



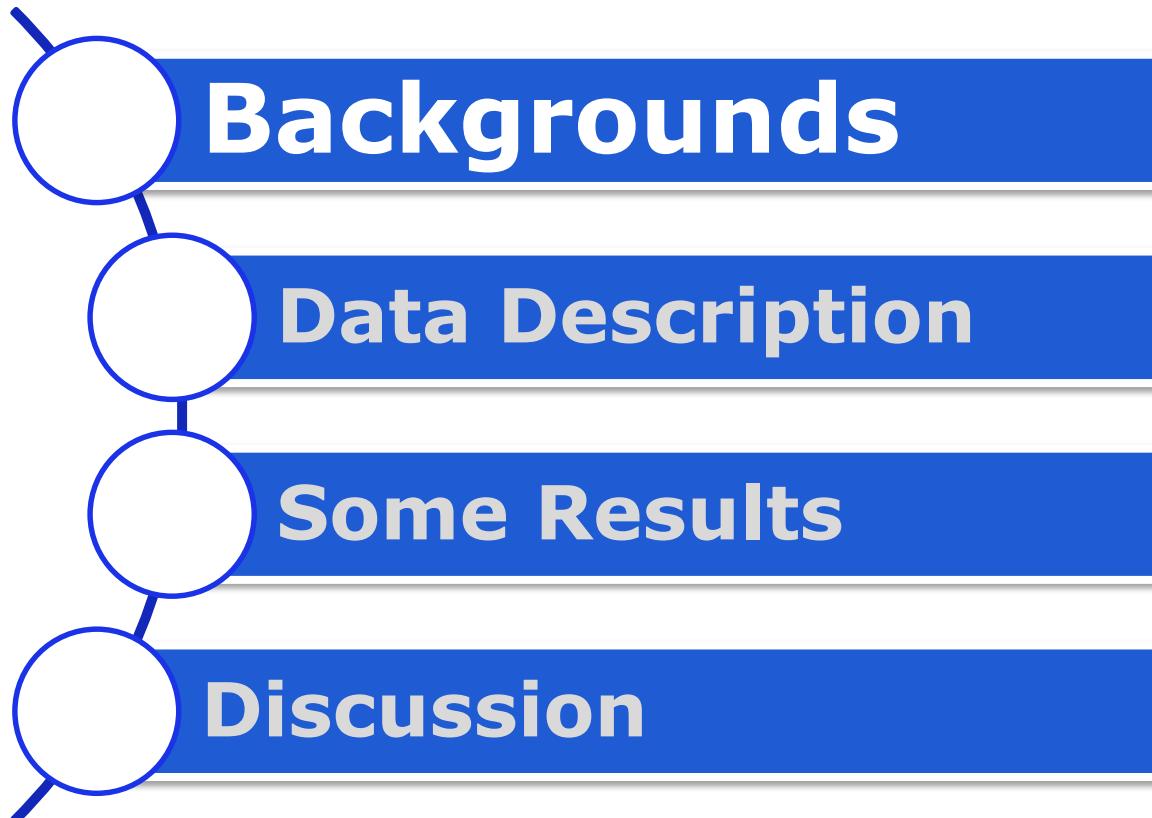
# Linking Companies and Economic Complexity

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Complex Lab, Web Sciences Center, UESTC

June 27, 2015



# Backgrounds

The World is....

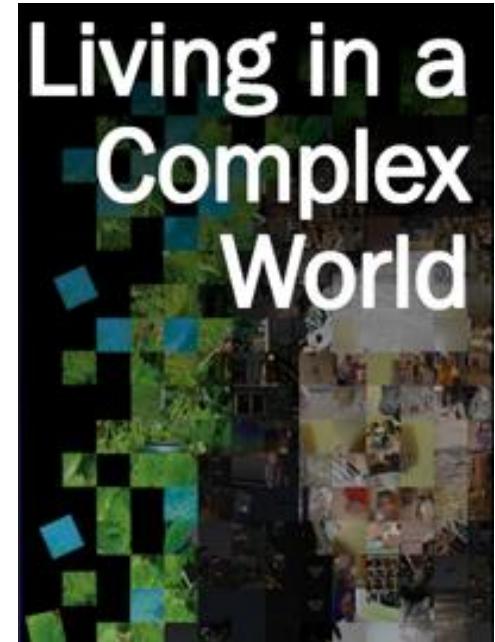
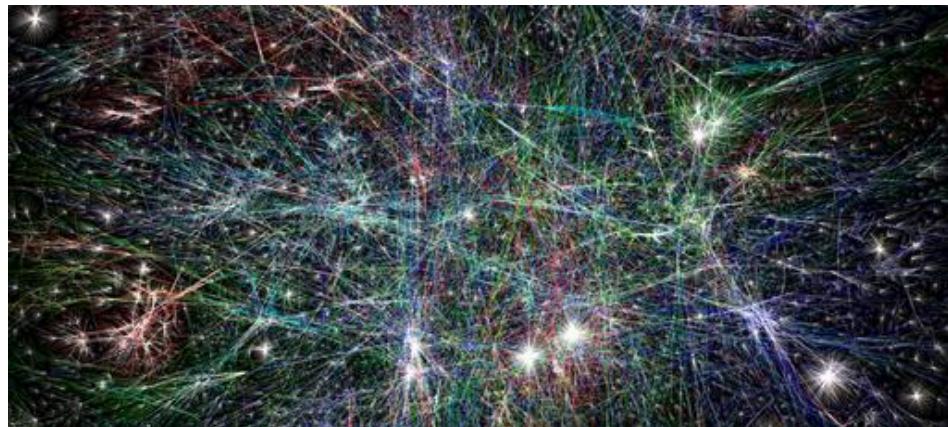
# Diverse



# Backgrounds

The World is also....

Complex



# Backgrounds

**Traditional macroeconomic theory has tended to assume away both Diverse and Complex.**



# Data Driven

# Network Science

# Backgrounds

## The Product Space Conditions the Development of Nations

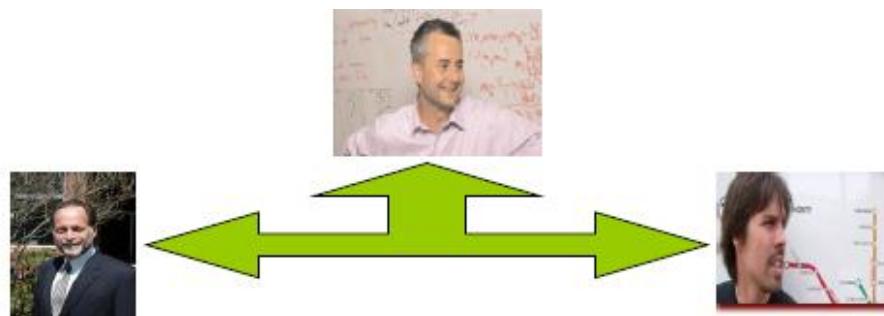
C. A. Hidalgo,<sup>1,\*†</sup> B. Klinger,<sup>2,\*</sup> A.-L. Barabási,<sup>1</sup> R. Hausmann<sup>2</sup>



Economies grow by upgrading the products they produce and export. The technology, capital, institutions, and skills needed to make newer products are more easily adapted from some products than from others. Here, we study this network of relatedness between products, or “product space,” finding that more-sophisticated products are located in a densely connected core whereas less-sophisticated products occupy a less-connected periphery. Empirically, countries move through the product space by developing goods close to those they currently produce. Most countries can reach the core only by traversing empirically infrequent distances, which may help explain why poor countries have trouble developing more competitive exports and fail to converge to the income levels of rich countries.

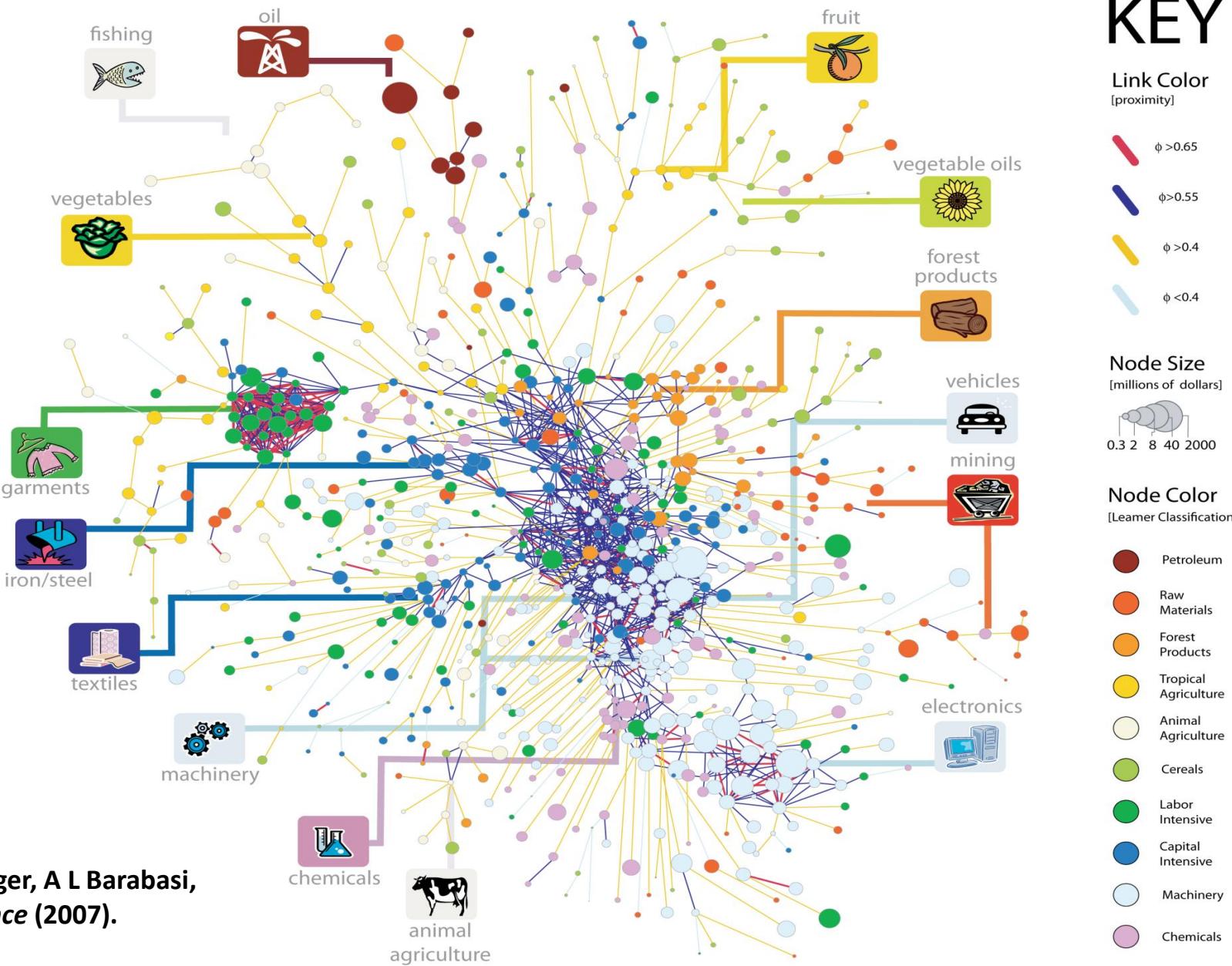
1 Center for Complex Network Research and Department of Physics, University of Notre Dame, Notre Dame, IN 46556, USA.

2 Center for International Development, Kennedy School of Government, Harvard University, Cambridge, MA 02139, USA.



# Backgrounds

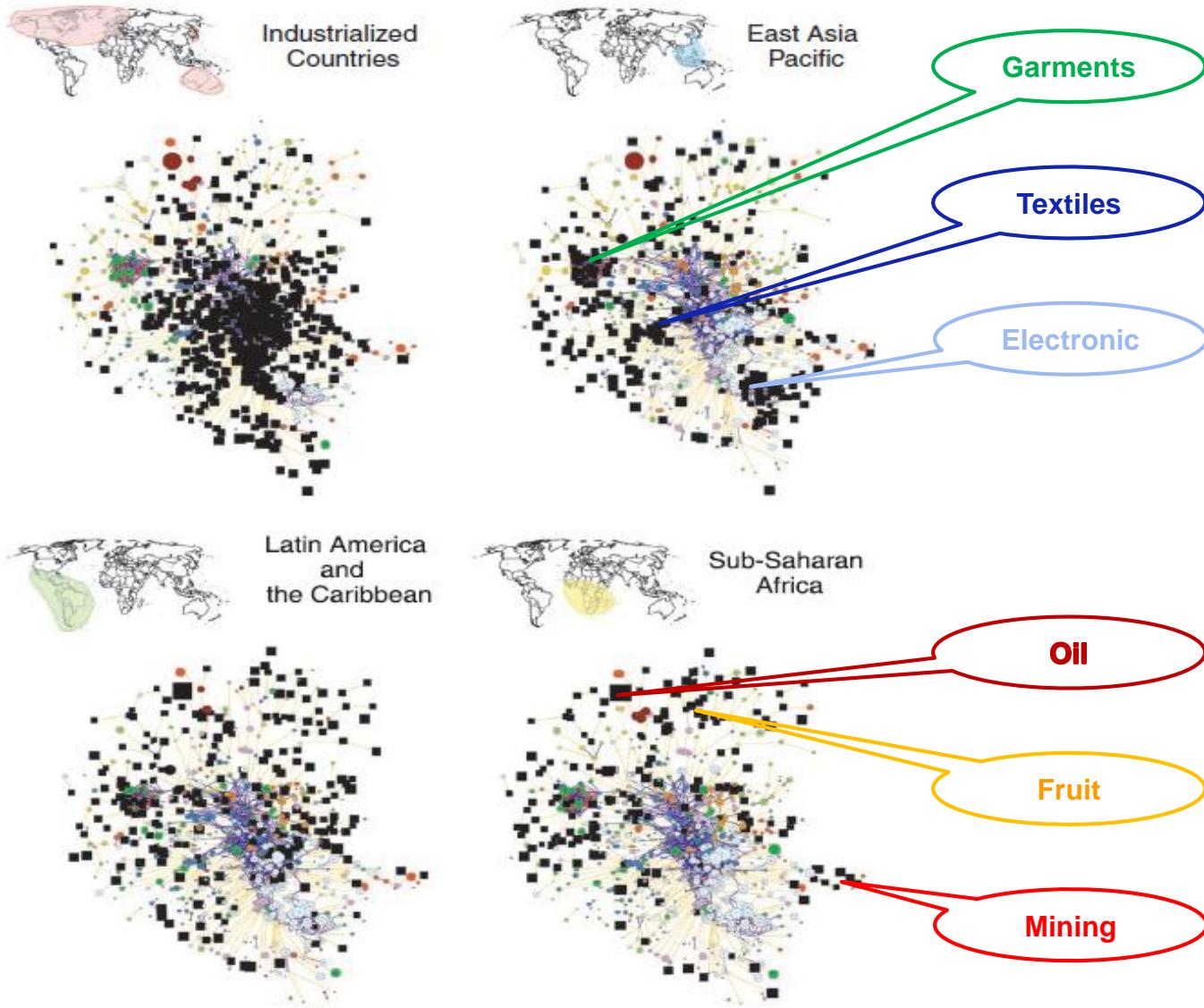
## Network Representation of the “Product Space”



C A Hidalgo, B Klinger, A L Barabasi,  
R Hausmann. *Science* (2007).

