Source: Bruce Emmerling, pixabay

CHAPTER 5
Pilot Impacts

What worked? Public and agency perspectives

Source: Wikimedia Commons, AgnosticPreachersKid

5 Pilot Impacts

parkDC's asset-lite approach to demand-based pricing can effectively improve parking availability and utilization, and functions as well as the typical approach for a fraction of the cost.

The asset-lite approach to demand-based pricing distinguishes the parkDC pilot from previous demand-based pricing projects. DDOT also advanced the state of the practice through exploration of multimodal demand-based pricing (i.e., loading zone pricing). Lessons learned from parkDC could enable DDOT to expand demand-based pricing to other zones in the District and serve as a guide for other jurisdictions seeking to effectively manage their parking supply. Consequently, the extent to which parkDC made it easier for drivers to find an available parking space, reduced congestion and pollution, improved safety, and encouraged use of other transportation modes were fundamental questions for the pilot evaluation.

In summary, the parkDC pilot team successfully developed a cost-effective, data-driven program. The pilot addressed parking problems for system users and DDOT through strategically applied data and a thoughtfully structured program. The pilot's success indicates that demand-based parking pricing programs can be applied effectively and sustainably, even in crowded urban environments and with fewer costly physical assets than have been deployed by other agencies. This chapter is organized into two areas of evaluation:

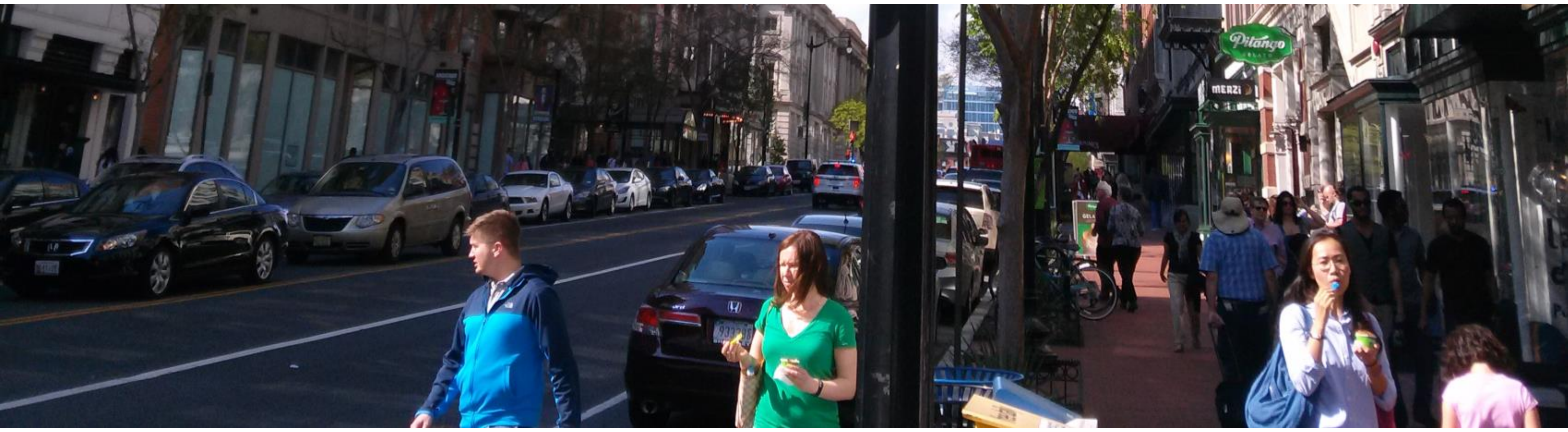
1 The user experience

The user experience is further divided into three levels: impacts felt by people parking in the area (level 1), impacts for those traveling in or through the area (level 2), and impacts on economic and multimodal activity (level 3):

- **Level 1: Curbside effects**. These outcomes are most directly tied to the pilot's parking pricing and policy changes. They include the pilot's influence on customer ability to find parking, duration of stay at a parking space, and instances of illegal parking.
- **Level 2: Pilot area network effects**. This includes the impacts on the surrounding transportation system, including the availability of parking information, placard use and abuse, and safety.
- **Level 3: Broader transportation and land-use activity.** This is the wider transportation ecosystem that included the parkDC pilot. Outcomes include broader transportation impacts on multimodal mobility and economic vitality.

2 The agency perspective

The agency perspective provides the outcomes experienced by DDOT, the managing agency of the parkDC Penn Quarter/Chinatown pilot.



Key findings are highlighted below and throughout this chapter to help the reader more easily identify key information and outcomes from the pilot.

Key Findings

The parkDC pilot met many of its goals and objectives. This was despite several external factors that would have been expected to increase demand for parking, including increases in local economic activity and automobile ownership and a sharp decrease in regional transit use.

- Across five price changes, the parkDC pilot decreased rates on 7% of all block faces, increased rates on 31%, and maintained existing prices on 63%. Average meter rates rose 32% from $2.30 to $3.03. In total, the number of block faces where demand matched supply increased by 16% between the first and last price changes.
- A conservative approach to price changes allowed the parkDC team to increase meter rates and effectively manage parking without aggravating users. Fewer than 1% of all block faces (five total) jumped more than two price bands during a price change; fewer than 1% (three total) that decreased to the lowest available rate and had to be increased during the following price change; and 100% that were increased to the highest available rate did not need to be decreased during the following price change.
- Automated data indicated average time to find parking was reduced by two to three minutes per trip. This was consistent with self-reported time to find parking, which dropped throughout the pilot, from close to 18 minutes before the first price change, to less than 12 minutes after the fifth price change. Correspondingly, the time vehicles spend circling for parking decreased by between 7% and 15%, depending on the time of day.
- After the parkDC team extended parking time limits on 22 low-demand block faces (24% of the pilot area) on weekday evenings and Saturdays, these block faces experienced a 12% increase in occupancy and a 14-minute increase in length of stay during weekday evenings. The average length of stay per vehicle decreased by three minutes throughout the entire pilot area.
- Average observed double parking decreased during the pilot, and citations for double parking went down throughout the pilot period.
- To reduce double parking in loading zones, DDOT applied demand based pricing at loading zones during and extended loading zone hours of operation. The number of minutes vehicles were observed double parking in loading zones decreased following DDOT's loading zone adjustments.

Key Findings

- DDOT determined that unauthorized use of the motorcoach zone was insignificant and did not make any changes to the motorcoach zone's pricing or operations.
- Average placard use decreased by 14.3% in the pilot area, versus 9.7% in the control area

5.1 THE SYSTEM USER EXPERIENCE

This section discusses the impacts felt by people parking in the area (level 1), those traveling in or through the area (level 2), or the area's businesses and the wider transportation ecosystem (level 3).

5.1.1 Level 1: Curbside Effects

This first level addresses the more direct outcomes of DDOT's changes to curbside policy. Outcomes include the pilot's influence on customer ability to find parking, duration of stay at a parking spot, and instances of illegal parking. This section is informed by curbside data collected before the first price change (October 2015) and after each successive price change.

5.1.1.1 Parking availability increased on high-demand blocks, underutilized spaces found more takers

Key Findings

- The number of block faces at equilibrium increased by 31% between the first and last price changes.
- The low-demand area with increased time limits during evenings and weekends experienced a 12% increase in occupancy and the length of stay increased 14 minutes during weekday evenings.

The parkDC pilot price changes influenced demand and parking behavior. Changes in occupancy drove price adjustments and increases in the number of blocks staying at the same price show how the changes helped nudge block face occupancy to equilibrium (between 70% and 90%). Table 5-1 shows price changes across all five rate changes and highlights that the number of blocks nearing equilibrium increased over the course of the pilot. In total, the number of block faces at equilibrium increased by 31% between the first and last price changes.

Table 5-1. parkDC progress over time

parkDC progress over time

Pilot Measure	Pre-Pilot	Round 1 October 2016	Round 2 February 2017	Round 3 May 2017	Round 4 August 2017	Round 5 November 2017
Number of Price Points	1	3	5	7	8	9
Increased Price	-	94 blocks	172 blocks	143 blocks	71 blocks	89 blocks
Steady Price	-	229 blocks	186 blocks	220 blocks	262 blocks	266 blocks
Decreased Price	-	48 blocks	13 blocks	8 blocks	38 blocks	16 blocks
Average length of stay M-F	63 min	66.1 min	63.9 min	60.3 min	60	60.9
Blocks at Equilibrium[1]	-	61.7%[2]	50.1%	59.3%	70.6%[3]	71.7%

[1]Near target occupancy; no change recommended

[2]Conservative approach to first round price changes

[3]Higher percentage not changed due to construction

DDOT was able to observe the effects of each block-level price change on motorist behavior and parking occupancy. Figure 5-1 shows price changes between the fourth and fifth price changes by time band. While block faces that hold constant have exhibited occupancy rates near the established target, those with increased or decreased prices require additional pricing incentives to induce motorists to changes their behavior.

Figure 5-1. Round Five price changes

The parkDC pilot also aimed to improve turnover of high-demand parking spaces by encouraging shorter vehicle stays. By the fifth price change, the average vehicle length of stay in the pilot area had decreased by three minutes compared to pre-pilot conditions (Figure 5-2). Overall, this is a positive result for a generally high-demand area like the Penn Quarter/Chinatown pilot area. However, because the pilot area did have low-demand blocks for some areas during certain times, this measure alone is too simplistic to use in describing the impacts of the pilot on curbside space and should be considered within the context of the other findings.

DDOT also assessed trends in occupancy and length of stay to understand if and how length of stay differed between low and high occupancy block faces. Figure 5-2 shows how the relationship between occupancy and length of stay has evolved between price changes. After the first price change (top-left chart), low-occupancy block faces experienced an increase in occupancy and length of stay (blue trendline). Block faces at target occupancy experienced slightly less pronounced increase in occupancy and length of stay (green trend line). High-occupancy block faces experienced a decrease in occupancy and length of stay (red trend line).

Occupancy and length of stay trends stayed relatively consistent for low-occupancy block faces and target occupancy block faces between the first and fourth price changes. High-occupancy block faces, on the other hand, experienced an increase in occupancy and length of stay following the second price change, third price change, and fourth price change (top-right, bottom-left, and bottom-right charts, respectively). Following the fourth price change, high-occupancy block faces experienced slightly less marked increases in occupancy and length of stay than in previous price changes. This is likely due to the implementation of higher prices on high-occupancy blocks and time limit changes on low-occupancy blocks, discussed in greater detail below.

Figure 5-2. Occupancy Comparison to Length of Stay (Pre-Pilot to Fourth Price Change)

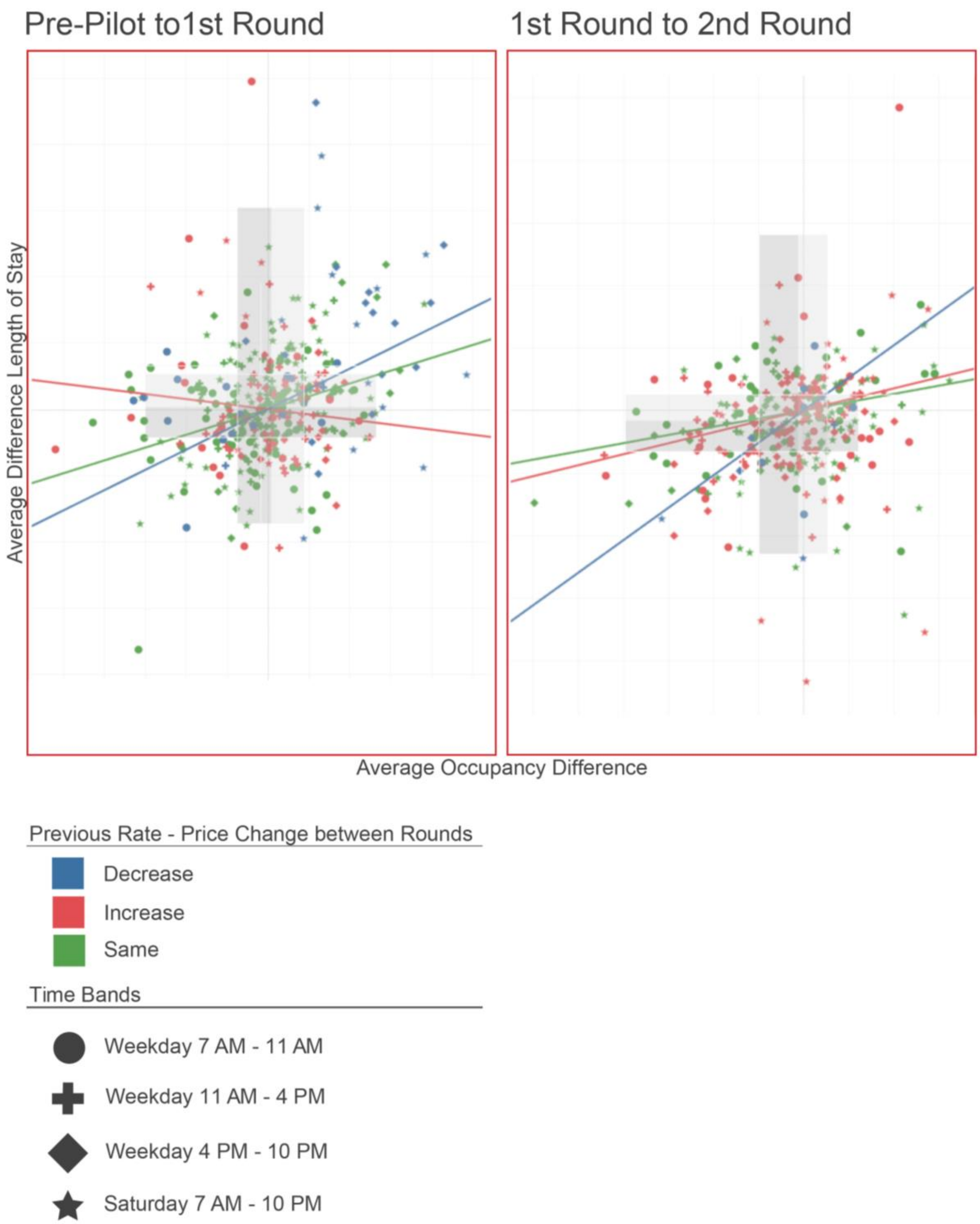
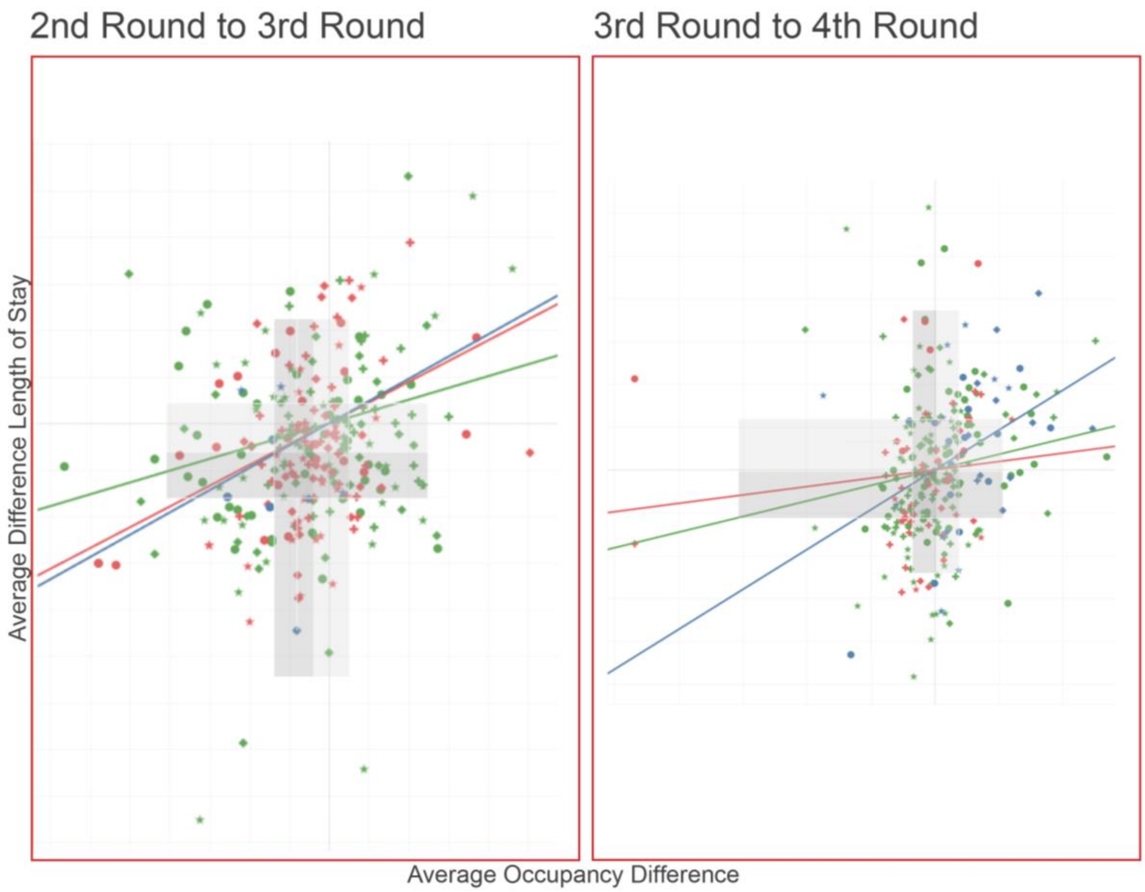


Figure 5-2. Occupancy Comparison to Length of Stay (Pre-Pilot to Fourth Price Change) (Continued)



Graphs show where block faces by time band fall in terms of average difference in length of stay (vertical axis) and average occupancy difference (horizontal axis) between price changes.

Each point is block face during a time band, colored by the price change between rounds.

