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Commuting Impacts of Spatial Decentralization: A Comparison of Atlanta and Boston

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Abstract. The change in commuting time in the process of spatially decentralized development has generated debates on the commuting impacts of spatial decentralization. Using Atlanta and Boston as two sizable but contrasting regions, this research compares commuting and urban spatial structure across space and over time, and examines commuting length increase in relation to the simultaneous decentralization of employment and residence. The empirical results indicate that, while decentralized development is unavoidable in growing regions, alternative decentralization pathways can result in very different transportation outcomes. The relatively spatially constrained decentralization in Boston results in a shorter commuting time and distance compared to the much more sprawling Atlanta.

1. Introduction

Decentralized metropolitan growth, coupled with increasing peak period congestion in many American metropolitan areas, has prompted researchers to study widely the relationship between commuting and land development patterns (Crane, 2000). A particular question is how commuting length is affected by the spatially decentralized development of metropolitan areas. By comparing commuting and land development patterns among different parts of a single region (Cervero, 1989, 1996; Shen, 2000; Peng 1997; Wang 2001), or comparing multiple regions (Gordon, *et al*, 1989), researchers have debated with each other on the significance of job-housing balance strategies for shortening commuting and relieving congestion.

Besides the above cross-sectional approach, researchers have stepped up efforts to look into the commuting-growth linkage over time. The temporal perspective has firstly appeared in the "commuting paradox" (Gordon, *et al*, 1991), which hypothesizes, without proving, that spatial decentralization brings jobs and workers closer to each other, thereby helping shorten commuting length. Several empirical studies have been carried out to examine the commuting – land use connection over time. Wachs, *et al* (1993) studies the changing commuting in relation to job-housing balance for a specific job center in a multicentric region and concludes that the increased commuting time can be attributed to congestion rather than job-housing imbalance. The research, however, does not examine whether the increase in congestion has something to do with the changing job-housing patterns across the region. A more recent paper (Crane and Chatman, 2004) uses seven waves of American housing surveys (1985-1997) to research the commuting impacts of employment decentralization across the USA. It finds that workers in regions with more employment decentralization have shorter commuting distances. However, this research does not measure household decentralization. Therefore, it only proves that employment decentralization tends to shorten commuting when households are already decentralized. Considering the fact that employment decen-

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tralization and household decentralization are two chained processes and decentralized employment enables households to live farther away from the urban core, the commuting impact of spatial decentralization would not be clear until suburban household and employment growth have been considered simultaneously.

This paper follows the above discussion of the commuting – growth linkage. It examines commuting time and distance in relation to spatial decentralization pathways of both jobs and workers in two sizable but contrasting regions - Atlanta and Boston. These two regions are in the second tier of the USA's urban hierarchy. They have experienced increased commuting time from 1990 to 2000. A recent report sorted American metropolitan areas by the increase in commuting time during 1990s, Atlanta ranks first while Boston ranks seventh (McGuckin and Srinivasan, 2003).

This research examines not only how decentralization changes commuting length in terms of time and distance, but also how different spatial decentralization pathways can lead to different commuting outcomes. The data include three decades (1980, 1990 and 2000) of census transportation planning packages (CTPP), which have census tract level information on job and worker distribution, and journey-to-work patterns. The decentralized spatial structure in Boston and Atlanta will be compared in terms of suburban growth, ratios of jobs to employed residents, and density. In addition, the changing spatial relationship between workplace and residence will be measured with a recently developed "commuting spectrum" method (Yang and Ferreira, 2005). Descriptive and regression analysis indicates that Atlanta and Boston are significantly different from each other in terms of decentralization pathways, which explains their differences in commuting time and distances.

2. Defining the spatial framework

The research employs census' definition of metropolitan boundaries. However, metropolitan areas tend to extend outward as the population and economy grows. We choose the 1990 boundary as the standard and cut the 1980 and 2000 CTPP data to fit the 1990 boundary. Because of this, our statistics of job and worker counts and commuting time would be slightly different from other sources[2].

