Review of Miami-Dade Transit Corporate Discount Program, Price Elasticity, and the Effects of Gas Price Changes on Bus Ridership

Introduction

Miami-Dade Transit (MDT) has been making a number of efforts to enhance its operational performance. A new Metro line has been added and old buses are being replaced with new ones. Nevertheless, there are still concerns relating to how MDT could further improve its performance in terms of ridership. As a result, the Office of the Commission Auditor (OCA) reviewed and analyzed some aspects of MDT operational programs to assess the possibility of increasing its ridership. This report summarizes the results of our work. Specifically, in our review and analysis, we covered the following:

- We compared the performance of MDT's Corporate Discount Program (CDP) with similar programs of other transit systems to determine whether MDT needs to make some improvements in order for its CDP to compare favorably with those of its peers;
- We performed an analysis of the effects of transit fare changes (Price Elasticity) on transit system ridership to see whether MDT could increase ridership by reducing fares, without a negative impact on its total operational revenue; and
- We reviewed industry studies on the effects of gas price changes on transit system ridership; and we analyzed the changes in MDT's bus ridership from October 1, 2012 through July 31, 2015 in the light of decreasing gas prices.

Background

MDT is the 15th largest public transportation system in the United States. As part of the Transportation Strategic Area, MDT provides approximately 28.9 million miles of Metrobus annual service, 95 routes with a fleet of 713 full-sized buses, 25 articulated buses, and 77 minibuses. MDT's system also includes a 25-mile dual elevated Metrorail track, a 20-mile Bus Rapid Transit (BRT) line that is among the longest in the United States, and a 4.4-mile dual elevated Metromover track. In addition, MDT provides Special Transportation Services (STS) to eligible participants. The transit system serves a population of approximately 2.6 million residents of Miami-Dade County (County). Currently, MDT averages a total daily boardings of approximately 326,000 (*approximately 12.5 % of the County's population*).

MDT's Corporate Discount Program

In 1986, MDT implemented the Discount Group Corporate Metropass Program to encourage employees to use public transportation for the purpose of commuting. In 2007, the program was rebranded as the CDP. Since its inception, the corporate program has been attracting employees. MDT's CDP currently offers a discount of ten percent to employers having between four and 99 participating employees, and 15% to having 100 or more participants. As of May 2015, about 200 employers in the County offered the CDP to their employees as part of their benefits package, including the University of Miami, Baptist Health Trust, Intercontinental Hotel, and Jackson Memorial Hospital. Over 12,000 employees are currently enrolled in the program through those employers. The program has generated an average of $9 million for the past three years (2012-2014). Although the CDP has been fulfilling its intended purposes, improving the program to attract more businesses to participate will extend its benefits to more employees, and generate increased ridership and revenue for MDT.

Results
The results of our review of the CDPs are summarized in Attachment I and detailed below:

Miami-Dade Transit (MDT)
- Average revenue for three years, $9,116,426.
- Average number of passes sold for three years, 11,478.
- Number of participating businesses, 200.
- Number of participating employees, 12,000.

San Diego Transit System (SDTS)
- Average revenue for three years of $1,751,374 is lower than MDT's by $7,365,052.
- Average number of passes sold for three years of 24,333 is higher than MDT's by 12,855.
- Number of participating businesses of 23.(*Please, see note 1*) [1]
- Number of participating employees of 4,349 is lower than MDT's by 7,651.

DALLAS Rapid Transit System (DRTS)
- Average revenue for three years of $9,933,042 is higher than MDT's by $816,616.
- Average number of passes sold for three years of 17,175 is higher than MDT's by 5,697.
- Number of participating businesses of 220 is higher than MDT's by 20.
- Number of participating employees of 19,000 is higher than MDT's by 7,000.

Metropolitan Atlanta Transit Authority (MATA)
- Average revenue for three years of $15,500,000 is higher than MDT's by $6,383,574.
- Average number of passes sold for three years of 10,500 is lower than MDT's by 978.
- Number of participating businesses of 257 is higher than MDT's by 57.
- Number of participating employees of 10,000 is lower than MDT's by 2,000.

