Spatial dynamics of the logistics industry in California metropolitan areas

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Overview

❑ What is "logistics sprawl"?

❑ Why should we care?

❑ Why should location patterns change?

❑ What do we know?

❑ Our approach

❑ Results

❑ Discussion

Urban sprawl in the literature

"The uncontrolled spreading of urban development into areas adjoining the edge of a city"*

❑ An enduring urban planning problem

- 1950s suburbanization
- 1974 *The Costs of Sprawl*
- Critiques of suburban development
  - Newman and Kenworthy
  - Cervero, Ewing, others
  - New urbanism

*www.thefreedictionary.com

Main critiques

- Public and private capital and operating costs
- Transportation and travel
- Land, natural habitat
- Quality of life
- Social segmentation

What is logistics sprawl?

"Logistics sprawl is the phenomenon of relocation and concentration of logistics facilities (warehouses, cross-dock centres, freight terminal, etc.) towards suburban areas outside city centre boundaries" (Dablanc and Rakotonarivo, 2010)

- A <u>shift</u> of location from central areas to suburban or exurban areas
- <u>Spatial concentration</u> of activities in logistics clusters

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Skechers, Moreno Valley

Why should we care?

- ❑ Warehouse and distribution sector is growing faster than US economy
    - ▪ From 2003 -2013, 33% increase in W&D employment, 4% increase in total employment
- ❑ W&D activity generates negative externalities
    - ▪ Truck trip generation hot spots
    - ▪ Air pollution, GHG emissions, noise, quality of life, possibly environmental justice impacts

If W&Ds are moving further from markets, truck travel and impacts increase

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Why should location patterns change?

- ❑ Economic restructuring
  - Global, geographically dispersed supply chains
  - Reduced transport costs
  - Access to regional, national, global markets
    - Access to highways, rail nodes, intermodal
  - From "push" to "pull" logistics
    - Velocity and reliability, minimized dwell time
- ❑ Scale economies
  - Ever larger facilities
  - Automation
- ❑ Land availability and prices
  - Larger parcels, favorable zoning

What do we know?

❑ Decentralization
  ▪ Los Angeles and Atlanta, 2000s, increase in geographic spread
  ▪ Seattle, 2000s, decrease in geographic spread
  ▪ UK and Japan, 2000s, suburbanization
❑ Concentration
  ▪ One case study, Netherlands, increased concentration

Little evidence so far of consistent location trends across metro areas

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Research approach and methods

Some considerations

- Changing location with respect to what?
    - If population and employment are decentralizing, then W&D may be following the market
    - If markets are national or global, does metropolitan location matter?
- Many possibilities for spatial shifts
    - Centralization vs decentralization
    - Concentration (clustering) vs dispersion
   - Implications for truck travel vary

Our approach

- ❑ Measures to capture
  - ▪ Absolute and relative change
  - ▪ Centrality and concentration
- ❑ Many possibilities
  - ▪ Use several measures and compare results
- ❑ Unit of analysis
  - ▪ Establishments, employment

