The Impact of TACOMA LINK Light Rail on Employment by Industry

Matt Miller (Corresponding Author)
City and Metropolitan Planning Department
Room 131B AAC (375 South 1530 East)
University of Utah
Salt Lake City, UT 84112
801-581-8254
matt439miller@gmail.com
Arthur C. Nelson
Arthur C. Nelson
Professor of Planning and Real Estate Development
College of Architecture, Planning and Landscape Architecture
University of Arizona
Tucson, Arizona 85719

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Abstract

For the Tacoma LINK light rail, this study uses shift-share to decompose the variance in employment change into a number of factors. It then uses dynamic shift-share to create time series of the shift-share components. Doing so clearly demonstrates the correlation between the industry mix and the competitive benefit, therefore the shift-share is extended to better disaggregate components. Simple descriptive analysis suggests that Health Care dominates employment near transit, but classic shift-share suggests that the Administration industry is one of the main benefactors. Comparing the competitive benefit of proximity to the rail line by various buffers reveals that while increases in Administration employment are highly correlated with transit, they are not caused by transit, but by a common factor—a downtown location. Finally, dynamic shift-share reveals the competitive benefit associated with the transit line tends to fade over time.

1- Introduction

This article assesses the relationship between Tacoma LINK and changes in the number and industry sector of jobs in the nearby area. Due to unfamiliarity with transit, the initial transit system for any metro area tends to be a 'hybrid system' with characteristics of multiple rail transit types. Tacoma Link is one such system, having characteristics of both light rail and streetcar. While branded as light rail, Tacoma Link is effectively streetcar, running at-grade in mixed traffic with closely spaced stations. The success of the Portland (modern) Streetcar has inspired many imitators, notably Seattle's own South Lake Union line, the Salt Lake S-line streetcar, the Tucson SunLink, all attempting to imitate the associated development impacts. Yet all imitators have begun operating only recently, and their effects have been confounded by the Great Recession. Tacoma LINK began operations in 2003, so using it as a case study makes it possible evaluate the long term effects of proximity, and to do so outside the context of Portland's unique context. The time period of the analysis also runs through the Great Recession, making it possible to compare its effects on employment near Tacoma Link.

Not all industries can be expected to benefit equally from proximity to transit. Employment growth should vary by industry sector, 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 high peaks of visitors) would also benefit. Finally, institutions with large parking demands (universities, colleges, hospitals, and some government offices) may find proximity to transit valuable.

Employment is a highly spatial phenomenon. Employment is not distributed randomly or evenly, but tends to be concentrated. Employment in certain industries tends to be hyper-concentrated, either in campuses or specialized districts. Transit lines tend to be matched to dense employment locations. Only a limited number of industries are capable of concentrated employment, typically those compatible with mid-rise office settings. Thus, the industry mix near transit stations may be highly atypical of the region as a whole.

This analysis is intended to determine if certain industries experienced greater growth in employment due to proximity to the Tacoma LINK. Most New Starts transit projects were constructed as congestion relief measures. Yet due to the influence of the TIGER grant program, their potential for economic development has becoming increasingly important (*1*), (*2*).

Establishing the accessibility premium for transit, and how that premium varies by proximity to transit and by industry provides critical information for practice. First, knowing the premium is essential for effectively planning Transit Oriented Development, by determining which land uses are compatible with proximity to transit stations. This makes it possible to zone and regulate accordingly.

Second, it is key to funding additional transit infrastructure through Business Improvement Districts (BID) and residential Tax Increment Financing (TIF). Long before transit was public, mass transit was a privately funded enterprise, where transit was a loss-leader to facilitate real estate development. Owning the land made it possible to capture the value of the additional accessibility generated by a new transitway. BID/TIF programs make it possible to recoup some of the costs associated with the investment.

Measuring the economic development effects of transit station in terms of change in employment has a long history, but has recently become much more effective due to the availability of the LODES dataset, which provides industry data at a very fine geographic scale.

