MAX Yellow Line
Portland, Oregon

Do TODs Make a Difference?

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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 residence 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 section.

2-DATA AND METHODS

Data from before and after the opening of a transit line was 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 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. 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 then 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 metro 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 use was matched.

For comparable corridors, the emphasis was placed on creating corridors viable as transit corridors. This meant that corridors 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 Transit Oriented Development (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 is classified using the North American Industrial Classification System (NAICS), and data is available for each Census Block at the two-digit summary level. Data was 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 was downloaded from http://onthemap.ces.census.gov/. The data was downloaded 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 Transit Oriented Development (TOD), and Transit Adjacent Development (TAD). The latter refers to any development happens to occur within the Transit Station Area (TSA), or half mile buffer around a fixed guide-way transit station, while the former refers to land uses and build 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.

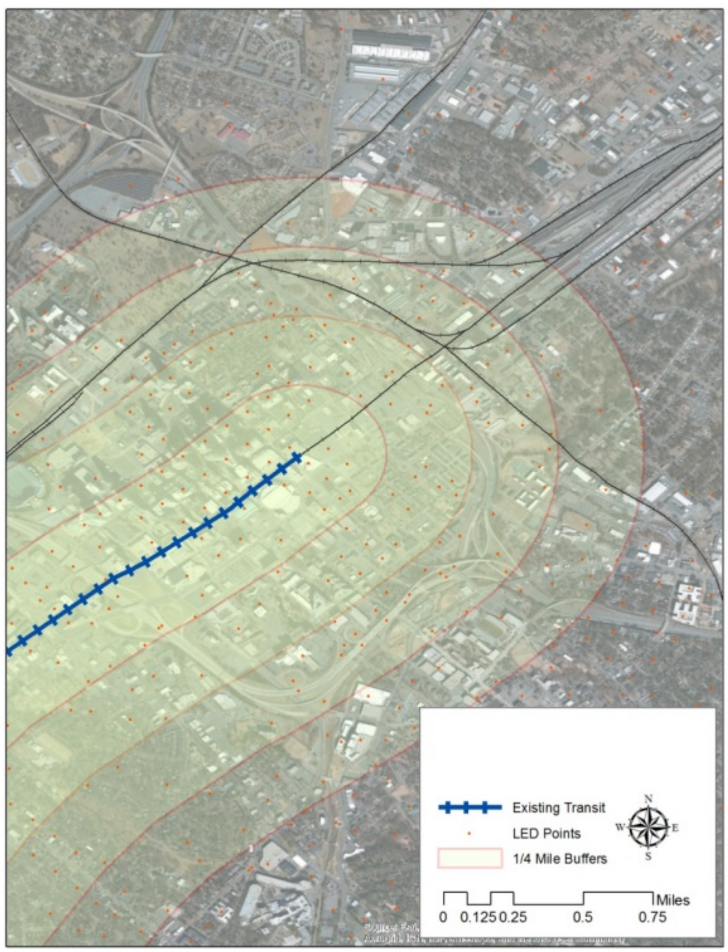


Figure 1: Example corridor, buffers, and LED census block points

Study Area

This study examines the Portland MAX's Yellow Line. The Yellow Line is a 5.8 mile long light rail line that began service on May 1, 2004. The Yellow Line was chosen because it parallels a freeway and it goes through downtown. The comparable corridor was chosen because it echoed the Yellow Line on Albina Avenue.

There are currently four light rail lines in Portland. The Yellow Line is the newest line. The first MAX line began service on September 5, 1986.

