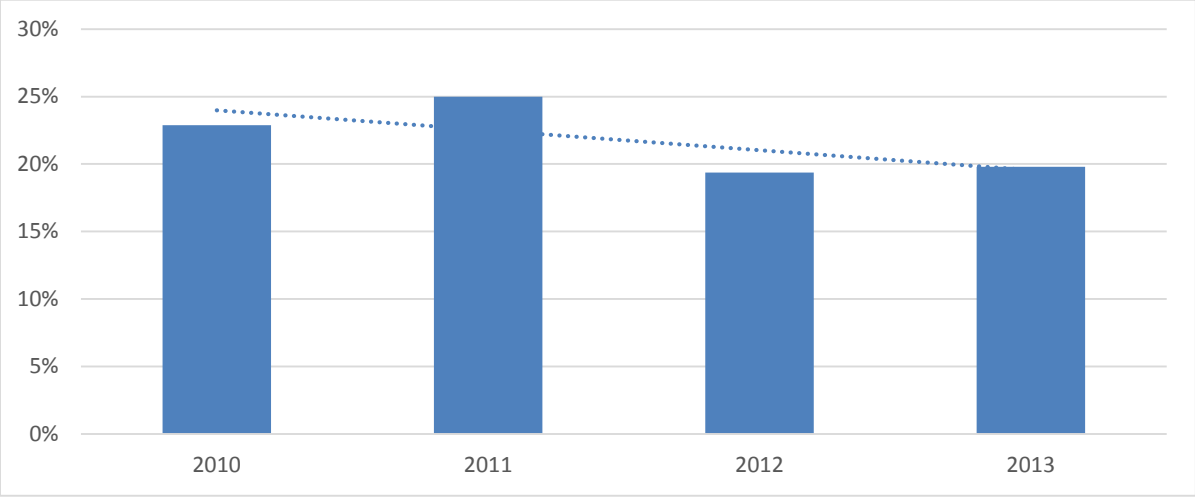
Memo

Potential Impact of Modifications to Circulator Fares on Ridership, Revenue, & Costs

Background

The purpose of this memo is to project the effects revised Circulator fares would have on overall ridership and fare revenue. In FY2015, the DC Circulator will embark on the first phase of a major service expansion, making this an opportune time to explore changes to the Circulator fare structure. Currently riders pay a $1.00 fare to ride the service regardless of whether they pay with cash or by SmarTrip Card. Fares have remained flat since the Circulator launched in 2005, effectively meaning that fares today are worth 25% less than they were 9 years ago because of inflation. Cost recovery in the system has declined over time; between 2011 and 2013 fare box recovery declined 20 percent, from a peak of 25 percent in 2011 to 20 percent in 2013. (See Figure 1).

Figure 1: Cost Recovery Ratio by Year



Due to additional discounts available for transfers, seniors, persons with disabilities, children, and students, the system receives on average $0.61 per trip paid by SmarTrip and $0.82 per trip paid with cash. The price differential is due to a higher portion of discount fares being paid by SmartTrip rather than cash.

Four different fare scenarios were tested, including:

Scenario One:	Free cash and SmarTrip fares
Scenario Two:	$1.50 SmarTrip and $2.00 cash fare
Scenario Three:	$1.75 SmarTrip and $2.00 cash fare
Scenario Four:	$2.00 SmarTrip and $2.00 cash fare

Methodology

The impact of fare changes on ridership and revenue is most often measured through *fare elasticity.* Elasticity measures the price sensitivity of demand for a product. An elasticity of -1 means that on average, every 1% increase in price there is a corresponding 1% decrease in demand. While there is extensive literature on transit fare elasticity, there is no universal standard relationship between fare increases and corresponding decreases in ridership. Studies have shown that factors such as city size, type of commute, and length of trip all impact elasticity. Overall, transit tends to be an inelastic good, meaning that ridership declines by a smaller percentage than price increases. Most national studies have placed fare elasticity at around -0.34, while studies specific to Metrobus have estimated a lower regionally specific elasticity of between -0.22 and -0.27. Elasticity values represent the midpoint slope of an arc; plotted on a graph elasticity follows a curve with small changes in fares having a smaller marginal impact on ridership than large fare increases or decreases.

Two fare elasticity rates were used in this analysis. The first, -0.245 is based on the observed fare elasticity rate of Metrobus[1]. This rate is used by all scenarios where fares do not exceed Metrobus's approved FY15 fare of $1.75.

