NITC NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

South Miami-Dade Busway

Miami-Dade, Florida

Do TOD's Make a Difference?

THE UNIVERSITY OF UTAH Metropolitan Research Center

OTREC OREGON TRANSPORTATION RESEARCH AND EDUCATION CONSORTIUM

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Disclaimer

PROJECT TITLE

Project Title: **DO TODs MAKE A DIFFERENCE?**

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1-INTRODUCTION

This analysis was intended to help answer the following policy questions:

Q1: Are TODs attractive to certain NAICS sectors?
Q2: Do TODs generate more jobs in certain NAICS sectors?
Q3: Are firms in TODs more resilient to economic downturns?
Q4: Do TODs create more affordable housing measured as H+T?
Q5: Do TODs improve job accessibility for those living in or near them?

The first question investigates which types of industries are actually transit oriented. Best planning practices call for a mix of uses focused around housing and retail, but analysis provides some surprises. The second question tests the economic development effects of transit—do locations provided with transit actually experience employment growth? The third question is intended to determine the ability of employers near transit to resist losing jobs; or having lost jobs, to rapidly regain them.

The fourth research question confronts the issue of affordable housing and transit. Transit is often billed as a way to provide affordable housing by matching low-cost housing with employment. Yet proximity to transit stations is also expected to raise land values. Proximity to transit, however, may increase actual affordability, regardless of increases in housing costs, because of the reduction in transportation costs.

The final research question considers the relationship between workplace and residential locations. To be able to commute by transit, both the workplace and home must be near transit. Effective transit should increase both the number and share of workers who work and live along the transit corridor.

Report Structure

The rest of the report is structured as follows. The following section details the study area and corridors used for analysis in all of the research questions with each research question given its own section. Each section contains a short review of relevant research as well as a description of additional data sources and analytical techniques. Each section then provides relevant analysis, discussion of the analysis, and relevant conclusions. The report concludes with a summary of outcomes from each.

2-DATA AND METHODS

Data from before and after the opening of a transit line were analyzed to determine if the advent of transit causes a significant change in area conditions. To control for exogenous factors (such as things affecting the entire metro area), changes in transit corridors were then compared to changes in comparable corridors located in the same metropolitan region, matching length, location, mix of land uses, and suitability for transit. As corridors differ primarily in their lack of transit, the corridor matching represents a 'natural experiment', where one corridor receives the treatment (a fixed guide-way transit line) and the comparable corridor acts as a control. Because of the need to perform this matching, this study used the corridor as its unit of analysis rather than station points. For most transit systems, stations lie within a mile of one another, so the areas are quite similar. Without a network analysis of walking paths, exact distances to transit are difficult to determine.

The remainder of this section describes the selection of existing transit (treatment) corridors, the creation of comparable corridors, and the data used for analysis. It also provides an overview of the transit corridor being analyzed.

Selection of Treatment corridor

The process began with Center for Transit Oriented Development (CTOD)'s Transit Oriented Development (TOD) Database (July 2012 vintage). The database's unit of analysis is the station. For each station there is information about the station's location, providing both address and lat-long points. Station attributes include the transit agency for that station as well as the names of routes using that station. The database was enriched with the addition of transit modes for all stations since many transit stations serve more than one mode.

While the database contained routes, it did not identify the corridor for each station. Most transit routes make use of multiple corridors. While routes change in response to operational needs, a corridor consists of a common length of right-of-way that is shared by a series of stations on the corridor. Typically, all stations along a corridor begin active service at the same time. Transit systems grow by adding additional corridors to the network. Initial systems may consist of only a single corridor.

Distinct corridors for each system were identified on the basis of prior transportation reports (Alternative Analysis, Environmental Assessments, Environmental Impact Statements, Full Funding Grant Agreements) as well as reports in the popular media. Whenever possible, a corridor that started operation after 2002 but before 2007 was preferred. Stations relevant to analysis were then queried out, and imported into Google Earth as a series of points. Using aerial images, the path of the corridor was traced. The corridor was then exported as a KML file and imported into a geodatabase in ArcGIS.

Creation of Comparable Corridors

Numerous draft corridors were created and then compared with the existing transit corridor. The following criteria were used while creating a comparable corridor:

Comparable Corridors Criteria

1. Same MSA
2. Equal length
3. Existing transit route; express transit preferred
4. Direct; no doubling back
5. Anchored on both ends (unless the original line was not)
6. Anchors of equal magnitude; downtowns, transit centers, shopping centers, malls, etc.
7. Along a major corridor; major/minor arterial
8. Similar land use mix along the corridor; both corridors contain substantial commercial development
9. Conformity with existing rapid transit plans
10. Existing corridor; rail or highway
11. Similar relative nearness to a parallel freeway in both distance and degree
12. Commuter rail follows existing corridors; either rail or freeway

Keeping the comparable corridor in the same metropolitan area reduced a large number of confounding effects. Maintaining the same length meant a similar amount of area was included in the analysis. Bus routes in analogous locations were used to create draft corridors. Because of their high cost per mile, rapid transit corridors tend to be direct. They also tend to be 'stretched' until they reach a reasonable terminus to anchor each end. Whenever possible, the type and magnitude of each anchor used was matched.

For comparable corridors, the emphasis was placed on creating corridors that were contiguous and followed a continuous existing right-of-way that was viable as a transit corridor. Availability of right-of-way was the primary concern, and this dictated either existing major roads or existing railway right-of-way. For the former, highways and major arterials were preferred. For the latter, this meant the majority of right-of-way needed to follow an existing rail corridor. Whenever possible, proposed or future corridors from official planning documents were used, with some limitations.

For all commuter rail systems and most light rail corridors, the availability of right-of-way determines the location of the transit line. For many rail lines, this means that the transit corridor is located alongside incompatible or inappropriate uses, such as light industrial or low density single family residential units. These characteristics affect station accessibility. The mix of land uses along the corridor affects ridership in other ways. For instance, commercial locations generate more trips per acre than either residential or industrial uses, so similar levels of commercial exposure were sought in creating comparable corridors.

Finally, proximity to freeways was matched. The benefits ascribed to TOD are on the basis of the improved accessibility provided by transit. Because freeways also provide accessibility, the confounding effect of proximity to a competing mode can be considerable.

Data Source and Extent

The data used originated from the Census Local Employment-Housing Dynamics (LEHD) datasets. Both the Local Employment Dynamics (LED) and LEHD Origin-Destination Employment Statistics (LODES) were used. Employment data are classified using the North American Industrial Classification System (NAICS), and data are available for each Census Block at the two-digit summary level. Data were downloaded for all years available (2002-2011). The geographic units of analysis are 2010 Census Blocks Points. The database contains information on employment within each block. The data were downloaded from http://onthemap.ces.census.gov/ for each metro area, using the CBSA (Core Based Statistical Area) definitions of Metropolitan/Micropolitan. In cases where either the transit or comparable corridor extended beyond a CBSA metro area, adjacent counties were included to create an expanded metropolitan area.

There is a vast difference between TOD, and Transit Adjacent Development (TAD). The latter refers to any development that happens to occur within the Transit Station Area (TSA), or a 0.5-mile buffer around a fixed guide-way transit station, while the former refers to land uses and built environment characteristics hospitable to transit. This analysis assumes that while the existing development during the year of initial operations (YOIO) may not be TOD, land uses respond to changes in transportation conditions over time, phasing out TAD and replacing it with TOD. On this basis, the TOD is conflated with TSA for the purpose of this analysis.

Data Processing

ArcGIS was used to create a series of buffers around each corridor in 0.25-mile increments. Those buffers were then used to select the centroid point of the LED block groups within those buffers, and summarize the totals. Because the location of census block points varies from year to year (for reasons of non-disclosure), it was necessary to make a spatial selection of points within the buffer for each year rather than using the same points each year. Figure 1 shows an example corridor, the buffers around the corridor, and the location of LED points in reference to both.

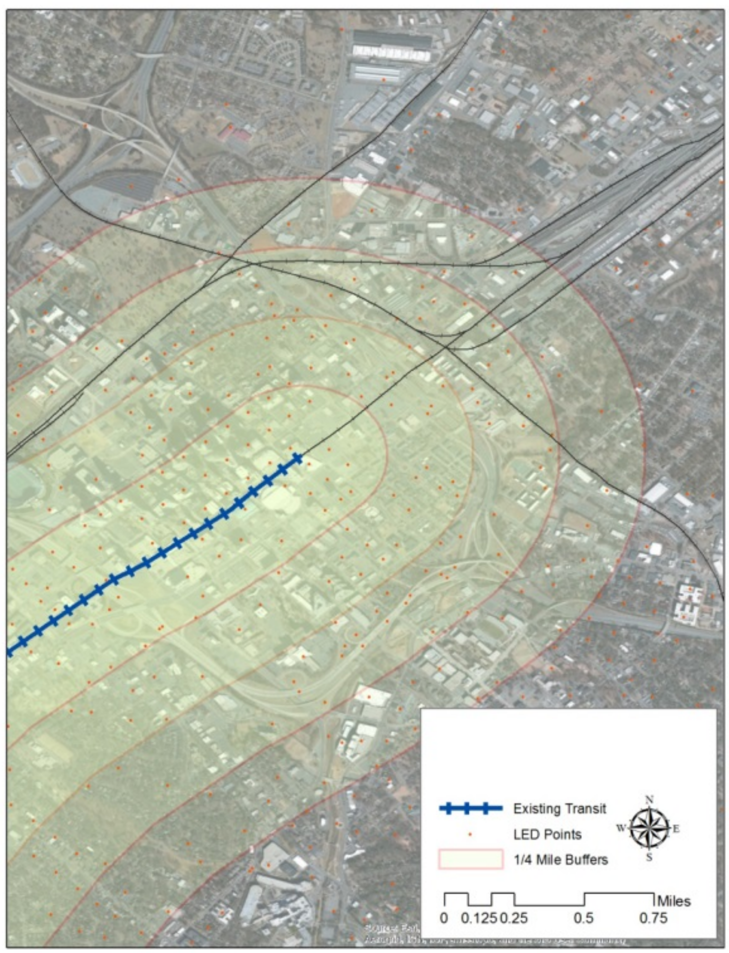

Figure 1: Example corridor, buffers, and LED census block points

Study Area

This study examines South Miami-Dade busway in Southeast Florida. Until recently, it was an open busway rather than a full status Bus Rapid Transit (BRT). Any and all buses can make use of the busway, which has no branded buses of its own. The busway was originally constructed in 1997 using right of way intended for highway expansion. It has since been extended twice, once in 2005 and again in 2007. It is anchored at the north end by the Coral Gables MetroRail station and the Florida Station at the other. The comparable corridor follows State Route 823 between the Opa-Locka station and the Sawgrass Mills Mall.