Overall, MDT's CDP appears to be quite similar to most of the other programs in terms of the results produced. However, it appears to have underperformed in comparison to the other three peers in terms of the average passes sold expressed as a percentage of the total population served. MDT serves a population of 2.66 million and sold an average of 11,478 CDP passes (0.43%); SDTS serves a population of 3.26 million and sold an average of 24,333 passes (0.75%); DART serves a population of 2.52 million and sold an average of 17,175 passes (0.68%); MATA serves a population of approximately one million and sold an average of 10,500 CDP passes (1.05%). MDT's ability to encourage more employers to participate in its CDP will certainly enhance its performance comparatively.

Price Elasticity Considerations in Fare Adjustments
To encourage more employers to participate in the CDP, MDT could implement a reduction in fare, as it is generally assumed that demand can be enhanced by lowering price. Nevertheless, such decision could lead to a loss of revenue; and the gain in ridership may be insignificant. Hence, the need to consider the Price Elasticity (PE) of MDT's ridership.

PE focuses on how changes in price affect demand. It is a measure of the variations recorded in demand as a result of changes in price. Economists believe that there is a relationship between changes in price and changes observed in demand. A change in price may or may not have an impact on demand. When a change in price causes an impact on demand, the impact could be large,

[1] We did not compare the number of participating businesses for SDTS with that of MDT because the number 23 includes a business association that purchases passes on behalf of an undisclosed number of member businesses.

proportional or small. The degree to which a change in price affects demand determines whether demand is *perfectly inelastic*, *unitarily elastic* or *perfectly elastic*.

If demand does not change when price changes, demand is said to be *perfectly inelastic* (i.e. the PE of demand is equal to zero). PE values between zero and 0.99 indicate that demand is *inelastic*. This occurs when the percent change in demand is less than the percent change in price. If the percent change in demand is equal to the percent change in price, demand is *unitarily elastic* (PE of demand equals one). Finally, if the percent change in demand is greater than the percent change in price, demand is considered to be *perfectly elastic* (PE of demand is greater than one)[2].

Determining the impact of a change in price on the demand for a particular service or commodity involves the use of some complex mathematical formulas. MDT, however, simplifies the calculation process by applying a common and highly simplified model using data provided by the American Public Transportation Association (APTA). APTA's data assumes that for every ten percent increase in a given fare rate for any transit mode, a corresponding 3.6% decrease in ridership is obtained. The relationship between the 3.6% decrease in ridership and the ten percent increase in fare rate ((-3.6%/10%)=-0.36) is called the *Midpoint Elasticity Constant (MEC)*, a value that falls within a range typical of transit applications.

MDT applies the MEC to a model that uses variables such as old fare, newly discounted fare and total current number of riders per category of riders to anticipate changes in ridership. The model is expressed as follows.

R = [{(MEC-1) x (CF x CRC)} – {(MEC+1) x (NDF x CRC)}] / [{(MEC-1) x NDF}-{(MEC+1) x CF}]

Where:

R = Ridership for a given category of riders;
MEC = Midpoint Elasticity Constant;
CF = Current Fare;
CRC = Current Ridership per Category; and
NDF = New Discounted Fare.

The current level of MDT's ridership for the CDP, by group categories, is detailed in *Table I* below.

Table I
MDT Corporate Discount Program Users as of August 2015

	Groups of 4 to 99	Groups of 100 and above	Total
Number of Users	2,845	5,194	8,039
Number of Companies	159	10	169
Percent of Discount	10%	15%	N/A

Source: MDT

It is important to note that formulas for short-term elasticity are not exact, and that losses or gains in a given commodity or service as a result of increases or decreases in prices are approximations based both on simplified assumptions and on empirical data.

[2] http://www.investopedia.com/terms/priceelasticity.asap

Using MDT's model, we created three different scenarios (as detailed in *Table II*). In Scenario 1, we further discounted the standard fare ($112.5) by 20% and 25% respectively for groups of four to 99 (Category A) and groups of 100 and above (Category B) *(the two categories of rider groups that are currently receiving corporate discount of ten percent and 15% respectively)*. The higher discount rates of 20% and 25% generate a total ridership levels of 2,968 and 5,433 respectively. This produced a combined total of 8,401 riders (***an increase of 362 over the current ridership level of 8,039***). There is, however, ***a total decrease of $59,201*** from the current revenue figure of $784,758 to a new revenue figure of $725,557.

