Identification of BRT-Advantaged Age-group and Income level group by examining various BRT Cities

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Abstract

Bus Rapid Transit (BRT) has generated great interest among small and large cities across the United States (e.g., Detroit, MI, Grand Rapids, MI, and Aspen, CO) as a means of improving mobility and accessibility, and optimizing the use of street space, at a relatively modest cost per mile ($10-$27 million). The main advantage of BRT is its ability to operate on all types of road infrastructures: mixed-flow arterials, mixed-flow freeways, dedicated arterial lanes, at-grade or fully grade-separated transitways, managed lanes, and tunnels. The purpose of this study is to identify BRT-advantaged age-groups and income level groups by examining various BRT cities. A group or sector is said to be “BRT-advantaged” when its population grows at a higher rate within a BRT shed than within the larger metropolitan region during the same time period.
Shift-share analysis was conducted to identify various BRT-advantaged attributes. Shift-share analysis is used to decompose changes in an attributes (such as age-group and income level) in local areas. For example, the analysis identifies age groups that have comparative advantage in local areas. The technique provides a picture of how well a region’s income level group and age groups are growing at a given moment in time. As a part of this effort, age-group and income level data of five BRT cities were collected before and after the implementation of BRT at region and BRT-shed level. BRT-advantaged attributes by each city, as well as combined were identified. With the precedent of specific populations thriving in a BRT shed, communities and their planners can target the appropriate age and income level groups in their marketing efforts. The author discussed the causes behind the influence of BRT on the various population groups.

INTRODUCTION

Bus Rapid Transit (BRT) has generated great interest across the United Sates in recent years. Both small and large cities, including the metro Detroit region, are considering BRT as a means to improve mobility, accessibility, and effective use of street space, all at a relatively modest cost. This paper presents various BRT- advantaged attributes such as age-groups and income levels by examining a number of existing BRT systems.

This paper is intended to answer following BRT related inquires:

- Are there any BRT-Advantaged age groups ?
- Are there any BRT-Advantaged Income levels ?
- Are there any BRT-Advantaged job sectors ?
- Are BRT-Advantaged attributes uniform among various BRT cities?

What is BRT-Advantaged Attributes?

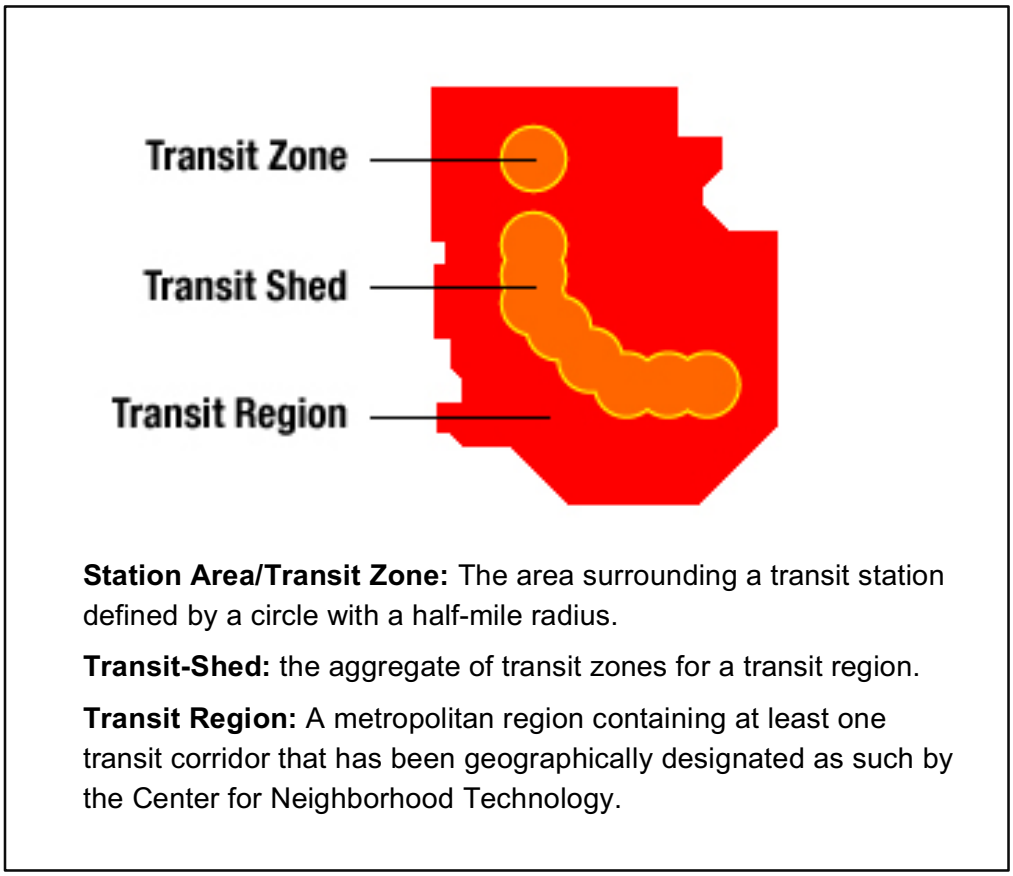
A BRT related attribute (including group or sector) is said to be "BRT-Advantaged" when its population grows at a higher rate within a BRT shed than within the larger metropolitan region during the same time period. BRT-shed and regions are defined in Figure 1. BRT-Advantaged attribute such as age groups can be established by comparing related data before and after BRT implementation. The first three questions investigate which groups of income level, job sectors, and age have experienced higher growth within BRT-shed compare to region. The last question examined the uniformity of "BRT-Advantaged" factor among various BRT cities. With this knowledge, communities and their planners can target the appropriate stakeholders in their marketing efforts.

