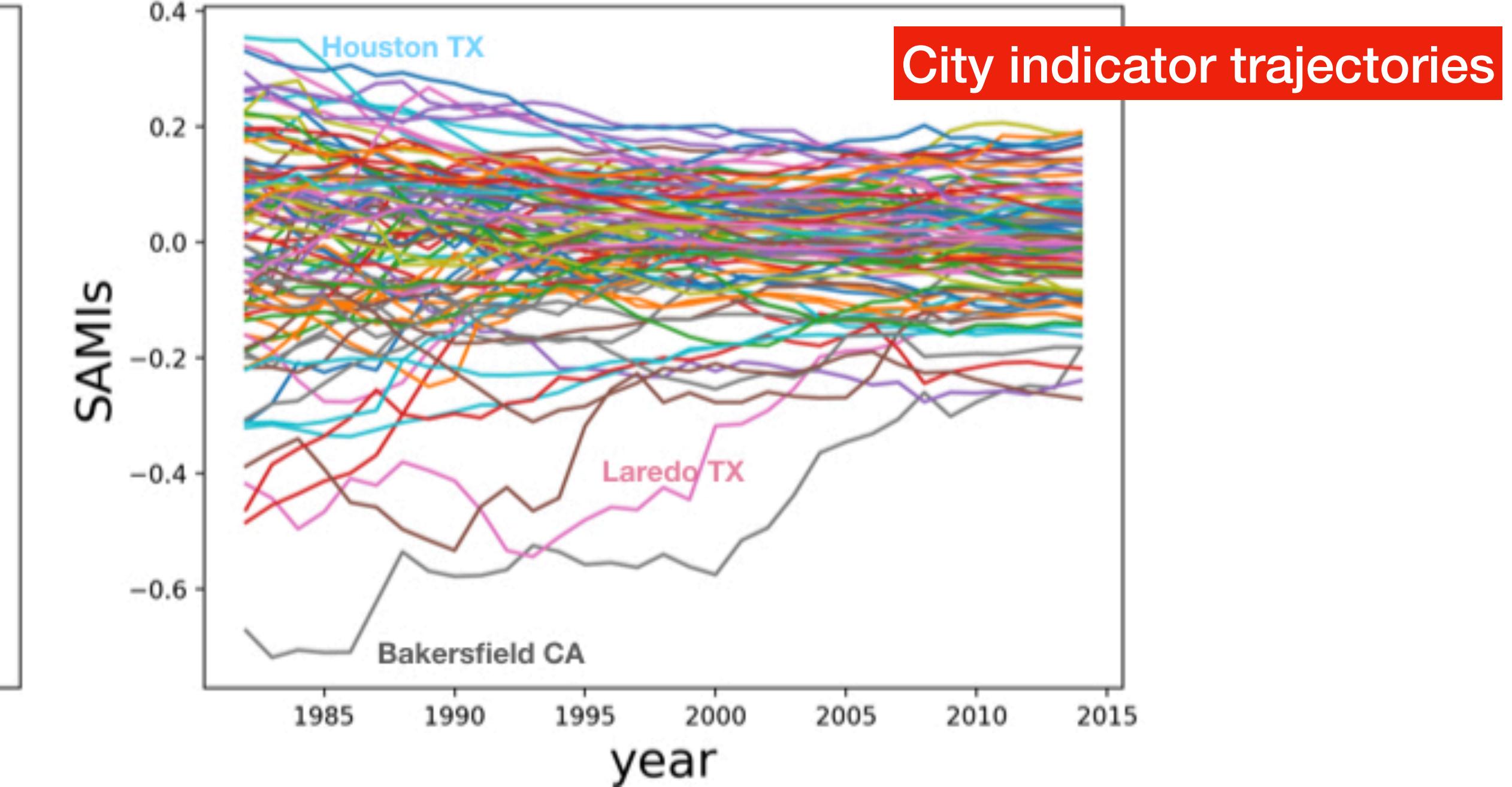
4

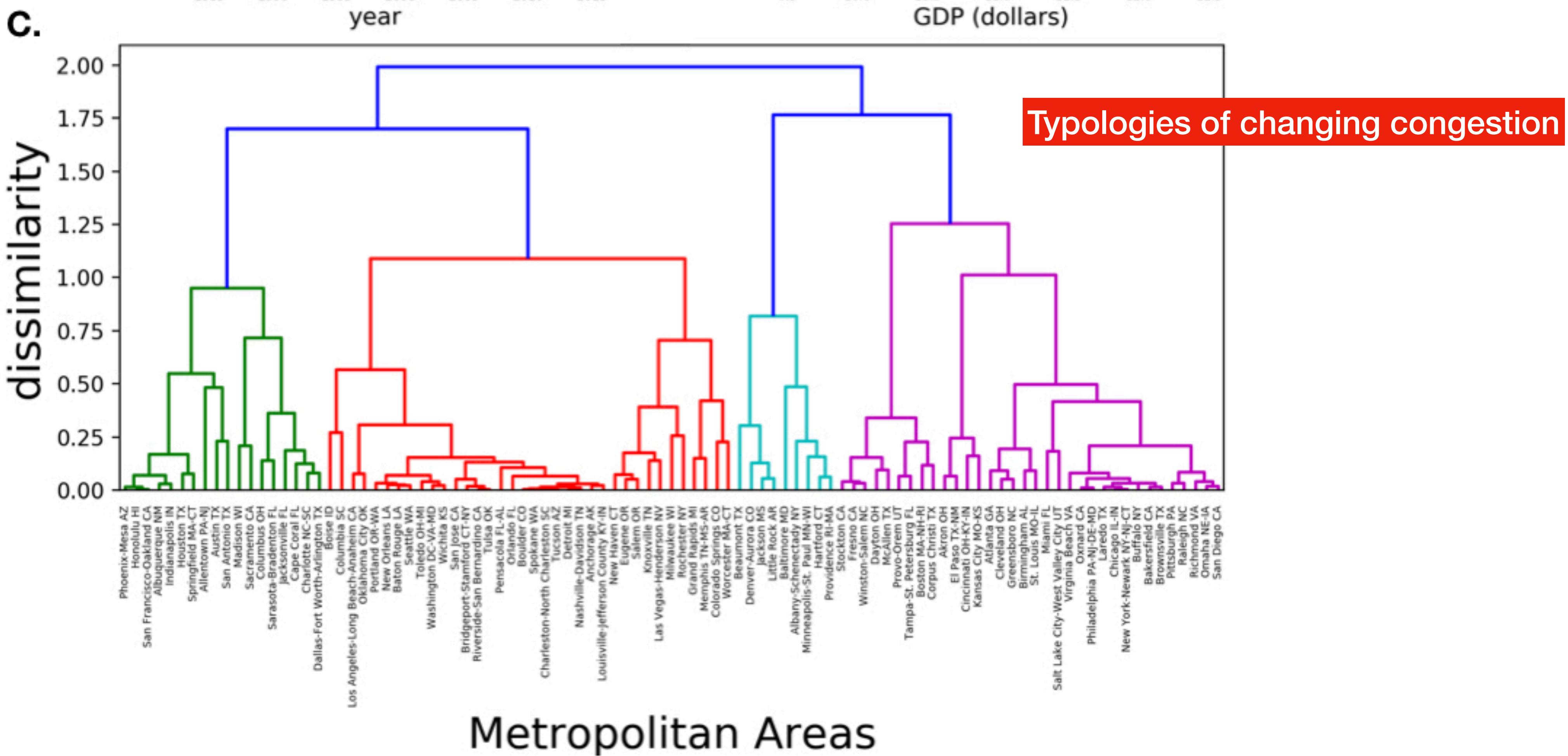
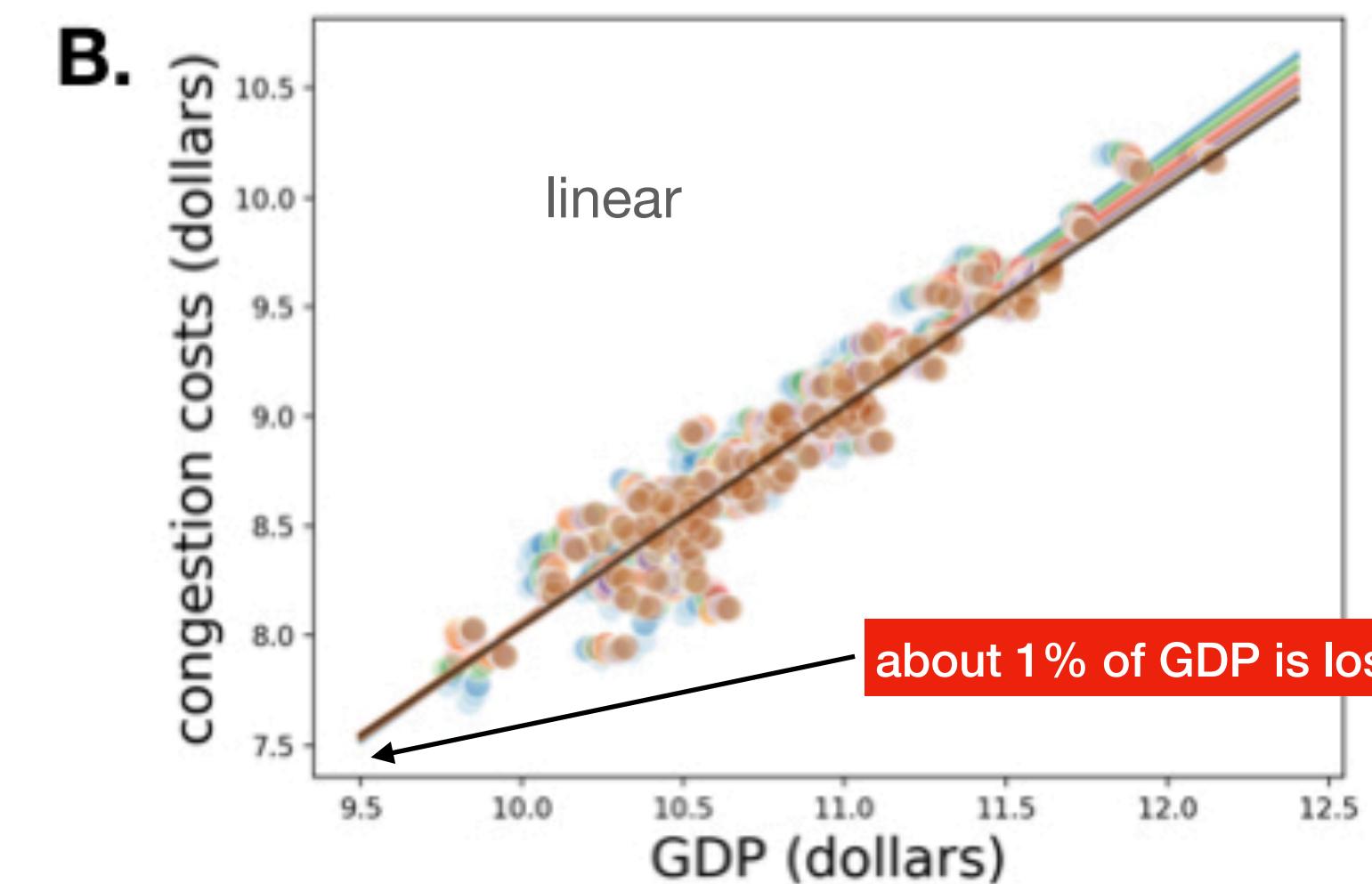
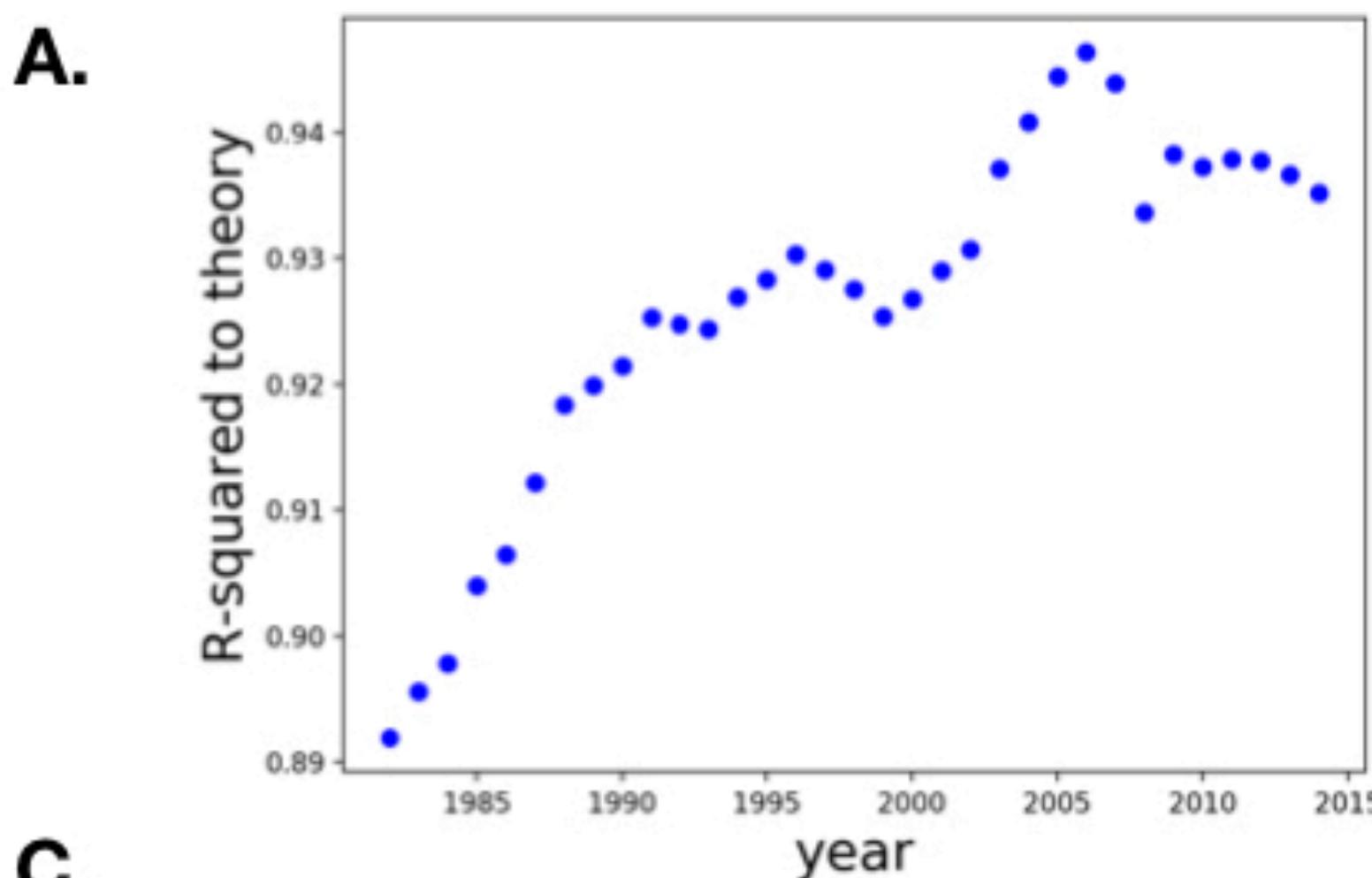
Tanur college project set to be fast-tracked