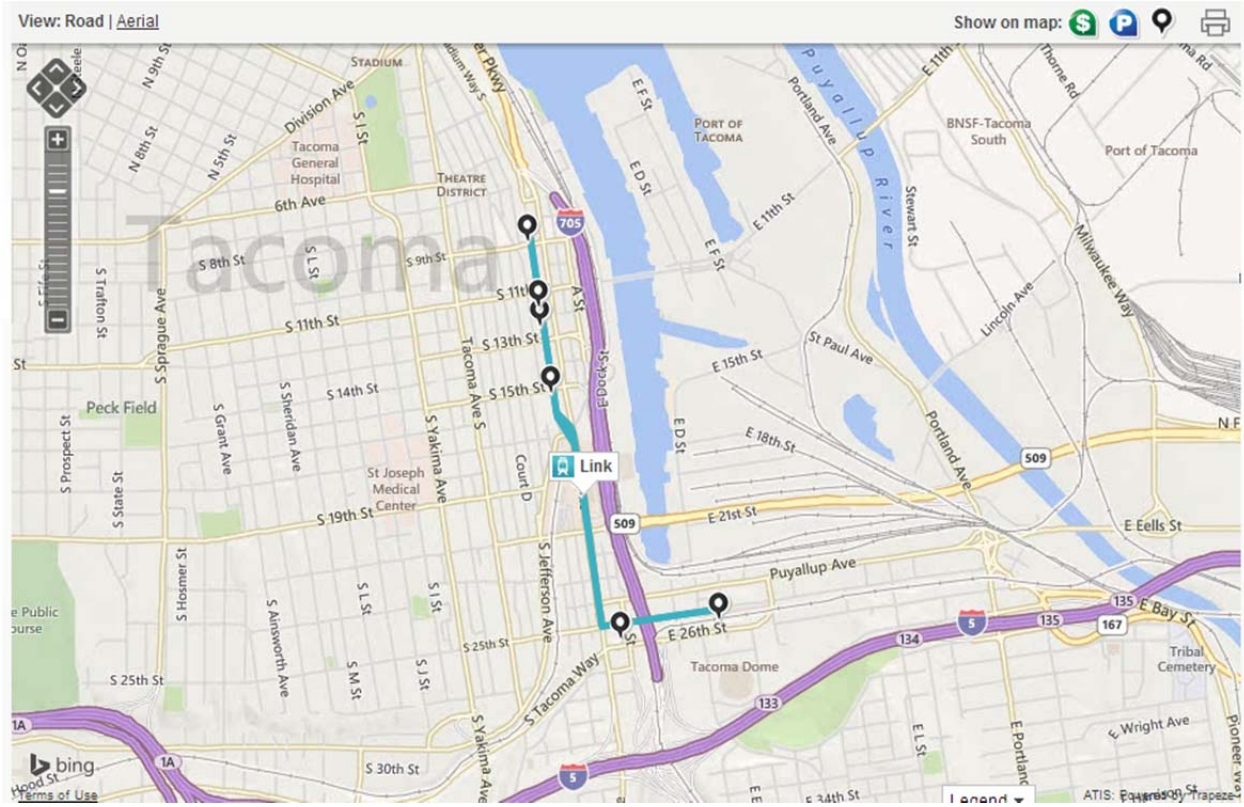
This paper is organized as follows. Section 2 provides relevant background material, Section 3 presents methodology, data and variables; Section 4 reports results, and Section 5 contains discussion and implications.

Background

The Tacoma LINK light rail in Tacoma, Washington began operations in 2003. The 1.6 mile line has 5 stations. It runs north-south between the Tacoma theatre district and the Tacoma Dome Sounder Commuter Rail station. The northern portion runs along Commerce Street, while the southern portion runs along Pacific Avenue. It is street running for the entire length. While branded as a light rail, the Tacoma Link uses the same Skoda/ tram vehicles used for the Portland streetcar. However, like the Salt Lake Streetcar, the transitway was engineered for much larger and heavier light rail rolling stock. Although branded as light rail, it is more similar to streetcars, given its length, station spacing and transitway type. While most of the right of way is single track, there are extensive portions of double-track. Due to the Sound Transit policy of not collecting fares unless the value of fares exceeds the cost of collecting them, Tacoma Link has been free to ride. In response to a rising value of fares, Sound Transit was scheduled to begin collecting fares, a process that has been delayed due to payments from the Business Improvement District (BID) associated with the system.

