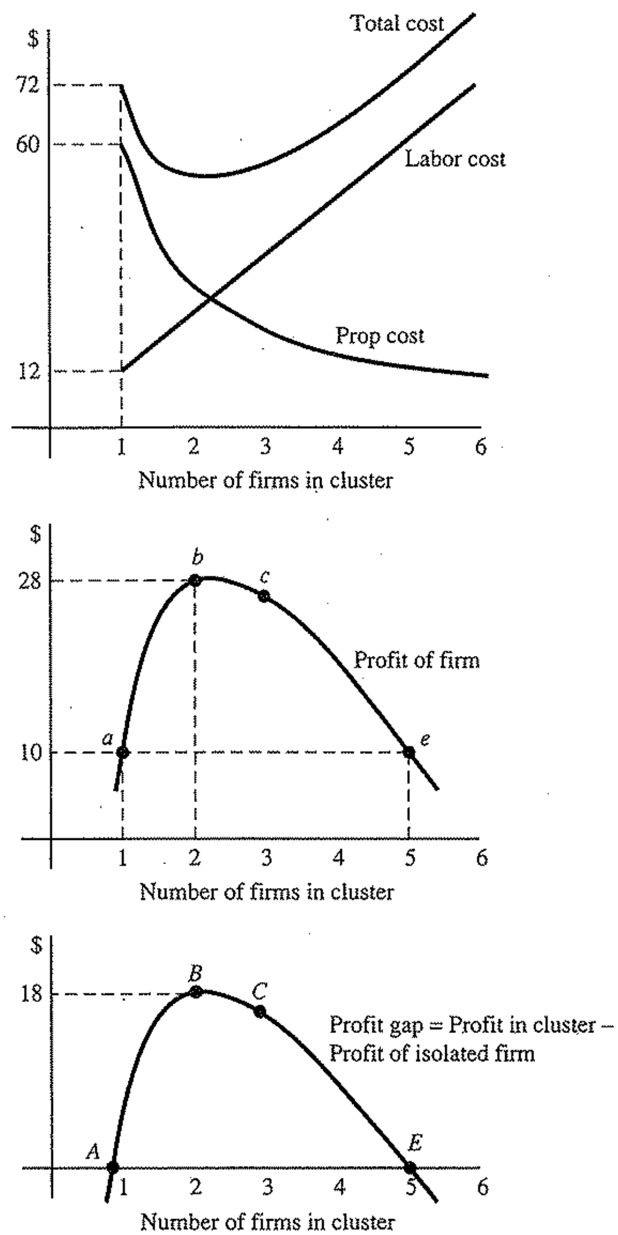
II. COSTS IN CLUSTERS

in general: there are conflicting cost trends in clusters
- labor cost is normally higher in clusters
- other costs might fall

FIGURE 3–2 Self-Reinforcing Effects and Clustering



The profit gap, equal to the profit for firm in a cluster, minus the profit of an isolated firm increases, then decreases, reflecting the trade-offs from lower advertising costs and higher labor costs. The profit gap reaches zero with five firms in the cluster, the equilibrium number.

III. LOCALIZATION ECONOMIES

→ cluster of same kind of industry

advantage of dispersion:
- no competition for workers
- closer to consumers

advantage of clustering
external econ of scale
- share input supplier
- share labor pool
- share info/knowledge

(1) Sharing input supplier
useful if
- input demand of one firm not large enough to exploit econ of scale of supplier
- transportation cost high and proximity important (face-to-face-contact)

examples
Button – Dresses – Industry in Manhattan (Garment district, Time Sq & Penn Station)
- large econ of scale for button producers
  10 dressmakers share button maker and save cost
  econ of scale lager for button makers than for dressmakers
  still they could share button maker and order from catalog
- fashion changes quickly ---> new dresses all the time
  important to face-to-face contact, changes all the time

Corporate headquarters
- large advertising companies have econ of scale
  work for many firms --> share advertising firm
- in addition --> face-to-face with executives required (CEO)

Newspapers and magazines
- share experts that are need infrequently
  (expert on Persian Law or German beer drinking culture)
- share graphic design firms' services

→ locate near research institutes, universities, etc.

(2) Sharing Labor Pool

example
TV industry produces great hits and lots of flops
cluster in NYC and LA → share pool of labor

(2A) Switching Cost and Wages

→ Labor pooling lowers switching cost and may lead to lower wages

example:
assume a worker takes on a job at a company and doesn't know whether the firm will remain successful. There is a 50% chance that the firm will fail next year.