# Backgrounds

## Localization of the Productive Structure



# Backgrounds

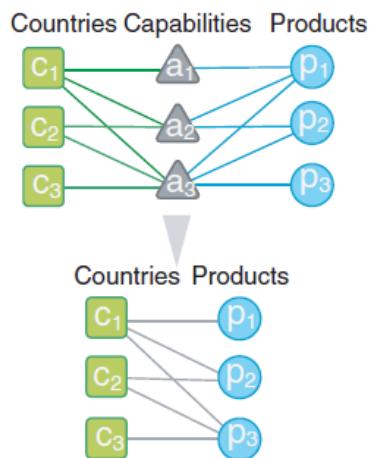
## The building blocks of economic complexity

César A. Hidalgo<sup>1</sup> and Ricardo Hausmann

Center for International Development and Harvard Kennedy School, Harvard University, Cambridge, MA 02138

Edited by Partha Sarathi Dasgupta, University of Cambridge, Cambridge, United Kingdom, and approved May 1, 2009 (receive

For Adam Smith, wealth was related to the division of labor. As people and firms specialize in different activities, economic efficiency increases, suggesting that development is associated with an increase in the number of individual activities and with the complexity that emerges from the interactions between them. Here we develop a view of economic growth and development



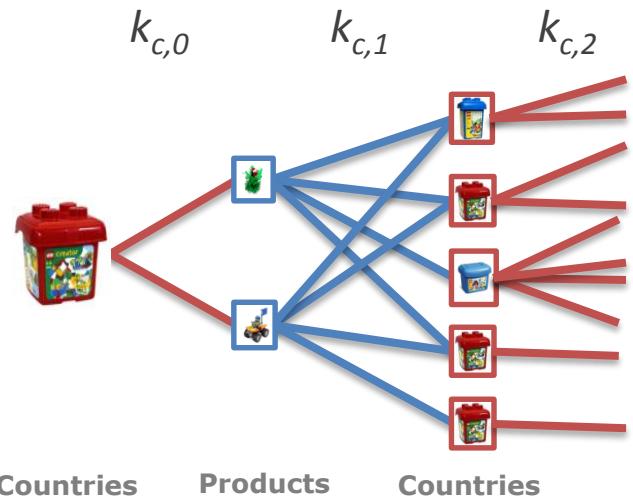
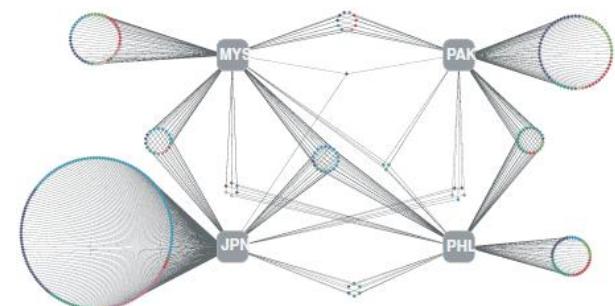
### Bipartite Network

$$k_{c,0} = \sum_p M_{cp}$$

$$k_{p,0} = \sum_c M_{cp}$$

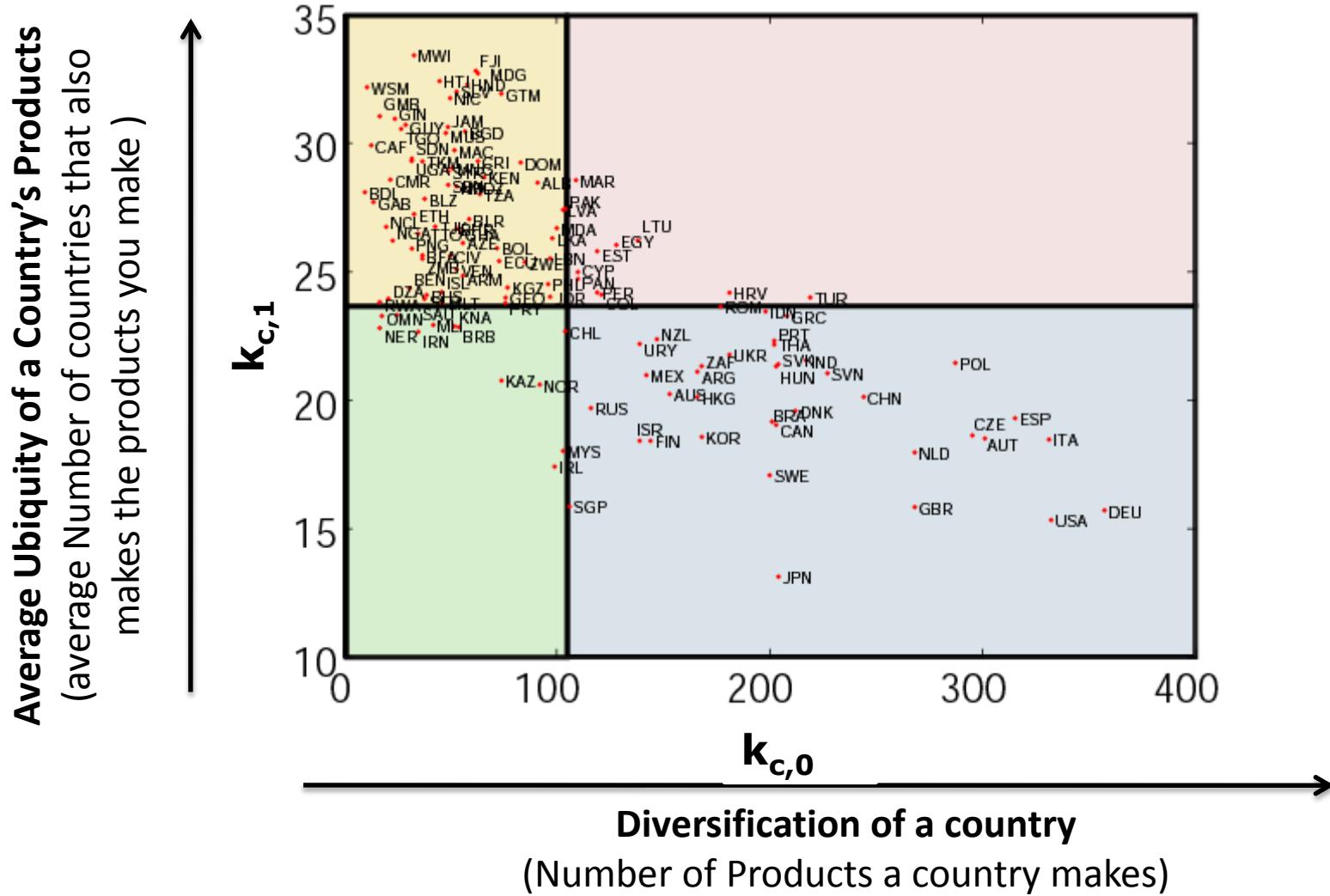
$$k_{c,n} = \frac{1}{k_{c,0}} \sum_p M_{cp} k_{p,n-1}$$

$$k_{p,n} = \frac{1}{k_{p,0}} \sum_c M_{cp} k_{c,n-1}$$

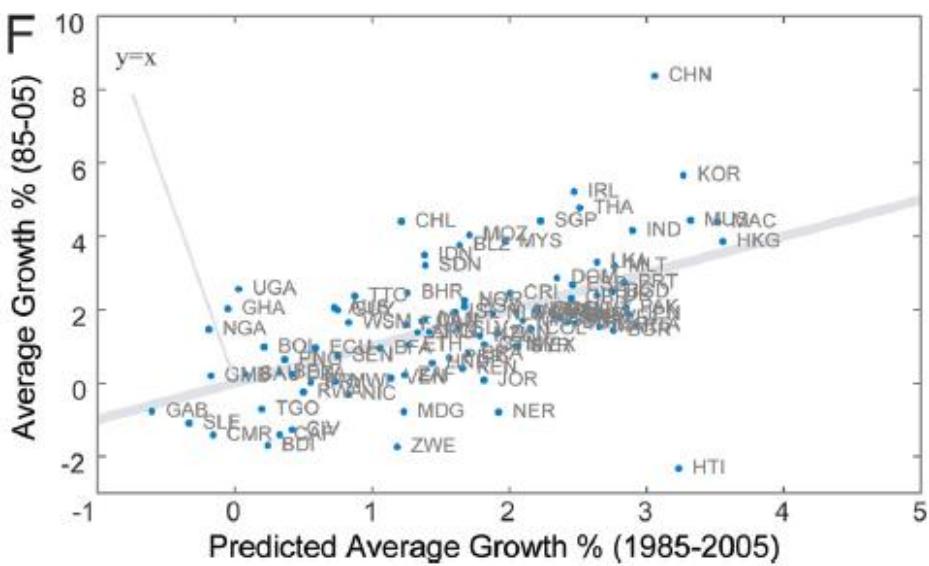
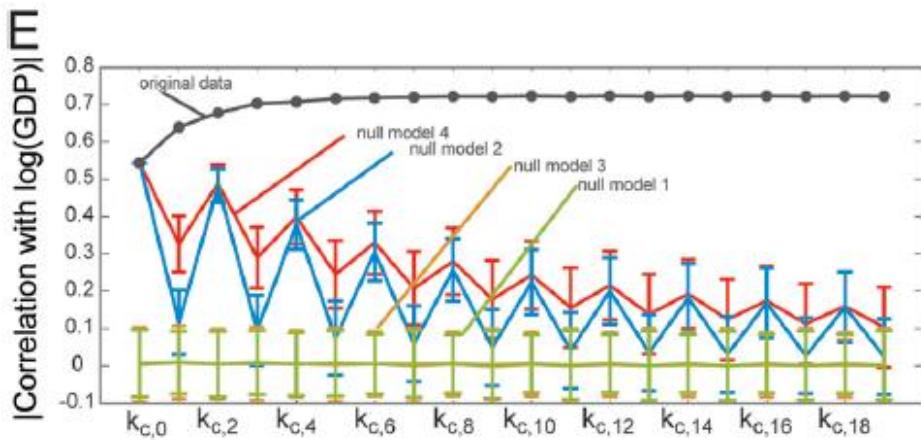
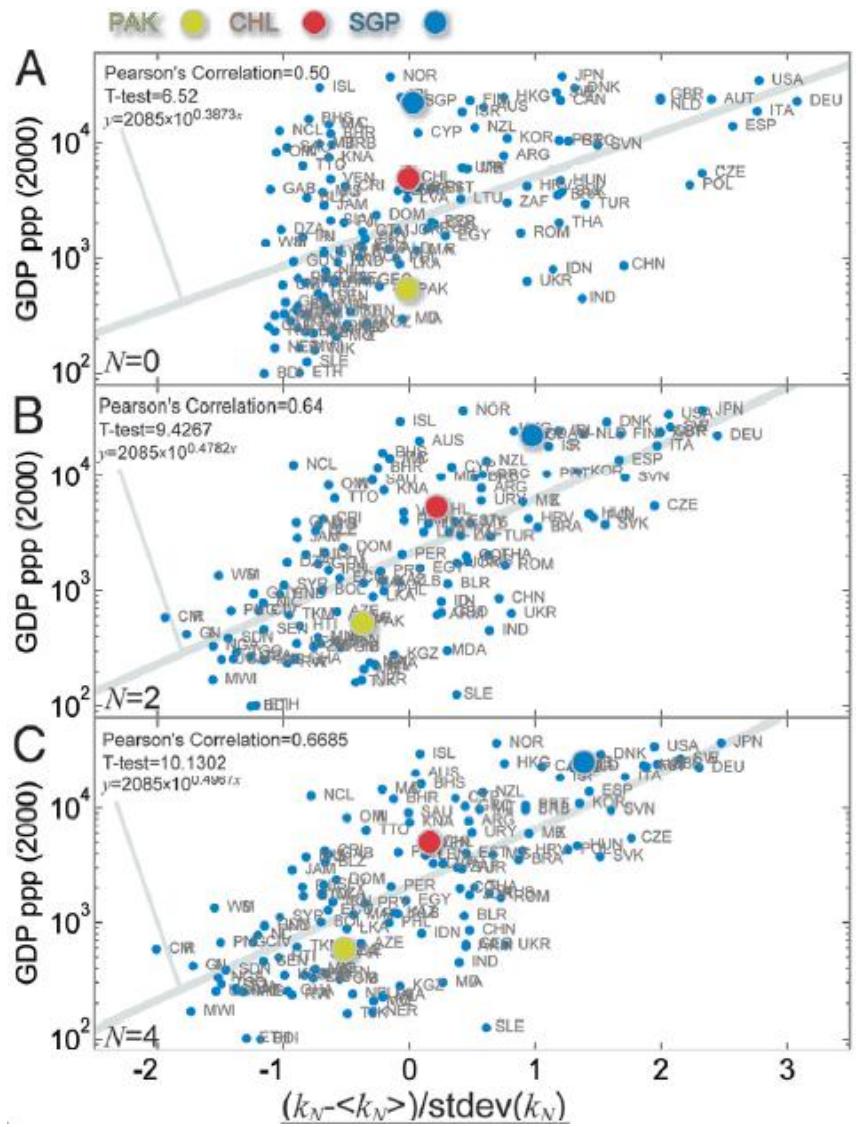