Spatial measures

Spatial structure	Absolute	Relative
Centrality	Measure 1 Decentralization 1-1 Ave distance to CBD 1-2 Ave distance to freight nodes 1-3 Ave distance to W&D geographic center	Measure 2 Relative decent. 2-1 Ave distance to all employment 2-2 Ave distance to all population
Concentration	Measure 3 Concentration 3-1 W&D Gini coefficient	Measure 4 Relative conc. 4-1 WD distribution relative to total emp density distribution
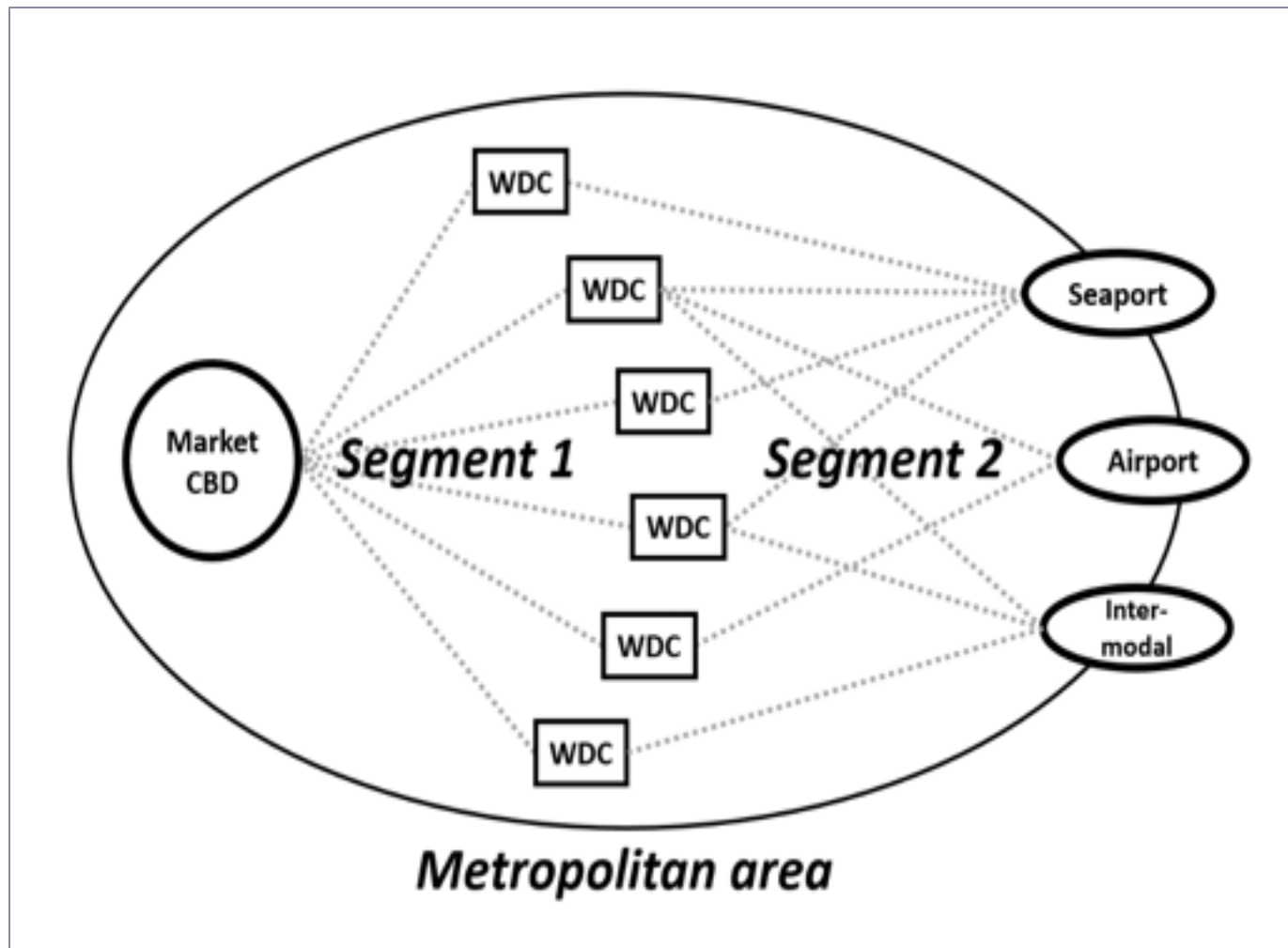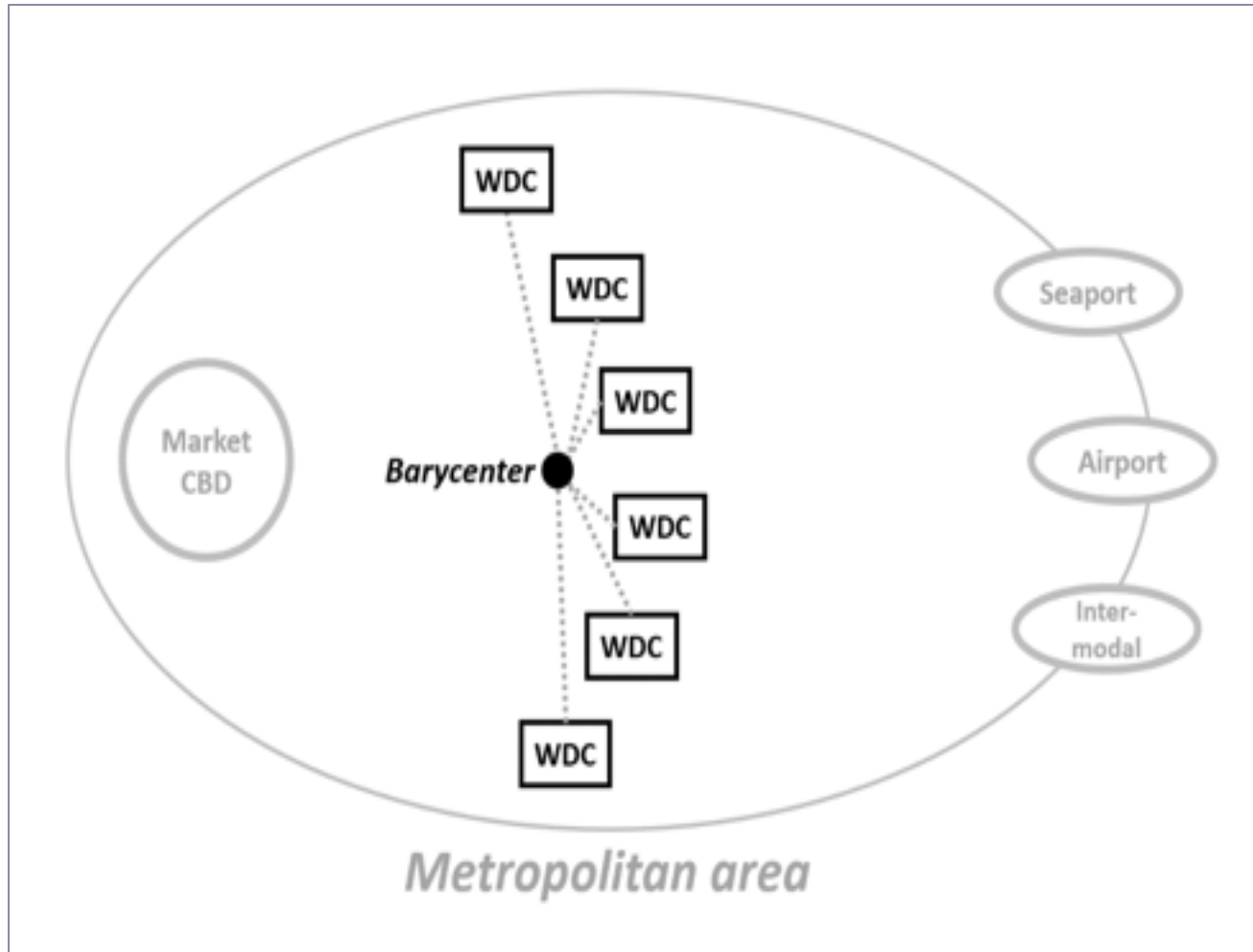
Measure 2