Scenario 1 is in many ways the hardest of the four scenarios to estimate the ridership impacts. Only a limited number of North American systems have experimented with free fares and their experiences widely differ[2]. It was decided to apply -0.245 as the fare elasticity because it best reflects local conditions.

In instances where fares were increased to $2.00, more than Metrobus's approved FY15 fare of $1.75, fare elasticity was estimated to be -0.34, the observed mean elasticity nationwide[3]. This higher rate was selected because presumably some riders may switch to overlapping Metrobus services if Circulator fares are no longer cost-competitive.

Table 1: Elasticity Rates by Scenario and Fare Type

Scenario	SmartTrip Elasticity	Cash Elasticity
Scenario One: Free cash and SmarTrip fares	-0.245	-0.245
Scenario Two: $1.50 SmarTrip and $2.00 cash fare	-0.245	-0.34
Scenario Three: $1.75 SmarTrip and $2.00 cash fare	-0.245	-0.34
Scenario Four: $2.00 SmarTrip and $2.00 cash fare	-0.34	-0.34

[1] Based on mean value of elasticity range of -0.22 to -0.27, WMATA, *Finance & Administration Committee Information Item III-A*, February 27, 2014
[2] TCRP Synthesis – 101 *Implementation and Outcome of Free Fare Transit*, p10.
[3] Ibid.

The analysis is based on an estimated FY2015 ridership that reflects the current fare structure. Baseline ridership includes all current and proposed routes except for a new route serving NoMa and the National Mall route. The route serving NoMa was excluded because the route has not been finalized, while the National Mall route was excluded because ridership characteristics will be significantly different from the other routes. The National Mall route's anticipated high ridership could skew the results of this fare elasticity exercise. Moreover, since the ridership profile of the route will differ substantially from the other routes (tourist and leisure focused), the route likely would have a different overall fare elasticity.

The baseline ridership was broken down by whether riders paid with a SmarTrip card or cash. The breakdown was assumed to be static and is based on the current proportion of 83% of trips paid by SmarTrip and 17% by cash.

Once ridership was calculated by fare type, revenue estimates were produced by multiplying fare type ridership by the average anticipated fare. Due to additional discounts available for transfers, seniors, persons with disabilities, children, and students, Circulator receives on average 61% of the full fare per trip when paid by SmarTrip and 82% or the full fare when paid with cash.

Calculating Operating Cost and Peak Vehicle Needs:

For this analysis, additional calculations were performed for Scenario 1 (free fares) to determine the peak vehicle needs and operating cost impacts of eliminating fares. Additional ridership can impact Circulator's operating costs if higher ridership requires the service to operate more buses to meet demand. Ridecheck data collected in 2013 was utilized to determine how much additional Circulator service is needed. The data provides the average hourly maximum passenger load on weekdays, Saturday, and Sunday for each route. These loads were increased by the expected growth in ridership and compared to maximum recommended load to determine if a route is overcrowded. For this exercise, the maximum load factor is defined as 1.5, meaning buses are considered at capacity if they are carrying 50% more passengers than the available seating (48 passengers for a 40 foot Van Hool bus with 32 seats). As every additional hourly trip decreases average hourly maximum loads by 0.167, the load factor could be utilized to calculate how many additional trips and peak period buses are needed.

This analysis was only performed for Scenario 1. As existing services operate with 10 minute headways, a decrease in passengers would result in lower load factors but would not cause a measurable decrease in operating costs or peak bus needs.

Subsidy per Rider

Subsidy per rider is based on projected subsidy for the system in FY2015 divided by projected trips. An hourly cost of $93.88 is utilized. Scenario 1 (no fare) assumes an increased operating cost based on the results of the peak vehicle need analysis.

Results – Revenue and Ridership Impacts

Scenario 1: Free cash and SmarTrip fares

Free fares will lead to a significant increase in ridership (+65%), coupled by the loss of all fare revenue (-$4,384,905). The increase in ridership is in addition to the anticipated growth in ridership due to system expansion at the start of FY2015. The additional passengers will likely lead to capacity constraints on many Circulator routes during peak travel periods and necessitate approximately 13,200 additional annual revenue hours of service (see detailed discussion below) to accommodate riders in addition to the requirement of up to 11 additional buses at a cost of $7,810,000 ($710,000 per bus). Eliminating fares would create an operating deficit of $5.63 million when additional service requirements are combined with loss of fare revenue.