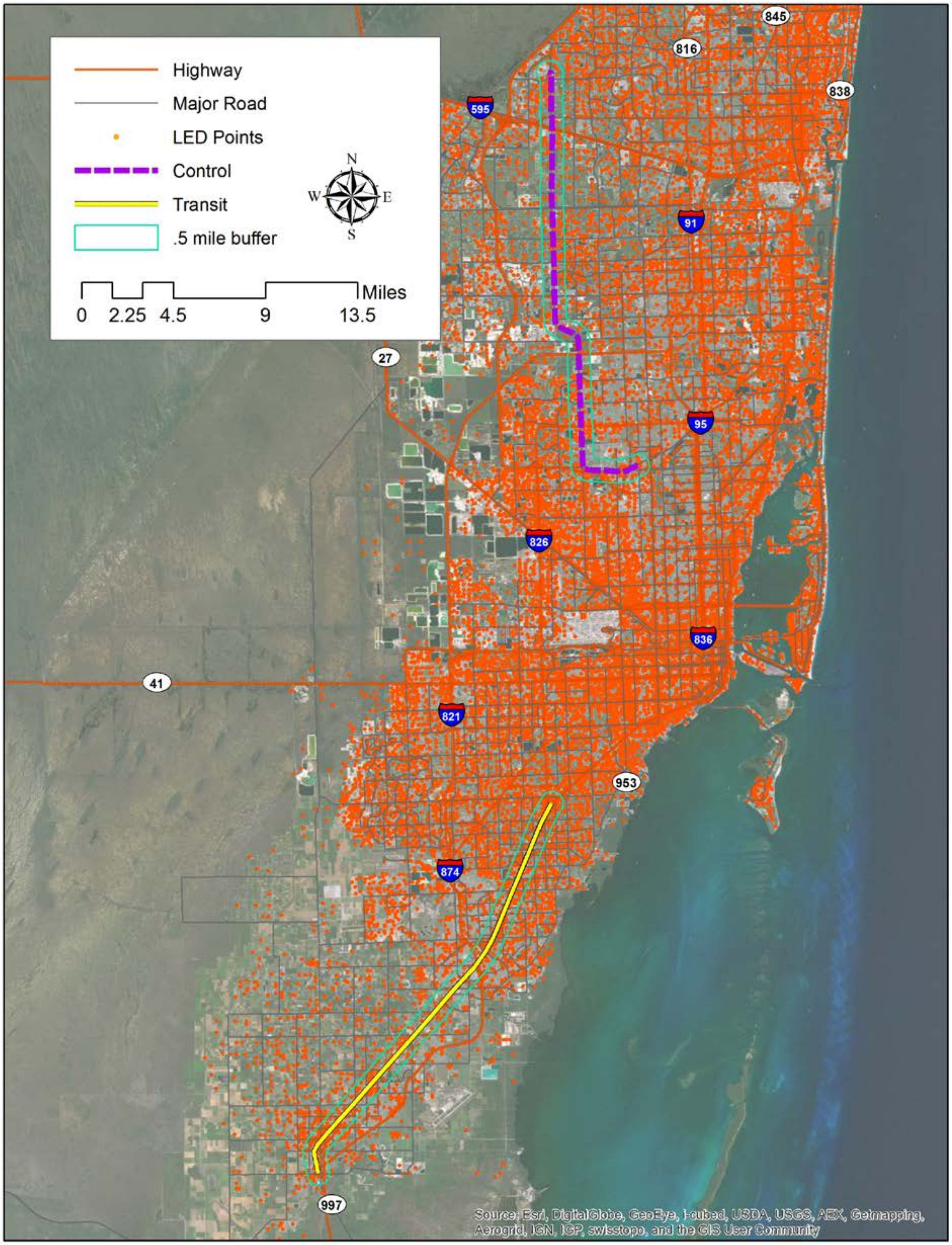

Figure 2: Transit and comparable corridor locations

3-EMPLOYMENT CONCENTRATION

Introduction

This section is intended to determine if TODs are more attractive to certain NACICS industry sectors. Case studies indicate that economic development and land use intensification are associated with heavy rail transit (HRT) development (Cervero et al. 2004; Arrington & Cervero 2008). Case studies associated with light rail transit (LRT) have inconsistent results, suggesting that much of the employment growth associated with transit stations tends to occur before a transit station opens (Kolko 2011). A study by CTOD (2011) examined employment in areas served by fixed guide-way transit systems, and explored how major economic sectors vary in their propensity to locate near stations, finding high capture rates in the Utilities, Information, and Art/Entertainment/Recreation industry sectors.

Data & Methods

To analyze the difference in the attractiveness of TODs, location quotient was used to analyze the concentration of different industries over time. Location quotient is a calculation that compares the number of jobs in each industry in the area of interest to a larger reference economy for each corridor. The analysis then compares the location quotients of each industry between each corridor. A 0.5-mile buffer around each corridor was used as the unit of analysis.

Results

The location quotients within a 0.5-mile buffer for the transit corridor is shown in Table 1. Location quotients are shown for the first and final years, with a sparkline to show trends between the years. Changes in location quotient between the 2002 and the advent of transit are calculated, as well as the advent of transit and 2011. The final column is the difference between the changes in the two periods.

Both corridors are located in a pre-existing, built-up urban area, so additional growth must occur through redevelopment of existing urban land, while the urban area that forms the denominator of the location quotient continues to grow through both development and redevelopment. With an expanding urban area, the location quotient for a fixed area would be expected to fall over time. Any increase in location quotient for a corridor should indicate locational advantage.

Industry	Location Quotient			Changes
	2002	2002-2011	2011	Δ 2002-2011
Utilities	0.88		0.07	-0.80
Construction	0.86		1.06	0.20
Manufacturing	0.44		0.56	0.12
Wholesale	0.63		0.62	-0.01
Retail	2.63		2.47	-0.16
Transportation	0.26		0.28	0.01
Information	0.84		0.91	0.08
Finance	1.83		1.27	-0.56
Real Estate	0.69		0.55	-0.14
Professional	0.97		1.13	0.16
Management	3.69		1.22	-2.46
Administrative	0.59		1.06	0.47
Education	0.05		0.21	0.16
Health Care	0.57		0.51	-0.06
Arts, Ent. Rec.	0.34		0.42	0.08
Lodging & Food	1.38		1.23	-0.15
Other Services	0.82		0.72	-0.10
Public Admin	0.37		0.43	0.06

Table 1: Location quotients comparison for transit corridor

In the transit corridor in 20011, industries with the highest location quotients within the 0.5-mile buffer of the transit corridor were: Retail at 2.47, followed by Finance, Lodging/Food, and Management at 1.22.

Between 2002 and 2011, significant increases in location quotient occur in the Administrative industry. In contrast, Management declined precipitously from 3.69 to 1.22, and Finance declined from 1.83 to 1.27. Decreases in the location quotient may indicate that either the amount of employment within the corridor has shrunken, or that employment in that industry has grown outside the transit corridor.

For both the transit and comparable corridors, changes in location quotient for the time period after the advent of transit are shown in Figure 3. Only some industries benefit from proximity to the transit corridor. Industries that benefit from proximity to transit should experience larger increases in location quotient in the transit corridor than in the comparable corridor. The y-axis is numeric change in location quotient.

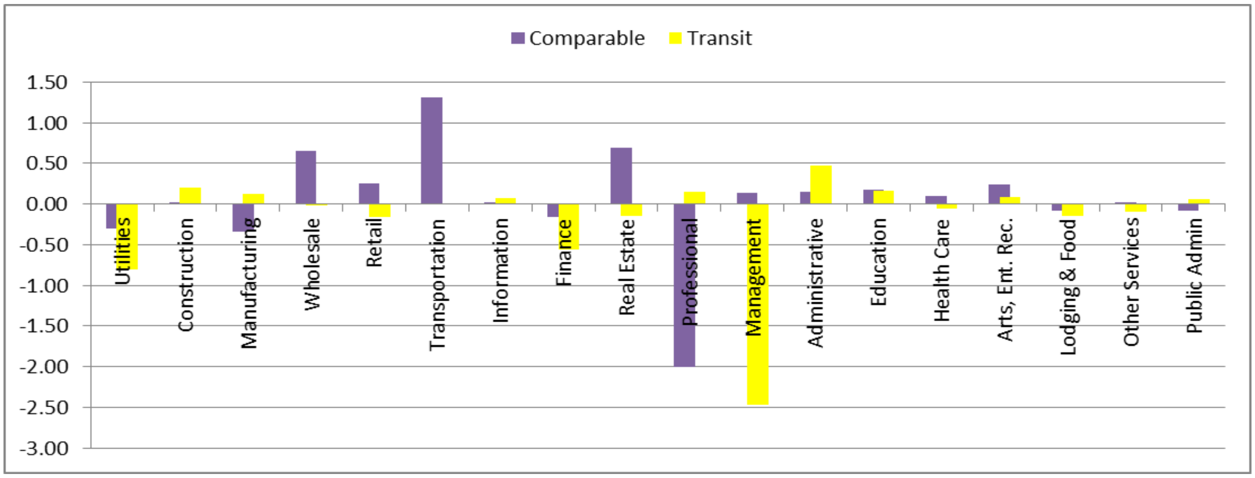

Figure 3: Changes in location quotient by corridor for the time period after the advent of transit

The graph shows industries where the transit corridor did better than the comparable corridor. In industries where the location quotient increased for both, the transit corridor did better in the Construction and Administrative industries. The Professional and Manufacturing industries continued to increase their location quotients, even as they fell in the coparable corridor. The transit corridor did the same or worse for all other industries.

Discussion & Implications

Attributing causal effect to transit lines is always problematic. Which industry sectors do well near transit corridors is not simply a function of proximity to a transit corridor. None of the location quotients for the transit corridor are especially high, indicating that there are not regional centers for any industry within the corridor. Increases in location quotients near transit may be confounded by the effect of highway proximity, which is far more important to most industries than transit access. While the Miami-Dade busway runs adjacent to US highway 1, the highways is not a limited access development, and so the clustering of freeway oriented development around interchanges fails to occur.

The lack of any employment growth or development in the transit corridor in the 'Eds/Meds/Feds' trifecta is puzzling. Most other transit systems have seen extensive growth in the Education, Health Care, and Public Administration categories. In the era of the Federal 'New Starts' transit program, designing successful transit networks is largely a game of connect-the-dots, linking together major employment centers with employee housing along congested corridors. Many stations are co-established with new campuses for major institutions, such as school, hospitals, and government office complexes.