In order to see how growth happens unevenly in different parts of a region, three sub-regions with consistent boundaries are selected. Each of these subregions is formed by aggregating the basic spatial analysis units - the Census tracts, depending upon their proximity to certain major roads. One cannot compare the census level data directly because many census tracts changed boundaries in the last two decades. In addition, a tract level comparison provides more detail than what is required in this research. The three subregions include an urban core, inner suburbs, and outer suburbs. Figure 1 presents the configuration of the metropolitan boundaries, the sub-region boundaries and the limited access highways. Boston and Atlanta are mapped with the same scale.

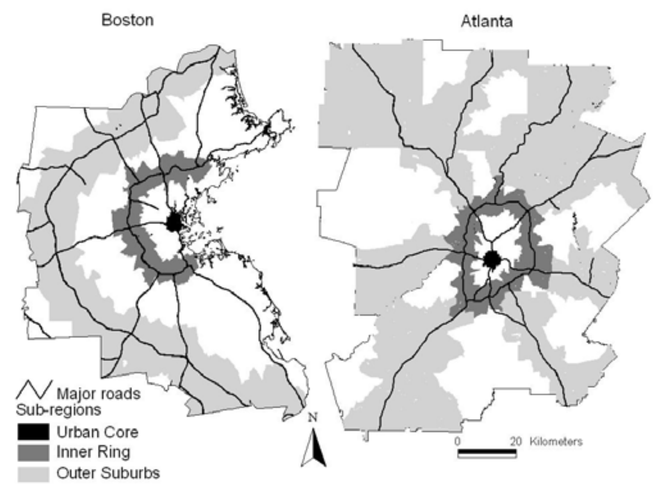

Figure 1. Urban Core, Inner Ring, and Outer Suburbs

The 'urban core' is defined to include all census tracts whose centroids are within 3 km of the downtown area. Both Boston and Atlanta have ring roads about 15 km from downtown. In Boston, the ring road is Route 128. In Atlanta, the ring road is Interstate 285. The 'inner ring' subregion is defined to be those census tracts whose centroids are within 4 km of the ring road. The 'outer suburbs' subregions are defined differently for Boston and Atlanta. Boston has a second ring road, Interstate 495, which is about 50 km away from downtown. Census tracts within 8 km of I-495 are selected to represent Boston's outer suburbs. In Atlanta, there is no second ring road but there are sev-

[2] The expanding metropolitan boundary from one year to the other can complicate decade-to-decade comparisons. In Boston, for example, the 1990 boundary extends beyond the 1980 boundary at the southern tip of the region. Therefore, the 1980 information is missing for that part of the region. However, this kind of boundary change should not affect our conclusions on urban growth trends since the added outer suburbs typically have very low density and have a very limited number of workers and jobs. In Boston, for example, there are seven towns included in the CTPP modeling region in 1990 but not included in 1980. The sum of the area of the seven towns is 745 sq km, about 1/10 of the whole region. However, they have a total population of only 0.15 m residents, only 2% of the region's total.

eral radial roads that extend outward from the urban core and beyond the inner ring road. Outer corridors along the major radial roads are selected to represent Atlanta's outer suburbs. These corridors include census tracts whose centroids are within 8 km of the radial ring roads (not including those tracts already counted as part of inner ring or tracts within the inner ring). These subregions provide the spatial framework to track the suburban growth and to compare spatial decentralization pathways in Atlanta and Boston.

3. Similarities and Differences in Decentralization

Based on 1990 boundaries, Boston covers an area of 7,340 km^2 and Atlanta covers 11,470 km^2. In 2000, there are 2.3 m jobs and 2.1 m employed residents within the Boston metro area, and 1.9 m jobs and 2.0 m employed residents within the Atlanta metro area. With such similar sizes of jobs and labor markets, Boston and Atlanta are two comparable regions in 2000. Table 1 summarizes job (employment) and worker (employed residents) counts in each region as well as for each subregion in different years.

Note, first, there is a strong suburban growth in both regions. From 1980 to 1990, significant growth happens at the inner rings and outer suburbs. From 1990 and 2000, the growth at the inner ring slows down. Outer suburbs become the primary location for job and worker growth.