Area near Malappuram Civil Station

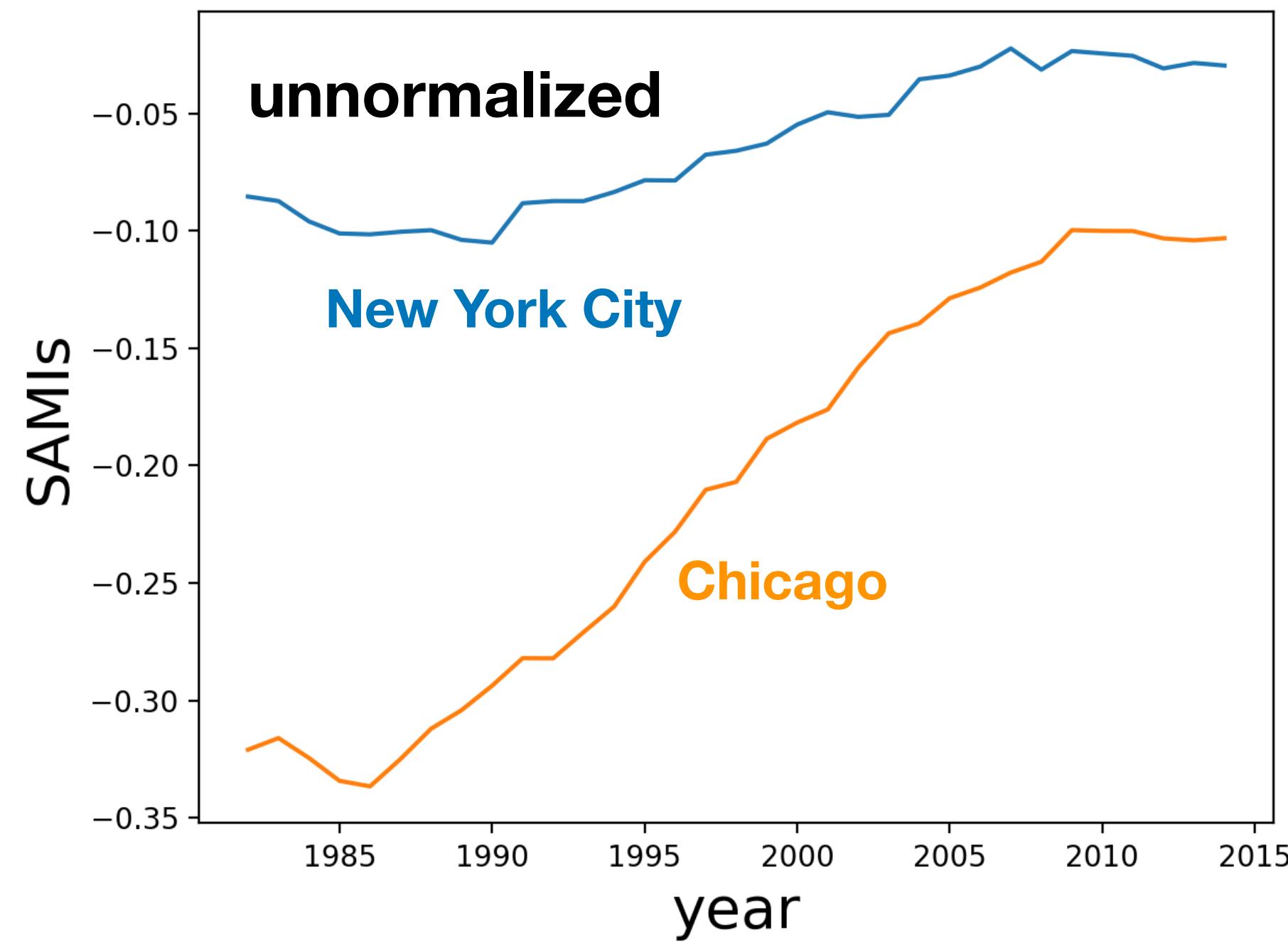
MALAPPURAM: Three of the world's 10 fastest-growing urban areas are in [Kerala](#), according to a survey published by The Economist

A.**B.****C.****D.**

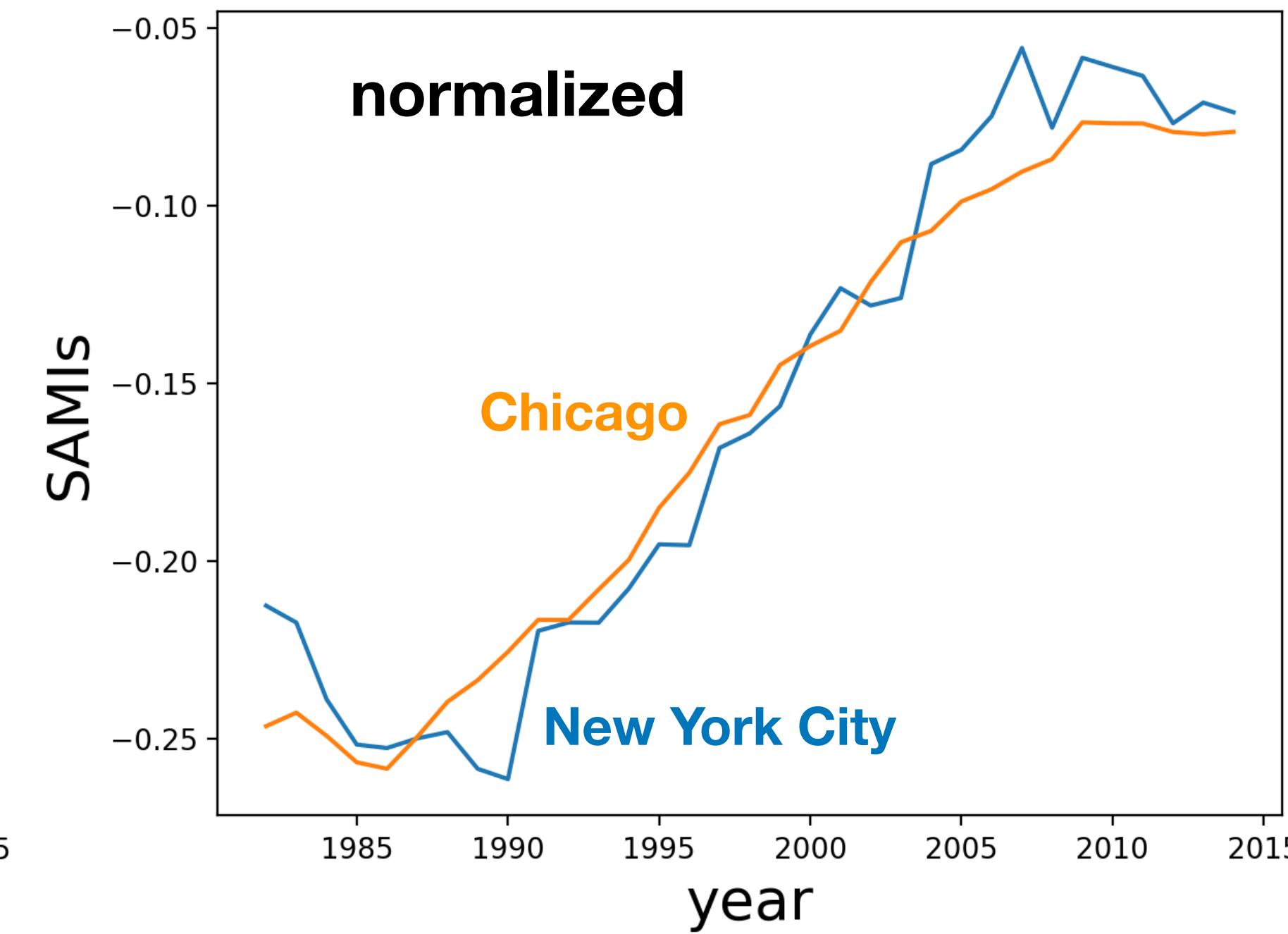


Typologies are not general: they depend on measures of similarity

A.