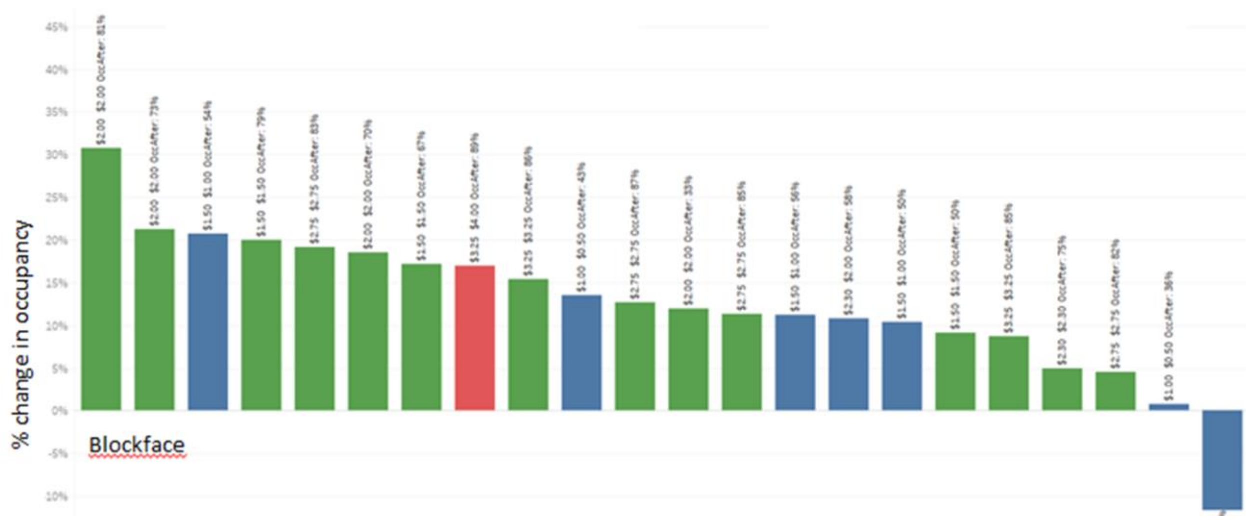
Colored lines show the trend line by rate change type (decrease, increase, steady).

The vertical shading shows the 25th to 50th percentile of difference in occupancy in light grey, and the 50th to 75th percentile of difference in occupancy in dark grey.

The horizontal shading shows the 25th to 50th percentile of difference in occupancy in light grey, and the 50th to 75th percentile of difference in occupancy in dark grey.

DDOT also tested the influence of time limit changes on customer behavior. During the fourth price change, time limits at low occupancy blocks in the eastern third of the pilot area were increased to incentivize parking during the weekday evenings and on Saturdays. These blocks experienced a 12% increase in occupancy and the length of stay increased 14 minutes during weekday evenings. Figure 5-3 shows the block faces that experienced increases in activity due to extended time limits.

Figure 5-3. The impact of time limit changes on parking occupancy between the 4th and 5th price changes (Weekday, 4 PM – 10 PM)



5.1.1.2 Customers spent less time finding a parking space

DDOT used three approaches to estimate parking search times - automated parking search time (AVI) data, manual bike survey data, and customer feedback - to understand how the parkDC pilot influenced the time it took customers to find a parking space.

Key Findings

- Automated data indicated average time to find parking was reduced by two to three minutes per trip
- Manual surveys of the time to find parking with a limited sample size produced mixed results, which further highlighted the benefits of the automated data collection approach
- Customer-provided feedback suggests that the perceived time to find parking has decreased by seven minutes since the pilot was implemented

Source: Bruce Emmerling, pixabay

5.1.1.2.1 Time to find a parking space

A stated goal of the pilot was to reduce the time to find parking. Progress towards this goal can be measured by looking at the length of time of cruising trips. The length of time of cruising trips was identified by time of day[1] for weekdays and weekend days and partitioned by price change period (Figure 5-4 and Figure 5). As shown, the length of time spent finding an open parking space is down during all time periods on both weekends and weekdays. Average cruising times were reduced by two to three minutes per trip.

[1] Time bands for cruising analysis align with pilot time bands but further bisect the AM and PM Periods: Morning Rush: 7:00 - 9:30 AM; Mid-Morning: 9:30 - 11:00 AM; Mid-day: 11:00 AM - 4:00 PM; Afternoon Peak: 4:00 - 6:30 PM; Evening: 6:30 - 10:00 PM

Figure 5-4. Weekday Cruising Trip Times

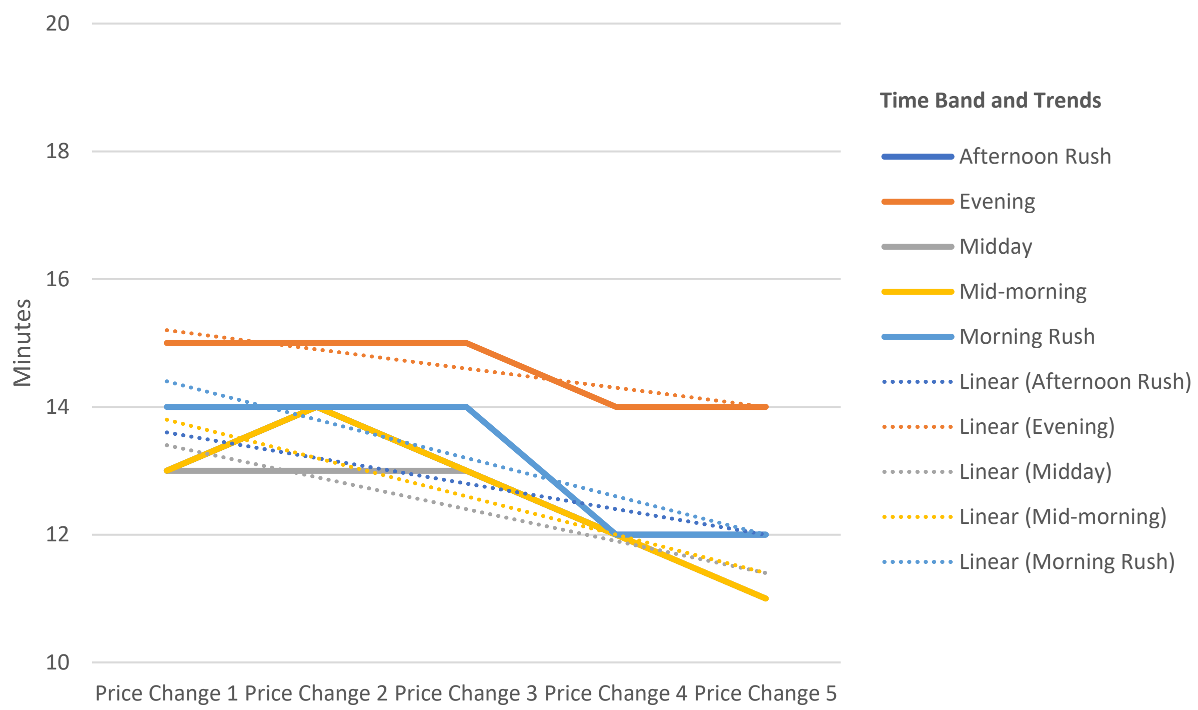
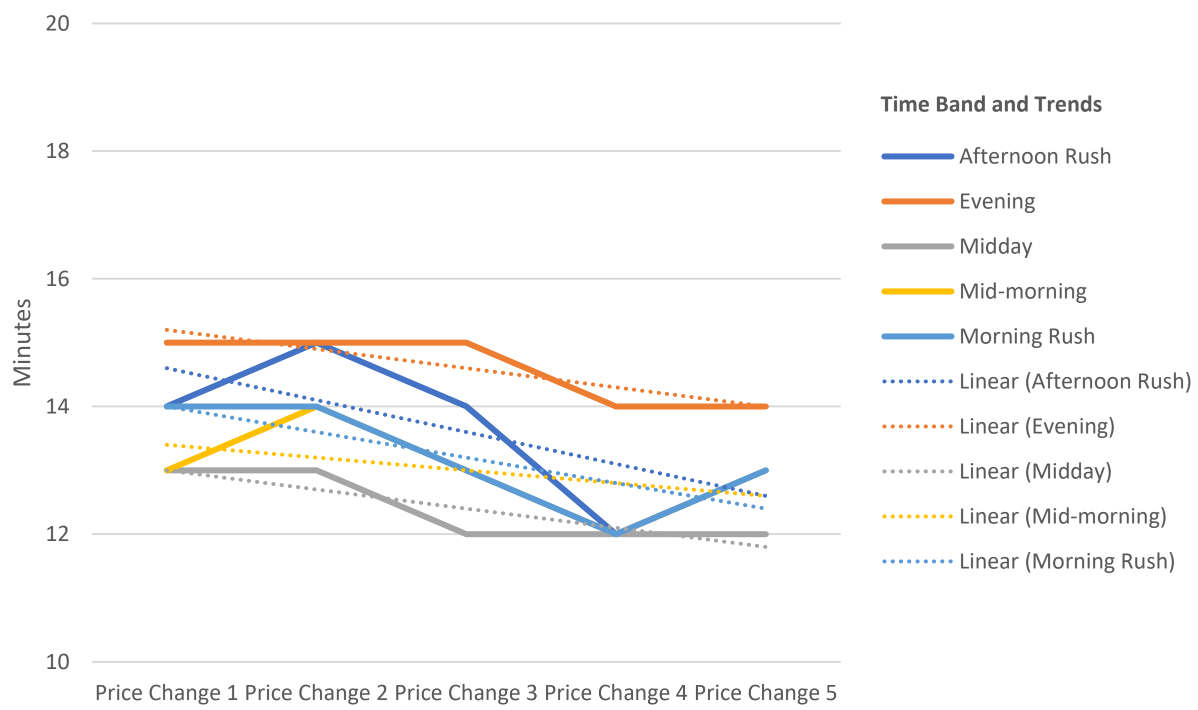


Figure 5-5. Weekend Cruising Trip Times



5.1.1.2.2 Manual Parking Search Times

In addition to assessing parking search time using AVI data, DDOT collected time-to-find parking data using manual bike surveys before and after pilot implementation to understand changes to the average time to find parking.

As shown in Figure 5-6 and Figure 5-7, the average weekday time to find parking increased in the morning and evening time periods (80% and 516% increases, respectively) but decreased by 25% in the midday time period in the pilot area. This is counter to the automated time to find parking data and inconsistent with the time to find parking in the control area, which dropped during all three time periods. It was later noted that the day used to collect the time to find parking data in the "after" time period coincided with a Janet Jackson concert at the Capital One Arena which likely skewed the after-data collection.

Figure 5-6. Changes in average weekday time to find parking

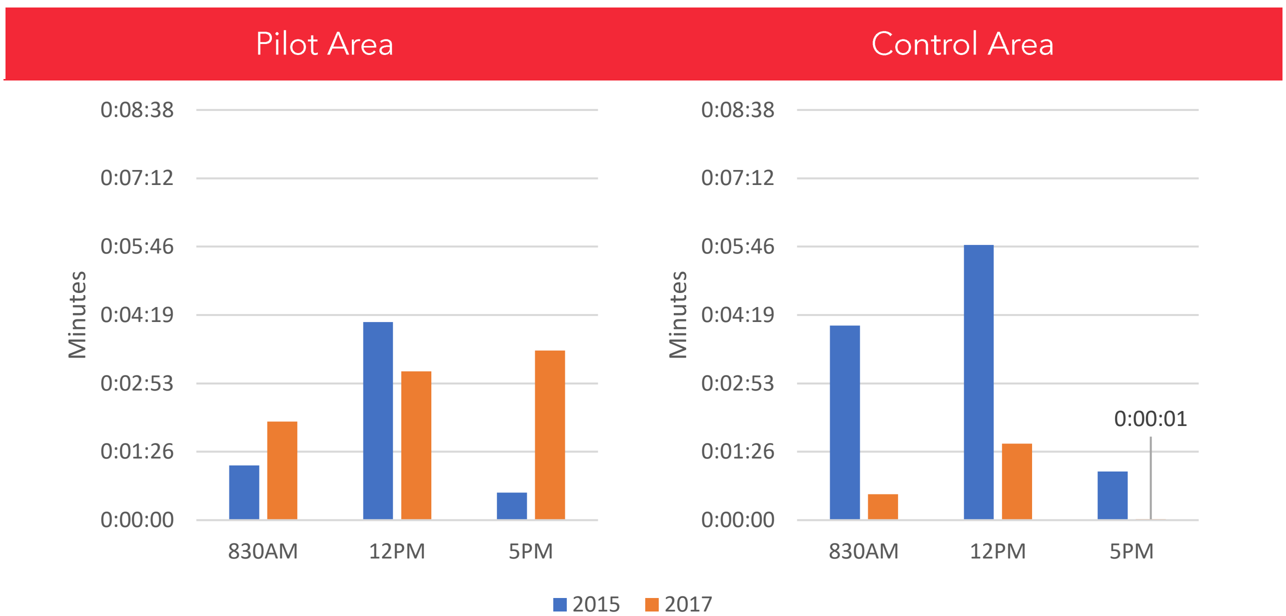
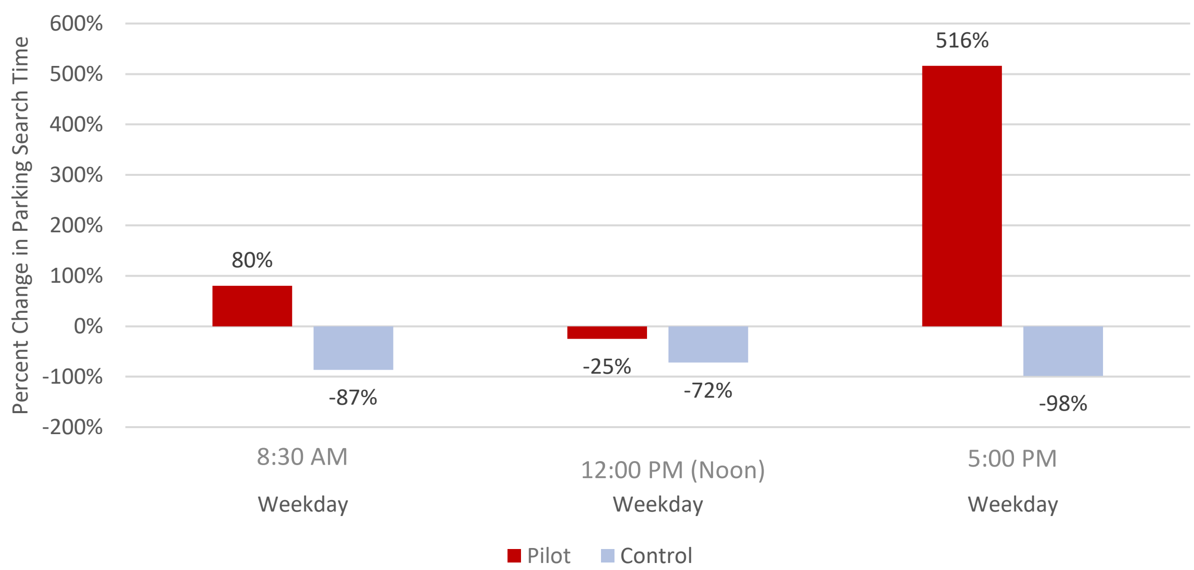


Figure 5-7. Percent change in average weekday time to find parking



As shown in Figure 5-8 and Figure 5-9 the average Saturday time to find parking increased in all time periods in both the pilot area and control area (78% to 147% increases observed in the pilot area, 55% to 85% increases observed in the control area). DDOT also assessed time to find parking on Sundays. As shown in Figure 5-8, the average Sunday time to find parking increased by almost six minutes or by 415% in the control area and remained high in the pilot area. Sunday parking is currently unregulated, suggesting that pricing and time limits help maintain lower weekday and Saturday parking search times.