# Backgrounds

(Year 2000) Data by Feenstra 129 countries 772 products (SITC-4)



# Backgrounds

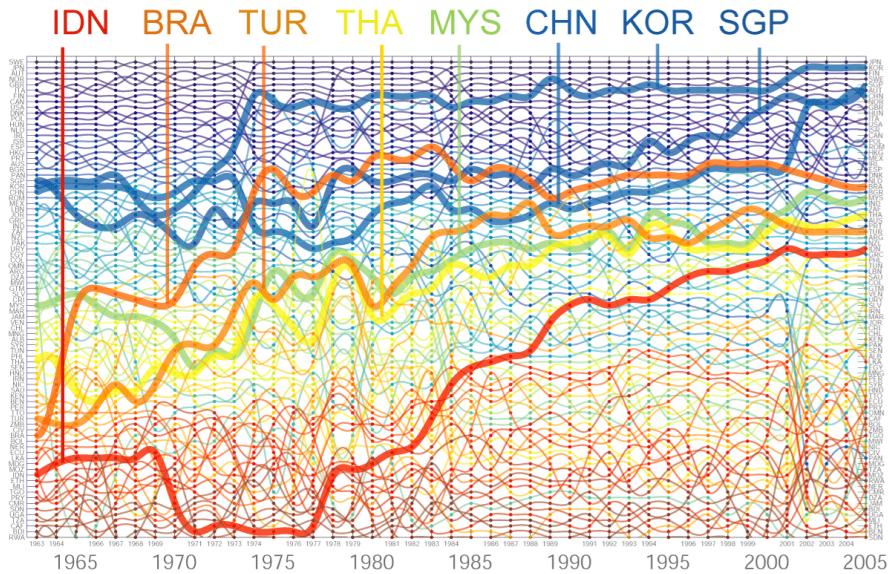


# Backgrounds

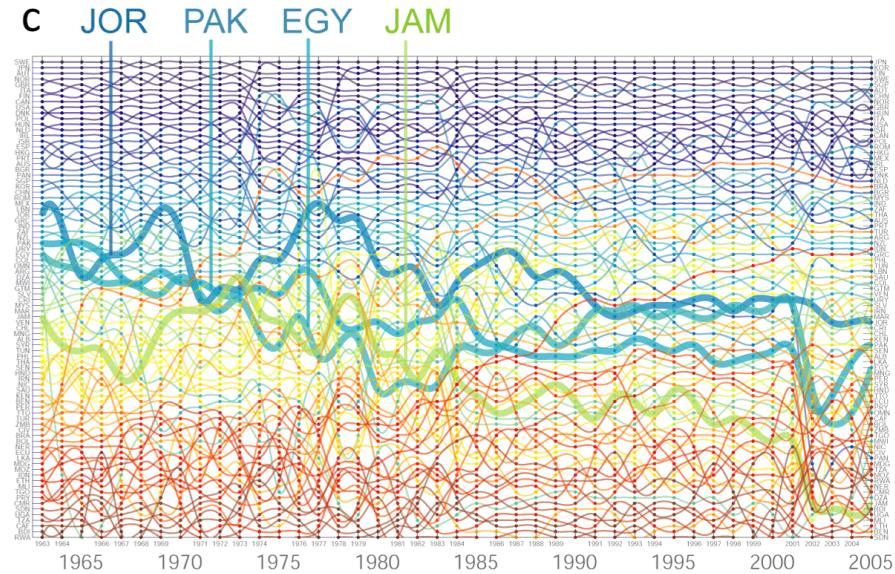
A different history of the economy ...

The evolution of the Economic Complexity ...

b



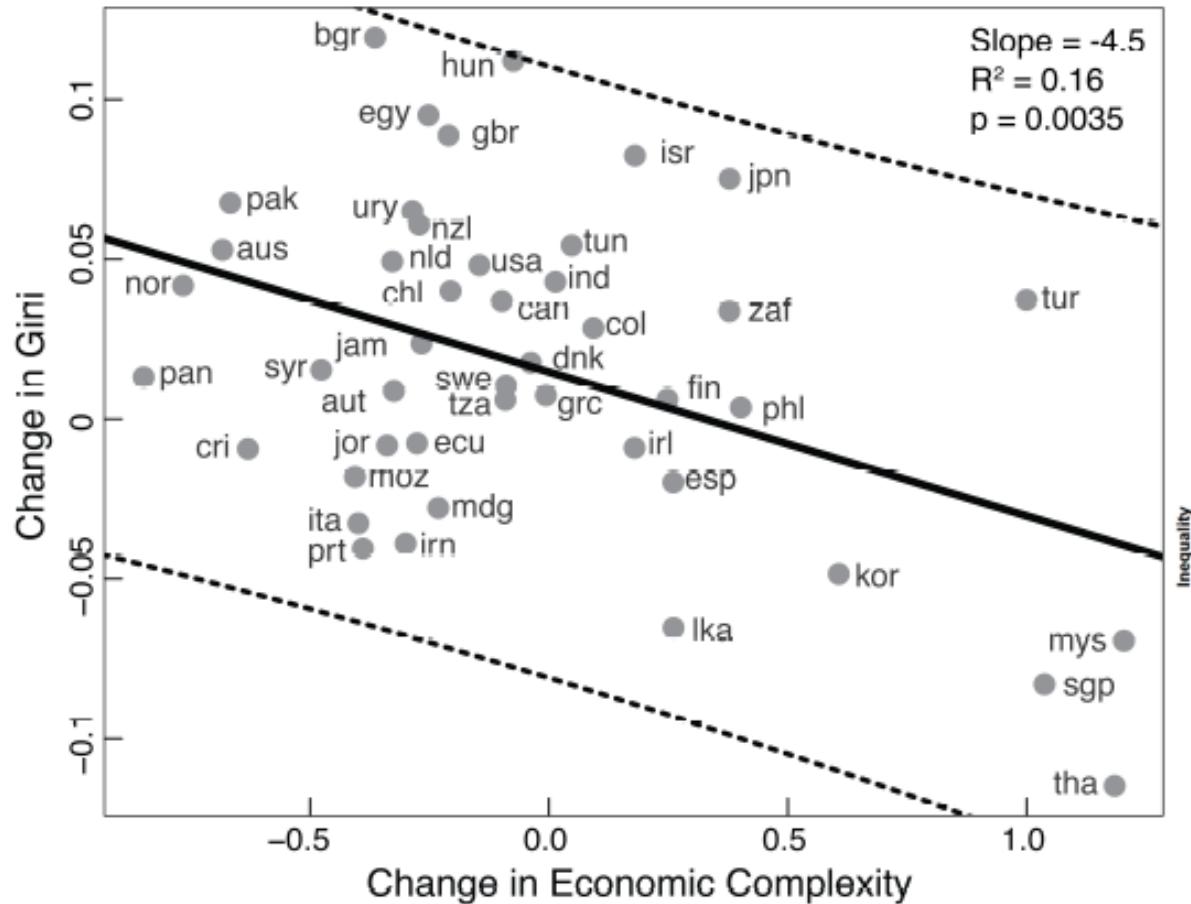
c



# Backgrounds

Change in economic complexity and income inequality between 1963-2008

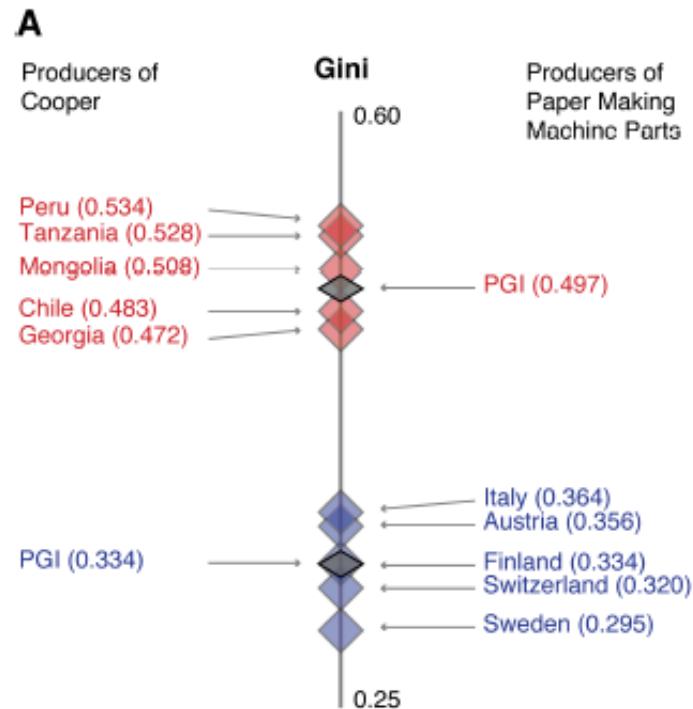
arXiv.org



Kuznets curve

# Backgrounds

## Decomposing inequality at the product level:

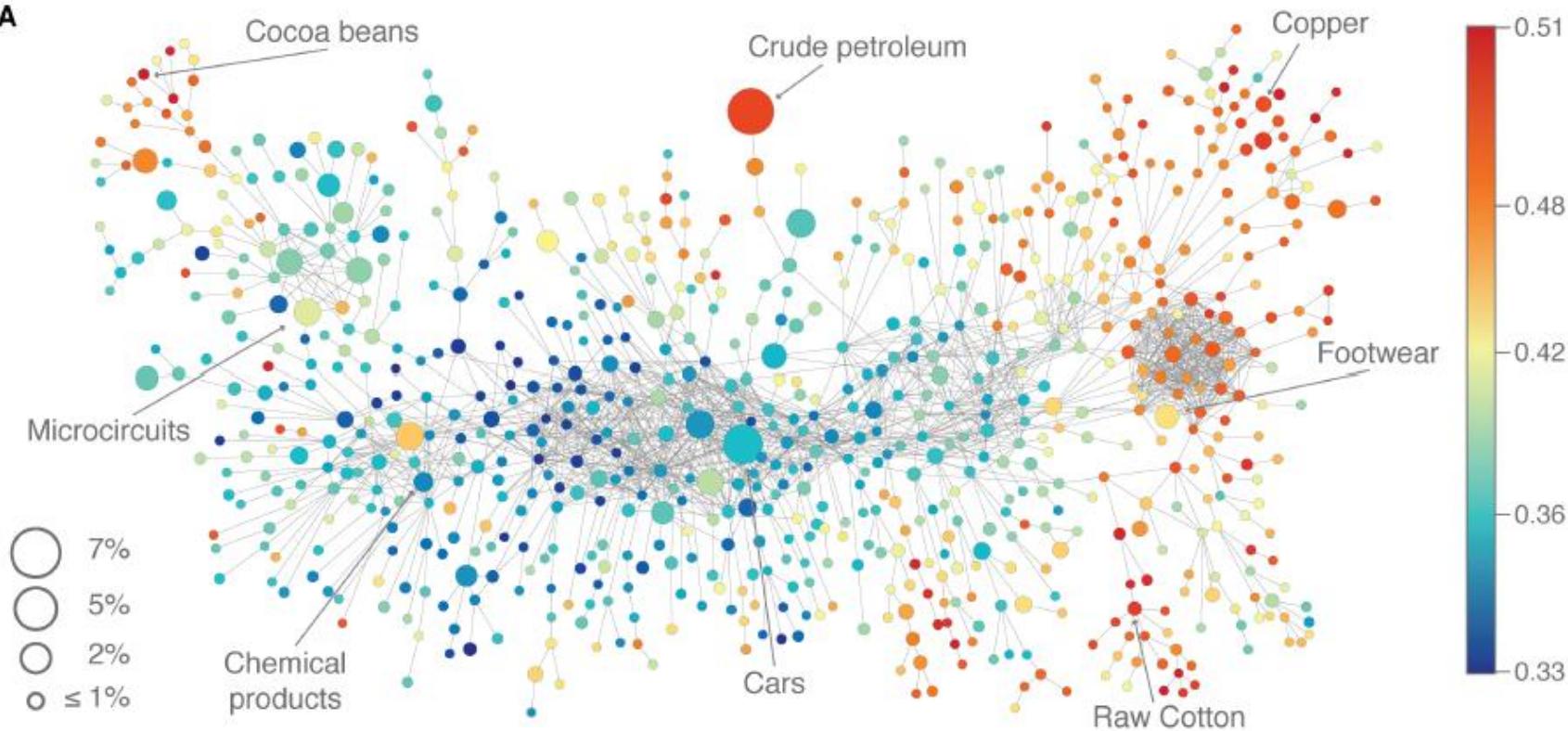


The product Gini index (PGI) is a weighted average of the Gini coefficients of the countries that export a product.