Data Collection and Analysis

Data from before and after the opening the five BRT systems were analyzed to determine "BRT-Advantaged" group. In this context age groups and income level groups, data from the Center for Transit Oriented Development (CTOD)'s TOD database (http://toddata.cnt.org/index.php) for the years 2000 and 2010 of five existing BRT cities were collected. They are:

- Cleveland
- New York
- Los Angeles

- Eugene
- Kansas city



Source: (http://toddata.cnt.org/index.php)

Figure 1 Transit Zone, Shed, and Region Illustrated

Please note that Other than Kansas city (Light BRT system), remaining systems are heavy BRT. Light BRT shares road infrastructure with other traffic and costs approximately $1 million to $3 million per mile, whereas heavy BRT uses dedicated lanes and costs approximately $10 million to $27 million per mile. Related information of each system is presented in Table 1

Table 1. Various Features of Existing Five BRT Systems

Systems	BRT Type	Year of Operation	Number of Stations
Cleveland	Heavy	2008	36
Eugene	Heavy	2007	18
Kansas City	Light	2005	47
Los Angeles	Heavy	2005	18
New York	Heavy	2008	16

Data Analysis Method

Shift-share analysis is a well-established technique for disaggregating regional measures into component parts, but the literature review shows it has rarely been used in transit analysis [1]. Shift-share analysis is used to decompose increases or decreases in various attributes within a given area at two or more points in time. This technique identifies components of the changes that are attributable to regional influence, growth within the attribute (such as age group), or local influence (such as BRT-shed). The technique provides a picture of how a region's mix of industries, income level and age groups is changing within a given timeframe. This analysis decomposed the growth within an attribute for any transit-shed into three components:

- Regional share (RS)
- Age group mix (AM)
- Transit shed shift (TS)

Regional Share (RS) Component

RS is based on equation 1 and answers the following questions:

- What percentage of an attribute (such as age group, income level, job sectors, etc.) of class (i) within a specific BRT-shed (s) should change due to regional (r) growth during analysis period?
- If the BRT-shed's particular attribute (such as age group) grew at the same regional (r) growth rate, what would be the result?

$$RS_{is}^{t} = E_{is}^{t-n} \times \left(\frac{E_{r}^{t}}{E_{r}^{t-n}} \right) \qquad \text{(EQN 1)}$$

Where:

t = end of analysis period (year) t-n = start of analysis period (year)

i = specific age cohort group class s = specific BRT-shed

E_r^t = Sum of all age groups at end of the analysis period (t) for regional level (r)

E_r^{t-n} = Sum of all age groups at the start of the analysis period (t-n) for regional level (us)

E_{is}^{t-n} = Number of specific age group class (i) at start of the analysis period (t-n) for BRT-shed(s)

Attribute Group Mix (AM) Component

- Equation 2 defines the degree to which growth or decline of a specific attribute group class within a BRT-shed is due to changes in those populations in the larger metropolitan region.
- AM estimates the share of growth of the BRT-shed (s) attribute group class (i) that is due to regional (r) growth in attribute group class (i).

