

Disaggregate Analysis of Relationships Between Commercial Vehicle Parking Citations, Parking Supply, and Parking Demand

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Over the past several decades, road space and curb space have become increasingly scarce in urban areas. Commercial vehicles are then forced to compete with passenger vehicles for this limited space; this situation leads to an increase in illegal commercial vehicle parking. Increased commercial vehicle parking causes increased congestion, reduced safety for other road users, and an increase in the cost of final goods and services. For appropriate policies to be selected to address this problem, the relationships between illegal commercial vehicle parking and the built environment must be better understood. This research aimed to quantify the relationships of illegal commercial vehicle parking, parking supply, and parking demand through the estimation of a distance-decay-weighted regression model. Data on commercial vehicle parking citations from 2012 for the City of Toronto, Ontario, Canada, are presented. This information was used together with employment data and a parking inventory to estimate the number of tickets issued by address. A distance-decay-weighted method was applied in an attempt to capture the spatial relationships between these variables. Results of this model showed that off-street parking facilities, such as loading bays, surface lots, and parking garages, were related to lower rates of illegal commercial vehicle parking, whereas higher business densities and the restriction of existing on-street parking spaces were related to increased illegal commercial vehicle parking. These results suggest that policies encouraging the creation of off-street loading facilities for commercial vehicles and making off-street parking more attractive for passenger vehicles may help reduce the incidence of illegal commercial vehicle parking.

Three primary problems are caused by illegal commercial vehicle (CV) parking in urban areas. The first problem is cost. In 2012 alone, CVs incurred more than CAN\$27 million in parking fines in the City of Toronto, Ontario, Canada (CAN\$1 = US\$1.003 in 2012). These fines are a major contributor to the high costs associated with the last mile of the supply chain (1). Toronto recently increased the amount of parking fines during peak periods from CAN\$60 to CAN\$150 with the goal of reducing congestion caused by illegal on-street parking (CAN\$1 = US\$0.863 in 2014) (2). However, many CV operators treat parking fines as a cost of doing business in urban areas (3).

The second problem is congestion. Illegal CV parking in urban areas results in 476 million vehicle-hours of delay each year in the United States. This makes illegal CV parking the third leading cause of delay, behind only construction and crashes (4). However, unlike construction, which is necessary to maintain existing infrastructure, and crashes, which are unintentional, illegal CV parking is an intentional and unnecessary source of congestion.

The third problem is safety. When any vehicle parks illegally in a bike lane, cyclists are forced to merge into the travel lane. This is a potentially unsafe maneuver even in nearly free flow conditions, and it can become more dangerous in the congested conditions frequently observed on urban arterials during peak periods. In New York City, on average 14% of on-street CV loading events result in a conflict with a cyclist (5). Consider also that CVs have been found to cause a disproportionately high number of cyclist fatalities, in part because of these conflicts (6).

Illegal CV parking is already causing significant problems in urban areas, and these problems will only be exacerbated by the increased employment and population density expected in major urban centers over the next several decades. The greater Toronto and Hamilton, Ontario, Canada, area grew 9% between 2006 and 2011, and it is now home to more than 6.5 million people (7). If the problems caused by illegal CV parking are not adequately addressed in the near future, cities will become increasingly expensive and inefficient.

Many potential policy measures have been recommended, but most are aimed at addressing location specific problems or are based on interviews and focus groups rather than analytical methods. For example, FHWA has developed a series of case studies for major U.S. cities (Los Angeles, California; New York City; Washington, D.C.; and Orlando, Florida) to document prominent goods movement strategies (8–11). Other studies have taken a more general approach and presented policies that may be more broadly applicable (12–14), but they have relied on expert opinion and driver interviews rather than quantified relationships.