B.



$$\vec{\xi} = (\xi(t_0), \xi(t_1), \dots, \xi(t_n))$$

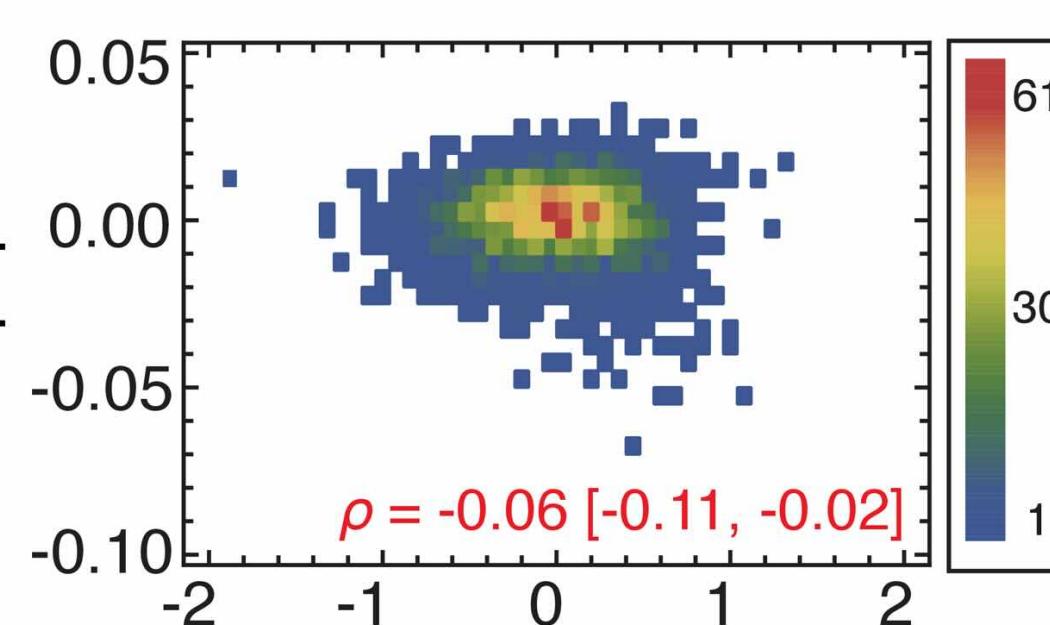
$$\vec{\xi} \rightarrow \frac{\vec{\xi}}{|\vec{\xi}|} : \sum_t \vec{\xi} \cdot \vec{\xi} = 1$$

