Improving Access to Jobs via Effective Public Transportation:
A Framework for Mobility in San Juan

Executive Summary of Progress to Date

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Much research has contended that reasonable access to jobs significantly improves levels of employment, and also, that differing levels of access among urban neighborhoods or races of people affect similar patterns of differing employment rates. One critical component of employment, then, is physical access to job opportunities. The extent to which accessibility affects employment, however, remains a highly debated and unresolved issue.

John Kain's research, published in 1969, examined the relationship between residential segregation and joblessness among non-whites in Chicago and Detroit. His conclusions laid foundations for what economists and urban sociologists have since termed "spatial mismatch". The hypothesis states that segregation of housing markets in the U.S. has strongly and negatively affected the distribution and level of employment among non-white poor, specifically because non-whites who are concentrated in central city ghettos have extremely limited access to abundant entry-level jobs in growing, suburban areas that are inaccessible.

While this theory is well-understood, much uncertainty remains regarding its level of independence from many other social and economic factors. Just how strongly do spatially segregated or relatively immobile groups experience inferior job accessibility as a result of their locations or inability to travel long distances? Many factors affect job accessibility -- including technical skills, access to information about employment opportunities, work experience, familial responsibilities (e.g., child care or care for an aging parent), or racial discrimination, to name only a few. How, then, may one isolate the effects of location and spatial impedance upon job accessibility, from these other important factors? Up to now, no method has been so comprehensive or cogent to convince a majority of academia.

Since Kain first discussed his hypothesis, the technology and information available for spatial research and transportation planning has evolved considerably, allowing more detailed work to be conducted by greater numbers of engineers, transportation planners and urban sociologists. This research uses basic Geographic Information System (GIS) technology to examine spatial relationships in the San Juan Metropolitan Area (SJMA) and provide thematic maps upon which to base conclusions.

Though race in Puerto Rican culture plays a relatively minor role compared to mainland U.S. cities, San Juan's strict residential segregation of those earning differing incomes remains a strong reality. Since incomes in mainland cities fall so clearly along racial lines, spatial mismatch studies effectively have addressed accessibility issues of the wealthy versus poor, while attributing differences to racial discrimination of housing markets. Thus, an examination of spatial mismatch in San Juan is clearly applicable on the basis of

income segregation. In addition, such research may shed important light upon the relative contributions of race and income upon job accessibility in the mainland U.S., and will provide the first basis for understanding accessibility issues of Latin American cities.

Practical Motivation: San Juan and Tren Urbano

More importantly, San Juan and Puerto Rico stand to benefit greatly from an alleviation of factors contributing to spatial mismatch in the island's largest city and economic engine. The SJMA's unemployment rate typically rests around 18%, while other U.S. cities experience unemployment no higher than 6.5%. In similar respect, the SJMA's median annual income is roughly two-thirds the U.S. metropolitan average, though living expenses on the island are comparable to most mainland cities. As a result, many San Juan residents may experience more difficulty meeting living needs.

Renters in Puerto Rico on average spend 40% of their incomes paying rent; meanwhile, SJMA households on average spend 40% of their incomes on transportation. Without sacrificing either transportation or housing, a low-income family living in San Juan may experience much difficulty. It is for this reason that 47% of renting households in the Tren Urbano corridor do not own or lease a car, even though existing transit in the city is inadequate.

In addition to existing economic factors, recent U.S. welfare reform legislation makes the job accessibility issue particularly timely for San Juan. The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 requires states and territories to shrink their welfare rolls by significant margins during upcoming years. The act provides incentives to states and territories that reach employment benchmarks for its formerly welfare dependent, but penalizes those that do not by withholding Federal funds. Since only 6% of those leaving welfare rolls claim access to an automobile, physical job accessibility becomes a pivotal issue for them from the start. Providing job access to the economically disadvantaged is always of high societal and economic importance; recent welfare reform legislation asserts even greater relevance to examining long-term solutions to mobility.

Thus, San Juan, of all U.S. cities, stands most to benefit from examining and bridging the spatial gap between low-income residents and suitable jobs. The fact that this research will use welfare recipients as a proxy for low-income residents, thus, is to both the research's and San Juan's great advantage. The 2001 implementation of Tren Urbano presents a great opportunity to positively affect the social and economic vitality of San Juan. Since públicos presently compose the majority of San Juan's public transportation, examining employment access now capitalizes upon both the highly improved mobility that Tren Urbano will provide and also the possibility of more effectively using públicos as a flexible means toward improving regional accessibility.