Figure 5-8. Changes in average weekend time to find parking

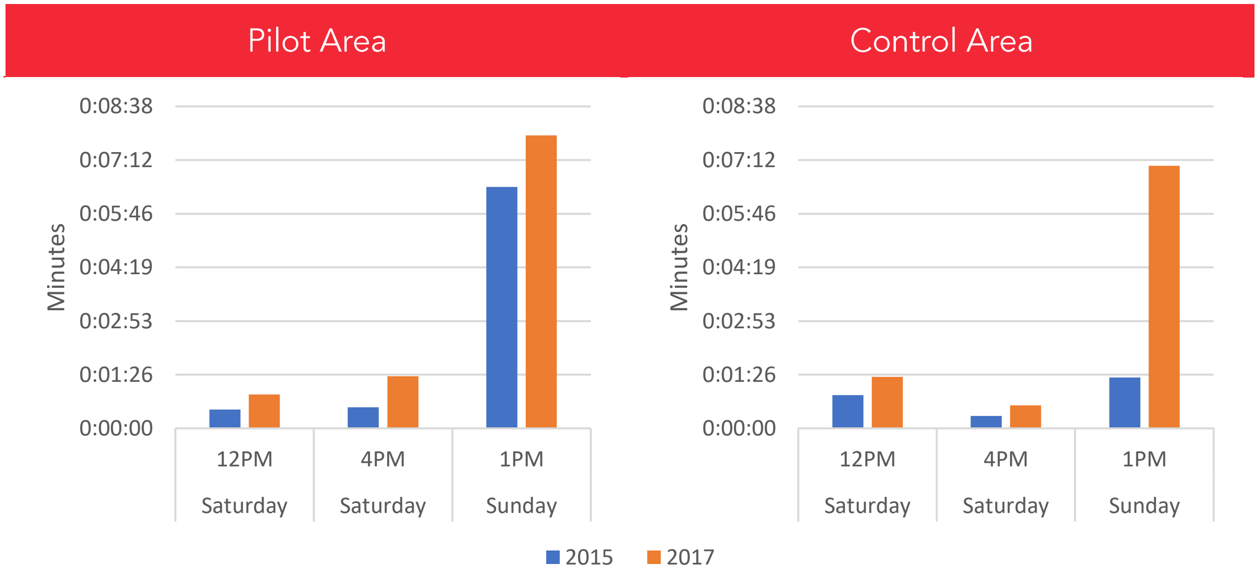
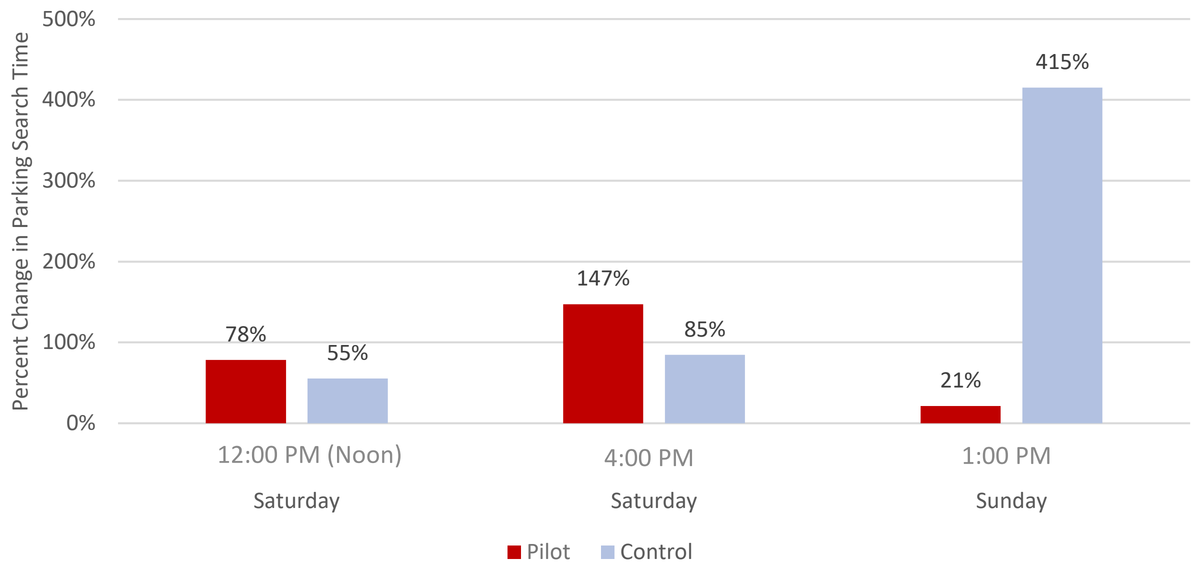


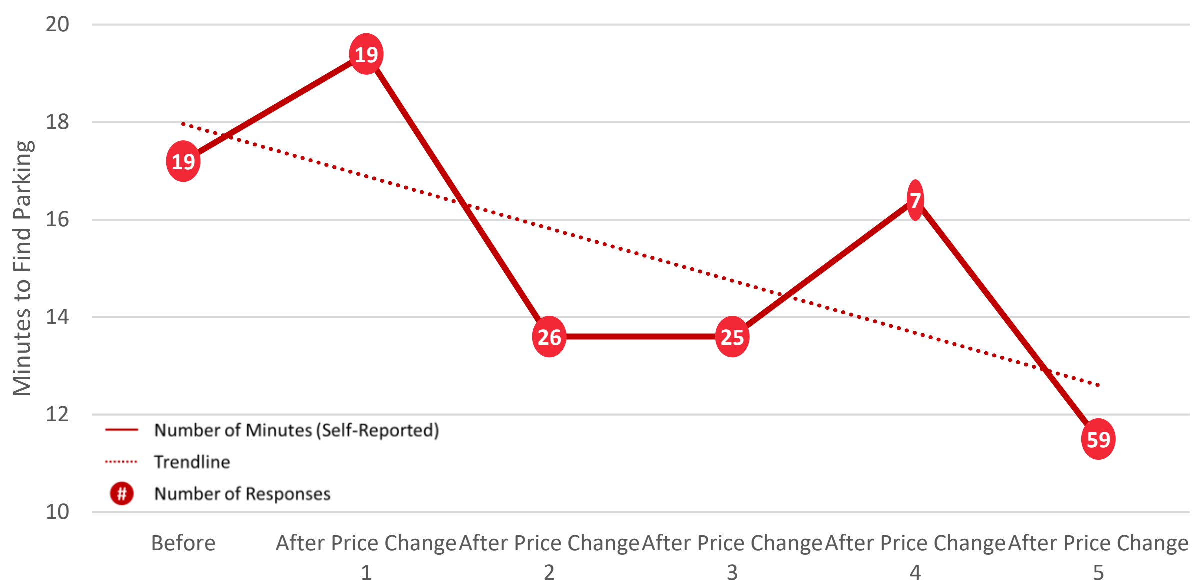
Figure 5-9. Percent change in average weekend time to find parking



Customer Feedback on Time Needed to Find Parking

DDOT collected customer feedback on the time needed to find parking before the pilot was implemented and throughout its duration. Based on customer feedback, the perceived time to find parking in the pilot area has decreased by seven minutes, suggesting that the parkDC pilot has helped improve the customer experience. Figure 5-10 shows how changes in perceived time to find parking have changed over time. As shown, the average self-reported time to find parking has dropped throughout the pilot, from close to 18 minutes before the first price change, to less than 12 minutes after the fifth price change. The self-reported data is consistent with the automated time to find parking data which showed similar reductions in the time to find parking.

Figure 5-10. Changes in perceived customer time to find parking



5.1.1.3 As supply opened, double parking decreased

Key Findings

- The pilot area experienced a 0.9% decrease in instances of double parking between the 2015 and 2017 studies, while the control area also saw decreases in double parking, albeit to a lesser extent (0.4% decrease).
- Double parking occurred at less than one percent of all parking spots in the pilot area during the 2017 round of data collection. As in 2015, the pilot area experienced lower levels of double parking than the control area in 2017.
- To reduce double parking in loading zones, DDOT increased loading zone prices during Price Change 4 in September 2017 and extended loading zone hours of operation in October 2017.
- DDOT determined that unauthorized use of the motorcoach zone was insignificant and did not make any changes to the motorcoach zone's pricing or operations.

Double parking is a strong symptom of high parking demand and low parking supply. To understand pilot impacts on double parking, DDOT conducted a before and after study to compare the change in instances when vehicles were observed double parking in both the pilot area and a control area, assessed double parking citation issuance, and conducted a before and after study to compare the number of minutes that vehicles were observed double parking at loading zones. Decreases in observed double parking, citations issued for double parking, and in the number of minutes that vehicles were observed double parking at loading zones all point to the positive impacts of DDOT's demand-based pricing pilot on parking supply and demand.

5.1.1.3.1 Double parking comparison: pilot versus control areas

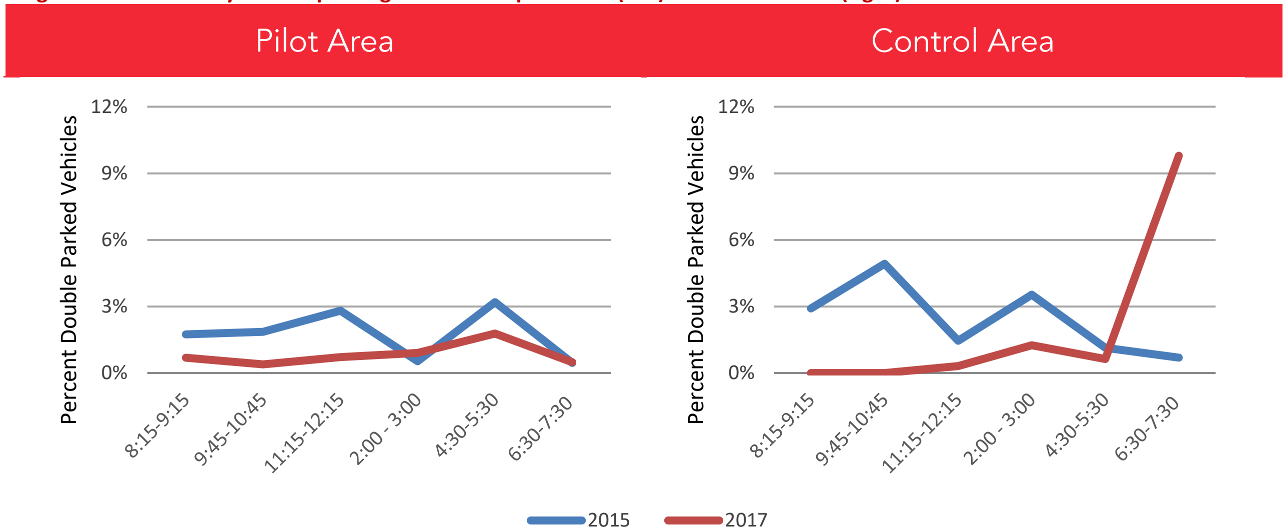
DDOT collected double parking data before and after pilot implementation in the pilot area and a control area. In the context of this analysis, double parking was defined as observed double parking vehicles as a percent of total curbside spaces in the pilot and control areas. Overall, the pilot area experienced a 0.9% decrease in instances of double parking between the 2015 and 2017 studies (Table 5-2). The control area also saw decreases in double parking, albeit to a lesser extent (0.4% decrease). While the parkDC pilot likely played a role in the increase in available parking spaces in the pilot area, observed decreases in double parking could also be due to reconfigurations of available on-street parking, improved access to alternative modes of transportation, and other external factors.

Table 5-2. Observed changes in average double parking

	Pilot Area	Control Area
	Average Double Parking	Average Double Parking
Before (2015)	1.8%	2.4%
After (2017)	0.8%	2.0%
Change over Time	-0.9%	-0.4%

Figure 5-11 shows how observed double-parked vehicles as a percent of total spaces changed throughout the day on weekdays between 2015 and 2017 in the pilot area and in the control area.

Figure 5-11. Weekday double parking rates in the pilot area (left) and control area (right)



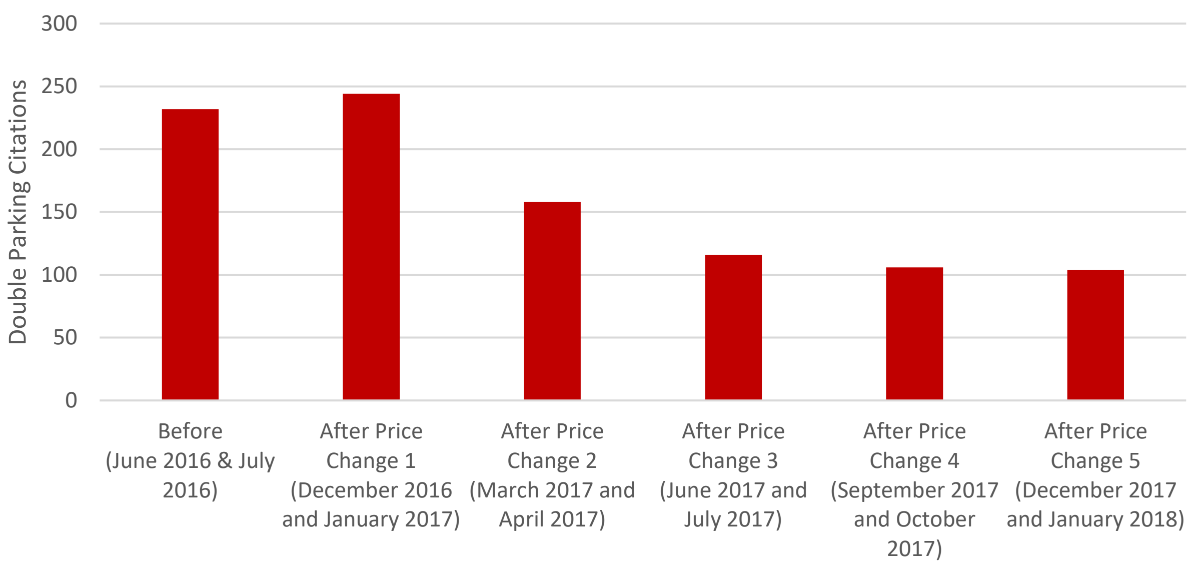
In the 2015 round of data collection (shown in blue), the highest levels of double parking were observed early in the mid-morning and evening peak periods, which coincided with competing demands for loading zones in both the control and pilot areas. 65% of vehicles observed double parking in the pilot area and 91% of vehicles observed double parking in the control area were commercial vehicles. Average daily double parking occurred at less than 3% of all parking spots in the pilot and control areas during the 2015 round of data collection. The pilot area experienced slightly lower levels of double parking than the control area.

The 2017 round of data collection (shown in red) found that double parking decreased in both the pilot and control areas. The highest levels of double parking were observed in the evening in the control area. Double parking occurred at less than one percent of all parking spots in the pilot area during the 2017 round of data collection. As in 2015, the pilot area experienced lower levels of double parking than the control area in 2017.

5.1.1.3.2 Double parking citations

Double parking instances are a proxy for indicating when a block is full. Consequently, the number of citations given for double parking can indicate the number of times blocks are full and serve as an indicator whether there is enough parking available to serve drivers. As shown in Figure 5-12, the number of double-parking citations initially stayed about the same after the first price change, and then continued to decrease as the study progressed. However, as previously indicated in Chapter 3, this decrease may have also been the result of inconsistent enforcement, and therefore no conclusions can be drawn from this data.

Figure 5-12. Double parking citations during the study period



5.1.1.3.3 Double parking in loading zones

Additional loading zone data was collected in January 2018 so DDOT could assess the results of its loading zone strategies implemented during the fourth price change in September 2017 (increased loading zone prices) and October 2017 (extended loading zone hours of operation). Using time-lapse camera footage, DDOT found that while the number of unique instances of double parking increased by 13% after prices increased, the number of minutes vehicles were observed double parking in loading zones decreased by 43% (

Table 5-3). More follow-up data is needed, however, because of the relatively small sample size and several outliers, particularly on the 500 block of 10th Street NW, which does not allow paid parking and therefore did not have parking regulations or price changes. DDOT intends to build on the preliminary findings from the parkDC pilot to grow its loading zone pricing and enforcement program, recognizing that a robust program has the potential to reduce instances of double parking and shift delivery and other commercial trips to off-peak periods.

Table 5-3. Minutes vehicles were observed double-parked at loading zones

Location	Minutes Before (August 2017)	Minutes After (January 2018)	Percent Change
504 10th Street NW	463.7	5.0	-99%
511 10th Street NW	398.6	100.0	-75%
905 E Street NW	125.0	80.0	-36%
501 G Street NW	110.0	115.0	+5%
977 F Street NW	30.0	40.0	+33%
1006 E Street NW	20.1	40.0	+99%
755 8th Street NW	15.0	20.0	+33%
777 7th Street NW	15.0	225.0	+1400%
650 F Street NW	5.0	45.0	+800%
Total Minutes	**1182.4**	**670.0**	**-43%**
Average	131.4	74.4	

In addition to the time-lapse camera footage, DDOT also reviewed the number of citations given in the pilot area to unauthorized vehicles in a loading zone. However, inconsistent enforcement in the pilot area during the pilot made it impossible to draw conclusions from the citation data. The number of citations for unauthorized vehicles in a loading zone is provided in Figure 5-13.

Figure 5-13. Citations for unauthorized vehicle in a loading zone

5.1.1.3.4 Double parking in a motorcoach zone

DDOT recognized that high tourist demand in the Chinatown and Penn Quarter neighborhoods could possibly result in tour buses illegally parking or idling in travel lanes, temporarily diminishing the capacity of the pilot area's busy streets. As part of the preliminary loading zone analysis conducted in 2016, DDOT sought to identify if there was a clear issue with non-motorcoach vehicles parking illegally in the single motorcoach zone located on 10th Street NW. The team planned to modify pricing in the motorcoach zone if substantial unauthorized use of the motorcoach zone was evident. The 2016 study revealed that the motorcoach zone experienced some of the lowest levels of unauthorized use by passenger vehicles compared to other loading zones in the pilot area. Seventy-nine percent of vehicles recorded in the loading zone were motorcoach vehicles (Table 5-4). Motorcoaches occupied the motorcoach zone for 41% of the full study period, unauthorized vehicles utilized the motorcoach zone for 10% of the full study period, and the motorcoach zone stood empty for 46% of the full study period.

Based on the results of the 2016 analysis, DDOT determined that unauthorized use of the motorcoach zone was insignificant and did not make any changes to the motorcoach zone's pricing or operations. Outside of the motorcoach zone in the broader pilot area and other sites in the District frequently visited by tourists, motorcoach idling is routinely observed. To address motorcoach idling across the District, DDOT decided to advance other initiatives separate from this pilot study.

Table 5-4 Motorcoach zone utilization (2016)

Number of Vehicles			Average Length of Stay		
Passenger Car	Commercial Vehicle	Bus	Passenger Car	Commercial Vehicle	Bus
22	10	120	8 min	22 min	15 min

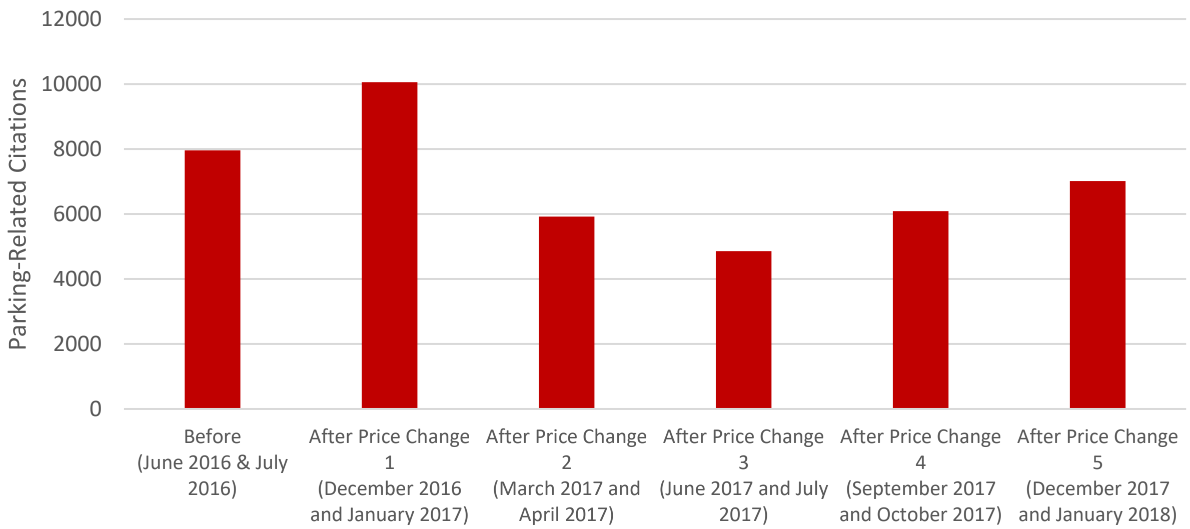
Vehicle Occupancy			Total Time of Vehicle Occupancy			
Passenger Car	Commercial Vehicle	Bus	Passenger Car	Commercial Vehicle	Bus	Vacant
14%	7%	79%	5%	5%	41%	46%

KEY: Passenger Car; Commercial Vehicle; Bus; Vacant

5.1.1.4 Parking enforcement

Based on findings from other performance parking initiatives, in particular SF*park,* DDOT expected the increased availability of open parking spaces to reduce the temptation to park illegally, resulting in fewer parking violations. As shown in Figure 5-14, the total number of parking-related citations given (not including failure to display receipt infractions, discussed later) initially increased from around 8,000 to approximately 10,000 after the first price change, but then decreased to between 5,000 and 7,000 over the next three price changes., While these findings lined up with expectations, no conclusions can be drawn from this data due to the inconsistent enforcement assumed to have occurred based on citation numbers and citation types issued throughout the duration of the project.