$$D = \frac{\sum_{j=1}^{N}[(\frac{\sum_i^n D_{ij} \times X_i)}{X}] * E_j}{E}$$

Where,

D_{ij} = distance to ZIP Code (i) from each W&D (j) or distance to census tract (i) from each W&D (j) (i = 1, 2, . . , n; j = 1, 2,…, N)

X_i = total employment in ZIP Code (i)

X = sum of X_i

E_i = the number of W/D establishments or employment in ZIP Code (j)

E = sum of E_i

Data

❑ Test our measures with four largest metro areas in California

- Los Angeles (CSA)
  - Largest US international trade center
  - Second largest US metro area
- San Francisco (CSA)
  - Largest US high tech center
- Sacramento (CSA)
  - State capitol
  - Agricultural trade center
- San Diego (MSA)
  - Border city

Employment and establishment data

❑ Zip Code business patterns (ZBP), 2003 – 2013
  ▪ Annual data
  ▪ 6-digit industry code
  ▪ Establishments and employment
❑ Advantages
  ▪ Reliable and consistent
  ▪ Covers entire US
❑ Disadvantages
  ▪ Location limited to zip code centroids
  ▪ Zip codes vary in size, not consistent with political boundaries
  ▪ Data suppression for small numbers

Population and employment trends

	Population (millions)		Employment (millions)	
	2000	2010	2003	2013
Los Angeles	16.4	17.9	6.4	6.5
San Francisco	7.6	8.2	3.4	3.4
Sacramento	2.0	2.4	0.7	0.7
San Diego	2.8	3.1	1.2	1.2

Source: US Census, ZBP

Trends in W&D activity

Year	Los Angeles		San Francisco		Sacramento		San Diego	
	Est.	Emp.	Est..	Emp.	Est.	Emp.	Est.	Emp.
2003	775	34,333	257	9,603	80	3,699	84	1,650
2013	1001	49,266	311	11,476	143	5,641	86	1,720
%Δ	29%	43%	21%	20%	79%	52%	2%	4%

W&D = NAICS 493, facilities that store goods and/or provide logistics services

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Trends in employment/establishment

Year	Los Angeles	San Francisco	Sacramento	San Diego
2003	44.3	37.4	46.2	19.6
2013	49.2	36.9	39.4	20.0
%△	11%	-1%	-15%	2%