In Scenario 2, we further discounted the standard fare for the two categories of rider groups (Categories A and B) by 25% and 30% respectively. The higher discount rates of 25% and 30% generate a total ridership levels of 3,037 and 5,569 respectively. This produced a combined total of 8,606 riders (***an increase of 567 over the current ridership level***). However, there is a ***total revenue decrease of $89,937***.

In Scenario 3, we further discounted the standard fare for the two categories of rider groups (Categories A and B) by 30% and 35% respectively. The higher discount rates of 30% and 35% generate a total ridership levels of 3,113 and 5,718 respectively. This produced a combined total of 8,831 riders (***an increase of 792 over the current ridership level***). Again, there is a ***total revenue decrease of $121,452***.

Table II
Fare Changes Comparison

	Current	Scenario 1	Scenario 2	Scenario 3
Midpoint Elasticity Constant	0	-0.36	-0.36	-0.36
Standard Fare (per month)	$112.5	$112.5	$112.5	$112.5
Discounted Fares:				
Group with 4 to 99 employees (*A1*)	$101.25	$90.00	$84.38	$78.75
Percent of Discount (%)	*10%*	*20%*	*25%*	*30%*
Group with 100 plus employees (*B1*)	$95.63	$84.38	$78.75	$73.13
Percent of Discount (%)	*15%*	*25%*	*30%*	*35%*
Number of Riders:				
Group with 4 to 99 employees (*A2*)	2,845	2,968	3,037	3,113
Group with 100 plus employees (*B2*)	5,194	5,433	5,569	5,718
Total Riders	***8,039***	***8,401***	***8,606***	***8,831***
Revenues:				
Group with 4 to 99 employees (*A1 x A2*)	$288,056	$267,120	$256,262	$245,149
Group with 100 plus employees (*B1 x B2*)	$496,702	$458,437	$438,559	$418,157
Total Revenues	***$784,758***	***$725,557***	***$694,821***	***$663,306***
Change in Revenues	0	$(59,201)	$(89,937)	$(121,452)
Change in Number of Riders	0	362	567	792

The above results show that the more we increase the discount rates, the larger the amount of decrease in fare revenue.

Based on our analysis, it would not be financially beneficial to the County to further discount the present corporate fare rates for the purpose of increasing the ridership level. However, to the extent that the County is willing to encourage more ridership for MDT through the CDP by a way of subsidy (revenue decrease), a fare reduction could be implemented. In addition, MDT may also be able to increase ridership by enhancing the quality of its service delivery. Experts in transit systems agree that this factor can play a significant role in enhancing ridership as much as fare discounts.[3]

Effects of Gas Price Changes on Transit Bus Ridership

Fluctuations in gas prices is one of the external factors that can affect ridership in all modes of transit (including bus, commuter rail, light rail and heavy rail).

Several studies have shown that there are a number of conditions that influence the effects of gas price changes (Gas Price Elasticity) on transit ridership. Such conditions include, but are not limited to:

- Whether a given rider has the option to either drive or take public transit for his or her trip;
- The effect of a gasoline price increase on the generalized cost of making a trip;
- The type of transit mode;
- Trip purposes;
- The duration of the gas price change; and
- The range within which gas price falls before and after the change.

For individuals who do not own personal vehicles, travel behavior is less likely to be affected by gas prices. On the other hand, those who own personal vehicles are potentially transit riders by choice. For a change in gas price to cause a shift in travel modes, the effect of the gas price change (increase/decrease) on the generalized cost of making a trip must be substantial. For this reason, individuals traveling long distances may be more sensitive to gas price changes. Transit riders' sensitivity to gas price changes also varies among transit modes – bus riders who own personal vehicles are more likely to utilize the transit system for financial reasons than their rail riders counterparts. Such bus riders are likely to be more sensitive to changes in gas price.