Scenario 2: $1.50 SmarTrip and $2.00 cash fare

Scenario Two would lead to an 11% decline in ridership and 41% increase in revenue over the existing baseline. Cost recovery from fares in this scenario would grow from 21% to 29%.

Scenario 3: $1.75 SmarTrip and $2.00 cash fare

Scenario Three would lead to a 14% decline in ridership and 54% increase in revenue over the existing baseline. Cost recovery from fares in this scenario would grow from 21% to 32%.

Scenario 4: $2.00 SmarTrip and $2.00 cash fare

Scenario Three would lead to a 20% decline in ridership and 59% increase in revenue over the existing baseline. Cost recovery from fares in this scenario would grow from 21% to 33%. Due to fares surpassing those on Metrobus, the model estimates higher ridership loss as riders switch to overlapping Metrobus service.

Table 2: Ridership Effects by Scenario

Scenario	SmartTrip Riders	Cash Riders	Total Ridership	Total Ridership Change from Baseline
FY2015 Base	5,636,474	1,154,458	6,790,932	0%
Scenario One: Free cash and SmarTrip fares	9,294,545	1,903,702	11,198,247	65%
Scenario Two: $1.50 SmarTrip and $2.00 cash fare	5,110,027	919,411	6,029,438	-11%
Scenario Three: $1.75 SmarTrip and $2.00 cash fare	4,930,223	919,411	5,849,634	-14%
Scenario Four: $2.00 SmarTrip and $2.00 cash fare	4,488,888	919,411	5,408,298	-20%

Table 3: Revenue Effects by Scenario

Scenario	SmarTrip Revenue	Cash Fare Revenue	Total Revenue	Revenue Change from Baseline	Farebox Recovery Ratio
FY2015 Base	$3,438,249	$946,656	$4,384,905	0%	21%
Scenario One: Free cash and SmarTrip fares	$0	$0	$0	-100%	0%
Scenario Two: $1.50 SmarTrip and $2.00 cash fare	$4,675,675	$1,507,834	$6,183,508	41%	29%
Scenario Three: $1.75 SmarTrip and $2.00 cash fare	$5,263,014	$1,507,834	$6,770,847	54%	32%
Scenario Four: $2.00 SmarTrip and $2.00 cash fare	$5,476,443	$1,507,834	$6,984,276	59%	33%

Potential Real-World Variations from Model Output

The estimated ridership and revenue impacts to Circulator service are based on a theoretical model and changes may vary in reality. It is challenging to predict ridership changes due to free fares. Circulator may find that eliminating fares induce a large number of trips by riders who currently walk. Inversely, Circulator may see a smaller than expect increase in ridership because its limited stop service makes Circulator uncompetitive for very short trips, and the existing fare structure already attracts the cost-sensitive riders drawn by the one dollar fare and additional discounts for seniors, children, and students.

On the other extreme, introducing a fare of $2.00 may lead to a smaller decline in ridership than anticipated. While Circulator would no longer be cheaper than Metrobus, the 25 cent difference in fares could be too small to have a noticeable impact on ridership behavior. Moreover, surveys of Circulator riders show that people are attracted to the service not only for its affordable fares, but because of its comfort, convenience, and high frequencies. Riders could accept slightly higher fares than competing Metrobus service if Circulator continues to be perceived as a premium product.

Results – Operating Cost and Peak Vehicle Need Impacts

Additional calculations were performed for Scenario 1 (free fares) to determine the peak vehicle needs and operating cost impacts of eliminating fares. The other scenarios were not included in this analysis, as decreases in ridership would not impact the number of revenue hours of Circulator service currently being provided. The introduction of free fares is estimated to result in 64.5% higher ridership. Much of this ridership can be absorbed by the existing Circulator level of service as buses typically operate under capacity, however this ridership increases will cause capacity constraints during the peak period on some routes. In order to maintain maximum passenger loads below a load factor of 1.5 (48 passengers in the current 32 seat configuration of Circulator buses)[4], the Circulator would have to operate approximately 13,200 additional revenue hours of service, costing $1.24 million in FY2015 dollars. Most of the additional trips needed will occur during the peak period, necessitating up to eleven additional buses during the evening peak period and nine during the morning peak. As Table 4 shows, only three existing routes and two extensions would see capacity constraints due to free

[4] Seating capacity on the existing Circulator fleet is only 28 seats compared to 40 seats on typical 40 foot buses. Basing this analysis on different fleet types or load factors will greatly impact the results.

fares. The Woodley Park – McPherson Square route would be most affected as maximum loads would exceed a load factor of 1.5 by 67% during the evening peak period. As previously mentioned, this scenario could also result in the requirement for up to 11 additional buses at a cost of $7,810,000 ($710,000 per bus).