Spatial trends, establishments

Los Angeles

N of warehousing establishments by ZIP code in 2003-2013

Legend

N of Est. by ZIP code
- 1 - 3
- 4 - 8
- 9 - 18
- 19 - 31
- over 32

Data Year
- Data in 2013
- Data in 2003

San Francisco

Sacramento

N of warehousing establishments by ZIP code in 2003-2013

Legend

N of Est. by ZIP code

○ 1
○ 2
○ 3
○ 4
○ over 5

Data Year

○ Data in 2013
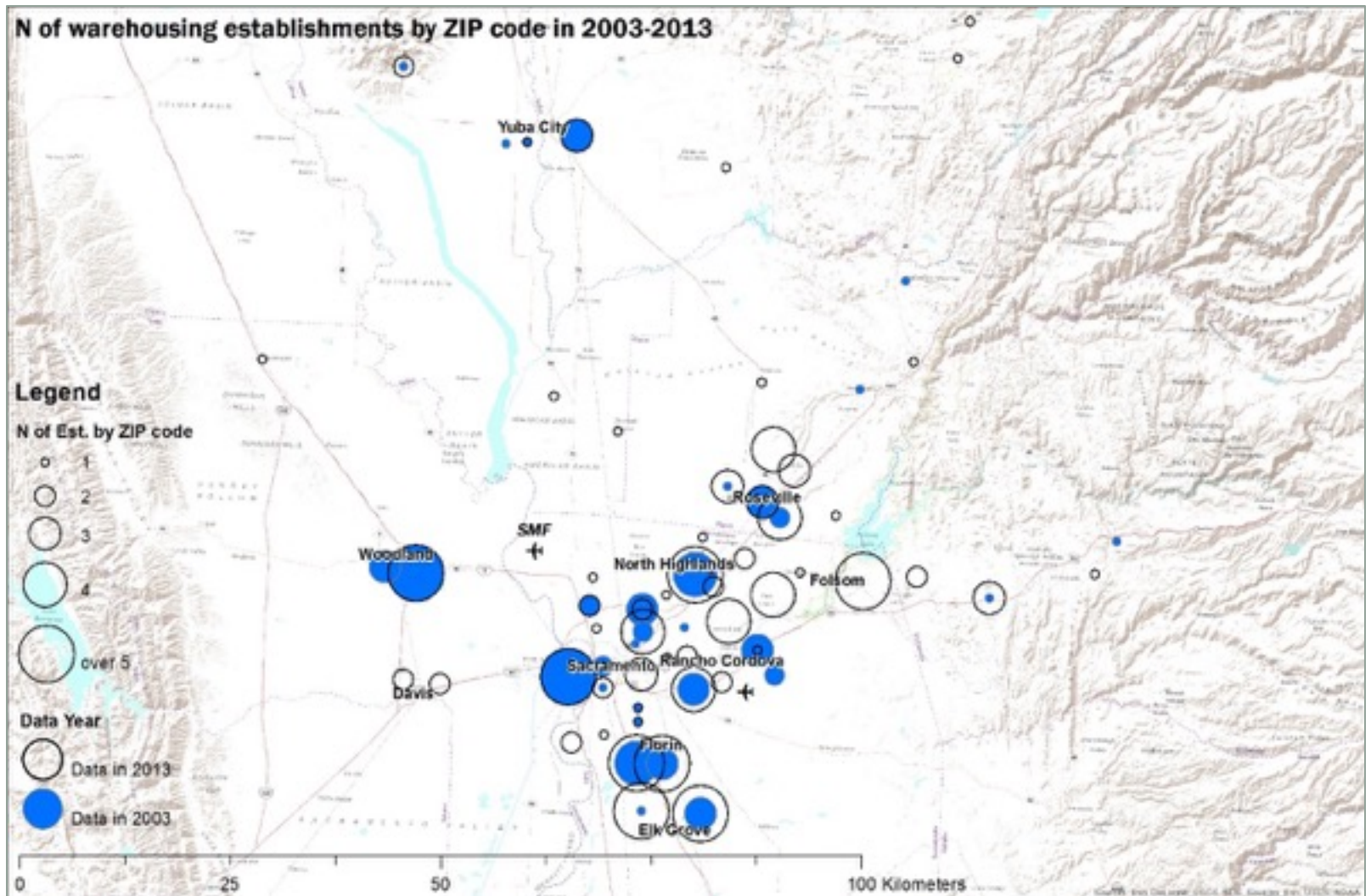● Data in 2003
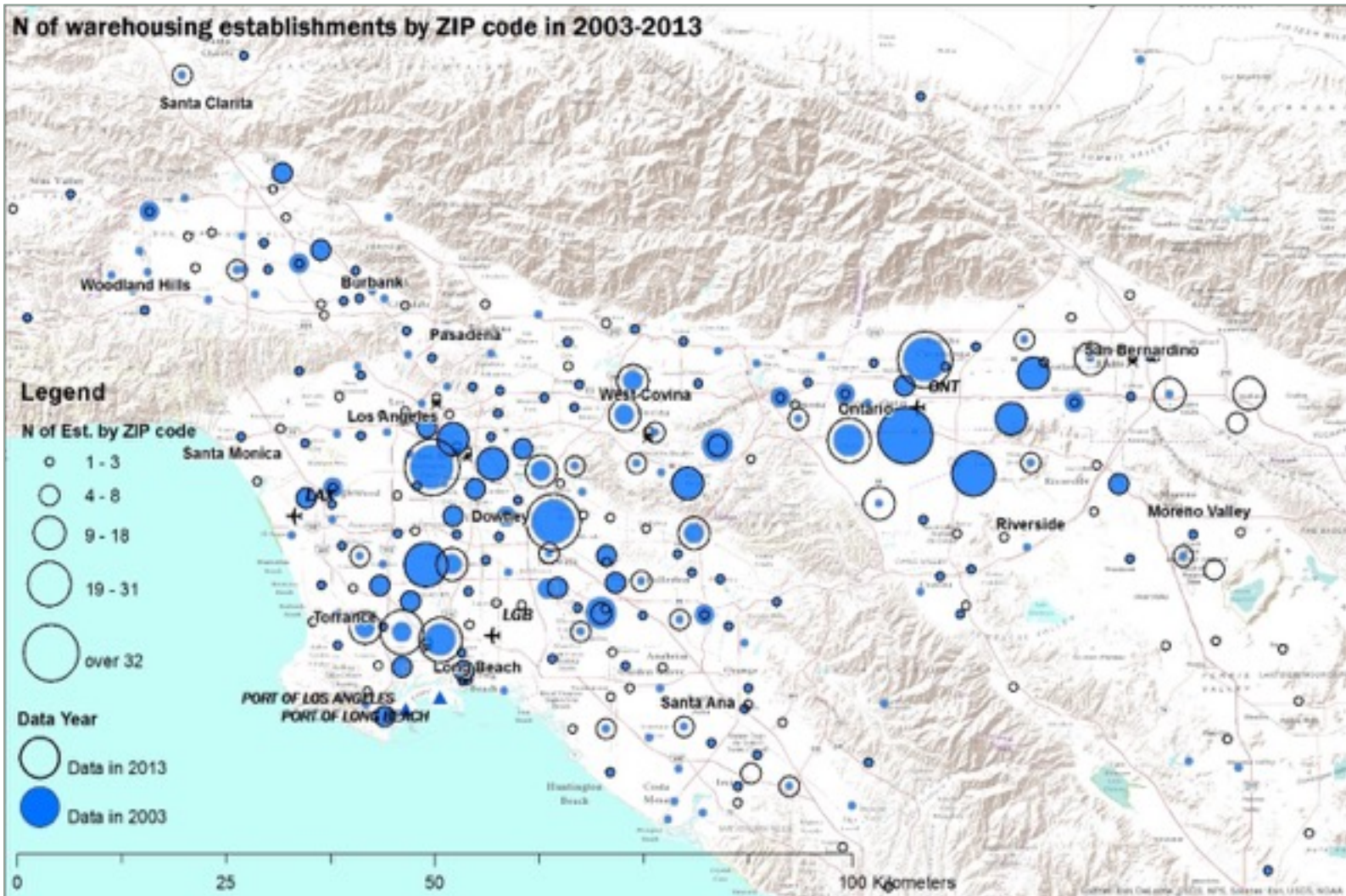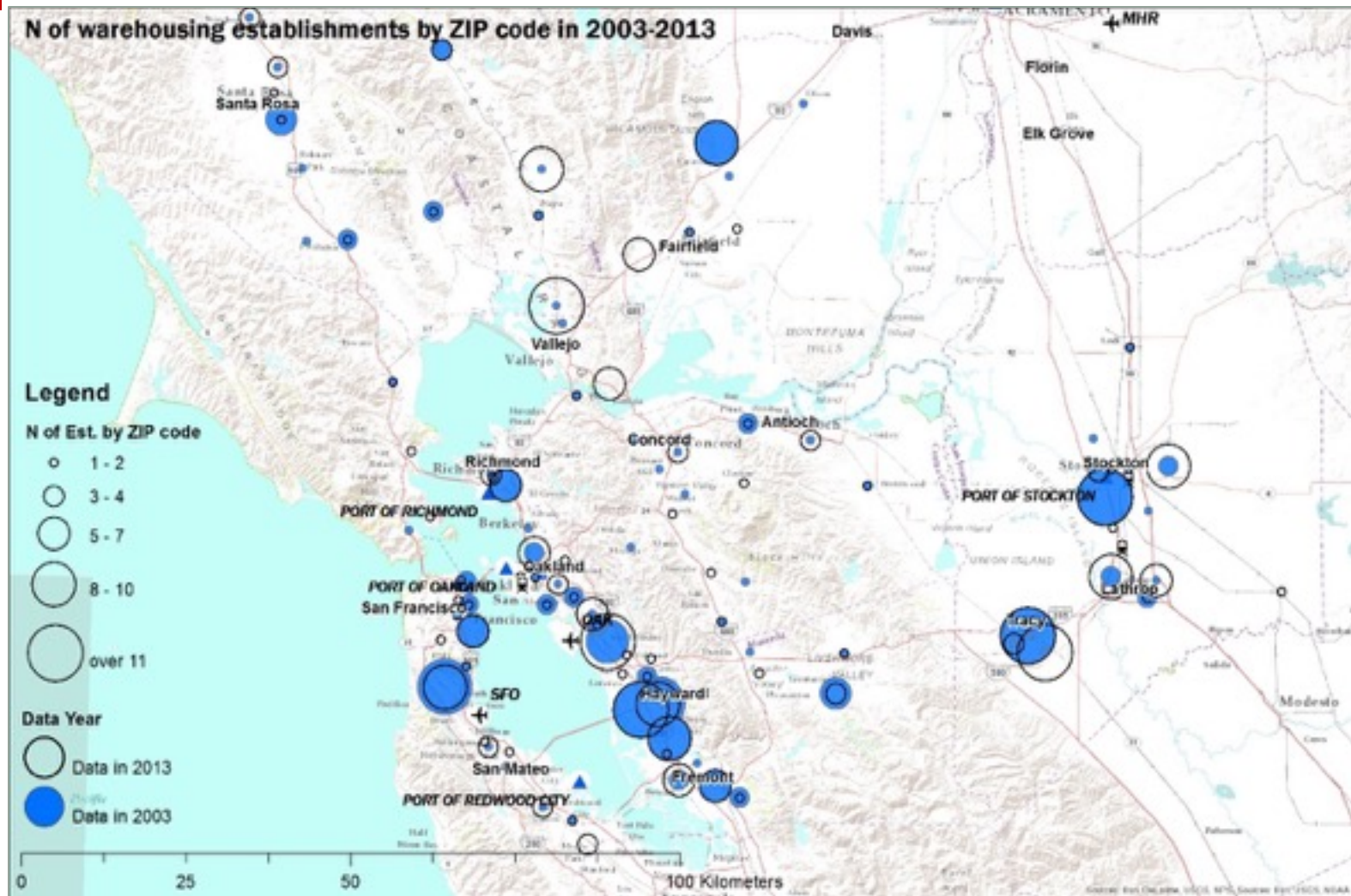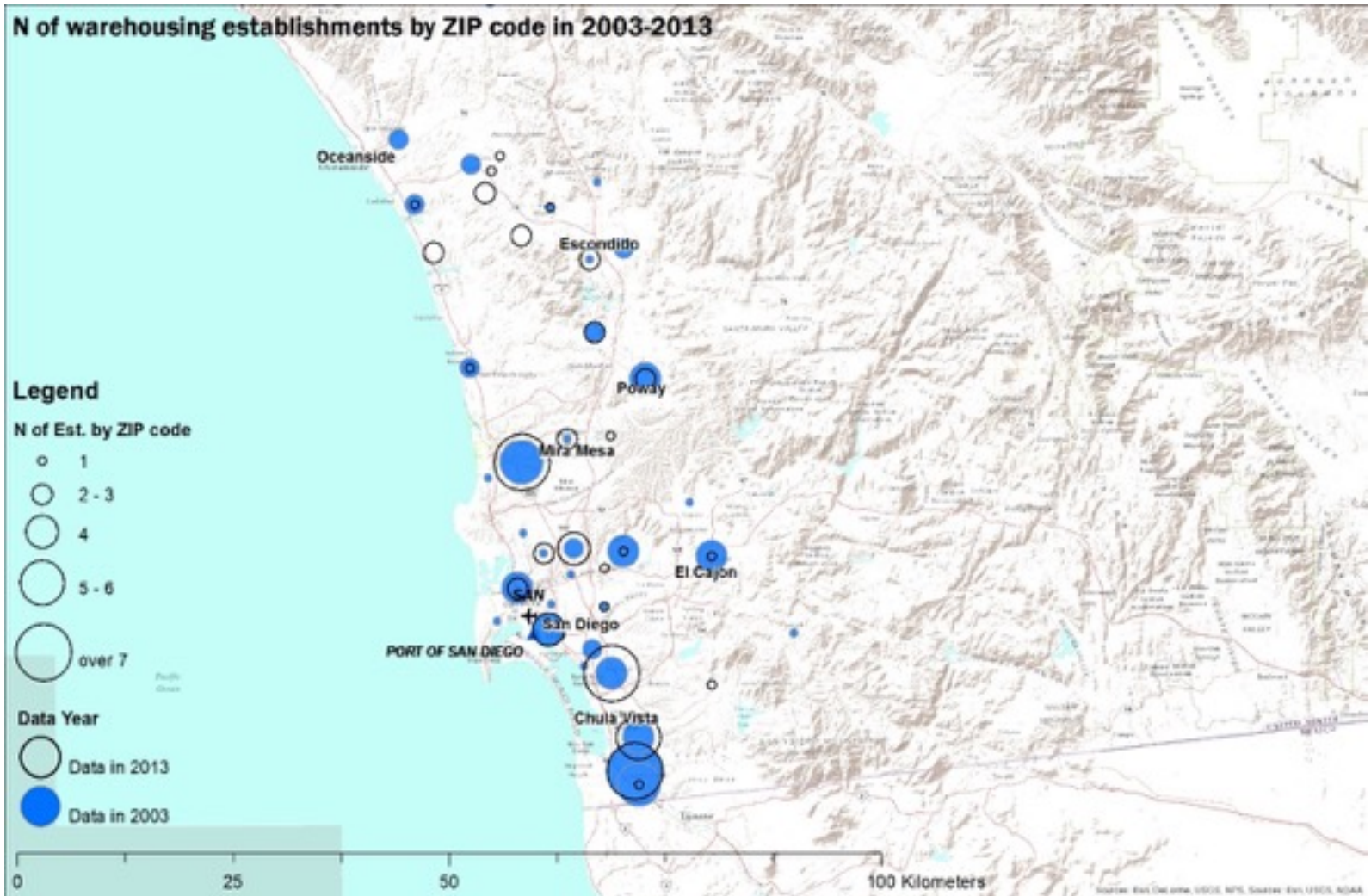
San Diego