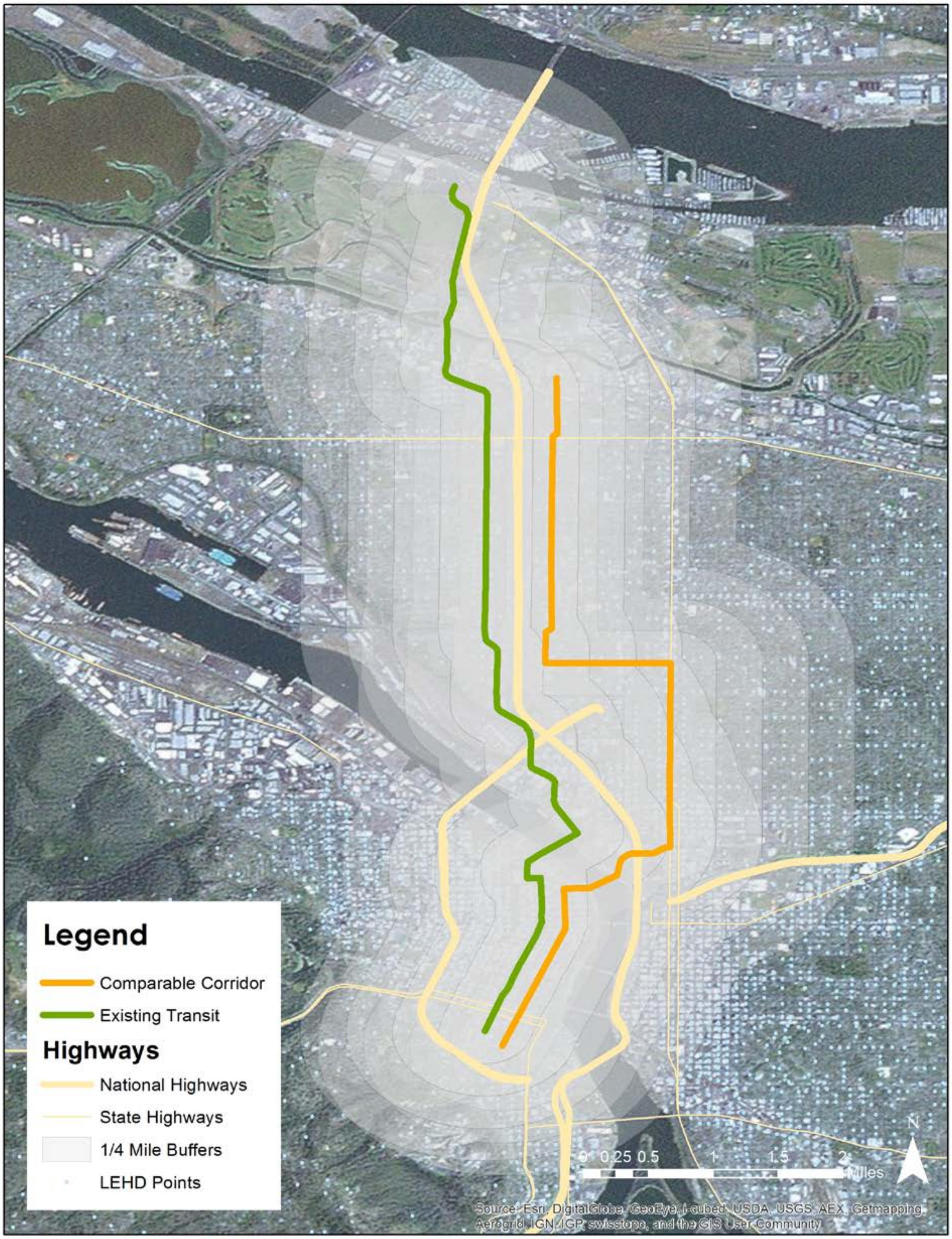


Figure 2: Transit and comparable corridor locations

2-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.

We define location quotient (LQ) "as a ratio of ratios" following Miller, Gibson and Wright (1991: 66):

$$\mathrm{LQ} = \frac{\left(\frac{e_i}{\sum e}\right)}{\left(\frac{E_i}{\sum E}\right)}$$

where:

e_i = Employment in industry i in corridor
$\sum e$ = Total employment in corridor
E_i = Employment in industry i in the metropolitan area
$\sum E$ = Total employment in the metropolitan area

The analysis then compares the location quotients of each industry between each corridor for 0.25 mile and 0.5 mile buffers around each corridor. Because the Portland MAX Yellow Line light rail corridor was already in operation in 2004 (our data spans 2002-2010), we can compare the employment concentrations before and after its existence. Our analysis will focus on whether there were higher concentrations of employment opportunities along the transit line within each of the two buffer distances during the analysis period.

Both the existing and comparable corridors are located in pre-existing, built-up urban areas, so additional growth must occur through redevelopment of existing urban land. Therefore, 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.

Results & Discussion

Table 1 shows the location quotients for the quarter mile and half mile buffers are presented below, for both the Existing and Comparable corridors. The average location quotient for two periods (one before the opening of Portland MAX's Yellow Line, and one after) has been calculated and compared, with changes over time reported. Finally, differences between the Existing and Comparable corridors were calculated and reported in the 'Corridor Differences' column. Both the Comparable corridor and Existing Transit corridor show strong changes in industry concentrations both before and after the MAX Yellow Line began operation.