Second, the growth of jobs and workers is imbalanced in both regions. For example, in Boston, the ratio of jobs to employed residents (JER) in the urban core remains almost the same (4:1) from 1980 to 1990, which means that the urban core has remained a job rich area with a constant ratio of jobs to labor. Boston's inner ring was slightly labor rich in 1980, with a JER of 0.91. However, JER increased significantly to 1.35 in 1990, and then stabilized at 1.37 in 2000. Boston's outer ring was labor rich in 1980, with a JER of 0.73. Further decentralization of jobs tends to increase the supply of jobs within this sub-region. In 1990, JER reaches 0.94, and it grows further to 0.97 in 2000. This originally labor rich area becomes almost balanced. This is also true for Atlanta. The urban core was the only job rich sub-region in 1980, then the inner ring joined the list in 1990, and the outer suburbs reach a JER of almost 1 by 2000. These numbers seem to indicate that the urban core, inner suburbs and outer suburbs become job rich areas in a sequential manner.

At the region level, Atlanta and Boston are also becoming increasingly job rich. In Atlanta, JER increases from 0.76 in 1980 to 0.98 in 1990 and further to 1.05 in 2000. In Boston, JER increases from 0.93 to 1.06 and then further to 1.08. These numbers point out that residential decentralization extends beyond the geographical scope of job decentralization, implying that resident decentralization drives employment decentralization or, alternatively, that continuing resident decentralization is further enabled by employment decentralization.

Despite all the above similarities in spatial decentralization, Boston and Atlanta are different in many other aspects. First, speaking of the growth rate, Atlanta has grown much faster than Boston. Boston grew from 1.7 m jobs in 1980 to 2.3 m jobs in 2000, implying an annual increase of 30 thousand jobs. Atlanta in 1980 had only 0.72 m jobs. However, in 2000, the count increased to 2.0 m. The annul increase rate is about 64 thousand. The growth rate of jobs in Atlanta has been about twice that of Boston. A similar difference exists in worker growth.

Second, the decentralization trend is stronger in Atlanta than in Boston. In Atlanta, as seen in Table 1, the share of jobs within the urban core drops from 19.7% to 7.7%. In Boston, the share of jobs within the urban core, however, decreases only slightly from 19.9% in 1980 to 18.9% in 2000. The share of workers within the urban core even increases from 4.6% to 5.0%.

In contrast to the declining or stable shares of jobs and workers within the urban core, job and worker shares of the outer suburbs increase significantly. As seen in Table 1, the job share of the outer suburbs in Atlanta increases from 6.2% in 1980 to 39.4% in 2000, with a 32.8% increase. The corresponding numbers in Boston are 15.6% and 23%, with only 7.4% increase, indicating a much more moderate decentralization trend in Boston.

Lastly, land is more densely utilized in Boston than Atlanta. Table 2 summarizes the density of jobs and employed residents at the metropolitan level and at the sub-region level[3].

In 1980, density in Boston is about three times that of Atlanta. After significant densification from 1980 to 2000 in Atlanta, Boston's density is still almost two times that of Atlanta. These density differences between Atlanta and Boston do not simply arise because Atlanta is configured to include more low-density outer suburbs. A comparison of density by subregion can show this.

[3] When calculating density, crude land area is used as the denominator. Note that the expansion of metropolitan boundary from 1980 to 1990 is already accounted. A smaller area (in sq km) for 1980 outer suburbs is used to compute the 1980 density.

Table 1. Number of workers and jobs by subregion.

Region	Subregions	1980 Jobs (thousand)	1980 Workers (thousand)	1980 JER	1980 Job share (%)	1980 Worker share (%)	1990 Jobs (thousand)	1990 Workers (thousand)	1990 JER	1990 Job share (%)	1990 Worker share (%)	2000 Jobs (thousand)	2000 Workers (thousand)	2000 JER	2000 Job share (%)	2000 Worker share (%)
Boston	Metropolis	1,704	1,826	.93	100	100	2,201	2,074	1.06	100	100	2,315	2,147	1.08	100	100
	Urban core	338	85	4.00	19.9	4.6	408	102	4.02	18.5	4.9	437	106	4.10	18.9	5.0
	Inner ring	237	260	0.91	13.9	14.2	370	274	1.35	16.8	13.2	379	276	1.37	16.4	12.8
	Outer ring	266	365	0.73	15.6	20.0	469	501	0.94	21.3	24.1	532	550	0.97	23.0	25.6
Atlanta	Metropolis	715	943	0.76	100	100	1,399	1,428	0.98	100	100	1,999	1,905	1.05	100	100
	Urban core	141	17	8.03	19.7	1.9	153	18	8.44	10.9	1.3	154	21	7.31	7.7	1.1
	Inner ring	230	287	0.80	32.1	30.4	431	335	1.29	30.8	23.5	472	361	1.31	23.6	18.9
	Outer ring	44	253	0.17	6.2	26.8	355	537	0.66	25.3	37.6	787	833	0.95	39.4	43.7