N of warehousing establishments by ZIP code in 2003-2013

Average distance to CBD (miles)

	Los Angeles	San Francisco	Sacra-mento	San Diego
Establishments				
2003	25.1	33.8	14.3	13.5
2013	28.9	35.1	15.0	12.8
Employment				
2003	25.3	41.4	13.2	8.6
2013	36.1	44.8	13.8	10.4

Average distance to geographic center (miles)

	Los Angeles	San Francisco	Sacra-mento	San Diego
Establishments				
2003	20.7	28.8	14.7	12.9
2013	22.7	29.5	14.1	12.6
Employment				
2003	19.3	25.1	11.4	8.8
2013	23.0	26.3	13.7	9.8

Metro area	1-1 Ave distance CBD		1-2a airports		1-2c seaports	
	Est	Emp	Est	Emp	Est	emp
LA	+	+	+	+	+	+
SF	ns	+	ns	+	ns	+
Sac	ns	+	ns	+	na	na
SD	ns	+	ns	+	ns	+

Metro area	1-3 Ave distance WD geo-center	
	Est	Emp
LA	**+**	**+**
SF	ns	**+**
Sac	ns	**+**
SD	ns	**+**

Decentralization with respect to employment, but not establishments

Metro area	2-1 Ave distance all employment		2-2 Ave distance all population	
	Est	Emp	Est	Emp
LA	+	+	+	+
SF	ns	+	ns	+
Sac	ns	+	ns	ns
SD	ns	+	ns	+