Homicides in Brazilian Cities

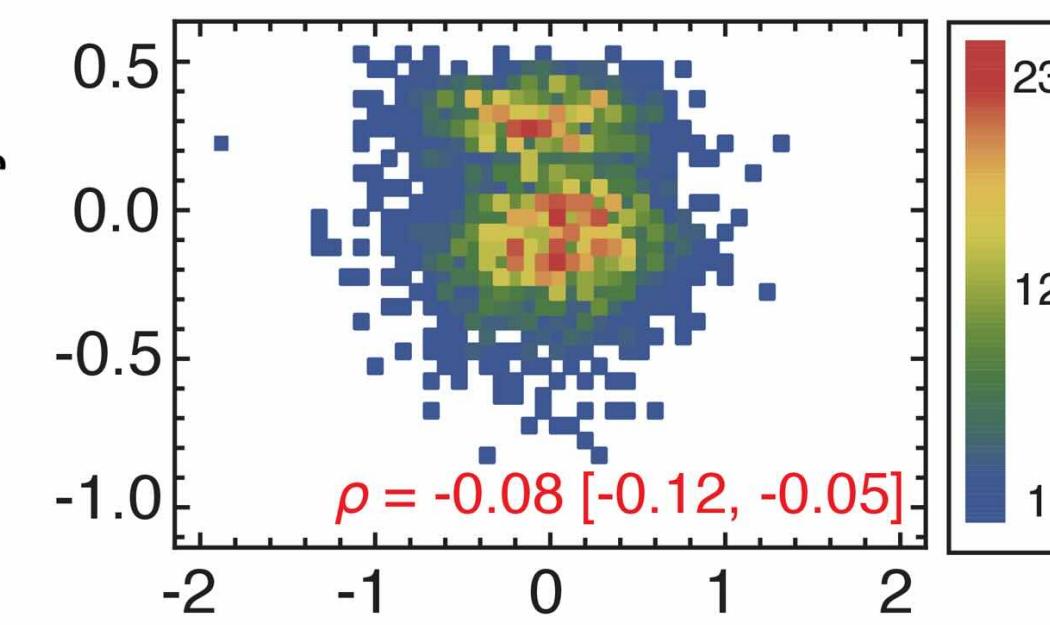
$\zeta_{\text{other quantities}}$

Distance

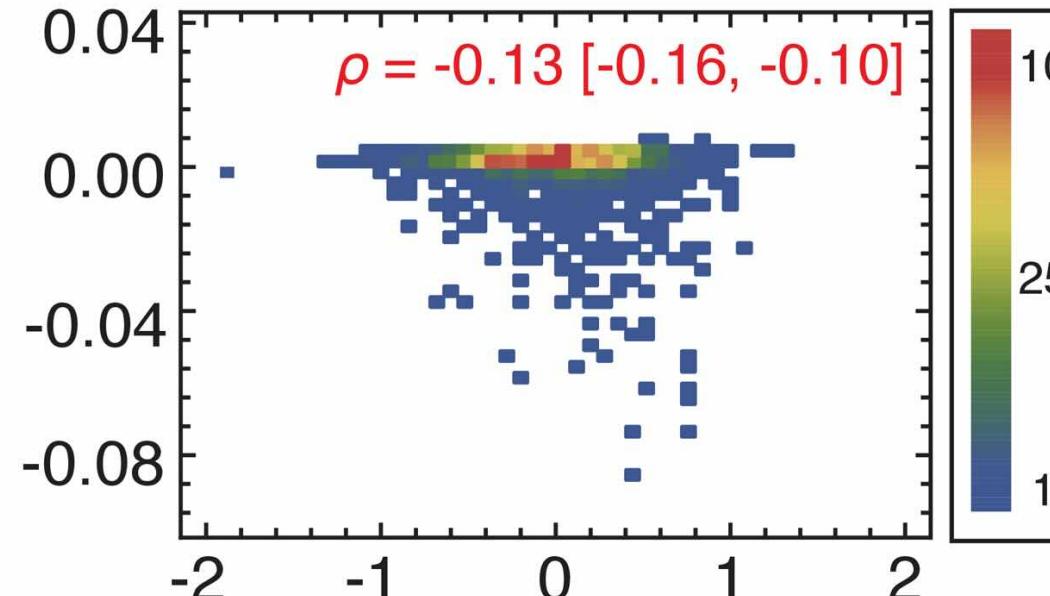
Female population



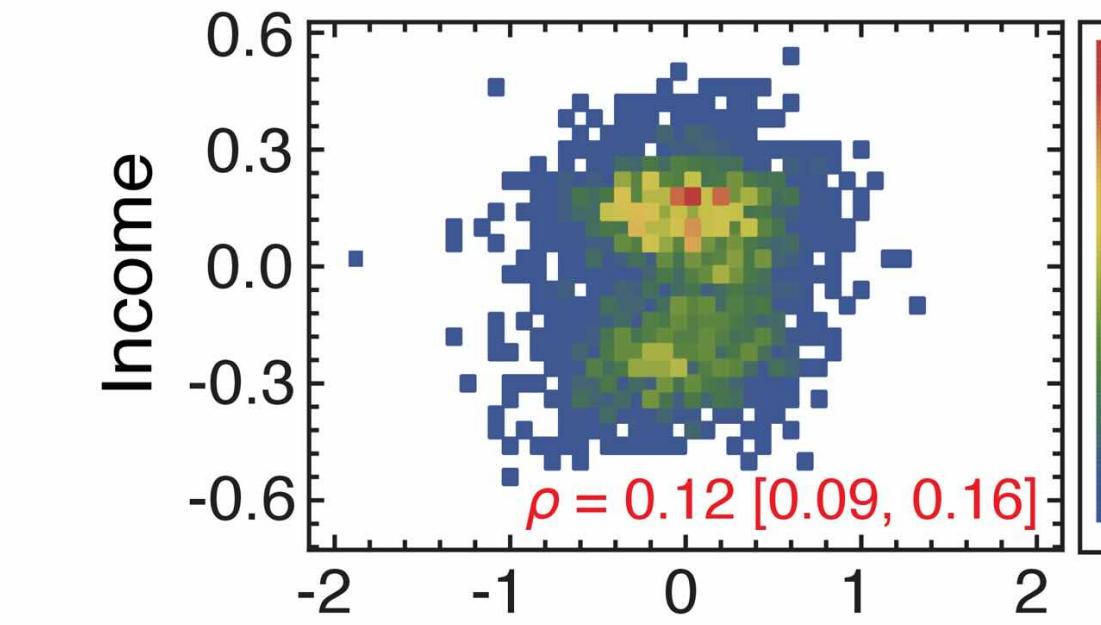
Illiteracy



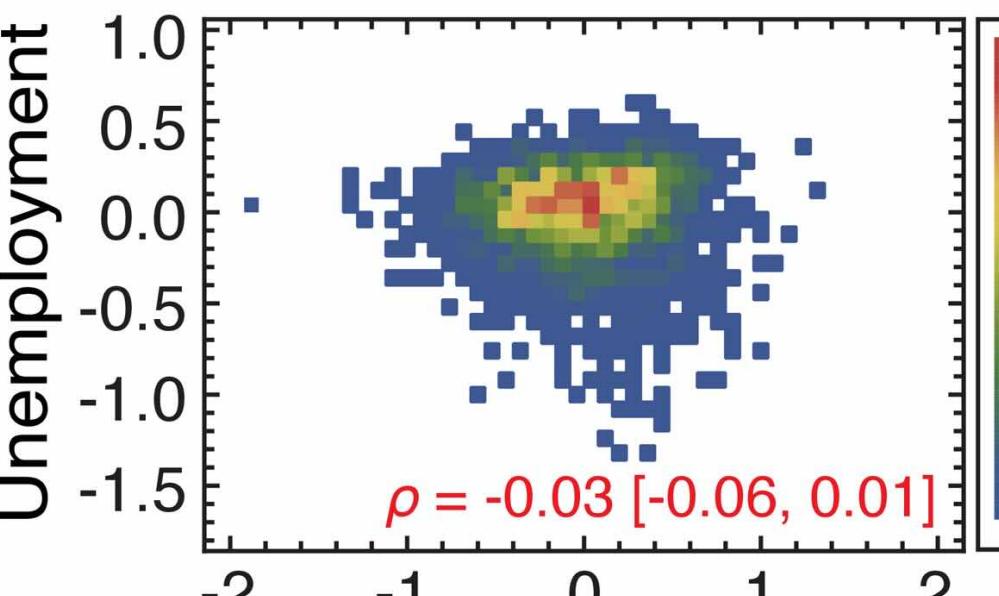
Sanitation



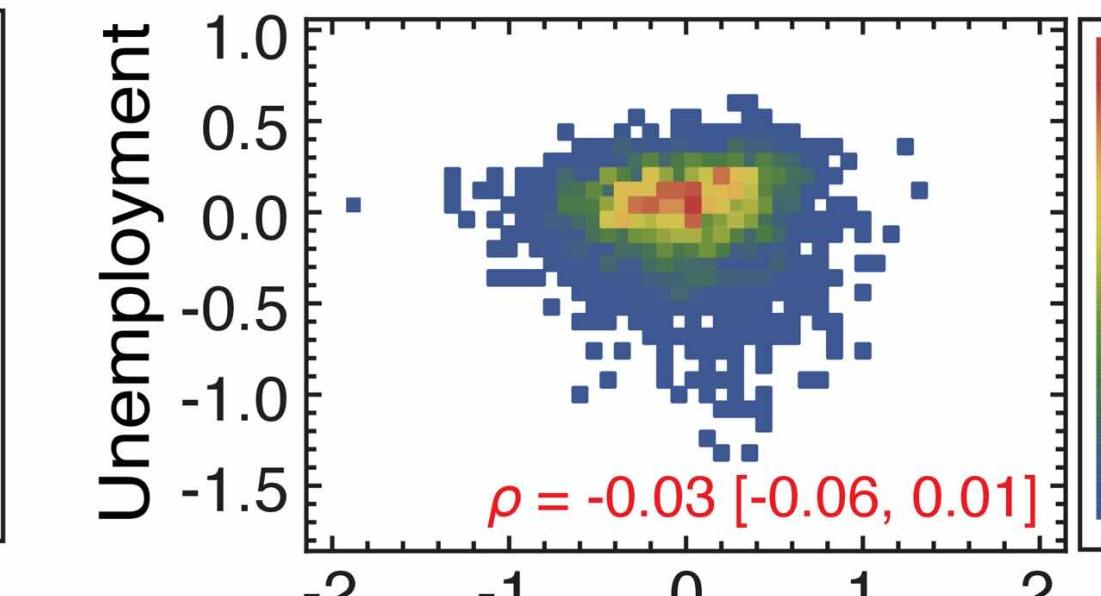
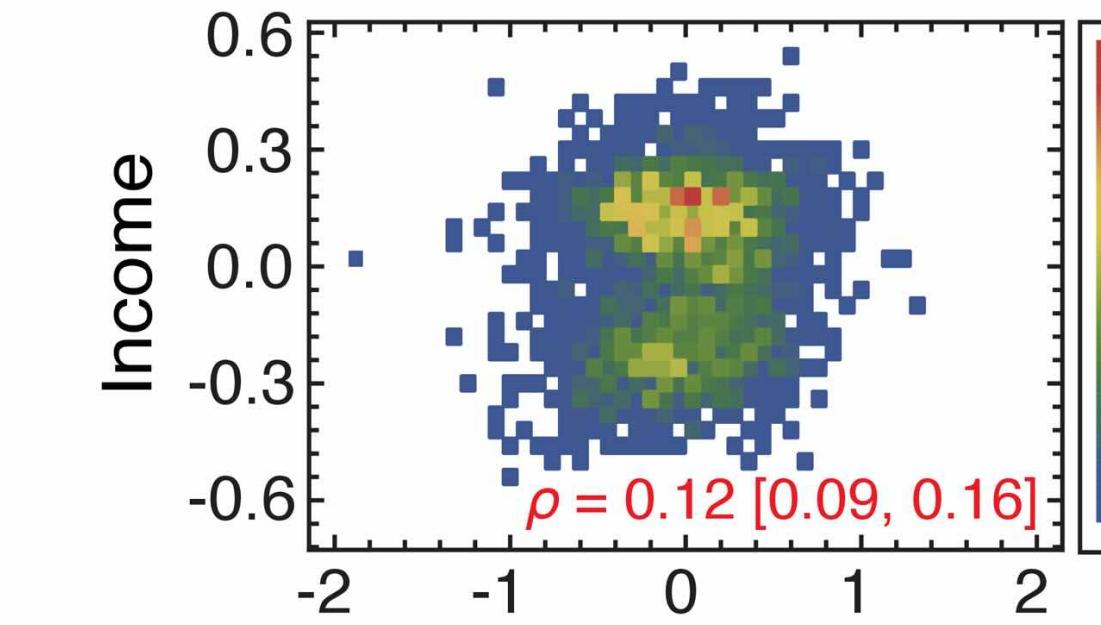
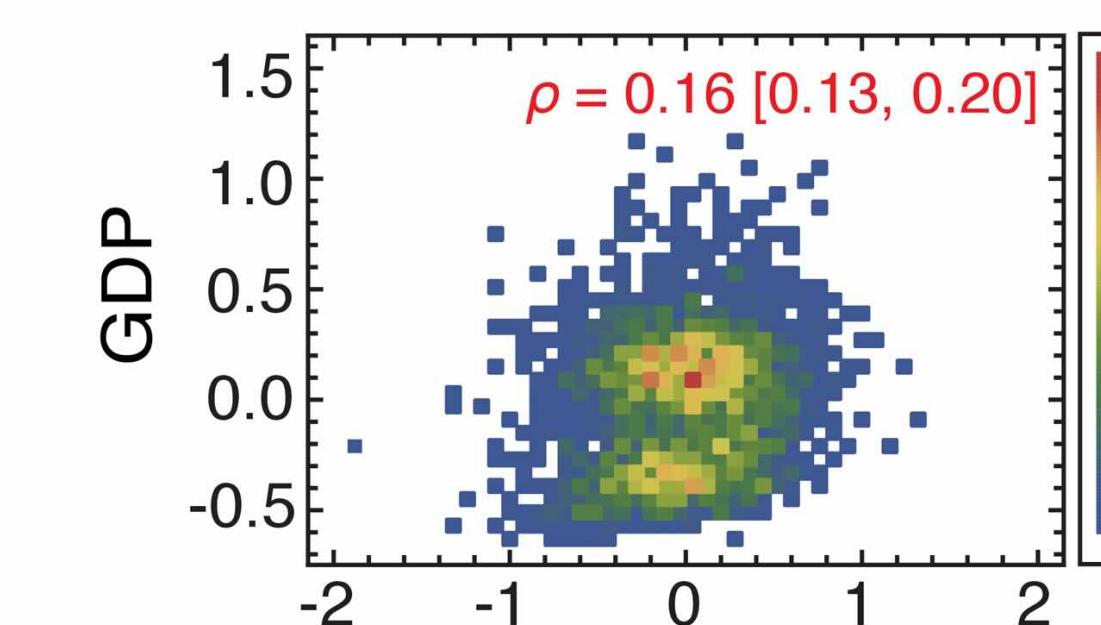
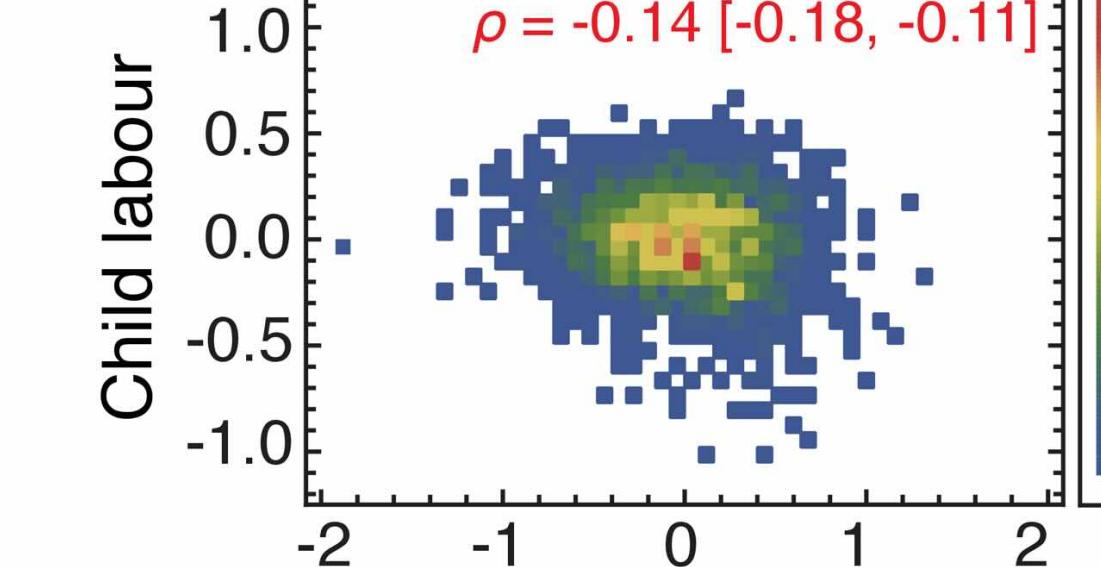
Income