Note: In this table, “jobs” represents the number of jobs in each metropolis or in each sub-region, and “workers”, the number of employed residents. JER is the ratio of jobs to employed residents. Job share and worker share are the percentages of jobs and employed residents in each sub-region.

The job and worker density for the inner rings have been fairly similar for Atlanta and Boston throughout the two decades. Atlanta’s inner ring job density increased from 72% to 93% of Boston’s, and the worker density increased from 82% to 97%. But Atlanta’s urban core densities have remained much lower than Boston’s throughout the two decades. Atlanta’s urban core job density stays below 40% of Boston’s and drops to 34% in 2000. Atlanta’s urban core worker density never tops 20% of Boston’s. In the outer suburbs, Atlanta’s density increased substantially, especially for jobs. By 2000, both job and worker density in Atlanta’s outer corridors has reached 70% of Boston’s corresponding densities. Therefore, the major density gap is in the urban core, not the outer suburbs.

Overall, the above numbers suggest that urban growth and suburban development in Boston has been more spatially concentrated than in Atlanta. Their differences in growth rate, share of jobs and workers among different parts of the region, and land utilization intensity suggest that, although Boston and Atlanta have comparable sizes today, they come from different decentralization pathways.

4. Commuting Outcome of Decentralization

Commuting length is an important aspect of commuting patterns. CTPP data offers self-reported commuting time averaged at the census tract level. In addition to commuting time, commuting distance between each pair of census tracts is estimated based on

Table 2. Density of jobs and workers in Boston and Atlanta (person / sq km)

Region	Subregion	1980 density		1990 density		2000 density	
		Job	Worker	Job	Worker	Job	Worker
Boston	Metropolis	258	277	300	282	315	293
	Urban core	11669	2918	14065	3502	15067	3671
	Inner ring	396	434	617	457	632	460
	Outer suburbs	106	146	149	159	169	175
Atlanta	Metropolis	78	103	122	124	174	166
	Urban core	4685	583	5104	605	5146	704
	Inner ring	285	356	535	416	586	448
	Outer suburbs	9	52	53	81	118	125
Percent: Atlanta/ Boston	Metropolis	30%	37%	41%	44%	55%	57%
	Urban core	40%	20%	36%	17%	34%	19%
	Inner ring	72%	82%	87%	91%	93%	97%
	Outer suburbs	8%	36%	36%	51%	70%	71%

the major road layer provided by ESRI. This road network is much denser than the limited access roads presented in Figure 1. The estimated distance is the shortest route distance along major roads between the centroids of the residence and workplace census tracts.

The actual commuting distance might be longer than the shortest route distance by major roads. However, since we have no reason to believe that this computation biases one sub-region relative to the others, the computed commuting distance should provide a base for comparing commuting distance among different places and among different years. Table 3 summarizes the commuting time and distances for workers who live in each region and each subregion. These time and distances are the weighted average computed based on workers' reported residence location.

Table 3. Commuting in Boston and Atlanta

Year		Boston			Atlanta		
		1980	1990	2000	1980	1990	2000
Region	Time (min)	23	24	28	27	26	30
	Distance (km)	11.3	14.7	16.3	18.5	21.7	22.1
Urban Core	Time (min)	20	20	22	29	26	28
	Distance (km)	4.8	6.0	6.7	8.6	10.1	12.2
Inner suburbs	Time (min)	21	22	25	25	25	30
	Distance (km)	11.4	13.2	14.1	15.2	17.3	18.4
Outer suburbs	Time (min)	21	23	27	30	27	31
	Distance (km)	14.5	18.7	21.2	27.7	26.0	24.2

4.1 Spatial variation of commuting

As seen in Table 3, there is an obvious difference in commuting distances among subregions in a single region. In either Boston or Atlanta and in each year, commuting distance for people living in the urban core is the shortest, and that in the outer suburbs is the longest. Recall that residence decentralization always extends beyond job decentralization and JER is the highest in the urban core. The shortest commuting distance in the urban core, therefore, can be explained with the most over-supplied jobs relative to labor presence. Following the same line of reasoning, the outer suburbs are best supplied with labor force relative to the presence of employment opportunities, resulting in longest commuting distances for people living there.