Tacoma Link passes by the University of Washington (Tacoma), the Museum of Glass, the Washington State History Museum, and the Greater Tampa Convention Center. At the Commerce Street Station, there is a very large structured parking garage that serves as a park and ride. The Tacoma LINK runs parallel to I-705, and as I-705 provides additional access to downtown Tacoma from the I-5, the Tacoma Link also provides additional access from the Sounder commuter rail. Tacoma Link post-dates Sounder commuter rail, which began operations in 2000, but pre-dates the Central LINK light rail system, which began operations in 2009. The maintenance and storage barn is located east of the Tacoma Dome Station, along 26th Street. Tacoma LINK operates 5:00a-6:36a. It has a12-minute headway from 6:36a-8:00p, and a 24-minute headway at other times.

ABOUT HERE Figure 1: Tacoma Link Location and Route
Source: http://www.soundtransit.org/Schedules/Tacoma-Link-light-rail?tab=Map



ABOUT HERE: Figure 2: Tacoma LINK Inekon Tram Vehicle
Source: http://en.wikipedia.org/wiki/Tacoma_Link#mediaviewer/File:Taclinkdome.JPG

Data and Methods

The study area is in the Seattle-Tacoma metropolitan region, focused on downtown Tacoma, around the Tacoma LINK rail corridor. The unit of analysis is the 2010 census (reporting) block.

The data source was the Longitudinal Employer-Household Dynamics (LEHD) LEHD Origin-Destination Employment Statistics (LODES) database, downloaded from the Census OnTheMap website on June 30, 2013, version 6.1. Technical documentation about the data can be found at: http://lehd.ces.census.gov/data/#lodes. The data consists of a geodatabase of point data where each point represents the centroid of a 2010 census block. The LEHD data is available for each year, from 2002-2011. Employment is summarized by 2-digit NAICS industry sectors.

The data was processed in ArcGIS 10.2, using the appropriate State Plan projection. Census blocks were assigned membership within a buffer based on the location of their centroid using GIS. Due to the proximity of the stations and the degree of overlap, the transit line as the origin of the buffer, rather than individual stations. The employment within each buffer was summed and then exported to a spreadsheet. The Agriculture, Mining/Oil, and Utilities sectors have been removed from the dataset, as they represent only a fraction of a percent metropolitan employment and are thus prone to generating outliers. The Construction industry has likewise been removed, because the nominal place of employment rarely matches the actual place of work.

The streetcar began operations on July 18, 2003, and so 2003 was used as the beginning of the analysis period. While it has been suggested that appreciation associated with transit predates the beginning of operations the research is based on the addition of new corridors to existing systems, rather than initial segment of a new system.

Shift-share analyses will be used to disaggregate employment change in order to determine what portion of employment change can be attributed proximity to transit. The classic shift-share formulation (*3*) (*4*) (*1*) disaggregates employment change into three portions:

1. Growth Effect

2. Industry Mix

3. Competitive Benefit

The growth effect determines what portion of the growth in local employment can be attributed to growth in the larger economy, through the indirect or induced effect embedded in a growing economy through industrial linkages and transfer payments. The industry mix is the proportion of employment growth due to having firms in expanding industries. The competitive benefit represents the unexplained portion of change attributable to conditions specific to the analysis geography. Loveride & Selting provide one of the clearest explications of the method (*4*) as seen below:

About Here Fig. 3: Shift Share Formulation

Source: Loveridge and Selting 1998

$$E_{ij}^{t} - E_{ij}^{t-1} \equiv \Delta E_{ij} \equiv NE_{ij} + IM_{ij} + CE_{ij},$$

where

E_{ij}^{t} is Employment (income) in the ith sector in the jth region at time t,
NE_{ij} is National Growth Effect,
IM_{ij} is Industry Mix Effect,
CE_{ij} is Competitive Effect.

The three effects are computed as follows:

$$NE_{ij} = g_{00} \times E_{ij}^{t-1}, \quad (1)$$

$$IM_{ij} = E_{ij}^{t-1} \times (g_{i0} - g_{00}), \quad (2)$$

$$CE_{ij} = E_{ij}^{t-1} \times (g_{ij} - g_{i0}), \quad (3)$$

where

g_{ij} is percent change, employment (income) in industry i, region j relative to a base year $(t-1)$,
g_{i0} is percent change, nationwide employment (income), industry i,
g_{00} is percentage change in nationwide employment (income),
i is sectoral designator,
j is regional designator.