In contrast, the Miami-Dade busway was upgraded to ‘full’ BRT status after 2011. Consequently, there were no stations around which for centers to form, and it acted as an ‘open’ busway, where local buses could use any portion of the busway as an express lane. Thus, while the busway may add substantial benefits to the transportation network, those benefits are diffused over the network, rather than concentrated around stations.

4-EMPLOYMENT GROWTH BY SECTOR

Introduction

This section is intended to determine if TODs generate more jobs in certain NAICS sectors. To determine if the new jobs are actually created as a result of proximity to transit, it is necessary to determine what portion of changes in employment can be attributed to transit and what portion of changes is determined by other factors.

In theory, employment in different NAICS sectors should be variable depending on the NAICS code, as some industry sectors are better able to take advantage of the improved accessibility offered by transit. For example, industries in which employment is characterized by low-income workers in need of affordable transportation or salaried office workers with long distance commutes are more likely to make use of transit. Likewise, arts and entertainment venues prone to serious congestion (due to their high peaks of visitors) would also benefit. Finally, institutions with large parking demands (universities, colleges, hospitals, and some government offices) could be expected to find proximity to transit valuable.

It is difficult to determine to what degree employment growth is caused by location near transit, and what is a product of self-selection, as rapidly growing industry sectors locate next to transit. Shift-Share analysis helps answer this question.

Data and Methods

A shift-share analysis attempts to identify the sources of regional economic changes to determine industries where a local economy has a competitive advantage over its regional context. Shift-share separates the regional economic changes within each industry into different categories and assigns a portion of that the change to each category. For the purpose of this analysis, these categories are Metropolitan Growth Effect, Industry Mix, and the Corridor Share Effect.

1. Metropolitan Growth Effect is the portion of the change attributed to the total growth of the metropolitan economy. It is equal to the percent change in employment within the area of analysis that would have occurred if the local area had changed by the same amount as the metropolitan economy.
2. Industry Mix Effect is the portion of the change attributed to the performance of each industrial sector. It is equal to the expected change in industry sector employment if employment within the area of analysis had grown at the same rate as the industry sector at the metropolitan scale (less the Metropolitan Growth Effect).
3. Corridor Share Effect is the portion of the change attributed to location in the corridor. The remainder of change in employment (after controlling for metropolitan growth and shifts in the industry mix) is apportioned to this variable. Within regions, some areas grow faster than others, typically as a result of local competitive advantage. While the source of competitive advantage cannot be exactly identified, the methods of analysis used suggest that the cause of

competitive advantage can be directly attributed to the presence of transit, or factors leveraged by the presence of transit.

Results

A shift-share analysis of changes in employment within a 0.5-mile buffer of the transit corridor is presented in Table 2. The first batch of columns shows numeric and percentage changes in the metropolitan area, and the second batch of columns shows the numeric and percentage changes in the buffer around the transit corridor. The third batch of columns is the actual shift-share analysis, and apportions the numeric change in the buffer around the corridor.

NAICS Sector	Metro				Transit Corridor				Sources of Employment Change		
	2002	2011	# Change	% Change	2002	2011	# Change	% Change	Metro Share	Industry Mix Share	Corridor Effect
Utilities	6,108	5,904	(204)	-3%	107	9	(98)	0%	6	(4)	(100)
Construction	112,407	81,380	(31,027)	-28%	1,934	1,809	(125)	-6%	103	(534)	306
Manufacturing	116,900	77,390	(39,510)	-34%	1,020	908	(112)	-11%	54	(345)	179
Wholesale	132,217	131,971	(246)	0%	1,665	1,716	51	3%	88	(3)	(34)
Retail	251,854	309,081	57,227	23%	13,226	16,054	2,828	21%	702	3,005	(880)
Transportation	88,902	86,464	(2,438)	-3%	470	504	34	7%	25	(13)	22
Information	63,996	46,674	(17,322)	-27%	1,071	897	(174)	-16%	57	(290)	59
Finance	92,095	102,222	10,127	11%	3,366	2,734	(632)	-19%	179	370	(1,181)
Real Estate	59,323	53,740	(5,583)	-9%	820	621	(199)	-24%	44	(77)	(165)
Professional	141,684	157,051	15,367	11%	2,756	3,727	971	35%	146	299	526
Management	23,328	24,789	1,461	6%	1,719	638	(1,081)	-63%	91	108	(1,280)
Administrative	170,536	171,065	529	0%	2,011	3,798	1,787	89%	107	6	1,674
Education	181,973	188,476	6,503	4%	189	837	648	343%	10	7	631
Health Care	253,427	317,431	64,004	25%	2,863	3,404	541	19%	152	723	(334)
Arts, Ent. Rec.	40,789	43,596	2,807	7%	278	388	110	40%	15	19	76
Lodging & Food	197,068	229,055	31,987	16%	5,424	5,906	482	9%	288	880	(686)
Other Services	84,026	87,458	3,432	4%	1,379	1,332	(47)	-3%	73	56	(177)
Public Admin	106,781	127,970	21,189	20%	784	1,155	371	47%	42	156	174
Total	**2,123,414**	**2,241,717**	**118,303**	**6%**	**41,082**	**46,437**	**5,355**	**13%**	**2,182**	**4,364**	**(1,191)**

Table 2: Shift-share analysis for 0.5 mile buffer of transit corridor

From 2002 to 2011, the metropolitan area enjoys an increase in employment of 6 percent. In contrast, the transit corridor enjoys an increase of over twice that, about 13 percent. This still represents the addition of over 5,000 jobs. In numeric terms, the industry to enjoy the most significant numeric increase is Retail, followed by Administrative. Education, Health Care and Lodging/Food all add over 400 employees. Employment in the Education sector increases by almost 350 percent, and employment in the Administrative sector by 89 percent. The Professional industry enjoys a smaller increase, although from a larger base. Serious declines occur in the Finance and Management industries.

After using Shift-Share analysis to disaggregate the cause of change in employment, different patterns emerge. All gains within the corridor can be attributed to the Metro Share or Industry Mix, as the total Corridor Effect is strongly negative. However, there are notable exceptions for which the Corridor Effect is highly positive, particularly the Administrative, Education, and Professional industries. The Corridor Effect has the largest negative value for the Management and Finance industries.

Information about the Corridor Effect is presented for both the transit and comparable corridor in Table 3. Differences between the corridors are also presented. It is intended to confirm that the corridor effects attributed to transit are specific to the transit corridor, and not the result of another effect. The 'Corridor Benefit' relates the change employment in employment totals to the change due to the Corridor Effect. It is calculated as the corridor effect divided by the absolute value of employment change. A value of 1 indicates that almost all the change can be attributed to the corridor effect, while a value of 0 means that the corridor has almost no effect.

Industry	Comparable			Transit			Transit Advantage		
	# Change	Corridor Effect	Corridor Benefit	# Change	Corridor Effect	Corridor Benefit	Difference, # Change	Difference, Corridor Effect	Difference, Corridor Benefit
Utilities	-35	-36	-1.0	-98	-100	-1.0	-63	-64	0.0
Construction	-381	-31	-0.1	-125	306	2.4	256	337	2.5
Manufacturing	-2509	-748	-0.3	-112	179	1.6	2397	926	1.9
Wholesale	1713	1566	0.9	51	-34	-0.7	-1662	-1600	-1.6
Retail	3523	1301	0.4	2828	-880	-0.3	-695	-2180	-0.7
Transportation	2159	2145	1.0	34	22	0.6	-2125	-2124	-0.3
Information	-130	-4	0.0	-174	59	0.3	-44	63	0.4
Finance	-148	-338	-2.3	-632	-1181	-1.9	-484	-843	0.4
Real Estate	677	699	1.0	-199	-165	-0.8	-876	-865	-1.9
Professional	-5156	-6205	-1.2	971	526	0.5	6127	6730	1.7
Management	78	64	0.8	-1081	-1280	-1.2	-1159	-1343	-2.0
Administrative	558	389	0.7	1787	1674	0.9	1229	1285	0.2
Education	683	629	0.9	648	631	1.0	-35	2	0.1
Health Care	1614	517	0.3	541	-334	-0.6	-1073	-851	-0.9
Arts, Ent. Rec.	215	191	0.9	110	76	0.7	-105	-115	-0.2
Lodging & Food	188	-473	-2.5	482	-686	-1.4	294	-213	1.1
Other Services	124	1	0.0	-47	-177	-3.8	-171	-177	-3.8
Public Admin	-119	-214	-1.8	371	174	0.5	490	388	2.3
Total	**3054**	**-546**	**-2.3**	**5355**	**-1191**	**-3.0**	**2301**	**-644**	**-0.8**

Table 3: Shifts by corridor and comparison between corridors

Comparing corridors, the Corridor Benefit provides a metric that is independent of the magnitude of employment. Contrast with the comparable corridor shows that the transit corridor emphasizes the negative magnitude of the corridor effect. The Corridor Benefit for the transit corridor has a value of -3.0, compared to a value of -2.3 for the comparable corridor. The Corridor Benefit is much larger for the transit corridor for the Construction, Public Administration, Professional, and Manufacturing industries. Differences in the Corridor Benefit strongly suggest that the Other Services, Management, Real Estate and Wholesale industries were negatively impacted by proximity to the transit corridor.

The Corridor Effect benefitted neither corridor, but was substantially worse for the transit corridor. However, the Transit Advantage columns suggest that the transit corridor does substantially better in regard to some industries. The difference in the Corridor Effect suggests that the Professional industry did better, although that may be an artifact of how badly the comparable corridor did. In contrast, Administrative had a positive Corridor Effect in both corridors, but was much larger in the transit corridor.

Discussion & Implications

Florida's original housing boom came decades ago. One of the side effects of a housing boom was rapidly rising property prices, forcing locals and newcomers alike to locate cheaper housing at the periphery of the metropolitan area, requiring long commuters in the face of rapidly rising gas prices. The road network fails to expand as rapidly as population, so that additional development clusters around existing roadways. Roadway expansion in Florida continued for decades for the combined effects of wetland protection and the 'concurrency' growth management regime slowed housing construction.

The transportation system for a metropolis always matches the dominant mode when the metropolis was undergoing its greatest growth, so Florida is dominated by the automobile. As both the density and size of the metropolitan area have grown, so has congestion, and Florida was forced to turn to transit on its most congested corridors. But as a metropolis built for the car, the retrofit has proved difficult, and the shear uniformity of the urban environment meant that a large bus network has been the result.