The variation of commuting time by subregion is not as significant as commuting distance because of the intervening effects of mobility conditions. In Boston, although commuting time follows the exact order of commuting distance, the difference in commuting time between subregions is relatively small. In Atlanta, the shortest commuting time is not at the urban core, but at the inner ring, implying that the relatively less congested traffic condition at the inner ring enables workers to commute a longer distance within a shorter time. In addition, there is mode affect. The high concentration of minorities in the urban core means that a large proportion of workers commute by public transit (The Brookings Institution, 2000), the average speed of which is much lower than by automobile.

The above numbers suggest a correlation between commuting and job-housing balance, implying that the commuting – land use linkage is embedded within the spatial structure in Atlanta and Boston. Continuing from this point, we further analyze how spatial decentralization leads to increased commuting time and distance in the last two decades.

4.2. The Commuting-Growth Linkage

As seen in Table 3, commuting distance increases steadily over time. At the metropolitan level, commuting distance per trip in Boston increases from 11.3 km in 1980 to 14.7 km in 1990 and further increases to 16.3 km in 2000. In Atlanta, commuting distance increases from 18.5 km in 1980 to 21.4 km in 1990, and then further increases to 22.1 km in 2000. Commuting time also increases, although the percentage increase is not so high.

Note that both commuting time and distance in Atlanta are longer than in Boston. In 2000, when Boston and Atlanta approach the same size, commuting time is 28 minutes in Boston compared to 30 minutes in Atlanta. Measured by distances, commuting is even longer in Atlanta than in Boston. Average commuting distance is 22.1 km in Atlanta compared to 16.3 km in Boston.

One may recall our previous description of the similarities and differences in decentralization in Atlanta and Boston and hypothesizes that spatial decentralization in general tends to increases commuting length and a stronger spatial decentralization tendency leads to longer commuting. The following part explains how spatial decentralization can lengthen commuting, the first step of which is to measure the changing job-housing balance in the process of spatial decentralization.

Many job-housing balance indicators have been developed. Readers can refer to a previous paper (Yang and Ferreira, 2005) for a comparative evaluation of measures such as ratios of jobs to employed residents, gravity type accessibility and minimum required commuting. A better approach, the "commuting spectrum" method, is developed to examine commuting behavior in relation to job-housing balance across space, over time and between different regions (Yang and Ferreira, 2005). This method, on the one hand, measures the changing settlement patterns with minimum required commuting (MRC) and proportionally matched commuting (PMC), which illustrates the local and regional configuration of job-housing distribution across space and over time. On the other hand, the method reveals the commuting impacts of the settlement patterns by examining the position of actual commuting along the spectrum of commuting possibility ranging from MRC to PMC. A simple presentation of MRC and PMC is below.

MRC shows how much people have to commute conditioned on a given job-housing distribution. In a region with n census tracts, MRC of the region average is computed with the following minimum cost assignment:

Minimize

$$Z = \frac{1}{N}\sum_i \sum_j c_{i,j} x_{i,j}$$

Subject to: $$\sum_j x_{i,j} = N_i$$

$$\sum_i x_{i,j} = E_j$$

$$x_{i,j} \geq 0$$

where N is the total number of commuters in a region. N_i and E_i represent worker and job counts in tract i. C_{ij} is the travel distance between tracts i and j. X_{ij} is the solution variable representing number of workers living in tract i and working in tract j.

With MRC, jobs are matched with closest available workers. Therefore, MRC values mainly reflect the local configuration of job-housing distribution. When travel cost is still important in location decisions of workplace and housing, the change of MRC over time should, to some extent, mirror the change of actual commuting.