At an isolated site, the firm will pay a wage of $20/h in case of success. In case of failure, the worker needs to invest $8 to switch to another company (e.g., for moving or learning a new skill), which also pays $20/h.

Low switch cost:
(a) low job search cost because
- info about jobs spread quickly within cluster
- all nearby, formal search easy (just walk or take bus)
(b) switch easy, no moving cost

In the industry cluster, there is also a 50% chance of failure but there is no switching cost. In case of failure the worker can costlessly switch to another firm.

How much does the firm in the industry cluster have to pay to compete with the employer at the isolated site?

The table shows that the expected wage in both cases the expected wage equals $16 making the worker indifferent. Thus, wages in clusters can be lower.

	wage	switch cost	probability of switch	Expected net wage
Isolated site	$20	$8	0.5	0.5*20+0.5*12=16
Cluster	$16	0	0.5	0.5*16+0.5*16=16

(2B) Varying Demand for Labor and Profits

→ higher profits in cluster when demand for labor varies

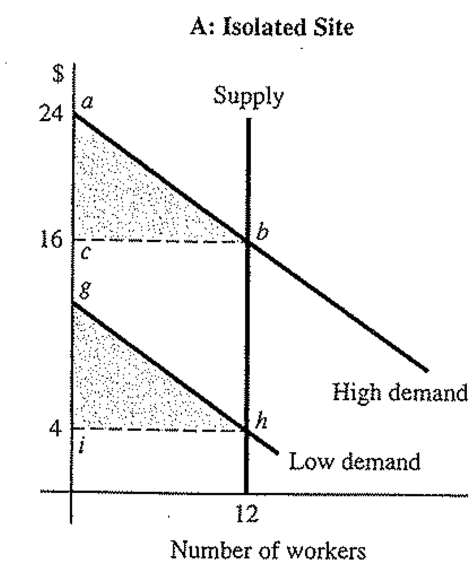
<u>Advantages of large labor pool</u>
assumptions:
- boom and bust have a 50% chance to occur
- labor pool in isolated site is fixed at 12 (→ labor supply is perfectly inelastic)
- wage varies with shift in demand curve (from 4 to 16)

→ expected wage = 10

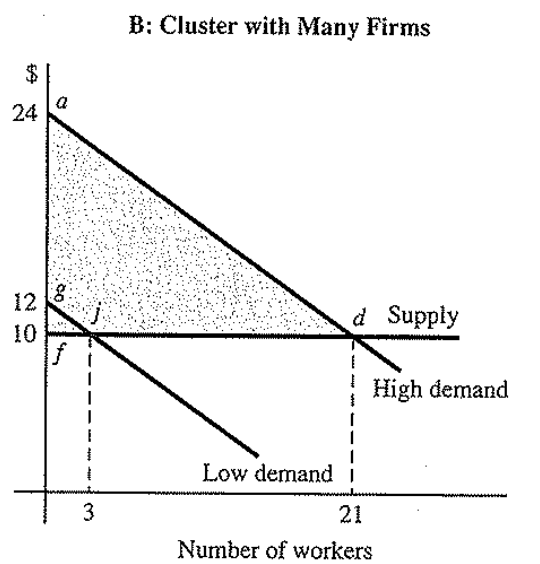
- in cluster labor pool is larger and elastic with respect to the wage
- assuming a constant wage of 10 quantity of labor employed varies

Compare expected consumer surplus of firm
isolated state: 0.5*[12*8]=48
cluster: 0.5*[0.5*(2*3)+ 0.5*(21*14)]= 75
→ in cluster firms can profit more from boom!

Also note: The profits (Consumer Surplus) of firms at the isolated site are identical in boom and recession. This is only possible because the entire price decline (shift in demand curve) is to be borne by workers (inelastic labor supply).



In an isolated site, the firm faces a perfectly inelastic supply of labor (12 workers). The firm hires the same number of workers during high demand and low demand but pays a higher wage during high demand.



In a cluster, the firm faces a perfectly elastic supply of labor, and the wage is fixed at $10. The firm hires 21 workers during high demand but only three workers during low demand.

(2C) Sharing a Labor Pool: Matching

→ if firm is uncertain about future skills needed, returns to labor are higher in cluster

<u>example:</u>
there are 5 skill types, the likelihood that one particular skill type will be used is 20%. A perfect match produces an output of 6. But the more the skill type deviates from the actual need the worker's output will decline (by $1 per distance unit from ideal match).