Two variants of shift-share are used to investigate the Tacoma LINK for its economic development impacts. First, the familiar (static) shiftshare, and second the less familiar but more sophisticated dynamic shift-share method (*2*). The static shift-share will include descriptive statistics about employment change. The static shift-share will be performed for multiple buffers around the transit station, to determine how the competitive benefit changes with distance to the Tacoma Link.

Use of both shift-share methods is necessary. Static shift-share fails to consider the effects of the 'compounding' of employment over time (*2*). Thus, it tends to mis-estimate the share of growth which can be attributed to regional growth. This is especially important when the rate of growth within the local economy differs significantly from the regional economy. Additionally, using dynamic shift-share makes it possible to construct time-series for both overall employment and employment in each industry, to determine how long it requires for sector employment changes to respond to the transit line. It also makes it possible to disaggregate employment changes post and prior to the Great Recession.

The virtues of shift-share as an analytical technique are often disputed, given advancements in regression analysis. Its main virtue is often held to be its analytical tractability (*3*). However, it continues to be widely used in regional analysis, especially in contexts where data is scarce. For the same reason, it has a found a niche application in evaluating transit corridors (*9*) (*10*) (*11*).

For most transit analysis, census tracts, block groups or blocks are the geography of analysis. The state of the practice calls for the use of a half-mile (Euclidian) buffer around stations as suitable for analyzing the effects of transit, resulting in a very limited number of datapoints. This is compounded by the length of transit corridors. Many transit corridors are short. At 20 miles, Phoenix's initial corridor was one of the longest. SunLink, the Tucson streetcar is only 3.9 miles. Tacoma Link is only 1.6 miles. Consequently, there are often insufficient datapoints to perform a full regression analysis.

While there is growing evidence that the effects of transit extend beyond the half mile buffer (*12*), (*13*) — using the real estate market to eastablish catchment areas, (*14*) the relationship between transit type (metro commuter rail, light rail, streetcar), mode of access, and street network connectivity has not been sufficiently explored, so the half-mile buffer has been used as the default area of analysis.

Following Nelson (*7*), rather than using the national economy, the Seattle-Tacoma-Bellevue, WA Metropolitan area was used as a reference economy, and buffers around the Tacoma Link were treated as the sub-area region.

Results

This section presents the results for each of the shift-share analyses. The static shift-share is conducted for multiple buffer distances, and the dynamic shift-share is used to create a time-series.

Static Shift-Share

A shift-share analysis of changes in employment within a half-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. The shift-share analysis is representative of a half-mile radius around the transit corridor.

ABOUT HERE: Fig. 4: Shift-share analysis for 0.5 mile buffer of transit corridor

NAICS Sector	Metro				Transit Corridor				Sources of Employment Change			Benefit / Change Ratio
	2003	2011	# Change	% Change	2003	2011	# Change	% Change	Growth Effect	Industry Mix	Competive Benefit	
Manufacturing	163,515	164,497	982	1%	1,571	1,024	(547)	-35%	178	(169)	(556)	(1.02)
Wholesale	75,517	82,529	7,012	9%	616	473	(143)	-23%	70	(13)	(200)	(1.40)
Retail	164,301	168,576	4,275	3%	479	250	(229)	-48%	54	(42)	(241)	(1.05)
Transportation	66,369	67,098	729	1%	225	157	(68)	-30%	25	(23)	(70)	(1.04)
Information	78,909	97,207	18,298	23%	188	338	150	80%	21	22	106	0.71
Finance	70,878	59,441	(11,437)	-16%	3,200	2,440	(760)	-24%	362	(879)	(244)	(0.32)
Real Estate	33,155	30,999	(2,156)	-7%	331	270	(61)	-18%	37	(59)	(39)	(0.64)
Professional	90,442	120,448	30,006	33%	1,873	1,886	13	1%	212	409	(608)	NA
Management	29,006	28,005	(1,001)	-3%	688	257	(431)	-63%	78	(102)	(407)	(0.94)
Administrative	73,179	87,179	14,000	19%	844	1,444	600	71%	96	66	439	0.73
Education	124,503	132,744	8,241	7%	6,342	5,968	(374)	-6%	718	(299)	(794)	(2.12)
Health Care	161,494	206,653	45,159	28%	7,940	10,519	2,579	32%	899	1,321	359	0.14
Arts, Ent. Rec.	30,570	37,147	6,577	22%	321	493	172	54%	36	33	103	0.60
Lodging & Food	111,124	122,794	11,670	11%	1,432	1,549	117	8%	162	(12)	(33)	(0.29)
Other Services	67,177	98,743	31,566	47%	799	982	183	23%	91	285	(192)	(1.05)
Public Admin	52,178	64,441	12,263	24%	7,894	8,150	256	3%	894	961	(1,599)	(6.25)
Total	**1,392,317**	**1,568,501**	**176,184**	**13%**	**34,743**	**36,200**	**1,457**	**4%**	**3,935**	**1,501**	**(3,980)**	**(2.73)**