With PMC, travel cost has no impacts on the matching between workplace and residence. The number of workers living in tract i and working in tract j is as follows:

$$X_{i,j} = \frac{N_i * E_j}{\sum E_j}.$$

That is to say, the chance a worker living in tract i and working in tract j is proportional to tract j's share of the regional job stock. A weighted average of commuting distance with the proportional matched commuting flow results in the average PMC value for a region. Since PMC has nothing to do with travel cost, PMC value reflects the regional, rather than the local configuration of job-housing distribution. In the decentralized suburban areas with higher mobility, the choice of residence and job location may be more affected by the spatial distribution of opportunities, which is measured by PMC, rather than constrained by the spatial separation of workplace and residence implied by MRC. This observation is supported by the literature that regards choice of workplace and housing location as a random spatial search process (Rouwendal, 1998).

Note that MRC and PMC have nothing to do with how people actually commute. They measure the spatial relationship between workplace and residence, rather than commuting behavior. In addition, they measure the location of employment and residence relative to each other. Therefore, the change of MRC and PMC can track the simultaneous decentralization of employment and households. Figure 2 presents MRC and PMC together with actual commuting distances (AC).

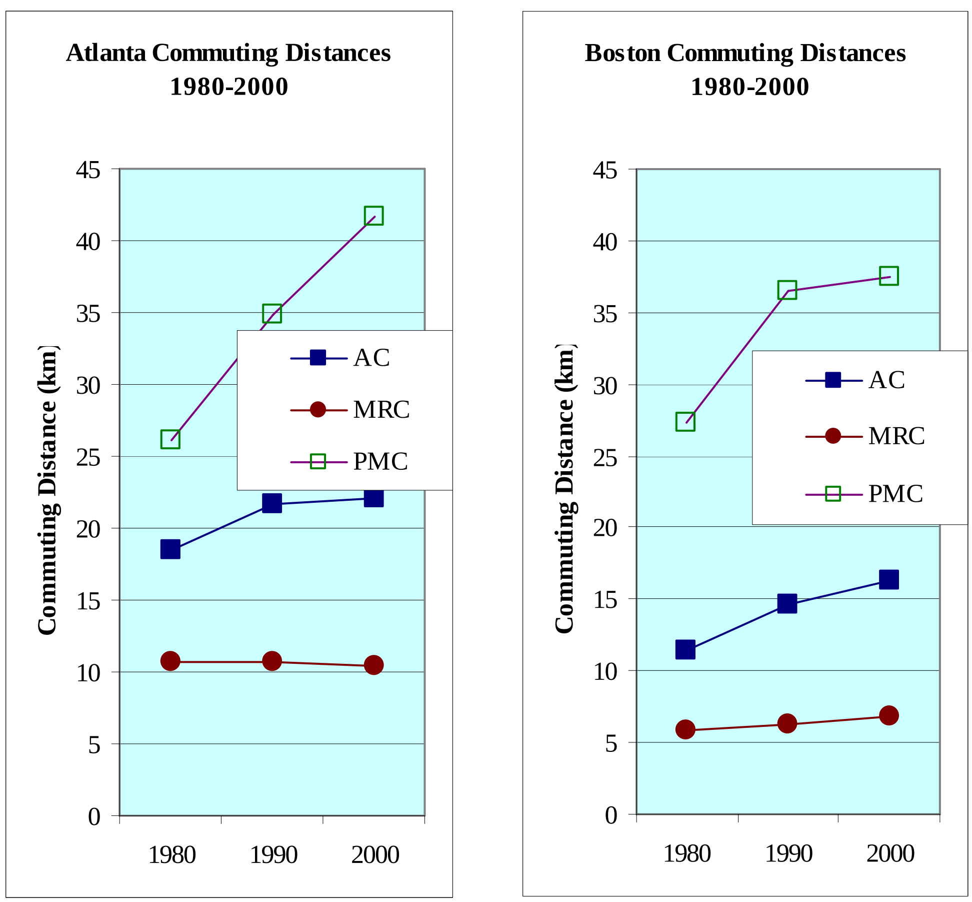

Figure 2. Commuting and spatial decentralization in Atlanta and Boston

First, the change of MRC values tells whether spatial decentralization forces people to commute longer. In Boston, MRC increases from 5.9 km in 1980 to 6.2 km in 1990 and further to 6.8 km in 2000. This implies that spatial decentralization increases the spatial separation between workplace and residence and imposes a higher minimum standard over time. In Atlanta, MRC has stayed around 10.5 km in the last two decades.