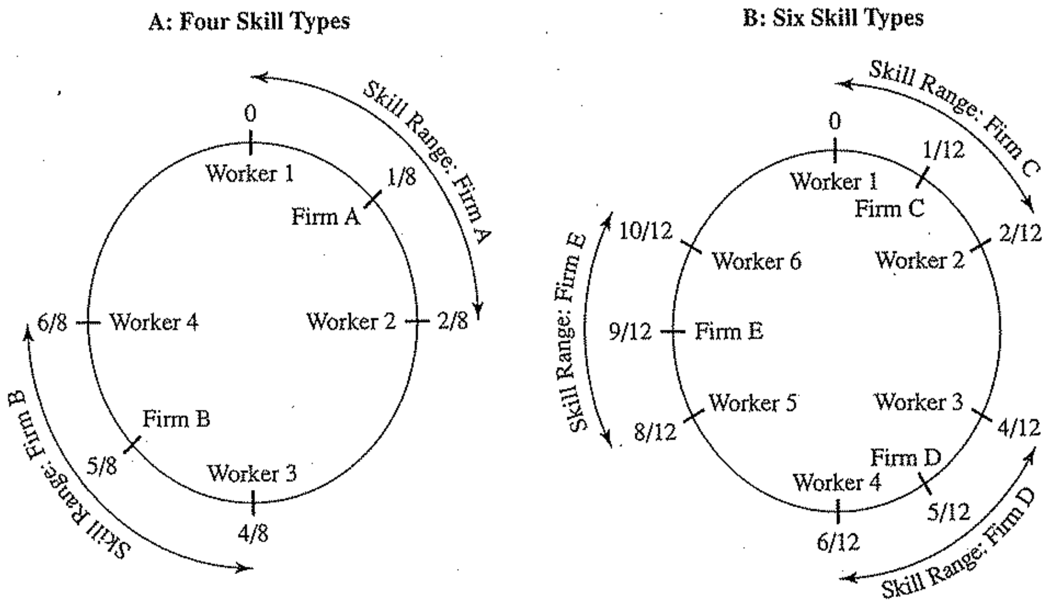
The expected worker output at the isolated site equals $4.80

	Type 1	Type 2	Type 3	Type 4	Type 5
Available at Isolated Site			X		
Output	$4	$5	$6	$5	$4
Expected output	0.2*4 + 0.2*5 + 0.2*6 + 0.2*5 + 0.2*4 = $4.80				

The expected worker output in the cluster equals $5.60

	Type 1	Type 2	Type 3	Type 4	Type 5
Available at Isolated Site	X		X		X
Output	$6	$5	$6	$5	$6
Expected output	0.2*6 + 0.2*5 + 0.2*6 + 0.2*5 + 0.2*6 = $5.60				

Similarly, the skill mismatch can be shown in a circle:
(Model of labor skill matching by Helsley and Strange (1990))



With four skill types, worker addresses are {0, 2/8, 4/8, 6/8}. There are two workers per firm, so two firms will enter with skill requirements {1/8, 5/8}, and the mismatch per worker is 1/8.

With six skill types, worker addresses are {0, 2/12, 4/12, 6/12, 8/12, 10/12}. There are two workers per firm, so three firms will enter the market with skill requirements {1/12, 5/12, 9/12}, and the mismatch per worker is 1/12.

→ the expected skill mismatch declines with the availability of skills (in clusters)

<u>assumptions of skill matching model</u>:
- econ of scale (cost will fall if firm hires more than one worker)
  here: each firm hires 2 workers
- free entry and exit
- each firm has a local monopsony (=only buyer) for worker in surrounding skill range (→ worker have to work for close-by firm)
- firm pays a wage minus training costs
  net wage = gross wage - (skill gap * unit training cost)

Here: wage = $12
unit training cost = $24

<u>Panel A:</u>
in equilibrium skill gap = 1/8
this net wage = $12 – (1/8)*24 = $12 - $3 = $9
(or, if the firm pays for training cost: its cost is $12+$3=$15)

Panel B:
in equilibrium skill gap = 1/12
this net wage = \$12 – (1/12)*24 = \$12 - \$2 = \$10
(or, if the firm pays for training cost: its cost is \$12+\$2=\$14)

Skill gap is a function of the number of workers:

No. of workers	Skill gap
1	½
2	¼
4	1/8
6	1/12
12	1/24

Result:
→ net wages increase with better matches
→ better matches increase with number of workers
→ thus: more workers → higher net wages