$$AM_{is}^{t} = E_{is}^{t-n} \times \left[\left(\frac{E_{ir}^{t}}{E_{ir}^{t-n}}\right) - \left(\frac{E_{r}^{t}}{E_{r}^{t-n}}\right)\right] \quad \text{(EQN 2)}$$

E_{ir}^{t-n} = Number of specific attribute group class (i) at start of analysis Period (t-n) for region (r)

E_{ir}^{t} = Number of Specific Attribute group class (i) at the end of analysis Period (t) for region (r)

BRT-Shed Shift (TS) Component

- TS is the growth in the attribute group class (i) in the BRT-shed due to attractiveness of the BRT. This residual volume is interpreted as uniqueness of BRT.
- Identifies the shed's leading and lagging attribute group class

$$TS_{is}^{t} = E_{is}^{t-n} \times \left[\left(\frac{E_{is}^{t}}{E_{is}^{t-n}}\right) - \left(\frac{E_{ir}^{t}}{E_{ir}^{t-n}}\right)\right] \quad \text{(EQN 3)}$$

E_{is}^{t-n} = Number of specific attribute group class (i) at start of analysis period (t-n) for shed (s)

E_{is}^{t} = Number of specific attribute group class (i) at the end of analysis period (t) for shed (s)

BRT-Advantaged Age group

Shift-Share analysis of age data of Kansas City is shown in Table 2. The 15–34 age group was identified as the BRT-Advantaged group. Again, an advantaged or leading age group is one for which the group's growth rate within the BRT shed is higher than its regional growth rate. Similarly, a lagging age group is one for which the group's growth rate within the BRT shed is less than its growth rate at the regional level. An assumption that was made for purposes of this analysis is that if BRT has no effect on a region's age group composition, it would be the same after implementation of BRT as it was before implementation. There may be factors other than introduction of BRT that occurred during that time that are more difficult to quantify.

Results of the Shift-Share analysis of age group data for other cities are presented in Table 3 and Figure 2. This table presents percent of growth due to BRT (similar to the last column of Table 2). Similarly to Kansas City, other BRT cities identified the 15-34 age group as BRT-Advantaged age group.

It should be noted that in the case of Kansas City, and other BRT cities, BRT was accompanied by changes in land policies that encouraged the 15-24 and 25-34 age group to live close to BRT. However, this action resulted in displacement of other age groups away from the BRT shed due to higher rent, noise, etc. The BRT Influence column in Tables 2 and 3 show that the growth of various age groups in the BRT shed was due to the introduction of the BRT. According to the AAA, from 2007 to 2011 the number of cars purchased by the 18-24 and 25-34 age group fell by almost 34%. Only 44% of teens obtain a driver license within the first year of their eligibility, and only 54% are licensed before the age of 18 [2]. A study by the University of Michigan's Transportation Research Institute (UMTRI) found that, in 2011, the 55–65 age group was 15 times more likely to purchase new vehicles than young millennials (ages 18–24); moreover, consumers 75 years and up have been buying cars at higher rates than those in the 18-24 and 25-34 age groups[3]. Although 18–24 year-olds rank lower in car ownership, they nonetheless travel for work, school, and recreation. From the experience of BRT cities, it can be stated that public transit is playing a role in this context. Transit planners should accommodate this trend when planning public transit systems and Transit Oriented Development (TOD).

BRT-Advantaged Income level

Shift-share analysis of Income level data for all five cities and combined data are presented in Table 4 and Figure 3 as staked chart. There is no clear winner. However, BRT's influence on people with annual income level over $45,000 is very significant. BRT-Advantage diminished when income level exceeds $200,000. Review of Table 4 and Figure 3 reveals that there is a higher percentage of wealthier people living within the BRT-shed compare to region. This phenomenon is known as Gentrification. According to PBS, Gentrification is a general term for the arrival of wealthier people in an existing urban district due to increase in rents and property values, and changes in the district's character and culture [4]. In other words, this process often results in the displacement of poor communities by rich outsiders. Policy makers should take preemptive action to minimize the gentrification impact. For example, as a part of approval process, a city may require a fixed percent of rental properties for low income residents.

