Exploring the Roles of Location and Transportation Provision on Business Establishment Formation, Dissolution, and Relocation

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Based on work with
Dr. Srinath K. Ravulaparthy (now Scientist at Lawrence Berkeley National Lab) and Dr. Adam W. Davis (now PostDoc at UC Davis)

Online Talk at the Center for Spatial Business
University of Redlands, School of Business, October 13, 2021

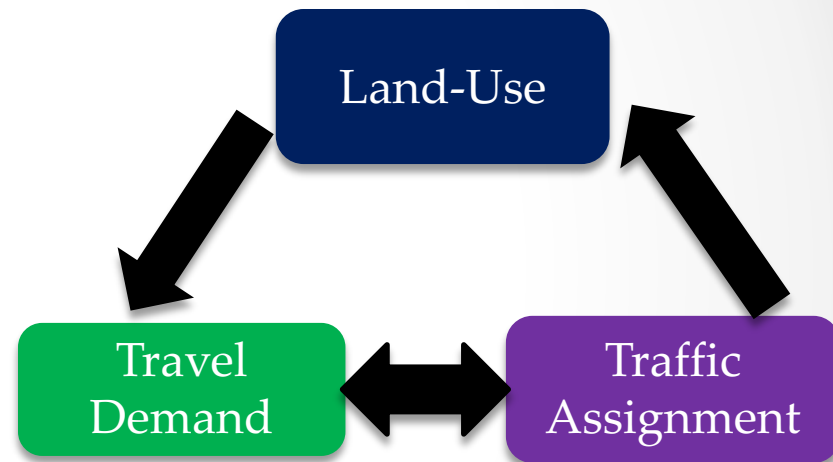# Background and Policy Context

Policy Measures

- Senate Bill 375 of California
  - Integration of transportation and land use policies
  - Reducing GHG emissions
  - Sustainable Communities
- Examples of policy measures
  - Transit Oriented Development
  - Compact neighborhood design
  - Complete Streets
  - Business friendly principles
- Need to develop integrated land-use transport models to assess the impact of policy actions
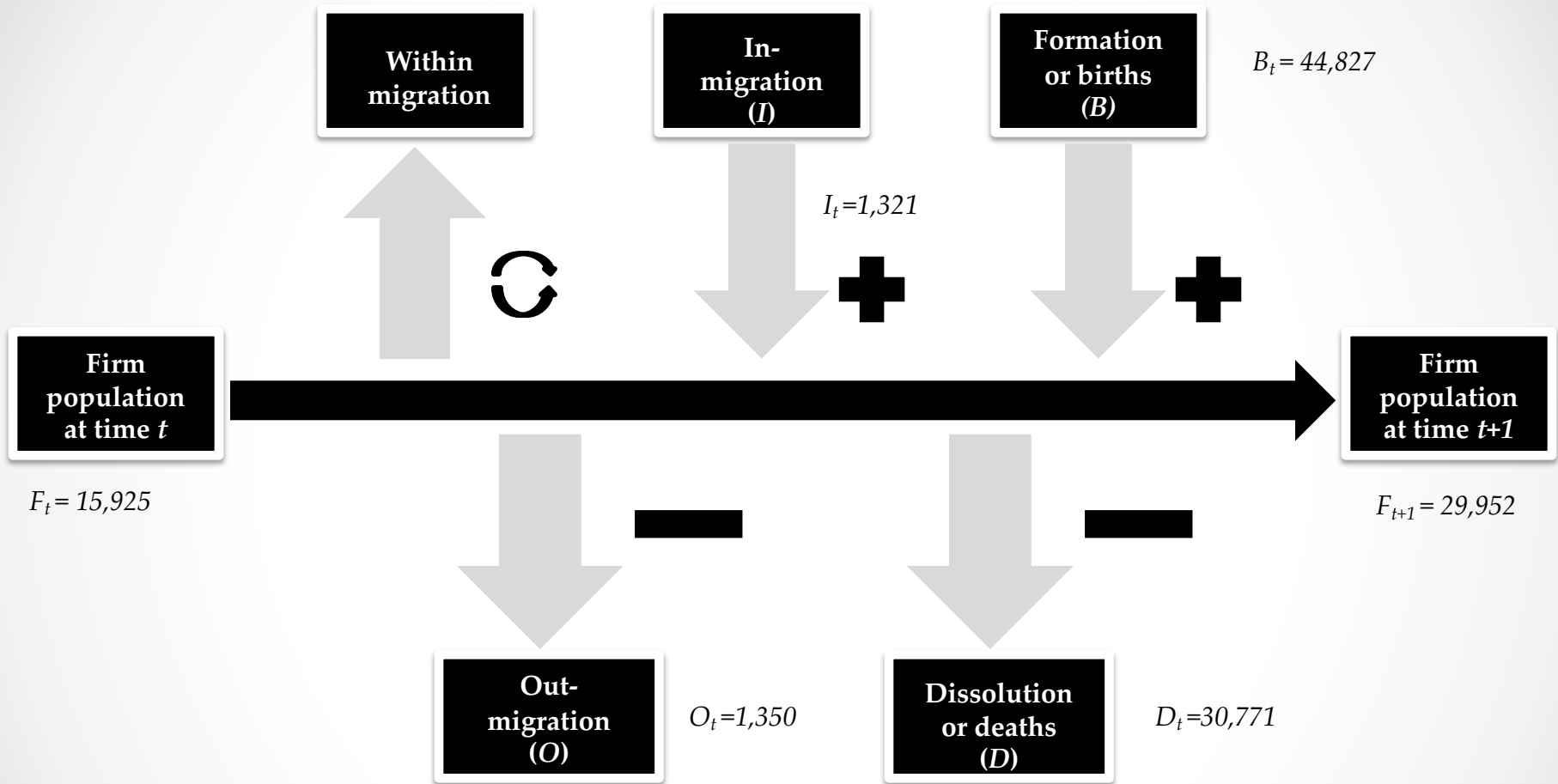
Integrated Urban Modeling

- Land-use model provides regional spatial distribution
  - Population
  - Economic activity
  - Land development
- Transportation model provides for a region
  - Activity and travel patterns
  - Travel times and Travel costs
  - Vehicle Miles Travelled and Pollutant Emissions
- Agents in an Urban Environment
  - Households and their members
  - **Firm/Business Establishments**
  - Land developer
  - Freight operators
- Accessibility – ease (or difficulty) of reaching activity opportunities from a given location
  - Impacts the decision making processes of the agents
  - Decision to locate a restaurant

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        Land-Use
       ↙        ↖
Travel          Traffic
Demand ⟷        Assignment
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Alonso (1964), Miller et al. (1999), and Waddell (2002); Pendyala et al. (2012)

Firm Demography

- Firm Demography
    - economy driven by individual firms
    - basic unit is a firm but location is a business establishment
    - Business establishment events of formation, growth/decline, relocation and closure

- Firmography (business establishments)
    - firm-level microsimulation-based approaches
    - micro-representation of spatial economy
    - ideal approach for integrated land use – transportation models
    - better assess ramifications of regional planning policies

van Wissen (2000); Hunt et al. (2003); Elegar and Miller (2006); Moeckl (2009); de Bok (2009); Maoh and Kanaroglou (2013);

Evolution of business establishment (BE) population

- Accurately describe the evolution of BE population in space and time
- $[F_{t+1} = F_t + B_t - D_t + I_t - O_t]$
- Example: BE population almost doubled in Santa Barbara County from 1990 to 2010
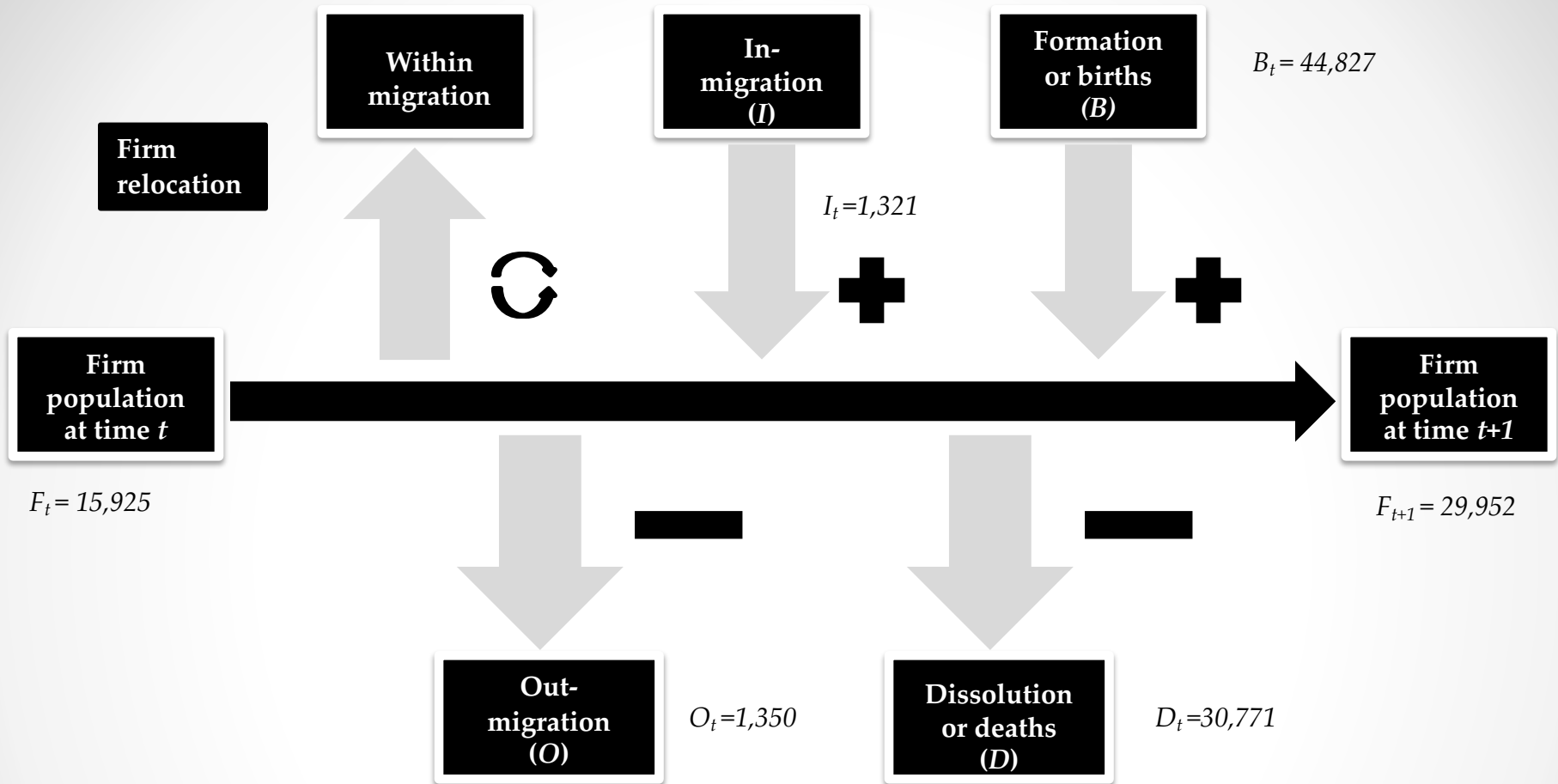
- Fundamental events are formation, relocation and dissolution
- Spatial distribution of economic activities in a region critical for
-accessibility measurement
-activity and destination choice
-land-simulation models
-commercial vehicular movements

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Motivation & Objectives

- Motivation
  - In simulation models we want to:
    - ADD geographical dimension of firm and BE processes and factors triggering these events
    - ADD detailed representation of spatial environment of BEs (e.g., urban street network and structure along which stores are located)
    - TEST land use policies
- Initial research questions and objectives
  - Can we operationalize location in-terms of its - importance, quality and advantage?
  - *What role does location play in triggering BE events such as* birth, relocation and death?
  - Any significant role in efficiency (ratio of revenues over costs)?

Data Used

California Data

- U.S. Census data of 2000 and 2010
  a. Blocks, Block groups, tiger line networks
  b. Population, household structure, and employment

- National Establishment Time Series Database
  a. Unit of observation is a business establishment
  b. Longitudinal data on BEs from 1990-2013
  c. 6.7 million BEs with a longitudinal record of employment, sales, industry type, birth, death, location and relocation (addresses and longitude & latitude in later years verified)
  d. Classified by the 6-digit North American Industrial Classification System (NAICS)

- Industry types classified by 2-digit NAICS code
  o 16 industry types

- For zoomed in studies supplementary data
  o Tax assessor parcels (land area and tax value)
  o Detailed roadway network and public transportation accessibility

Case Study 1: Santa Barbara County

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Ravulaparthy, S. K., & Goulias, K. G. (2014). Characterizing the composition of economic activities in central locations: Graph-theoretic approach to urban network analysis. *Transportation Research Record, 2430*(1), 95-104.
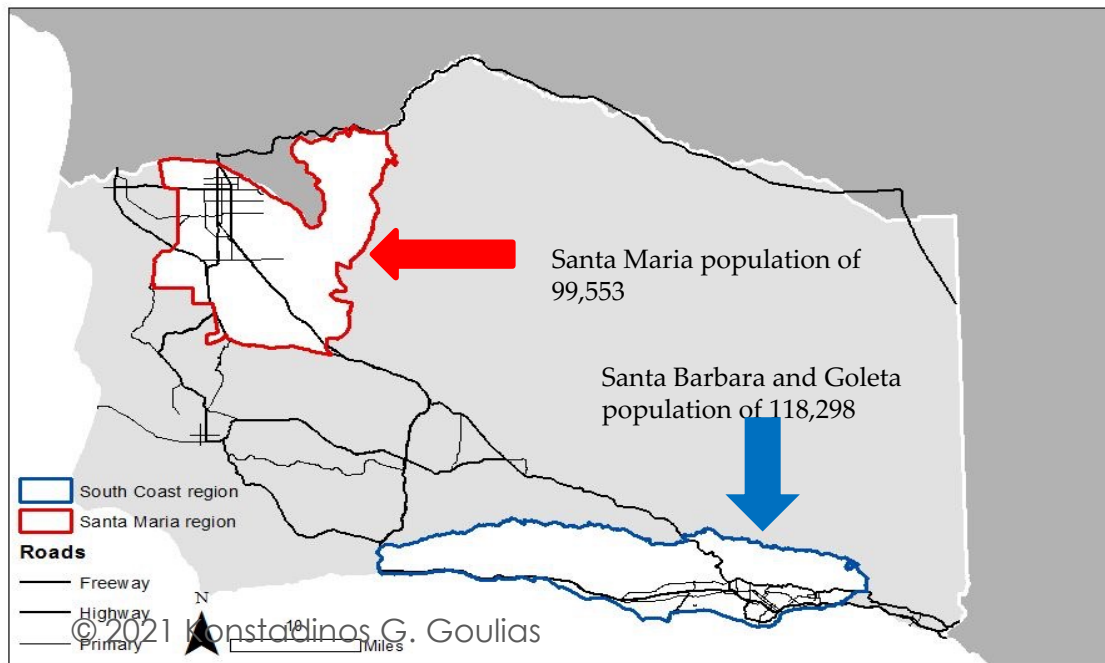
Study Region and Data

- Santa Barbara County U.S. Census 2000
  a. 399,347 population
  b. 215,440 employment
- National Establishment Time Series Database
  a. Unit of observation is a firm or a business establishment
  b. Longitudinal data on BEs from 1990-2010
  c. Employment, sales, industry type, birth, death, location and relocation
- Descriptive stats for 1990-2010
  a. 61,987 BEs in the database
  b. Mean employment size of 9.15
  c. Average sales of 0.88million USD
- Industry types classified by 2-digit NAICS code
  o 16 industry types
- Year 2000 U.S. Census Tiger Line Network
  o 32,395 nodes with 64,790 links
  o 303.41 meters average link length
- Year 2000 U.S. Census block demographic information
  o Population
  o Household structure
- Year 2000 Santa Barbara County Tax Assessor Parcel
  o Land area
  o Price per unit area