# Backgrounds

## The product space and the income inequality

A

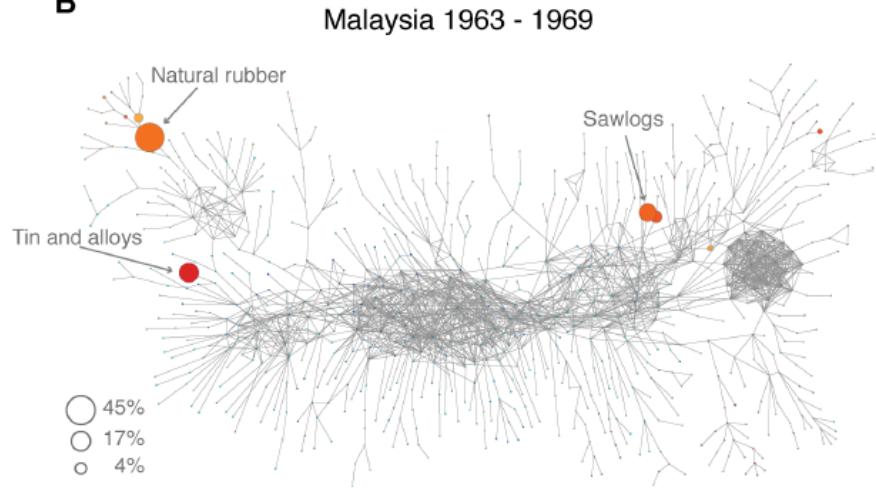


- Node color: product's PGI as measured in the 1995-2008
- Node sizes: proportional to world trade between 2000 and 2008
- Link strength: conditional probability that the products are co-exported

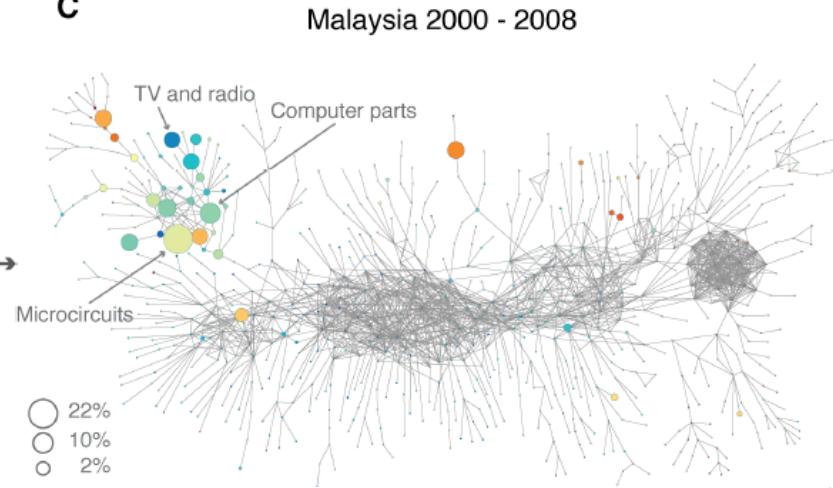
# Backgrounds

## The product space and the evolution of income inequality

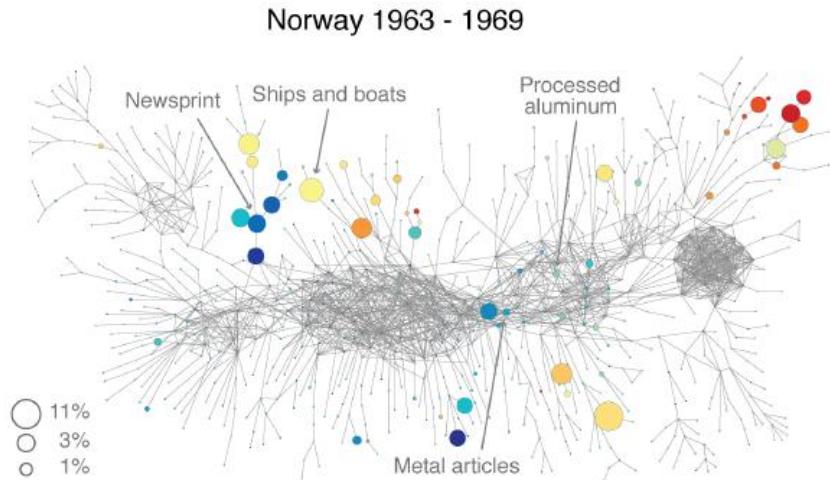
B



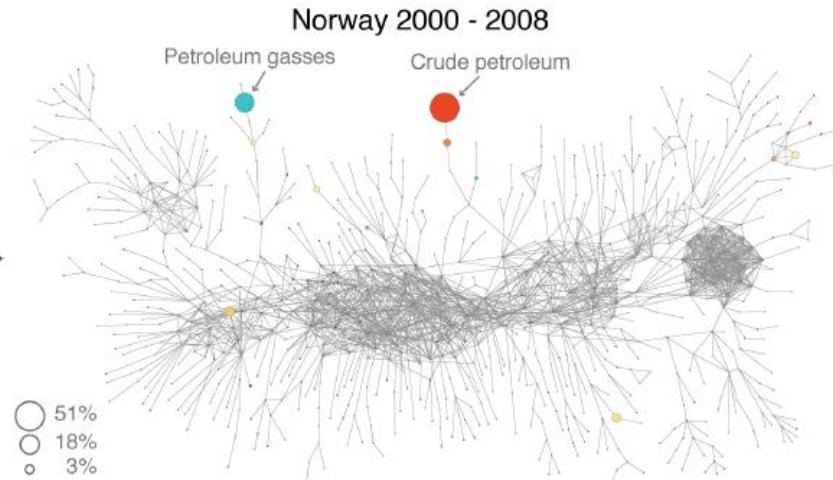
C



D



E



# Backgrounds

## Scaling laws between population and facility densities

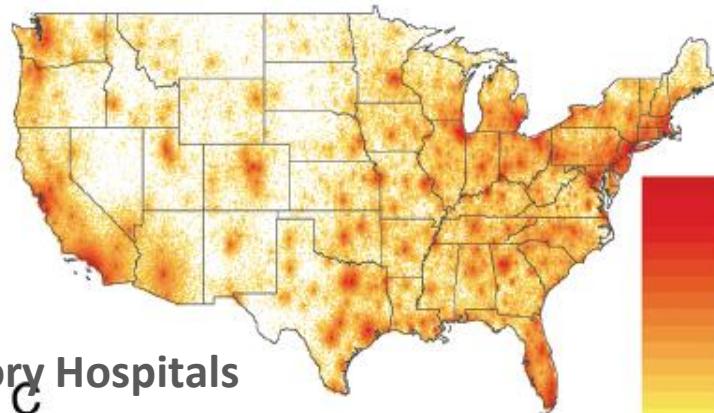
PNAS

Jaegon Uma<sup>a,1</sup>, Seung-Woo Son<sup>b,1</sup>, Sung-Ik Lee<sup>c</sup>, Hawoong Jeong<sup>b,2</sup>, and Beom Jun Kim<sup>d,2</sup>

<sup>a</sup>Department of Physics, Pohang University of Science and Technology, Pohang 790-784, Korea; <sup>b</sup>Department of Physics, Institute for the BioCentury, Korea Advanced Institute of Science and Technology, Daejeon 305-701, Korea; <sup>c</sup>National Creative Research Initiative Center for Superconductivity, Department of Physics, Sogang University, Seoul, 121-742, Korea; and <sup>d</sup>BK21 Physics Research Division and Department of Energy Science, Sungkyunkwan University, Suwon 440-746, Korea

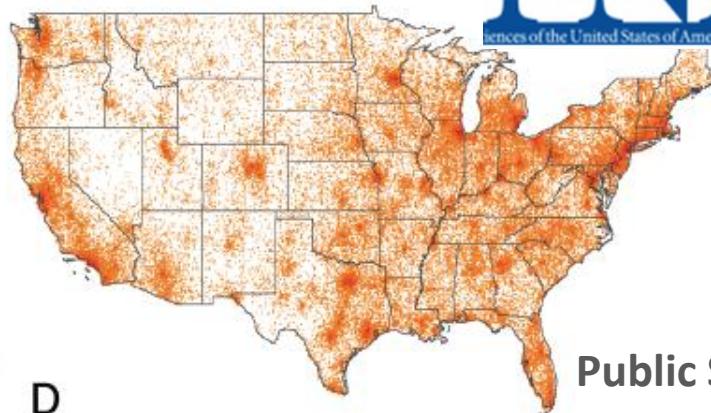
PNAS  
Sciences of the United States of America  
www.pnas.org

A



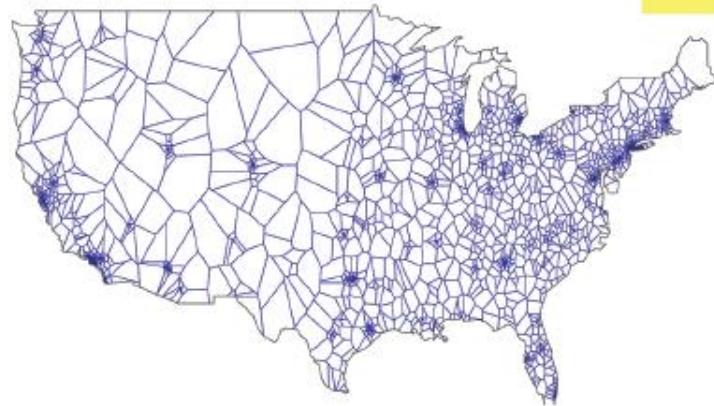
Ambulatory Hospitals

B

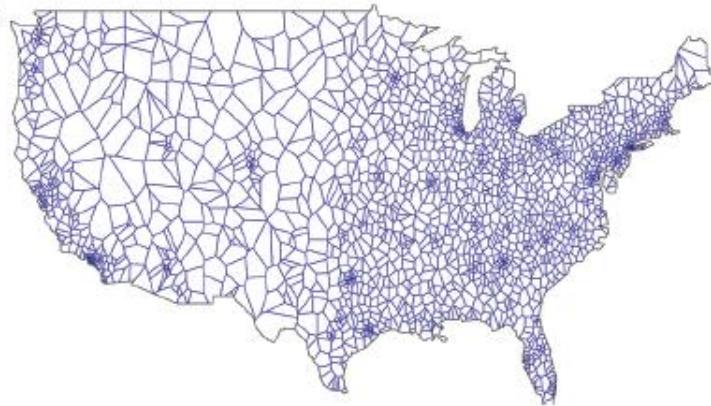


Public Schools

C

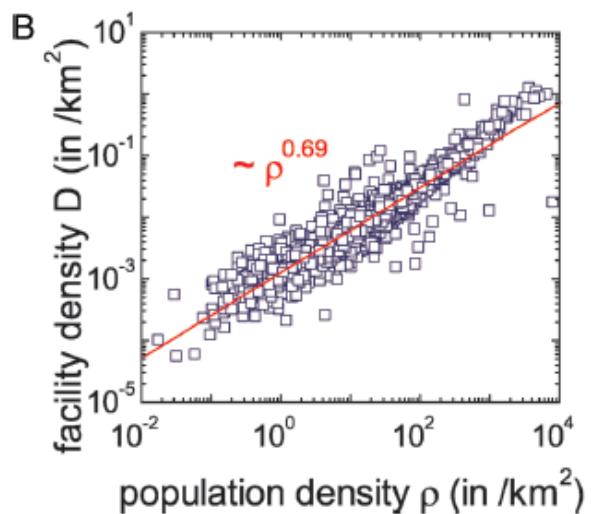
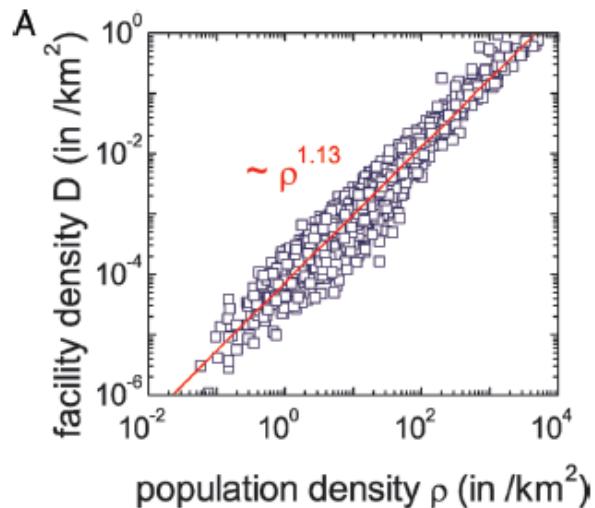


D



# Backgrounds

A country is composed of a collection of companies



US facility	$\alpha$ (SE)	$R^2$
Ambulatory hospital	1.13(1)	0.93
Beauty care	1.08(1)	0.86
Laundry	1.05(1)	0.90
Automotive repair	0.99(1)	0.92
Private school	0.95(1)	0.82
Restaurant	0.93(1)	0.89
Accommodation	0.89(1)	0.70
Bank	0.88(1)	0.89
Gas station	0.86(1)	0.94
Death care	0.79(1)	0.80
* Fire station	0.78(3)	0.93
* Police station	0.71(6)	0.75
Public school	0.69(1)	0.87
SK facility	$\alpha$ (SE)	$R^2$
Bank	1.18(2)	0.96
Parking place	1.13(2)	0.91
* Primary clinic	1.09(2)	1.00
* Hospital	0.96(5)	0.97
* University/college	0.93(9)	0.89
Market place	0.87(2)	0.90
* Secondary school	0.77(3)	0.98
* Primary school	0.77(3)	0.97
Social welfare org.	0.75(2)	0.84
* Police station	0.71(5)	0.94
Government office	0.70(1)	0.93
* Fire station	0.60(4)	0.93
* Public health center	0.09(5)	0.19

# Backgrounds

## The mortality of companies

Madeleine I. G. Daeppe<sup>1,2</sup>, Marcus J. Hamilton<sup>1,3</sup>, Geoffrey B. West<sup>1,4</sup>

and Luis M. A. Bettencourt<sup>1</sup>

# INTERFACE

[rsif.royalsocietypublishing.org](http://rsif.royalsocietypublishing.org)