The Miami Dade busway was the result of leftover right of way, after an effort to build a limited access highway facility collapsed. The focus was not on TOD, but instead it was on transportation. Rather than intending to build centers around the transit, the busway has been a purely transportation facility. This has been compounded by its location adjacent to US highway 1, which makes walk access to the busway difficult.

As of 2001, both Miami-Dade and the transit corridor are growing rapidly compared to the rest of the nation. The economic recovery would be the envy of most other metropolitan areas. The shift-share indicates that most of the big gains in employment in the corridor can be attributed to causes other than the effect of the transit corridor, with the notable exception of Administration, and it is difficult to attribute that, given the confounding effects of proximity to US highway 1.

5-EMPLOYMENT RESILIENCE

Introduction

Resilience is defined as the ability to absorb and recover from shocks or disruptions. Resilient systems are characterized by diversity and redundancy. The resilience of employment is a critical factor in community economic health. For many communities, the loss of a single primary employer can be catastrophic, resulting in a state of sustained collapse. Employment resilience is the capacity to recover from such disruptions, due to locational characteristics.

Access to transit can help improve employment resilience because proximity to transit is a source of competitive advantage for some industries. Firms located near transit also benefit from reduced employee and visitor parking needs. This translates into an ability to economize on the size of parcels required, both reducing costs and increasing the number of viable sites for business locations.

Transit provides a mechanism to meet transportation needs and unusual or unexpected conditions, such as an automobile breakdown or lower income, and it provides alternate transportation options during conditions that impair other modes, such as weather, construction projects, or accident-induced delay. It also provides accessibility to a population unable to drive such as the young, the elderly, and the poor (VPTI 2014). These factors act to reduce tardiness and absenteeism, thus reducing employment turnover.

Transit also helps create ‘thick’ markets for employment, whereby employees can match themselves to numerous different employment opportunities. This reduces the time necessary to find matches, unemployment duration, and the unemployment rate.

Data and Methods

An interrupted time series was used to compare the resilience of employment in both areas to determine if proximity to transit represents a locational advantage. An interrupted time series divides a time series dataset into two time series with the datasets separated by an ‘interruption’ and compares the differences. For the purpose of this analysis, the interruption is the Great Recession, considered to have begun in 2007.

If an interruption has a causal impact, the second half of the time series will display a significantly different regression coefficient than the first half. Failure to be adversely affected by a severe economic shock indicates employment resilience. A low R-squared (R^2) represents larger variability in total employment. Industry sectors with a high R^2 demonstrate robust trends, indicating that employment failed to change regardless of the effects on the larger economy. The regression coefficient represents the relationships between the change in variables, and the R^2 explains how much of the variance in the data is explained by the regression equation—a measure of the ‘goodness’ of the regression.

Results

A line graph of the employment by industry time series is presented in Figure 4. The time series (2002-2011) for each is interrupted in 2008. The vertical axis shows total employment in each industry sector along the corridor. Illustrative regression lines with R^2 values have been added for some of the industries. The trend lines and associated R^2 values for all industry sectors can be found in Table 4.

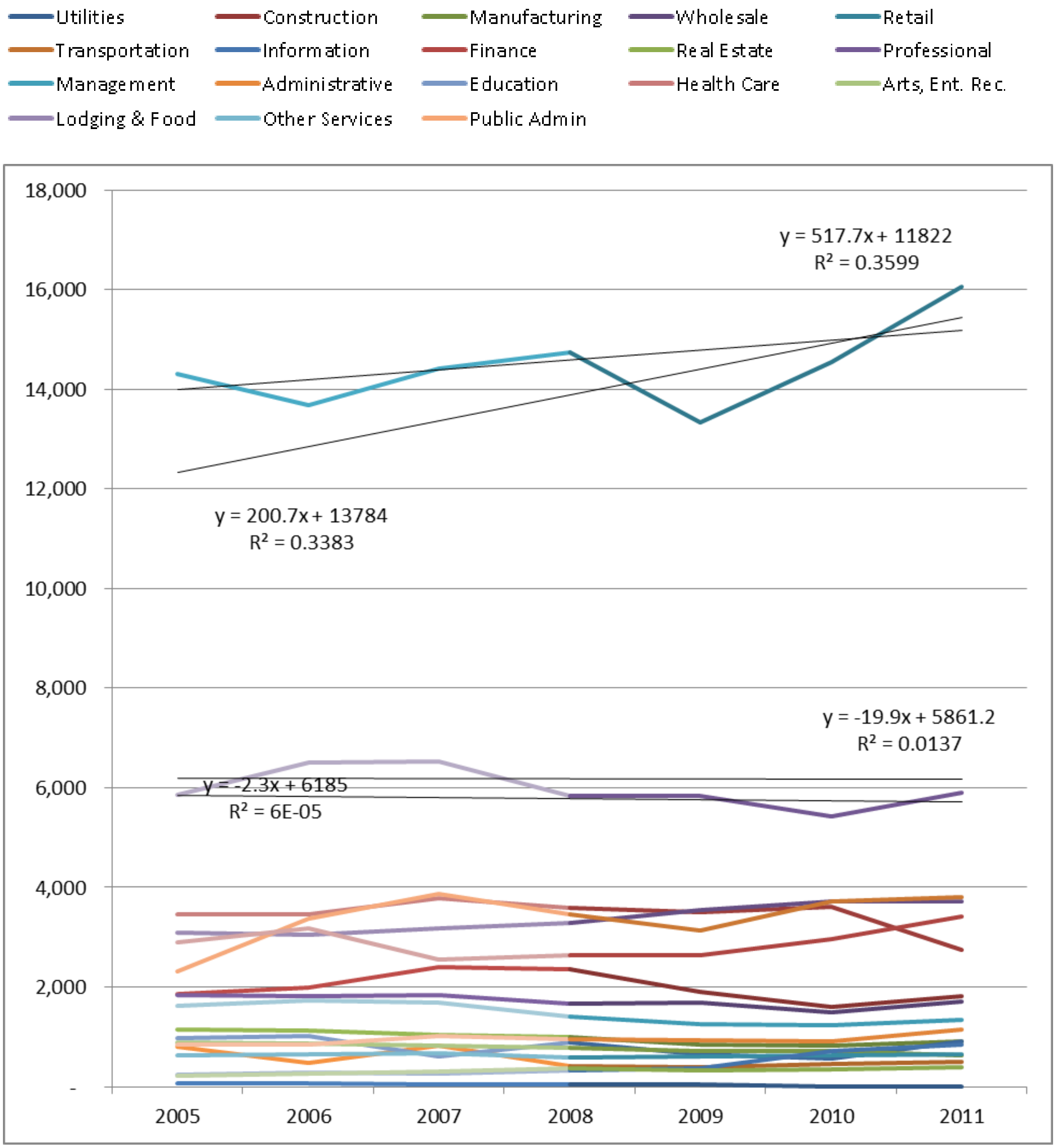

Figure 4: Regression trend lines and R-squared values for different industries

As the graph shows, industry employment varies by year, with many industries affected by substantial fluctuations in employment, both before and after the recession. While visual inspection is valuable, more rigorous interpretation is necessary.

Resilience by industry is presented in Table 4. It highlights the resilience of different industries between 2002-2008 and 2008-2011. The trend number is the linear regression line on industry employment over time. Trends indicate whether total employment increases or decreases during each time period. A negative trend indicates sustained loss of employment while a positive trend indicates a sustained gain. The trend number is the slope of the regression line. However, industries with larger total employment will have larger slopes. To normalize trend numbers for comparison between industries, the trend percent is presented. It is calculated by dividing the trend number for a time period by the average employment for that period. Finally, the R^2 column indicates how strong a trend is. Industry sectors with a high R^2 demonstrate robust trends—trends in employment change that are consistent over time with less tendency to fluctuate.

The change in the trend between the two time periods is given in the differences column. A positive value for the trend number represents a change from employment loss to employment gain, or a reduction in the rate of decline in employment for that industry. The change in strength of trend is given by the R2 column. A positive value indicates that a previously erratic trend has become more consistent. A negative value means a previously consistent trend has become more erratic.

Industry	2005-2008			2008-2011			Differences		
	Trend #	Trend %	R2	Trend #	Trend %	R2	Trend #	Trend %	R2
Utilities	-12	-23%	0.84	-14	-58%	0.59	-1	-34%	-0.24
Construction	192	9%	0.86	-194	-10%	0.61	-386	-19%	-0.24
Manufacturing	-53	-5%	0.93	-26	-3%	0.22	27	2%	-0.71
Wholesale	-45	-3%	0.55	-5	0%	0.00	40	2%	-0.54
Retail	201	1%	0.34	518	4%	0.36	317	2%	0.02
Transportation	-83	-13%	0.26	31	7%	0.70	113	20%	0.45
Information	-64	-7%	0.20	-8	-1%	0.00	56	6%	-0.20
Finance	69	2%	0.35	-245	-7%	0.57	-314	-9%	0.22
Real Estate	-37	-4%	0.97	-45	-6%	0.83	-8	-2%	-0.14
Professional	65	2%	0.73	152	4%	0.87	87	2%	0.15
Management	-11	-2%	0.12	19	3%	0.99	30	5%	0.87
Administrative	395	12%	0.59	160	5%	0.47	-234	-8%	-0.11
Education	24	9%	0.68	185	33%	0.92	161	24%	0.24
Health Care	-138	-5%	0.42	260	9%	0.86	398	14%	0.44
Arts, Ent. Rec.	49	17%	1.00	11	3%	0.27	-38	-14%	-0.73
Lodging & Food	-2	0%	0.00	-20	0%	0.01	-18	0%	0.01
Other Services	-68	-4%	0.37	-26	-2%	0.18	42	2%	-0.19
Public Admin	53	6%	0.58	61	6%	0.47	8	0%	-0.11
Total	395	1%	0.26	860	2%	0.33	465	1%	0.07

Table 4: Changes in employment trends for 0.5 mile buffer of the transit corridor

Prior to the 2008, about half of the industries had positive trends in employment. The largest positive trends were for the Management industry, followed by the Retail industry, and then the Construction industry. The Arts/Entertainment/Recreation had the largest Trend %, followed by the Administration industry. The strongest positive trends, as measures by R^2, were for Arts/Entertainment/Recreation, followed by Construction. The Health Care and Others services industry had the largest negative trends.

During the post-recessionary period, overall employment rose. The majority of industries had rising employment. The industries with the largest positive trends were Retail and Health Care, although Education and Administrative also had large positive trends. However, the low R^2 value for Administrative indicates it was an erratic trend. The Trend % was largest for Education. Numerically, the worse trend was for the Finance industry, which declined sharply, although the Utilities industry declined by a larger Trend %.