BRT-Advantaged Job sectors

In order to identify BRT-Advantaged Job sectors, authors used Job sectors data of Nelson et.al [1]. This represents the job data of the BRT city, Eugene, Oregon. The growth in various job sectors in 2010 due to the influence of BRT is presented in Figure 4. Growth in the following job sectors within 0.5 miles of the BRT shed were positive. Job sectors were

- Retail trade
- Transportation
- Information
- Finance
- Management
- Administration

Table 2 Shift-Shift Analysis of Household Age Group for Kansas City (Light BRT) 2000–2010

Age Group	Region			BRT Shed			Reason for Change in Share by Age Group 2000–2010			
	2000	2010	Change	2000	2010	Change	Region Influence	Age Group Influence	BRT Influence	% Growth Due to BRT
15-24	38,380	35,928	-2,452	1,344	1,465	121	1,500[a]	-241.9[b]	206.9[c]	14.1
25-34	130,110	135,977	5,867	3,060	3,751	691	3,415	-217.3	553.0	14.7
35-44	165,222	146,198	-19,024	2,173	1,836	-306	2,425	-502.5	-86.8	-4.7
44-54	141,246	167,930	26,684	1,976	1,896	-80	2,205	143.9	-453.3	-23.9
55-64	89,164	136,775	47,611	1,097	1,826	729	1,224	458.4	143.2	7.8
65-74	67,855	79,455	11,600	842	890	48	939	46.3	-96.1	-10.8
74-84	47,736	51,226	3,490	728	542	-186	812	-31.3	-239.2	-44.1
85+	14,766	21,604	6,838	331	232	-99	369	114.8	-252.3	-0
Total	694,468	775,093	80,625	11,551	12,438	887	12,892	-229.4	-224.6	-1.8

Source: Compiled from http://toddata.cnt.org/index.php[i]

Notes:

[a] **=** (Number in age group class (shed) in year 2000) *(Total region age group in 2010/ Total Region age group in 2000) = 1344*(775,093/694,468) =1,500 (Equation #2)

[b] = (Number in age group class (shed) in year 2000)*(Number in age group class (region) in 2010/Number in age group class (region) in 2000) – a = 1,344 *(35,928/38,380)-1,500 = -241.9 (Equation #3)

[c] = (Number in age group class (shed) in year 2000)*(Number in age group class (shed) in 2010/Number in age group class (shed) in 2000)-a-b = 1,344*(1,465/1,344) - 1,500 – (-241.9) = 206.9 (Equation 4)

Table 3. Percent Growth Rate of Various Age Group due to BRT in Year

Age Group	Percent growth due to BRT in Various BRT Cities in 2010					
	Los Angeles	Kansas city	Eugene	Cleveland	New York	Combined
15-24	6.1238946	14.991429	4.568242	18.532128	6.123895	3.9
25-34	10.4170213	4.4525945	0.976132	19.421791	10.41702	9.1
35-44	2.74371829	-8.7288945	-3.70	-22.95854	2.743718	2.8
45-54	-56.194537	-25.730915	0.389114	-6.969853	-56.1945	-8.0
55-64	7.29259346	7.7487435	-1.49929	-17.43839	7.292593	-90.9
65-74	-8.600753	-15.486648	0.80	-32.02278	-8.60075	7.7
75-84	-15.494294	-47.912233	-12.7	-10.01003	-15.4943	-5.6
85+	-9.8189195	-93.301301	-35.7748	-59.87588	-9.81892	-25.5