Area
- **Total** 3,789 sq mi (9,810 km^2)
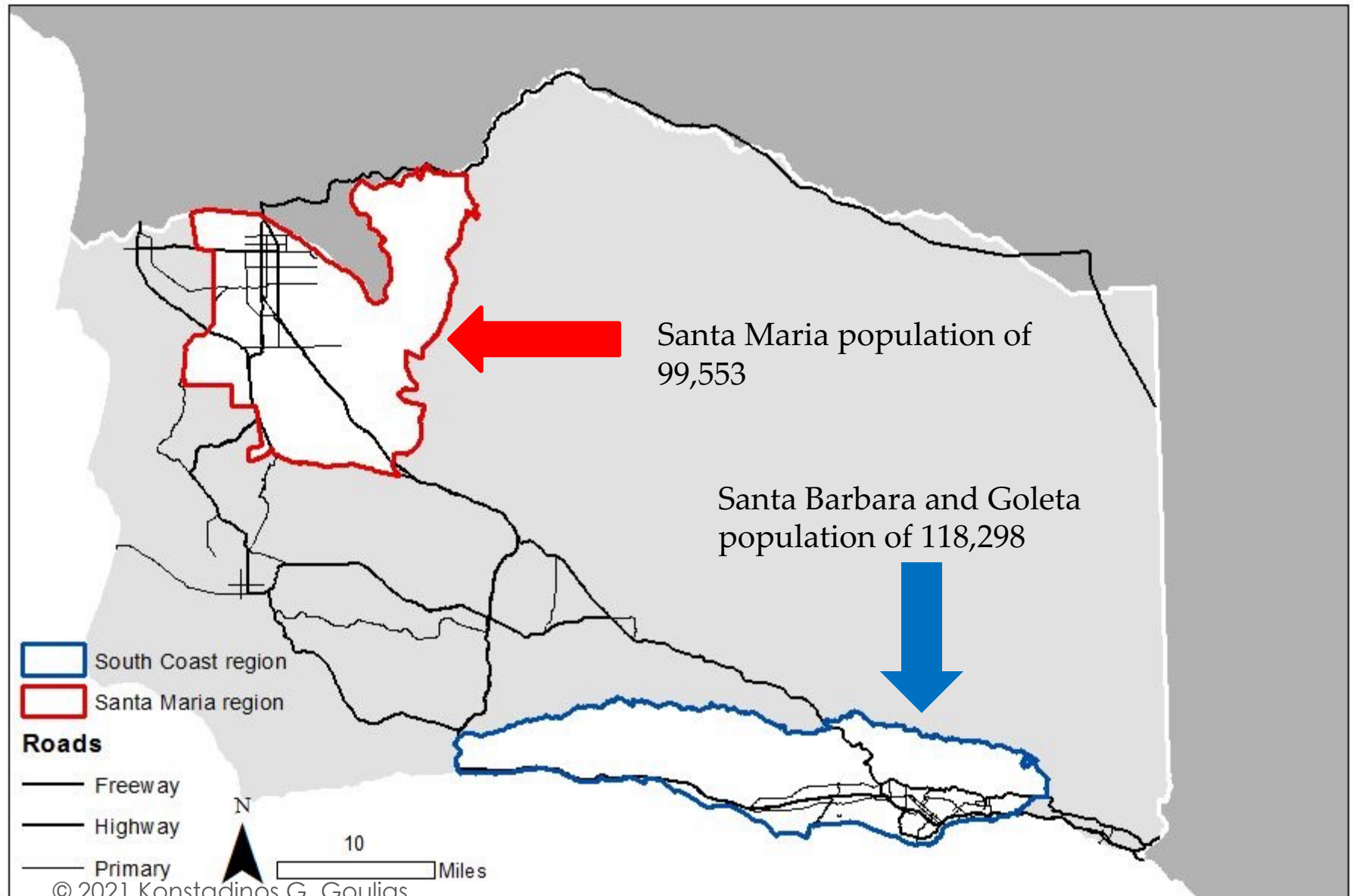- **Land** 2,735 sq mi (7,080 km^2)
- **Water** 1,054 sq mi (2,730 km^2)

Population
- **Total (2010)**   423,895
- **Estimate** (2014)   440,668
- **Density**   110/sq mi (43/km^2)

Santa Maria population of 99,553

Santa Barbara and Goleta population of 118,298

South Coast region
Santa Maria region

Roads
— Freeway
— Highway
— Primary

N

Miles

Santa Barbara County

Study Region

Santa Maria population of 99,553

Santa Barbara and Goleta population of 118,298

South Coast region
Santa Maria region

Roads
— Freeway
— Highway
— Primary

N

10 Miles

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BE Events: Definitions

- Relocation
  - o Change in address of the BE from one location to another in the NETS database

- Formation
  - o First year in which the BE was recorded in NETS database in Santa Barbara County only

- Dissolution
  - o Last year in which the BE was recorded in NETS database in Santa Barbara County only

- BEs formed or closed outside county not included

BE Events Over Time
## (in 1990 we had 15,925 and in 2010 we had 29,952 BEs)
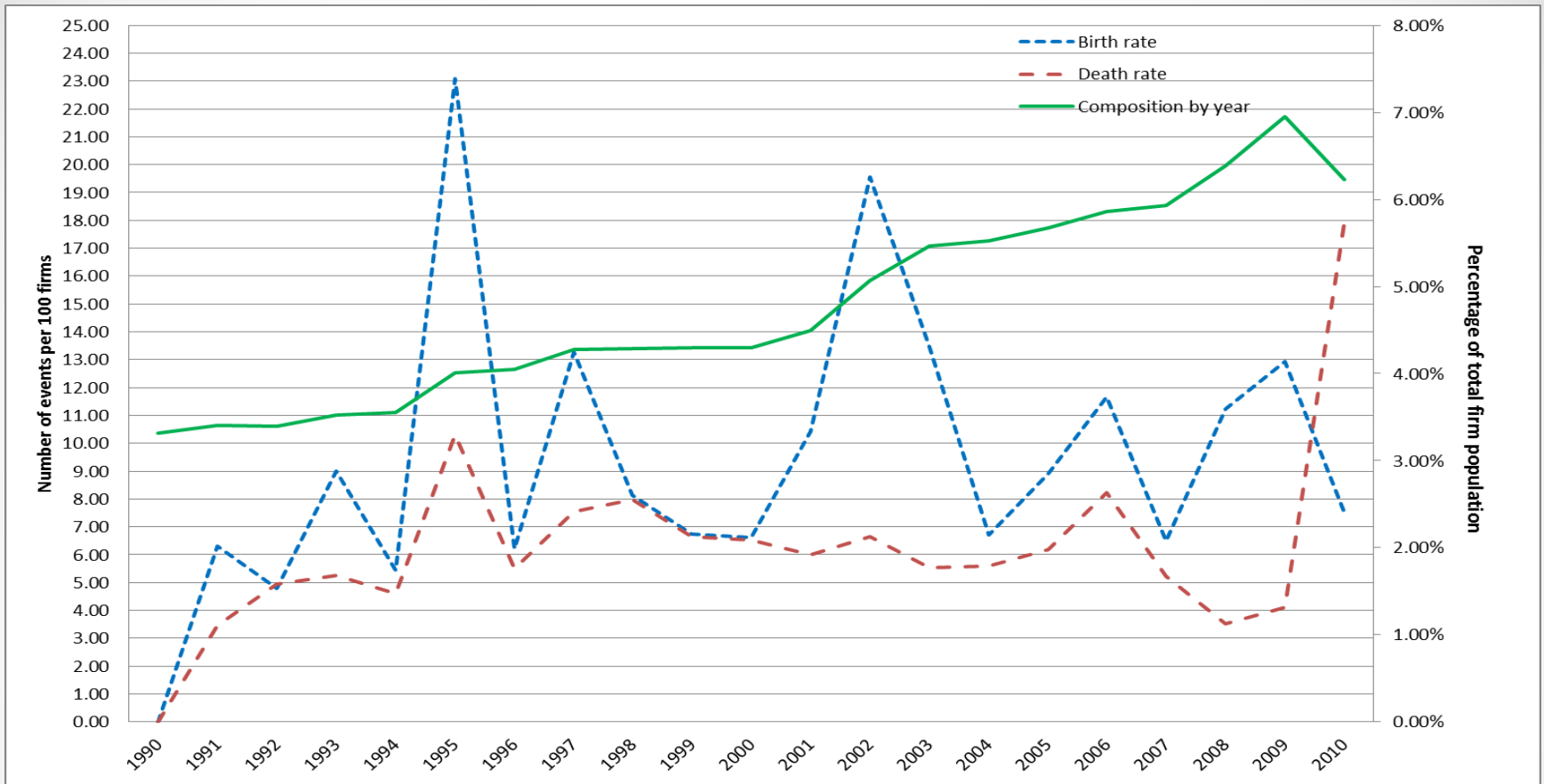
- Increase in BE population (in green) with an average annual growth of 2.9%
- Persistent formation of new BEs (in blue) with an average of 9.45 new BEs per 100 BEs
- BE closures (in red) fairly stable with an average of 6.27 deaths per 100 BEs with *noticeable effect of recession in 2010*