Differences in trends (number and percent) and the strength of trends (R^2) indicate which industries in the corridor did better after 2008, as the recession reached its trough and the recovery began. Considering only industries that had positive trends before 2008, the Retail, Professional, Education, and Public Administration industries can be considered resilient. The retail industry both improved its trend, and did so without suffering a significant decline in the R^2 value. The R^2 value for Professional actually improved, as did that for education.

The same trend information for a comparable corridor is presented Table 5. Industries with similar trends and trend strengths in both corridors are likely due to factors affecting both corridors, such as metropolitan scale trends.

Industry	Differences						Differences in Differences		
	Transit			Comparable					
	Trend #	Trend %	R2	Trend #	Trend %	R2	Trend #	Trend %	R2
Utilities	-1	-34%	-0.24	0	6%	0.30	-2	-40%	-0.54
Construction	-386	-19%	-0.24	-252	-18%	0.29	-134	-1%	-0.53
Manufacturing	27	2%	-0.71	-478	-11%	0.80	505	13%	-1.50
Wholesale	40	2%	-0.54	59	1%	-0.31	-19	1%	-0.23
Retail	317	2%	0.02	103	1%	0.10	214	1%	-0.08
Transportation	113	20%	0.45	-69	-4%	-0.59	182	24%	1.04
Information	56	6%	-0.20	93	20%	-0.72	-37	-14%	0.52
Finance	-314	-9%	0.22	128	11%	-0.32	-442	-20%	0.55
Real Estate	-8	-2%	-0.14	67	7%	0.40	-75	-9%	-0.54
Professional	87	2%	0.15	-52	-4%	-0.25	139	6%	0.40
Management	30	5%	0.87	33	22%	0.79	-3	-17%	0.08
Administrative	-234	-8%	-0.11	1588	35%	-0.38	-1822	-43%	0.26
Education	161	24%	0.24	-37	-6%	0.02	197	30%	0.22
Health Care	398	14%	0.44	-368	-7%	-0.71	766	21%	1.14
Arts, Ent. Rec.	-38	-14%	-0.73	18	5%	0.49	-56	-19%	-1.21
Lodging & Food	-18	0%	0.01	-28	-1%	-0.82	10	1%	0.83
Other Services	42	2%	-0.19	-101	-7%	-0.16	143	9%	-0.03
Public Admin	8	0%	-0.11	3	1%	-0.16	5	0%	0.05
Total	465	1%	0.07	669	2%	-0.22	-204	-1%	0.29

Table 5: Comparison of resilience by corridor

Comparison of the two corridors suggests that the transit corridor has the advantage in about half the industries. The most notable is for the Health Care industry, with a much stronger numerical trend, followed closely by the Manufacturing industry, although the latter is largely a function of weakness in the comparable corridor. As a Trend %, the major differences between the corridors lie in the Education, Transportation, and Health Care industries, all of which have stronger trends (as measured by R^2) in the transit corridor than in the comparable corridor.

Discussion & Implications

To be resilient is to have the capacity to endure shocks and recover to a previous equilibrium. That equilibrium may refer to a prior employment level, or to a prior employment trend.

Prior to the recession, the Construction industry was a mainstay of many economies. Typically, both the Construction and Retail industries suffered as part of the Recession. The Miami-Dade BRT transit corridor is extremely uncommon in that the Retail industry did better after 2008 then before. Growth in the Education, Public Administration and Health Care industries has been a near-constant for post-recessionary urban centers, but the recovery in the Professional industry is atypical. The Miami-Dade metropolitan area may simply be ahead of schedule on economic recovery, or proximity to the Miami-Dade busway may represent a competitive advantage for both the Professional and Retail industries.

Some caveats are necessary. Employment in any industry sector is variable over time, and the amount of variability increases with smaller geographic units of analysis. Because the geographic unit of analysis is small, the amount of fluctuation is larger. Changes might 'average out' over a larger unit of geographic aggregation have may have significant effects. In a given year, the relocation of a single firm, or the addition of a new building, would be sufficient to dramatically change employment trends in any industry. Finally, the area within a 0.5-mile buffer is fixed, so new development requires the displacement of existing development. The new development may employ workers in different industries, or new residential development may replace existing employment.

6-HOUSING AFFORDABILITY

Introduction

It is not always possible to maintain a supply of affordable housing for a growing population by adding housing at the urban periphery. Such locations are the furthest from employment and services, requiring long distance travel to meet basic needs. Total cost of automobile ownership is considerable, given not only the cost of the automobile itself, but also the operations and maintenance costs associated with fuel, insurance, and repairs. Housing in exurban locations may be cheap without actually being affordable.

It is necessary for housing affordability to include both housing and transportation costs (H + T). Housing costs do not exist in isolation but within the context of transportation costs. While housing in an urban location with transit access may cost more than suburban housing, it may still be more affordable once the effect of associated transportation costs has been taken into account. Low-income households tend to spend a high proportion of their income on basic transportation (VPTI 2012). Faced with high transportation costs, close proximity to public transit networks is an effective solution. Populations in poverty remain concentrated in central cities partially because such locations enjoy high quality public transit (Glaeser et al 2008).

While the effects of heavy rail transit on housing affordability has been extensively researched, the effects of non-heavy rail TOD on housing affordability is mixed. Matching low-income employment to high-income housing fails to improve housing affordability, and matching high-income employment to low-income housing may actually decrease affordability through gentrification-induced displacement. Maintaining affordable housing through TODs may require the allocation of affordable housing resources (NAHB 2010). A review of the hedonic literature reporting the price effects of transit stations on housing suggests that TODs may be an anathema to the provision of affordable housing, given their propensity to increase housing values (Bartholomew and Ewing 2011).

Calthorpe (1993) initially proposed a ten-minute walk, or about a 0.5-mile radius, as the ideal size for a TOD. Empirical studies confirm that while the majority of walk trips occur for distances of or equal to 0.5 mil, the effects of proximity to transit can be detected out to 1.5 miles away (Nelson 2011). Access to fixed guide-way transit systems is frequently by non-walk modes such as bicycle, bus, and automobile. The characteristics of the built environment within a 1.0-mile buffer of a station can still affect transit ridership (Guerra, Cervero, & Tischler 2011).

Data and Methods

This section describes the data used for analysis, and the techniques used to process and analyze the data. Unlike all other analysis contained in this report, the housing affordability analysis included data from multiple 0.25-mile buffers, not just a single 0.5-mile buffer. Doing so makes it possible to relate the magnitude of the effect of proximity to transit. Near things are more related than distant things (Tobler 1970). This makes it possible to track the relationship between magnitude of effect and proximity to transit. The area within the smallest buffers should show the strongest effect from transit.

Data Source and Geography

This study uses the Location Affordability Index (LAI). The Location Affordability Index was developed under the aegis of the Sustainable Communities, an inter-agency partnership between the Housing and Urban Development, US Department of Transportation, and the Environmental Protection Agency. The LAI is an effort to use statistical modeling to determine the factors which underlie the causes of housing and transportation costs. It controls for a number of factors known to influence transportation and housing costs, such as income and number of workers. The full methodology for the LAI can be found at: http://lai.locationaffordability.info/methodology.pdf.

The LAI provides an estimate of the total cost of housing plus transportation for different locations. The LAI offers eight different household profiles of different family types. For this analysis, type 1 household (hh_type1) was used. It represents the Regional Typical household, with average household size, median income, and an average number of commuters per household for the region. A full data dictionary can be found at: http://lai.locationaffordability.info/lai_data_dictionary.pdf

The unit of analysis for the dataset is the 2010 Decennial Census Block Group. The data extent is the Census 2010 Core-Based Statistical Area (CBSA). When transit lines crossed the boundary into adjacent statistical areas, both statistical areas were included.

Data Processing

The data were downloaded from: http://www.locationaffordability.info/lai.aspx?url=download.php as CSV (Comma Separated Values) files. It was then joined to a shapefile of the 2010 Decennial Census Block Groups from https://www.census.gov/geo/maps-data/data/tiger.html

Census Block Groups represent an unacceptably large geography for transit relevant analysis. It was necessary to devise an alternative to determining buffer membership by selecting a centroid. Instead, ArcGIS was used to create a series of buffers around each corridor, in 0.25-mile increments, out to 2 miles. Those buffers were then used to clip the block groups. The characteristics of each block were then weighted by geographic ratio, which is the ratio between the area of the block group, and the area of the portion of the block group that was within a buffer. For instance, if a block group represented 3 percent of the area in the buffer, H+T characteristics for that block group received a weight of 3 percent. The weighted variables were then summed to obtain a geographically weighted value for the buffer.

For the purpose of comparison, a metro index was devised. Because the metropolitan area contains all census blocks, not just urban blocks, weighting the blocks by area was deemed inappropriate. Census block groups are intended to contain similar amounts of population, rather than volumes of area, so the size of Census block groups varies by orders of magnitude. Consequently, the comparison value for the metro area was calculated by weighting the block group characteristics by Census 2012 block group population. This weighted average is intended to provide a referent for what are normal values for the metropolitan area.

This analysis makes use of seven characteristics from the location affordability index: Housing Costs as a Percent of Income and Transportation Costs as a Percent of Income, for owners, renters, and all households in the region. Additionally, it makes use of the median income to translate percentages into dollar amounts.

Results

The change in housing and transportation (H+T) costs are presented below with three results presented:

1. Housing, Transportation, and H+T dollar costs for the transit corridor
2. Housing costs by tenure, by percent of income
3. Change in LAI H+T costs for transit and comparable corridors

For interpreting the Location Affordability Index, housing is considered affordable if total housing and transportation costs do not exceed 46 percent of income.

The 2009 combined housing, transportation, and H+T dollar costs for the transit corridor are shown in Figure 5. The vertical axis shows the dollar cost of housing and transportation. The horizontal axis shows how the total varies by buffer distance from the transit corridor. A stacked graph has been used to display the disaggregated effects of housing and transportation on H+T affordability.