M3 Gini coefficient, change 2003-2013

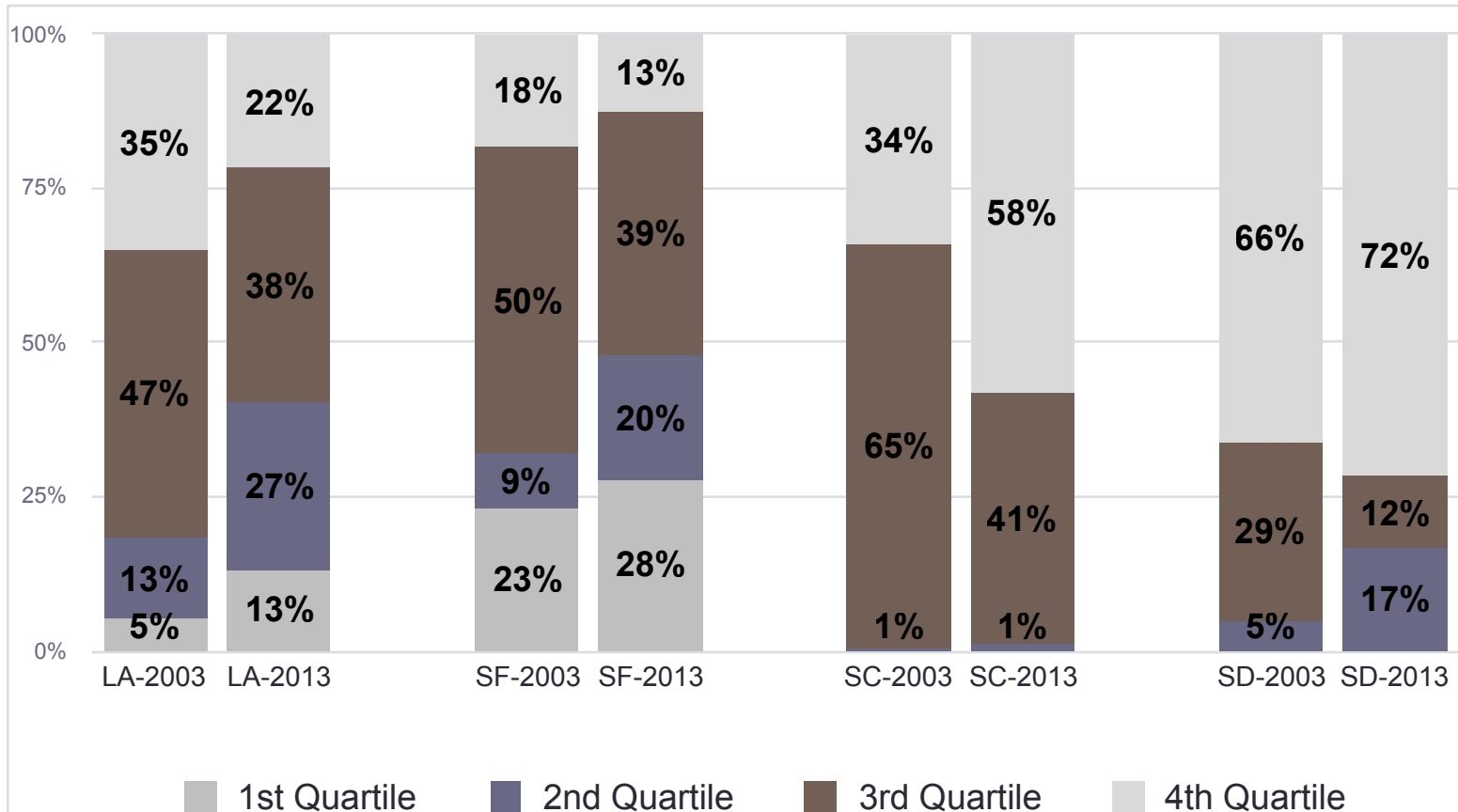| Metro area	3 Gini coeff	
	Est	Emp
LA	+	+
SF	+	ns
Sac	ns	+
SD	+	+