3 Sharing Information: Knowledge Spillover

→ opportunity of exchanging ideas
esp. important for IT industry ("idea-oriented industries")

examples
- Silicon Valley: small companies with niche products
  need inputs from many other firms, all very interdependent

URBANIZATION ECONOMIES

→ cluster of diverse industries
→ benefits from scale of entire urban economy (not just one industry)

similar to localization economies

Input Sharing, Labor Pooling, Labor Matching
(1) Share Input Supplier
most firms share services (e.g., accounting, banking, insurance, bldg, mainten.)
(2) Share Public Infrastructure (e.g., street network, trains, airports, universities)
and private infrastructure (e.g., better phone coverage in cities)
(3) Share Labor Pool esp. when labor demand varies across industries
(industry A shrinks, when industry B grows; low search and moving costs)
(4) Better Labor Skill Matching
more variety of skills in diverse industry cluster

Corporate Headquarters (HQ) and Functional Specialization
company headquarters tend to share many similar inputs
- marketing
- legal services
- accounting

→ tendency to cluster to lower cost (marketing/legal/account. large fraction of TC)
→ increasing concentration of management functions in larger clusters has lead to "division of labor" among cities: large management cities and small production cities
This division has grown more pronounced over time (see Table)

	Percentage Gap between Metropolitan Ratio of Management to Production Workers compared to the National Average		
Population	1950	1970	1990
5-20m	+10.2	+22.1	+39.0
1.5-5m	+0.3	+11.0	+25.7
75,000-250,000	-2.1	-7.9	-20.7
67,000-75,000	-4.0	-31.7	-49.5

Source: Duranton and Puga (2005). From sectoral to functional specialization. *Journal of Urban Economics*, 57, 343-370.

→ functional specialization was mainly caused by the fact that the cost of managing from far away has fallen (due to telephone, fax, photocopy machines, emails, lower air fares etc.)

Knowledge Spillover
→ inter-industry exchange of knowledge

spillover from industry to industry

often measured by number of patents per capita
→ most patents in urban areas
1. San Francisco (8.9/100,000 pop)
2. Boston (8.7)
3. New York (4.2)
4. Philadelphia (3.6)

patents always cite prior patents that are the foundation of the current patent.
examining these citations has shown that
(1) most cited patents are from the same metro area suggesting enormous knowledge spillover (5times as much as with no spillover)
(2) the localization of the citations is high at the beginning but declines after a few years (→ knowledge proliferates out of the cluster into surrounding regions)

Effects on Labor Supply

<u>(1) Joint Labor Supply</u>
often family members have different skills
"power couples" (both have a college degree" are most likely to both find a job in urban area

cause–effect–line unclear
diverse cluster → attracts power couples → attracts diverse industries

<u>(2) Learning Opportunities</u>
urban worker more productive → earn higher wages

Is this really a "productivity effect"? yes:
- if worker from rural region moves to city he won't get the high urban wage right away (i.e., he must learn first)
- if worker from city moves to rural region wages does not fall immediately (i.e., he must first de-learn?)

<u>(3) Social and Consumption Opportunities</u>
cities offers better interest matches for people (i.e., it's easier to find people who share your rare hobby in a large city than in a village)

similarly, city offers more opportunities with respect to
- shopping
- cultural experience (there is no jazz club and no symphony orchestra in Walla Walla)

EMPIRICAL EVIDENCE

localization Economies

Labor Productivity
Measured by elasticity of output per worker with respect to industry output
(workers get more productive with industry size)

Henderson (1986) reports productivity elasticities of
machinery equipment: 0.05
pulp and paper: 0.02
petroleum: 0.11
(e.g., for the machinery equipment industry: a 10% increase in the industry size results in a 0.5% increase in labor productivity)

Plant Birth
Rosenthal and Strange (2000) examine plant births as a function of
(1) the number of worker in the same industry (Localization)
(2) the number of worker in other industries (Urbanization)
(see Table 2a below)

The main results are:
- Localization Economies are more important than Urbanization Economies for software, food, apparel, metal
- a few industries benefit more form urbanization economies (e.g., printing)
- the optimal distance to the core of the cluster varies (e.g., apparel benefits from being in the city center; the food industry benefits most from a 1 to 5 mile distance.)
- these results are more or less confirmed when "new plant employment" is considered (Table 2b)

TABLE 2a
BIRTHS OF NEW ESTABLISHMENTS
(Numbers in Parentheses are t-ratios)