Figure 5-14. Total parking-related citations given during the study period*



*This chart excludes citations for failure to display the meter receipt because these were incorrect citations in the pilot area's pay-by-space configuration.

5.1.1.5 Pay-by-space makes parking spaces easier to find

The transition to a demarcated, pay-by-space environment proved effective for DDOT and customers. As detailed in Chapters 3 and 4, the demarcation of parking spaces impacts perception and the efficient use of limited available parking spaces. While no specific data was collected for this, it is expected that because customers can park more efficiently in a demarcated environment, this configuration likely contributed to making it easier to find a parking space.

5.1.2 Level 2: Pilot area Network Effects

This includes the surrounding transportation system, and impacts reported include the availability of parking information, placard use and abuse, and safety. This section is informed by curbside data collected before the first price change (October 2015) and after each successive price change.

Source: Wikimedia Commons, Another Believer

5.1.2.1 Cruising for parking decreased in the pilot area

Key Findings

- Vehicle cruising rates generally decreased throughout the duration of the pilot

In the context of this analysis, the cruising rate is defined as the percentage of vehicles searching for parking. There are several objectives behind this analysis. DDOT wanted to understand the proportion of vehicles cruising for parking, identify where in the network cruising activity is occurring, and understand shifts in cruising rate patterns based on time of day. The number of cruising and non-cruising trips were identified by time period for weekdays and weekend days and partitioned by price change period. As shown in Figure 5-15 and Figure 5-16, the percentage of vehicles cruising for parking within the pilot area is consistently between 20% and 40% depending on the time of day and price change period. However, trendlines for most times of day showed decreasing cruising rates, with two exceptions. First, cruising rates stayed relatively steady during the "afternoon rush" on both weekends and weekdays, which may reflect the restricted supply of parking due to rush hour parking restrictions on weekdays. Second, the trendline for weekday midday cruising was slightly up; this time of day has also had the largest share of price increases as blocks were not able to reach equilibrium. The seasonality of activity in the pilot area is also visible in the cruising trends, with higher activity in the fall and early winter after price changes 1 and 5.

A more in-depth review of the data identified areas with heavy cruising, which include 7th Street between the National Portrait Gallery and the Capital One Arena. Cruising intensity near the intersections of 9th Street and G Street NW and the 9th Street and F Street NW remains high throughout the day. Further, cruising is noticeable around the National Building Museum (from 4th to 6th streets and F to G streets), with cruising intensifying as the day progresses.

Figure 5-15. Weekday Cruising Rates

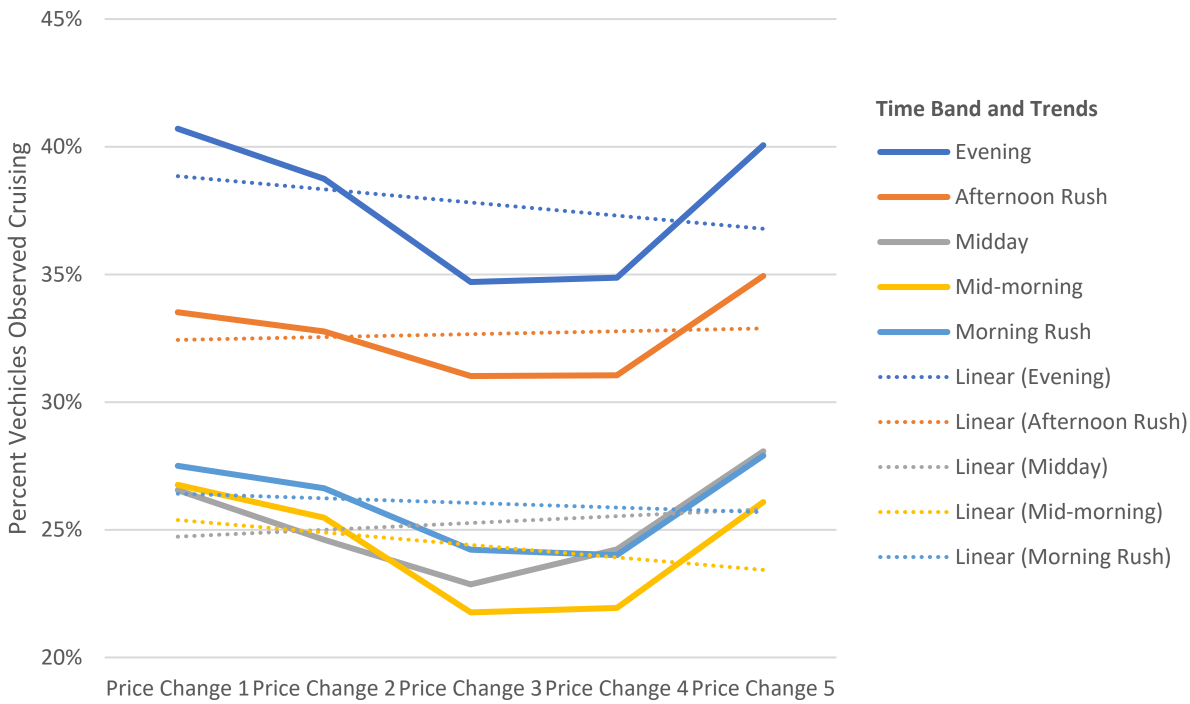


Figure 5-16. Weekend Cruising Rates

5.1.2.1.1 Cruising Contribution to Vehicle Miles Traveled

While the cruising rate tells us what percent of trips are searching for parking, it does not consider the length of trips. The contribution of cruising to total area VMT can account for varying trip lengths. Given that cruising vehicles would be expected to have longer trips within the pilot area as they circled around searching for parking, improved parking availability would be expected to reduce cruising trip lengths and therefore total cruising VMT.

The share of total observed VMT due to cruising trips was identified by time of day for weekdays and weekend days and partitioned by price change period (Figure 5-17 and Figure 5-18). As shown, the percentage of vehicle miles that cruising contributes to the pilot area VMT is consistently between 40% and 60% depending on the time of day and price change period. As expected, the cruising vehicle's share of VMT is higher than their share of total trips. Also noticeable is that on weekdays, except for the "evening," the total cruising contribution trendline was down. On weekends, cruising's contribution to VMT was up during the "evening" and "afternoon rush" time periods, but down for the other three time periods.

Figure 5-17. Weekday Cruising Contribution to VMT

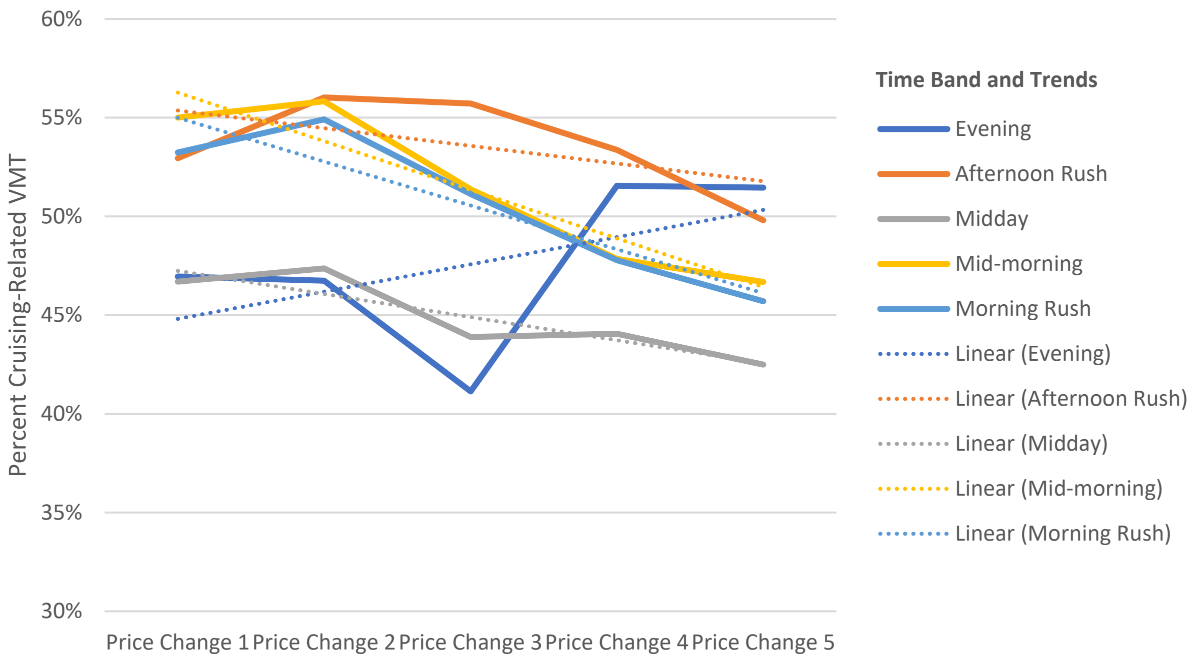
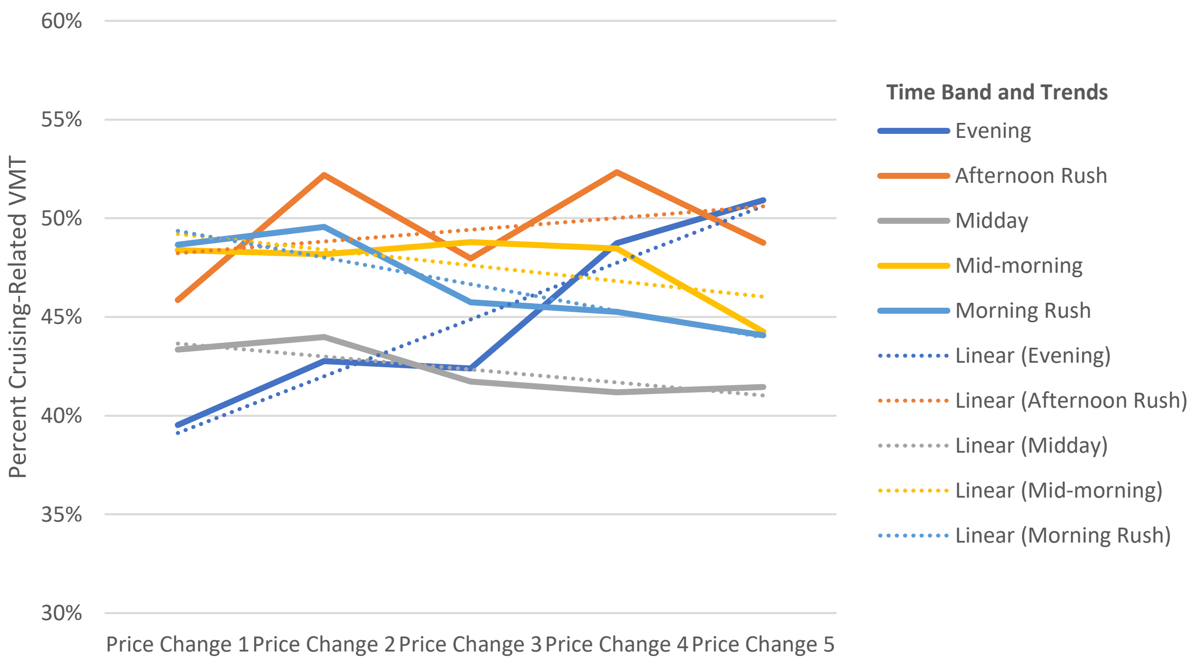


Figure 5-18. Weekend Cruising Contribution to VMT

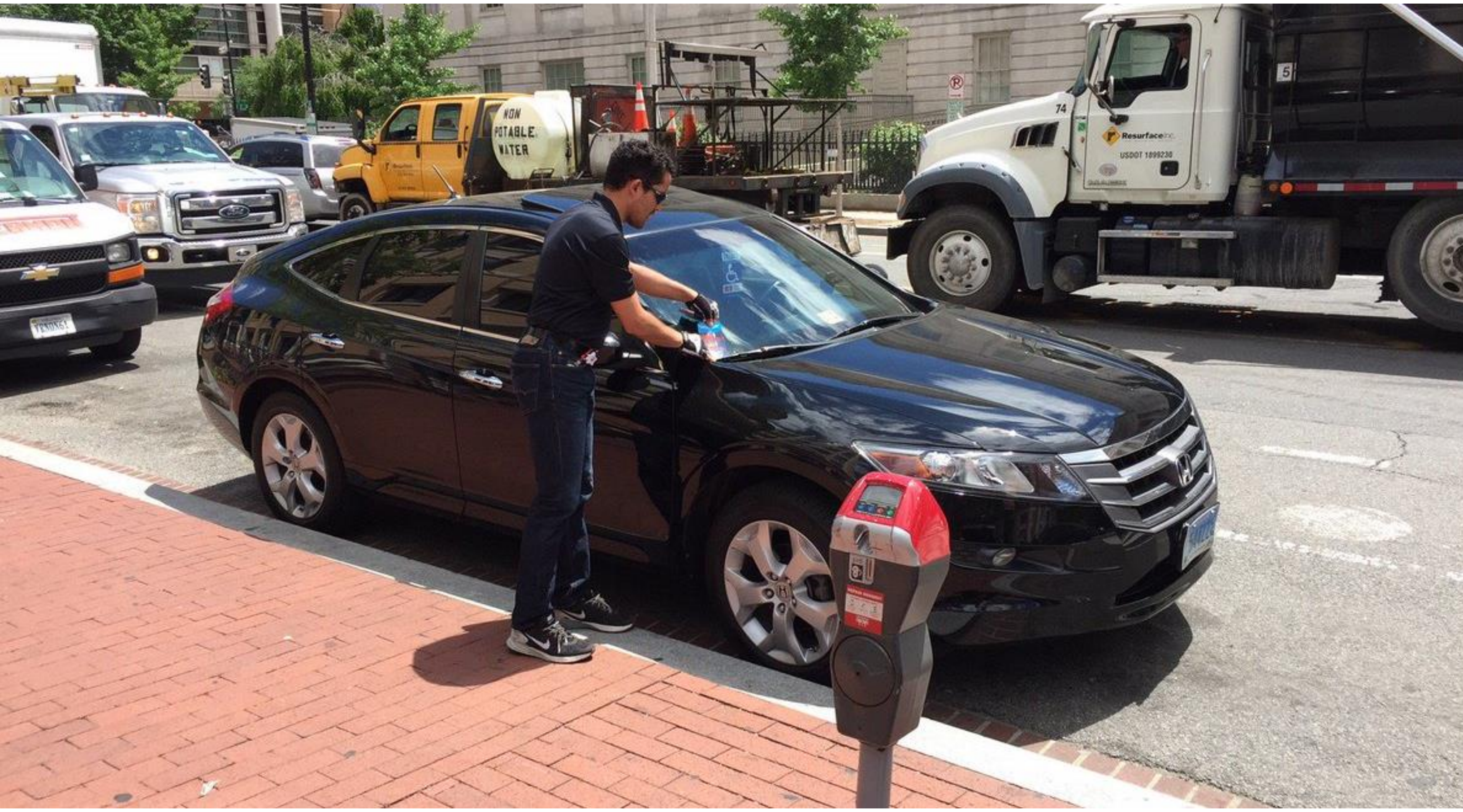


5.1.2.2 Availability of parking information

Key Findings

- An ongoing survey showed an increase in the percentage of customers who think that parking regulations and pricing are clear and easy to understand.

DDOT's cost-effective, data-driven approach to demand-based pricing enabled the agency to increase the abundance and accessibility of parking information. Two mobile applications (described in Chapter 5) provide real-time estimates of parking availability. New parking signs and calendar-style decals on parking meters (also described in Chapter 5) more clearly conveyed information about when customers could park and how much parking would cost. An ongoing survey (described in Section 0) showed an increase in the percentage of customers who think that parking regulations and pricing are clear and easy to understand.



5.1.2.3 Placard use

Key Findings

- In 2017, average placard use decreased by 14.3% in the pilot area, and 9.7% in the control area.

The 2015 round of data collection indicated motorists were consistently using placards to occupy curbside parking spaces. In the pilot area, placard use peaked just above 35% in the midday time period before declining into the evening time period (Figure 5-19). The pilot area experienced slightly higher levels of placard use than the control area.

In 2017, average placard use decreased by 14.3% in the pilot area, and 9.7% in the control area (Table 5-5). While placard use in the pilot area exceeded placard use in the control area in 2015, placard use in the control area exceeded placard use in the pilot area in 2017, though the two areas had much more similar usage rates in 2017. 2017 placard use in the pilot area stayed relatively consistent throughout the day, while placard use in the control area continued to experience sharper peaks (Figure 5-19). The overall decrease in use indicates that placard users are likely now paying for parking or there has been an increase in curbside availability for paying customers.