BE Formation by Industry Type
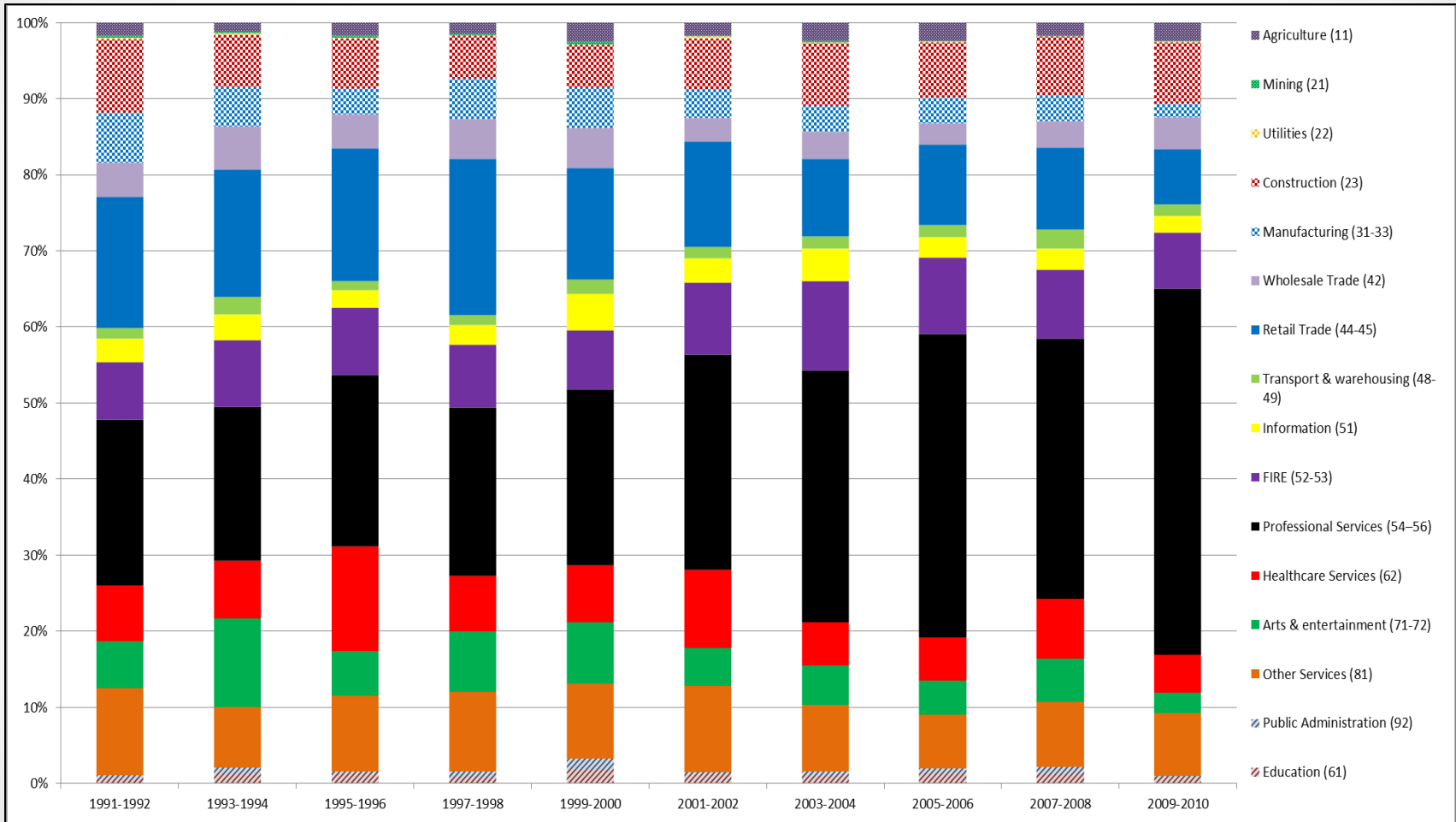
- Professional services (black), retail trade (blue) and other services like beauty salons and auto repairs are high in proportion
- New healthcare service firms (in red) are high in 1995-1996 and 2001-2002
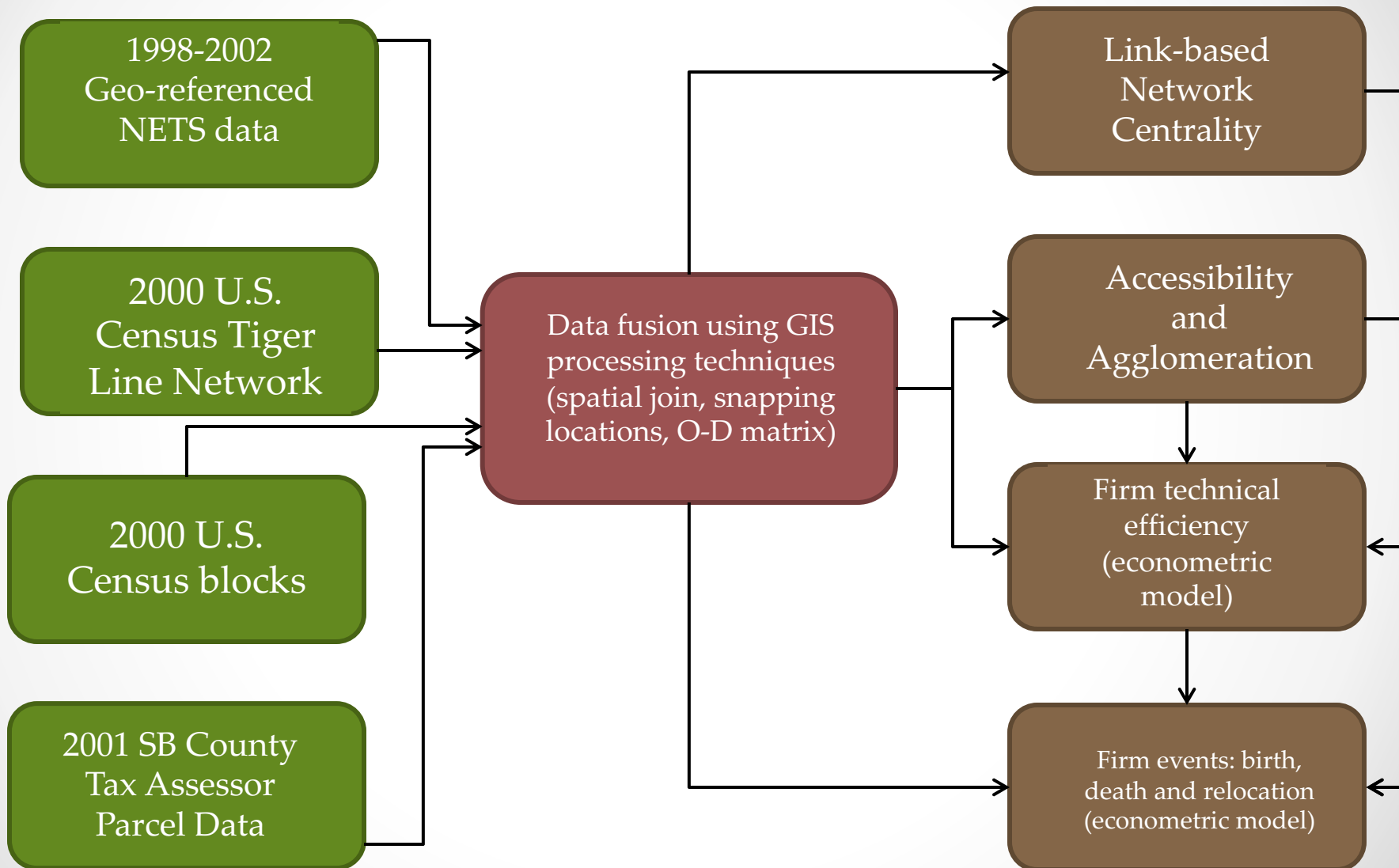
BE Relocation by Industry Type
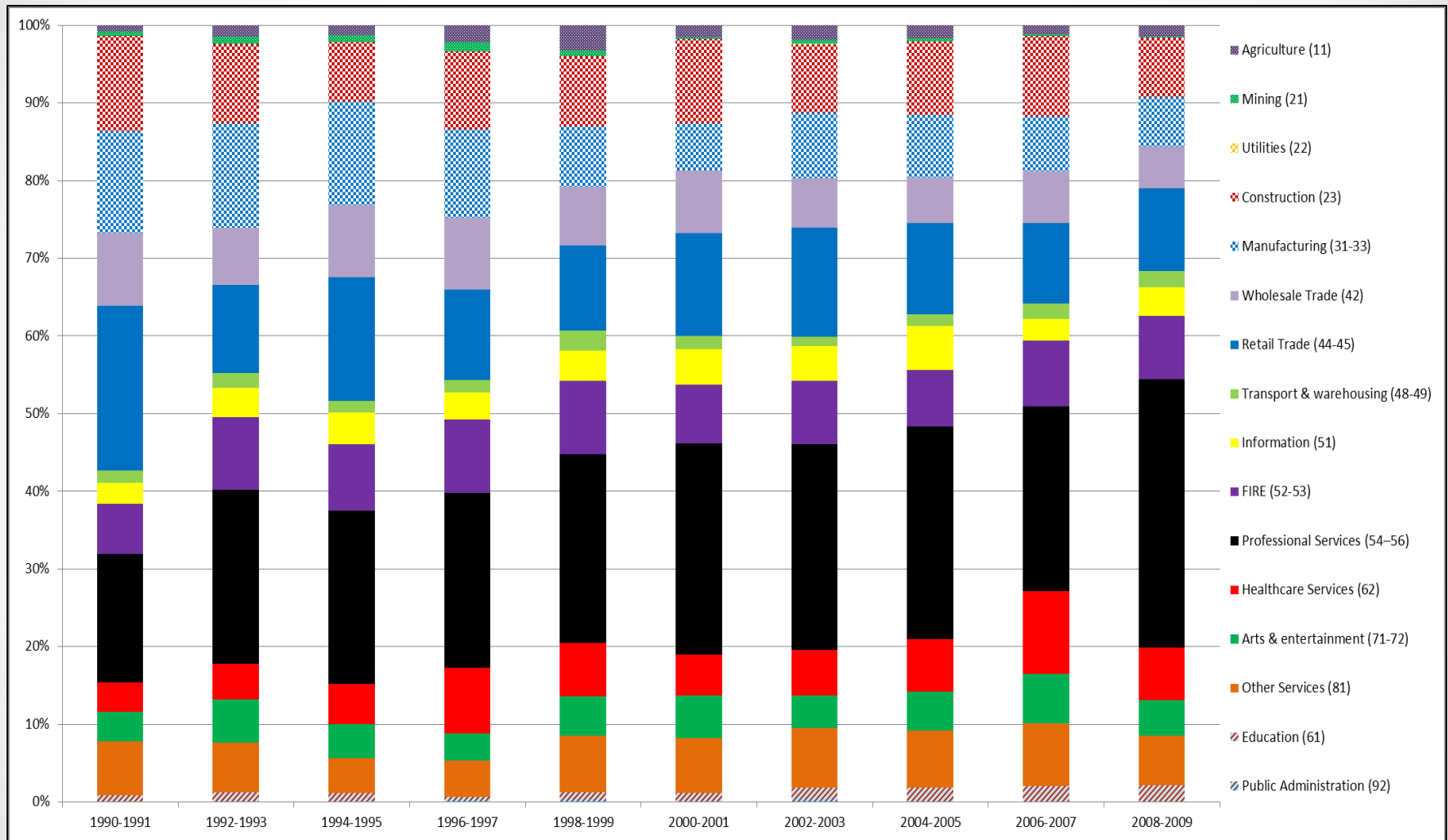
- Within relocation = 62%; In-migration = 18.7%; Out-migration = 19.3%
- Professional services, retail trade and construction are most mobile
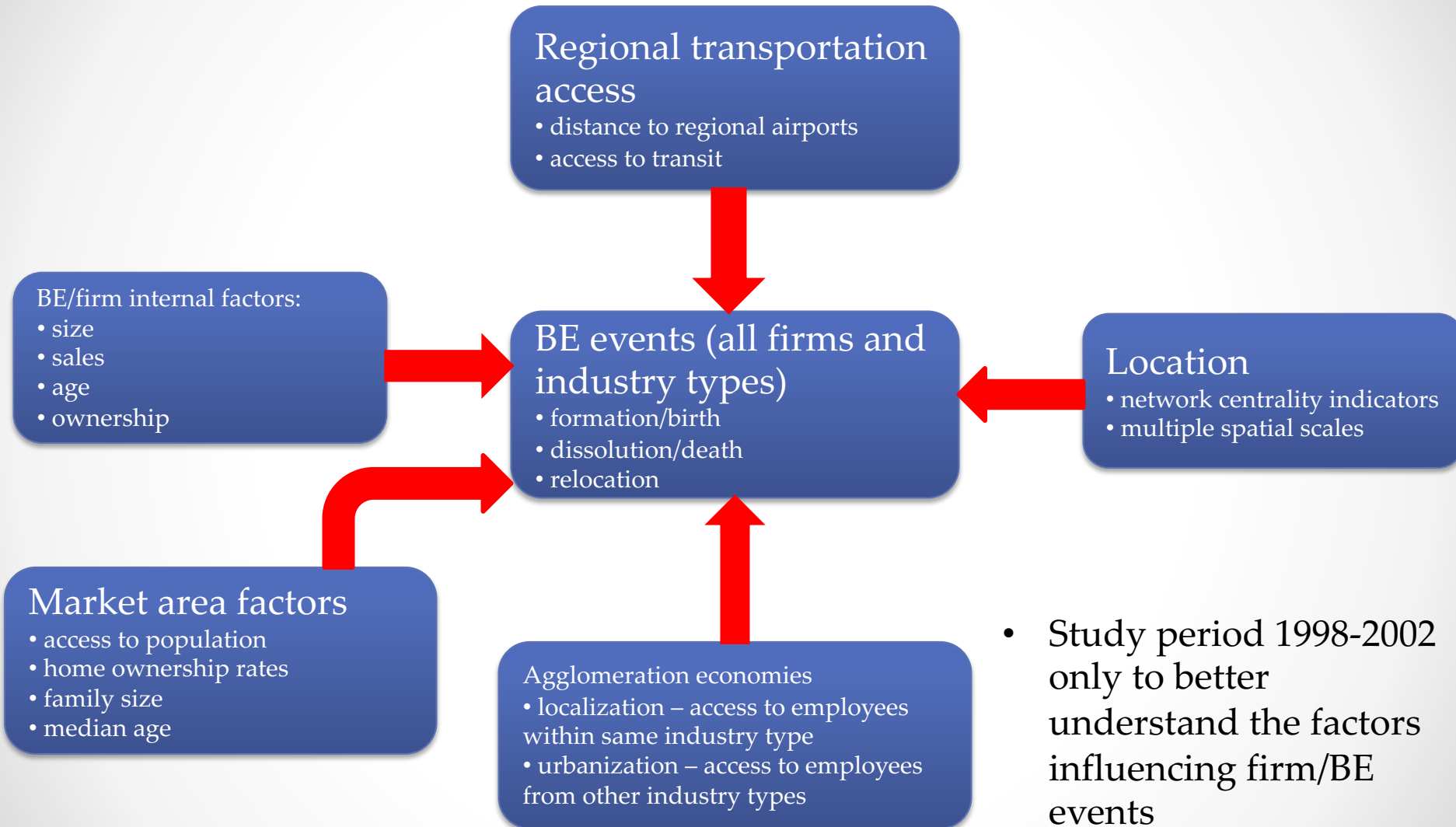
BE Dissolution by Industry Type
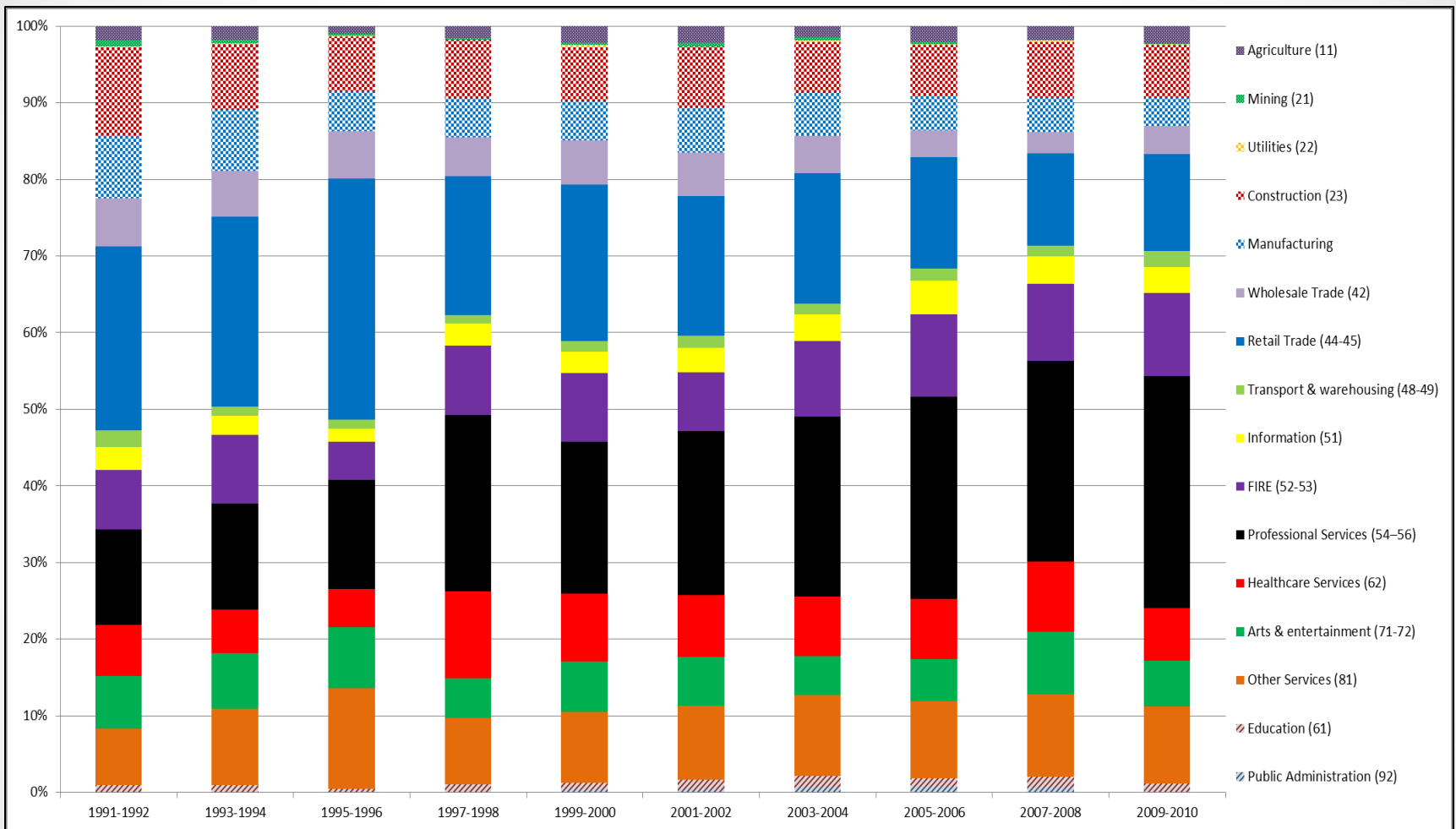
- Professional services, retail trade and other services are high in proportion

Data Processing

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┌─────────────────┐
│  1998-2002      │
│  Geo-referenced │
│  NETS data      │
└─────────────────┘

┌─────────────────┐          ┌──────────────────────┐          ┌─────────────────┐
│  2000 U.S.      │          │  Data fusion using   │          │  Link-based     │
│  Census Tiger   │───────▶  │  GIS processing      │───────▶  │  Network        │
│  Line Network   │          │  techniques (spatial │          │  Centrality     │
└─────────────────┘          │  join, snapping      │          └─────────────────┘
                             │  locations, O-D      │
┌─────────────────┐          │  matrix)             │          ┌─────────────────┐
│  2000 U.S.      │          └──────────────────────┘          │  Accessibility  │
│  Census blocks  │                                             │  and            │
└─────────────────┘                                             │  Agglomeration  │
                                                                └─────────────────┘
┌─────────────────┐                                             ┌─────────────────┐
│  2001 SB County │                                             │  Firm technical │
│  Tax Assessor   │                                             │  efficiency     │
│  Parcel Data    │                                             │  (econometric   │
└─────────────────┘                                             │  model)         │
                                                                └─────────────────┘

                                                                ┌─────────────────┐
                                                                │  Firm events:   │
                                                                │  birth, death   │
                                                                │  and relocation │
                                                                │  (econometric   │
                                                                │  model)         │
                                                                └─────────────────┘
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Methodology

Modeling Framework

Regional transportation access
- distance to regional airports
- access to transit

BE/firm internal factors:
- size
- sales
- age
- ownership

BE events (all firms and industry types)
- formation/birth
- dissolution/death
- relocation

Location
- network centrality indicators
- multiple spatial scales

Market area factors
- access to population
- home ownership rates
- family size
- median age

Agglomeration economies
- localization – access to employees within same industry type
- urbanization – access to employees from other industry types

- Study period 1998-2002 only to better understand the factors influencing firm/BE events

Regression framework

- BE events in both space and time
  - Panel based binary outcome model
  - Formation (*b*), dissolution (*d*) and relocation (*r*)

- Models estimated
  - For all BEs using random effects binary probit model
    - To account for serial correlation
  - For industry specific using pooled estimation

Operationalizing Location using Network Analysis

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Link-based Multiple Centrality (location "quality")

- ## Remoteness Centrality -
  - d_{ij} network shortest-path distance between links i and j
  - Captures the cost of overcoming spatial separation between places

- ## Betweenness Centrality -
  - n_{jk} number of shortest paths between links j and k
  - $n_{jk}[i]$ number of these shortest paths that pass through link i
  - Prominence of a link acting as a facilitator or intermediary among other links

- ## Straightness Centrality -
  - Ratio of straight line (δ_{ij}) to network shortest-path distance (d_{ij})
  - Grid network like feature measuring corridor property

- ## Reachness Centrality -
  - Enumerates the number of links that can be reached from link i

- ## Computed at multiple spatial-scales
  - **2.5km, 6km, 12km and all county**
  - account for relative importance of the link in the region