Recent studies in Chicago, Illinois, and New York City have begun to apply data driven approaches to analyzing illegal CV parking. The Chicago study estimated a regression model for CV parking citations, and it identified several socioeconomic and land use factors that contributed to high densities of CV parking citations. Although complete information on the supply of parking was not available for this study, alleyways were found to be able to reduce the incidence of illegal CV parking (15). The New York study estimated the demand for and supply of parking in the Manhattan borough and found that many areas had CV occupancy rates well over 100%. This result indicates a

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significant deficiency in the supply of CV parking facilities and is likely a major contributing factor to illegal CV parking in New York (16). This study gives credence to the claims made by CV operators that often there is simply nowhere for them to park legally. However, most urban areas in North America are not as densely populated as Manhattan.

In light of the importance of this issue and the fact that relatively little prior analytical research has been done on this topic, this paper aims to identify relationships between illegal CV parking and the built environment. This research attempts to go beyond previous efforts by using a distance-decay-weighted regression model to identify these relationships. The model attempts to predict parking citations using data on the supply of and demand for parking. The significant variables and coefficient estimates resulting from this model can help to identify policy measures that are most likely to reduce the incidence of illegal CV parking.

The remainder of this paper is organized as follows. The next section presents the data used in this study, followed by a description of the methods and analysis of their results. The paper concludes with a summary of key findings and policy implications.

DATA

This research draws on four sets of data: parking tickets, parking supply, employment, and passenger trips. To allow for the inclusion of parking supply data, the study area was limited to an area in downtown Toronto bounded by Queen Street on the north, Front Street on the south, Victoria Street on the east, and Simcoe Street on the west. This study area captures what can be referred to as the core

of Toronto’s central business district (CBD). This area is approximately 800 m by 800 m (approximately ½ mi by ½ mi) and contains the highest employment density areas in Toronto. The study area is shown in Figure 1. Each of the data sets used in this research is described in the following section.

The parking ticket data used in this research was obtained from the City of Toronto Open Data Catalogue (17). This data catalogue is part of a recent open government movement, and it contains up-to-date information on everything from the locations of automated external defibrillators to water main breaks throughout the city. The 2012 City of Toronto parking ticket database contains the following information:

- Date of infraction,
- Infraction code,
- Description of infraction,
- Amount of applicable fine,
- Time of infraction,
- Street address, and
- Province or state code of vehicle license plate.

A Freedom of Information Act request was submitted to obtain information indicating whether the each citation was issued to a vehicle owned by an individual or by a company. This information was used to segment the ticket data into personal vehicles and commercial vehicles. Though segmenting the data in this way could result in cars purchased for employee use being included in the commercial vehicle category, the number of nondelivery or service vehicles is likely small.

The ticket data set contains 2,373,687 records. Of this total, 630,280 records, or more than one-quarter of all tickets issued (26.5%), are identified as commercial vehicles. The total fine amount for