While the changes in placard use cannot be directly tied to the parkDC pilot, DDOT identified a few factors that may have affected use. The implementation throughout the central business district of Red Top accessible parking meters made long-term and free on-street parking unavailable (and illegal) to a high number of placard holders. DDOT also conducted outreach to law enforcement and government placard users to discourage placard use, which may also have contributed to the decline in placard use. However, DDOT did not collect detailed data on the types of parking placards observed in the before and after studies. Because of this oversight, DDOT could not make specific observations about trends in placard use based on placard user type (i.e., disabled placard holders vs. government placard holders).

Figure 5-19. Average Weekday Placard Use (Red Top Meters Deployed May 2017)

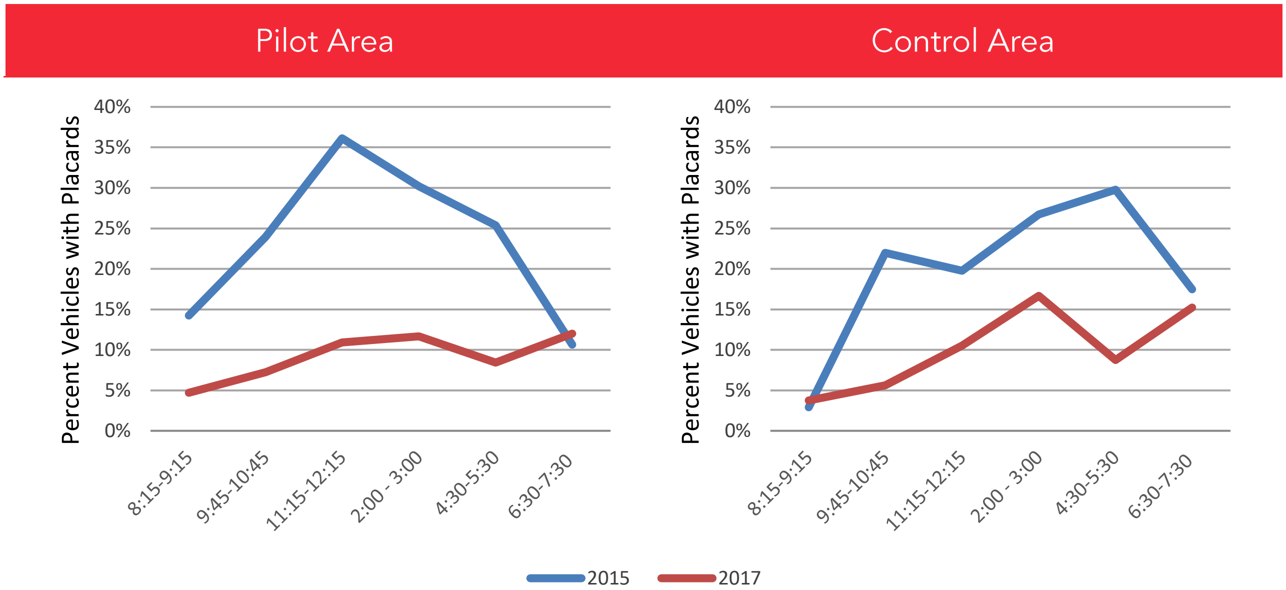


Table 5-5. Observed changes in placard use

	Pilot Area	Control Area
	Average Placard Use	**Average Placard Use**
Before Red Top Meters Deployed (2015)	23.4%	19.8%
After Red Top Meters Deployed (2017)	9.2%	10.1%
Change over Time	-14.3%	-9.7%

5.1.2.4 Safety

Vehicles competing for limited on-street parking spaces tend to circle for parking, contributing to downtown congestion and safety concerns associated with erratic or unpredictable motorist behavior. Although detailed safety data were not available for analysis during the pilot implementation period, the pilot's role in making it easier to find and pay for parking likely resulted in more predictable motorist behavior and fewer erratic movements.

5.1.3 Level 3: Broader Transportation and Land-Use Activity

This is the wider transportation ecosystem that included the parkDC pilot. Outcomes include broader transportation and land use activity and impacts on multimodal mobility and economic vitality.

The urban core of the District, including the Penn Quarter/Chinatown neighborhoods, is affected by changes to the transportation system both locally and region-wide. While changes, both temporary and permanent, tend to reverberate regionally, they have especially large and compounding impacts in the District and the urban core.

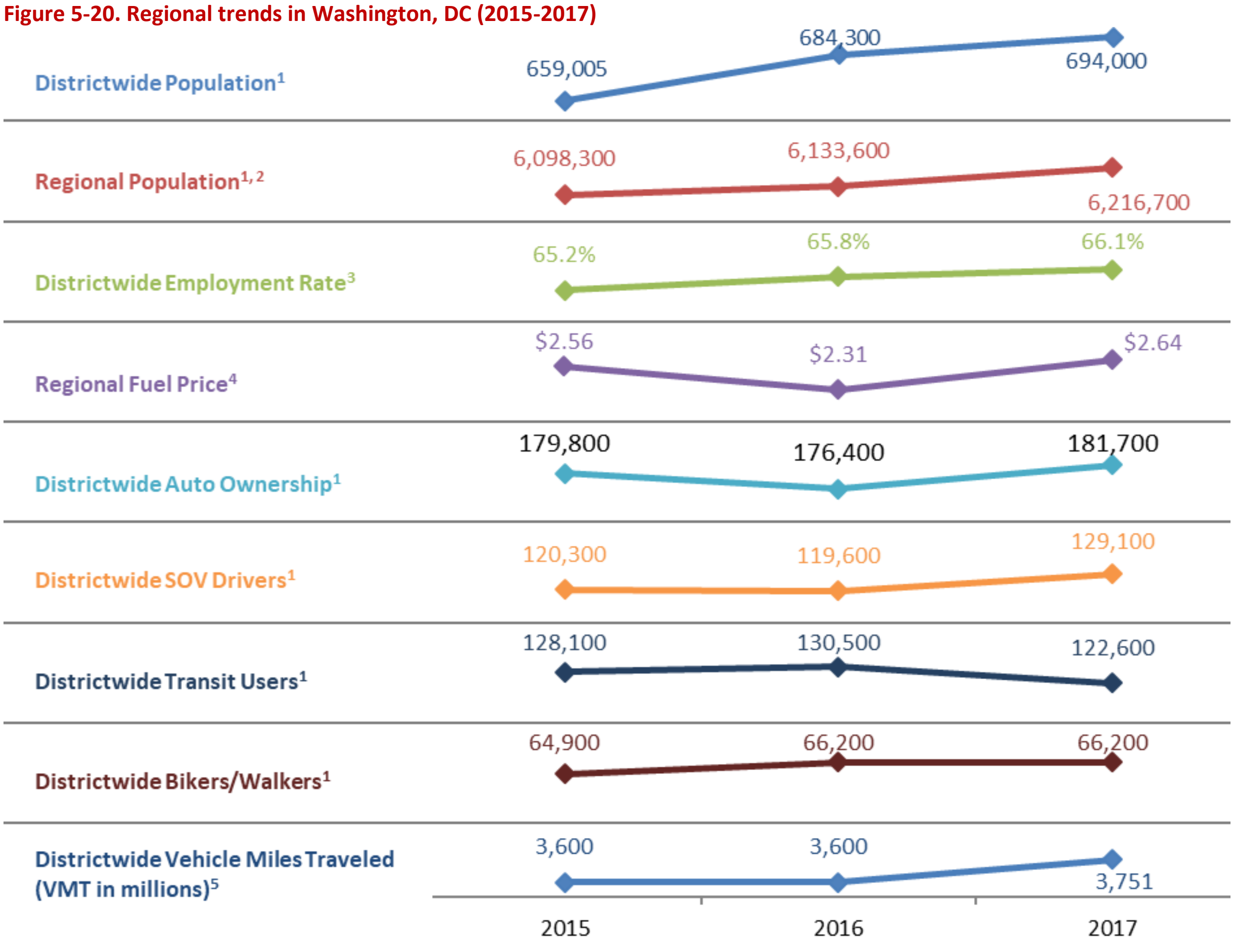
5.1.3.1 Districtwide Trends

Key Findings

- In most cases, trends in the pilot area aligned with Districtwide trends: both saw an increase in population, automobile ownership, and biking and walking to work.
- In contrast to a Districtwide upward trend in single occupancy vehicle drivers, the pilot area saw a downward trend in single-occupancy vehicle drivers.

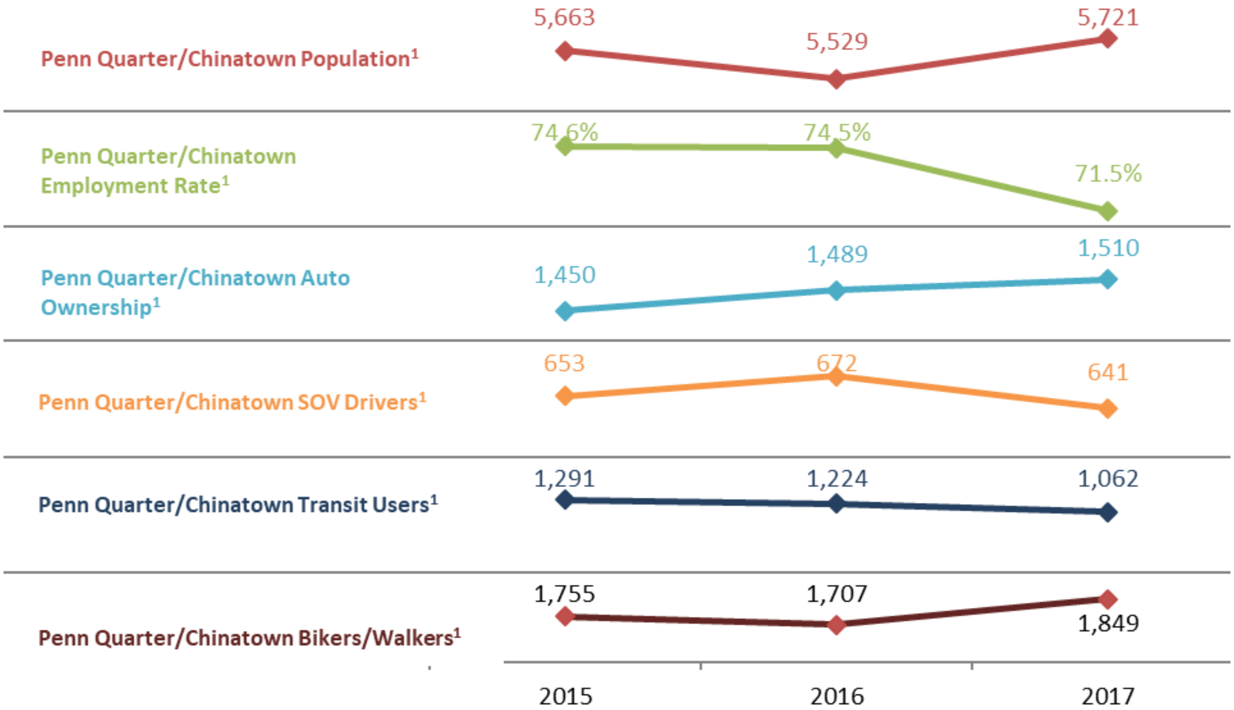
Changes to the District's population, employment, travel demand, economic activity, and multimodal transportation network can influence parking demand in the District, including the areas studied in the parkDC pilot. As shown in Figure 5-20, increases in auto ownership and single-occupancy vehicle (SOV) drivers among District residents from 2015 to 2017 suggest an increase in District-based parking demand during the pilot period. However, changes in regional travel patterns, population, employment, non-motorized travel, and fuel price may have offset these trends.

Figure 5-20. Regional trends in Washington, DC (2015-2017)



[1]American Community Survey 1-Year Estimates
[2]Washington-Arlington-Alexandria Metropolitan Statistical Area
[3]Bureau of Labor Statistics
[4]U.S. Energy Information Administration
[5]FHWA Office of Highway Policy Information

Figure 5-21. Trends in the parkDC pilot area (2015-2017) – values represent Penn Quarter/Chinatown residents only



[1]American Community Survey 5-Year Estimates

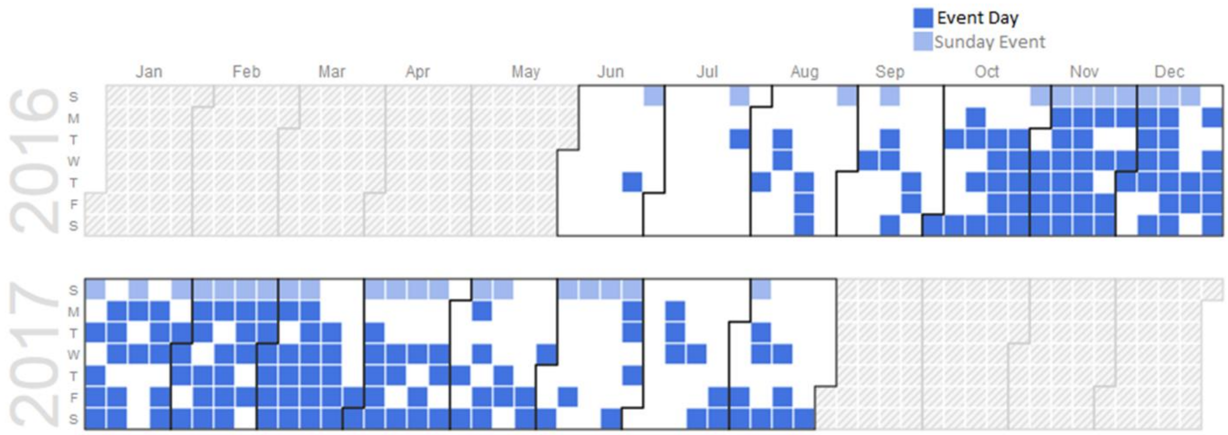
Most regional and pilot-area-specific trends observed during the pilot are likely related to external influences. DDOT has considered and investigated a range of external factors that could be influencing parking demand in addition to price changes, including:

- **Metro Activity and SafeTrack:** WMATA's SafeTrack program implemented long-duration track outages for major safety projects in key parts of the Metro system between June 2016 and July 2017. As a result, changes in service impacted local commutes and could have affected people's decisions to drive, take transit, or use some other form of transportation to get to work.

- **Street closures and temporary parking removal:** Parades, motorcades, construction, and other activities can all prompt street closures or occupy the parking lane for an extended period. DDOT tracked street closures and developed rate recommendations for impacted blocks accordingly.

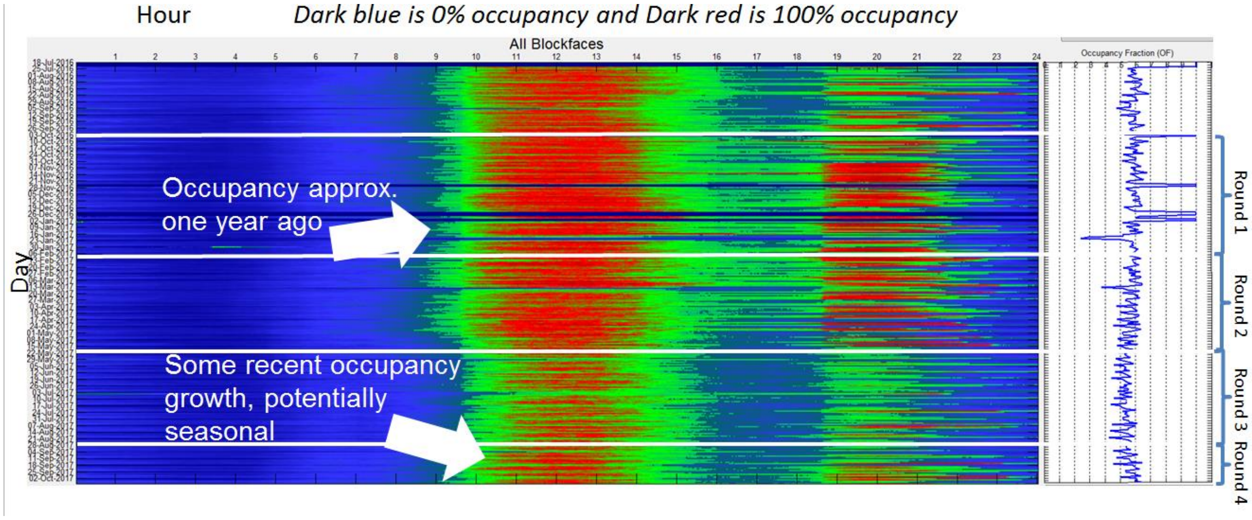
- **Capital One Arena events:** Located in the heart of the pilot area, the Capital One Arena draws thousands of visitors to the area to attend sporting and entertainment events. DDOT assessed the monthly frequency of Arena events to better determine how they may affect occupancy in the pilot area (Figure 5-22). Events generally peak between late fall and early spring, with over 20 occurring every month between October 2016 and April 2017.

Figure 5-22. Capital One Arena events by month



- **Seasonality:** Seasonal impacts also likely influenced the number of people traveling to the pilot area. Changes in activity such as holidays and Congress shifting in and out of session appear to have influenced the magnitude of visitors to the pilot area, as well as events at the Capital One Arena. Figure 5-23 uses a heat chart to show how occupancy levels in the pilot area fluctuated throughout the year.