Modified link-based version of Multiple Centrality

Link-based Multiple Centrality

- Remoteness Centrality
    1. Captures network connectivity and concentration
    2. Identifies major urban centers
- Betweenness Centrality
    1. Role of a link as a pass-through nexus or traversing point in the region
    2. Importance of local and collector roads serving as connectors within 2.5km

(a) Remoteness Centrality within 2.5km Network Buffer

(b) Betweenness Centrality within 2.5km Network Buffer
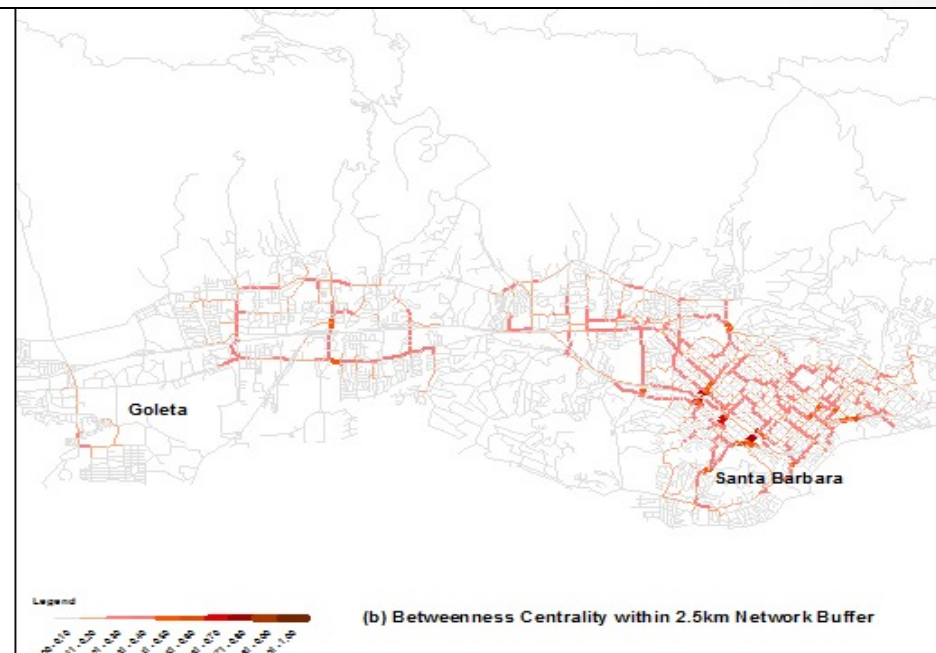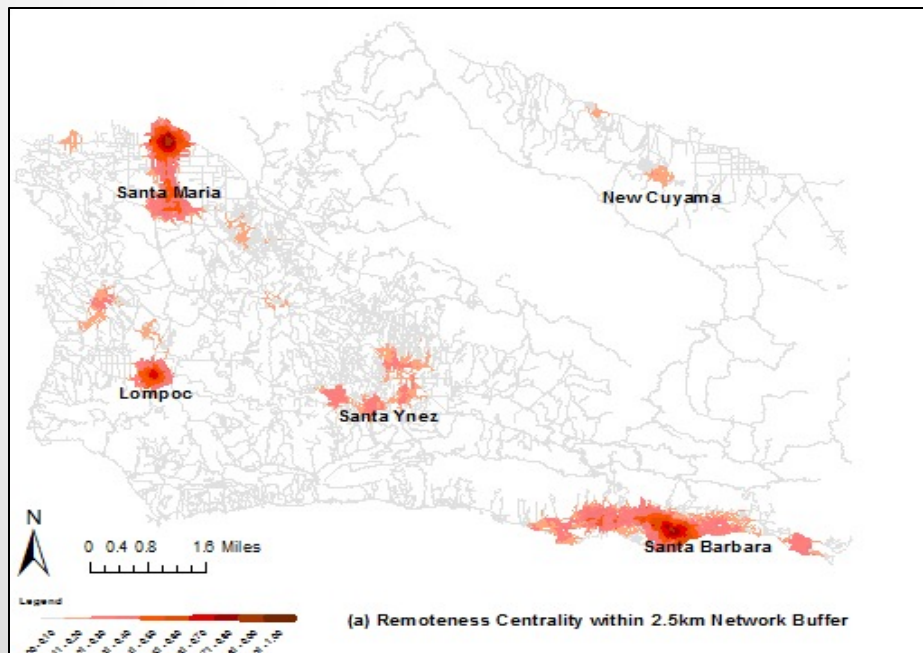
Remoteness Centrality within 2.5km   Betweenness Centrality within 2.5km

Link-based Multiple Centrality

- Straightness Centrality
    1. Network shortest-paths resembling Euclidean distances
    2. Urban centers and effects of local network structure
    3. Grid-network like design in downtown areas
- Reachness Centrality
    1. Number of links reached within the network buffer
    2. High concentration of network links in downtown areas

(c) Straightness Centrality within 2.5km Network Buffer

(d) Reach Centrality within 2.5km Network Buffer

Straightness Centrality within 2.5km   Reachness Centrality within 2.5km
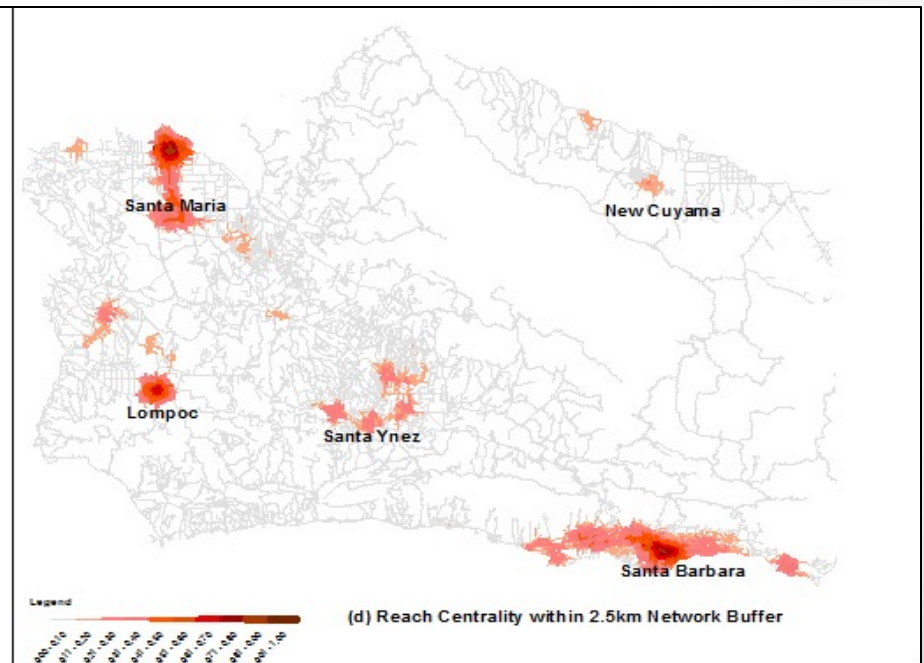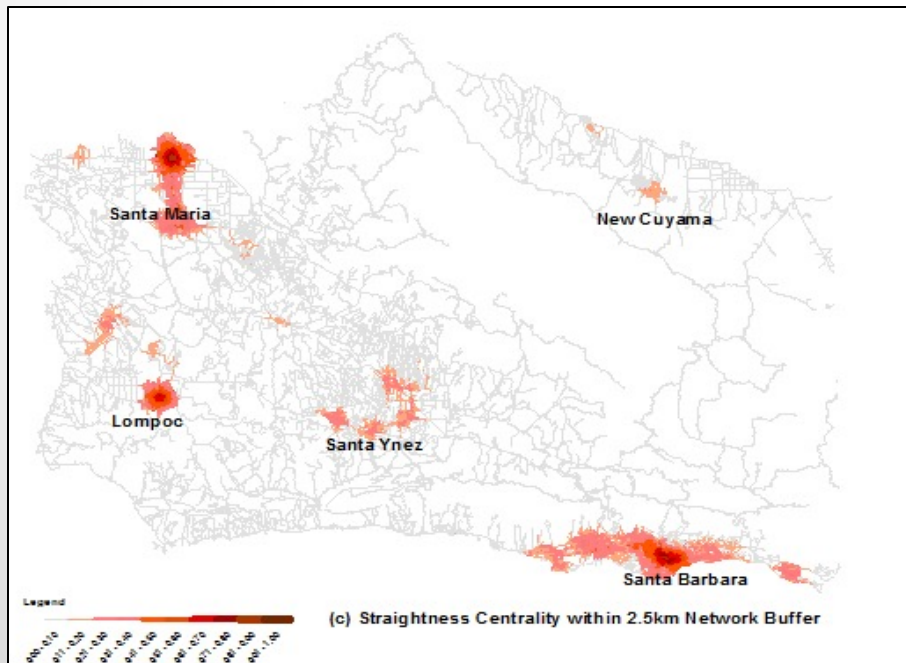
Networks and Structure Matters: Key Findings

Link-based Centrality: BE Formation

Centrality indices	All firms	Retail Trade	Professional Services
Log(betweenness within 2.5km)	0.015 (2.57)	---	---
Log(reachness within 2.5km)	0.808 (2.17)	---	0.505 (2.134)
Log(straightness within 2.5km)	-1.353 (-4.39)	---	---
Log(remoteness within 2.5km)	0.444 (2.47)	---	---
Log(betweenness within 6km)	---	0.162 (2.35)	---
Log(reachness within 12km)	---	---	1.127 (1.86)

- BE formation is significantly impacted by structure and configuration of the regional transportation network.
- Higher probability of BE formation in downtown areas => centrality indicators within 2.5km capturing local network structure (e.g., ease of access for pedestrians for business opportunities)
- Retail trade BEs more likely to be born in locations along major and minor arterials => potential for business opportunities by traversing trips

Link-based Centrality: BE Relocation

Centrality indices	Retail Trade	Manufacturing	Healthcare Services	Professional Services
Log(betweenness within 2.5km)	---	---	---	-0.107 (-2.48)
Log(betweenness within 6km)	---	---	-0.339 (-1.87)	
Log(betweenness within 12km)	---	---	0.324 (2.115)	
Log(reachness within 2.5km)	---	1.56 (1.402)		
Log(reachness within 12km)	-3.679 (-2.04)	-5.261 (-2.05)		

- Network centrality indicators have varying levels of impact on business relocation
- Manufacturing and Retail trade are more likely to stay-put with high reachness index => value access to roadways that are major arterial and freeways
- Healthcare services more likely to relocate from locations with high betweenness within 12km => fewer traversed links having fewer pass-through trips for potential opportunities

Link-based Centrality: BE Dissolution

Centrality indices	All firms	Retail Trade
Log(betweenness within 2.5km)	-0.022 (-1.97)	---
Log(reachness within 2.5km)	0.711 (2.19)	---
Log(straightness within 2.5km)	-0.551 (-2.09)	---
Log(remoteness within 2.5km)	-0.199 (-1.92)	---
Log(betweenness within 12km)	---	-0.095 (-1.67)

- Higher probability of survival in downtown areas => local network structure of concentration and connectivity that provides ease of access for vehicular and pedestrian flow
- Retail trade BEs are less likely to fail in locations along major arterials and sections of freeways=> potential for economic opportunities with high betweenness centrality (e.g., gas stations and trips along freeways)

Porta et al. (2009), Wang et al. (2011)

Other location factors: Key Findings

Population density

(a) Santa Maria

(b) Solvang and Santa Ynez

(c) Santa Barbara and Goleta

(d) Downtown Santa Barbara
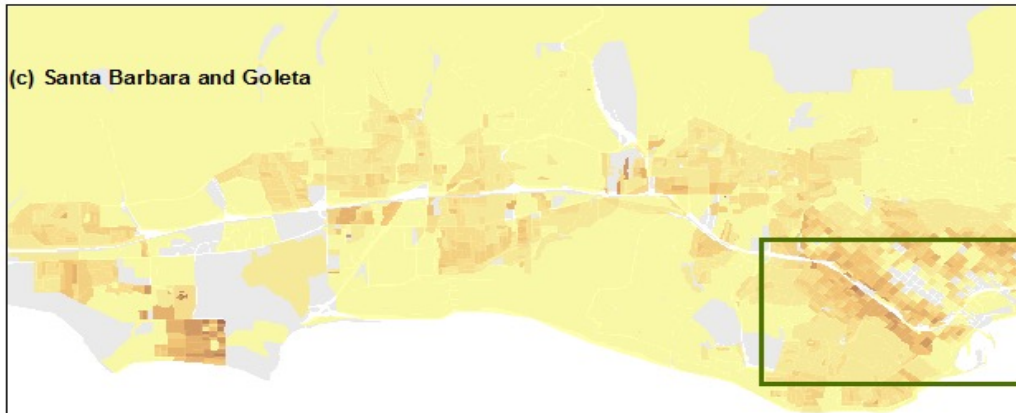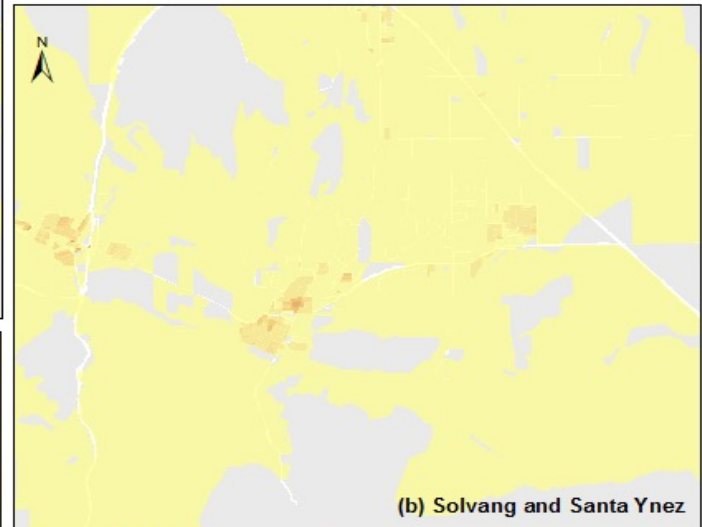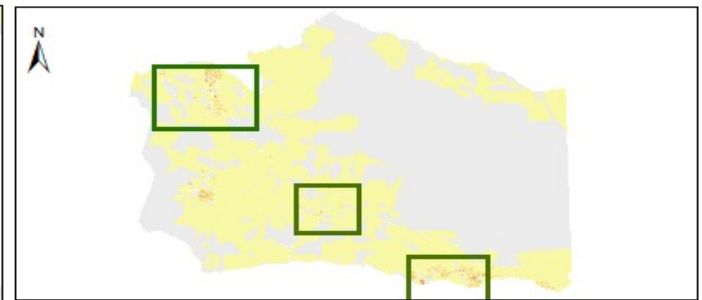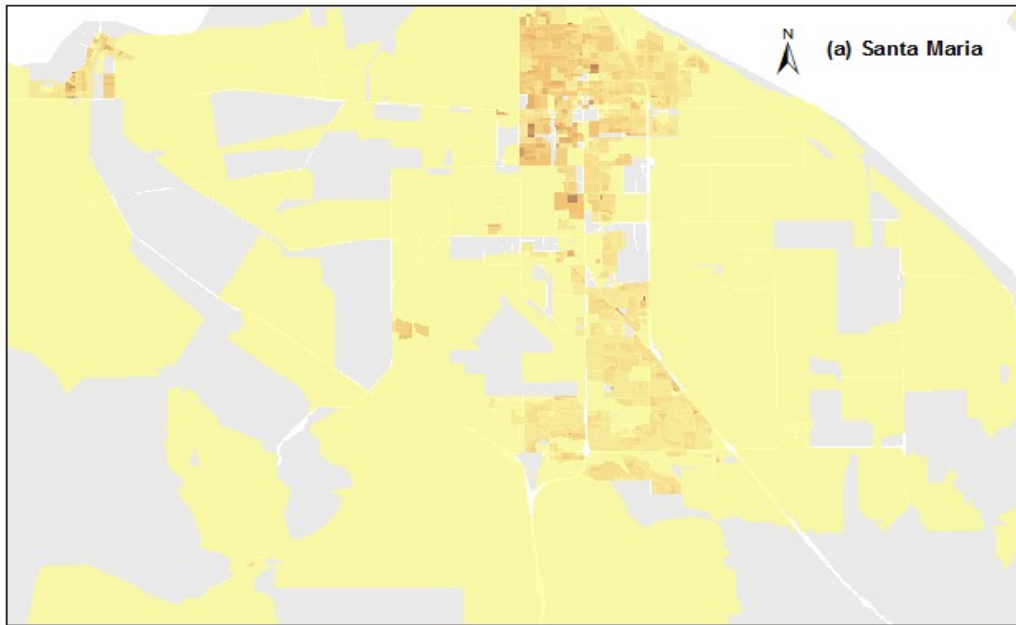
Population density distribution for year 2000
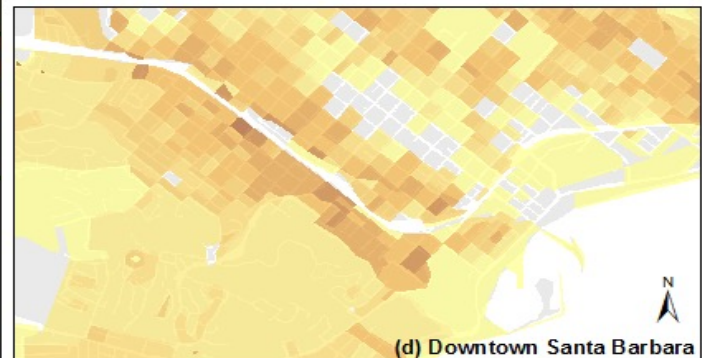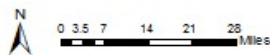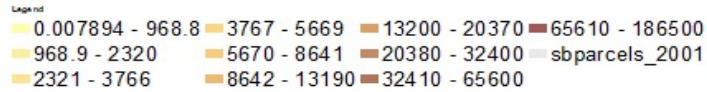
Legend
- 0.007894 - 968.8
- 968.9 - 2320
- 2321 - 3766
- 3767 - 5669
- 5670 - 8641
- 8642 - 13190
- 13200 - 20370
- 20380 - 32400
- 32410 - 65600
- 65610 - 186500
- sbparcels_2001