	Comparable (0.25 mi)			**Existing (0.25 mi)**			**Corridor Differences (0.25 mi)**		
	2002-2004	2005-2010	Change	2002-2004	2005-2010	Change	2002-2004	2005-2010	Change
Utilities	3.12	3.05	-0.02	3.00	3.02	0.00	-0.12	-0.04	0.03
Construction	0.51	0.40	-0.20	0.45	0.39	-0.12	-0.06	-0.01	0.08
Manufacturing	0.06	0.06	-0.02	0.09	0.08	-0.08	0.03	0.03	-0.05
Wholesale	0.32	0.29	-0.09	0.32	0.31	-0.01	0.00	0.02	0.07
Retail	0.49	0.44	-0.10	0.54	0.50	-0.08	0.05	0.06	0.02
Transportation	0.35	0.31	-0.13	0.37	0.28	-0.23	0.01	-0.03	-0.10
Information	2.35	2.16	-0.08	2.42	2.22	-0.08	0.07	0.06	0.00
Finance	3.42	3.43	0.01	3.17	3.09	-0.03	-0.24	-0.35	-0.03
Real Estate	1.43	1.58	0.10	1.42	1.41	-0.01	-0.01	-0.17	-0.11
Professional	2.79	2.79	0.00	2.77	2.87	0.04	-0.02	0.08	0.04
Management	2.51	3.08	0.22	1.76	1.76	0.00	-0.75	-1.32	-0.23
Administrative	1.31	1.27	-0.03	1.03	1.19	0.16	-0.28	-0.08	0.18
Education	0.54	0.66	0.22	0.79	0.82	0.05	0.25	0.17	-0.17
Health Care	0.31	0.33	0.08	0.37	0.37	0.01	0.06	0.04	-0.07
Arts, Ent., Rec	0.93	0.84	-0.10	1.17	1.21	0.04	0.23	0.37	0.14
Lodging, Food	1.02	1.07	0.05	1.07	1.16	0.08	0.06	0.09	0.03
Other services	0.74	0.78	0.06	0.81	0.93	0.14	0.08	0.15	0.08
Public Admin	3.23	3.13	-0.03	3.27	3.18	-0.03	0.04	0.05	0.00
	Comparable (0.5 mi)			**Existing (0.5 mi)**			**Corridor Differences (0.5 mi)**		
	2002-2004	2005-2010	Change	2002-2004	2005-2010	Change	2002-2004	2005-2010	Change
Utilities	2.11	2.42	0.15	2.15	2.27	0.06	0.04	-0.15	-0.09
Construction	0.43	0.45	0.05	0.42	0.42	0.00	-0.01	-0.03	-0.05
Manufacturing	0.09	0.09	0.08	0.13	0.13	0.02	0.04	0.04	-0.06
Wholesale	0.38	0.39	0.03	0.35	0.34	-0.05	-0.03	-0.06	-0.08
Retail	0.62	0.66	0.05	0.55	0.57	0.03	-0.07	-0.09	-0.03
Transportation	0.29	0.25	-0.15	0.35	0.29	-0.17	0.06	0.05	-0.01
Information	2.06	2.10	0.02	2.17	2.12	-0.02	0.11	0.02	-0.04
Finance	2.51	2.66	0.06	2.48	2.66	0.07	-0.03	0.00	0.01
Real Estate	1.33	1.42	0.07	1.45	1.58	0.09	0.12	0.16	0.02

Professional	2.18	2.34	0.07	2.32	2.59	0.12	0.14	0.25	0.04
Management	1.84	2.39	0.30	1.42	1.67	0.18	-0.42	-0.71	-0.12
Administrative	1.12	1.18	0.05	0.89	1.05	0.18	-0.23	-0.13	0.13
Education	1.24	0.71	-0.42	1.51	0.80	-0.47	0.27	0.08	-0.05
Health Care	0.90	0.81	-0.11	0.76	0.78	0.03	-0.14	-0.02	0.13
Arts, Ent., Rec	1.02	1.08	0.06	1.32	1.39	0.05	0.30	0.31	-0.01
Lodging, Food	0.99	1.12	0.13	1.06	1.24	0.16	0.08	0.12	0.03
Other services	0.84	0.92	0.09	0.86	0.95	0.11	0.01	0.03	0.02
Public Admin	2.47	2.51	0.01	2.36	2.43	0.03	-0.11	-0.08	0.01

Table 1: Location quotients comparison for existing transit and comparable corridors

As shown in the last column of Table 1 above, industry sectors such as Administrative, Other Services and Lodging and Food registered positive changes in the 0.25 mile location quotient and show a higher concentration closer to the LRT line, and other sectors such as Transportation, Construction, Information and Manufacturing were decreasing in job concentration around the LRT line.

Attributing causal effect to transit lines is always problematic. Designing successful transit networks is largely a game of connect-the-dots, linking together major employment centers with employee housing along congested corridors. The Portland MAX Yellow Line connects the Portland Expo Center in the north through North Portland and downtown Portland, and reaches Portland State University at its southern terminus. A careful study of the differences in location quotient in Table 1 above reveals different patterns of economic development and employment concentration with the quarter-mile and half-mile buffers, for both the Existing and Comparable corridors. Within the quarter-mile buffer, Administrative, Arts, Entertainment and Recreation and Other Services industries showed the greatest increases in the Existing LRT corridor compared to the Comparable corridor. On the other hand, within the same quarter-mile buffer, Education and Management industries experienced greater loss of job concentration.

For the 0.5 mile buffer around the Existing Transit corridor, there are notable increases in the Administrative and Health Care industries when compared to the Comparable corridor, while smaller increase are registered for the Professional and Lodging and Food industries. On the other hand, these sectors lost the most jobs: Management, Utilities, Wholesale, Manufacturing and Construction. As the areas around the Portland MAX Yellow Line are becoming more accessible for both residents, workers and consumers, it is reasonable that many industries associated with hospitality and professional services are becoming more concentrated along the light rail corridor while others that may have fewer demands for consumer access (such as Construction or Management) or have higher needs for space (such as Manufacturing) show a gradual shift out of corridors that are made easily accessible by the new light rail line.

3-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 changes is determined by other factors.

In theory, employment in different NAICS sectors should be variable depending on the NAICS code, as some NAICS 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, large 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, in attempt to identify 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 (Metro Share) 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 (Industry Mix) 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 (Transit Share) 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.