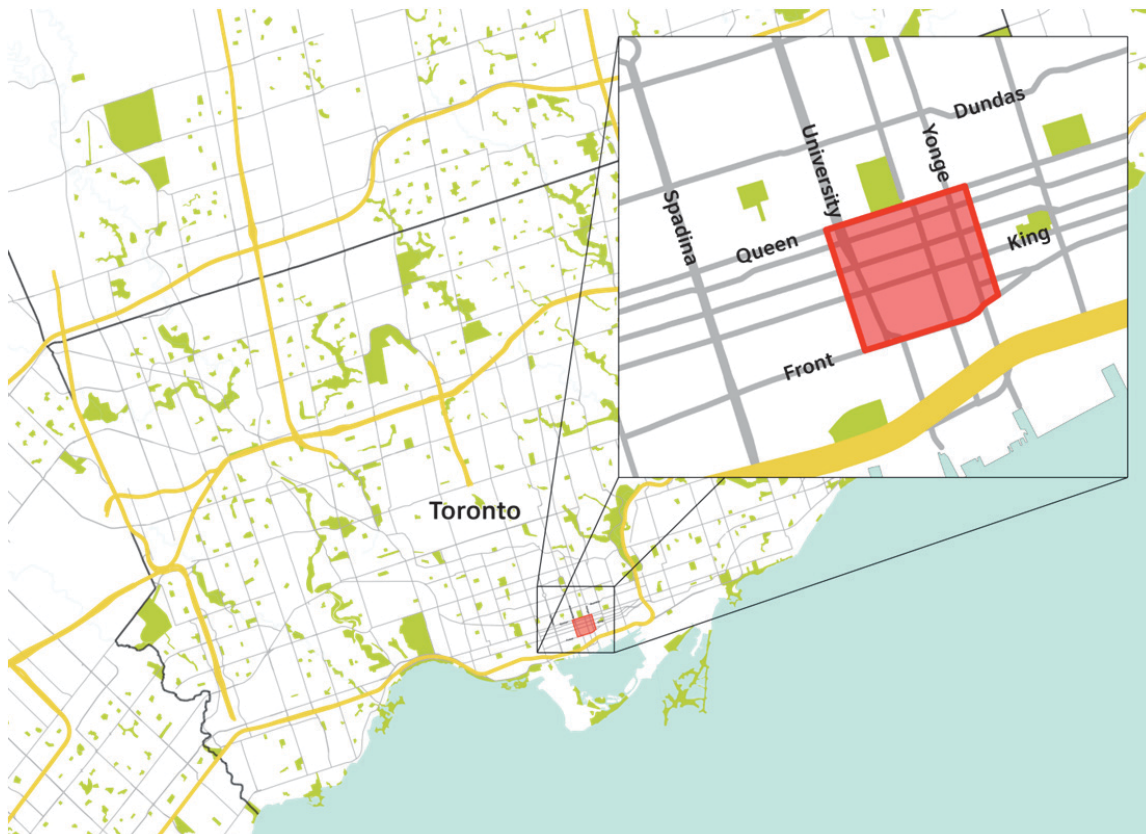


FIGURE 1 Study area in downtown Toronto.

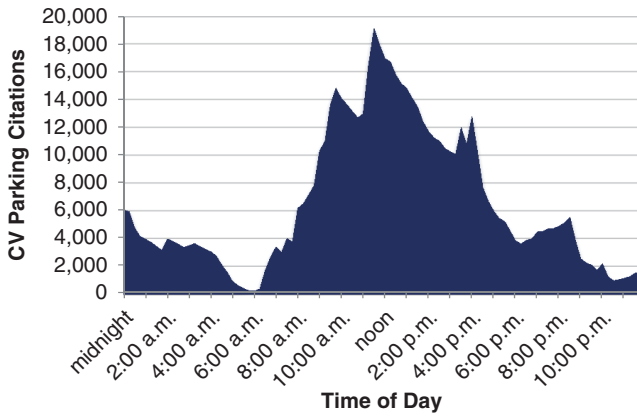


FIGURE 2 Temporal distribution of CV parking citations issued within the City of Toronto.

personal and commercial vehicles combined is CAN\$96,058,390. Parking fines issued to commercial vehicles make up 28.7% of this amount, or CAN\$27,615,375.

Figure 2 shows the temporal variation of CV parking tickets for the entire city of Toronto. Peaks are clearly visible at several times throughout the day: midnight, 10:00 a.m., noon, and 4:00 p.m. These peaks can be explained by a combination of time periods with more strict parking regulations and times of peak CV activity. The peak at 10:00 a.m., for example, can be attributed to the large number of deliveries that occur during the a.m. peak period. The peaks at noon and 4:00 p.m. can be attributed to restrictions beginning at 11:30 a.m. and 4:00 p.m., respectively.