Further, transit ridership sensitivity to gas price changes varies by trip purposes (work, school, leisure, shopping, or holiday related). Riders having work related trips are more sensitive to gas price changes (*because of the aggregate effect of the change on their budget*) than riders with leisure or shopping related trips. The duration of the gas price changes also influences how riders react to changes. For instance, it is less likely that riders will change travel mode in response to a gas price change that does not last for more than a few days. Lastly, the range within which the gas price falls before and after the price change also influences how riders respond to such changes. According to a 2014 study titled, *Net Effects of Gasoline Price Changes on Transit Ridership in U.S. Urban Areas* by the Minnesota Transportation Institute, the elasticity value (magnitude of impact) of gas price changes on ridership varies, depending on the percent of the change and whether or not the $3 or $4 (gas price) mark is crossed after the price change, as explained below.

The study considers the magnitude of the impacts of gas price changes for different gas price ranges (below $3; from $2.90 to a little above $3; and between $3 and $4) at different percent of increase (five, ten, and 20 percent). For transit bus ridership, the effect of price change for gas price below $3 is positive but very small. When gas price increases, crossing the $3 mark (*no matter how little*

[3] FSUTMS Mode Choice Modeling: Factors Affecting Transit Use and Access.

above $3), the effect on ridership increases significantly. Further, the effect becomes even higher for increase in gas price within the $3 - $4 price range. The results of the study that relate to bus ridership is shown in *Table III* below. The table shows the non-constant effects of gas price changes on bus ridership.

Table III

Non-Constant Effects of Gas Price Changes on Bus Ridership

Gas Price (GP)	Percent Increase in Ridership
For a 5% increase in GP	
GP below $3	0.14 %
GP crossing the $3 mark (from $2.90)	0.36 %
GP within the $3 - $4 range	0.85 %
For a 10% increase in GP	
GP below $3	0.27 %
GP crossing the $3 mark (from $2.90)	1.17 %
GP within the $3 - $4 range	1.67 %
For a 20% increase in GP	
GP below $3	0.52 %
GP crossing the $3 mark (from $2.90)	2.72 %
GP within the $3 - $4 range	3.23 %

The above table shows that when gas price is below $3, bus ridership increases by 0.14%, 0.27%, and 0.52% for a five, ten, and 20 percent increase in gas price respectively. When gas price crosses the $3 mark, ridership increases by 0.36%, 1.17%, and 2.72% for a five, ten, and 20 percent increase in gas price respectively. And when gas price is within the $3 - $4 range, ridership increases by 0.85%, 1.67%, and 3.23% for a five, ten, and 20 percent increase in gas price respectively. The effect on ridership is reversed for a gas price decrease (*i.e. a decrease in gas price leads to reduction in ridership*). It must be noted, however, that studies have shown that a decrease in gas price does not discourage transit use as much as an increase in gas price encourages ridership. Hence, the percent reduction in ridership for the above scenarios would be lower for a decrease (*rather than an increase*) in gas price.

There are many factors (*including fare increase or decrease; vehicle revenue miles – the miles that vehicles are scheduled to or actually travel while in revenue service; frequency of service, quality of service, and gas price changes*) that influence the increase or decrease in transit ridership. Explaining the aggregate ridership increase or decrease in a given transit system would require the decomposition of the aggregate number by the effects of any of the aforementioned factors that are applicable in a given period.

With regard to how changes in fuel price affect MDT specifically, we compared the bus ridership for FY 2012-13, 2013-14, and the ten months (up to July) of 2014-15 as shown in *Table IV*. The

national average gas (regular) price for 2013 and 2014 were $3.49 and $3.37[4] respectively (*approximately 3.44% decrease*). MDT bus ridership for FY 2012-13 and 2013-14 were 78,383,965 and 76,842,660[5] respectively (*approximately 1.96% decrease*). A decrease of 1.96% in MDT bus ridership for a 3.44% decrease in gas price appears to be higher than what one would expect (*no more than 0.85% decrease, given the results of the study shown in table III on prior page*). However, this difference between the actual ridership decrease of 1.96% and the 0.85% would be partly explained by the additional effects of a 12.5% fare increase that was implemented by MDT effective October 1, 2013 - when MDT increased Metrorail/ Metrobus one-way fare from $2 to $2.25[6]. The fare increase of 12.5% by itself could have reduced bus ridership by at least 3.6% (going by the APTA data that assumes a 3.6% decrease in ridership for every ten percent increase in fare).