Figure 5-23. Impacts of seasonal changes on parking occupancy



5.1.3.2 Congestion reduction

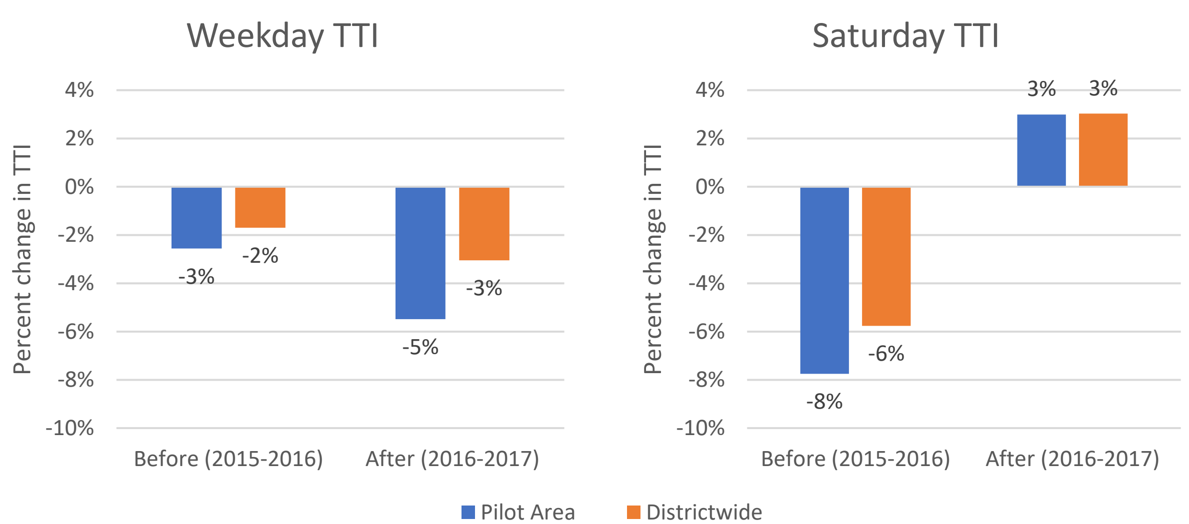
This section highlights lessons learned from the effect of demand-based pricing on traffic congestion. Major roads in the pilot area traditionally experience high levels of congestion and low travel time reliability. The parkDC pilot sought to alleviate this congestion through improved access to parking, which was expected to reduce circling for parking and double parking, both of which contribute to congestion.

Key Findings

- Congestion trended downwards during the pilot decreasing by five percent in the pilot, matching Districtwide trends which showed a three percent reduction
- Travel time reliability improved slightly during the pilot with a five percent improvement in the pilot area, matching Districtwide trends which showed a three percent improvement

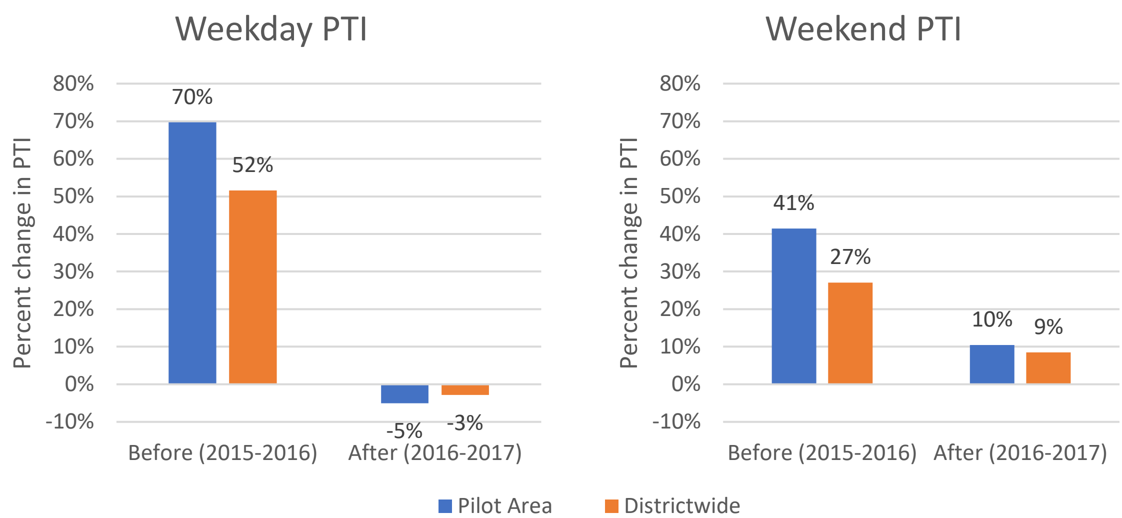
The percent change in travel time index (TTI) and planning time index (PTI) from 2015 to 2016 (before) are compared to the percent change from 2016 to 2017 (after). Congestion levels (indicated by TTI) decreased by five percent in the pilot area on weekdays, compared to a Districtwide decrease of three percent. Congestion levels increased by three percent in both the pilot area and Districtwide on Saturdays. Figure 5-24 compares percent weekday and Saturday congestion levels in the pilot area and across the District.

Figure 5-24. Average change in travel time index (congestion) scores



Travel time reliability (indicated by PTI) improved by five percent in the pilot area on weekdays, compared to a Districtwide improvement of three percent. Travel time reliability worsened by ten percent in the pilot area on Saturdays, compared to a nine percent decrease in travel time reliability Districtwide on Saturdays. Figure 5-25 compares the percent change in weekday and Saturday travel time reliability in the pilot area and across the District.

Figure 5-25. Average change in planning time index (travel time reliability) scores



The congestion and reliability data suggest that the pilot did not negatively impact traffic congestion in the area may have helped to alleviate traffic congestion.

5.1.3.3 Economic access

Parking access directly relates to people's access to school, work, entertainment, food and shopping. This section examines the relationship between the parkDC pilot and economic activity in the Penn Quarter/Chinatown neighborhoods. Economic data from within the pilot area and Districtwide showed generally positive trends after the study. Positive trends in sales volume, employment and the number of establishments in the parkDC pilot area aligned with trends Districtwide. As with congestion impacts, however, the parkDC pilot's impact on economic access and vitality is inconclusive.

Key Findings

- Changes in economic activity in the pilot area generally align with Districtwide trends
- Entertainment sales in the pilot area increased during the pilot despite a Districtwide decrease in entertainment sales.

DDOT assessed changes over time in sales volume, sales volume per establishment, total establishments, total employees, and employees per establishment in both the pilot area and Districtwide. Figure 5-26 shows how these economic data points changed between 2015 and 2017 in the pilot area and Districtwide.

Figure 5-26. Economic trends in the pilot area compared to Districtwide (2015 – 2017)

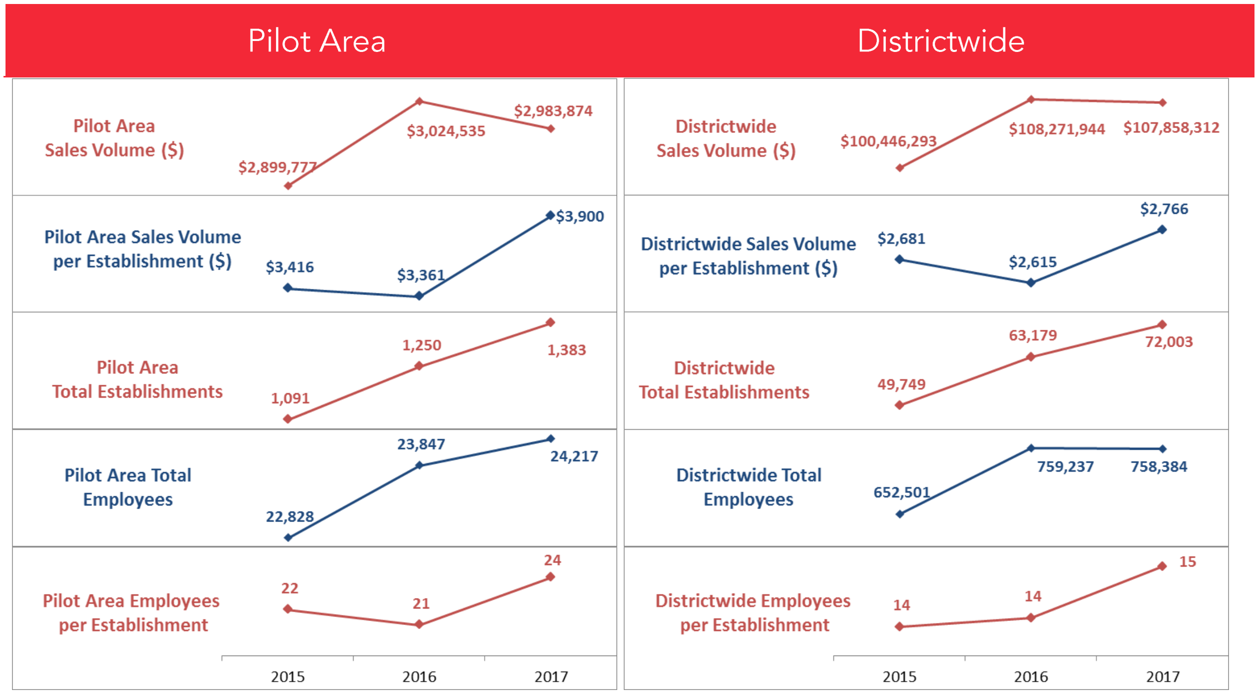


Figure 5-27 highlights how sales for specific industries changed between 2015 and 2017 in the pilot area and Districtwide. These industries provide a cross section of the economy in the pilot area and have varying demands for on-street parking throughout the day. Economic trends in the pilot area generally align with Districtwide ones, indicating that the parkDC pilot did not have a strong positive or negative effect on economic activity. The one exception is entertainment sales, which decreased Districtwide and increased in the pilot area.

Source: Wikimedia Commons. Nesnad

Figure 5-27. Sales trends for specific industries in the pilot area compared to Districtwide (2015 – 2017)

5.1.3.4 Multimodal interactions

In an urban area like the Penn Quarter and Chinatown neighborhoods, the relationships between various modes of travel make it likely that when operations for one mode changes, the other modes are affected. This section investigates potential pilot impacts on multimodal performance in the pilot area. Changes in transit, pedestrian, and bicycle activity are detailed below.

Key Findings

- Bus speeds remained relatively constant after the pilot was implemented, aligning with Districtwide trends
- Bus ridership declined slightly after implementation, aligning with Districtwide trends
- Metrorail ridership increased slightly after implementation, in contrast with a steady systemwide decline in ridership
- Capital Bikeshare ridership grew after implementation, aligning with Districtwide trends

5.1.3.4.1 Observed Changes in Bus Transit

Figure 5-28 shows average bus speeds in the pilot area and Districtwide before, during, and after the parkDC pilot. Average bus speeds in the pilot area experienced a very slight decline after the pilot (0.02 mph), but this decline matches a trend that began before the pilot (0.03 mph decline between 2015 and 2016). Districtwide, average bus speeds are higher than in the pilot area, since the pilot area is located within one of the denser, congested neighborhoods in the District. Average bus speeds outside of the pilot area similarly stayed relatively consistent before and after the pilot was implemented.

Figure 5-28. Change over time in weekday bus speeds (2015 -2017)

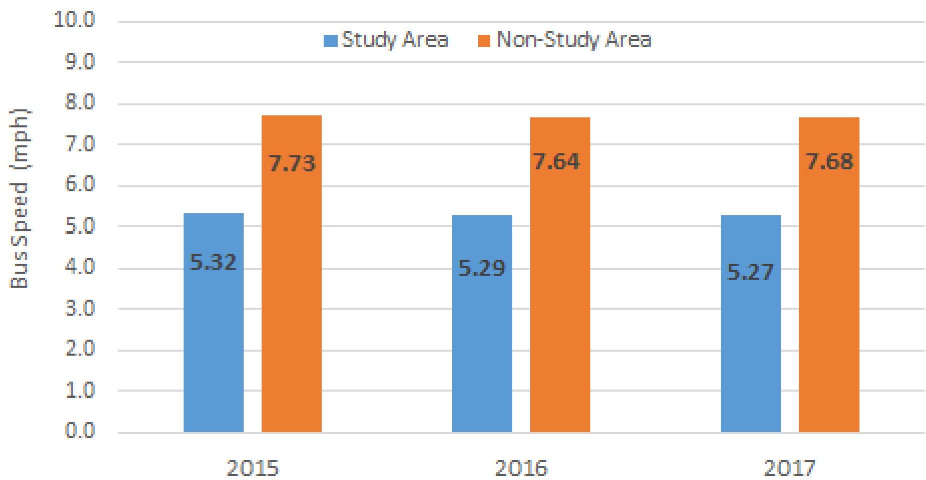
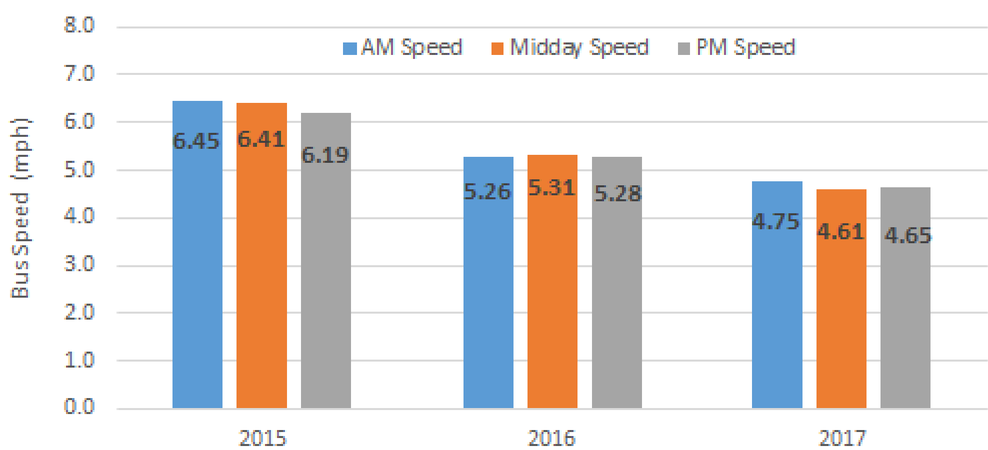


Figure 5-29 shows how bus speeds in the pilot area have changed based on time of day. The average trend of declining bus speeds occurs across all time periods. After the pilot was implemented, the greatest decreases in bus speeds in the pilot area occurred in the midday and PM peak periods.

Figure 5-29. Change in bus speeds by time of day in the parkDC pilot area



DDOT also investigated changes in bus ridership. Figure 5-30 shows changes in bus ridership in the pilot area and Districtwide before, during, and after the pilot was implemented. Average ridership in the pilot area experienced a slight decline after the pilot, but this decline matches a trend that began before the pilot. Average ridership outside of the pilot area decreased before the pilot was implemented and stabilized after implementation. Figure 5-31 shows the percent change in daily average stop-level ridership over the course of the parkDC pilot. A range of factors are contributing to declining bus ridership in the District as a whole, including broader shifts in travel behavior and ongoing work on the Metrorail system (see discussion in next section). Ridership changes may have had a greater impact on ridership in the pilot area since average daily stop-level ridership in the area is much higher than average daily stop-level ridership Districtwide (Figure 5-31). The impacts of the parkDC pilot on bus speeds and bus ridership are inconclusive.

Figure 5-30. Change in daily average ridership by time of day Districtwide (left) and in the parkDC Pilot Area (right)

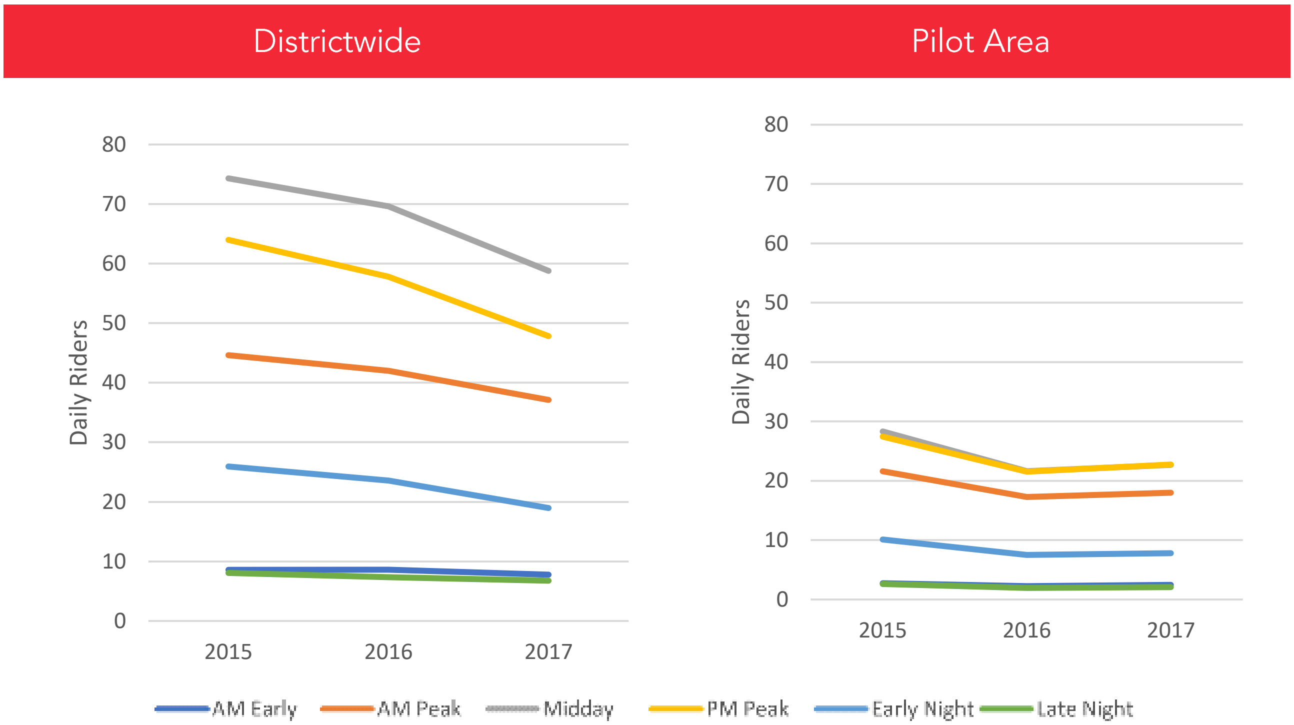
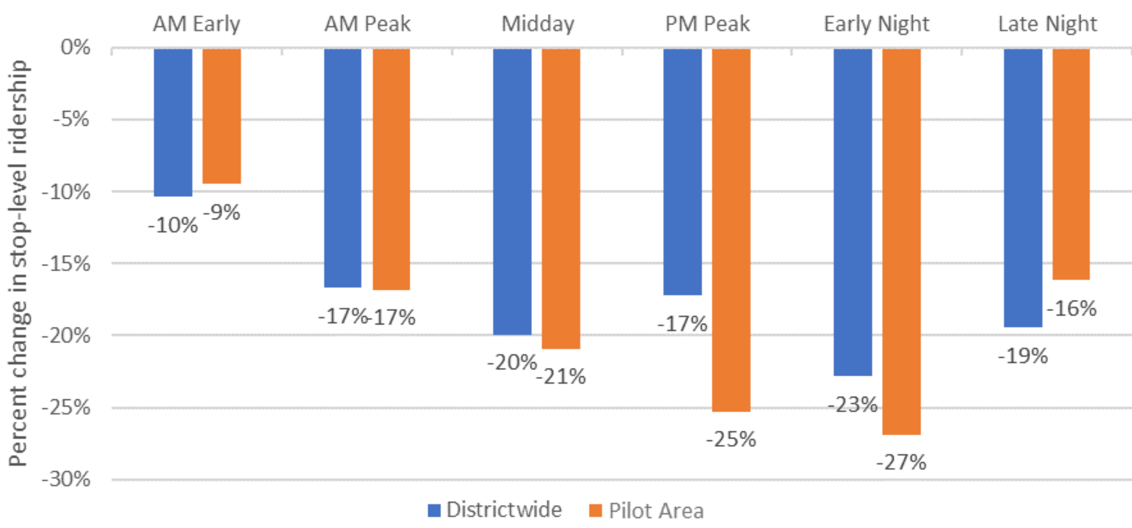