The metropolitan area enjoyed substantial increases in employment of about 13% between 2003 and 2011. In contrast, employment in the ½ mile buffer around the transit corridor increased by only 6% over that time period, representing about 1500 new jobs.

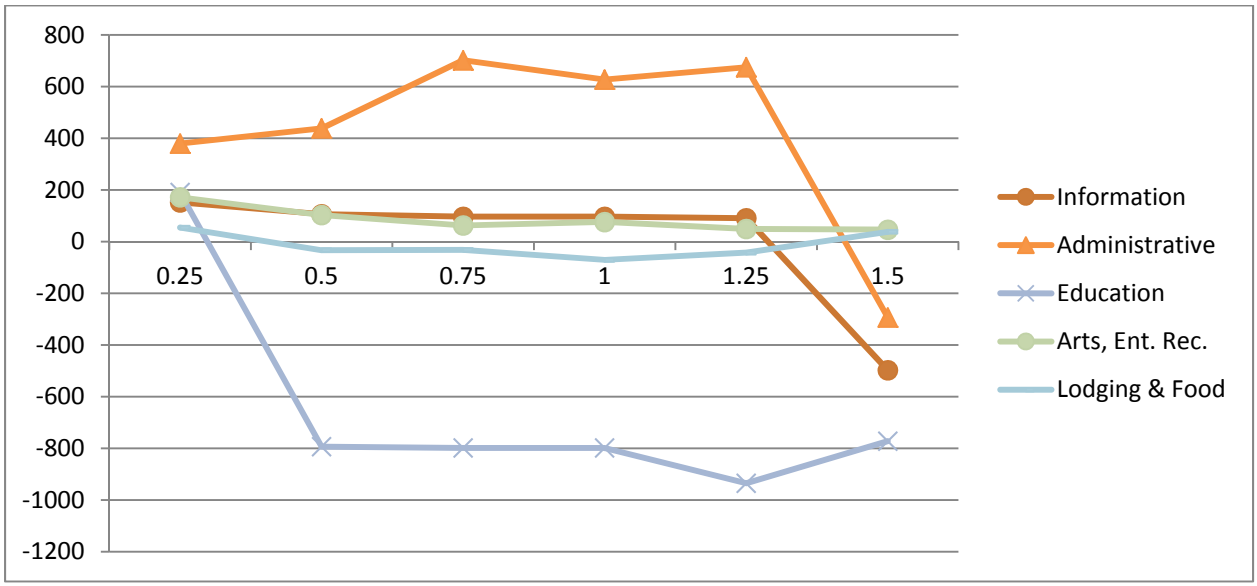
In numeric terms, the Health Care industry enjoyed the most significant increase, of over 2500 jobs, with the Administrative industry a distant second, adding only 600 jobs. However, in percentage terms, this represented an increase of 71%. The Information industry also experienced substantial percent increase of 80%. The Arts/Entertainment/Recreation Industry also did well, with total employment in the half mile buffer increasing by 54% 2003-2011. Both the Finance and Construction industries experienced substantial numeric declines over the same time period.

After using a shift-share analysis to disaggregate the cause of change in employment, different patterns emerge. It confirms that a significant portion of the change in Health Care can be attributed to the Growth Effect, and to the concentration of the Health Care industry in the corridor, but even controlling for these factors, the Health Care industry enjoys a strong competitive benefit in the corridor. In contrast, most of the employment change in the Administrative industry can be attributed to the competitive benefit of the corridor.