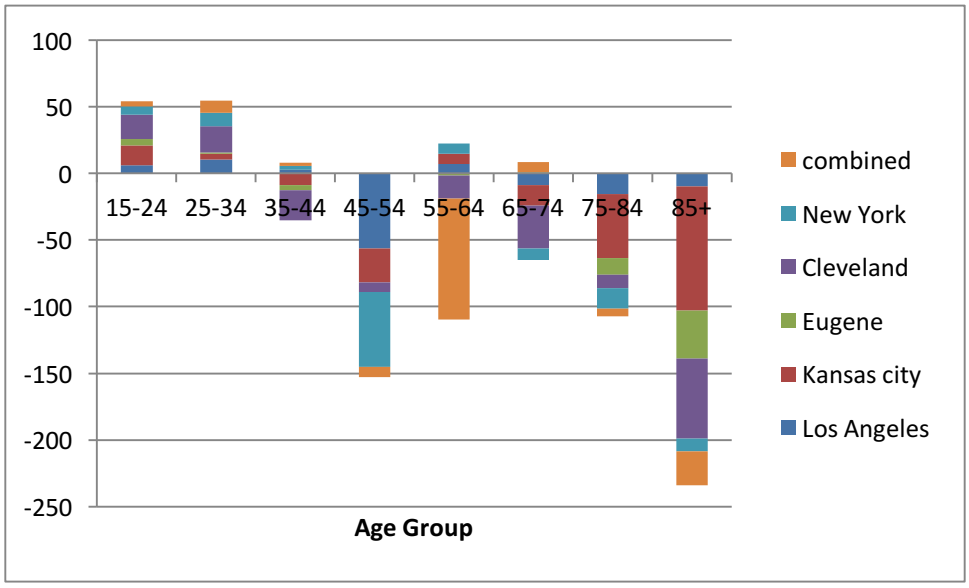


Figure 2. Staked Chart of Percent growth due to BRT

Table 4. Percent growth due to BRT in Various BRT Cities between 2000-2010

Income Level	Percent growth due to BRT in Various BRT Cities in 2010					
	Los Angeles	Kansas City	Eugene	Cleveland	New York	Combined
Less Than $10,000	-18.0975	2.672031	24.09338	1.821426	-1.98077	0.003837344
$10,000 - $14,999	-4.52105	-27.171	11.2382	-18.0034	3.092332	-0.643836505
$15,000 - $19,999	-9.90281	-11.4079	-13.6215	-3.69729	3.463892	4.004824435
$20,000 - $24,999	-8.29641	-10.4091	-5.34793	-3.58162	1.152922	1.061128923
$25,000 - $29,999	-9.75508	-11.912	16.24341	13.0912	0.741118	-1.456211588
$30,000 - $34,999	-12.9072	-1.03027	9.215609	28.23308	3.25634	1.880544428
$35,000 - $39,999	-12.9976	-2.90569	24.67026	23.85548	5.943294	2.456395116
$40,000 - $44,999	-0.38005	13.36945	-31.9635	18.86554	6.312839	1.599118007
$45,000 - $49,999	-4.00683	16.45349	10.22586	35.21725	9.07956	5.423715293
$50,000 - $59,999	27.61584	-3.58326	7.320911	17.63048	8.775263	6.093254279
$60,000 - $74,999	14.78984	5.014226	-20.2911	43.02223	14.25775	9.491436175
$75,000 - $99,999	19.73437	6.067765	-9.42081	-7.62888	16.13816	10.97162343
$100,000 - $124,999	15.1203	-6.51945	4.878932	28.20933	11.7923	6.338398531
$125,000 - $149,999	-8.66489	7.577944	29.70072	41.74808	8.64706	2.728373972
$150,000 - $199,999	12.83658	13.67249	38.98468	-52.872	3.572415	-1.673728008
More Than $200,000	-9.08345	3.875088	-4.94009	2.308644	-0.80356	-0.95087265