Figure 5-31. Percent change in daily average stop-level ridership (2015-2017)



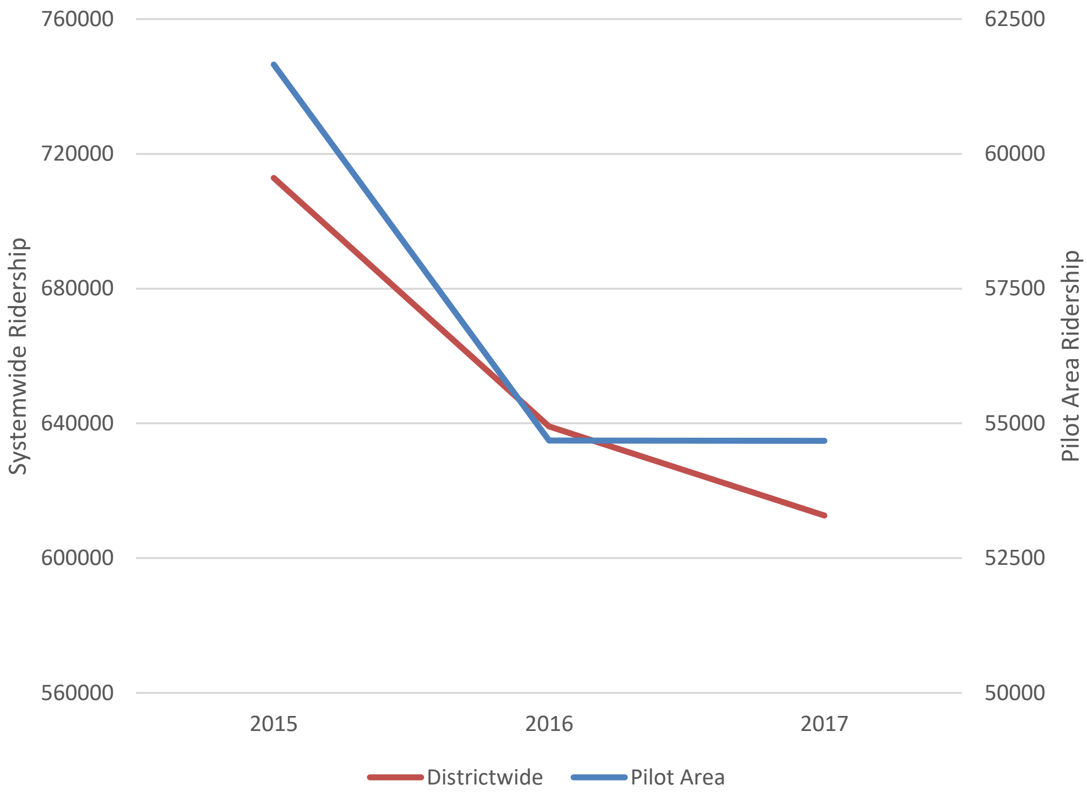
5.1.3.4.2 Observed Changes in Heavy Rail Transit

In June of 2016 WMATA announced its SafeTrack initiative, which accelerated track work on the Metrorail system to address safety recommendations and rehabilitate the infrastructure. SafeTrack included a series of "Safety Surges" that shut down line segments or necessitated continuous single-tracking for extended periods of time. These surges ranged from seven to 42 days in length, included work on each of the rail lines, and impacted stations in all three jurisdictions (the District, Maryland, and Virginia) served by Metrorail. The Safety Surges reduced capacity on the Metrorail system. To address the expected added roadway congestion during these surges, DDOT expanded hours of operation for rush-hour restricted parking. This necessitated adjusting signage and data collection to accommodate the changes.

Given the extensive work and subsequent impacts to service, the effects of SafeTrack should be considered when examining the relationship between transit performance and parking availability in the pilot area. Many changes observed in transit use may be partially attributed to SafeTrack and the pilot period being implemented simultaneously.

Data from 2015 to 2017 demonstrate the ridership for Metrorail stations in the pilot area performed better than the system as a whole (Figure 5-32). While ridership has decreased consistently for the Metrorail system, the decline in ridership at stations in the pilot area stabilized after the pilot was implemented.

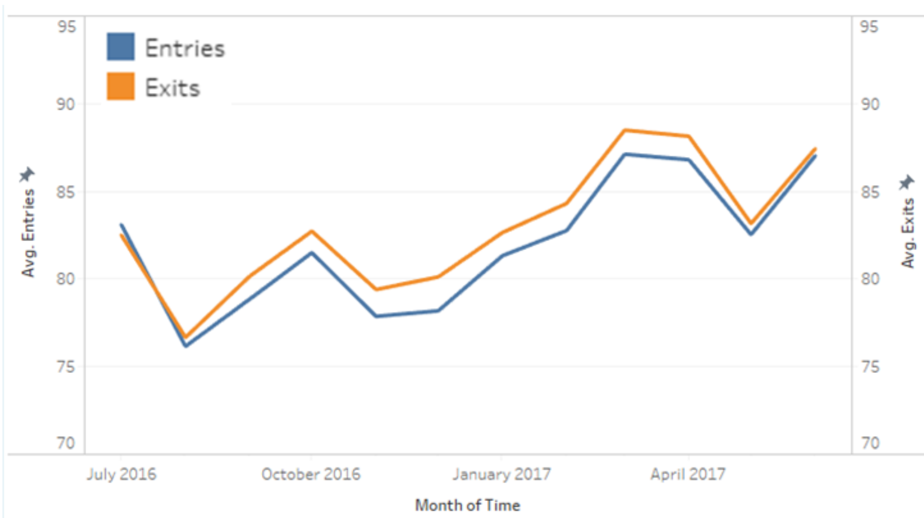
Figure 5-32. Change over time in Metrorail ridership (2015-2017)



DDOT then looked more closely at the Metrorail data to see if SafeTrack had an impact on ridership in the pilot area, and if any correlation between SafeTrack and changes in parking occupancy could be identified. Figure 5-33 displays the daily entries and exits at Metro stations within the pilot area since the time of the initial price change. As can be seen, the number of entries and exits has remained relatively stable since the first price change, apart from the large increase in January 2017 which corresponds with the 2017 Women's March on Washington (January 21, 2017) the day after the Presidential Inauguration (many of the pilot area Metro stations were closed for portions of the day during the Inauguration, lowering their ridership totals). When looking at this data aggregated by month on weekdays with outliers (Inauguration, holidays, etc.) removed, as shown in Figure 5-34, it becomes evident that Metro use within the pilot area has increased since the implementation of the first price change. This compares to a ridership decrease of about 12% on the Metrorail system as a whole in a similar time period, which is largely attributed to SafeTrack.

Figure 5-33. Entries and exits per day at pilot area Metro stations

Figure 5-34. Average weekday Metro entries and exits by month (no outliers) at pilot area Metro stations



Based on the observed changes in Metrorail ridership and Metrobus speeds, the pilot did not adversely impact transit operations in the area.

5.1.3.4.3 Relationship between Parking Availability and Bikeshare

During the pilot period, arrivals at Penn Quarter/Chinatown Capital Bikeshare stations slightly outnumbered departures each year (Figure 5-35). Bikeshare ridership stayed relatively consistent before the pilot was implemented but increased by approximately 36% after the pilot was implemented.

Figure 5-35. Change over time in Capital Bikeshare ridership in the pilot area (2015 – 2017)

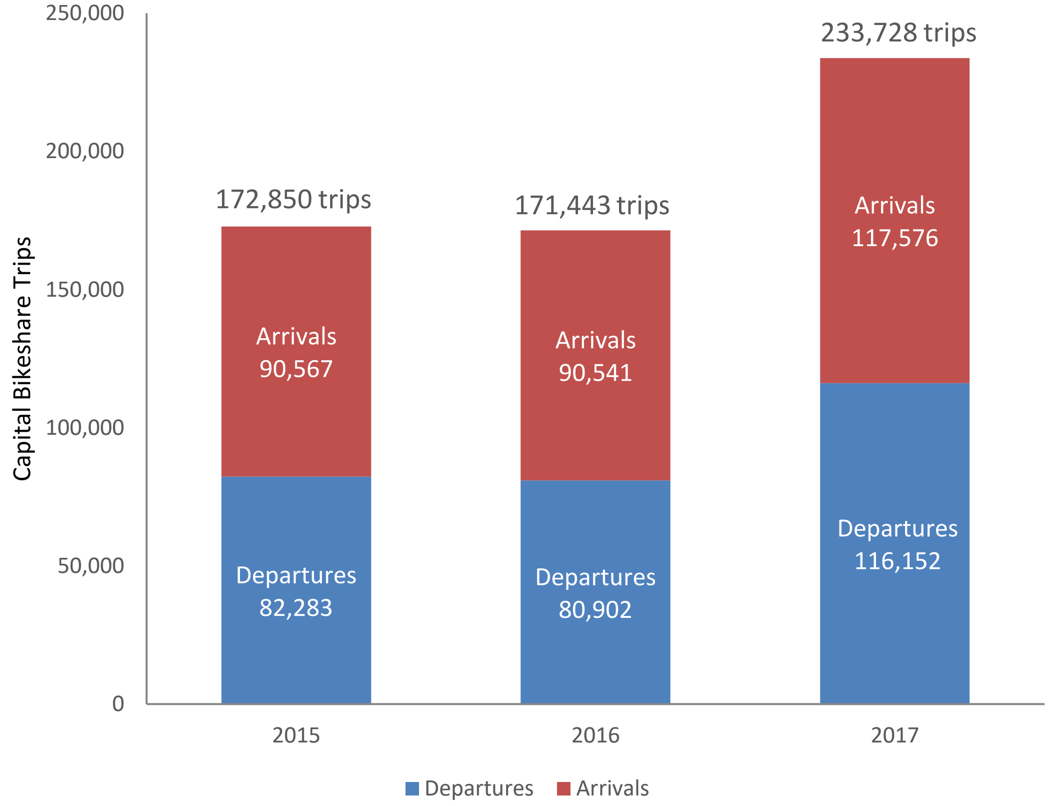
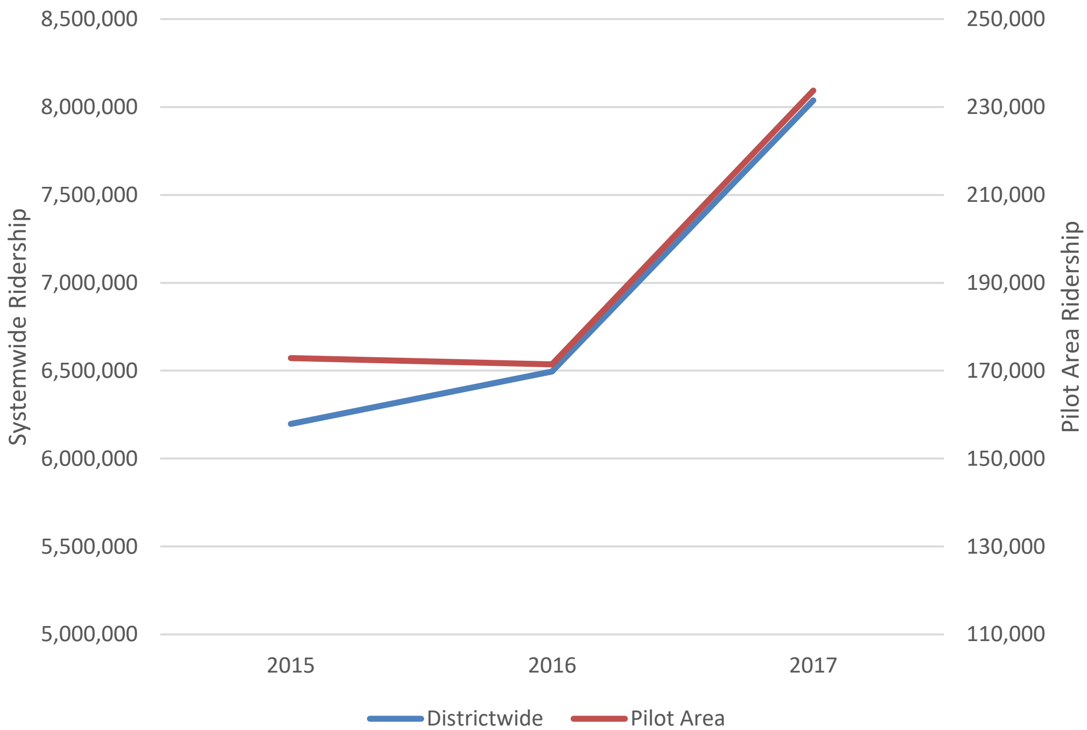


Figure 5-36 shows that the increase in Capital Bikeshare ridership in the pilot area aligns with systemwide trends. Based on the observed patterns in Capital Bikeshare ridership, the pilot did not adversely impact bicycle activity in the pilot area. As the pilot study was wrapping up, dockless bike and scooter share services began operating in the District. As of the time this report was written, these new modes were currently being evaluated by DDOT, but were not evaluated as part of this effort.

Figure 5-36. Change over time in Capital Bikeshare ridership in the pilot area (2015 – 2017)



5.2 THE AGENCY PERSPECTIVE

This section provides the outcomes experienced by DDOT, the managing agency of the parkDC Penn Quarter/Chinatown pilot.

5.2.1 Managing assets effectively

DDOT's step-down approach to a data-driven demand-based pricing program proved technically viable and cost effective. By reducing the need for in-ground sensor coverage through a blend of data sources, DDOT successfully provided real-time payment information and informed their pricing algorithm at a reasonable cost.

The pilot area's location in an active downtown area presented DDOT with a range of challenges when collecting data and provided valuable lessons learned. Collecting historic occupancy data through portable CCTV cameras proved cumbersome, and sensor installation met with challenges associated with dynamic urban environments (e.g. roadway construction, changes in bus stop locations, etc.). As with any use of emerging technologies, DDOT recognized the importance of taking a "sandbox approach" to its pricing program, which would allow DDOT to test a range of technologies to find the best fit from a technical and contractual perspective. DDOT built the necessary flexibility into its program design and contracting mechanisms to test and learn how to effectively apply a mix of new technologies. This approach helped DDOT ensure that its data-driven program was not only technically effective but also cost-effective.

The conversion to pay-by-space ensured the presence of a constant number of parking spaces and allowed for the collection of real-time payment data at a space level. The enforcement of pay-by-space proved challenging for the District's enforcement staff, likely because the rest of the District maintained its usual pay-and-display parking configuration. If DDOT chooses to transition its full on-street parking supply to a pay-by-space or similar configuration, the system-wide transition will likely reduce enforcement challenges.

5.2.2 Accommodating competing users

As detailed in lessons learned from the customer perspective, results from the pilot suggest that the parkDC team was able to better accommodate competing users. Bikeshare usage increased, Metrorail ridership stabilized, bus ridership declined slightly, and motorized vehicle congestion and travel time reliability remained stable compared to pre-pilot conditions. Double parking also decreased alongside on-street parking spaces and loading zones for commercial vehicles.

5.2.3 Improving the customer experience

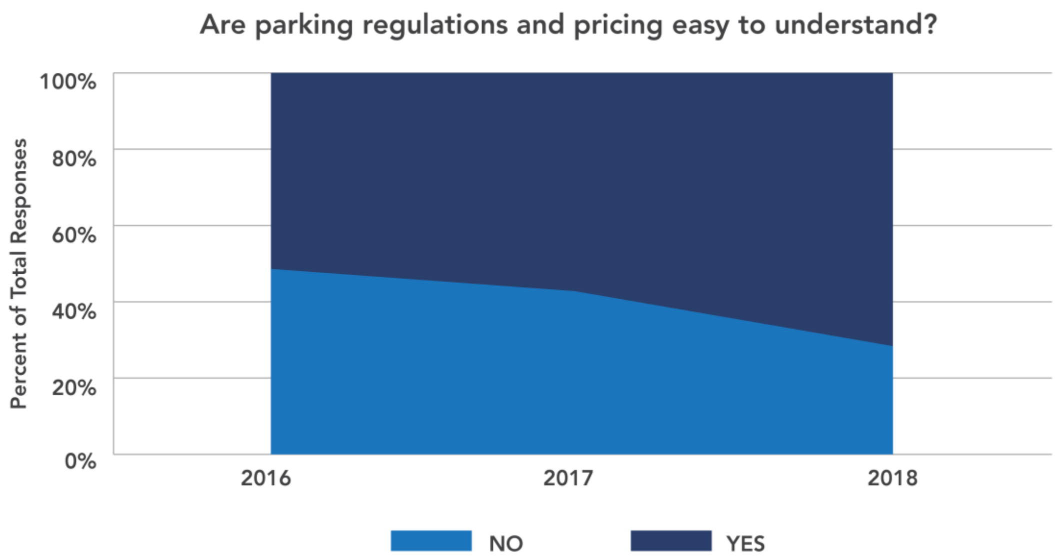
In addition to increasing available parking spaces through demand-based pricing, the parkDC pilot team made it easier to pay by improving how parking regulations and prices are communicated.