<sup>1</sup>Santa Fe Institute, Santa Fe, NM, USA

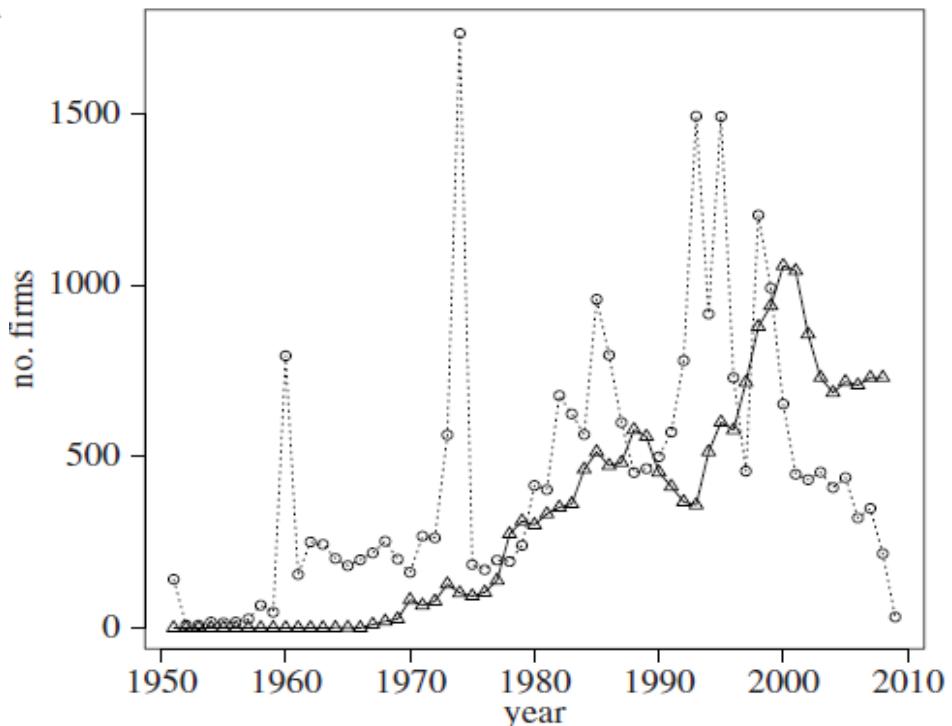
<sup>2</sup>Integrated Studies in Land and Food Systems, University of British Columbia, Vancouver, British Columbia, Canada

<sup>3</sup>School of Human Evolution and Social Change, Arizona State University, Tempe, AZ, USA

<sup>4</sup>Department of Mathematics, Imperial College London, London, UK

Circles: entering (births)

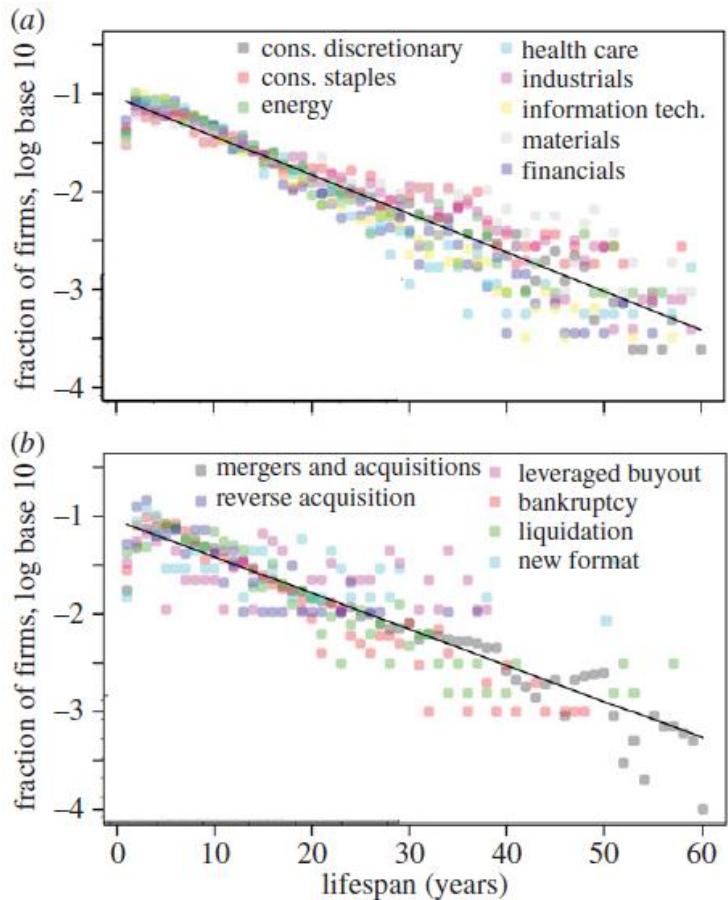
Triangles: exiting (deaths)



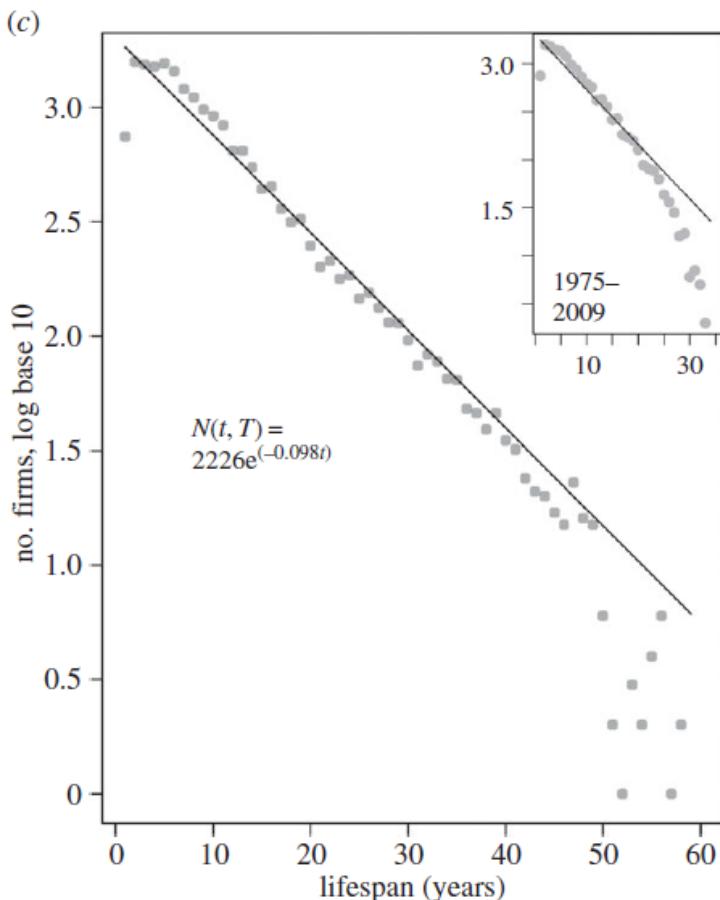
# Backgrounds

## The frequency distribution of firm lifespans

Economic sectors



Reasons of death

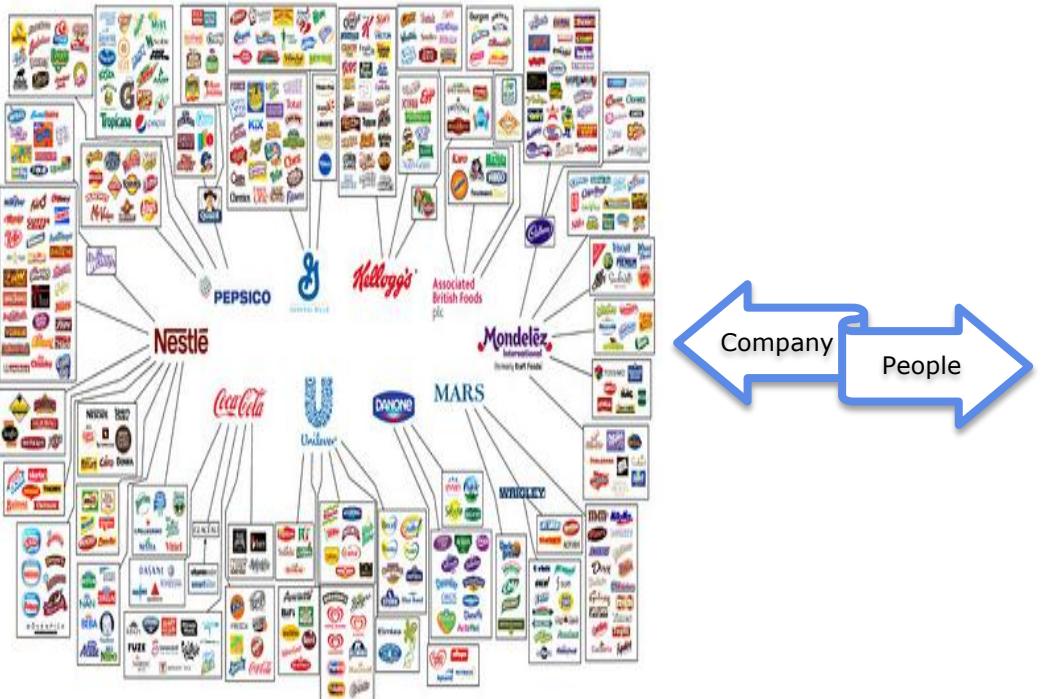


Model and simulation

- The distribution is approximately Exponential, independent of business sector
- The typical half-life of a publicly traded company is about a decade

# Backgrounds

Companies to Economy is just like People to Society





# Backgrounds

**“If you have a theory ....**

**Then you need data ...”**

# Outline



# Data Description

Data sets of over 20 millions companies within China

## 登记信息



## 股东信息



## 备案信息



# Data Description



## Data slices of over 20 millions companies within China

## 登记信息

注册号	名称	类型	法定代表人	注册资本	成立日期	住所	经营范围	核准日期	登记状态
5100000000	四川泸天化股份有限公司(上市)	股份有限公司(上市)	宁志培	58500 万元	1999年4月	四川省泸州市纳溪区	许可经营项目：生产氨、	2015年3月	存续
5100000000	通威股份有限公司	股份有限公司(上市)	刘汉元	81710.963	1995年12月	成都市高新区二环路	生产饲料及饲料添加剂；	2014年7月	存续
5100000000	四川路桥建设股份有限公司	股份有限公司	孙云	301973.26	1999年12月	成都市高新区高朋路	一般经营项目(以下范围不含)：	2014年10月	存续
5101060000	成都市万象印务有限责任公司(自然人投资或控股)	有限责任公司(自然人投资或控股)	余丁	200 万元	2002年11月	成都市金牛区黄忠	内部资料性出版物印刷(在	2012年4月	存续
5134340000	国网四川越西县有限责任公司(国有控股)	有限责任公司(国有控股)	王建	7400 万	2007年12月	越西县越城镇新大村	越西县区域内的电力购售、	2014年4月	存续

股东信息

注册号	名称	股东类型	股东	认缴额(万元)	实缴额(万元)
510706000009530	绵阳阳光房地产开发有限公司	自然人股东	缑然	8	8
510706000009530	绵阳阳光房地产开发有限公司	自然人股东	马青竹	792	792
513434000000161	国网四川越西县供电有限责任公司	企业法人	越西县宏民电力投资开发有限责任公司	1351	1351
513128000002645	四川雅安市庆源水能有限公司	企业法人	雅安幸福建筑有限公司	1100	1100
513128000002645	四川雅安市庆源水能有限公司	自然人股东	刘联	3432	3432

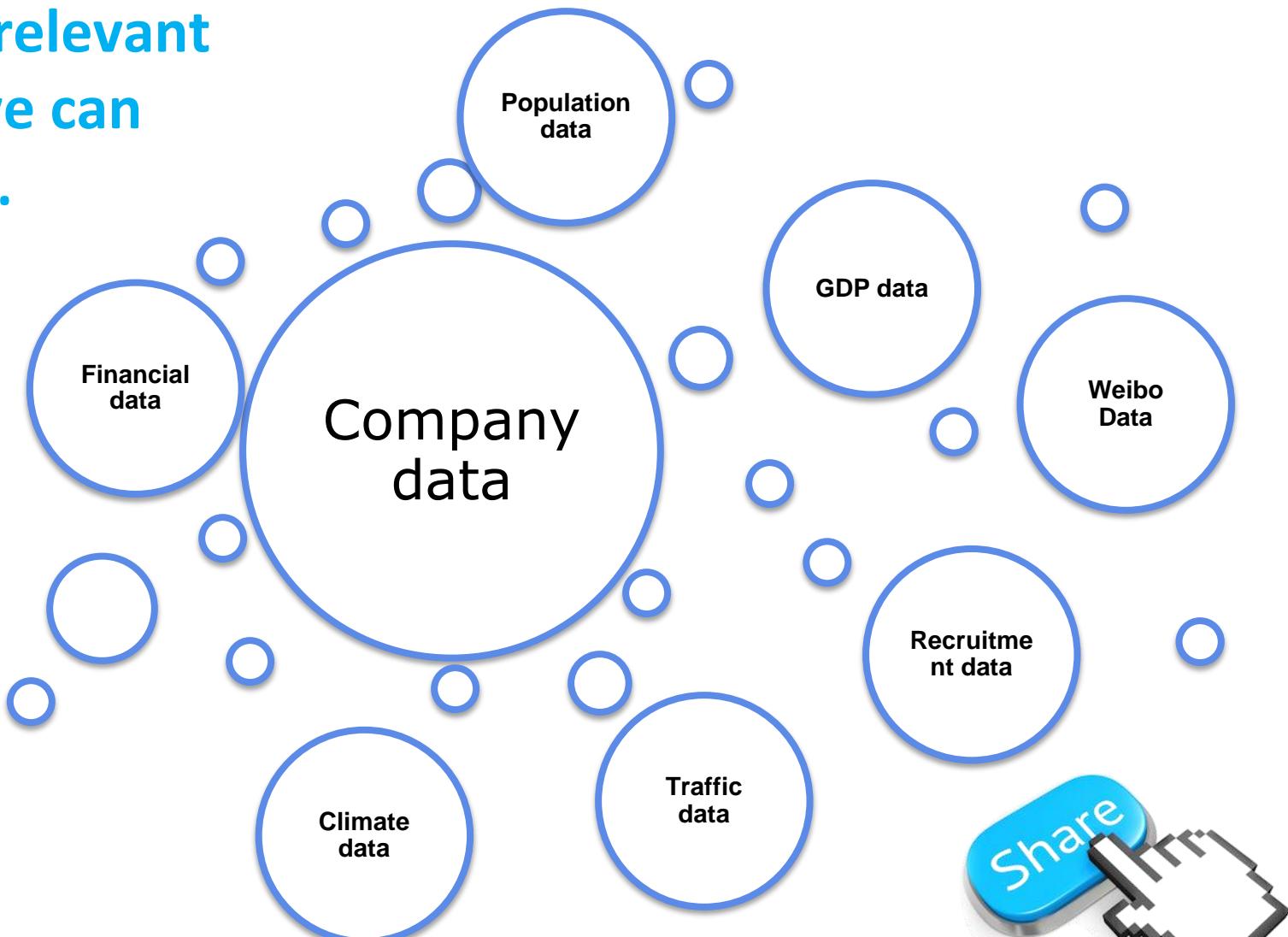
备案信息

注册号	名称	姓名	职务
5100000000154741	四川泸天化股份有限公司	宁忠培	董事
5100000000154741	四川泸天化股份有限公司	赵永清	董事兼总经理
510000000044041	通威股份有限公司	王若军	董事
510000000044041	通威股份有限公司	晏保全	监事
513434000000161	国网四川越西县供电有限责任公司	王国建	董事长



# Data Description

Other relevant  
data we can  
share...