Second, the change of PMC tells whether people tend to be attracted to commute longer because of the dispersion of jobs and households. In Boston, PMC increases from 27 km in 1980 to 37 km in 2000, which implies that, by regional average, employment opportunities are moving farther away from residence locations. Interestingly, PMC value in Atlanta increases much faster, reflecting its fast-paced decentralization. The regional average PMC for Atlanta is 26 km in 1980, 35 km in 1990 and 42 km in 2000.

Third, the differences in commuting distance between Atlanta and Boston correlate the differences in spatial decentralization pathways described by MRC and PMC. On the one hand, conditioned on a much higher MRC (10.5 km in Atlanta vs. 6.8 km in Boston), people in Atlanta face a much higher minimum standard in commuting. On the other hand, the stronger trend of region-wide decentralized development in Atlanta, represented by the fast increase in PMC, has attracted people to commute much longer than what it is required by MRC. Therefore, both the local and regional configuration of job-housing distribution contributes to the longer commuting time and distance in Atlanta than in Boston.

4.3. Quantifying the commuting impacts of decentralization

We further quantify the commuting impacts of decentralization with regression models. Dependent variables are the change of commuting time from 1980 to 2000. Independent variables include the changes of MRC and PMC from 1980 to 2000, which represent the changes in urban spatial structure. Several other variables are also included to control relevant socio-economic factors.

In addition to MRC, a variable "skill mismatch" is computed. In the previous discussion of MRC, no submarket effect is considered. However, the nearby jobs may not be desirable for the local workers because of skill mismatch. To catch this effect to some extent, we divided jobs and workers into two categories: high-skilled and low-skilled. The high skilled group includes executive, administrative, and managerial occupations, professional and specialty occupations, and technicians. All other occupations are classified as low-skilled. Then we rerun the minimum cost assignment for the region and compute average commuting at the tract level for this scenario. Since MRC in this case accounts for skill mismatch, it tends to be larger than the general MRC presented previously. The difference between the two MRC values represents a commuting penalty stemming from the spatial mismatch of different categories of jobs and labor force. So we call this difference skill mismatch.

Models also include variables of drive speed, percentage of female in the workforce, percentage of African American workers, percentage of Hispanic workers, percentage of households with at least two workers, and percentage of households with more than two workers. Since these variables are widely used in the existing studies, there is no need to explain these variables in detail (Shen, 2000; Wang, 2001).

Separate models are developed for Boston and Atlanta. The Boston model uses municipalities as the analysis units to provide consistent boundaries over time. All tract level variables are aggregated to municipal level first and then used in the model. After excluding non-values, 125 analysis units enter into the regression. In Atlanta, all 1990 and 2000 variables are aligned to the 1980 census tract boundary. Therefore, the Atlanta model uses the 320 census tracts within 1980 metropolitan boundary as the analysis units. Regression results are in Table 4.

After controlling for mobility condition and all the above socio-economic factors, MRC and PMC, the two variables of spatial decentralization pathways, have significant T scores in explaining commuting. In Atlanta, MRC and PMC are equally important in explaining commuting time change. One km increase in MRC or PMC leads to 0.4 minute increase in commuting time. The Boston result is different. One km increase in PMC leads to one minute increase in actual commuting time while one km increase in MRC leads to only 0.2 minute increase. Since spatial decentralization is associated with increases in MRC and PMC, the regression analysis confirms what we obtained from the previous descriptive analysis: decentralization in general leads to an increase in commuting time. Since PMC increases much more significantly than MRC, the increase of commuting time from 1980 to 2000, therefore, can be mainly attributed to the increase in PMC, which represents the region wide dispersion of jobs and workers.