These peaks are also visible if the area of interest is limited to the CBD, as shown in Figure 3. The peak at 4:00 p.m. is much more pronounced; this distinction is likely caused by a higher proportion of streets in the CBD having peak period parking restrictions than streets in the rest of the city. The CBD also sees virtually no tickets issued between midnight and 6:30 a.m. This absence of tickets could signal a lack of enforcement, lack of CV activity outside peak periods, or relative abundance of available parking spaces during off-peak periods. The lack of CV activity during this time period is likely to change in the short term, as some operators begin making trips during off-peak periods to achieve time savings. Unless noise mitigation measures are taken by off-peak shippers, this increased activity is likely to spur increased enforcement related to noise restrictions.

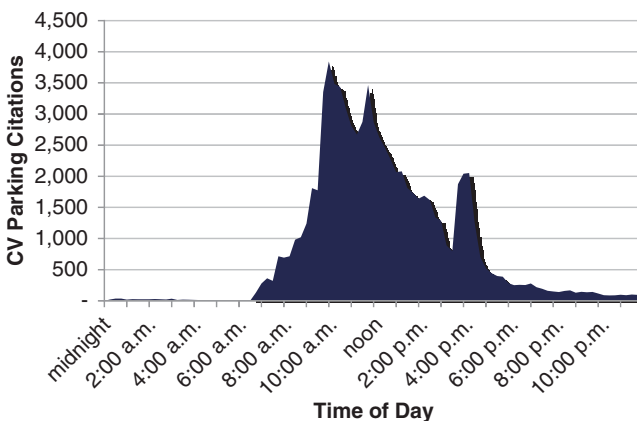


FIGURE 3 Temporal distribution of CV parking citations issued within Toronto CBD.

In 2012, 120,840 tickets were issued in Toronto’s CBD, totaling CAN\$5,505,015 in fines. Of this total, 80,316 tickets, or 66% of all tickets, were issued to CVs. CVs accounted for a similar amount of the total fines, accruing CAN\$3,734,030, or 67.8%. These figures show that CVs account for a much higher share of parking citations in the CBD compared with the same figures for the city as a whole (66% in the CBD and 26.5% in whole city). This proportion can be explained partly by the larger number of CV trips that are destined for the CBD.

Table 1 shows the most frequent infractions for which CVs in the CBD are cited. The majority of tickets are issued to vehicles for parking, stopping, or standing during a prohibited time. This helps explain the peaks in Figure 3 that occur at noon and 4:00 p.m., as parking during these times are generally prohibited. Vehicles occupying on-street spaces during restricted periods account for about 80% of all CV parking citations. The most common of the remaining citations include failing to pay for parking or parking a vehicle in a prohibited location, such as on the sidewalk or in front of a transit stop.

Data on the supply of parking were initially collected in August 2010. They were compiled to form a complete parking inventory for the Toronto CBD. This inventory includes all on-street spaces, off-street surface lots, alleyway loading zones, loading bays, parking garages, and private garages, as shown in Figure 4. A more in-depth description of the data collection can be found in Kwok (18). The on-street portion of this inventory was updated in August 2013 to include detailed information on the timing of parking restrictions for on-street parking, standing, and stopping.

Data on the demand for parking were derived from two sources. For CVs, business establishment location, industry classification, and employment data were obtained from an Info Canada database. These data were used to calculate CV trips using a previously estimated freight trip generation (FTG) model (19). Establishment data were available for 213 addresses located in the study area, representing 5,000 unique establishments employing more than 161,000 people. These establishments were found to generate more than 1,000 CV trips per day.

Passenger vehicle trips to the study area were obtained from the 2006 Transportation Tomorrow Survey (TTS). The TTS is a comprehensive travel survey of individuals in the greater Toronto and Hamilton area and is conducted once every 5 years. Data from the TTS were made available by the Data Management Group at the University of Toronto. More than 5,000 passenger vehicle trips were made to this area each day during the p.m. peak period.