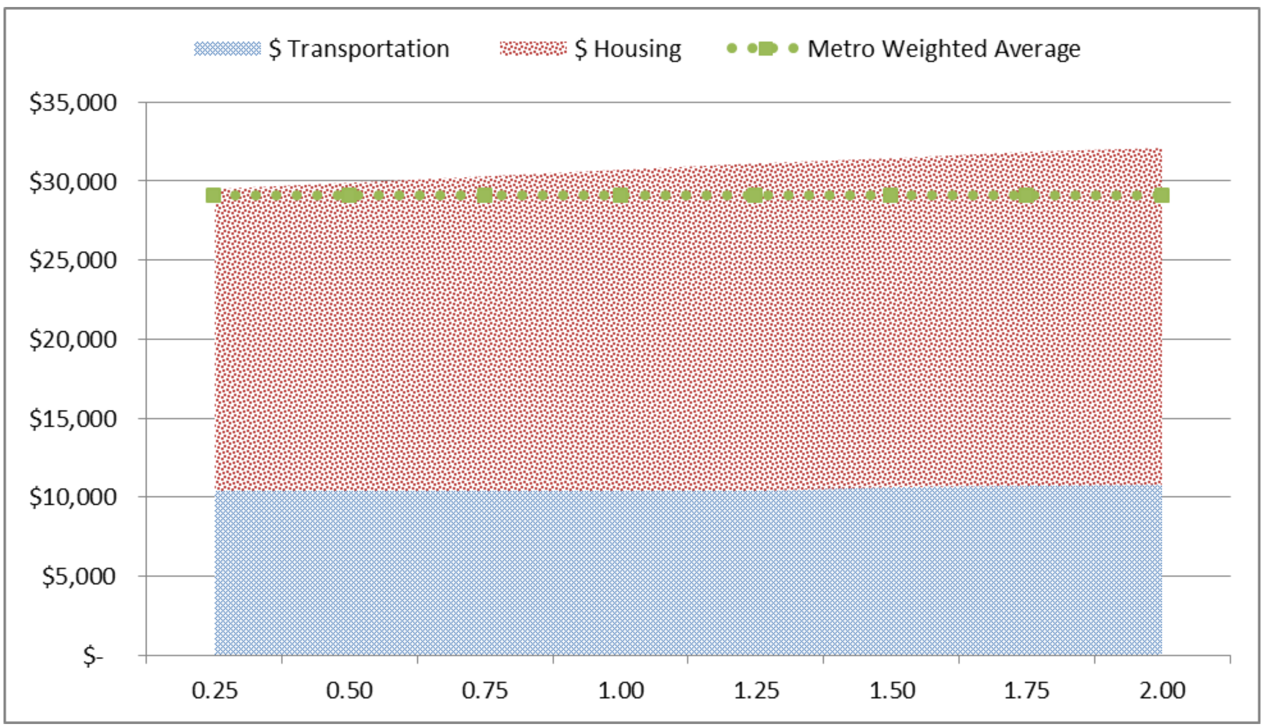

Figure 5: Housing, transportation, and H+T costs for the transit corridor, 2009, by buffer distance

As the above graph shows, H+T costs near the transit line are higher than the metropolitan average. Housing costs are lower nearer to the transit line, steadily increasing with distance to the transit line. Differences in transit costs are not as significant as differences in housing costs, and vary minimally with distance to the transit corridor.

Transportation costs and housing costs by tenure are shown in Figure 6. The vertical axis shows the percent of income needed to meet housing costs. The horizontal axis shows how the total varies by buffer distance from the transit corridor. The response to transit should be more significant nearer to the transit line.

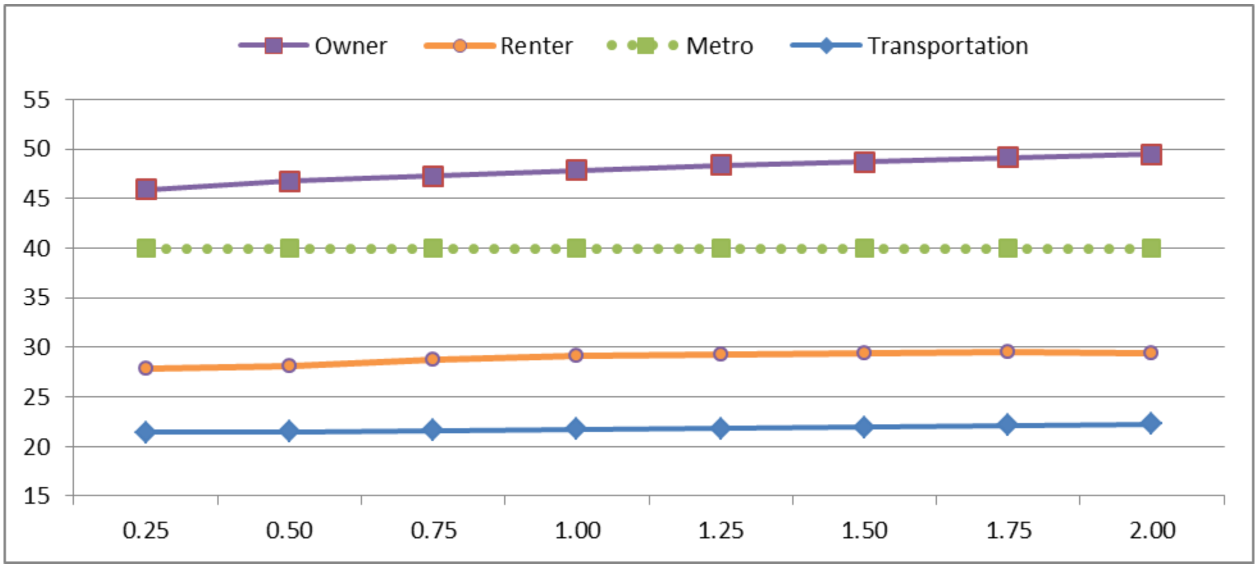

Figure 6: Transportation costs & Housing costs by tenure, by buffer distance.

Housing costs for owners near the transit corridor are higher than the metro average, while the housing costs for renters are substantially lower. For both tenures, housing costs respond to distance to the transit line, although for owners, the relationship is stronger. Transportation costs, which are common to both tenures, are almost constant, varying less than a percent.

Dollar amount H+T costs for the transit corridor, comparable corridor, and metro area are shown below in Figure 7. The vertical axis shows dollar amounts, and the horizontal axis shows how the total varies by buffer distance from the transit corridor.

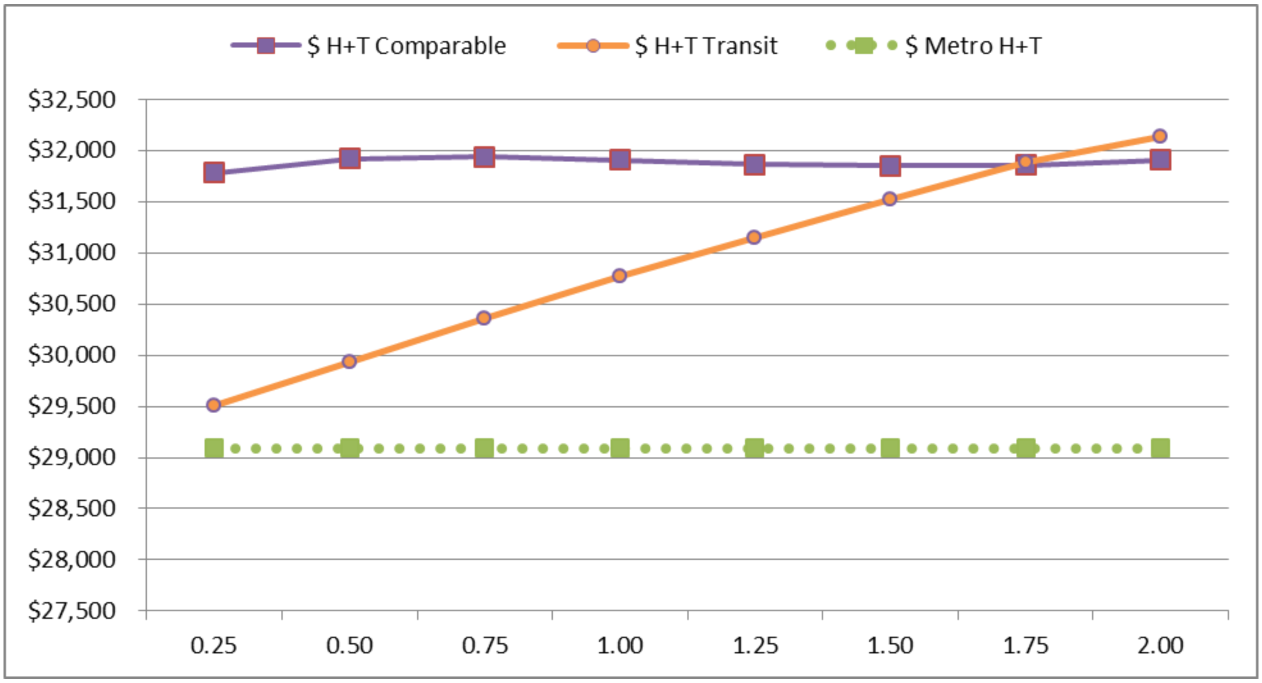

Figure 7: H+T costs for transit and comparable corridors, by buffer distance

The transit display significantly different patterns in H+T costs from the metropolitan area. It is higher than the metropolitan average for all distances. H+T costs for the transit corridor are lower nearer the transit corridor. The transit corridor experiences much lower H+T costs than the comparable corridor for all buffer distances less than 1.75 miles, with the greatest difference nearest to the corridor.

Discussion & Implications

Transit is expected to increase affordability overall, presuming that higher housing costs could be offset by lower transportation costs, with a lower overall H+T costs. The pattern of increases in H+T costs fails to match this relationship. Instead, transportation costs are constant, while housing costs are lower near the transit line. Theoretically, housing costs should be higher near the transit line, as the value of the additional accessibility generated by the transit lines should be capitalized into housing prices. Instead, housing costs are lower, indicating that proximity to the transit line is a nuisance. However, the relationship holds for distances out to 2.0 miles, far beyond the radius effect of any but the most severe nuisances. This indicates that the pattern of changes in housing costs much be the result of another confounding factor.

It seems likely that a highway is the confounder.

While the Miami-Dade busway runs parallel to US-1, Florida Highway 821 is a limited access highway with no at-grade intersections, permitting a much higher average travel speed. North of the City of Kendal, Florida Highway 874 is also parallel to the busway. The City of Miami proper is northward of the busway, so it seems likely that commuting flows in that direction, making access to a limited access highway a major factor affecting property values.

6-JOB ACCESSIBILITY

Introduction

Commuters have the ability to travel long distances more rapidly by fixed guide-way transit, making it possible to connect to destinations that are otherwise too distant. TOD is based on the premise that locating housing and employment in close proximity to transit stations will significantly enhance the accessibility of those locations. Because each transit line connects multiple stations, it creates a Transit Oriented Corridor (TOC) where people can live or work near any station and use the rapid transit system to access destinations at any other station along the corridor. Therefore, transit oriented development should significantly enhance employment accessibility along the corridor.