Objectives

Objectives of this research are several-fold:

1. Evaluate existing physical access of San Juan's low-income residents to low-wage employment.
2. Forecast "base level" impacts of Tren Urbano upon that accessibility.
3. Recommend transportation services and related public policies to bridge the likely spatial gap between low-income residents and entry-level jobs.
4. Evaluate future Tren Urbano extensions in terms of their abilities to better connect San Juan's poor and jobless to low-wage employment.
5. Create a framework by which to frequently analyze and re-evaluate accessibility, identify deficiencies and implement changes to the transportation system and to the policies that support it.

The recommendations' emphasis will be upon practical transportation solutions for the San Juan Metropolitan Area (SJMA), such as those of Objective #3 above. These recommendations, at base level, will embody identification of key público and AMA routes, many of which may differ from those currently projected or planned for San Juan.

Methodology

The research combines three sets of spatial data to produce meaningful geographic comparisons. These data are:

- Point locations of low-income households, proxied as the locations of welfare recipient households
- Point locations of entry-level jobs
- The transportation network, including roadways and transit

Use of point locations makes this analysis particularly rigorous. Typical examinations of accessibility use aggregated data that introduce large uncertainty.

In addition, the research uses a GIS mapping and analysis tool, TransCAD, to overlay these data layers onto a single display, thereby allowing easy examination of low-income households' job accessibility. The program's most powerful application to this research, however, will be the rigorous quantitative analysis it will perform. An accessibility model will quantify the distribution of benefits produced by changes in the transportation system, and aggregate those benefits among demographic groups and areas. By coupling sophisticated accessibility models with precise point data, the GIS program may perform a powerful and useful analysis of the effects of particular transportation improvements upon job accessibility in the San Juan area.

The research will use the 2001 transportation network, including Phase I of Tren Urbano and impending adjustments to the transit system, as the "base case". Then, it will introduce adjustments to that network, such as route realignments or changes in frequency, and evaluate and compare those adjustments by the same quantitative method used for the base case.

To facilitate interpretation of the analysis results, the research will conduct a similar study of one mainland city, namely Boston. Boston serves as an attractive laboratory for this purpose for several reasons:

- Location: Its location in the mainland U.S. makes study of Boston comparable to all previously published spatial mismatch analyses. Thus, a study of San Juan may have a "control" site against which to compare results. This fact is particularly relevant given the identical methodology the research will us for each city.
- Density: Density of development in Boston parallels that of San Juan.
- City Form: Boston's strong geographic focus upon a single central area make it more likely to exhibit city-like characteristics. On the other hand, the differences of Boston's city form from San Juan's may highlight important advantages of one as compared to the other.
- Data: Data for Boston, unlike data for San Juan, are readily available.

Study of Boston thus serves as an empirical foundation for study of San Juan. This study focuses particularly upon the physical accessibility of low-income workers to entry-level jobs in the Boston Metropolitan Area.

Work Completed

This research to now has covered the following work:

- Defined goals and objectives
- Planned methodology
- Reviewed the literature
  - spatial mismatch, urban economics
  - accessibility versus mobility planning
  - accessibility modeling
  - welfare reform
- Evaluated accessibility models

- Identified industry groups rich in entry-level jobs
- Requested and collected data (on-going process)
- Performed base study of Boston Metropolitan Area.

For brevity, this paper will not delve deeply into any one of the above. However, a longer report is available that discusses in much greater detail each of the above points. This paper briefly presented the research's objectives and methodology above, and reviewed the literature's most significant statements. The following briefly will discuss the evaluation of accessibility models, and afterward, a short section will summarize results from the base study of Boston.

Accessibility Models

Several accessibility models exist for possible application in this research. One important task of this research's first half has been examining the models themselves, evaluating their applicability to public policy formation and to the requirements of this study. A model should produce meaningful results that one may use for purposes of comparison. It also must be manageable and compatible with available data. Finally, its output should be easily interpretable. This last criterion holds particular importance in the realm of public policy formation. For this research, an accessibility model also must account for both the demand and supply of jobs. Clearly, a conflict of needs exists: a model must be sufficiently sophisticated, yet simple and easily interpretable. Since no single existing accessibility model fulfills all of these criteria, a combination of independently-run models will be used to produce meaningful, interpretable results.