TABLE 1 Top CV Citations, by Infraction

Infraction	Frequency	Percentage
Parking during prohibited time or day	42,390	52.8
Stopping during prohibited time or day	17,234	21.5
Standing during prohibited time or day	6,398	8.0
Failure to display parking receipt	2,588	3.2
Parking in travel lane	1,888	2.4
Failure to deposit parking fee	1,682	2.1
Stopping on sidewalk	1,227	1.5
Standing in taxicab standing area	1,131	1.4
Standing at signed transit stop	1,053	1.3
Other	4,725	5.8
Total	80,316	100



FIGURE 4 Parking supply in the Toronto CBD (20 (st = street; W = west; E = east; pl = place; ave = avenue).

METHODS

When attempting to find relationships between parking supply, parking demand, and parking citations, the spatial interactions between these variables must be accounted for. A special many-to-many relationship occurs between parking spaces and trip destinations, which are the points where parking is demanded. Generally, all parking facilities can be used by a vehicle with any destination. This means that even though an establishment may have on-street parking directly in front of its door, it is not used only by CVs or passenger vehicles making a trip to that establishment. Similarly, those vehicles making trips to the establishment are not limited to the spaces directly in front of the establishment. Drivers may choose from any number of parking facilities in a wide area surrounding the establishment. Therefore, each establishment has an effective parking supply that is some portion of all the parking spaces in the area around it. Drivers of passenger vehicles and CVs alike prefer to park as close as possible to their destinations (20, 21). Therefore, spaces located closer to the establishment should be given

more weight when the effective parking supply for an establishment is determined. A similar relationship exists between parking citations and destinations. Not all citations issued to vehicles are for those parked immediately in front of their destinations. A distance-based weighting factor should then also be applied to the dependent variable in this model.

A negative exponential relationship between parking spaces, parking citations, and establishments is assumed. The functional form for effective parking supply is shown in Equation 1.

$$E_{s_j}^i = s_j \times e^{-c \times d_{ij}} \tag{1}$$

where

- $E_{s_j}^i$ = effective value of parking spots at location j to establishment at location i ,
- s_j = parking spaces at location j ,
- c = calibration coefficient, and
- d_{ij} = distance between location i and location j .

This distance-decay function was applied to all variables used in the model. The distance between points was calculated as the grid distance. Several calibration coefficients were used, ranging from -0.001 to -0.1 . The smaller the absolute value of the calibration coefficient, the farther away a parking facility can be while still having the same impact on the effective supply at an establishment. Little evidence exists for the choice of any particular value for the calibration coefficient over another, so models were estimated using several values.

Addresses were used as the basic unit of analysis in the model. This unit of analysis was selected over other units, such as postal codes or intersections, because it is the most disaggregate. With the use of a disaggregate unit, hidden effects caused by aggregating locations with different characteristics that may drive different behaviors can be avoided. Conveniently, parking citations and employment data are both readily available at the address level. This makes the on-street parking supply the only variable of interest that is not already at the address level. On-street parking spaces were converted to the address level using Thiessen polygons and a spatial join procedure. Thiessen polygons are shapes drawn around each existing address such that the closest address to any point within a given polygon is the address at that polygon's center. A spatial join was then used to match each on-street parking space to the address from which the Thiessen polygon it intersected was created. Finally, the distance-decay function was applied to create a measure of accessibility to these spaces from all nearby addresses.

The final step before model estimation was to filter the data by day of week and time of day. Different travel patterns exist during weekdays than exist during weekends. In many areas, there are also different parking restrictions between these two periods. So that the model was not being forced to explain significantly different patterns that exist during different time periods, the data were filtered to include only weekdays. Because parking restrictions are also variable by time of day, the data should be filtered to include only certain time periods that have internally consistent parking restrictions. The time periods where these conditions exist are 7:30 to 9:30 a.m., noon to 1:30 p.m., and 4:00 to 6:00 p.m. Figure 3 shows that although high traffic levels occur in the a.m. peak period, not many CV citations are issued during this time. This may stem from the relatively few CVs on delivery during this time period. There are more citations issued during the midday period, but midday traffic levels are much lower than those during a.m. or p.m. peak period levels. Because of these reduced traffic volumes, congestion caused by illegal CV parking is not as much of a concern during the midday period. A large increase in the number of tickets issued occurs in the p.m. peak period, when heavy congestion occurs in the CBD. These factors make this time period potentially the most interesting and likely the time period in which the resultant policy recommendations would have the largest impact.