The formula below was used for the shift-share analysis:

Shift-Share = Metro Share + Industry Mix + Transit Share

where:

Metro Share = $C_i^0 . \left(\frac{M^1}{M^0}\right)$

Industry Mix = $\left\{C_i^0 . \left(\frac{M_i^1}{M_i^0}\right)\right\}$ – Metro Share

Transit Share = $C_i^0 . \left(\frac{C_i^1}{C_i^0} - \frac{M_i^1}{M_i^0}\right)$

where:

C_i^0 = Number of corridor jobs in industry (i) at the beginning of the analysis period (0)
C_i^1 = Number of corridor jobs in industry (i) at the end of the analysis period (1)
M^0 = Total Metro jobs at the beginning of the analysis period (0)
M^1 = Total Metro jobs at the end of the analysis period (1)
M_i^0 = Metro jobs in industry (i) at the beginning of the analysis period (0)
M_i^1 = Metro jobs in industry (i) at the end of the analysis period (1)

Results & Discussion

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 changes in employment by sector within a 0.5 mile buffer of the transit corridor between 2007 and 2010. The second batch of columns shows the changes in employment by sector in the Portland metropolitan area. The third batch of columns shows the results of the shift-share analysis, and apportions the source of employment change between the three categories of Metro Share, Industry Mix and Transit Shift.

NAICS Sector	Half Mile Buffer			Metro			Shift-Share Sources of Employment Change		
	2007	2010	% Change	2007	2010	% Change	Metro Share	Industry Mix	Transit Shift
Utilities	917	826	-9.9%	3,472	6,206	78.7%	-31	753	-89%
Construction	2,765	2,582	-6.6%	62,878	43,588	-30.7%	-92	-756	24%
Manufacturing	1,791	1,339	-25.2%	124,085	106,802	-13.9%	-60	-190	-11%
Wholesale	2,284	2,010	-12.0%	61,051	56,737	-7.1%	-76	-85	-5%
Retail	6,780	6,085	-10.3%	108,309	102,758	-5.1%	-226	-122	-5%
Transportation	1,067	1,015	-4.9%	37,397	34,081	-8.9%	-36	-59	4%
Information	6,118	5,178	-15.4%	26,784	24,697	-7.8%	-204	-273	-8%
Finance	12,543	11,765	-6.2%	44,209	39,489	-10.7%	-418	-922	4%
Real Estate	3,295	3,171	-3.8%	19,988	17,694	-11.5%	-110	-268	8%
Professional	15,142	16,176	6.8%	54,069	55,822	3.2%	-504	995	4%
Management	4,243	4,074	-4.0%	24,516	21,920	-10.6%	-141	-308	7%
Administrative	7,155	6,025	-15.8%	64,029	54,039	-15.6%	-238	-878	0%
Education	7,672	8,566	11.7%	87,477	98,254	12.3%	-255	1,201	-1%
Health Care	9,256	10,148	9.6%	109,668	127,654	16.4%	-308	1,826	-7%
Arts, Ent., Rec.	2,404	2,204	-8.3%	15,819	16,347	3.3%	-80	160	-12%
Lodging, Food	10,718	11,239	4.9%	81,826	79,948	-2.3%	-357	111	7%
Other Services	3,817	4,020	5.3%	38,406	38,175	-0.6%	-127	104	6%
Public Admin	8,651	8,019	-7.3%	31,420	38,057	21.1%	-288	2,115	-28%
Total	106,618	104,442	-2.0%	995,403	962,268	-3.3%	-3,519	3,403	1%