# Data Description

**What to do ...**

**What we can do ...**

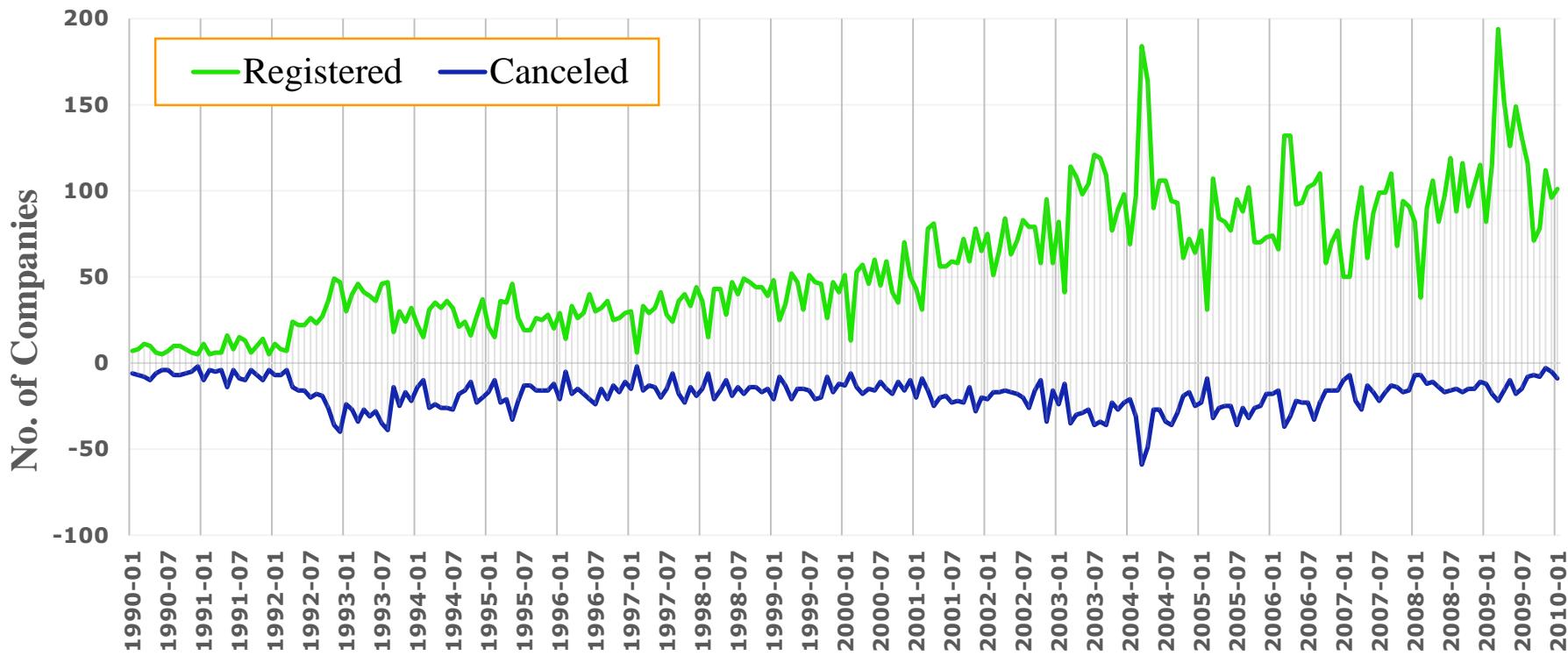


# Outline



# Some Results

Number of Registered and Canceled Companies from 1990 to 2010 in part of Sichuan Province



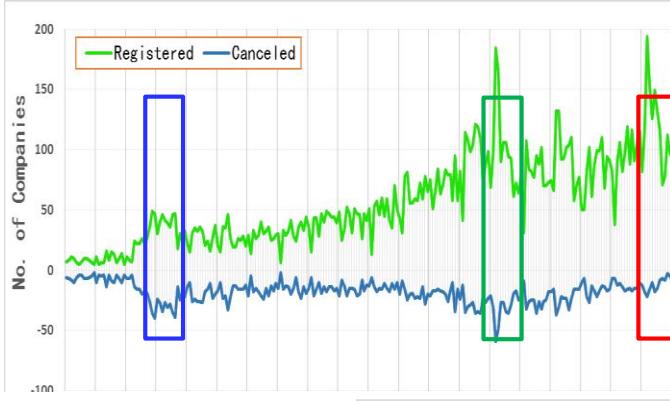
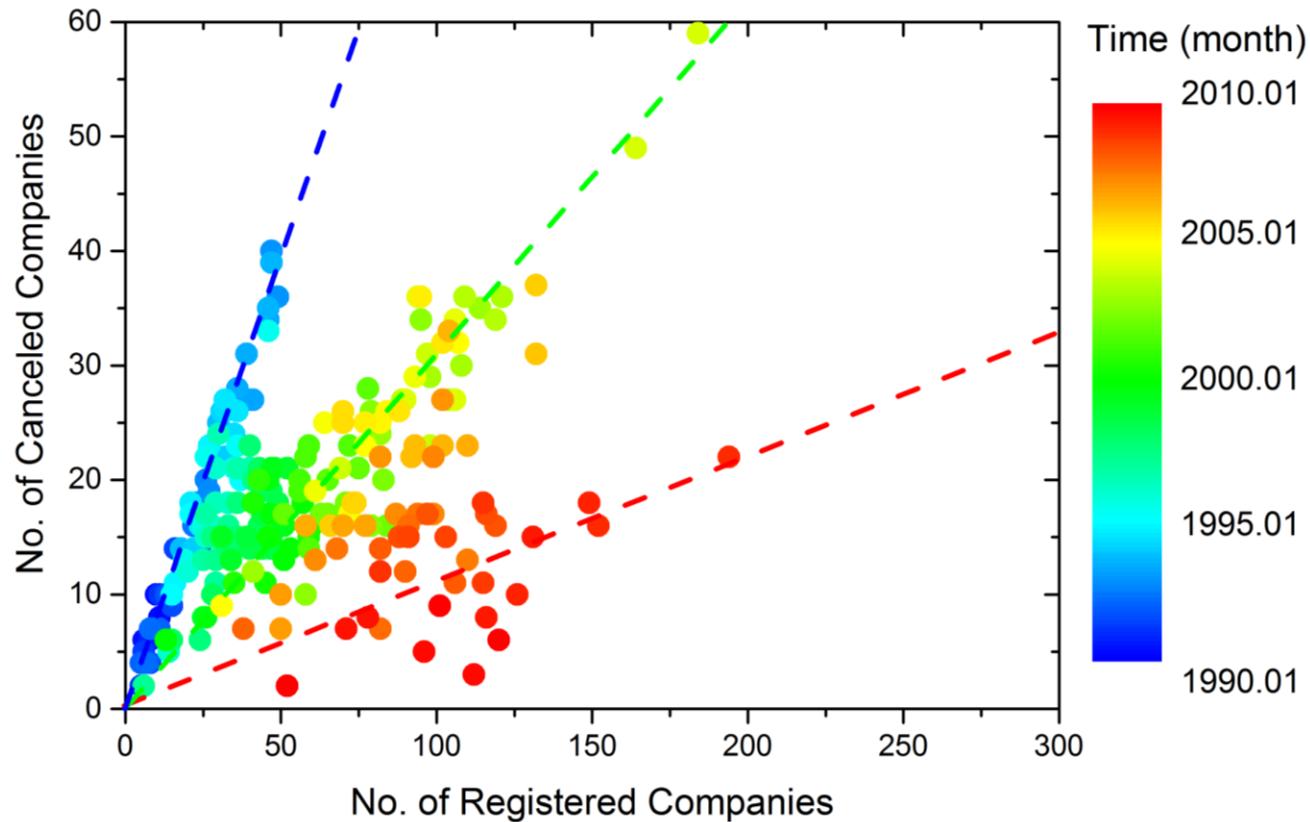
Gray vertical line marks January in each year.

- The probability of Registration is relatively low in February and high in March
- The probability of Cancellation is relatively low in December and high in March

# Some Results

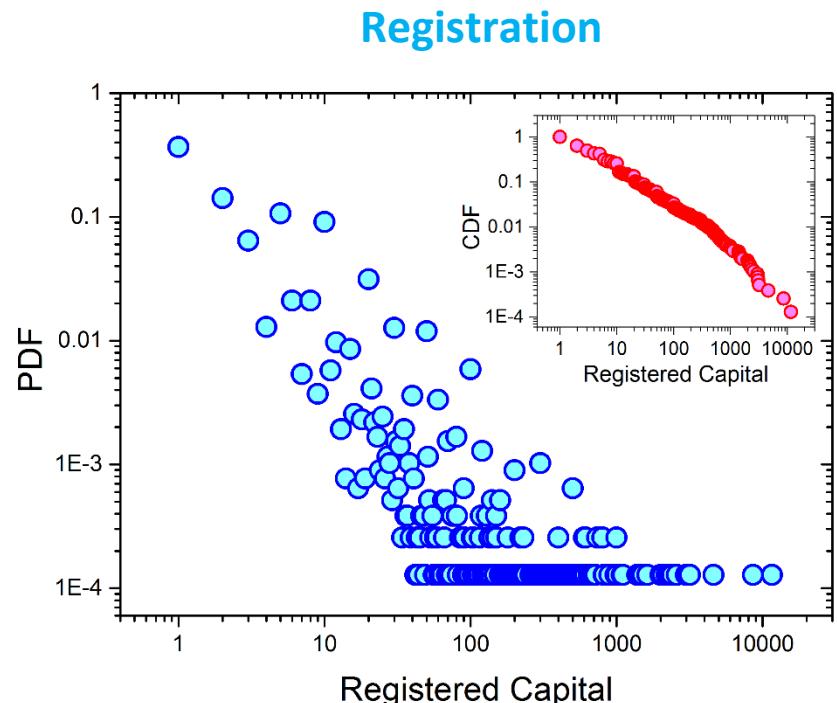
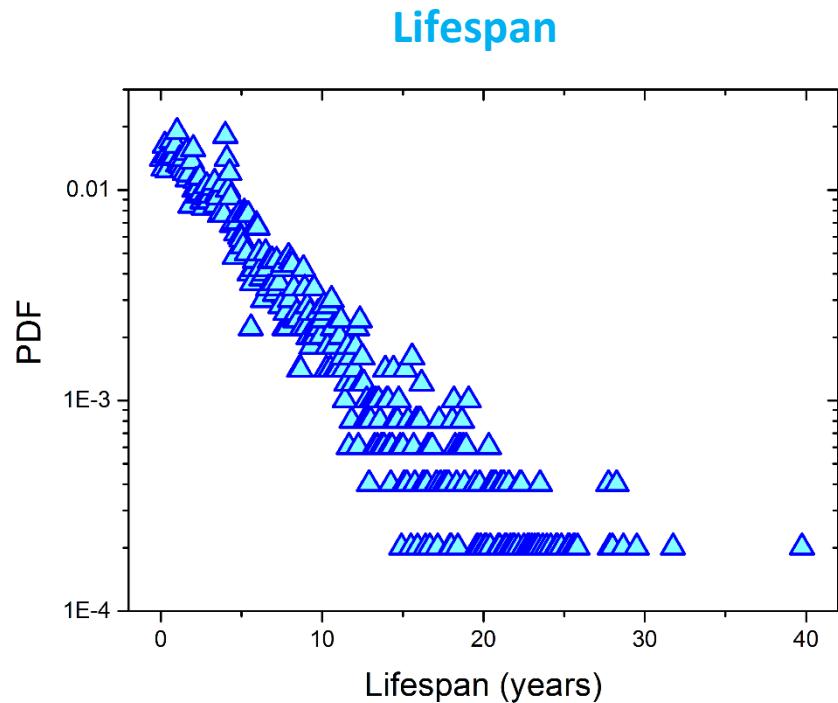
## The relations between Registration and Cancelation

- The diagram is divided in three regions by time:
  - 1) 2003-2004; 2) 2004-2005; 3) 2009-2010



# Some Results

The distributions of Lifespan and Registered Capital of companies in part of Sichuan Province