Key Findings

- Real-time traveler information apps and new parking signage improved the overall customer experience regarding parking payments.
- An ongoing customer survey showed a 15% increase in customers who think that parking regulations and pricing are clear and easy to understand.

DDOT conducted a before and after survey to begin to understand how the parkDC pilot had affected stakeholder parking experiences. While the results of the survey were not statistically significant with 196 respondents, they indicate that the various communications measures made it easier for stakeholders to understand parking regulations and pricing in the pilot area. Before the first price change, the number of people who found regulations and pricing easy to understand was split evenly with the number of people who found regulations and pricing difficult to understand. Since the first price change was implemented in 2016, the number of people who have found regulations and pricing easy to understand has increased by almost 10% while the number of people who have found regulations difficult to understand has decreased by the same amount (Figure 5-37).

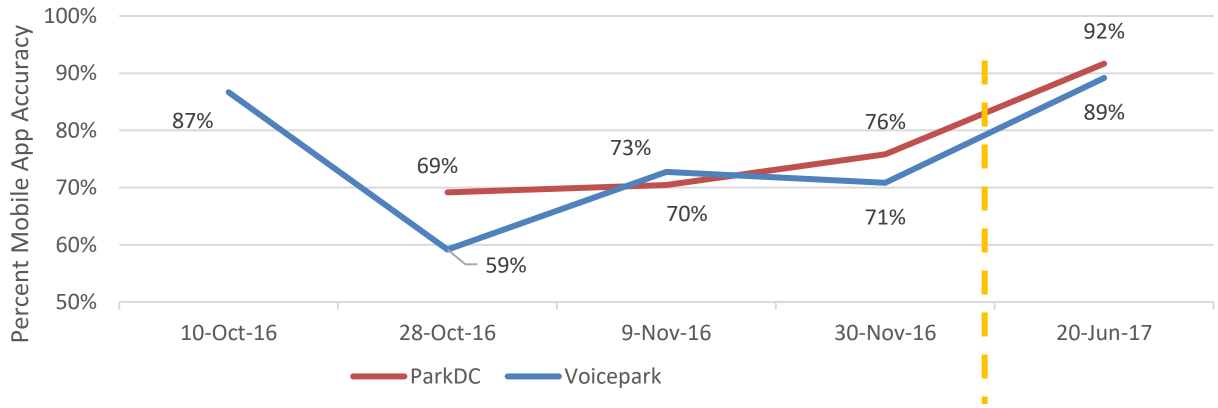
Figure 5-37. Stakeholder feedback on the clarity of parking regulations and pricing



5.2.4 Accuracy of Real-Time Traveler Information

DDOT conducted comprehensive, iterative tests of mobile app accuracy before and after both mobile applications were launched in December 2016. Figure 5-38 shows that the accuracy of both apps increased up until the launch and continued to increase, reporting between 89% and 92% accuracy six months after the launch. The positive results of the accuracy tests indicate that the iterative asset-lite approach allows DDOT to consistently improve the accuracy of real-time parking predictions. Improvement in the accuracy was due to app programming changes as well as tweaks to the real-time parking predictions over time.

Figure 5-38. Change over time in mobile app accuracy



5.2.5 Revenue stability

Key Findings

- The number of transactions remained relatively stable throughout the duration of the pilot, with seasonal fluctuations likely having a greater impact than price changes
- After an initial decrease in weekly average revenue following the implementation of the first price change, weekly average revenue collected in the pilot area surpassed pre-pilot revenue following the third price change with an increase of 10.8%.
- Due to the price changes, the amount of revenue per transaction increased during each subsequent price change

As shown in Table 5-6, the total number of transactions stayed relatively similar overall, though with fluctuations up and down over time. Seasonal factors likely had a greater impact on the number of transactions than did the price changes. After an initial decrease in weekly average revenue following the implementation of the first price change, weekly average revenue collected in the pilot area surpassed pre-pilot revenue following the third price change with an increase of 10.8% (10.8% increase in revenues from pay-by-cell and an 11.1% increase in revenues from meters). Due to the price changes, the amount of revenue per transaction increased during each subsequent price change as well.

Table 5-6. parkDC weekly revenue and transactions during the pre-pilot and after each price change

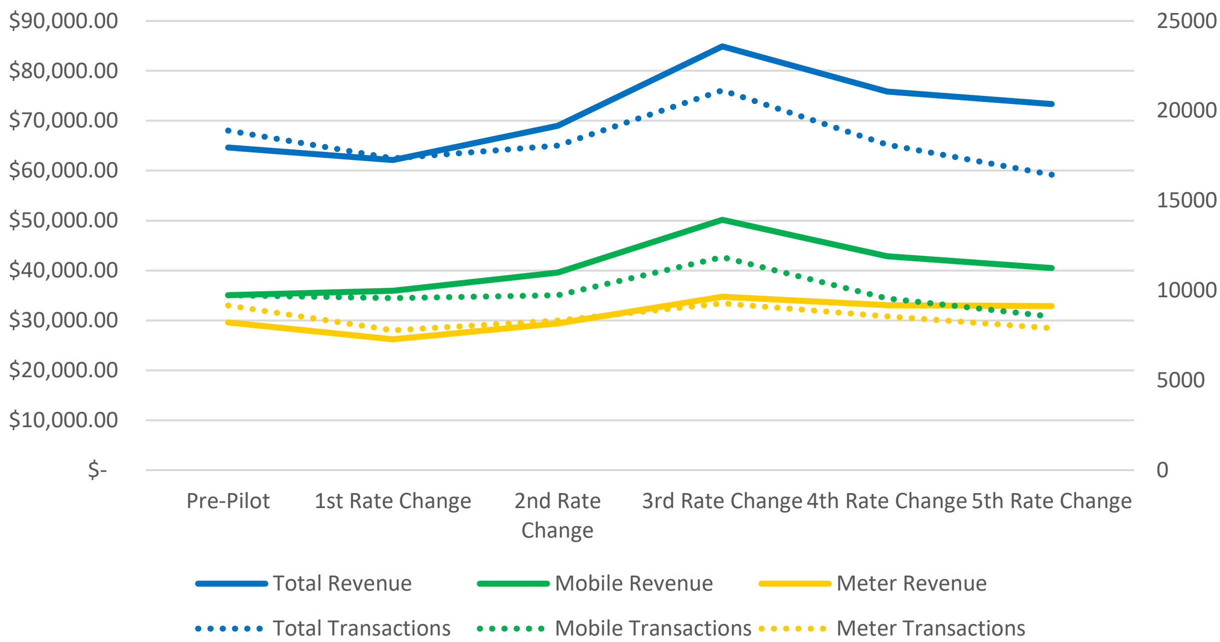
	Pre-Pilot	1st Rate Change	2nd Rate Change	3rd Rate Change	4th Rate Change	5th Rate Change
All – Transactions	*18,900*	*17,352*	*18,060*	*21,137*	*18,118*	*16,443*
Mobile Transactions	9,735	9,569	9,741	11,854	9,552	8,548
Meter Transactions	9,165	7,783	8,319	9,283	8,566	7,895
All – Revenue	*$64,656*	*$62,133*	*$69,008*	*$84,900*	*$75,871*	*$73,329*
Mobile Revenue	$35,063	$35,916	$39,617	$50,154	$42,829	$40,494
Meter Revenue	$29,593	$26,217	$29,392	$34,746	$33,041	$32,835
Revenue per transaction	$3.42	$3.58	$3.82	$4.02	$4.19	$4.46

The demand-based pricing pilot affected meter revenue by:

Implementing pay-by-space	**Changing** meter time limits in some locations	**Adjusting** rates based on demand

With the use of networked meters and mobile payments for collecting revenue, customers had several options for paying for parking. When considering the revenue by source, as shown in Figure 5-39, the weekly parking revenue increased by 17% from all sources, which includes a 22% increase from mobile payments and a 12% increase from meter payments.

Figure 5-39. Weekly parking revenue and transactions by source



Source: Wikimedia Commons, Ben Schumin

5.2.6 Cost Effectiveness

The District conducted a high-level cost-effectiveness evaluation to compare the asset-lite model to a "full-coverage" model with an in-ground sensor in every parking space. Since the objectives of the pilot—managing demand, increasing turnover, improving curbside use, promoting safety, etc.—are difficult to monetize, the cost-effectiveness model provides insights beyond typical cost-benefit analyses. DDOT's methodology involved the following steps:

1	**Identify** alternatives and determine the outcomes for comparison (e.g., accuracy, coverage, cost-effectiveness, etc.)
2	**Pilot** alternatives and measure outcomes (in this case, the full coverage and asset-lite models)
3	**Calculate** the costs of various alternatives
4	**Determine** the costs associated with the objectives/outcomes

By combining data on cost and efficacy, DDOT sought to inform future decisions in light of finite budgets. Specifically, DDOT identified several key findings to further reduce costs while maintaining the requisite level of accuracy:

- Sensor installation for the parkDC pilot cost 50% of the price of a full coverage model. This can likely be reduced further to between 35% and 40% of the cost of the full-coverage model based on additional refinement related to occupancy distribution, sensor deployment algorithms, and spatial dependence. Table 5-7 summarizes the differences in sensor cost between the two models.

- Costs for data gateway (equipment transmitting data to the back office) are represented as being half of those in a full coverage model. However, DDOT was able to reduce the number of data gateways further (approximately 15%) by applying apportionment algorithms to optimize their placement in the pilot area.

- Communication and related energy costs are based on cellular connectivity and solar power. Those costs would likely increase if landlines and AC power connections were required and additional wiring run through poles.

Maintenance is generally included in the sensor costs, but there are potential additional agency costs associated with permitting and oversight.

Table 5-7. Sensor cost comparison

	Full Coverage	Asset-Lite Model
Capital Costs*		
Sensors	$$$$	$$
Gateways	$$	$
Operations		
Communications (annual)	$$	$
Maintenance	$$	$
Baseline Data	$	$
Data Fusion/Analytics	$	$$
***Assumes 10 spaces per block, total of 100 spaces**		

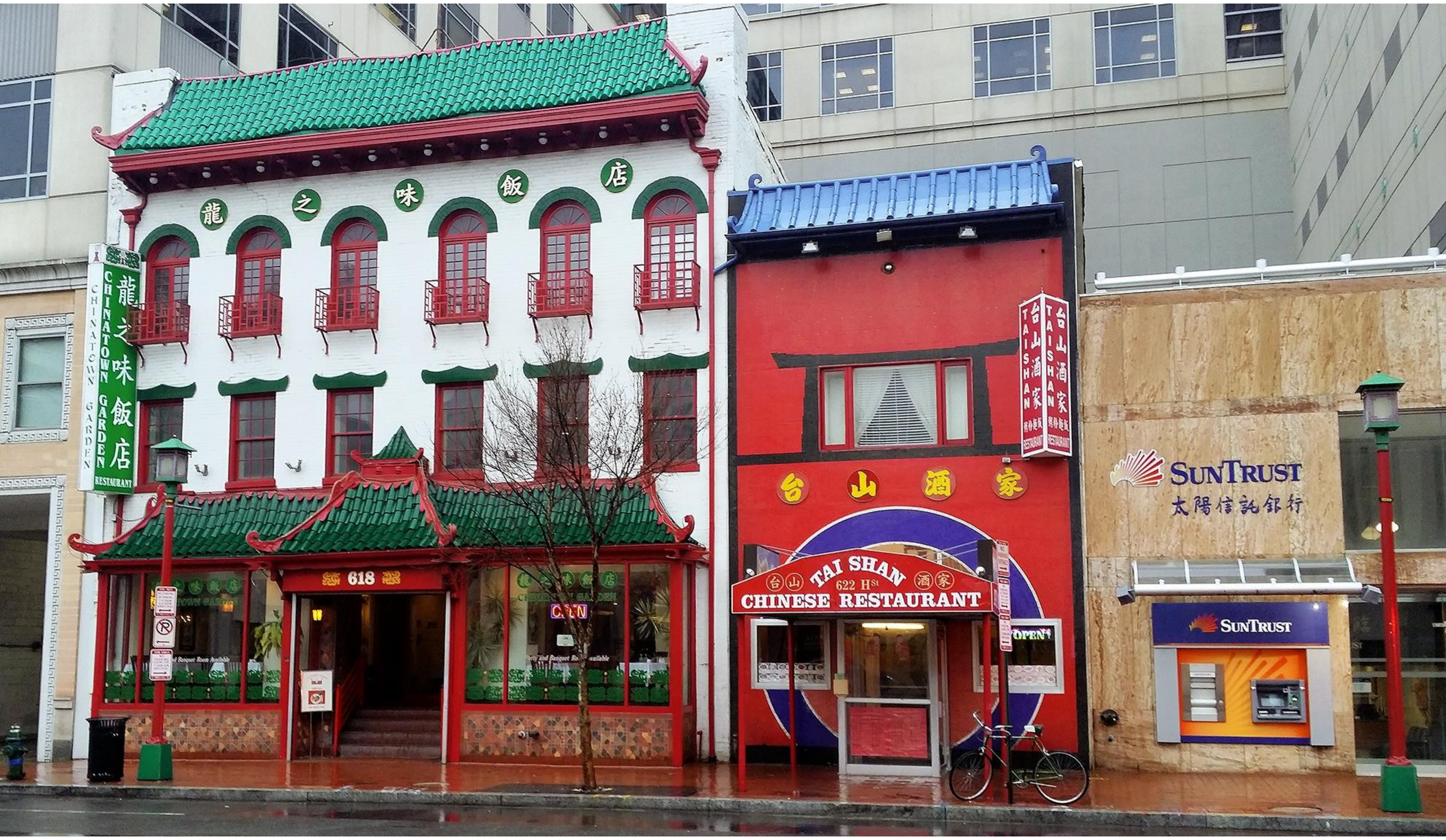
One common challenge with cost-effectiveness studies is reporting, or, rather, the lack thereof. Missing data or mistaken assumptions can color the study. DDOT has worked to provide a complete report the actions taken, reasons for those actions, and the results (which are available in this document and the associated data book). The goal is to ensure the models identified in this report can be translated into practice across the industry.

5.2.6.1 Cost Analysis

The expenses to operate a parking management program like the parkDC pilot generally include capital costs, ongoing administrative and operating costs, and enforcement costs. Within the District, DDOT is responsible for the planning and implementation costs, and ongoing administrative and operation. DPW is responsible for enforcement costs. More specifically, costs to be evaluated should include:

Capital Costs	Ongoing Support and Maintenance Costs	Enforcement Costs
▪ Per unit costs, including manufacturing, shipping, warranties, adhesive, coring, and labor for sensor installation. Also includes evaluating delays that may be caused by extremes in temperature, events, etc., and the rate of installation ▪ Gateway and communication infrastructure costs, including bucket trucks, permissions/leasing of non-municipal assets, inspection costs for said infrastructure ▪ Revenue impact of curbside closures for sensor or gateway installation ▪ Analysis to determine the optimized locations for the installation of infrastructure	▪ Monthly communications and interface costs ▪ Analysis and data visualization costs ▪ Maintenance or replacement of infrastructure as needed, due to sensor or gateway failures, permitted closures or removals, non-authorized closures or removals, and assets damaged by third parties	▪ Staff costs ▪ Device and platform costs ▪ Communication costs

From the outset and throughout the course of the project, DDOT expected a neutral direct revenue outlook based on the experiences from other cities that had previously implemented performance parking. Direct revenue is defined as revenue resulting from parking meter and citation revenue. Indirect revenues, like increases in transit use, improved sales tax receipts due to increased turnover, permit fees, etc., were not factored in projections. Managing demand properly means reducing rates in underused spaces and increasing rates where demand is highest. Consequently, shifting motorists to cheaper parking should theoretically offset revenue increases in areas where rates are higher and demand is inelastic.



Source: Bruce Emmerling, pixabay

For parkDC, however, there was an increase in direct meter revenue of approximately $10,000/week over the course of the pilot. This well surpassed the monthly operational costs and could have subsidized the initial capital costs. As discussed above, strict cost-benefit modeling fails to recognize the goals of the program that are difficult to monetize. For instance, if parking demand management programs result in travel behavior changes that address broader policy objectives, such as VMT reduction (and correspondingly, traffic congestion or air pollution), the benefits will enhance the cost effectiveness of the program. Still, setting those critical goals aside paints a positive revenue picture for parkDC. Assuming an initial capital expenditure of $800,000 in parkDC, it would take approximately 37 months for the program to break even financially. There is some evidence to suggest too that increasing rates in high demand areas will increase pay-by-cell payments, reducing wear and tear on parking meters and the need for collections. These operational efficiencies should further improve a cost-benefit analysis.

This said, the impact of similar programs in other municipalities or even other parts of the District should differ for several reasons. Some factors, among many, that will influence the cost-effectiveness and cost-benefit models include:

- Current enforcement staffing levels, citation capture rates, and meter compliance
- Present rate distribution; neighborhoods where rates are generally too high may witness revenue degradation while those where rates are exceedingly low will see revenue increases
- Hours of operation and time limits of the metered parking system influence demand, as does land use and the nature of businesses in an area
- Availability of infrastructure for communications and power will influence costs; in many cities, light poles are the property of utility companies and may require additional permissions and leases

Analysis of the parkDC project will continue and outcomes will be shared. The program provides a framework for further cost-effectiveness and cost-benefit analysis as nascent technologies are introduced and tested, occupancy proxies identified, and algorithms further improved.

Source: S Pakhrin