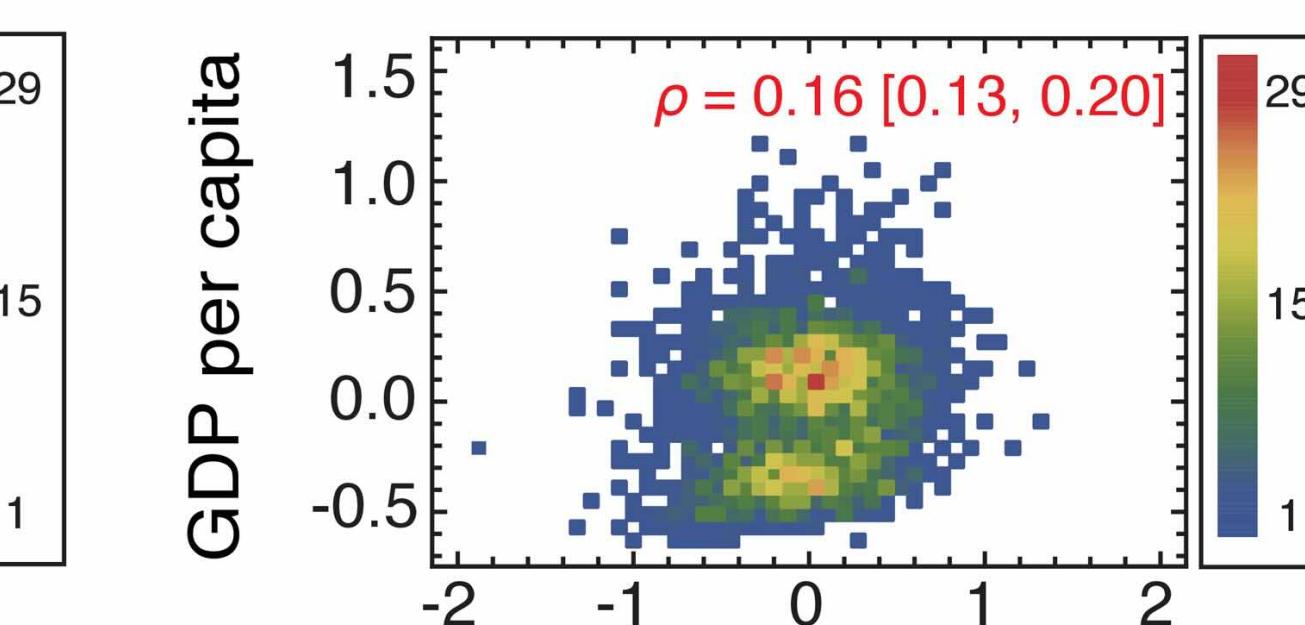
Unemployment



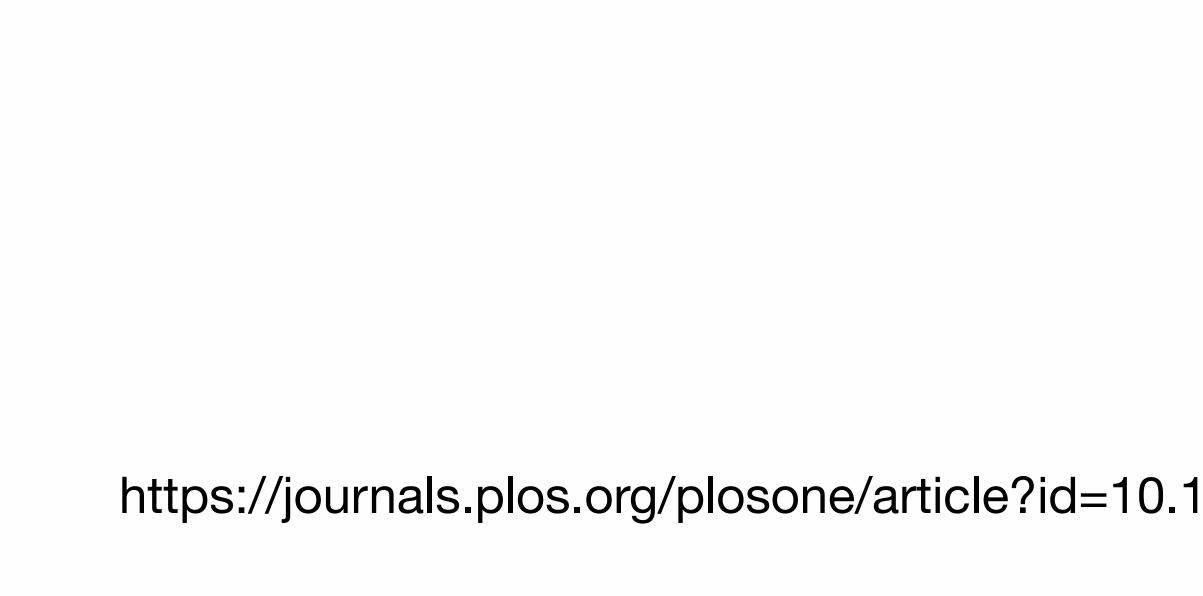
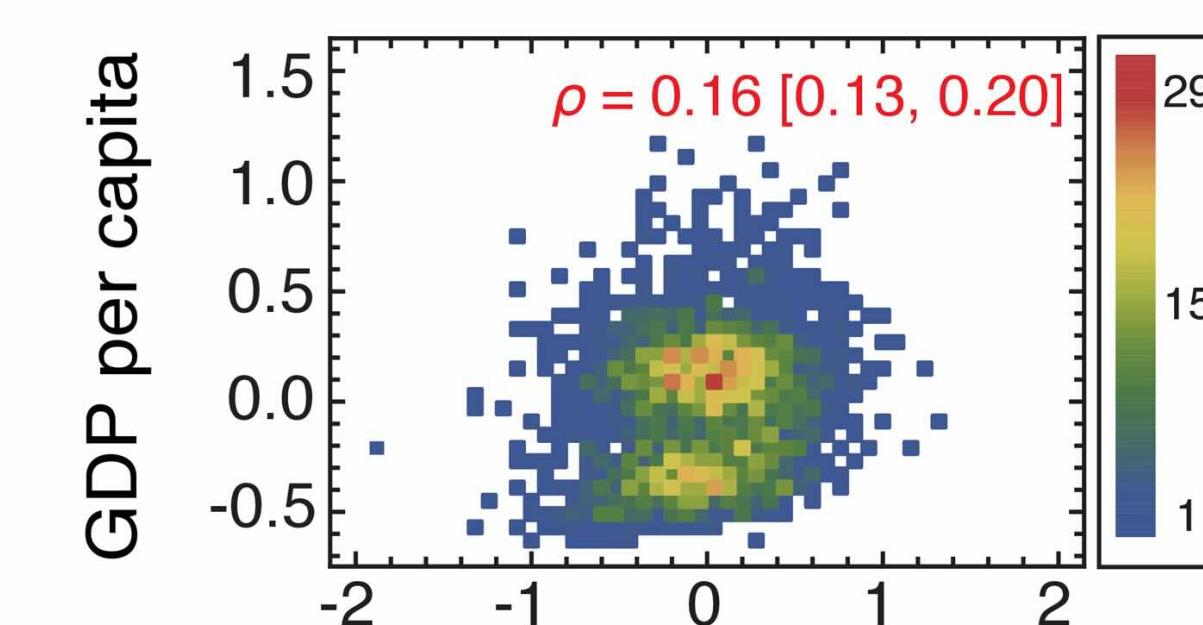
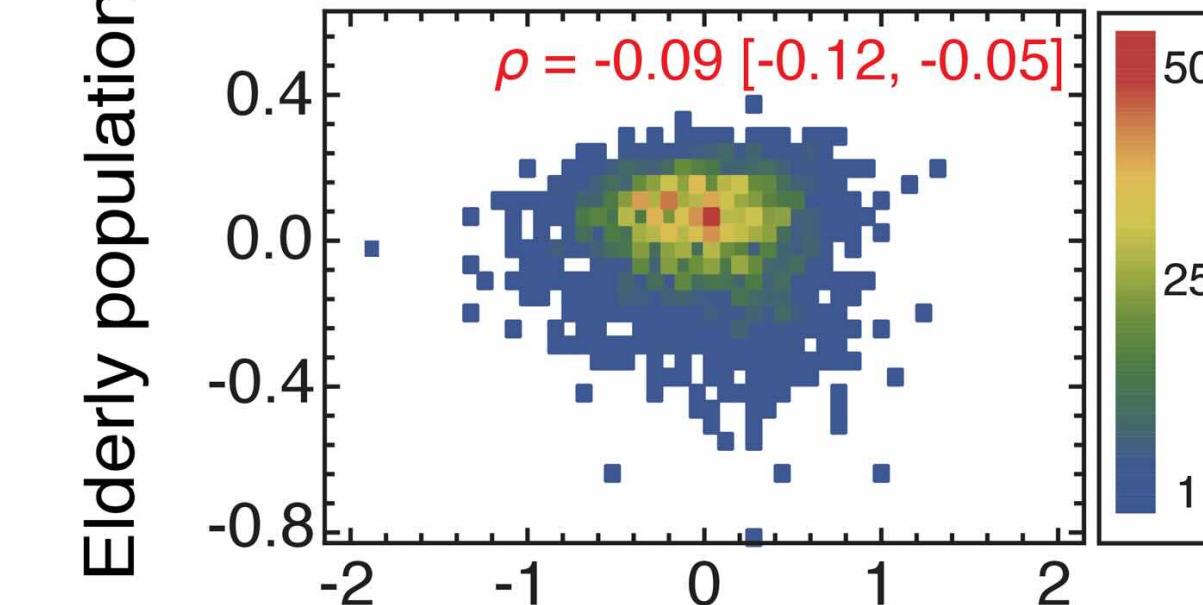
Distance ζ_{homicide}



Elderly population



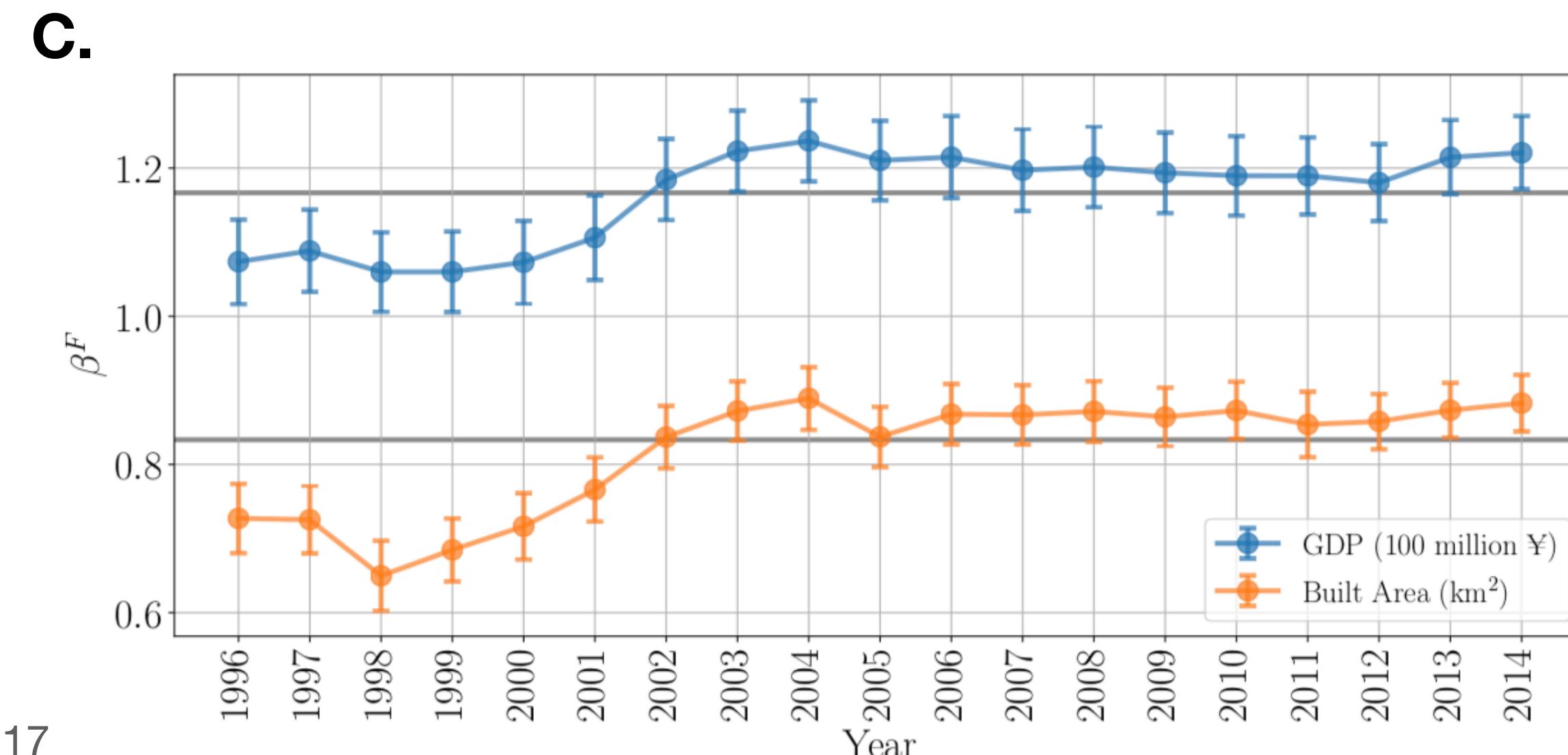
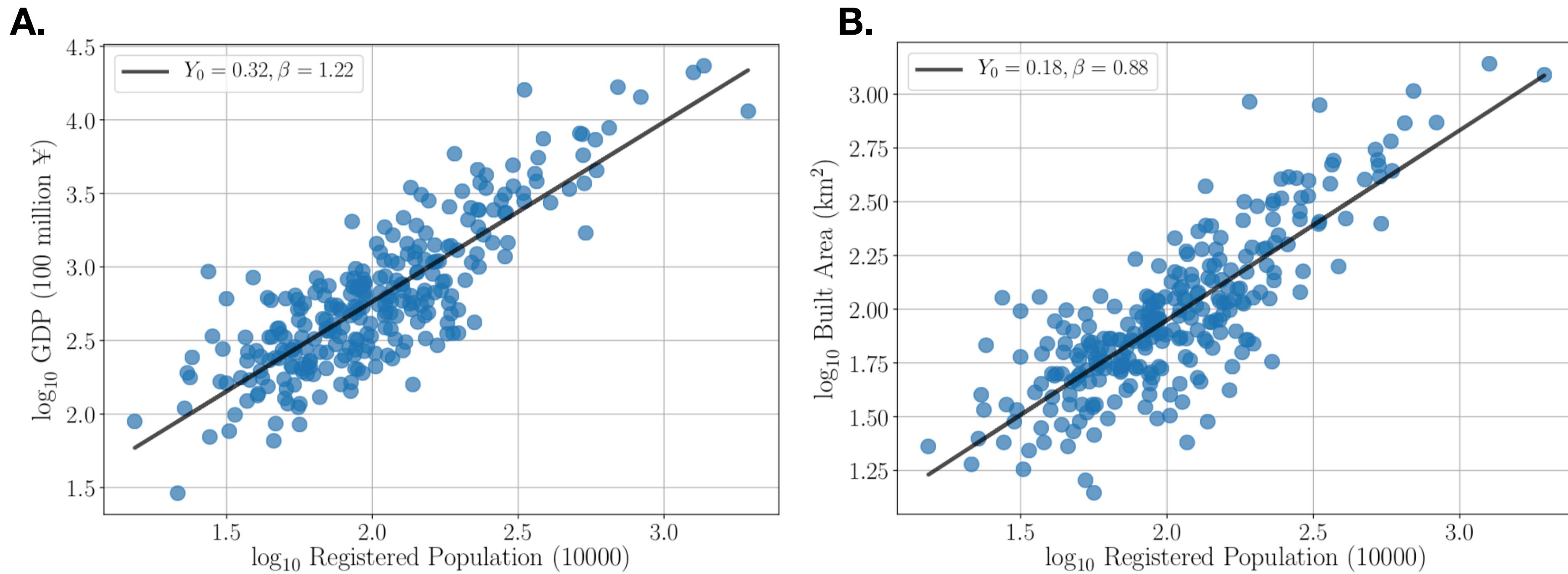
Male population