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

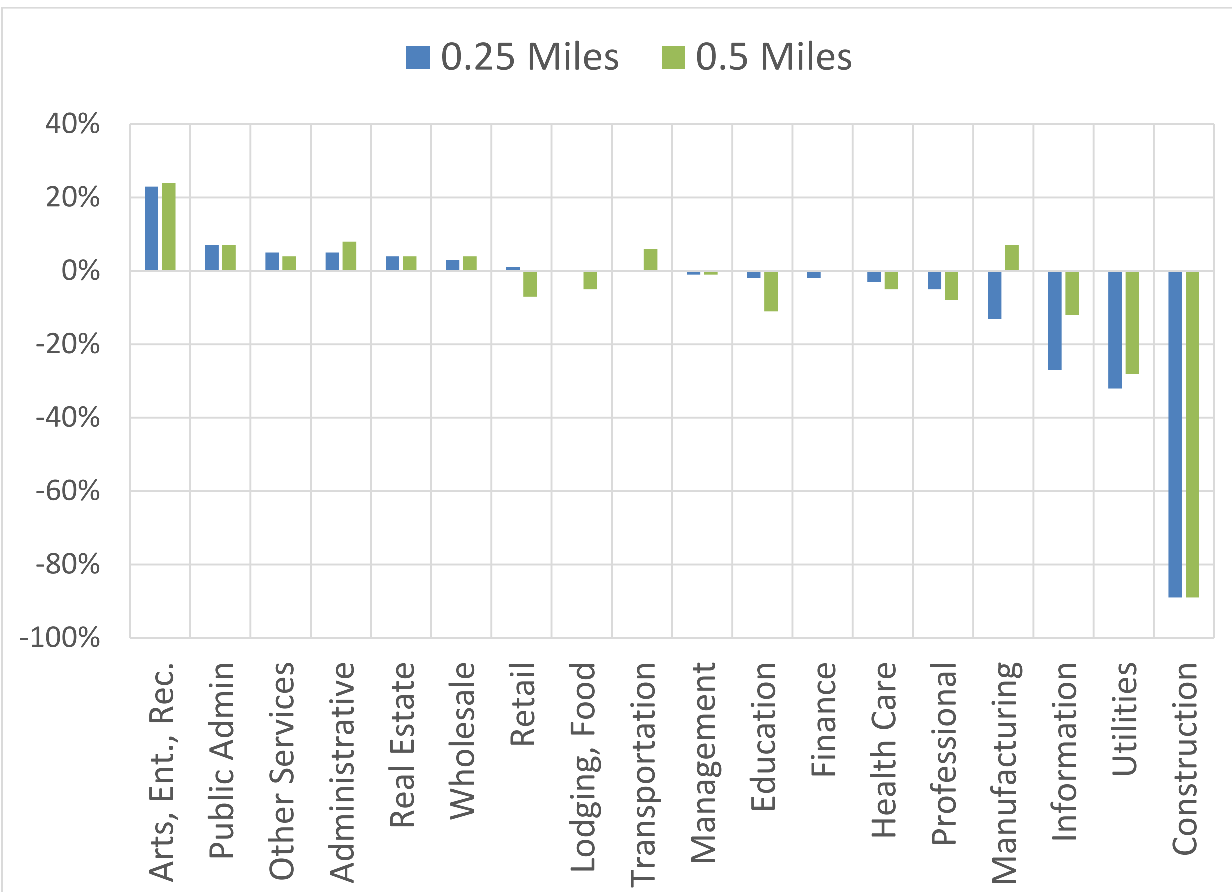
The entire Portland metro area lost 3.3% jobs, mainly in Construction, Administrative, Manufacturing, Finance, Real Estate, Management and Transportation sectors between 2007 and 2010. There was about 2.0% total loss in employment within the 0.5 mile buffer, concentrated in Manufacturing, Administrative, Information, Wholesale, Retail, Arts, Entertainment & Recreation, Utilities and Public

Administration sectors. The shift-share analysis itself shows different trends. After controlling for metropolitan growth and shift in the industry mix, the effect of the transit corridor on employment was slightly positive. The sectors that gained employment as a result of transit corridor impacts within the 0.5 mile included Construction, Real Estate, Management, Lodging and Food and Other Services.

Rather than presenting a series of tables for all buffers, Figure 3 presents the numeric shift for each industry by buffer distance in quarter mile increments out to 0.5 miles. This makes it possible to make a visual inspection of the relationship between proximity to transit and the magnitude of the 'transit shift'. The magnitude of effect should be greatest near the transit corridor, and fade out with increasing distance from the transit station. Previous research indicates that the effect of transit on employment can be noticed out to a half mile distance, but is only statistically significant within a quarter mile.

While the analysis is presented out to 0.5 miles for the purpose of trend analysis, the larger the buffer around the transit corridor, the less the magnitude of effect transit on that area, and the increasing potential to be confounded by picking up the effects of unrelated phenomena. In the context of which, outliers should be disregarded.

Figure 3: Transit Shift by Buffer Distance



Analysis of the Corridor Share Effect is presented for both the transit and comparable corridors in Table 3. This analysis is intended to confirm that the corridor share effects attributed to transit are specific to the transit corridor, and not the result of another effect. Namely, the Transit Advantage shows the change in employment due to the Corridor Share Effect (Transit Shift minus Control Shift).

NAICS Sector	Control Shift	% Shift	Transit Shift	% Shift	Transit Advantage
Utilities	-820.35	-0.13	-813.08	-0.13	7.26
Construction	-31.76	0.00	448.21	0.01	479.96
Manufacturing	-33.01	0.00	-13.67	0.00	19.34
Wholesale	-63.33	0.00	-41.66	0.00	21.67
Retail	-5.24	0.00	0.03	0.00	5.27
Transportation	114.77	0.00	27.70	0.00	-87.07
Information	-267.69	-0.01	-215.53	-0.01	52.16
Finance	1150.63	0.03	521.30	0.01	-629.32
Real Estate	254.60	0.01	121.41	0.01	-133.19
Professional	600.91	0.01	406.08	0.01	-194.83
Management	691.08	0.03	-478.22	-0.02	-1169.30
Administrative	-130.59	0.00	-134.51	0.00	-3.93
Education	239.07	0.00	-84.28	0.00	-323.34
Health Care	699.42	0.01	36.59	0.00	-662.83
Arts, Ent., Rec.	396.97	0.02	-448.37	-0.03	-845.34
Lodging, Food	525.93	0.01	534.23	0.01	8.31
Other Services	-7.88	0.00	3.42	0.00	11.30
Public Admin	-2503.49	-0.07	-2739.34	-0.07	-235.85
Total	**810.04**	**-0.09**	**-2869.70**	**-0.22**	**-3679.74**

Table 3: Shifts by corridor and comparison between corridors

Drawing any conclusion for the Portland MAX Yellow Line is difficult due to confounding factors. The corridor shift associated with the transit and comparable corridors are substantially different for most industries. The corridor effect for the transit corridor is stronger for Lodging and Food, Construction, Professional and Real Estate, while the comparable (control) corridor does substantially better in Management, Arts, Entertainment & Recreation, Health Care and Finance.