0 3.5 7   14   21   28 Miles

Retail employment density

(a) Santa Maria

(b) Solvang and Santa Ynez

(c) Santa Barbara and Goleta

(d) Downtown Santa Barbara

Retail employment density distribution for year 2000

Legend

Manufacturing employment density

(a) Santa Maria

(b) Solvang and Santa Ynez

(c) Santa Barbara and Goleta

(d) Downtown Santa Barbara

Manufacturing employment density distribution for year 2000
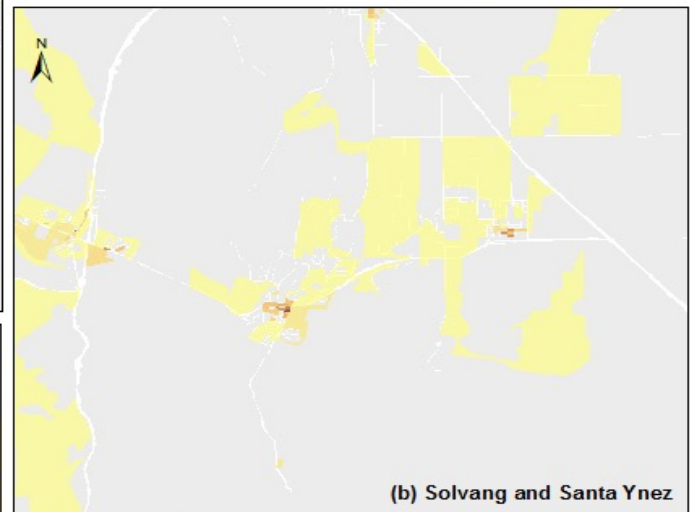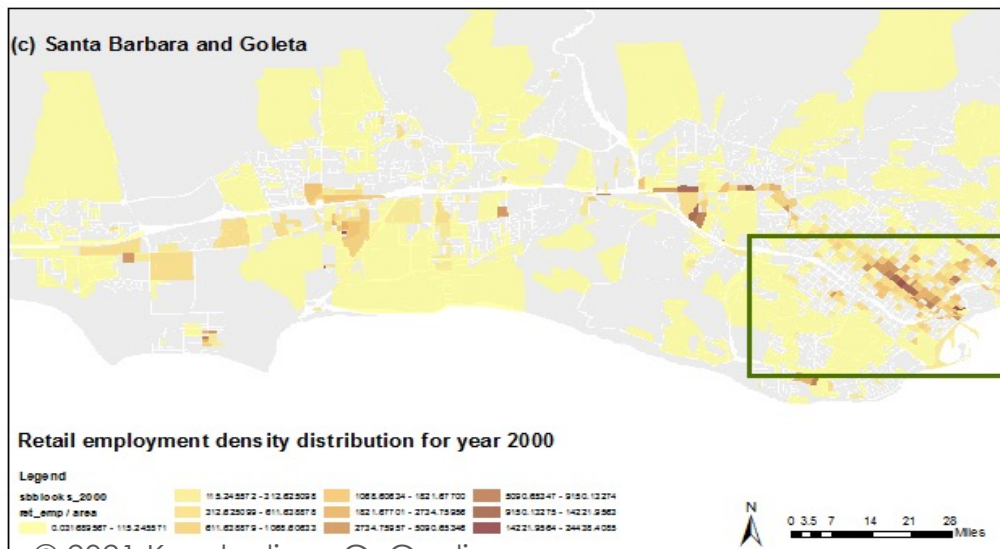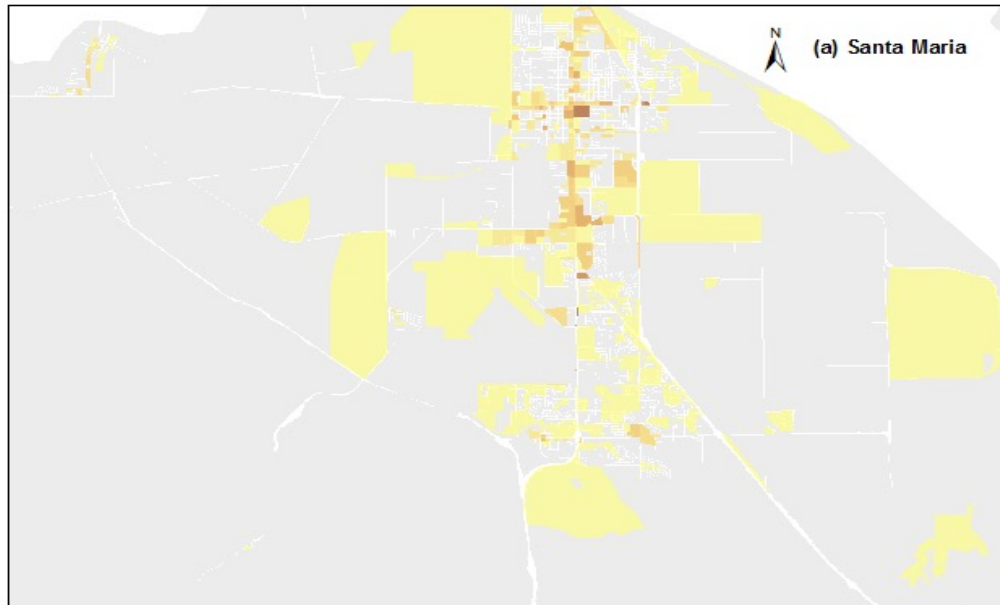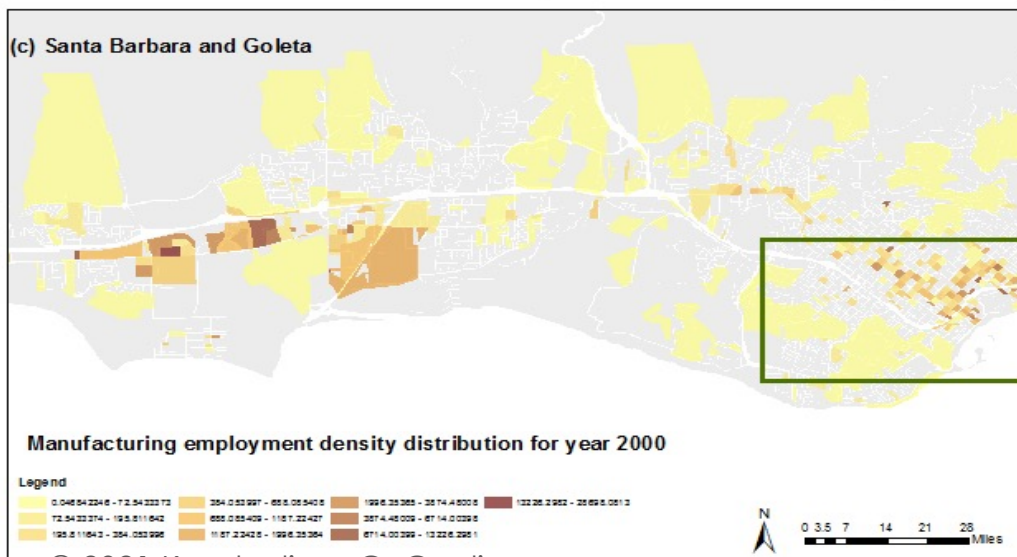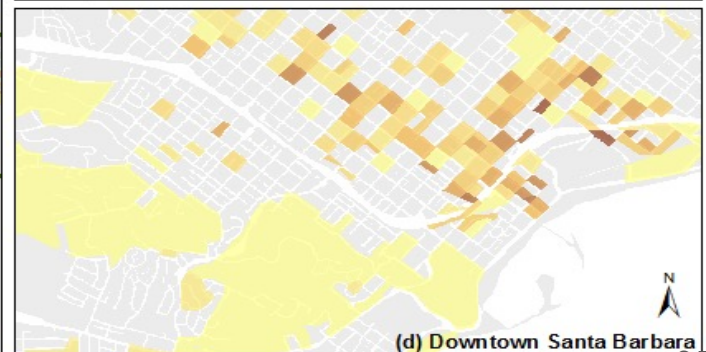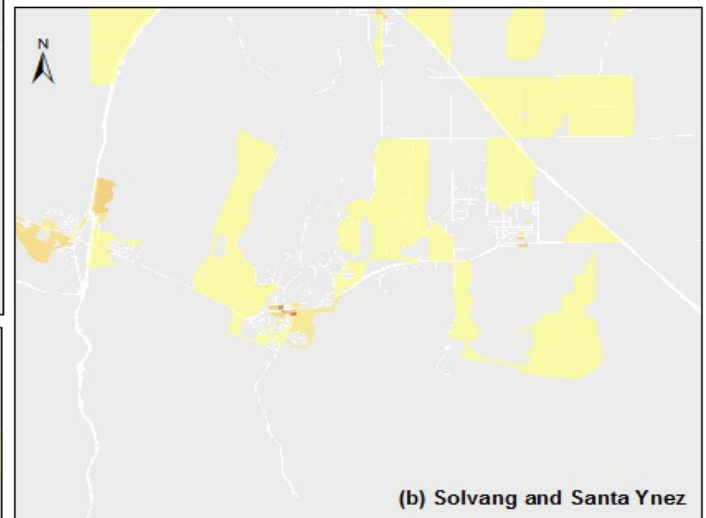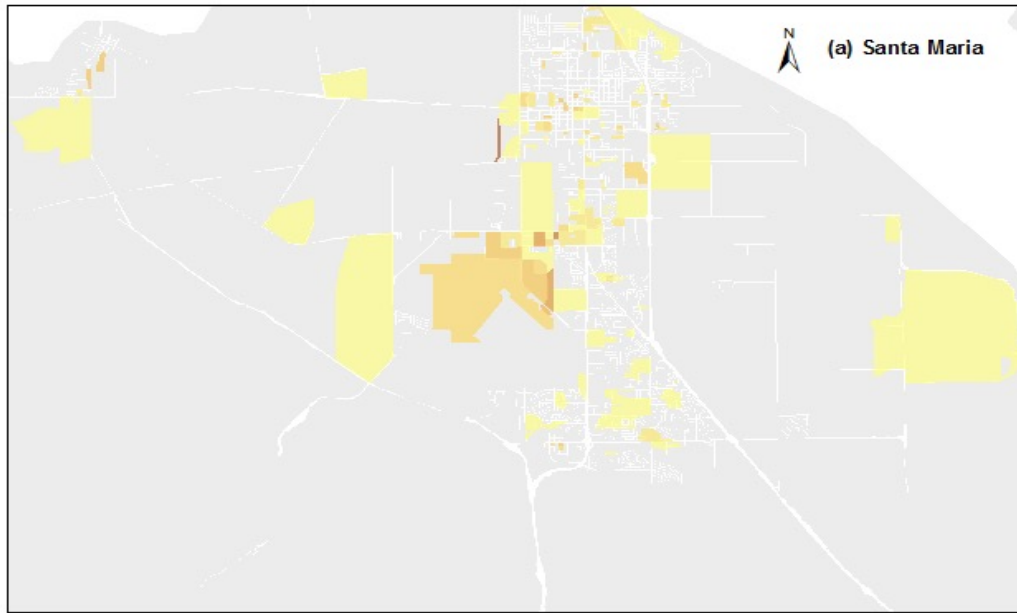
Firm/Bus. Establishments Events: Key Findings

- Access to population
  - **densely** populated areas have lower likelihood of relocation and **high probability of formation and failure**
  - prominent in **retail** trade and **healthcare** services
- Agglomeration economies
  - **local competition** increases **relocation** probability for retail trade, professional and healthcare services
  - urbanization economies (or **diversity**) acts as incubator for **new firm** formation
- Regional factors
  - firms are more likely to be formed and relocate from Santa Maria than other cities in Santa Barbara county
  - **Goleta** and **Carpinteria** have higher probability of **firm failure (**e.g., start-ups and professional services)
- Transportation access
  - BEs are less likely to relocate with higher access to transit stops (e.g., downtown area of Santa Barbara)
  - **Proximity to regional airports** (SBA and SMA) increases likelihood of **failure** (note the potential selectivity with location choice)

Pellenbarg et al. (2002); Sweeney and Feser (2003); van Oort et al. (2010); Fotopoulous (2013); Paleti et al. (2013); Targa et al. (2006); de Bok (2009); van Wissen (2000)

Firm/BE internal factors

Firm/Bus. Establishments Events: Key Findings

- ## Firm internal factors
  - firm events are primarily triggered by firm internal attributes

- ## Employment size
  - BE relocation and failure decreases with size=> **liability of size hypothesis**
  - Santa Barbara county has higher probability of smaller size firms being formed

- ## Age
  - younger firms are more likely to relocate and die => **liability of newness** hypothesis

- ## Technical efficiency
  - This is a property of a firm in effective use of inputs to achieve maximum output
  - highly efficient firms are more likely to stay-put and survive in their current location
  - accumulated property that is dependent on firm lifecycle (e.g., younger firms are less efficient)

van Dijik and Pellenbarg (2005); Stinchome (1965); Garafoli (1994); van Wissen (2000); Brouwer et al. (2004); Maoh (2005); Hanan and Freeman (1984)