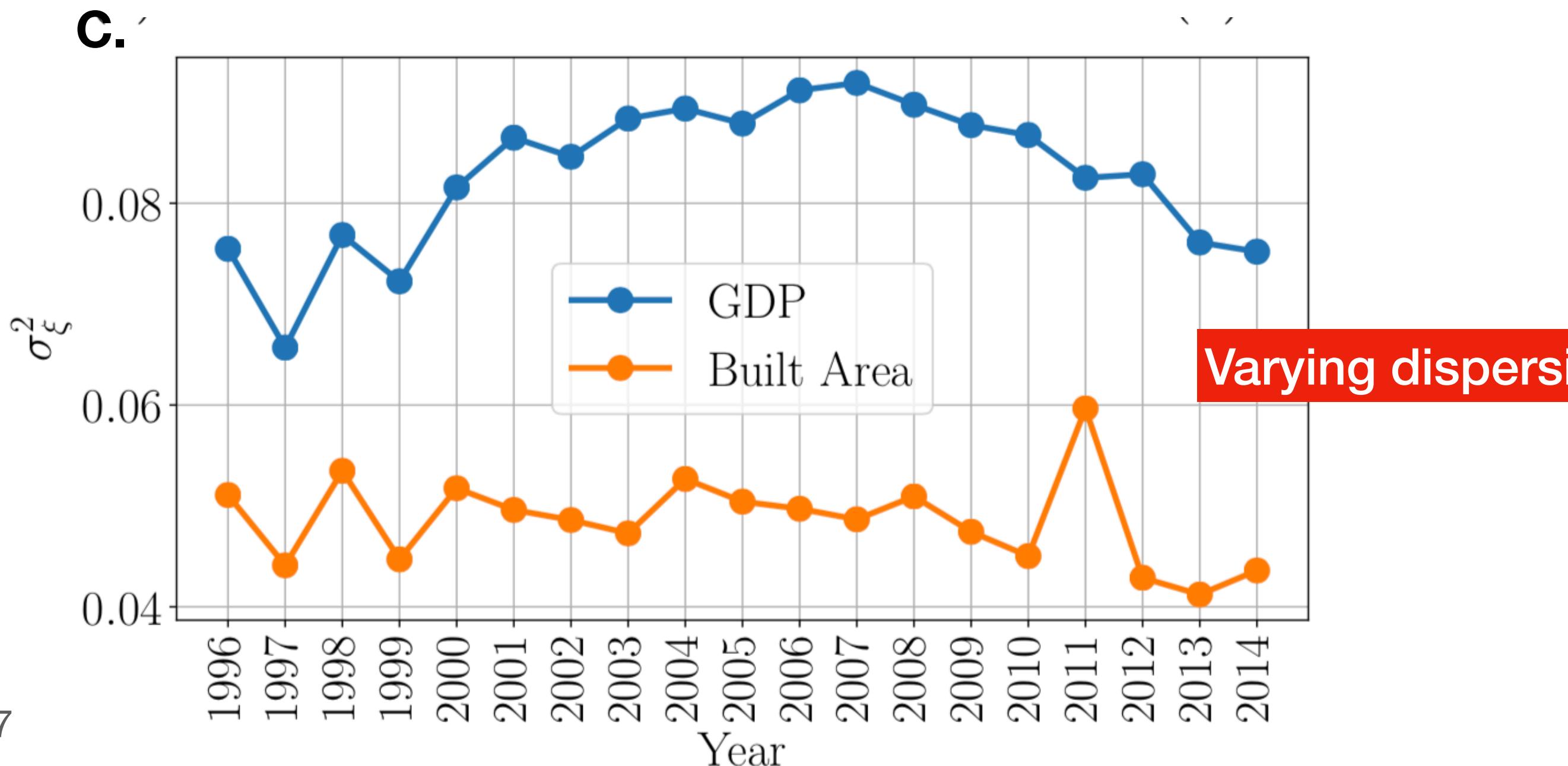
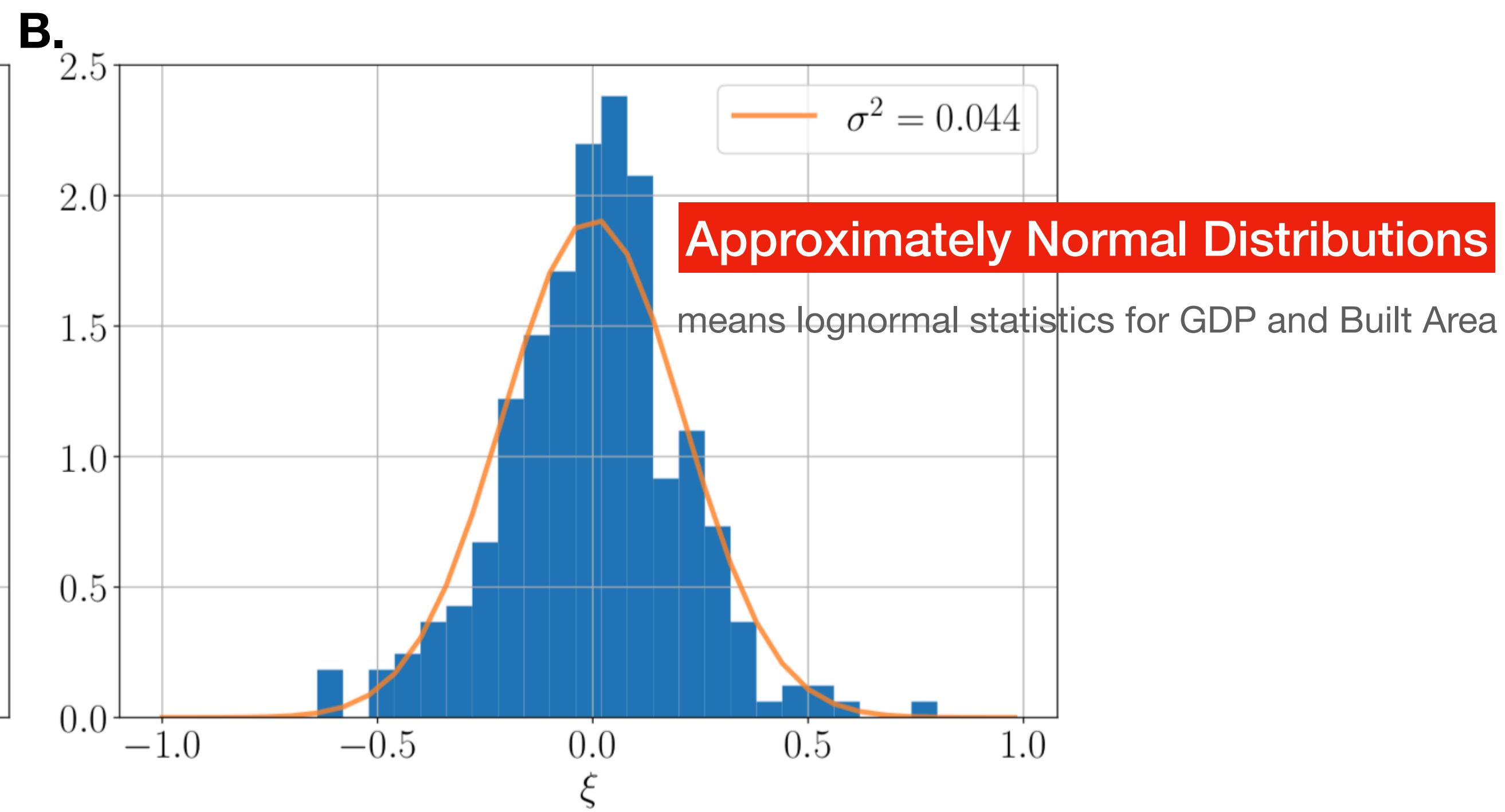
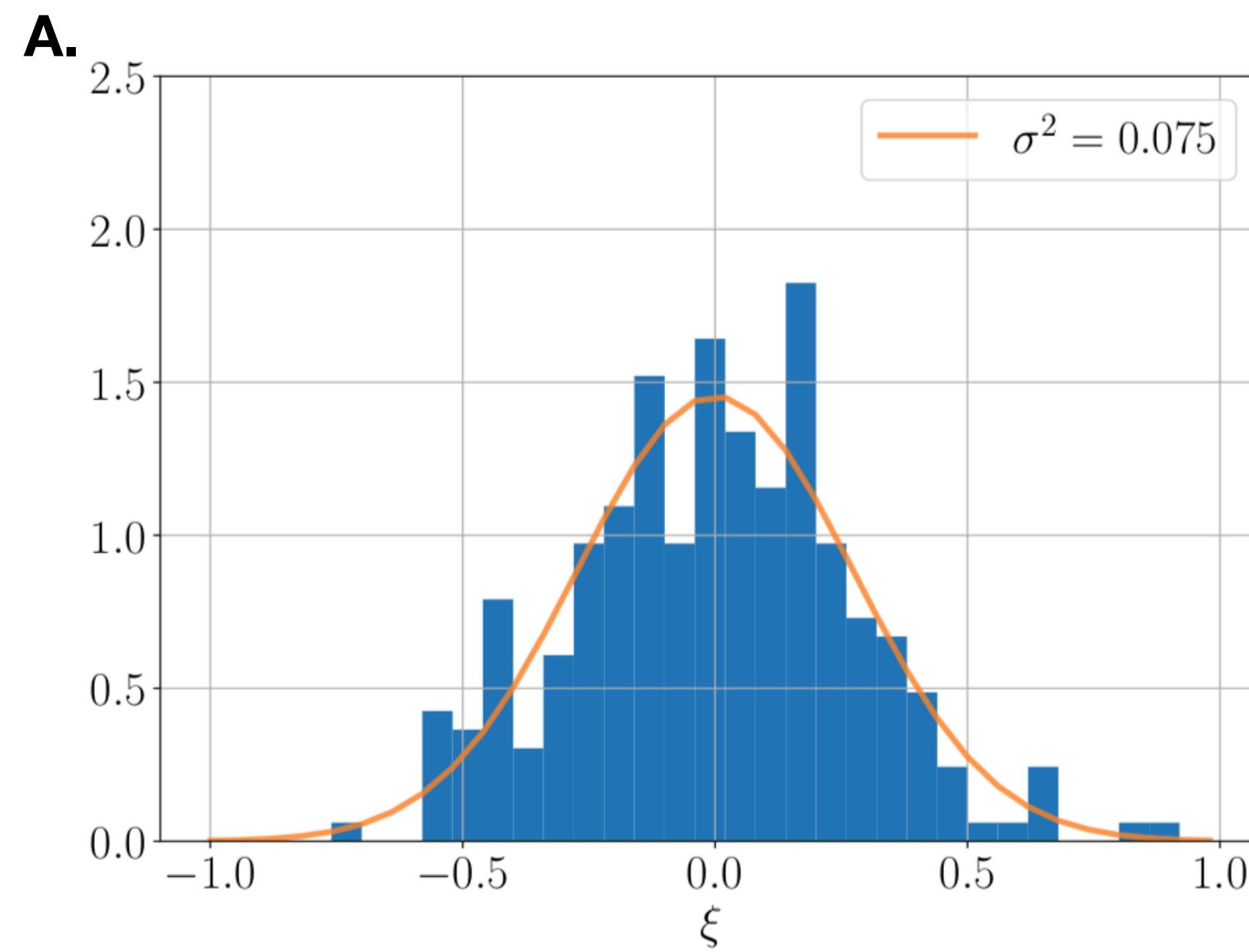