	Software SIC 7371-73, 75	**Food Products SIC 20**	**Apparel SIC 23**	**Printing & Publishing SIC 27**	**Fabricated Metal SIC 34**	**Machinery SIC 35**
	Zipcode Area, Diversity, and Competition Effects					
Zipcode Herfindahl Index	-1.040E+01	-3.634E+00	-2.151E+01	-6.036E+00	-1.395E+00	-2.265E+00
	(-36.369)	(-17.049)	(-17.551)	(-34.340)	(-20.190)	(-27.265)
Zipcode firms per	-9.466E+00	-3.349E+00	-1.329E+01	-5.149E+00	-1.631E+00	-2.160E+00
worker - other ind.	(-22.272)	(-12.051)	(-8.838)	(-19.763)	(-16.241)	(-18.948)
Zipcode firms per worker - own ind.	1.473E+00	4.561E-01	2.936E+00	4.859E-01	5.230E-02	-1.694E-01
	(13.151)	(5.875)	(7.969)	(6.459)	(1.924)	(-0.495)
	Urbanization Effects: Other (Total - Own) Industry Employment In The …					
0 to 1 Mile Ring	1.070E-06	1.060E-06	-2.000E-05	7.000E-06	-1.050E-07	5.010E-07
	(1.120)	(2.195)	(-5.445)	(7.529)	(-0.527)	(2.235)
1 to 5 Mile Ring	1.600E-06	2.180E-07	6.040E-06	1.360E-06	-2.820E-08	-2.260E-08
	(6.308)	(1.476)	(5.113)	(4.149)	(-0.494)	(-0.321)
5 to 10 Mile Ring	-2.570E-07	1.350E-07	1.110E-06	5.460E-07	2.050E-08	7.960E-09
	(-1.431)	(1.243)	(1.258)	(2.304)	(0.522)	(0.174)
10 to 15 Mile Ring	3.270E-07	-4.560E-08	1.780E-06	3.480E-07	3.610E-08	9.170E-09
	(2.094)	(-0.405)	-(2.2040)	(1.638)	(0.939)	(0.233)
	Localization Effects: Own Industry Employment In The …					
0 to 1 Mile Ring	3.843E-04	1.680E-05	8.054E-04	-5.950E-05	6.150E-05	6.360E-05
	(7.446)	(0.469)	(11.033)	(-3.966)	(4.145)	(6.088)
1 to 5 Mile Ring	5.030E-05	5.690E-05	-8.770E-05	-2.130E-06	2.330E-05	1.540E-05
	(3.844)	(4.830)	(-2.474)	(-0.340)	(5.017)	(4.818)
5 to 10 Mile Ring	3.380E-05	-1.160E-05	-3.870E-06	-8.170E-06	2.150E-06	-1.620E-06
	(3.669)	(-1.293)	(-0.139)	(-1.666)	(0.679)	(-0.747)
10 to 15 Mile Ring	-1.470E-05	5.700E-06	-6.100E-05	-5.530E-06	-1.170E-06	6.520E-06
	(-1.723)	(0.643)	(-2.127)	(-1.190)	(-0.425)	(3.483)
	Average Change In Localization Effect Per Mile From …*					
0.5 to 3 Miles	-1.34E-04	1.60E-05	-3.57E-04	2.29E-05	-1.53E-05	-1.93E-05
3 to 7.5 Miles	-3.67E-06	-1.52E-05	1.86E-05	-1.34E-06	-4.70E-06	-3.78E-06
7.5 to 12.5 Miles	-9.70E-06	3.46E-06	-1.14E-05	5.28E-07	-6.64E-07	1.63E-06
	Summary Measures					
Stnd Error	2.59	1.02	6.50	1.49	0.41	0.58
Log-L	-20,178.23	-4,658.13	-8,273.64	-14,274.27	-4,570.31	-7,660.18
2(LogL - $LogL_{NoFE}$)**	1,910.66	643.73	622.10	1,167.64	609.05	694.11
Uncensored	6,362	1,324	1,639	5,006	1,875	3,280
Total Obs	39,068	39,068	39,068	39,068	39,068	39,068
Fixed Effects	373	373	373	373	373	373

*Change per mile is computed by differencing the adjacent localization coefficients and dividing by the number of miles between the midpoints.

**The test statistic 2(LogL - $LogL_{NoFE}$) is distributed Chi-square with 372 degrees of freedom, where $LogL_{NoFE}$ is the value of the log-likelihood function when the fixed effects are omitted but a constant is retained.