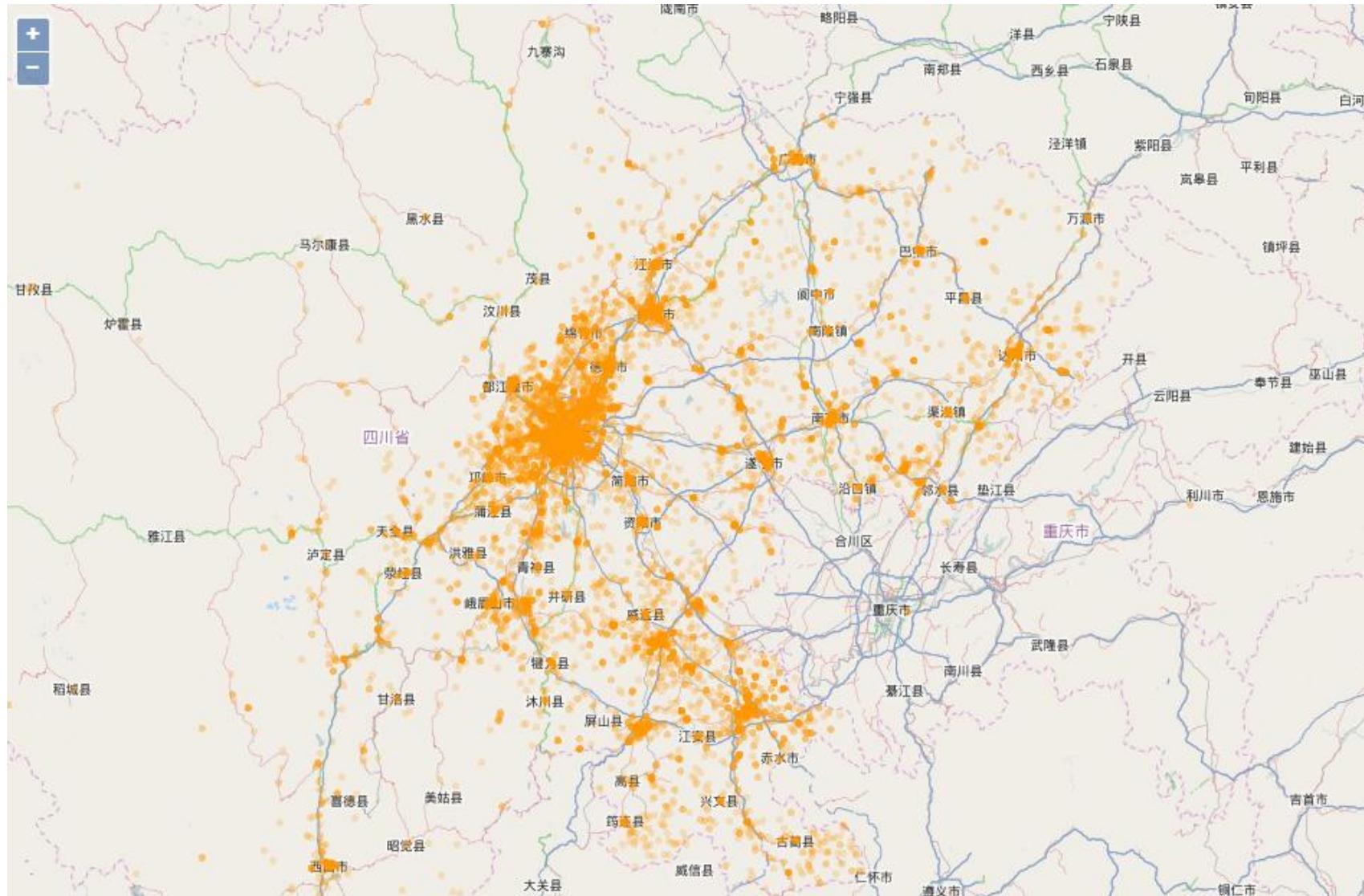


- Approximately Exponential

- Approximately Power-law

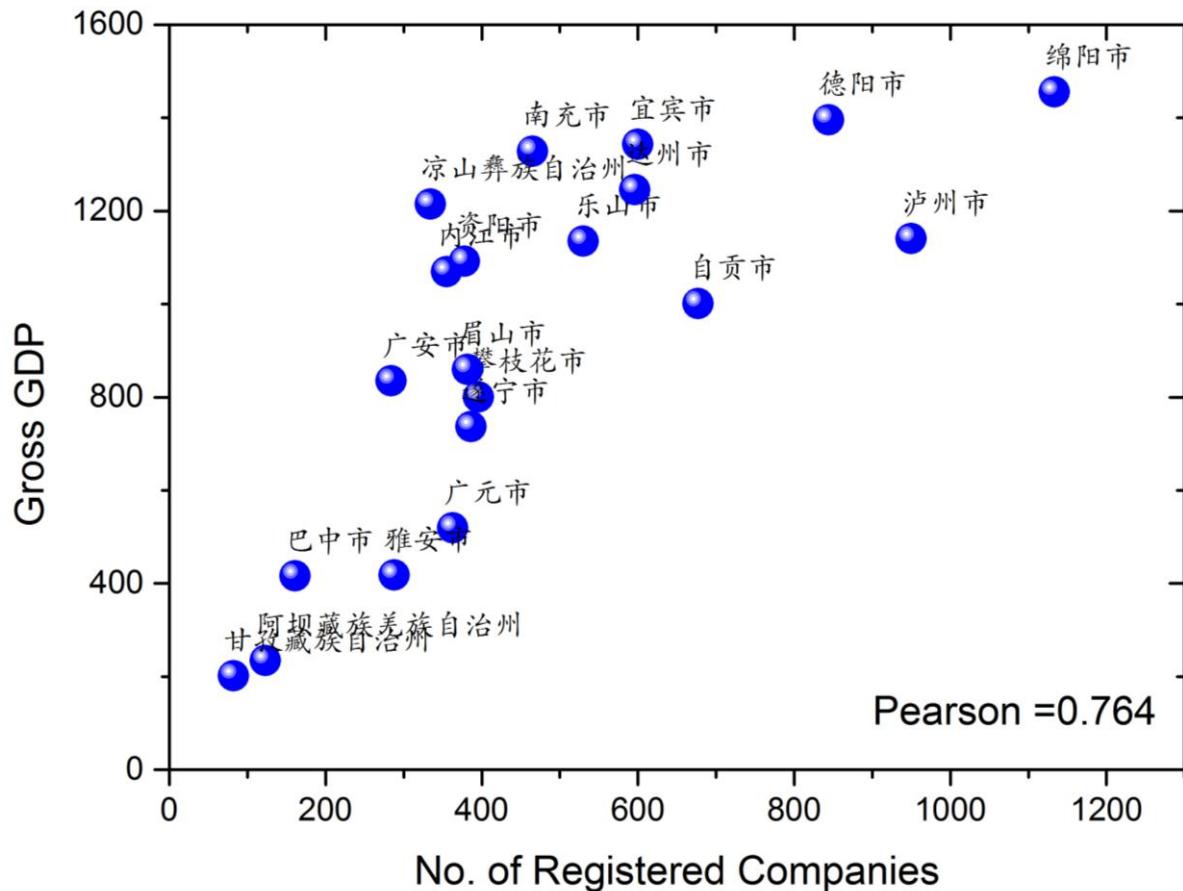
# Some Results

The location of registered companies in Sichuan from 1990 to 2015



# Some Results

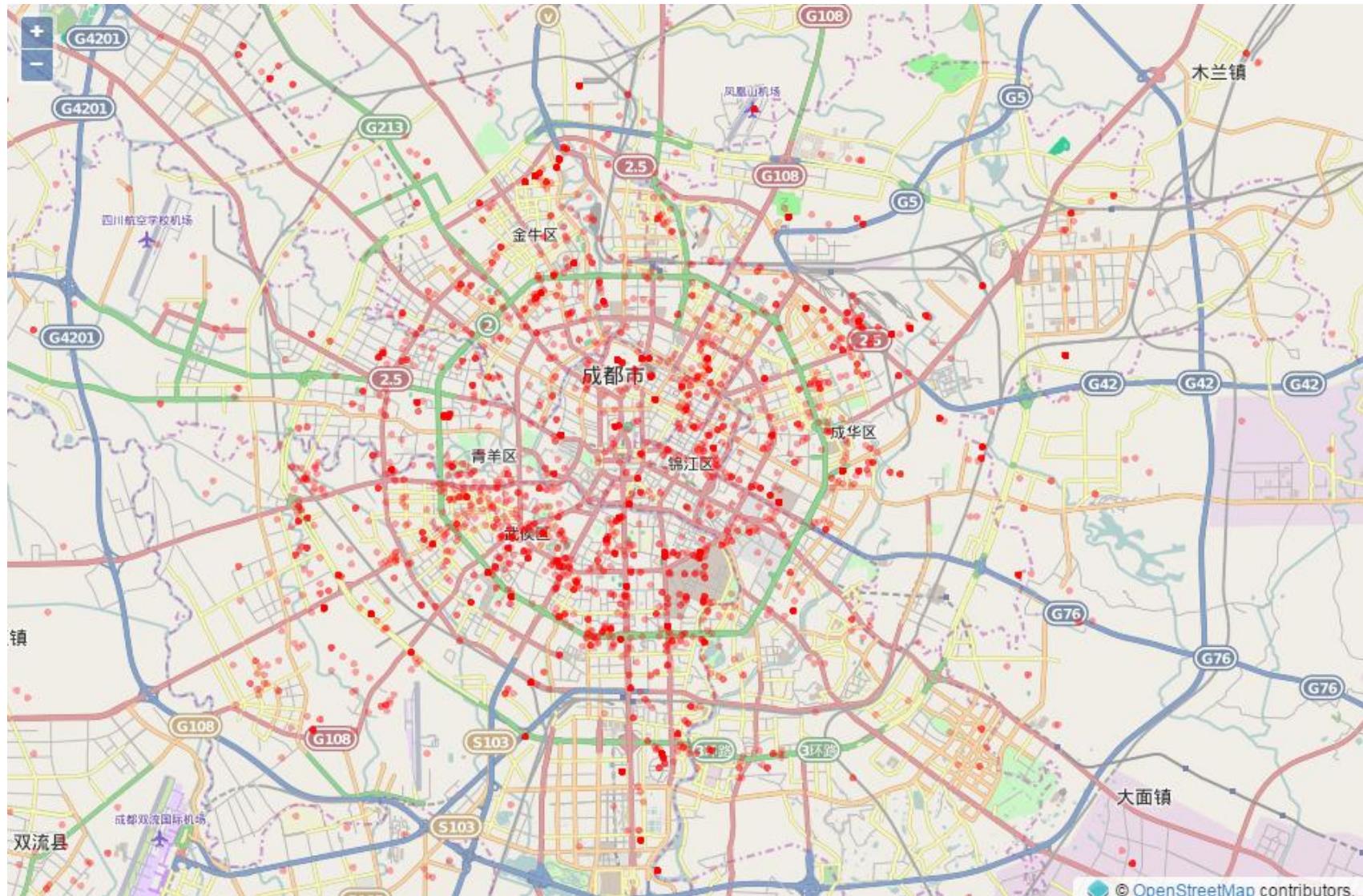
## The relations between the Registration and the Gross GDP



- The gross GDP is positively correlated with the number of registered companies in the cities in Sichuan Province