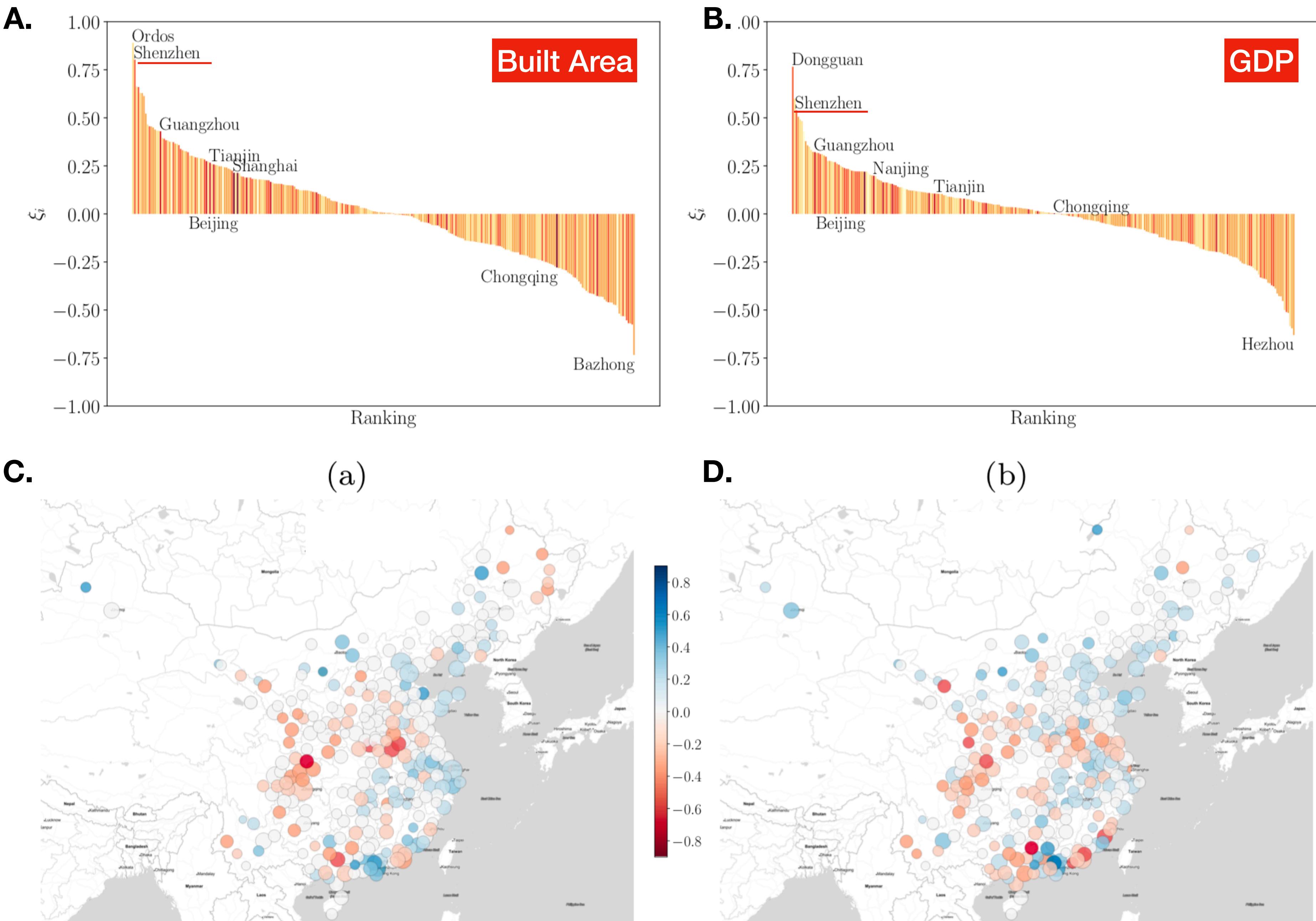
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0134862>

<http://dx.plos.org/10.1371/journal.pone.0069580>

Chinese Prefectural Cities







most built area per person



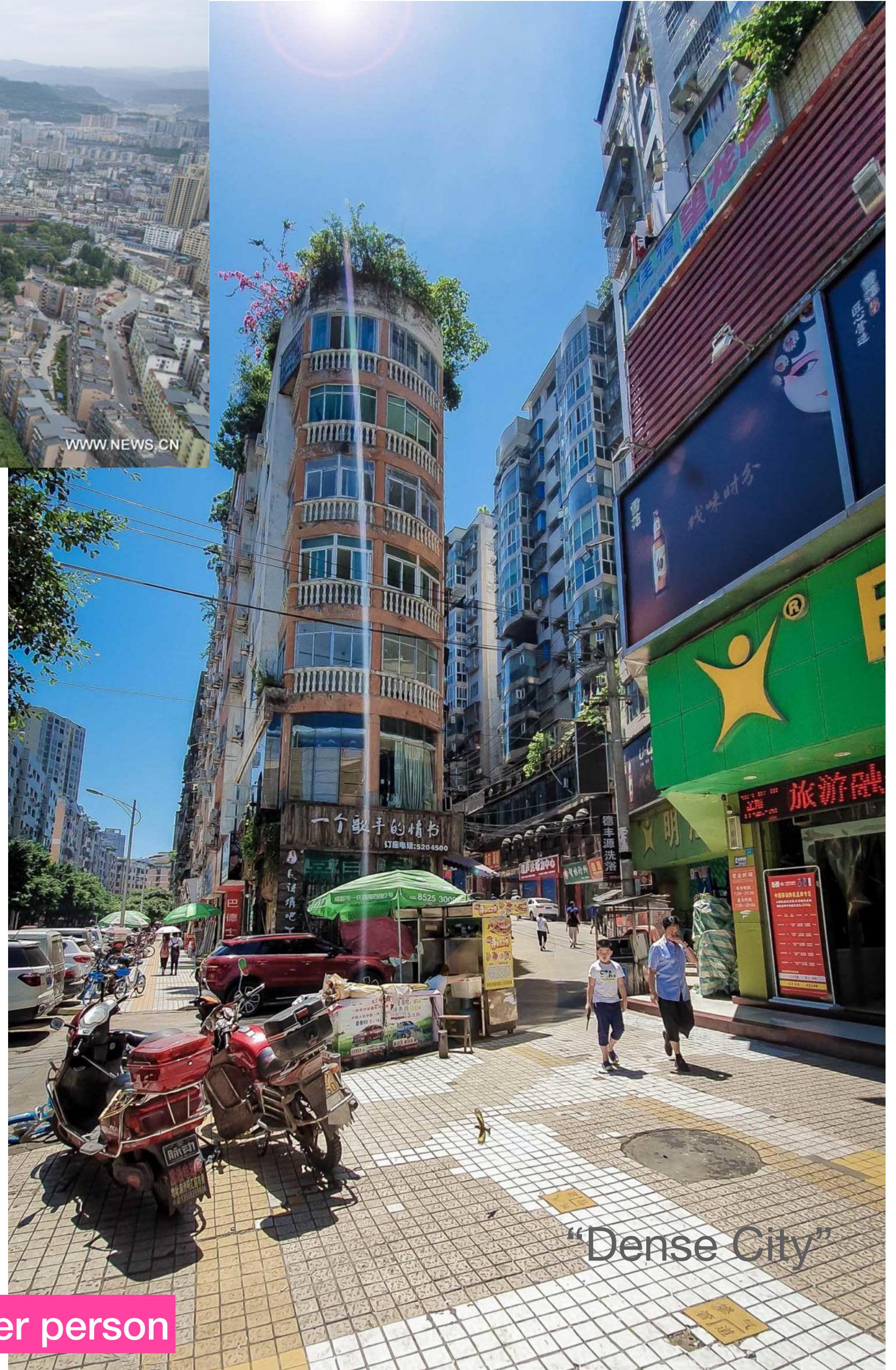
Ordos, Inner Mongolia

“Ghost City”

Bazhong, China



least built area per person



“Dense City”

highest GDP per person



Dongguan

lowest GDP per person



Hezhou

The Hukou System and Population Counts in Chinese Cities

JOURNAL OF
ECONOMIC
SURVEYS

ARTICLE |  Full Access

THE ERRONEOUS USE OF CHINA'S POPULATION AND *PER CAPITA* DATA: A STRUCTURED REVIEW AND CRITICAL TEST

John Gibson , Chao Li,

First published: 15 October 2016 | <https://doi.org/10.1111/joes.12178> | Citations: 14

[Go here for SFX](#)

 SECTIONS

 PDF  TOOLS  SHARE

Abstract

Hundreds of studies in economics misinterpret China's subnational population and *per capita* data. The most widely used population counts are of *hukou* registrations from each province, prefecture, county, or city rather than of the people living in each place and generating local gross domestic product. Over 220 million people have left their place of

China's radical plan to limit the populations of Beijing and Shanghai

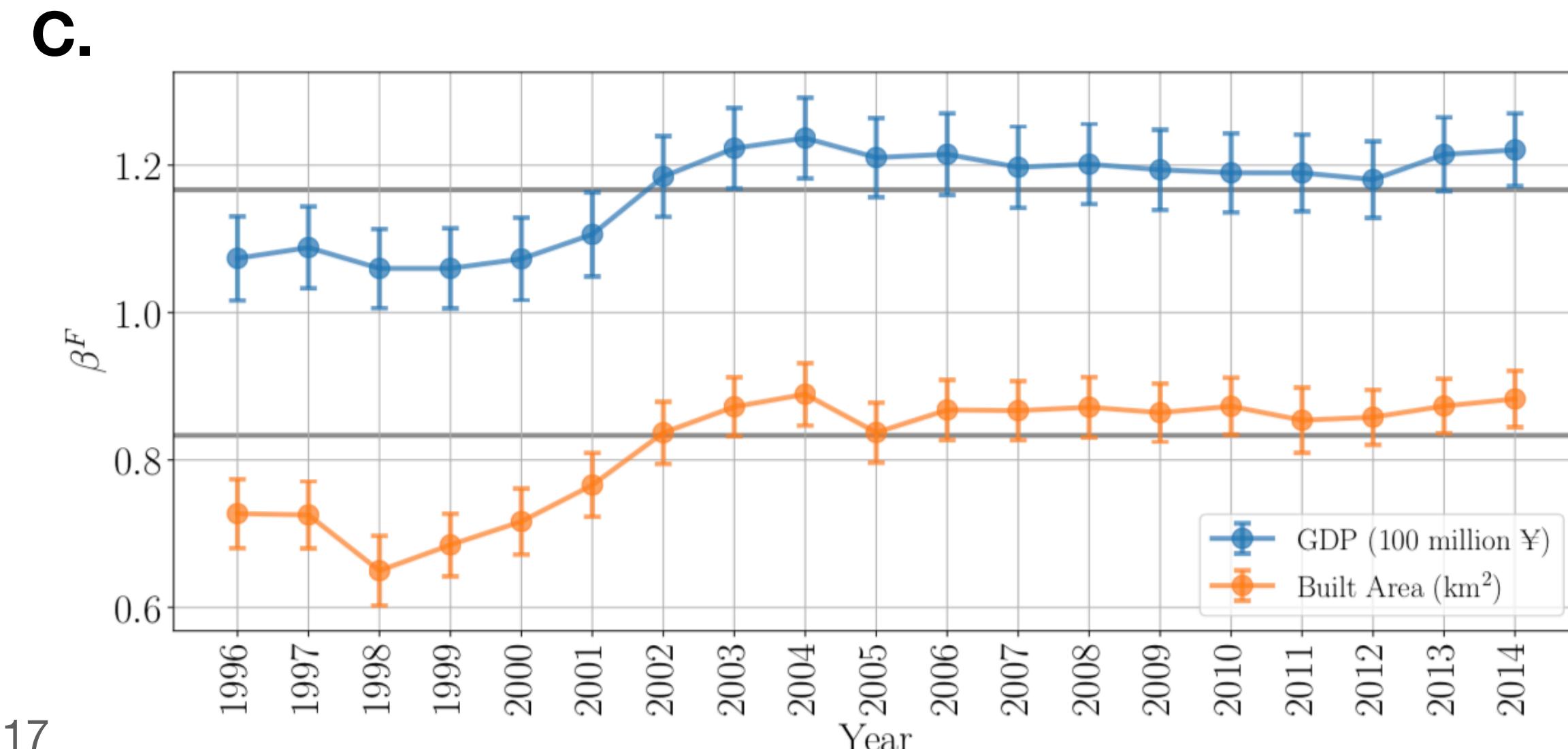
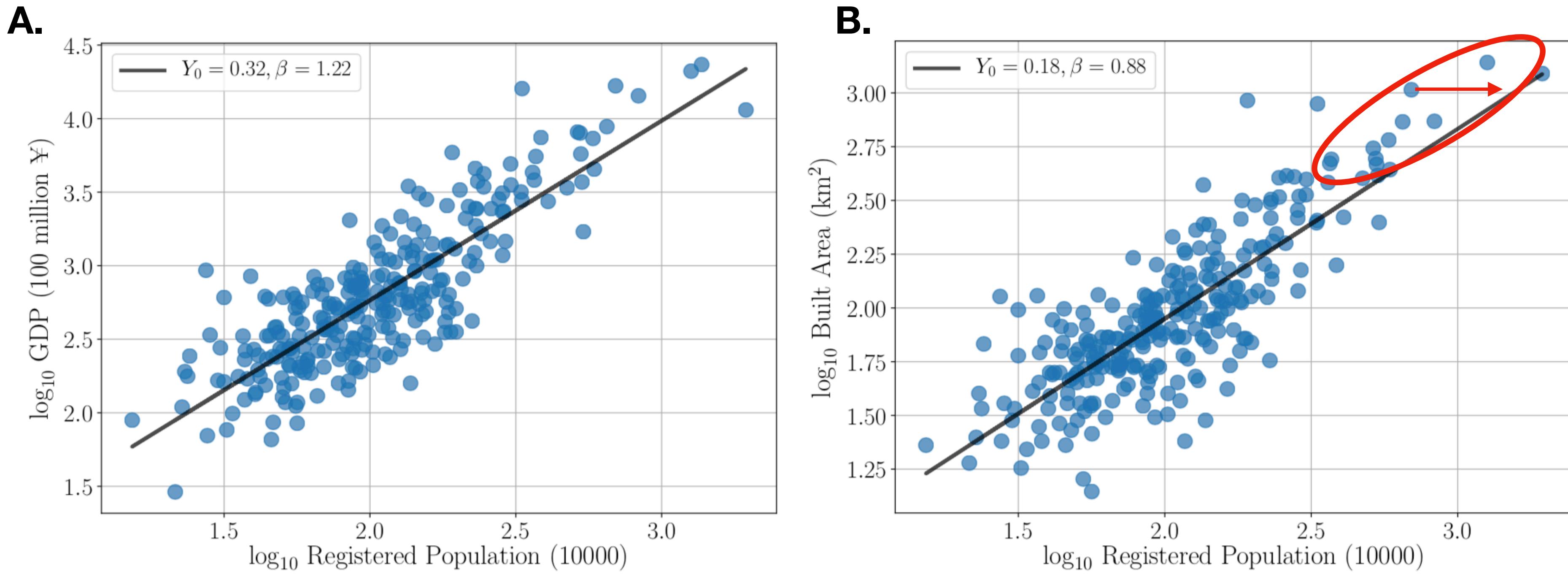