More concentration, but spatial configuration unknown

Share WD establishments in total emp density quartiles
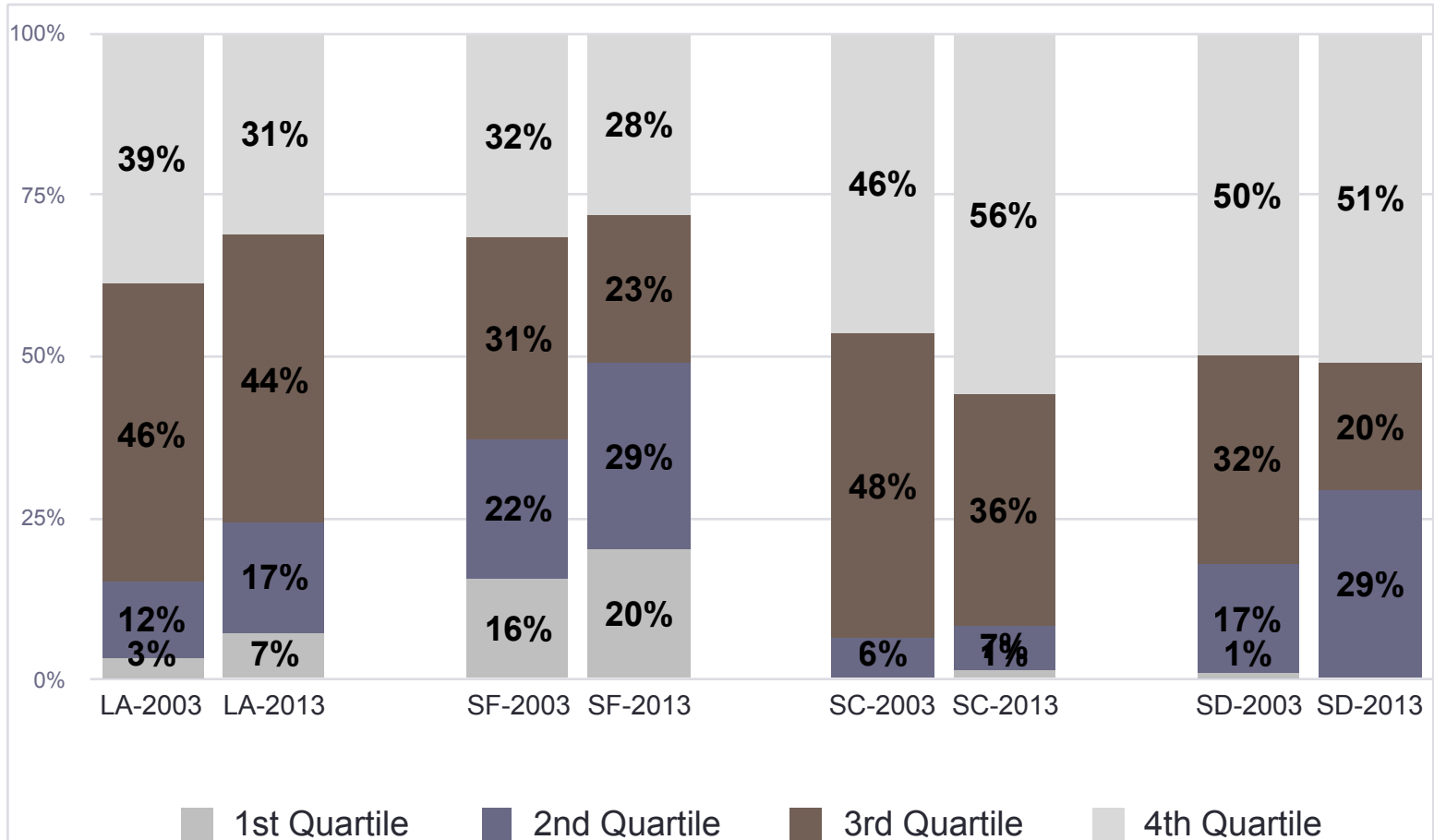
Share WD emp in total emp density quartiles

Results summary 1

- Decentralization
  - Establishments: consistent evidence of decentralization for LA only
  - Employment: consistent evidence of decentralization for all
- Land availability and price
  - Large facilities locating in places where land is more available and cheaper
  - Airports in LA, SF, SD are in/near core
    - Price, demand as push factors

❑ Importance of base conditions

  ▪ LA decentralized most, but SF is most decentralized

    • Physical geography likely plays a role

  ▪ Sacramento and SD much smaller, have much lower average densities, and far less decentralized by all measures

    • Labor force access as centralizer

❑ W&Ds are relatively concentrated

  ▪ Concentration increasing, but spatial patterns differ

❏ ## Metropolitan size

- ▪ Size correlated with density
- ▪ Density a proxy for demand, land price
- ▪ More land intensive activities are priced out of central locations
- ▪ Zoning may contribute
  - • Redevelopment of industrial zones
- ▪ Demand pressures evident in LA, SF, not in Sac, SD

❑ Economic structure

- Largest metro areas are trade centers
- W&Ds oriented to external markets have different location priorities
  - Access to national, international transport system
- LA and SF have more foreign trade than Sac and SD
- LA and SF have larger shares of employment in manufacturing, wholesale/ retail trade, transportation

Commodity flows, 1,000 tons, 2007

	Internal	Domestic	Foreign
Los Angeles	434,377	252,711	172,300
San Francisco	230,374	154,570	62,253
Sacramento	55,293	73,048	7,242
San Diego	46,349	37,721	14,003

Internal = origin and destination within zone
Domestic = origin or destination outside zone, in US
Foreign = origin or destination outside US

Source: Freight Analysis Framework, 2007

❑ Physical geography

- LA a vast (5400 mi²) metro area with decentralized population and employment

- SF has bay in center; land availability and access more constrained

- Main foreign trade source in SD is border, a physical constraint to location shifts

- Sacramento is located in flat plain with capacity to expand in all directions, but still plenty of land availability near core

Next steps

- ❑ Expand to 100 largest US metro areas
- ❑ Develop and estimate models to test factors associated with decentralization, concentration
- ❑ Consider methods to estimate impacts of spatial change

QUESTIONS

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