To achieve jobs-housing balance, there should be a rough proportionality between the amount of employment and the amount of housing. However, merely matching the total number of jobs and housing along a corridor is not enough. In recent years, the jobs-housing balance has been refined to include how well jobs (by income) are matched to housing (by income), to ensure that people working in the corridor can afford to live in the corridor. Proximity to light rail stations and bus stops offering rail connections is associated with low-wage job accessibility, but proximity to bus networks alone does not show the same correlation (Fan 2012). To check the degree of match between employment and residence, this analysis controls for both low and high wages. To further check for the degree of match, it compares the occupation balance of how well the number of people employed in the corridor matches the number of people residing in the corridor. If an industry is making heavy use of transit along the corridor, the numbers should be near equivalent.

If transit has a positive effect on jobs-housing balance, there should be a detectable change in the employment resident balance for both wage categories and for all occupation categories. Comparing the changes in these balances to the comparable corridor will ensure that the effect is contingent upon the transit corridor rather than metropolitan trends.

Data & Methods

The data used comes from the Census Local Employment-Housing Dynamics (LEHD) data source, using the Local Employment Dynamics (LED) datasets. Because the LODES data contains both place of employment and place of residence, it is possible to aggregate data to obtain both workplace area characteristics (WAC) and residential area characteristics (RAC). The ratio between the total workers at these different geographies was used as the jobs-housing balance. Corridors with better jobs-housing balance were presumed to have better job accessibility.

Three analyses were performed to determine job accessibility within the corridors: overall jobs-housing balance, jobs-housing balance by earnings category, and jobs-housing balance by industry. In addition to providing total number of employees per Census Block, the LED employment data are classified by earnings category. The LED classifies income by monthly earnings, into the following categories:

- $1250/month or less
- $1251/month to $3333/month
- Greater than $3333/month

The categories have been treated as low-medium-high income classifications. The actual monthly values are less significant than changes over time in the distribution of each of the categories in proximity to the transit corridor. LED employment data are also classified by industry using NAICS at the two-digit summary level.

ArcGIS was used to create a series of buffers around each corridor in 0.25-mile increments. Those buffers were then used to select the centroid point of the LED block groups within those buffers, and summarize the totals. Because the location of census block points varies from year to year (for reasons of non-disclosure), it was necessary to make a spatial selection of points within the buffer for each year, rather than using the same points each year. For this analysis, the 0.5-mile buffer was used.

Results

Overall jobs-housing balance for the existing transit and comparable corridor are presented below in Table 6 for each year. The ratio column indicates the ratio of workers who are employed within the corridor to the number of workers residing in the corridor. The year-on-year change for ratios is also presented. Sparklines at the bottom show the trend for each column. Years for which the transit system is in operation are shaded.

Overall Balance

The jobs-housing ratio at the metropolitan level represents a balanced level of jobs to workers. Comparing that value to the jobs-housing ratio for each corridor demonstrates how far out of balance both corridors are. Ideally, the addition of transit (years of operation highlighted in pink) should make the jobs-housing ratio more similar to the metropolitan level ratio.

Year	Metro			Comparable				Transit				Year
	Work, 000's	Home, 000's	Jobs-Housing Ratio	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	
2002	2,147	2,146	1.00	40.3	33.8	1.19	0.00	42.9	27.6	1.55	0.00	2002
2003	2,118	2,112	1.00	39.2	33.0	1.19	0.00	41.9	26.6	1.58	0.02	2003
2004	2,060	2,070	1.00	40.4	32.4	1.25	0.06	41.4	28.1	1.47	-0.10	2004
2005	2,219	2,239	0.99	43.5	35.0	1.24	0.00	44.3	28.6	1.55	0.08	2005
2006	2,243	2,236	1.00	42.2	35.6	1.18	-0.06	45.5	30.2	1.51	-0.05	2006
2007	2,301	2,301	1.00	41.0	35.3	1.16	-0.02	46.8	30.7	1.52	0.02	2007
2008	2,192	2,175	1.01	42.5	33.6	1.27	0.10	45.2	28.0	1.61	0.09	2008
2009	2,118	2,098	1.01	38.3	32.6	1.17	-0.09	42.8	27.5	1.56	-0.06	2009
2010	2,119	2,088	1.01	38.7	32.8	1.18	0.01	44.6	28.8	1.55	-0.01	2010
2011	2,261	2,195	1.03	43.4	31.6	1.37	0.19	48	27.4	1.74	0.19	2011
Trend												Trend

Table 6: Jobs-housing balance for all income categories

The Miami-Dade metro region has an unusually low jobs-housing ratio. This likely indicates that either a small number of workers are holding more than one job, or that workers are commuting to employment outside the region.

The overall jobs-housing ratio for both the comparable and transit corridors is job-rich. The transit corridor has about 1.5 times as many jobs per worker as the metropolitan area. While the jobs-housing ratio remains steady for several years, it shows a definite upward trend, including a spike in 2011. The initial improvement occurs as a result of a rise in the number of workers resident in the corridor, which peaks in 2007, and declines thereafter. The number of workers reaches its peak in 2007, declines in 2009, and then recovers to an all-time high in 2011. The general trend for the jobs-housing ratio in the transit corridor is away from parity, and toward being a job-rich area. While the jobs-housing ratio for the comparable corridor also moves toward being jobs-rich, it is never as job-rich as the transit corridor. The two corridors track each other strongly after 2005.

Income Balance

Jobs-housing balance by earnings category improves on the overall jobs-housing balance, as the overall jobs-housing ratio provides only a rough metric of the degree to which residents are matched to places of work within a corridor. Matching low income residents to high income workplaces will not increase job accessibility. Comparing the jobs-housing ratio by income category makes it possible to gauge not just the overall improvement in jobs-housing balance, but which earnings categories benefit the most from proximity to transit. To determine the degree to which an earnings-specific match is accomplished, Table 7 compares the jobs-housing balance to the earnings category.

Low Income												
	Metro			Comparable				Transit				
Year	Work, 000's	Home, 000's	Jobs-Housing Ratio	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Year
2002	663	668.30	0.99	14.7	9.5	1.54	0.00	17.5	9.6	1.83	0.00	2002
2003	654	656.33	1.00	13.6	9.3	1.47	-0.07	16.6	9.2	1.81	-0.02	2003
2004	620	628.33	0.99	13.9	9.1	1.53	0.06	16.7	9.0	1.86	0.05	2004
2005	626	640.82	0.98	14.4	9.2	1.56	0.04	16.5	9.0	1.84	-0.02	2005
2006	608	614.72	0.99	13.7	9.3	1.48	-0.09	16.2	9.0	1.80	-0.03	2006
2007	609	613.72	0.99	12.3	8.9	1.38	-0.09	15.9	8.4	1.89	0.09	2007
2008	550	548.46	1.00	12.1	8.0	1.50	0.12	15.0	7.4	2.02	0.13	2008
2009	522	519.44	1.01	10.6	7.5	1.41	-0.09	14.5	7.4	1.97	-0.05	2009
2010	516	508.64	1.01	11.2	7.6	1.48	0.07	14.7	7.4	1.98	0.01	2010
2011	563	537.57	1.05	12.9	7.1	1.82	0.34	16.3	7.0	2.33	0.35	2011
Trend												Trend

Medium Income												
	Metro			Comparable				Transit				
Year	Work, 000's	Home, 000's	Jobs-Housing Ratio	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Year
2002	926	924	1.00	1.8	14.1	0.13	0.00	17.2	11.3	1.52	0.00	2002
2003	909	906	1.00	1.8	13.8	0.13	0.00	17.4	11.0	1.58	0.06	2003
2004	878	884	0.99	1.8	13.3	0.14	0.01	16.9	11.8	1.43	-0.15	2004
2005	928	939	0.99	1.9	14.1	0.14	0.00	18.3	12.0	1.52	0.09	2005
2006	939	940	1.00	1.8	14.3	0.13	-0.01	18.7	12.9	1.46	-0.06	2006
2007	960	962	1.00	1.8	14.3	0.12	0.00	19.7	13.1	1.51	0.05	2007
2008	911	905	1.01	1.9	13.6	0.14	0.01	19.0	12.1	1.57	0.06	2008
2009	873	868	1.01	1.7	12.9	0.13	-0.01	17.9	11.6	1.53	-0.03	2009
2010	872	860	1.01	1.7	13.1	0.13	0.00	18.8	12.2	1.55	0.01	2010
2011	903	883	1.02	1.87	12.41	0.15	0.02	19.5	11.3	1.74	0.19	2011
Trend												Trend

High Income												
	Metro			Comparable				Transit				
Year	Work, 000's	Home, 000's	Jobs-Housing Ratio	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Work, 000's	Home, 000's	Jobs-Housing Ratio	Year on Year Change	Year
2002	559	554	1.01	7.3	10.2	0.72	0.00	8.2	6.7	1.22	0.00	2002
2003	556	550	1.01	7.7	9.9	0.78	0.07	7.9	6.4	1.22	0.01	2003
2004	562	558	1.01	8.4	10.0	0.84	0.05	7.9	7.4	1.06	-0.16	2004
2005	664	659	1.01	9.7	11.7	0.84	0.00	9.6	7.6	1.26	0.20	2005
2006	696	681	1.02	10.3	12.0	0.86	0.02	10.5	8.4	1.26	-0.01	2006
2007	733	725	1.01	11.1	12.2	0.91	0.05	11.2	9.3	1.21	-0.05	2007
2008	731	721	1.01	11.8	11.9	0.99	0.08	11.3	8.5	1.33	0.12	2008
2009	722	711	1.02	10.7	12.1	0.88	-0.11	10.4	8.5	1.23	-0.10	2009
2010	731	720	1.02	10.3	12.1	0.85	-0.03	11.0	9.2	1.20	-0.04	2010
2011	796	774	1.03	11.7	12.1	0.96	0.12	11.7	9.1	1.28	0.08	2011
Trend												Trend

Table 7: Jobs-housing balance by income category

The transit corridor is job-rich for all three income categories, but particularly for low income, which has 1.9 to 2.3 times as many workers as working residents. The jobs-housing ratio is low for medium-income workers, and lower still for high-income workers. As the sparklines show, over time the jobs-housing ratio for low and medium income workers tends toward becoming less well balanced as the areas grow more job-rich. The pattern of the jobs-housing ratio for high income workers is more erratic and displays no pattern.

The pattern is noticeably different than the comparable corridor. For low income workers in the comparable corridor, the jobs-housing ratio fluctuates, but tends toward parity with the metropolitan area. The comparable corridor is too job-poor for medium income workers for an effective comparison, but for high income worker, the comparable corridor shows a strong pattern of moving toward a more balanced jobs-housing ratio.