To aid comparison between industries, the ratio of the Competitive Benefit to Numeric Change has been calculated to standardize the amount of proportion of change in employment that can be attributed to the Competitive Benefit. It shows that Administrative has benefitted the most from being located in the half mile buffer, followed by the Information and Arts/Entertainment/Recreation industries, and that, despite massive employment increases, relatively little of the change in Health Care Employment can be attributed to a location within the corridor. The value for the Professional industry has been omitted as an extreme negative outlier.

The following chart shows the relationship between distance and competitive benefit. Distances are in ¼ mile (400m) increments. . Only industries with positive Competitive Benefits were included. Theoretically, if an industry responds positively to transit, the magnitude of the Competitive Benefit effect should decrease with distance.

ABOUT HERE: Fig. 5: Competitive Benefit by buffer distance, by selected industries.

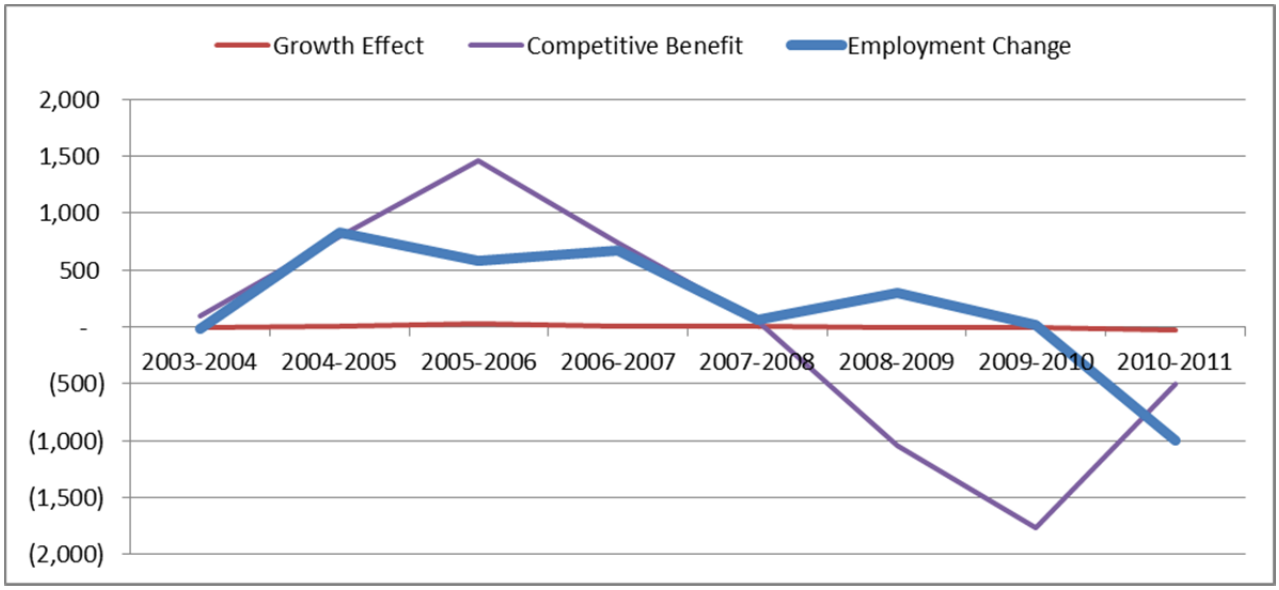


The Information and Arts/Entertainment/Recreation industries see the expected relationship, where the competitive benefit decreases with distance. Both the Education and Lodging/Food industries have a positive competitive benefit, but only within the first ¼ mile, or for areas directly adjacent to the Tacoma Link. Finally, the Administrative industry, indicated so strongly to be transit supportive by the earlier analysis, is actually revealed to be repulsed from transit. It seems likely that while it is correlated phenomenon, it is only because they share a common causal factor—a downtown location.

Dynamic Shift-Share

Dynamic shift-share re-evaluates the growth effect and industry mix for each time period, so it is more sensitive to shifts in conditions at a given point in time, rather than over a longer span of time. This propensity is important when economic conditions in the reference economy undergo dramatic changes that cause sudden changes in growth rates or the composition of the industry mix. As mentioned earlier, the long hallowed ½ mile buffer is used as the unit of analysis. Figure 6 presents the competitive benefit over time.