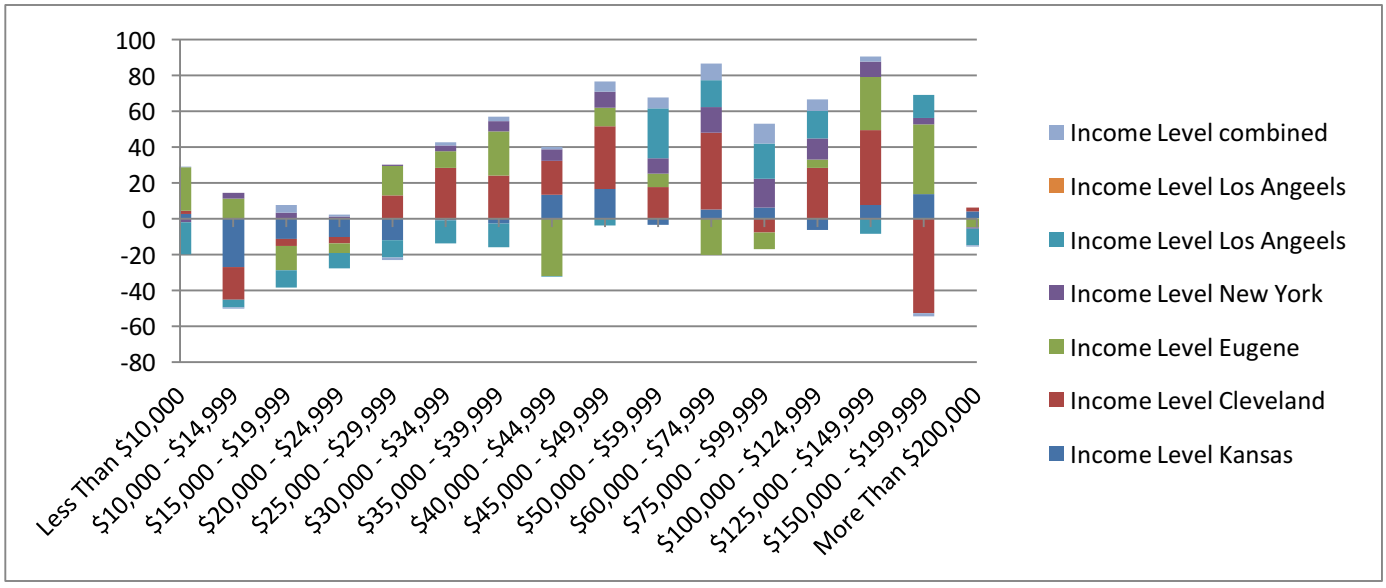


Figure 3. Shift-share analysis of Income Level data of Various BRT Cities (BRT influence growth)

BRT-Advantaged Job sectors

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- Retail trade
- Transportation
- Information
- Finance
- Management
- Administration

However, this growth in particular job sectors was realized at the expense of a number of other job sectors, namely Public administration, Healthcare, and others. These findings are similar to the findings of Center for Transit Oriented Development (CTOD 2014) for transit [5]. According to CTOD, in 37 transit sheds, a total of 29 percent of workers are employed in Knowledge-based sectors which include Information, Finance & Insurance, Real Estate and Management. While planning a BRT system, Regional Transit Authority (RTA) as well as city officials should act with due diligence.

Conclusions:

In this study Age group, income level and job sector data of a number of BRT regions as well as BRT sheds were analyzed to identify BRT-Advantaged groups or sectors. The authors attempted to relate the findings of this study with Gentrification, car ownership trend of younger people, and other factors. As a part of the planning process, officials should examine the impact of BRT-Advantaged sectors to envision their future community in which to live, work, and raise a family.

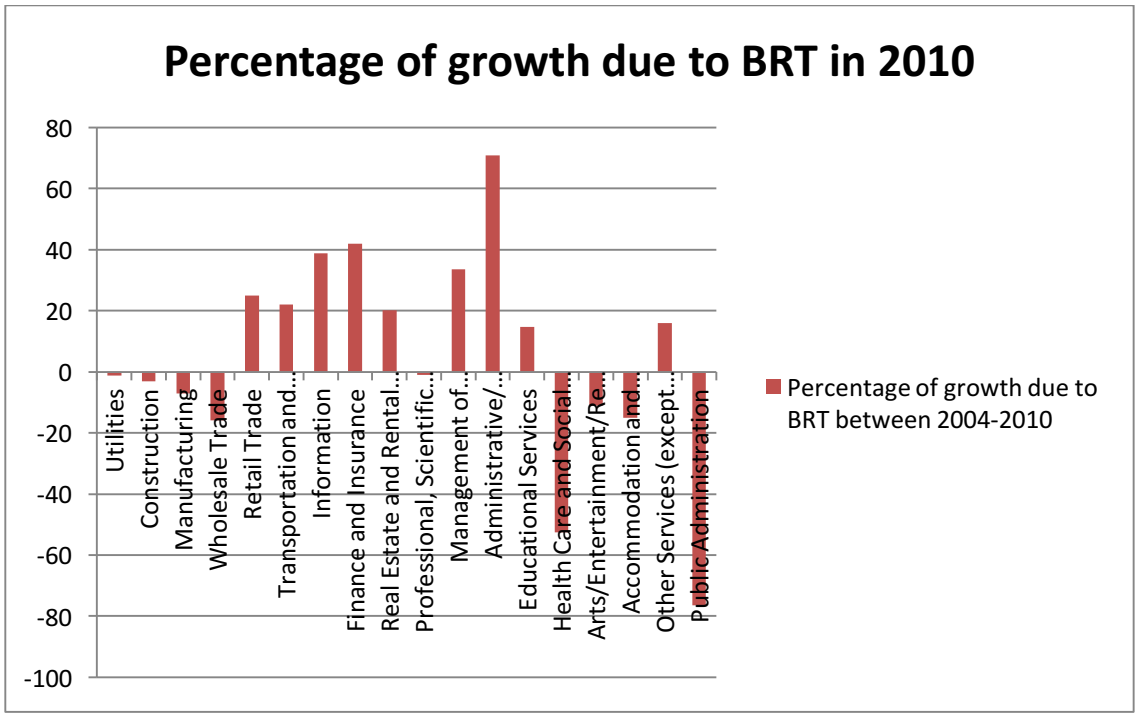

Figure 4. Display of BRT-Advantaged Job Sectors

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