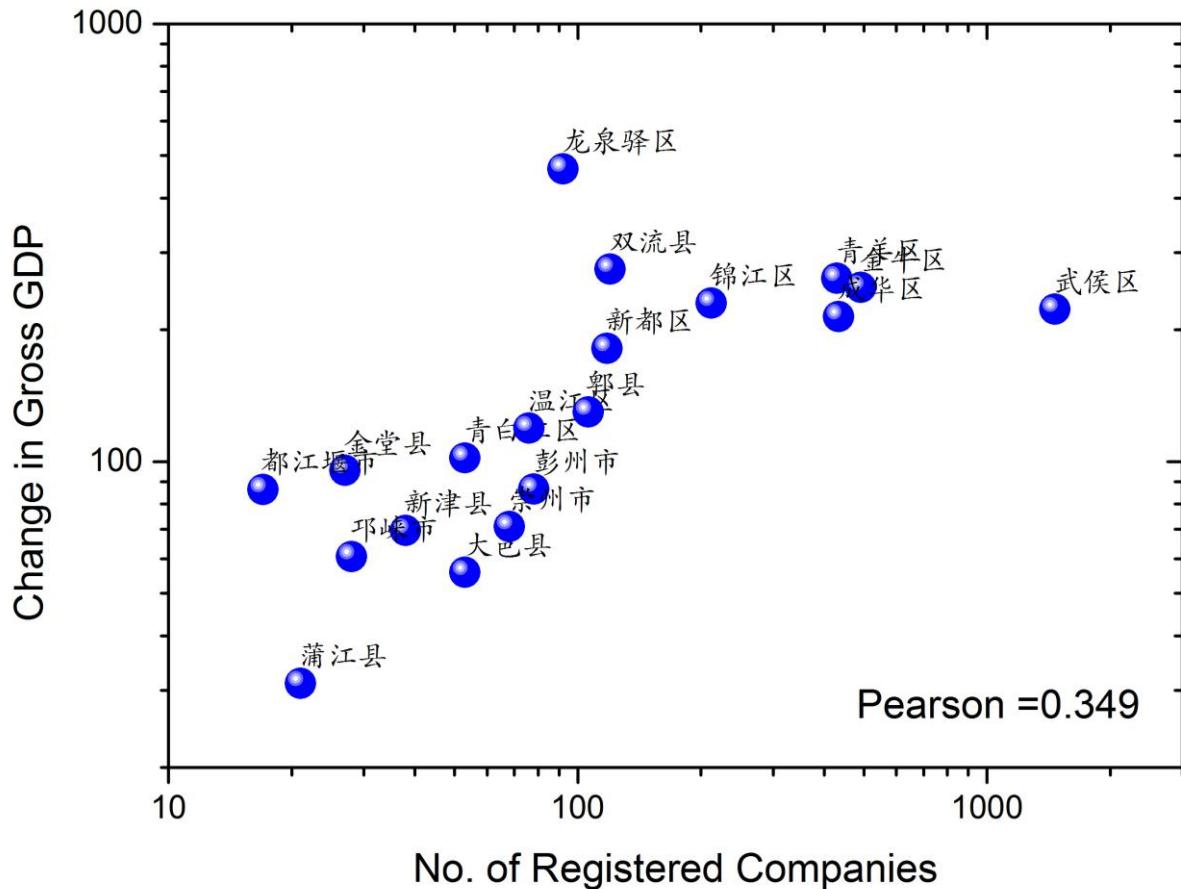
# Some Results

The location of registered companies in Chengdu from 2010 to 14



# Some Results

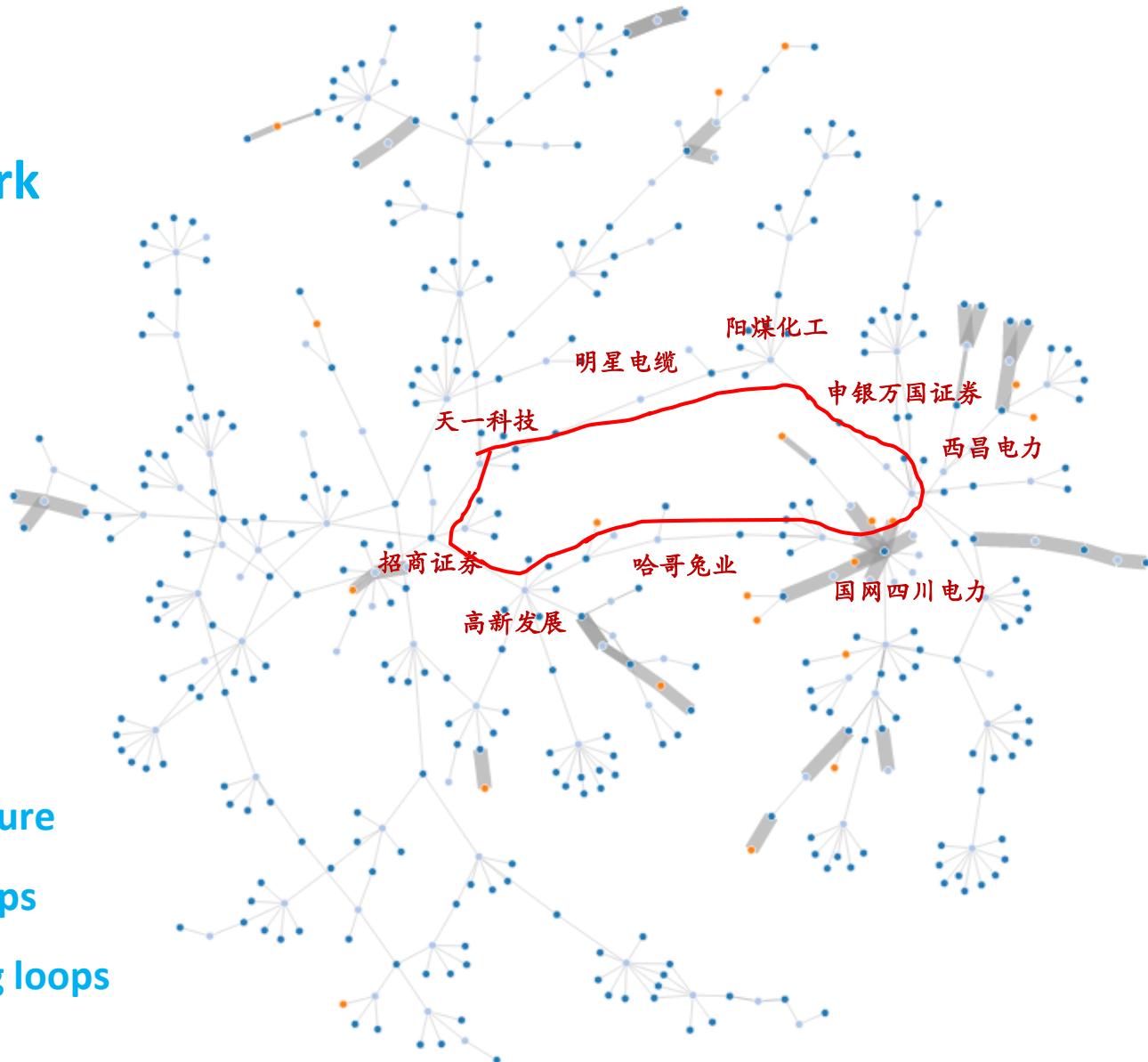
The relations between the Registration and the change of Gross GDP in Counties of Chengdu City from 2010 to 2014



- The change of gross GDP is positively correlated with the registration

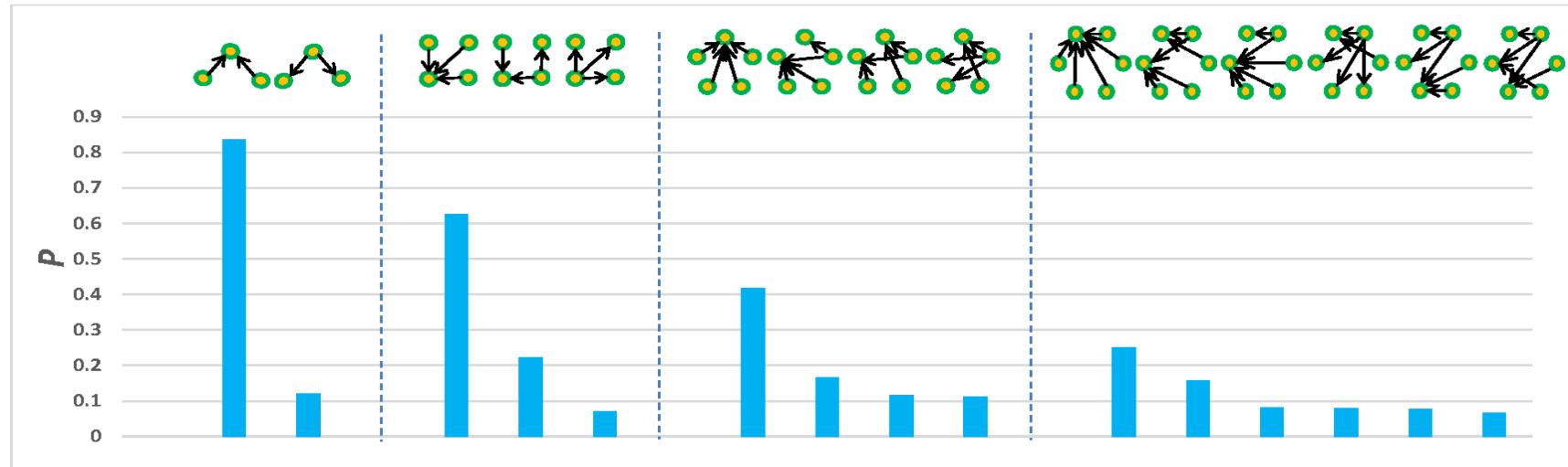
# Some Results

## Visualization of Investor Network (Sichuan)

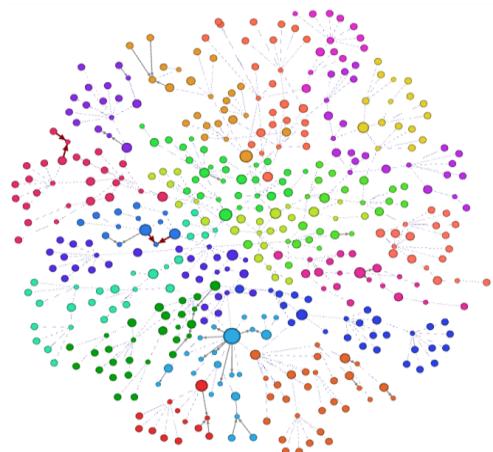


# Some Results

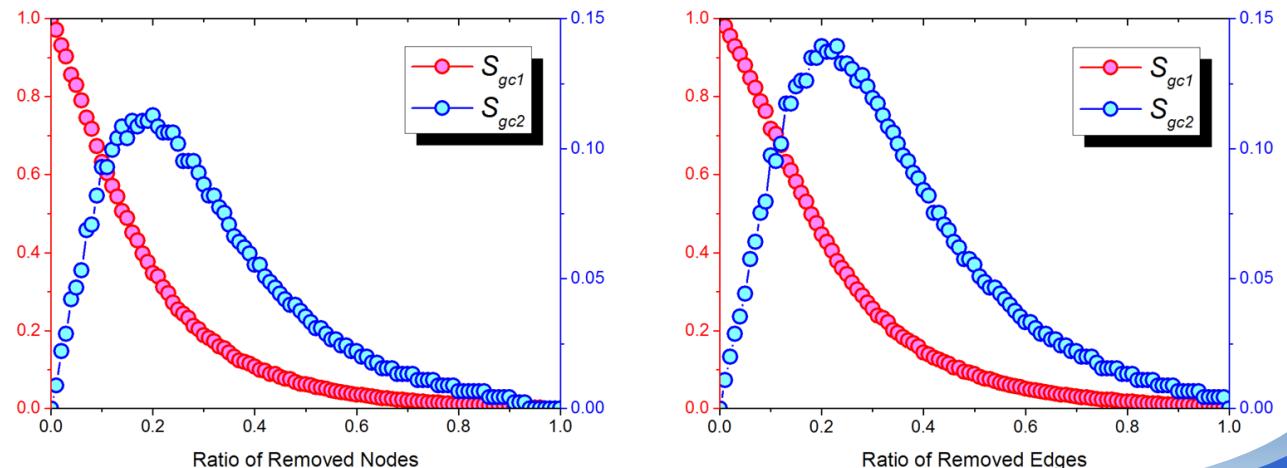
## Local Structure



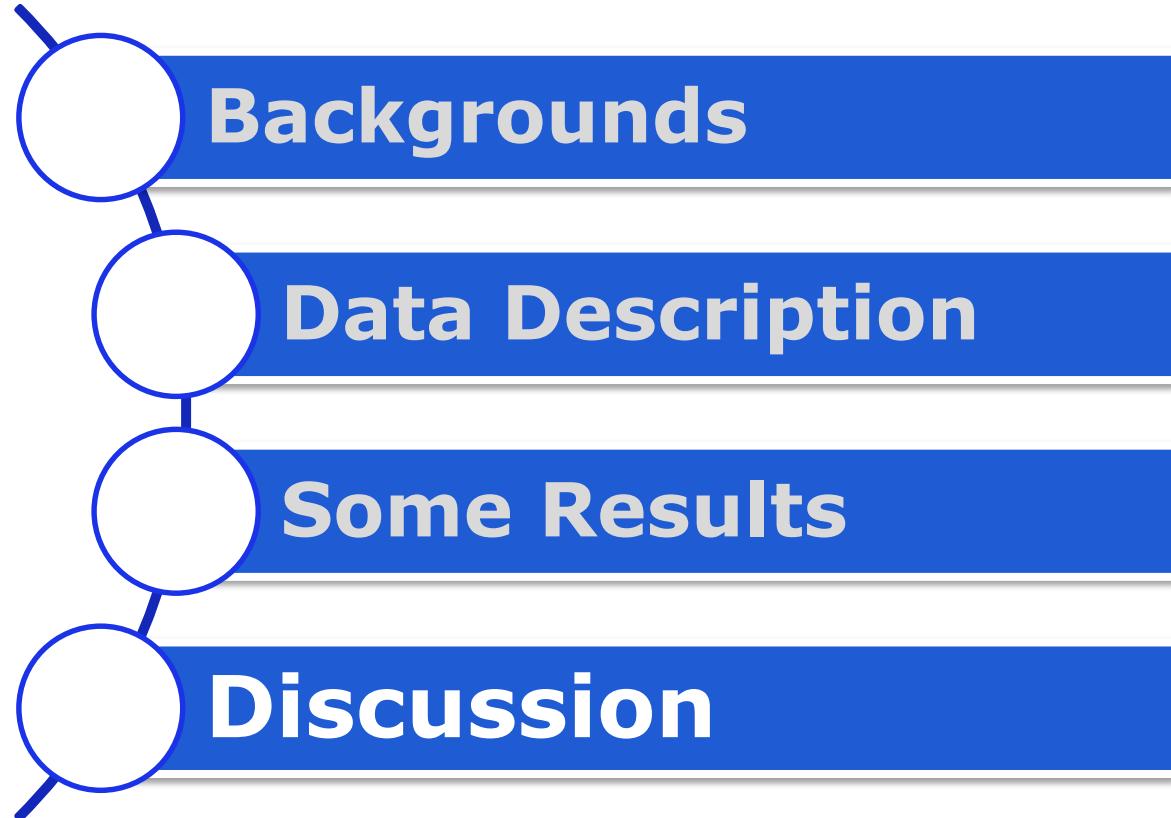
## Community



## Robustness



# Outline





# Discussion

**“If you have data ....**

**Then you need a theory ...”**



# One the way...

- Quantifying local economic complexity by “Company Space”
- Predicating the local economic development by company registration and investor network
- Optimizing and personalizing the management structure
- Answering economic puzzles in a quantitative way
  - Is there any threshold of average investment ratio in company assets, above which a considerable financial cascading may happen?
  - Can we identify the most influential companies in determining the development of a regional economic entity?
  - Can we describe the interaction between the economic environment and company evolution in a quantitative and predictive way?
  - Can we connect the features in company space to other social and economic issues, including some humanity problems, like justice and equity?

# One the way...

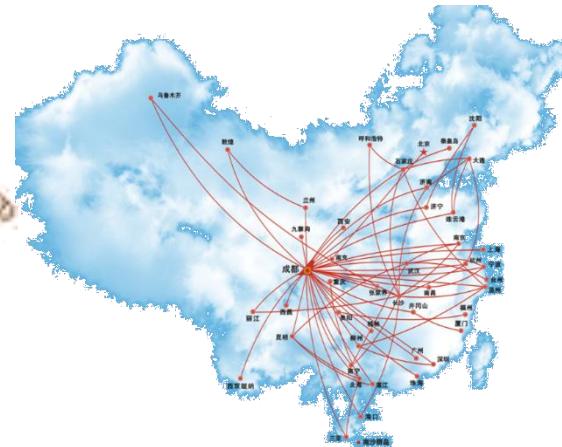
## Data Science



## Economic System



## Network Science





# Thanks for your attention!

JIAN GAO

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Complex Lab, Web sciences Center, UESTC

June 27, 2015