Spatial Births 1998-2002

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TIME

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Time Evolution of Firm Formation = different trajectories when controlling for all other factors (NOTE healthcare services!)
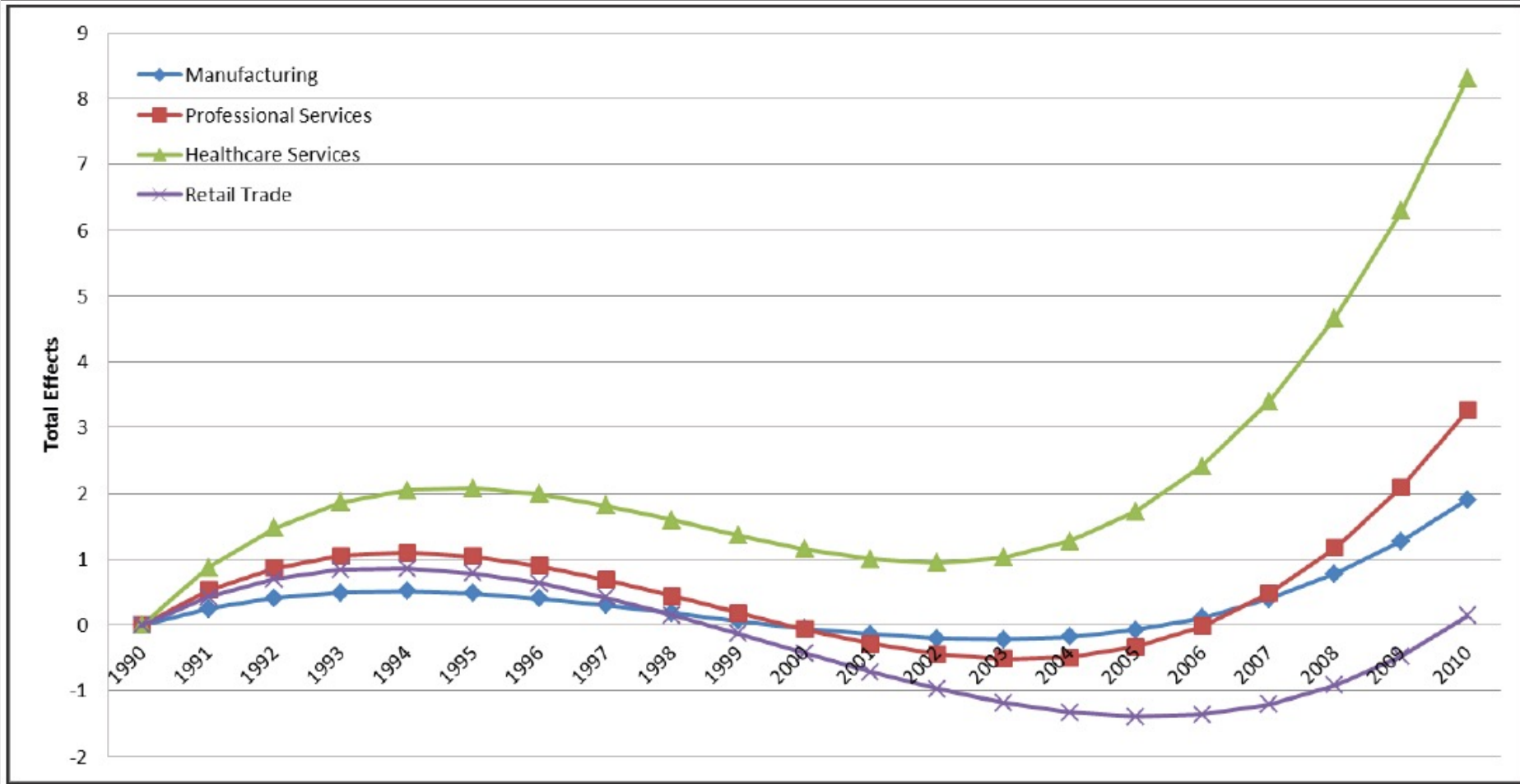
Time effects of business establishment deaths

Time Evolution of Firm Dissolution = different trajectories when controlling for all other factors (NOTE professional services!)
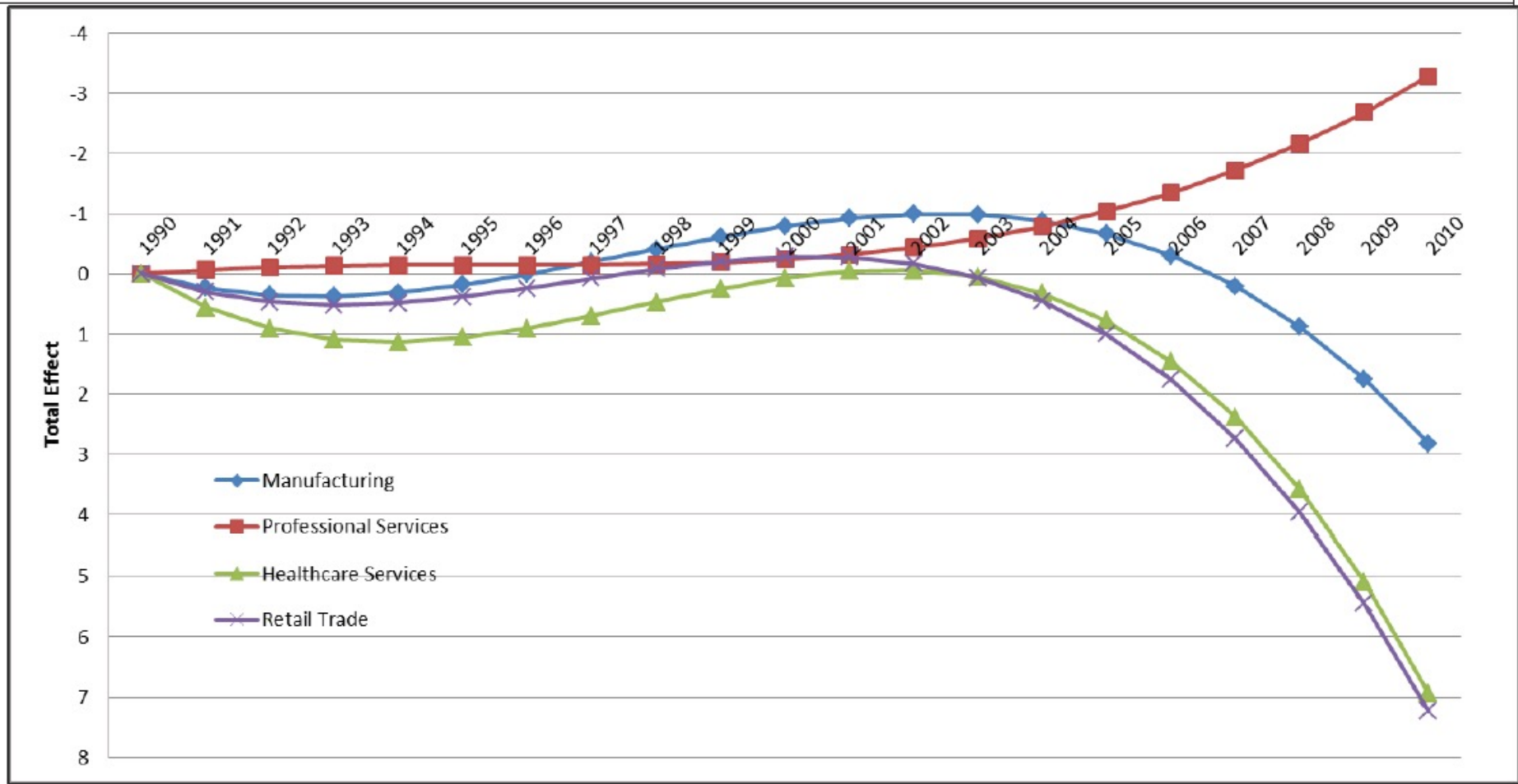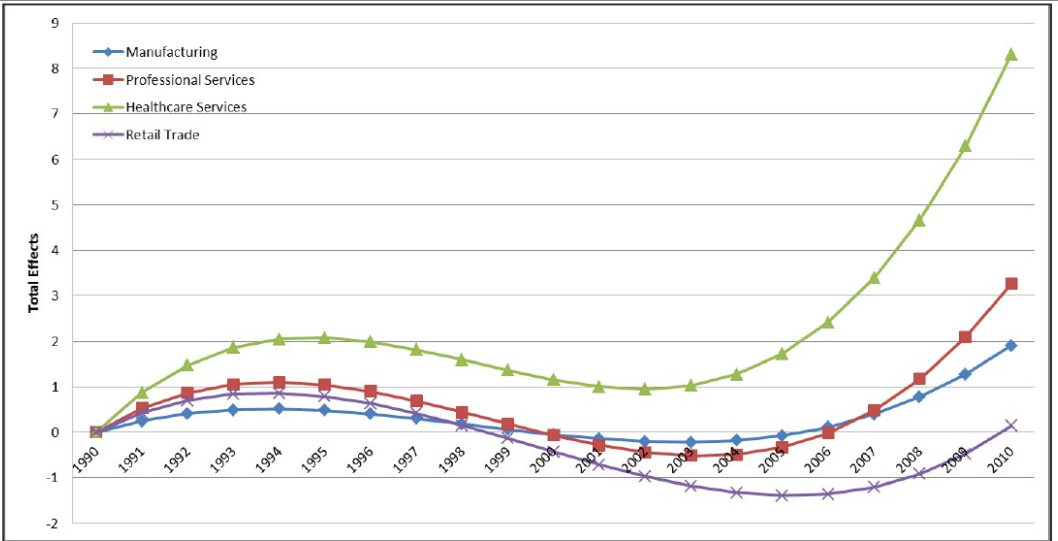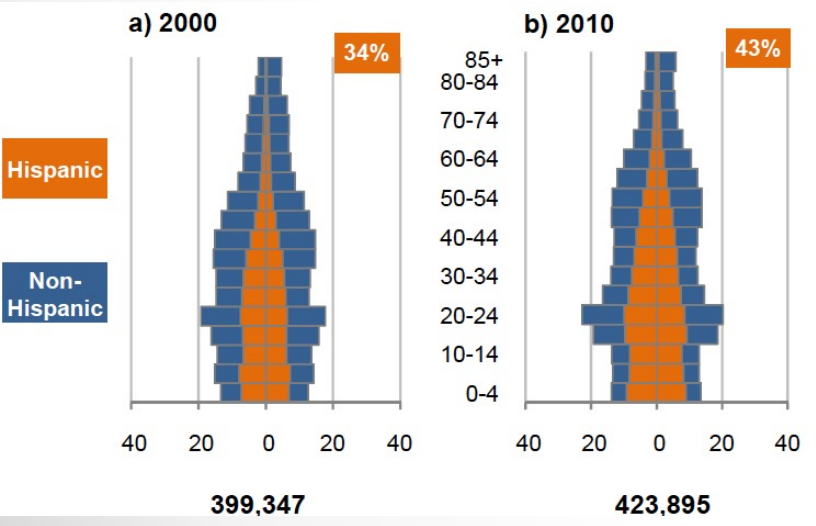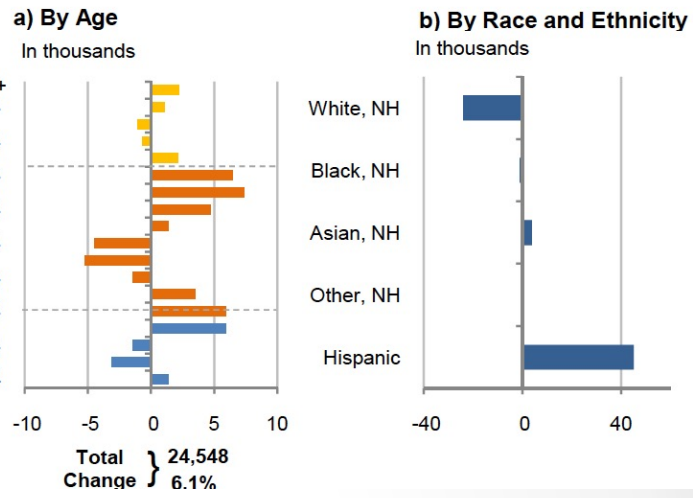

Time effects of business establishment births
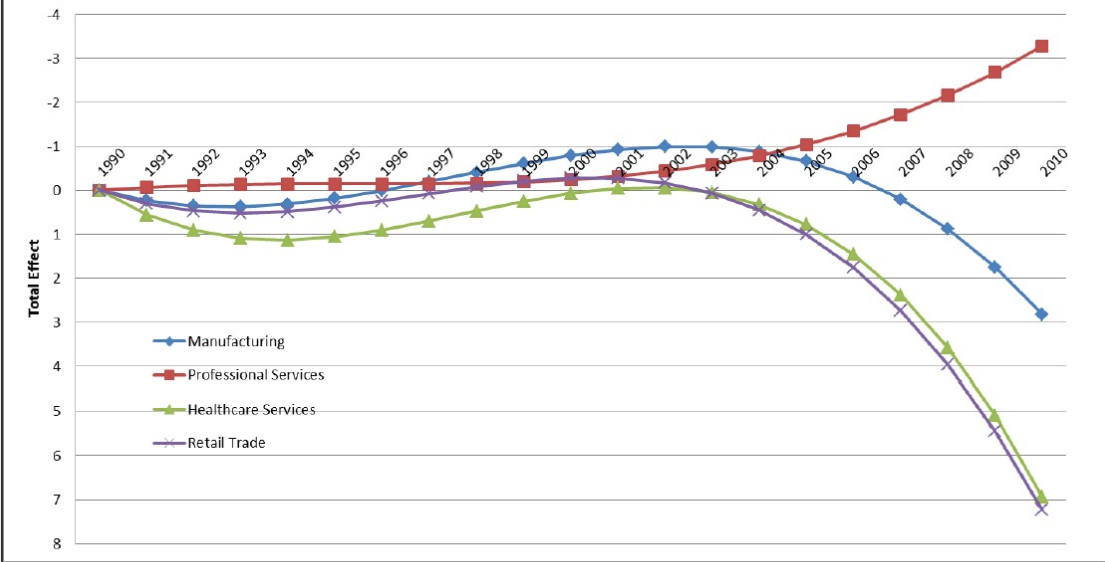
Time effects of business establishment births

7. 10-Year Change in Population, 2000-10

a) By Age
In thousands

b) By Race and Ethnicity
In thousands

Total Change } 24,548 6.1%

a) 2000 — 34%

b) 2010 — 43%

Hispanic

Non-Hispanic

399,347

423,895

Time effects of business establishment deaths

Summary and Conclusions

Conclusions

- Geometric configuration and structure of the network has a prominent role in spatial organization of economic activities
  - ***Presence of center-sub center type of city (e.g., Santa Barbara and Goleta)***
- Significant presence of spatial heterogeneity in firm lifecycle events
  - ***Network centrality measures have a pronounced impact on firm events depending on a firm's relative location in the region***
  - ***Urban centers serve as breeding grounds for new firms while also having higher probability of survival***
- Events are primarily triggered by firm-internal attributes especially size and age
- Technical efficiency is correlated with location (a different type of talk).