For the ten months period (October 1, 2014 through July 31, 2015), MDT bus ridership was 60,939,388, compared to the 64,213,113 for the corresponding period in prior year (*a decrease in ridership of 5.09%*). The national average gas price as of July 2015 was $2.67, compared to $3.37 for 2014 (*a decrease of approximately 20.77%).* Working by the research results in *Table III*, a 20.77% decrease in gas price would have been expected to have no more than a 2.72% decrease in bus ridership (*holding all other variables constant*) . The difference between the actual decrease of 5.09% and the expected decrease of 2.72% may be associated with other factors that influence transit ridership, including the fare increase of 2013.

Table IV
Changes in MDT Bus Ridership from Fiscal Year 2012-13 through July 2015

	Fiscal Year		Increase/ (Decrease)	Percent of Change
	2012-13	2013-14		
National Average Gas Price	$3.49	$3.37	($0.12)	3.44%
Bus Ridership	78,383,965	76,842,660	(1,541,305)	1.96%
	2013-14 (up to July)	2014-15 (up to July)	Increase/ (Decrease)	Percent of Change
National Average Gas Price	$3.37	$2.67	($0.70)	20.77%
Bus Ridership (*for ten months*)	64,213,113	60,939,388	(3,273,725)	5.09%

In conclusion, since the changes in gas prices are outside the control of MDT management, it would be expedient for the management to leverage other internal factors, including vehicle revenue miles, frequency and quality of service to improve and sustain transit ridership.

[4] http://fuelgaugereport.aaa.com/gas-facts/
[5] MDT Ridership Technical Reports : http://www.miamidade.gov/transit/ridership-technical-reports.asp
[6] http://www.miamidade.gov/transit/fares-oct-2013.asp

THIS PAGE INTENTIONALLY BLANK

Attachment I

Transit Fare Corporate Discount Program Analysis

County	County Population	Number of Passess Required to Obtain Discount	Number of Employees Required	Discount Granted	Standard Fare (Per Month)	Discounted Fare	Average Fare Revenue for 3 Years (2011-2014)	Average Number of Passes Sold for the Last Three Years	Number of Participating Businesses	Number of Participating Employees as of May 2015
SANDIEGO TRANSIT SYSTEM	3,263,431	300 -1200	25 - 100	10%	$72.00	$64.80	$1,751,374	24,333	*** 23	4,349
		1,212 - 4,800	101 - 400	20%	$72.00	$57.60				
		4,812 Plus	401 Plus	25%	$72.00	$54.00				
MIAMI DADE TRANSIT	2,662,874	No Minimum	4 - 99	10%	$112.50	101.25	$9,116,426	11,478	200	12,000
		No Minimum	100 Plus	15%	$112.50	95.65				
DALLAS RAPID TRANSIT	2,518,638	* 11 Minimum	No Minimum	25%	$80.00	$60.00	$9,933,042	17,175	220	19,000
		** 5 Minimum	No Minimum	25%	$960.00	$720.00				
METROPOLITAN ATLANTA TRANSIT AUTHORITY	996,319	0 - 49	No Minimum	0%	$95.00	$95.00	$15,500,000	10,500	257	10,000
		50 - 149	No Minimum	3%	$95.00	$92.15				
		150 - 1,999	No Minimum	5%	$95.00	$90.25				
		2,000 - 2,999	No Minimum	7%	$95.00	$88.35				
		3,000 - 5,999	No Minimum	8%	$95.00	$87.40				
		6,000 - Plus	No Minimum	10%	$95.00	$85.50				

Notes:

* The 11 Minimum is a requirement for monthly pass program.

** The 5 minimum is required for the yearly pass. The 960 and the 720 respectively, are the yearly standard and discounted fares.

*** The Downtown Business Center in San Diego (one of the 23 participating businesses shown on the table) purchases passes on behalf of member businesses. The number of those member businesses is undisclosed.