ABOUT HERE: Fig. 6: Competitive Benefit by period



As Figure 6 shows, total employment change in the years after the opening of the Tacoma Link is quite strong, and can largely be attributed to the competitive benefit of proximity, resulting in 1500 more jobs than would have otherwise existed. However, over time the competitive benefit declined, becoming negative by 2008. While employment gain continued into the next year, they too became negative over time. The relatively small growth effect strongly indicates that only a small amount of change in employment can be attributed to general growth in the metropolitan economy.

During the 2004-2005 period, the competitive benefit for the Health Care industry contributed the most to employment growth, adding over 1000 employees. In the 2005-2006 period, the competitive benefit affecting numerous industries, generating over 400 employees for in Administration and Public Administration. The competitive benefit for the Health Care, Education, and Lodging/Food industries also contributed to employment growth.

During the 2008-2009 time period, the Great Recession seriously affected employment in the corridor. A negative competitive benefit for Public Administration and Education indicates both were especially vulnerable. 2009-2010 was even worse, for Public Administration, resulting in over 1600 fewer jobs than might otherwise have been expected. The competitive benefit was strongly positive for the Administrative, Education and Public Administration industries in the 2010-2011 period, but not enough to overcome the vulnerabilities in Finance and Professional employment.

Discussion & Implications

Some of the economic development effects of the Tacoma LINK fail to reveal themselves in an analysis of employment, because many of the users of the Tacoma Link do not use it for commuting. Rather, they are tourists and visitors the stadium, convention center, theatres and museums which line the Tacoma LINK. While they require only a limited about of staffing, their economic impact is considerable. They also generate considering secondary activity in terms of lodging/food receipts.

Secondly, while shift-share can reveal the competitive benefit accorded by a location, it cannot determine the cause of that competitive benefit. While the Administration industry enjoyed a substantial competitive benefit within ½ mile of Tacoma LINK, it enjoyed an even larger one outside it, and through-out the downtown.

Finally, the competitive benefit resulting from proximity to the Tacoma LINK was not constant, but varied over time. When it comes to the built environment, the stock dominates. Barring the edge of the urbanized area, land use changes very slowly. Most areas near light rail stations are in already built urban land, typically badly depreciated. Fixed guideway transit projects are typically associated with redevelopment efforts. Adding transit improves accessibility, raising the value of a location, thus increasing rents. Increasing rents then spur either the rehabilitation or replacement of the existing building stock. The timescale at which each occurs depends on the type of the building stock near transit stations. Durable structures (such as offices) respond most quickly, followed by vacant lots and structures that can be treated as such. Mid-range structures with remaining marginal value tend to endure the longest, being incapable of being either torn down or rehabilitated. The mix of these three types of structures near transit strongly affects redevelopment conditions. A port city constructed prior to WWII, downtown Tacoma has an extensive stock of older, durable buildings. Locations with durable building stock tend to experience the more employment growth, as existing structure can be re-adapted to new uses. However, as that stock is exhausted, the capacity of the area to continue increasing employment is limited. Doing so requires new construction, and new construction both takes longer and is more expensive, making it riskier and requiring higher rent differentials to justify. Correspondingly, an extension is already being planned for Tacoma Link, to reach additional portions of the downtown and provide a fresh supply of newly accessible land.

This may or may not have the intended effect. In 2003, Tacoma LINK was the sole operating light rail system in the Seattle Metropolitan Area. After Tacoma LINK began operations, construction of the Central LINK light rail began, with revenue operations expected to begin in 2006 (later pushed back to 2009). The declining Competitive Benefit for proximity to Tacoma LINK may have resulted from competition from Central Link. A 13.9 mile line connecting downtown Seattle to Tukwila (and later SeaTac airport), its 13 stations offer better network connectivity than the Tacoma LINK.

As a caveat, there are about 500 (gross) acres of land within the half mile buffer of a transit station. As transit adjacent land represents such a small portion of the metropolitan total, the location decision (and performance) of a single large firm can significantly affect the employment outcome of a transit line. This

is especially true for such a short line as the Tacoma Link. Where the location of a single firm specialized in renal care significantly affected the total Health Care employment. Thus, care should be taken when generalizing these results, pending further research on the employment generating effects of additional transit lines.

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