Without more rigorous controls, it is difficult to attribute all of the corridor effect to the light rail line. The corridor was not arbitrarily chosen, but rather a process of ‘connecting the dots’ between major regional employment centers. The Portland MAX Yellow Line connects the Portland Expo Center in the north through North Portland and downtown Portland, and reaches Portland State University at its southern terminus. Based on the results of the shift-share analysis, there are industries that are strongly attracted to LRT transit corridors. The percent change, shift-share, and contrast with the comparable corridor all indicate that proximity to the Portland MAX Yellow Line appeared to be more attractive to Construction, Information, Wholesale and Manufacturing.

The analyzed corridors in Portland experienced job loss during the 2007 to 2010 period as a result of the Great Recession, and the number of jobs lost attributed to the Corridor Share Effect is higher in the transit corridor as opposed to the comparable corridor. This effect is particularly striking within the Management and Arts, Entertainment & Recreation industries which experienced positive employment concentration growth in the comparable corridor, but showed losses in employment in the transit corridor which are attributed to transit in the shift-share analysis.

4-EMPLOYMENT RESILIENCE

Introduction

Resilience is a characteristic 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 usual or unexpected conditions such as an automobile breakdown or lower income; it provides alternate transportation options during conditions that impair other modes: weather, construction projects, or accident-induced delay; finally, it 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, reducing 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 and compares the differences. The time series datasets are separated by an 'interruption'. 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 former represents the relationships between the change in variables, and the latter how much of the variance in the data is explained by the regression equation—a measure of the 'goodness' of the regression.

Results & Discussion

In Table 5, the differences in employment in each sector along the transit corridor are displayed. This study shows how many jobs were lost or gained between the year spans of 2005-2007 and 2008-2010. The trend number is the linear regression line on industry employment over time, or the slope of the regression line. Trend indicates 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 difference column reports the change in trend between the two time periods. A positive value for the difference number represents a change from employment loss to employment gain, or a reduction in the rate of decline in employment for that industry. Finally, the significance column (R^2) 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 industries with the most robust or significant trends were Transportation (0.971), Retail (0.968), and Wholesale (0.954). Although Health Care and Education sectors experienced significant losses in the number of jobs, the strength of the trend (significance) is not as high as the previously mentioned industries.

Table 4: Interrupted Time Series between 2005-2007 and 2008-2010

Sector	Difference	Significance
Utilities	-214.24	0.391
Construction	394.36	0.91
Manufacturing	588.41	0.943
Wholesale	-225.75	0.954
Retail	-268.88	0.968
Transportation	89.13	0.971
Information	-186.27	0.891
Finance	61.72	0.977
Real Estate	68.27	0.951
Professional	-417.88	0.877
Management	-288.52	0.833
Administrative	433.66	0.904
Education	-1,492.75	0.788
Health Care	-2,421.15	0.735
Arts, Ent., Rec.	-130.24	0.893
Lodging, Food	-689.65	0.885
Other Services	-240.87	0.919
Public Admin	-426.55	0.801
Total	-5,368.21	0.928

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. Manufacturing, Administrative and Construction industries did better than their prior trend before the Great Recession. These are also the industries that showed the most robust significance in its employment trends, possibly indicating their economic resilience compared with other 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 half-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 additional 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. 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 have 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 Transit Oriented Development (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 & Ewing, 2011).

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

Data and Methods

This section describes the data and techniques used for the analysis. Unlike all other analyses contained in this report, this housing and transportation 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 magnitude of effect for proximity to transit. The area within the smallest buffers should show the strongest reaction.

Data Source and Geography

This study uses Housing + Transportation (H+T) Affordability Index developed by the Center for Neighborhood Technology (CNT). The Index was initially developed for St. Paul, Minnesota in 2006. By the end of the 2006 year, the Center for Housing Policy had expanded the H+T index to include 28 metros. With support from the Brookings Institution, it was expanded to 52 metropolitan areas in 2008. In March 2010, CNT included additional metros in the index, for a total of 337 metropolitan areas. The H+T Index has since been expanded to include almost 900 metro areas. The 2010 vintage was used for this analysis.

The unit of analysis for the dataset is the 2000 Decennial Census Block Group. The data extent is the Census 2000 Metropolitan Areas. The H+T Index was developed using Decennial Census 2000 data, and then expanded to a time series format using data from the American Community Survey five-year estimates, 2009 vintage. Differences in Census data collection procedures means the two dataseries are not directly comparable. As a result, transportation costs were calculated using the National Median Income. This may result in over-estimation or underestimation of the value transportation cost amounts, but suffices for the purpose of trend detection.