To present accessibility models simply, the differences in their outputs may be summarized as follows:

- Isochrone Models: "94 jobs lie within 10 minutes travel. 458 jobs lie within 20 minutes of travel."
- Gravity Models: "Accessibility score for Zone A is 947. Accessibility score for Zone B is 349."
- Utility Models: "Alternative A produces a net benefit of $102 per year for Worker B."
- "Supply-Demand" Gravity Model: "Given a weighted average of 1.00, accessibility for low-income workers is 0.91; accessibility for high-income workers is 1.43"

The simplicity of Isochrone models and power of the Gravity and gravity-based "Supply-Demand" models will be combined to produced meaningful, interpretable results.

Case Study of the Boston Metropolitan Area

Objectives of this case study have been to:

- Examine applicability of spatial mismatch of low-income residents to entry-level jobs in 1990 in the Boston Metropolitan Area.
- Compare qualitative results to results from Shen's 1997 study of Boston.
- Apply findings to a preliminary examination of San Juan. Discuss results and their implications for San Juan.

Later, once a comprehensive study of San Juan has been completed, the comparable study of metropolitan Boston will be used to better understand conditions and needs of metropolitan San Juan.

Nine principal data sets were collected for this work: five geographic in nature and the latter four purely demographic. The demographic data included information such as household incomes, number of entry-level jobs by zone (TAZ), and point locations of welfare recipients' homes. Again, the spatial distribution of race was not examined; however, it is well known that incomes in the Boston Metropolitan Area correlate highly with race, as in all mainland U.S. cities. The geographic data included maps of rail transit, highways, municipalities, block groups and traffic analysis zone (TAZ) boundaries.

A geographic overlay and comparison of these data sets allowed for meaningful spatial observations. These overlays are available in map forms that allow formation of cogent conclusions. The most significant results for Boston follow:

- The highest concentration of both low-income workers and entry-level jobs is in the dense central city. However, the central city concentration of workers is much higher -- that is, entry-level jobs are more dispersed about the metropolitan area. Suburban areas, particularly those along the Route 128 beltway, have much higher concentrations of entry-level jobs than low-income workers. In addition, transportation services by which a large portion of entry-level workers would reach those jobs do no serve these areas. A clear spatial mismatch exists in the Boston metropolitan area.
- Density plays a very large role in the positive effect of concentrating entry-level jobs and low-income workers into similar areas. That is, it seems jobs and workers concentrate together in central Boston as a simple result of higher densities there.
- Furthermore, the data indicate that high densities over large areas significantly improve job accessibility -- both by locating many suitable jobs close to many workers and by making viable an effective transit system to move those

workers between home, work and other social services or recreational facilities within the city.

- Despite the spatial mismatch's presence, entry-level workers do gain a locational advantage by residing in the center city. In other words, though low-income workers experience large spatial impedance to accessing jobs, their location in the dense metropolitan center is most beneficial to them of all possible locations in the metropolitan area.

These observations explain in part why central areas typically display higher levels of poverty in mainland U.S. cities -- namely, because a critical mass and density of social services and opportunities exist within smaller ranges, across more easily traversed space. These observations also present many implications for transportation policy. Since entry-level job openings will occur more frequently in developing, low-density areas, located far from low-income workers, a flexible system of low-capacity transit services would best serve the needs of connecting people and jobs. Such services ideally would complement the existing, high quality rapid rail lines via timed transfers.

These observations for Boston present important implications for San Juan. Initial observation of San Juan reveals some significant differences in the distributions of demographic groups and transportation services within the metropolitan area. First, unlike Boson, San Juan's wealthier citizens reside in areas closest to the attenuated "center", where Tren Urbano will operate, while low-income residents reside at the periphery. On the other hand, the segregation of income groups in San Juan, though similarly strict to income segregation in Boston, occurs over much smaller areas. As a result, high-income and low-income neighborhoods, though separated, are more interspersed. Second, jobs in general in the SJMA concentrate into much smaller areas than in Boston, as compared to the general density of population in each city. Third, Tren Urbano seems to reach directly most existing job centers in San Juan, but will not directly serve most low-income areas.