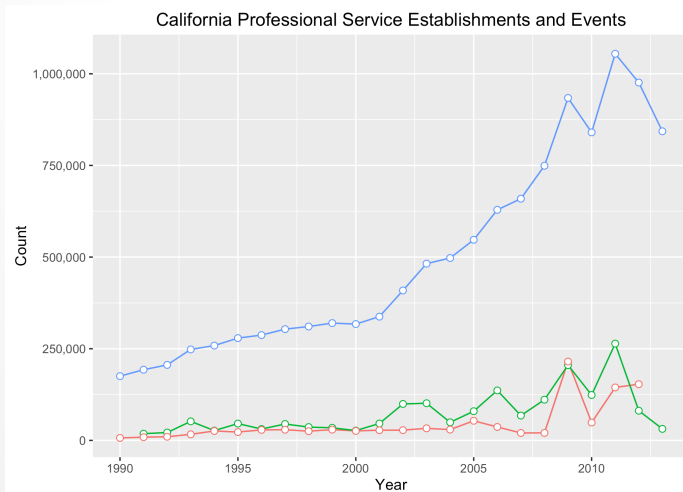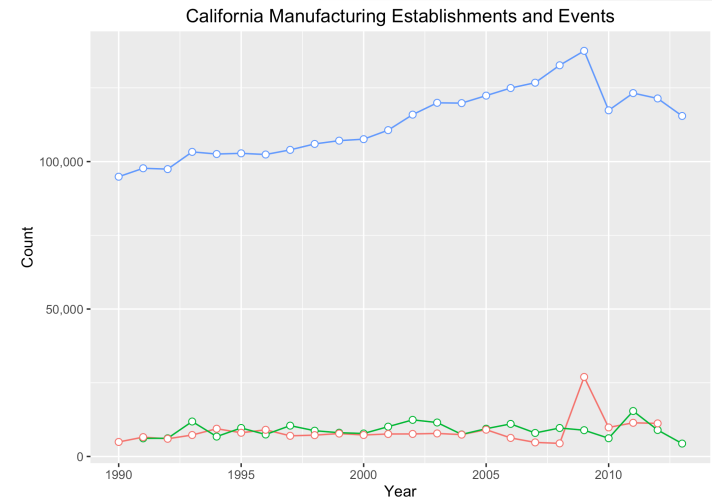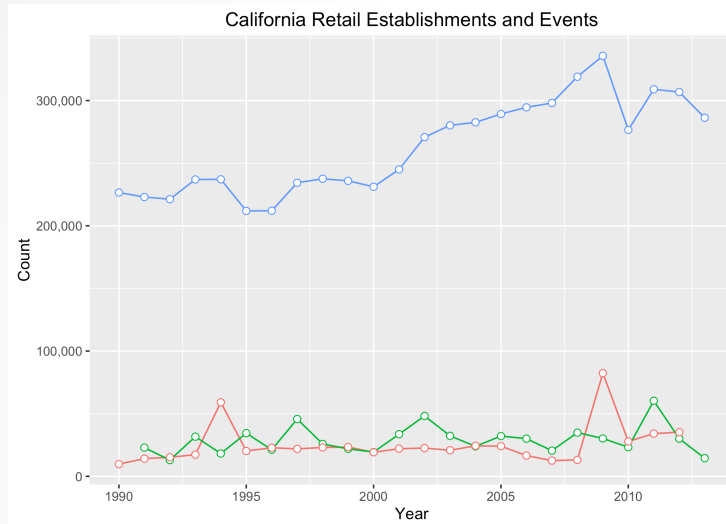# Case Study 2: Statewide Analysis

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Davis, A. W., Lee, J. H., McBride, E. C., Ravulaparthy, S., & Goulias, K. G. (2019). California Business Establishment Evolution and Transportation Provision. In The Practice of Spatial Analysis: Essays in memory of Professor Pavlos Kanaroglou (Editors: E. Briasoulis, N. Soulakellis, and D. Kavroudakis) (pp. 295-323). Springer.

Research Questions

- Statewide analysis asks higher lever questions and does not use network analysis (two big)
  - o In what ways does access to transportation infrastructure affect the success, failure, and relocation of businesses?
  - o In what ways does local land use affect the success, failure, and relocation of businesses?
  - o Which types of mixed-use environments are beneficial to business establishment success?
  - o How do the effects of land use and transportation accessibility vary across different business types?
  - o How do the factors that predict the formation of new business establishments relate to the factors that predict the dissolution of businesses?

Events

(total number of establishments are BLUE, dissolutions are RED, and establishment formations are GREEN)

Figure 4 Retail Establishment Events

Figure 5 Manufacturing Establishment Events

Figure 6 Professional Services Establishment Events

Figure 7 Health Care Establishment Events
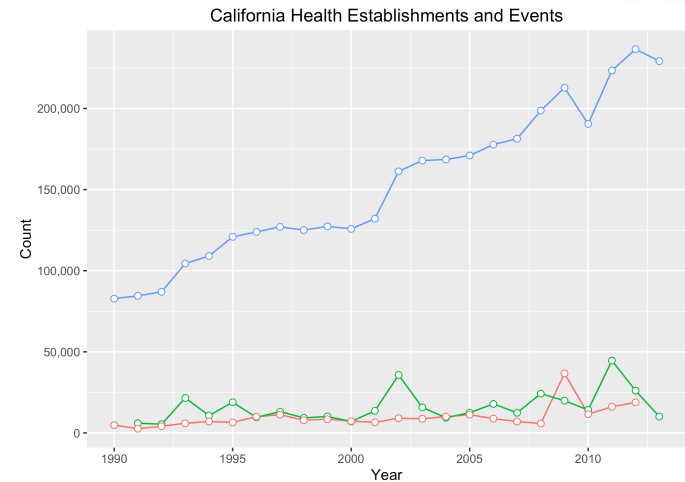
Methods

- Account and test for direct financial and other relationships among business types (see USA Input-Output).

Name	Agriculture, forestry, fishing, and hunting	Mining	Utilities	Construction	Manufacturing	Wholesale trade	Retail trade	Transport. and warehousing	Information	Finance, insurance, real estate	Professional and business services	Education, health, and social assistance	Arts, ent., food services, and accommodation	Other services, except government	Government
Agriculture, forestry, fishing, and hunting	103993	105	0	1399	280940	1547	2244	108	1	35	1799	916	8214	82	2292
Mining	2520	58402	43079	10742	560306	46	49	1580	339	4297	1563	435	1286	592	16944
Utilities	4955	4430	3076	2371	66293	5092	11171	6625	4414	71743	10765	25415	11448	4378	27741
Construction	2884	5713	4749	158	16279	1577	2980	4683	2733	128332	2153	2970	2387	3884	72240
Manufacturing	87134	52838	25686	281090	2042570	45665	59431	198525	105380	61146	163507	190020	155655	63114	355582
Wholesale trade	26447	8437	4813	47406	300870	41132	25790	37865	29959	15763	28149	39472	26013	10642	43856
Retail trade	220	230	378	82613	13762	813	7650	5505	406	7181	2694	1687	7992	5409	595
Transport. and warehousing	14259	13205	18308	20930	160719	66389	71188	119692	19398	29061	53577	25000	16158	6490	61579
Information	588	1225	1438	4530	26382	18091	20467	5818	241694	59498	79696	30260	10221	10078	173521
Finance, insurance, real estate	21044	19499	10768	31460	85593	101708	147946	75213	68530	884455	246119	316319	93082	83370	134123
Professional and business services	6245	45803	19550	46229	445816	206347	166840	65236	149996	440548	566526	251468	141266	45125	249852
Education, health, and social assistance	495	0	148	20	85	1230	9106	75	927	50	817	27265	1975	2562	43850
Arts, ent., food services, and accommodation	666	1197	2656	2444	23416	9312	6376	3398	35975	48182	69327	31235	29291	4222	31454
Other services, except government	1156	734	737	4900	18173	18919	12264	5413	10735	33889	35044	36953	12107	7354	25069
Government	47	6	454	26	6026	10472	6640	14479	2358	15152	9282	6726	6355	1824	8437

Methods

- Define density of business types (16 types different density for each observation year)

- Define other important variables
  - Time indicators (linear, quadratic, cubic)
  - Distance to airports and other major infrastructure (e.g., freeways)
  - Size, independence (not a franchise or a subsidiary), year established
  - Random parameters to account for serial correlation

- Panel Probit model (longitudinal binary)
  - Use Manufacturing and Retail as the two key industries but included also Professional Services and Health Services
  - We correlate their events to all the densities of all 16 "neighboring" industries
  - We expect all four industries to be different in their spatial relationships with other industries and places
  - Labor for each of these four industries very dissimilar (but professional services something to discuss)

Category	2-digit NAICS	Establishments (Unique DUNS)	Observations (DUNS:Years)
Agriculture, Forestry, Fishing and Hunting	11	78,990	728,397
Mining	21	6,676	55,160
Utilities	22	7,061	66,747
Construction	23	550,750	3,862,499
Manufacturing	31, 32, 33	343,107	2,916,915
Wholesale Trade	42	431,344	3,005,409
Retail Trade	44, 45	928,089	6,379,413
Transportation and Warehousing	48, 49	169,354	1,111,009
Information	51	212,048	1,337,209
Professional, Scientific, Management, Administrative and Waste Services	54, 55, 56	1,975,382	12,129,165
Health Care	62	466,341	3,700,886
Arts, Entertainment, Recreation, Accommodation and Food Services	71, 72	346,838	2,871,635
Other Services	81	699,929	5,259,591
Finance, Insurance, Real Estate and Rental and Leasing [FIRE]	52, 53	691,557	4,921,333
Public Administration and Armed Forces	92	29,665	247,909
Educational Services	61	84,159	787,201
Undefined	99	9,344	45,816

Figure 3 Average Employment Density at the US Census Block-Group Level in 2012
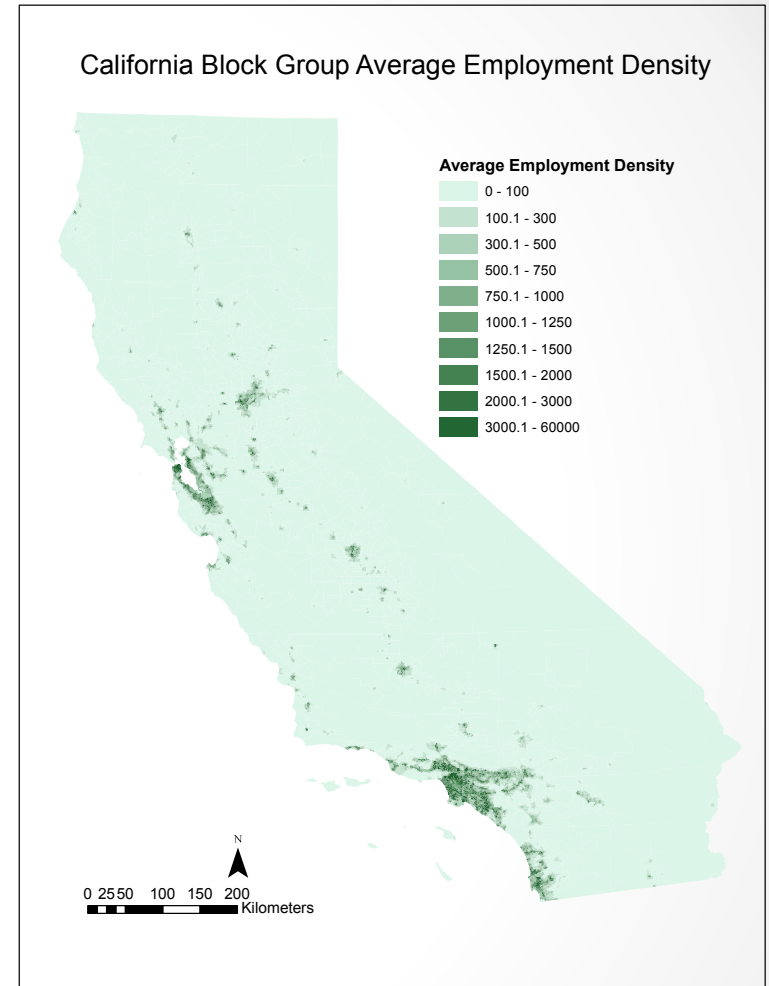
Findings Summary 1

- In what ways does access to transportation infrastructure affect the success, failure, and relocation of businesses?
  - Businesses with good access to infrastructure are not uniformly more likely to succeed.
    - Transportation impacts the initial location decisions of most firms as well as influencing success later on, and this increased demand drives up real estate costs and sometimes increases failure rates.
    - Businesses are less likely to relocate to less-accessible areas than to less-dense ones, but local **land use density** appears to play a more significant part in relocation decisions than does access to transportation.

Findings Summary 2

- In what ways does local land use affect the success, failure, and relocation of businesses? Which types of mixed-use environments are beneficial to business establishment success?
  - Density provides lots of opportunities for collaboration but also for competition.
    - Denser environments generally experience higher levels of turnover due to general competition and high real estate and labor costs.
    - Mixed land use shows good pairings
      - retail establishments are less likely to fail when they are located in environments that also provide customers with entertainment and dining opportunities;
      - manufacturing businesses may perform better when in close proximity to information technology firms.
      - manufacturing firms seem to do best in limited-use developments.
      - manufacturing turnover is lowest in areas with high density of manufacturing employees and somewhat more contained in specific areas.

Findings Summary 3

- How do the effects of land use and transportation accessibility vary across different business types?
  - Manufacturing and retail showed similar preferences across all the models.
  - Somewhat surprisingly, manufacturing showed no especially strong preference for access to freight processing centers, possibly reflecting the isolation of many of these centers in massive ports and inland train depots.
  - Access to freeways is generally beneficial for all types of business establishments.
  - As hypothesized, health care and professional services do not show any particularly strong preferences about transportation access, which indicates that their location decisions play a smaller role in their success/failure than do those made by retail and manufacturing firms.

Findings Summary 4

- How are the factors that predict the formation of new business establishments relate to the factors that predict the dissolution of businesses?
  - Many of the variables we examined here had a strong positive bearing on firm birth but also on firm death (or were negative in both models).
  - Rather than representing a net cost or benefit to a type of business, these variables serve as predictors of business turnover rates.
  - High rates of turnover in dense areas indicates that this event may not be as disastrous occurrence (except for employees of course), because these areas also have higher rates of firm establishment, and the constant renewal and creation of new opportunities may be beneficial to workers.

More on this in the next case study!