▲ 'Beautification' process ... Shanghai during the Chinese New Year holiday in February. Photograph: Imaginechina/REX/Shutterstock

Two Chinese megacities implemented population caps last year - and official data shows the policy might already be having an effect

Advertisement

Chinese Prefectural Cities



Estimates of actual populations from theory

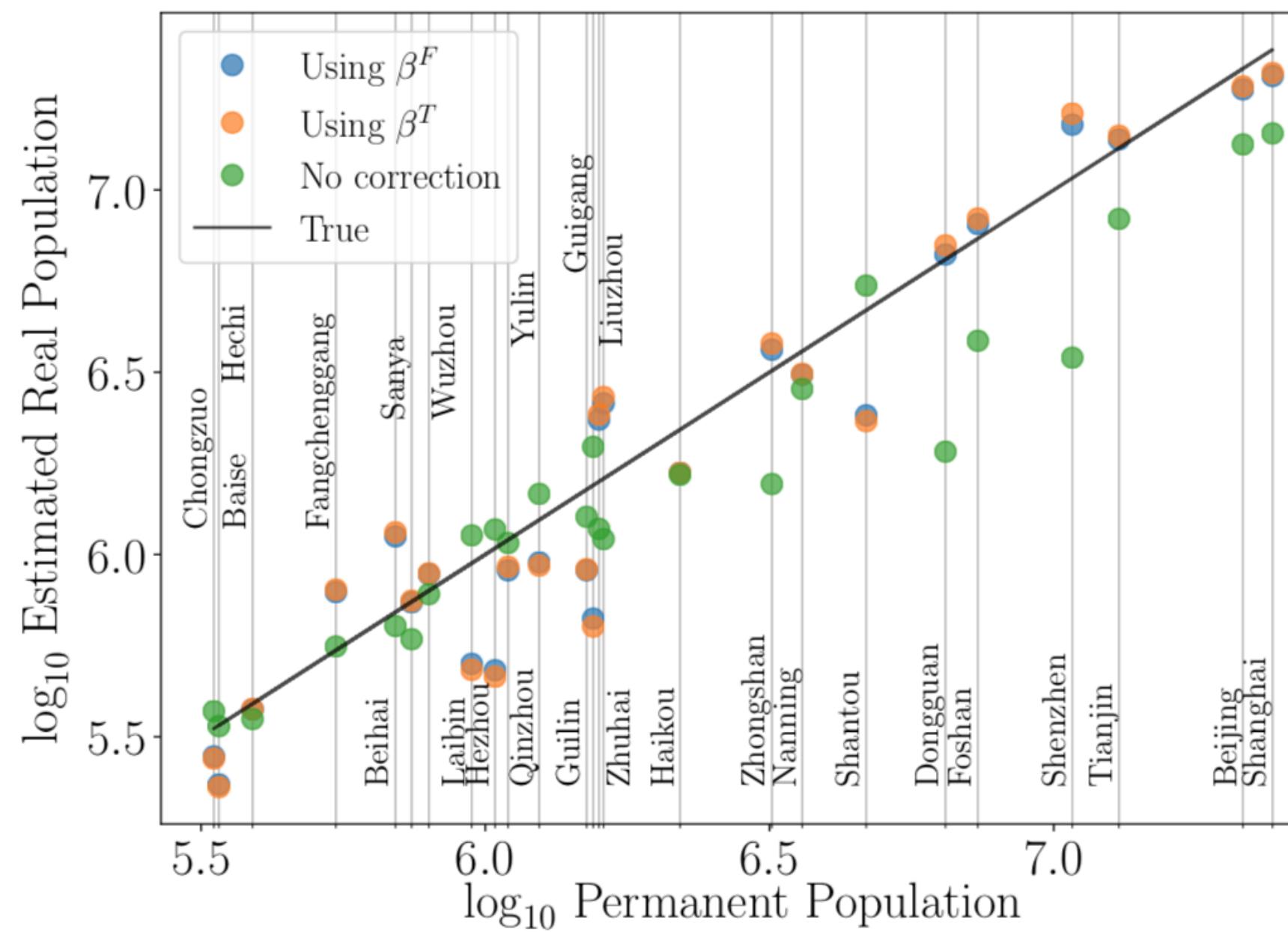
City	Resident Population	Hukou Population	Estimate β^F	Estimate β^T
Shanghai	24.26	14.29	20.54	20.93
Beijing	21.56	13.33	18.88	19.24
Tianjin	13.02	8.33	13.76	14.09
Guangzhou	11.17*	6.95	15.64	16.24
Shenzhen	10.78	3.47	15.10	16.20
Foshan	7.35	3.86	8.06	8.35
Dongguan	6.45	1.91	6.65	7.05
Shantou	4.68	5.47	2.41	2.32
Nanning	3.61	2.84	3.12	3.13
Zhongshan	3.19	1.56	3.65	3.79
Haikou	2.20	1.65	1.67	1.68
Zhuhai	1.61	1.10	2.60	2.70
Liuzhou	1.58	1.18	2.34	2.42
Guigang	1.55	1.97	0.67	0.63
Guilin	1.51	1.27	0.90	0.91
Qinzhou	1.24	1.47	0.95	0.93
Yulin	1.10	1.08	0.90	0.93
Hezhou	1.04	1.17	0.48	0.46
Laibin	0.95	1.13	0.50	0.48
Wuzhou	0.80	0.78	0.88	0.89
Sanya	0.74	0.59	0.74	0.75
Beihai	0.69	0.64	1.12	1.15
Fangchenggang	0.55	0.57	0.79	0.80
Baise	0.39	0.35	0.38	0.38
Hechi	0.34	0.34	0.23	0.23
Chongzuo	0.33	0.37	0.28	0.28

*Source: Guangzhou International.

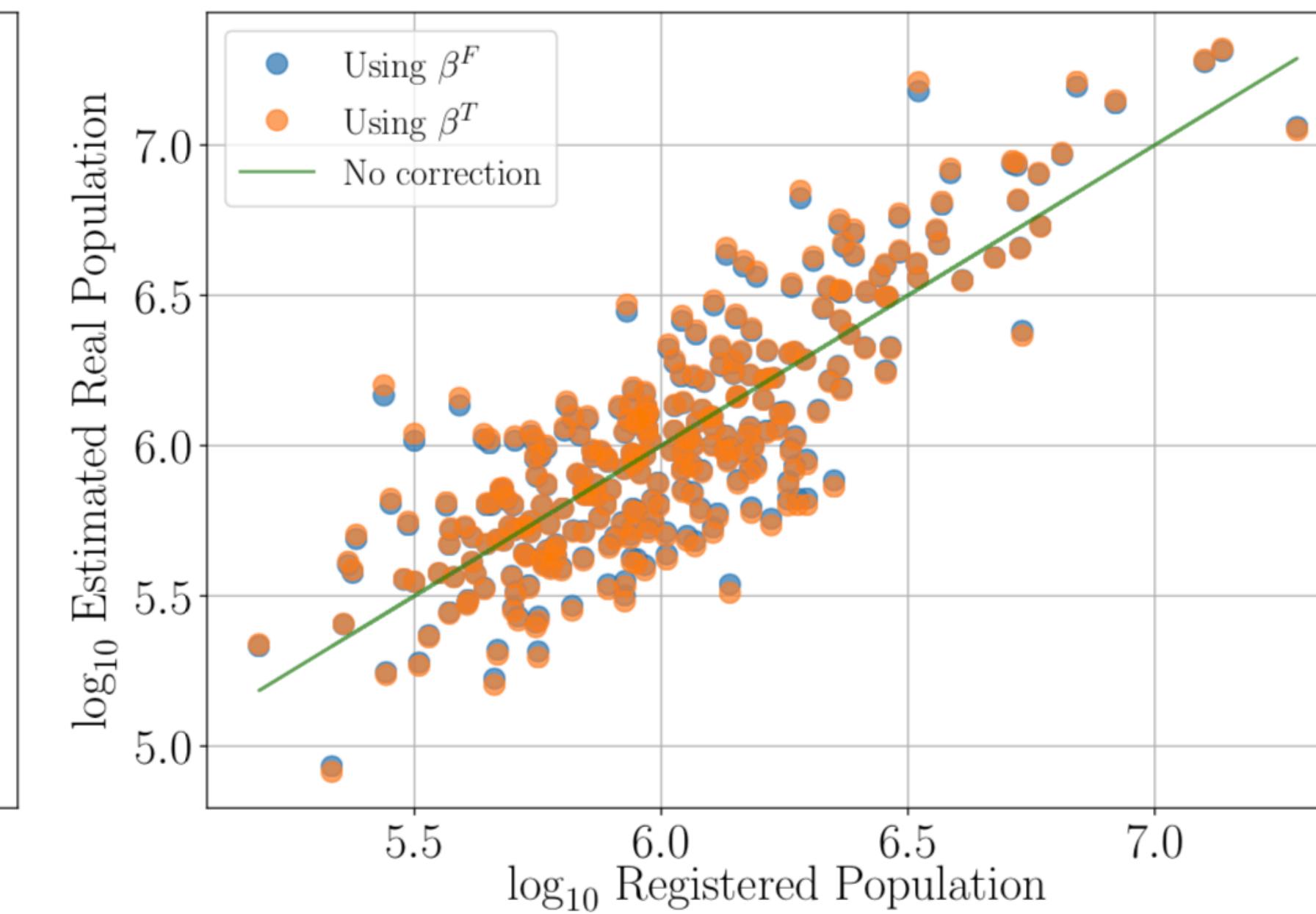
We can also use scaling relations as theory that helps us correct biased statistics

The actual population of large cities in China

A.



B.



So we can start to peel the onion, layer after layer of the structure of cities

From how cities work in general as networks (scaling) to the local flavor of each place (residuals)

From a general theory, to (additional!) more local theories

There will be some general aspects of diversity and inequality in cities, and some particulars and so on...