Table 4. Regression results of commuting impacts of decentralization

Variables (changes from 1980 to 2000)	**Atlanta** Commuting time change			**Boston** Commuting time change		
	Coefficients	Standard Error	t Stat	Coefficients	Standard Error	t Stat
Intercept	-1.53	0.88	-1.74	-1.13	2.08	-0.54
MRC	0.42	0.04	10.25	0.23	0.06	3.90
PMC	0.41	0.08	4.93	1.00	0.32	3.15
Skill mismatch	0.45	0.04	12.42	0.11	0.13	0.88
Drive speed	-0.21	0.04	-5.78	-0.03	0.04	-0.62
% HH w. at least two workers	-7.94	3.50	-2.27	-14.93	15.25	-0.98
% HH w. over two workers	-2.00	5.85	-0.34	-15.77	16.33	-0.97
% female workers	-5.53	4.47	-1.24	-15.64	26.17	-0.60
% Black workers	6.13	1.26	4.86	26.50	25.06	1.06
% Hispanic worker	12.49	3.67	3.41	14.08	10.68	1.32
Number of analysis units	320			122		
R square	0.65			0.25		

One may wonder why the estimates for MRC and PMC differ between Atlanta and Boston. This is primarily because the baseline of MRC in Atlanta is essentially different from that in Boston. In Boston, the low (6 km) MRC does not impose serious constraint on location decisions. Although the increase of MRC tends to increase actual commuting time, the magnitude of the increase is small. Therefore, the regional dispersion of job and worker opportunities due to spatial decentralization, as represented by the increase of PMC over time, has a dominating impact on commuting time. The situation in Atlanta, however, is different. MRC in Atlanta is much higher (over 10 km), implying a stronger constraint on location decisions than in Boston. The change of MRC, therefore, is more likely to result in changes in actual commuting in Atlanta than in Boston. Consequently, the impact of PMC increase on commuting is relatively weakened in Atlanta. The policy implication is that, to shorten commuting in Boston, strategies focusing on clustering and centering will be more effective than local balance of jobs and workers. In Atlanta, besides suburban clustering, additional effort should be devoted to densification and mixed use, which will reduce MRC significantly.

Interestingly, in the Boston model, MRC and PMC are the only two variables with significant impacts on the temporal change of commuting. In the Atlanta model, besides MRC and PMC, skill mismatch is also important in explaining the temporal change of commuting, reflecting the magnitude of social segregation in Atlanta. Increasing proportions of minority workers (African American or Hispanic) in the workforce is also associated with an increase in commuting time. None of the intercepts is significant at 95% level, implying that without any change in the examined variables, a locality tends to maintain the same commuting time from 1980 to 2000.

The model fits the Atlanta data much better than the Boston data, indicated by the higher R^2 for the Atlanta model. This can be mainly attributed to the differences in the explaining power of the socio-economic variables. None of these variables has a significant estimate (95% level) in the Boston model, although these estimates have the same sign as their counterparts in the Atlanta model. One preliminary interpretation comes from the history of these two regions. In Boston, significant spatial and social stratification had happened before the study period (1980 – 2000). The associated changes during the two decades, therefore, are not as significant as those happened in the Atlanta region, which is much younger.

Regression models using the change of commuting distances as the dependent variable are also developed. Since they have similar results, these models are not presented here in the interest of saving space.

5. Conclusions

Atlanta and Boston have both experienced significant suburban growth in the last two decades. However, they are significantly different from each other in terms of urban forms such as land use density, ratios of jobs to employed residents, and the share of jobs and workers in different subregions. Consequently, in 2000, when Boston and Atlanta begin to have comparable sizes, Atlanta has a longer commuting time and even longer commuting distance because of the faster paced spatial decentralization in a low-density format, which forces people to commute longer on the one hand and attracts people to commute longer on the other hand. This revealed commuting-growth linkage suggests that, although decentralized development may be unavoidable in a growing region, different pathways of spatial decentralization can result in significantly different transportation outcomes.

This research does not jump to any policy recommendation for Atlanta and Boston as planning is guided by multiple goals with urban transportation as only one of the many. For example, whether it is desirable to shorten PMC by adjusting the urban spatial structure needs more discussion. However, when there is enough motivation to change the land use patterns for a transportation benefit, the empirical results certainly point out directions of action. Due to the different baselines of MRC, urban growth strategies in Boston should emphasize a region wide clustering and centering. In Atlanta, however, the local balance of employment and housing opportunities are as important as the regional clustering strategies.

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