Case Study 3: Los Angeles

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Davis A.W., J. H. Lee, E. McBride, S. Ravulaparthy, and K. G. Goulias (2016) Business Establishment Survival and Transportation Level of Service. Final Report. University of California Santa Barbara. Department of Geography, GeoTrans Laboratory, Contract Number: 65A0528. Submitted to the California Department of Transportation, May 2016.
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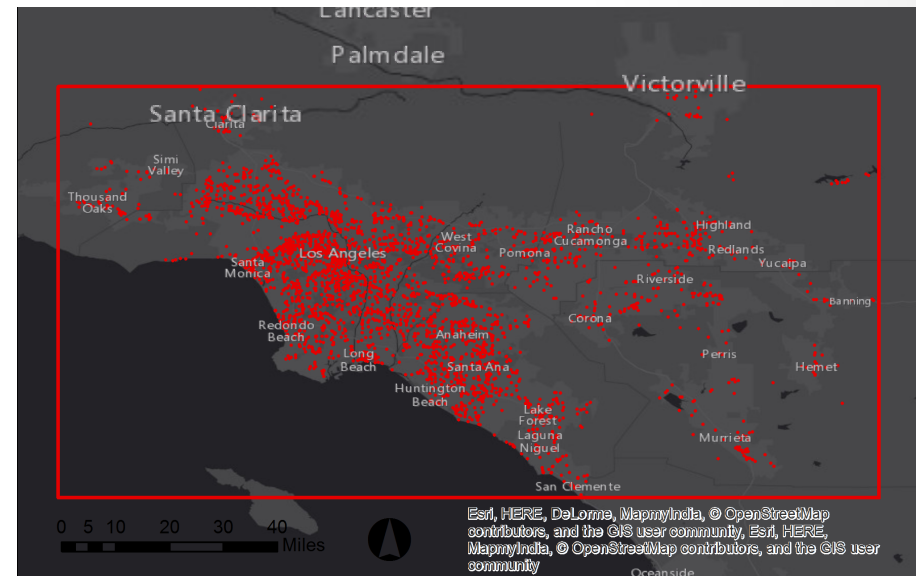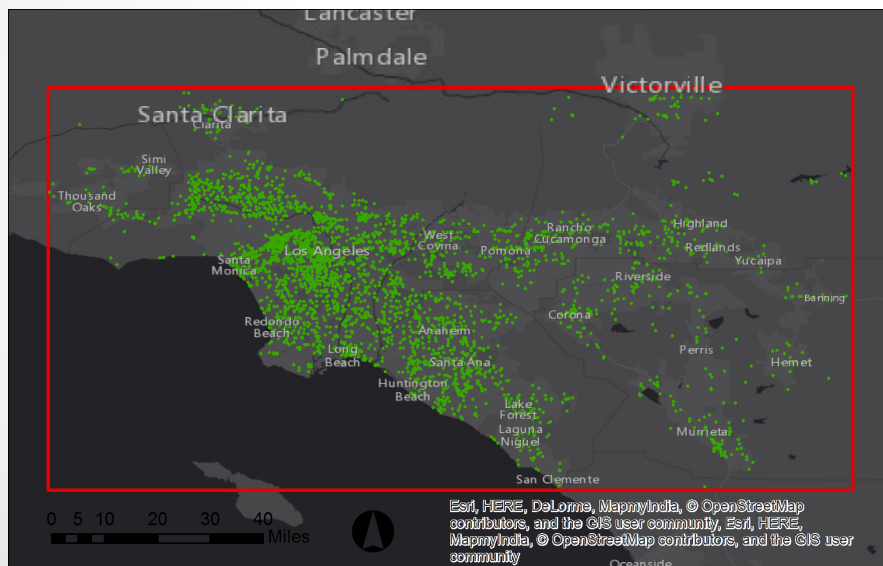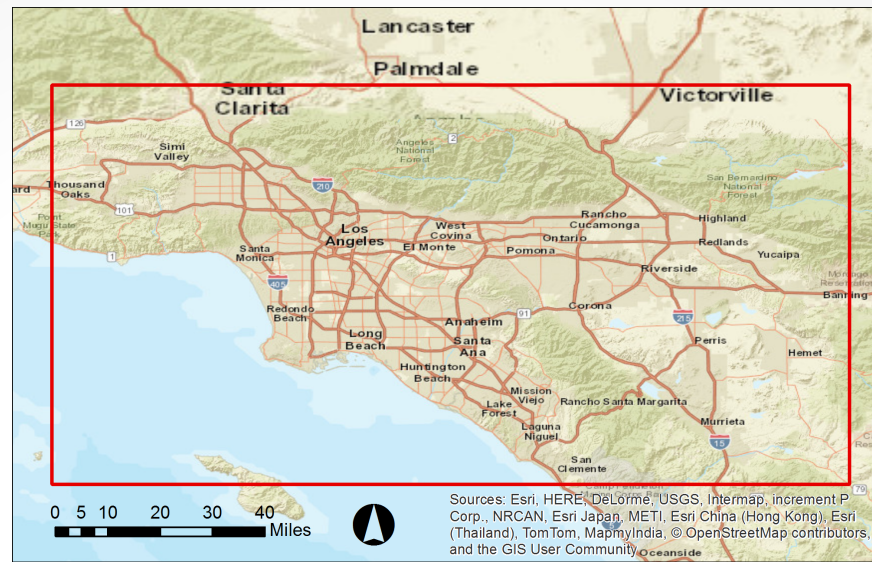
Year 2008
Green = Business Births/Formations;
Red = Business Dissolutions/Deaths

Methods

- Similar to the statewide analysis but cross-sectional Probit regression
  - Density of business types (16 types different density for each observation year)
  - Distance to airports and other major infrastructure (e.g., freeways)
  - Size, independence (not a franchise or a subsidiary), year established

- Included a wide array of opportunity-based accessibility computed for the Southern California Association of Governments (SCAG)
  - Roadway
  - Transit

Methods

- Opportunity based accessibility indicators include
  - The overall maximum number of employees reachable within 20 minutes on the automotive network and the transit network (for most blocks, this number is reached in the late morning);
  - The total length of network links reachable from each block group within 20 minutes by car; and
  - The number of stops reachable within 20 minutes by transit.

Note: To compute these indicators traffic congestion information and actual transit schedules were used to be much closer to the actual accessibility experienced by users of the infrastructure.

Chen, Y., Ravulaparthy, S., Deutsch, K., Dalal, P., Yoon, S. Y., Lei, T., ... & Hu, H. H. (2011). Development of indicators of opportunity-based accessibility. *Transportation Research Record*, 2255(1), 58-68.

Lei, T. L., Chen, Y., & Goulias, K. G. (2012). Opportunity-based dynamic transit accessibility in southern california: Measurement, findings, and comparison with automobile accessibility. *Transportation Research Record*, 2276(1), 26-37.
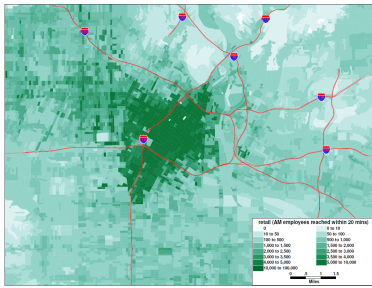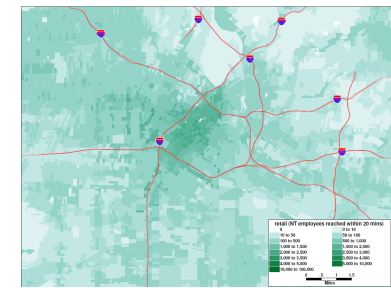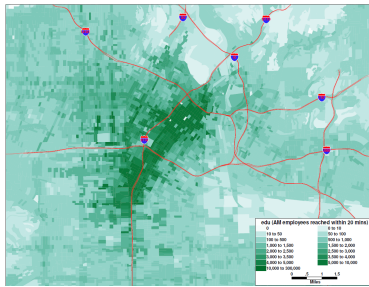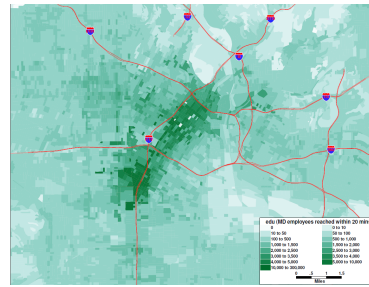
AM Peak　　　Midday　　　PM Peak　　　Night Time
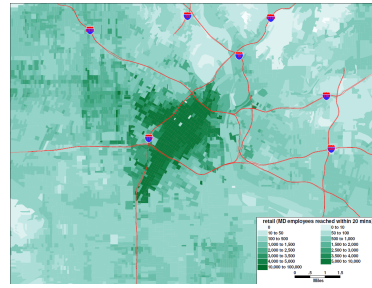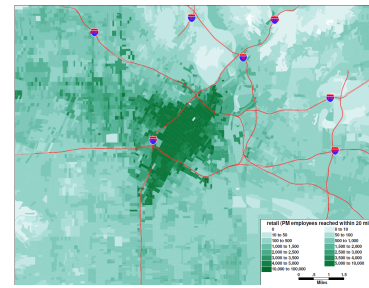
Maximum number of reachable retail employees for a 20-minute buffer by transit
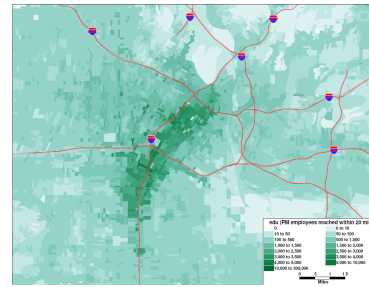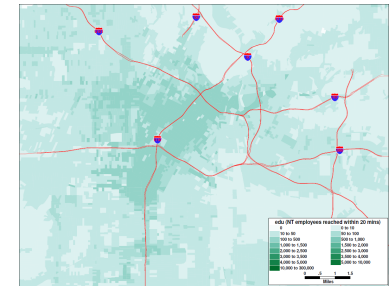by time of day in Central Los Angeles.

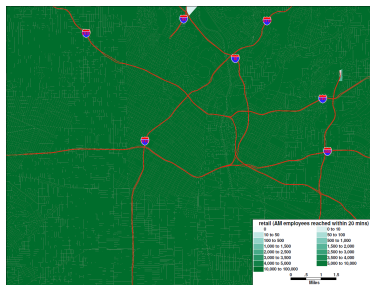# OPPORTUNITY-BASED ACCESSIBILITY

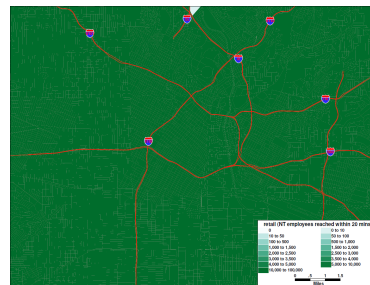AM Peak　　　Midday　　　PM Peak　　　Night Time

Maximum number of reachable education employees for a 20-minute buffer by
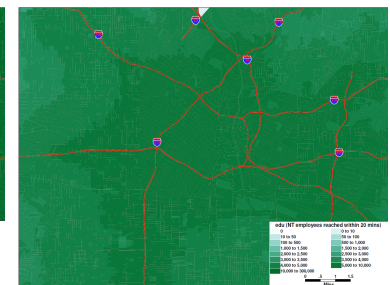transit by time of day in Central Los Angeles.

AM Peak　　　Night Time　　　AM Peak　　　Night Time

Maximum number of reachable retail employees for a 20-minute
buffer by time of day in Central Los Angeles by Private Car

Maximum number of reachable education employees for a 20-minute buffer by time of day in Central Los Angeles by Private Car
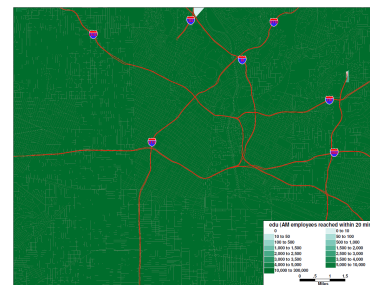
Findings

- In 2008 in this area:
  - Certain types of mixed use are more beneficial than others.
    - retail establishments in manufacturing areas more likely to fail;
    - manufacturing establishments near retail more likely to fail; and
    - professional services more likely to fail anywhere there is competition for real estate.
    - retail businesses benefit from the presence of workers in professional services
    - manufacturing benefits from presence of information industries
    - differences between sites affect overall success differently.

   These results indicate (when combined with the statewide findings)
    1. business survival is not just a matter of high-turnover vs low-turnover areas
    2. franchise/non-standalone penalty found in 2008/LA does not match the panel model results (we have a different mix of large companies consolidating locations earlier in the recession than smaller companies started to close).

Findings

- In 2008 in this area:
  - Transit a big influencer
    - Retail firms with high transit accessibility were considerably less likely to fail, and there is a positive coefficient on transit accessibility for firm births, which indicates that retail firms are showing a genuine preference for transit-accessible parts of the Los Angeles region.
    - Access to freeways is similarly important, as firms farther from freeways are more likely to close and new firms seek out areas closer to freeways.
    - These findings are generally unsurprising, as retail establishments require robust transportation systems to provide access to their customers and employees.
    - The findings here show that increasing the frequency of public transportation service has a direct and significant positive impact on business survival and therefore the local economy.
- In general, these models find that retail businesses were likelier to fail in marginal sites (low access to transportation or presence of manufacturing) or high-rent/high-competition areas (with high density of existing retail and finance firms), but this was counteracted by the presence of strong transportation infrastructure.
- **These findings can be taken to indicate that access to transportation (and particularly public transit) is very important for retail establishment success, at least in relatively developed areas like Los Angeles.**

Findi

(rendered maps of predicte
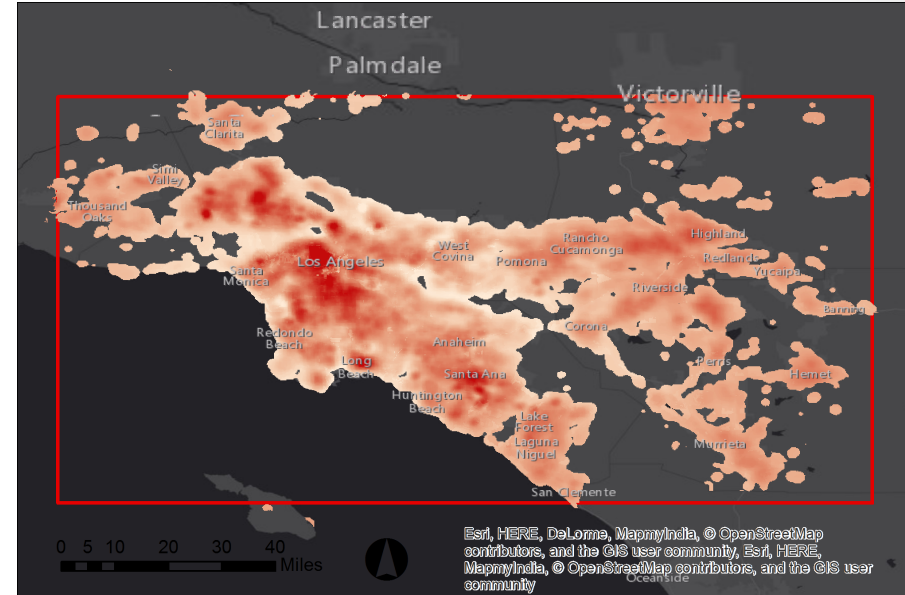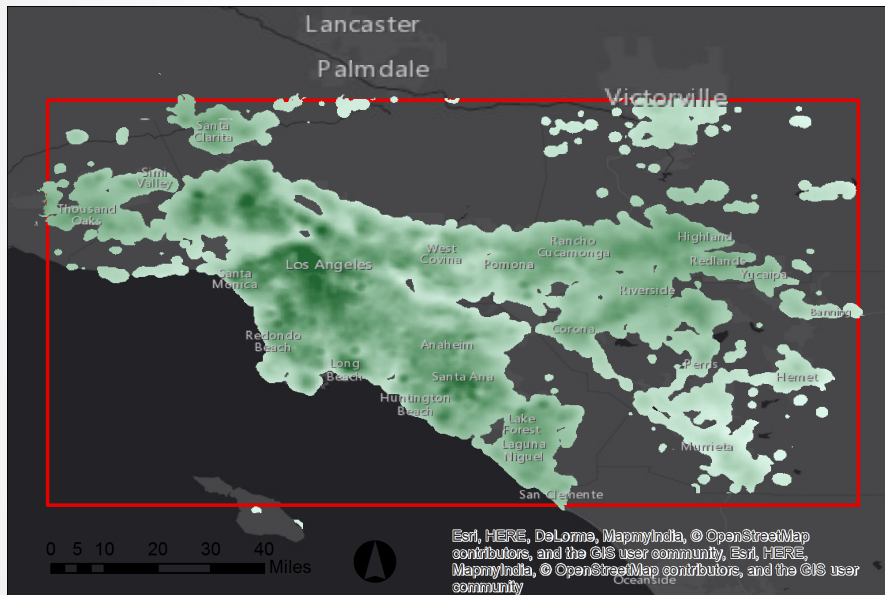
But there is more to explore!

Retail Sub-Category	Total Ests	Diss. Rate	Form. Rate	Transit Accessibility	Pop. within 2km.
Building Material and Garden Equipment and Supplies Dealers	6,764	3.9%	17.1%	4,466	35,745
Clothing and Clothing Accessories Stores	30,357	4.7%	14.1%	**19,756**	47,503
Electronics and Appliance Stores	10,253	4.7%	13.9%	7,025	39,833
Food and Beverage Stores	18,168	3.6%	9.5%	8,017	47,324
Furniture and Home Furnishings Stores	10,124	4.9%	13.0%	6,423	39,647
Gasoline Stations	3,489	3.3%	5.0%	5,240	38,901
General Merchandise Stores	3,208	3.2%	10.3%	9,145	**48,027**
Health and Personal Care Stores	10,896	3.9%	11.7%	8,230	43,464
Miscellaneous Store Retailers	28,955	4.0%	12.2%	7,866	40,476
Motor Vehicle and Parts Dealers	13,570	4.7%	10.8%	4,498	39,578
Nonstore Retailers	5,347	3.3%	8.5%	5,088	35,922
Sporting Goods, Hobby, Musical Instrument, and Book Stores	13,596	4.2%	10.5%	8,721	40,484