Table 4: Annual Operating Cost and Peak Vehicle Need Impact of Eliminating Fares

	Additional Annual Revenue Hrs.	Additional Annual Op. Costs	Additional Peak Buses	Peak Bus Period
Existing Routes				
Georgetown - Union Station	8,388	$787,475	7	6:30am - 8:30am
Woodley Park - McPherson	3,262	$306,265	5	5:30pm - 6:30pm
Rosslyn - Dupont Circle	335	$31,419	2	5:30pm - 6:30pm
Union Station - Navy Yard	-	-	0	
Potomac - Skyland	-	-	0	
Extensions				
Georgetown - Nat. Cathedral	938	$88,083	1	6:30am - 8:30am
Dupont Circle - Howard U	310	-	1	5:30pm - 6:30pm
Navy Yard - Waterfront	-	$29,062	0	
Skyland - Congress Heights	-	-	0	
Systemwide	13,233	$1,242,303	11	5:30pm - 6:30pm

Results – Subsidy per Rider

Scenario One and Three all have a projected lower average subsidy per trip than the baseline. Scenario 1 (no fares) would achieve the lowest subsidy per trip at $2.00 while Scenario 4 would achieve the highest subsidy per trip at $2.63. While Scenario 1 has the lowest subsidy *per passenger* it will result in the greatest total subsidy, a 33% increase over the baseline subsidy projected for FY2015. Inversely, Scenario 4 would result in the lowest total subsidy, a 15% decline over baseline levels.

Table 4: Subsidy per Trip and Total Subsidy

Scenario		Ridership	Total Subsidy		Subsidy Per Trip		Farebox Recovery
#	Name		Subtotal	Subtotal	Gross	Change	
-	Baseline	6,790,932	$16,824,880		$2.48		21%
1	Free	11,198,247	$22,452,088	33%	$2.00	-19%	0%
2	$1.50 / $2.00	6,029,438	$15,026,277	-11%	$2.49	1%	29%
3	$1.75 / $2.00	5,849,634	$14,438,938	-14%	$2.47	0%	32%
4	$2.00 / $2.00	5,408,298	$14,225,509	-15%	$2.63	6%	33%

Summary

The ideal fare structure depends on how important promoting ridership is compared to containing costs. Eliminating fares may boost ridership but at the price of a significant financial burden to the system and overcrowding on some routes; the total subsidy would increase by 33%. Introducing higher fares would increase the service's cost recovery ratio but decrease ridership. Overall Scenario 3 provides the largest percent increases in revenue per percent loss in ridership (3.93%). Scenario 4 results in the highest cost recovery ratio (33%), while Scenario 1 results in the largest ridership increase (64.5%).

As service frequency is tied to a policy headway of 10 minutes, decreasing ridership in Scenario 2, 3 and 4 should not result in any operating cost savings. Scenario 1 would lead to overcrowding during peak periods and require $1.24 million in additional funding to accommodate the increase in ridership, including up to 11 additional peak buses during the height of the evening rush hour.

Table 5: Summary of Revenue and Ridership Effects by Scenario

Scenario	Annual Projected Ridership	Change Over Baseline	Projected Revenue	Change Over Baseline
2015 Base	6,790,932	0%	$4,384,905	0%
Scenario One: Free cash and SmarTrip fares	11,198,247	65%	$0	-100%
Scenario Two: $1.50 SmarTrip and $2.00 cash fare	6,029,438	-11%	$6,183,508	41%
Scenario Three: $1.75 SmarTrip and $2.00 cash fare	5,849,634	-14%	$6,770,847	54%
Scenario Four: $2.00 SmarTrip and $2.00 cash fare	5,408,298	-20%	$6,984,276	59%