This analysis makes use of five characteristics: Transportation Costs, Transportation Costs as a percent of income, Housing Costs, Housing Cost as a percent of Income, and H+T costs as a percent of income. Data from both the 2000 and 2009 time periods were used.

Data Processing

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 H+T characteristics of each block were then weighted by weighted by geographic ratio. The geographic ratio 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% of the area in the buffer, H+T characteristics for that block group received a weight of 3%. The weighted variables were then summed to obtain a geographically weighted value for the buffer.

For the purpose of comparison, a metro H+T Index was devised. Because the metropolitan area contains all census blocks, characteristics could not be weighted by area. Nor would it have been appropriate to do so. 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 H+T Index value for the metro area was calculated by weighting the block group characteristics by Census 2000 block group population. This weighted average is intended to provide a referent for what are normal H+T values for the metropolitan area.

This analysis makes use of seven characteristics from the location affordability index: housing costs as a percentage of income and transportation costs as a percentage 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 & Discussion

This study used changes over time in the H+T Index (Housing+Transportation) developed by the Center for Neighborhood Technology (CNT) to detect the effects of the availability of fixed guide-way transit on housing affordability. It is necessary for housing affordability to include both housing and transportation costs. Housing costs do not exist in isolation, but in the context of transportation costs. Total cost of ownership associated with second and third cars is considerable, considering not only the cost of the automobile itself, but the operations and maintenance costs associated with fuel, insurance, and repairs. It is not always possible to maintain a supply of affordable housing for a growing population by adding additional housing at the urban periphery. Located on the fringe of the urbanized area, such locations are the furthest from employment and services, requiring traveling long distances to meet basic needs. Locating by transit should reduce these costs.

Overall, the analysis revealed that locating closer to transit was associated with affordability. Table 5 shows that as a household locates closer to a transit line, the portion of their income spent on housing and transportation declined by 0.40% and 1.08%, after controlling for housing and transportation costs within the comparable corridor in the quarter-mile and half-mile buffers. It was not surprising to find that housing and transportation costs declined slightly for those households living closest to the Portland LRT transit line since travelers self-select to live in TODs “due to habit, personal taste, or happenstance” (Cervero, 1994, p. 177).

Table 5: Affordability by Corridor

Corridor	2009		
	Comparable	Existing	Difference
Quarter-Mile	40.88	40.48	-0.40
Half-Mile	41.74	40.66	-1.08
Differences	0.86	0.18	-0.68

In addition to changes in over-all affordability, there were changes in the affordability by occupation. Different occupations have difference wages, which change at different rates over time. Comparing wage income by industry to the housing plus transportation costs for each industry sector shows a general fall in affordability. While there is little change in which occupations by industry sector are able to afford housing in either corridor, the percent of the income that must be devoted to each changes over time.

Table 6: H+T Costs by Occupation

Industry	**2009**			
	Existing ¼	*Existing ½*	*Comp. ¼*	*Comp. ½*
Agriculture, forestry, fishing, and hunting	0.667	0.670	0.673	0.688
Mining	0.261	0.262	0.264	0.269
Utilities	0.260	0.261	0.263	0.268
Construction	0.435	0.437	0.440	0.449
Manufacturing	0.397	0.399	0.401	0.409
Wholesale trade	0.351	0.353	0.354	0.362
Retail trade	0.730	0.733	0.737	0.753
Transportation and warehousing	0.470	0.472	0.475	0.485
Information	0.295	0.296	0.298	0.304
Finance and insurance	0.269	0.271	0.272	0.278
Real estate and rental and leasing	0.482	0.484	0.486	0.497
Professional, scientific, and technical services	0.284	0.286	0.287	0.293
Management of companies and enterprises	0.236	0.237	0.238	0.243
Administrative and waste management services	0.620	0.622	0.626	0.639
Educational services	0.559	0.561	0.564	0.576
Health care and social assistance	0.471	0.473	0.476	0.486
Arts, entertainment, and recreation	0.527	0.529	0.532	0.543
Accommodation and food services	0.973	0.978	0.983	1.004
Other services, except government	0.653	0.656	0.659	0.673
Government	0.397	0.399	0.401	0.410

7-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. Transit Oriented Development (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 work 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 et al., 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 or 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 overall job accessibility. In addition to providing total number of employees per Census Block, the LED employment data is 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 is also classified by industry, using the North American Industrial Classification System (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, on the 0.5 mile buffer was used.

Results & Discussion

This section tests how well transit actually achieves these aims using several tests: an analysis of the job-housing balance, job-income shares, incomes by corridor, and affordability by occupation. The job-housing balance compares the total number of jobs to the total number of housing using LED data about 'workplace area characteristics' (WAC) to that of 'residential area characteristics' (RAC) segmented by category of income between 2002 and 2010.