Combining these observations, one may conclude that in San Juan, Tren Urbano will serve directly areas with higher incomes and higher concentrations of jobs, and that públicos and AMA will serve a critical role in linking low-income residents to areas served by Tren Urbano. Phase 1, for example will reach near to dense areas of Santurce and Rio Piedras where many low-income households reside. Also, many low-income residents live east of the Hato Rey center. With effective intermodal links, Tren Urbano could effectively carry these residents to concentrated job centers throughout the metropolitan area.

Also, as in Boston, many San Juan residents may benefit greatly from flexible "reverse" commute services to growing suburban areas to the south. It also is clear that Phase I of Tren Urbano will not reach significant numbers of existing jobs in Santurce and Viejo San Juan, and that the rail line will not facilitate travel between low-income areas east of Hato Rey and some job rich areas west of Hato Rey. These observations again highlight the importance of pursuing an effective system of transportation services in San Juan, rather than a single mode -- whether auto or Tren Urbano. It is clear that Tren Urbano has very

great opportunity, when combined with other transportation services, to positively facilitate low-income residents reaching employment in San Juan. To do so, effective feeder services via AMA or públicos (or other modes) will be absolutely critical.

These observations are made based only upon initial inspection of demographic data in San Juan. Examination of Boston presented useful theoretical results, in terms of density, demographic distributions, job locations and transportation services. More detailed data of San Juan will facilitate a comprehensive understanding of San Juan's job accessibility patterns and reveal with much greater precision the specific transportation needs of San Juan.

Work Plan

To the research's benefit, work will continue to progress during the summer months. During the summer, the following tasks will be completed:

- Develop agility with TransCAD maps and utilities. Continue gathering data.
- Create initial maps of welfare recipient and entry-level job locations in San Juan, overlaying the transportation network.
- Examine maps and summarize initial findings for San Juan.
- Develop plan for creating and evaluating transportation alternatives.

Data for entry-level job locations in San Juan will be gathered from databases of Dunn and Bradstreet, a professional consulting firm. Work in the fall will proceed to the following tasks:

- Quantitatively evaluate effects of Tren Urbano and other impending "base case" changes to the transit network upon job accessibility in the SJMA.
- Create transportation alternatives -- including route systems, special services and/or policies.
- Test alternatives using accessibility models. Compare quantitative results. Re-run process, again testing and comparing new results.
- Draw conclusions, identifying strengths, weaknesses and opportunities of the "base case" transit system and identifying key route corridors and transportation services that should be implemented.

During the Spring of 1999, the research will conclude by creating a framework for periodic re-application the analysis. All recommendations and methodological processes will be presenting in thesis form.

Usefulness

In terms of Tren Urbano and the transit system, this research will facilitate of accomplish the following (listed below). The majority of this research's potential effectiveness, of course, depends greatly upon factors outside its direct influence. The following represent possible, eventual effects that this research strives toward:

- Recommend supplementary services during Phase I of Tren Urbano – in terms of public policy and re-deployed or new transportation services.
- Improve the effectiveness of públicos in context of San Juan's transportation needs; better integrate públicos into a cohesive regional transit system; provide an important foundation of ridership for públicos.
- Greatly improve the effectiveness of Tren Urbano and thereby better justify the implementation of future extensions.
- Evaluate and prioritize future extensions of Tren Urbano in terms of their potentials to provide improved access to jobs.

This research will contribute to the greater metropolitan area as well. In terms of the San Juan Metropolitan Area, results of this research have potential to:

- Better utilize Tren Urbano's high-speed service to extend the boundary of accessible jobs, and as a result bring many jobless residents to sustained, long-term employment.
- Develop a framework for the San Juan Metropolitan Area to periodically reassess its low-income residents' access to jobs and implement transportation services or public policies.
- Aid greatly Puerto Rico's efforts to absorb the effects of recent welfare reform legislation and support those persons leaving the welfare rolls. The Office of Socioeconomic Development (i.e., transitional assistance office) in San Juan has expressed an eager desire to receive this research's conclusions.

Each of these results is quite valuable in itself to both Tren Urbano and San Juan. To a large extent, moving San Juan's unemployed to work depends on the effectiveness of public transportation. Conversely, the long-term success of Tren Urbano depends upon its ability to serve the economic and societal needs of San Juan. This research addresses both components of this important issue, offering opportunity to greatly improve access to jobs in San Juan via improvements to its public transportation system.

Entry Level Jobs / Low Income People

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