Industry Balance

Industry balance provides a more refined understanding of the match between place of residence and place of work. Comparing the jobs-housing ratio by industry category makes it possible to determine which industries benefit the most from proximity to transit. The industry balance for the transit corridor is presented in Table 8. The jobs-housing ratio has been broken into two data series by the year of the advent of transit.

If any population is making extensive use of transit, they would be expected to be both working and living in the transit corridor. If so, the number of people in any given industry both working and living in the corridor should increase over time, bringing the jobs-housing ratio for the corridor closer to the ratio for the metropolitan area.

Industry	Comparable			Transit		
	2002	2002 to 2011	2011	2002	2002 to 2011	2011
Utilities	0.38		0.01	0.81		0.06
Construction	1.07		1.16	1.45		1.75
Manufacturing	2.71		2.87	1.15		1.33
Wholesale	1.21		2.21	1.21		1.31
Retail	1.95		2.68	4.22		4.43
Transportation	0.31		1.95	0.49		0.58
Information	0.56		0.59	1.73		2.11
Finance	0.80		0.66	2.84		2.47
Real Estate	0.67		1.61	1.47		1.26
Professional	2.96		0.67	1.62		2.50
Management	0.41		0.71	4.90		2.76
Administrative	1.11		1.60	0.92		2.04
Education	0.19		0.42	0.06		0.27
Health Care	0.91		1.18	0.94		0.82
Arts, Ent. Rec.	0.41		0.80	0.79		1.08
Lodging & Food	1.15		1.17	2.16		2.26
Other Services	1.18		1.42	1.50		1.55
Public Admin	0.21		0.12	0.68		0.64

Table 8: Job accessibility trends over time by industry sector and corridor

In 2002 the transit corridor was job-rich in about half of the industries. It was especially job-rich for Management and Retail. Between 2002 and 2011, most industries that were already job-rich became increasingly so, and industries that were job-poor became increasingly so. There were a limited number of exceptions to this pattern. Previously job-poor industries like Transportation, Education, and Arts/Entertainment/Recreation increased their jobs-housing ratio to one more similar to the metropolitan area. The Real Estate and Management industries saw very job-rich jobs-housing balances reduced to something more like the metropolitan jobs-housing ratio of 1.0.

Discussion & Implications

The Miami-Dade busway is an atypical BRT system. Most bus systems that claim to have BRT simply don't. Most BRT systems in America don't meet the Institute for Transportation and Development Policy's 'BRT Standard' by any criteria. The current generation of BRT systems in America are largely patterned after Cleveland's 'Healthline' or the Eugene, Oregon's Emerald Express. In contrast, the Miami-Dade busway is patterned after an earlier generation of BRT systems from Central and South America. Most claimed BRT systems are merely improved buses running in mixed traffic on surface streets. But the Miami-Dade busway harkens back to the Pittsburgh busway, and an effort to use limited access roadways to create bus-only highways as a sort of 'surface subway'. Like Pittsburgh, it makes use of pre-existing right-of-way. As such it is highly contrary to modern transit planning, which focuses on the use of transit as an economic development tool, through the use of TOD.

Until recently, the busway had no stations of its own, nothing to act as a center or focus for transit oriented development. Rather, it was an express route for buses. Rather than a catchment area defined by walkable access to the corridor, its catchment area consisted of local buses using the route, an entirely different geography than a normal walkable buffer.

Despite this, local buses still access the busway from arterial roads that intersect the busway. Formally, the buffer of the transit line should take place from the nearest bus-station to the busway, but with the given analytic geography (0.25 mile buffers), significant differences are unlikely to result. At such distances, the connectivity of the local street network has far more serious implications on access to transit.

7-SUMMARY OF FINDINGS

Summaries of the results of the analysis for the five policy questions bellow.

Are TODs attractive to certain NAICS sectors?
Do TODs generate more jobs in certain NAICS sectors?
Are firms in TODs more resilient to economic downturns?
Do TODs create more affordable housing measured as H+T?
Do TODs improve job accessibility for those living in or near them?

Q1: Attractiveness to NAICS sectors (Location quotient)

Transit corridor

- Most location quotients low.
- Highest location quotient for retail at 2.47.
- Declines Severely: Management and Finance
- Administration is largest increase at 0.47.

Transit advantage over comparable corridor

- Substantial: None
- Minor: Administrative & Manufacturing

Q2: Do TODs generate more jobs in certain NAICS sectors? (Shift-share analysis)

Numeric Change in Transit corridor

- Change in employment positive in metropolitan area.
  Change in transit corridor twice that for metropolitan area.
- Substantial numeric increases: Retail, Administrative, and Professional.
- Substantial percent increases: Education and Administrative.
- Substantial reductions: Management.

Effect of corridor, as per shift-share

- Metropolitan Growth and Industry Mix causes of employment growth.
- Corridor Effect is strongly negative.
- Corridor Effect worst for Management and Finance.
- Corridor Effect best for Administration.

Transit advantage over comparable corridor

- Corridor Benefit largest for Construction, followed by Manufacturing.
- Much less badly than comparable corridor: Professional and Public Administration.

Q3: Are firms in TODs more resilient to economic downturns? (Interrupted Time Series)

In this example, resilience is defined as the capacity to maintain a positive trend despite the economic shock of the 'Great Recession'. The R^2 values measure the amount of variation in trends before and after the recession. More resilient industries will have more comparable R^2 values.

Transit corridor before 2008

- Major positive trends: Administrative, Retail, and Arts/Entertainment/Recreation.
- Worst Trend: Health Care.
- Most consistent trend: Arts/Entertainment/Recreation and Real Estate.

Transit corridor after 2008

- Major positive trends: Retail, Education and Health Care.
- Worst Trend: Finance and Utilities.
- Most consistent trend: Management and Education.

Transit Corridor Differences before and after Great Recession

- Education, Health Care and Transportation prosper.
- Trends become more consistent for all three.
- Utilities, Construction and Arts/Entertainment/Recreation decline.
- Most consistent trend: Management and Education.
- More Resilient: Retail, Professional, and Education.

Advantage over Comparable corridor:

- Better trends: Education, Health Care and Transportation prosper.
- Did less badly than comparable corridor: Manufacturing.

Q4: Do TODs create more affordable housing measured as H+T? (Housing affordability)

Unlike other analyses in this report, this analysis measures changes in more than just the 0.5-mile buffers. The magnitude of the effect of transit should be proportional to proximity to transit.

Transit corridor

- H+T costs for the transit corridor are greater than the metropolitan average.
- H+T costs fall with proximity, largely as a result of housing.
- Transportation costs do not vary with proximity to the transit corridor.

Housing and Transportation cost changes by tenures

- Owner's housing costs greater than the metropolitan area average.
- Renter's housing costs less than the metropolitan area average.
- Housing costs lower near transit for both tenures.

Contrasts between transit and comparable corridors

- H+T costs for transit and comparable corridors dramatically different.
- H+T costs for transit corridor vary strongly with distance to transit.
- H+T costs similar to metro average within 0.25 miles, much higher 2.0 miles out.
- Simple linear relationship between distance and H+T costs in transit corridor.

Q5: Do TODs improve job accessibility for those living in or near them?

Jobs accessibility was operationalized as the balance between number of workers and number of workers residing in the corridor, using the jobs-housing ratio as a comparison. The jobs-housing ratio for the metro was used as the preferred ratio. The differences were compared for all workers in the corridor, for workers by earnings, and for workers by industry.

- Slightly job-rich at start of study period.
- Erratic trends, big year on year changes.
- Jobs-housing ratio for high income workers relatively steady.
- Both number of workers and number of workers in corridor recover before most other metropolitan regions.
- Comparable corridor becomes much more balanced for high-income workers.

- Job-rich before, became more balanced after: Transportation, Education, and Arts/Entertainment/Recreation
- Job-poor before, became more balanced after: Real Estate and Management

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9-APPENDIX A

LEHD

The Longitudinal Employer-Household Dynamics (LEHD) program is part of the Center for Economic Studies at the U.S. Census Bureau. The LEHD program produces new, cost effective, public-use information combining federal, state and Census Bureau data on employers and employees under the Local Employment Dynamics (LED) Partnership. State and local authorities increasingly need detailed local information about their economies to make informed decisions. The LED Partnership works to fill critical data gaps and provide indicators needed by state and local authorities.

Under the LED Partnership, states agree to share Unemployment Insurance earnings data and the Quarterly Census of Employment and Wages (QCEW) data with the Census Bureau. The LEHD program combines these administrative data, additional administrative data and data from censuses and surveys. From these data, the program creates statistics on employment, earnings, and job flows at detailed levels of geography and industry and for different demographic groups. In addition, the LEHD program uses these data to create partially synthetic data on workers' residential patterns.

All 50 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands have joined the LED Partnership, although the LEHD program is not yet producing public-use statistics for Massachusetts, Puerto Rico, or the U.S. Virgin Islands. The LEHD program staff includes geographers, programmers, and economists.

Source: http://lehd.ces.census.gov/

Shift-Share Calculations

	Local Economy				Reference Economy						
NAICS SECTOR	Initial Year	Final year	# Change	% Change	Initial Year	Final year	# Change	% Change	County Share (CS)	Industry Mix (IM)	Local Economy Effect (LEE)
Sector A	a	b	=(b-a)	=(b-a)/a	a2	b2	=(b2-a2)	=(b2-a2)/a2	=[(b2+d2+f2-(a2+c2+e2)]/(a2+c2+e2)	=a*[(b2-a2)/a2]	=[(b-a)]-CS+IM for Sector A
Sector B	c	d	=(d-c)	=(d-c)/c	c2	d2	=(d2-c2)	=(d2-c2)/c2	=[(b2+d2+f2-(a2+c2+e2)]/(a2+c2+e2)	=b*[(d2-c2)/c2]	=[(b-a)]-CS+IM for Sector B
Sector C	e	f	=(f-e)	=(f-e)/e	e2	f2	=(f2-e2)	=(f2-e2)/e2	=[(b2+d2+f2-(a2+c2+e2)]/(a2+c2+e2)	=c*[(f2-e2)/e2]	=[(b-a)]-CS+IM for Sector C
Totals	a+c+e	b+d+f	=(b+d+f)-(a+c+e)	=[(b+d+f-(a+c+e)] / (a+c+e)	a2+c2+e2	b2+d2+f2	=(b2+d2+f2)-(a2+c2+e2)	=[(b2+d2+f2-(a2+c2+e2)] / (a2+c2+e2)	na	na	Sum of LEE for Sectors A, B & C