Ideally, the two are balanced, and transit should have an effect of moving the amount of jobs and amount of housing toward parity. As the following table shows, for the Portland MAX Yellow Line corridor, there is a major jobs-housing imbalance, with a much larger number of jobs in both the quarter mile and half mile radius. The imbalance is greater closer to the transit corridor, and is greater for high-income jobs that for medium income or low income jobs.

Generally, job-housing imbalance seamed to decrease with proximity to the transit line due to the combined effect of loss of jobs and inadequate housing. At the half-mile radius of the transit line, the average ratio of workplace to residence was at 5.43:1 (see Table 7), representing a 32% decline from the 0.25 mile corridor. The trend of jobs-housing balance reflects an uneven growth in jobs and housing, with greater growth in higher income residents and slower growth of employment opportunities. In the years after the opening of the transit line, there is a notable decline in the percent share of low-income and medium-income workers residing near the transit line, while the share of high income workers either working or residing near the transit corridor rises

Table 7: Jobs-housing balance for income categories

Years	LOW			MEDIUM			HIGH			
	Work	Home	Ratio	Work	Home	Ratio	Work	Home	Ratio	Avg.
2002	24519	4991	4.9	46398	6873	6.8	46450	3698	12.56	7.54
2003	23589	4991	4.7	44159	6508	6.8	45267	3926	11.53	7.33
2004	21606	4811	4.5	35918	6440	5.6	41094	4206	9.77	6.38
2005	21553	4888	4.4	36212	6837	5.3	42324	4692	9.02	6.10
2006	22096	5442	4.1	35967	7582	4.7	46153	6347	7.27	5.38
2007	21317	5634	3.8	35572	7919	4.5	49826	7043	7.07	5.18
2008	21352	5419	3.9	35399	7869	4.5	53238	7722	6.89	5.24
2009	19426	4817	4.0	34034	7094	4.8	52907	7413	7.14	5.50

2010	18730	4705	4.0	32597	6896	4.7	53293	7918	6.73	5.36
2011	18909	4433	4.3	33303	6735	4.9	55781	8731	6.39	5.43

Clearly, proximity to transit had positive income effects over time (see Table 8 below). Within a quarter-mile of transit, there appeared to be retrogression of income over the years. Similarly, within the half-mile buffer of transit, incomes depreciated. However, the negative income effects were more pronounced in the half-mile buffers than the quarter-mile buffer. In all years, median household income is slightly higher as you get farther from the corridor. Across the board, median household income is lower in the existing corridor than in the comparable corridor.

Buffer	Comparable			Existing			Differences		
	2000	2009	2011	2000	2009	2011	2000	2009	2011
Quarter-Mile	39,080	39,282	42,246	38,977	38,689	38,214	103	593	4,032
Half-Mile	41,622	41,728	42,246	40,297	40,045	40,284	1,325	1,683	1,962
Differences	-2,542	-2,446	0	-1,320	-1,356	-2,070	-1,222	-1,090	2,070

Table 8: Household Median Income by distance band by year

We reach the following conclusions regarding job accessibility close to the transit line: (1) uneven distribution of jobs and housing; (2) higher likelihood of being poor; and (3) uneven jobs-housing balance for difference income groups. From these findings, it is possible to conclude that the uneven distribution of jobs coupled with lower job accessibility was making it difficult for households to move up on the economic ladder because they may have to pay more for housing and transportation.

8-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 attractive: Utilities, Public Administration, Finance
- Least attractive: Manufacturing, Transportation

Transit advantage over comparable corridor

- Substantial: Administrative, Health Care
- Minor: Arts, Entertainment & Recreation, Other Services

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

Change in transit corridor

- Employment in commuter rail corridor shrank less than metropolitan area
- Substantial percentage increases: Education, Professional, Other Services, Lodging and Food
- Substantial percentage reductions: Manufacturing, Administrative, Information

Shift-share analysis – Transit Shift

- Although Construction sector showed decreases in employment numbers, shift-share analysis shows largest positive contributions towards this industry.
- Employment in Real Estate, Management, Lodging and Food sectors are also positively impacted by transit

Transit advantage over comparable corridor

- Transit advantage is strongest for Construction, Information
- Strong transit disadvantage exists for Management and Finance

Q3: Are firms in TODs more resilient to economic downturns? (Difference-In-Difference)

In this example, resilience is defined as the capacity to maintain a positive trend despite the economic shock of the 'Great Recession'. We utilized an interrupted time series estimation to analyze resilience within each industry.

- Positive signs of resilience: Manufacturing, Administrative
- Negative signs of resilience: Health Care, Education (but this trend is not robust)

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

This report uses the Housing + Transportation (H+T) Affordability Index developed by the Center for Neighborhood Technology (CNT). The Index was initially developed for St. Paul, Minnesota in 2006.

- Households located close to the light rail line spend a smaller percentage on housing and transportation compared to the comparable corridor
- Affordability increases as households move closer to the transit line

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 and for workers by income levels.

- Jobs-housing ratio is higher for high income households than for low or medium income households.
- Jobs-housing ratio displays a downward trend for all income levels, with a small uptick in 2009.
- Lower average household income within transit corridor, and fewer low income jobs available

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10-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/