Table 2b
NEW-ESTABLISHMENT EMPLOYMENT (Numbers in Parentheses are t-ratios)

	Software SIC 7371-73, 75	Food Products SIC 20	Apparel SIC 23	Printing & Publishing SIC 27	Fabricated Metal SIC 34	Machinery SIC 35
	Zipcode Area, Diversity, and Competition Effects					
Zipcode Herfindahl Index	-2.208E+02	-2.085E+02	-9.332E+02	-3.239E+02	-1.189E+02	-1.147E+02
	(-34.372)	(-16.419)	(-15.692)	(-31.236)	(-19.28)	(-26.216)
Zipcode firms per worker - other ind.	-2.204E+02	-2.071E+02	-6.910E+02	-3.144E+02	-1.435E+02	-1.200E+02
	(-22.926)	(-12.37)	(-8.738)	(-20.267)	(-15.893)	(-19.577)
Zipcode firms per worker - own ind.	3.188E+01	2.275E+01	1.602E+02	2.718E+01	3.986E+00	-1.316E+00
	(12.615)	(4.700)	(8.159)	(6.094)	(1.603)	(-0.716)
	Urbanization Effects: Other (Total - Own) Industry Employment In The …					
0 to 1 Mile Ring -1.500E-05	-7.830E-05	-7.760E-05	-1.241E-04	2.538E-04	-4.800E-05	
	(-3.606)	(-2.424)	(-0.723)	(4.383)	(-2.344)	(-0.995)
1 to 5 Mile Ring	2.610E-05	1.670E-06	2.549E-04	3.630E-05	-1.400E-05	-7.450E-06
	(4.510)	(0.177)	(4.088)	(1.807)	(-2.505)	(-1.777)
5 to 10 Mile Ring	-1.030E-05	6.230E-06	4.810E-05	5.390E-05	-4.550E-06	-1.790E-06
	(-2.52)	0.930	(1.016)	(3.805)	(-1.203)	(-0.69)
10 to 15 Mile Ring	4.070E-06	2.120E-06	8.220E-05	1.500E-05	4.510E-06	-2.690E-07
	(1.156)	(0.3140)	-(1.9030)	(1.184)	(1.264)	(-0.124)
	Localization Effects: Own Industry Employment In The …					
0 to 1 Mile Ring	1.171E-02	1.245E-02	4.034E-03	-1.346E-03	6.613E-03	3.802E-03
	(10.385)	6.272	(1.061)	(-1.433)	4.602	(6.738)
1 to 5 Mile Ring	8.574E-04	2.945E-03	-5.261E-04	-5.659E-04	2.689E-03	6.897E-04
	(2.895)	4.032	(-0.288)	(-1.458)	6.368	(3.973)
5 to 10 Mile Ring	8.545E-04	-5.531E-04	-3.604E-04	-9.037E-04	4.750E-04	-9.560E-06
	(4.110)	(-1.015)	(-0.242)	(-3.086)	1.647	(-0.081)
10 to 15 Mile Ring	-1.215E-04	6.180E-05	-2.819E-03	-3.661E-04	-3.765E-04	2.666E-04
	(-0.63)	(0.115)	(-1.838)	(-1.32)	(1.480)	(2.637)
	Average Change In Localization Effect Per Mile From …*					
0.5 to 3 Miles	-4.34E-03	-3.80E-03	-1.82E-03	3.12E-04	-1.57E-03	-1.24E-03
3 to 7.5 Miles	-6.44E-07	-7.77E-04	3.68E-05	-7.51E-05	-4.92E-04	-1.55E-04
7.5 to 12.5 Miles	-1.95E-04	1.23E-04	-4.92E-04	1.08E-04	-1.70E-04	5.52E-05
	Summary Measures					
Stnd Error	58.17	60.76	346.65	87.44	36.26	30.78
Log-L	-39,825.85	-9,963.03	-14,809.64	-34,435.40	-12,710.56	-20,398.02
$2(\text{LogL} - \text{LogL}_{\text{NoFE}})$**	1,703.27	648.03	618.00	1,105.36	552.54	714.70
Uncensored	6,362	1,324	1,639	5,006	1,875	3,280
Total Obs	39,068	39,068	39,068	39,068	39,068	39,068

Fixed Effects	373	373	373	373	373	373

*Change per mile is computed by differencing the adjacent localization coefficients and dividing by the number of miles between the midpoints.

**The test statistic $2(\text{LogL} - \text{LogL}_{NoFE})$ is distributed Chi-square with 372 degrees of freedom, where LogL_{NoFE} is the value of the log likelihood function when the fixed effects are omitted but a constant is retained.