Figure 2: Summary of Ridership by Scenario

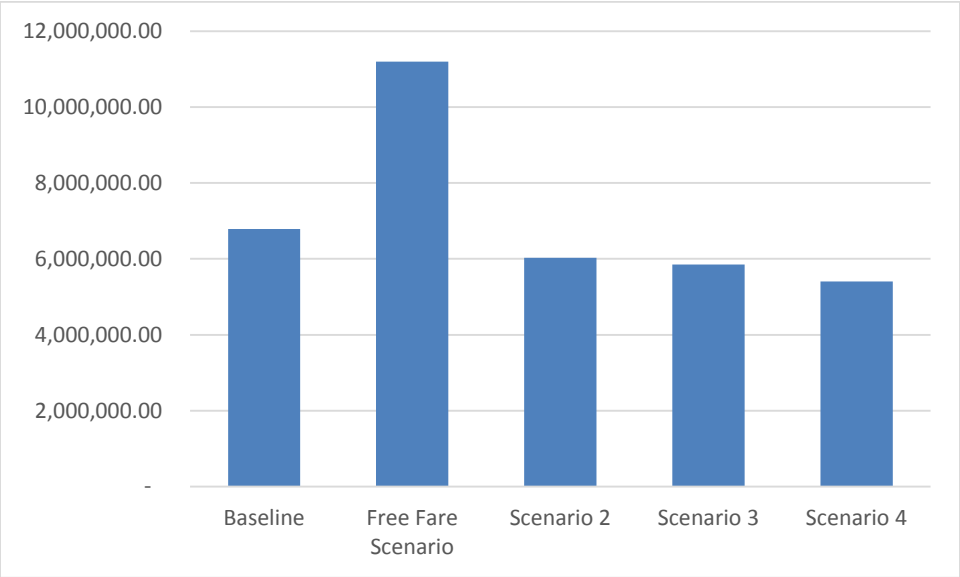
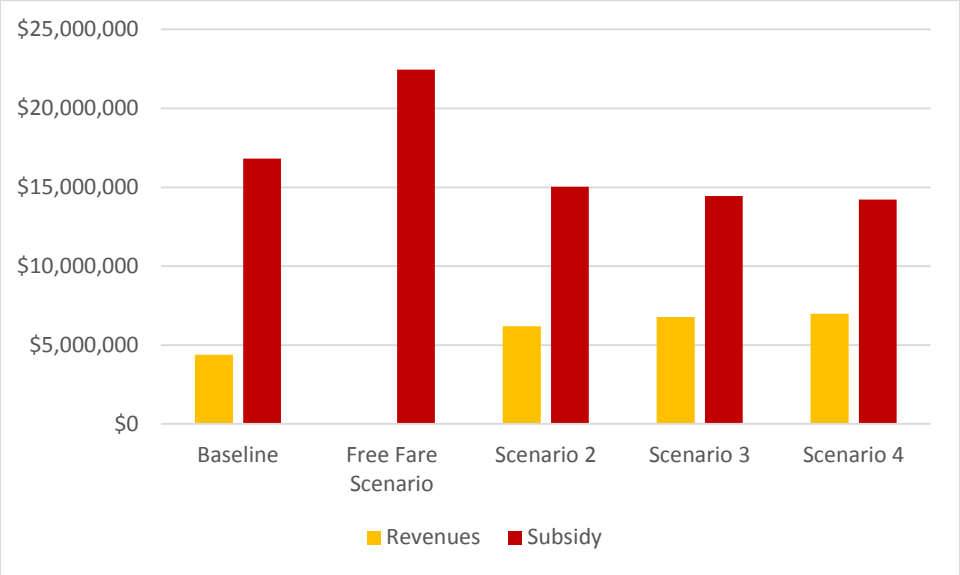


Figure 3: Summary of Revenue and Net Costs



Sources

The following resources were consulted to develop this memo:

- Mineta National Transit Research Consortium, *Long-Term Trends in Patron Satisfaction of DC Circulator*.
- Move DC Local Bus Study, *Maximum Load Data* Collected Fall 2013
- Perone, Jennifer S *Advantages and Disadvantages of Fare Free Transit,* Center for Urban Transportation Research
- TCRP Report 95 – Chapter 12: *Transit Pricing and Fares*
- TCRP Synthesis 101 – Implementation and Outcomes of Free Fare Transit
- Todd Litman, *Transit Price Elasticities and Cross Elasticity,* Victoria Transportation Policy Institute
- WMATA, *Finance & Administration Committee Information Item III-A*, February 27, 2014