The functional form of the model to be estimated is shown in Equation 2.

$$E_t = \alpha + \beta_1 E_1 + \beta_2 E_2 + \dots + \beta_n E_n \quad (2)$$

where

E_t = effective parking citations (t) after application of distance-decay function,

α = constant term,

β_{1-n} = estimated parameters, and

E_{1-n} = variables after application of distance-decay function.

TABLE 2 List and Description of Independent Variables

Variable	Description
tickets	Parking citations
cvtrips	p.m. peak period CV trips
paxtrips	p.m. peak period passenger trips
bizcount	Unique establishments at the location
employment	Employment
lzs	Loading zone spaces
lbs	Loading bay spaces
osl	On-street standing spaces
osp	On-street parking spaces
oss	On-street stopping spaces
sfs	Surface lot spaces
pgs	Parking garage spaces
restrictedspaces	On-street spaces where activity is restricted during p.m. peak period
hydrants	Fire hydrants

A list of independent variables that were tested for inclusion in the model is shown in Table 2.

DISCUSSION OF RESULTS

All variables presented in the final model are effective values, which have been processed by using the distance-decay function previously described. Models were estimated with a range of calibration coefficients, c , in the distance-decay function. A calibration coefficient value of -0.01 resulted in the best-fit model. This implies that a parking spot 100 meters away is worth about one-third of a spot located directly in front of an establishment when the effective parking supply is calculated for that establishment. The final model was constructed by using only parameters that were found to be statistically significant at the 95% confidence level. The final model results are shown in Table 3.

The model shows an adjusted R -squared value of .61. Positive coefficients were found for the number of restricted spaces as well as the number of establishments at an address, meaning that an increase in restricted spaces or number of establishments at a single address is associated with an increase in the number of CV parking citations. Business count was found to be a much better predictor

TABLE 3 Results of Ordinary Least-Squares Regression for CV Parking Citations

Independent Variable	Coefficient	t -Statistic
restrictedspaces	0.88	7.03
bizcount	1.41	19.6
lbs	-9.19	-10.36
sfs	-0.49	-4.84
pgs	-0.05	-4.84
Constant	-14.58	-0.86

NOTE: Dependent variable = weekday p.m. peak CV parking citations; observations = 721; adj. R^2 = .6179.

of citations than either the FTG models or raw employment. This finding could result from the error terms already included in the FTG model. Another possible explanation is that any establishment, regardless of employment, will have a minimum number of deliveries. This situation would mean that if there were two locations with equal employment, the location with unique establishments would attract more CV trips. Assuming all else is equal, the greater number of trips would then generate a greater number of citations.

Negative coefficients were found for the number of loading bay spaces, surface lot spaces, and parking garage spaces. All other parking supply variables did not enter the model. This is notable because it implies that efforts to increase the number of available on-street parking spaces may have little impact on the incidence of illegal CV parking. This result suggests that, instead, policies should focus on increasing the availability of dedicated loading facilities for CVs and off-street parking facilities for passenger vehicles. A possible explanation for this result is that during the p.m. peak period, CVs are unable to find available on-street spaces owing to the large number of spaces occupied by passenger vehicles. In areas with parking garages and surface lots nearby, long-term parkers will choose these facilities over on-street spaces. The result is more on-street spaces being available for CVs to park legally in front of their destinations. This finding is important for courier groups in particular, who have been working to create more on-street parking dedicated for CV use. According to the relationships shown by this model, their efforts may be better spent advocating for loading-facility requirements in new buildings or increased on-street parking prices to entice passenger vehicles to use the less expensive off-street facilities where available.

CONCLUSIONS AND FUTURE RESEARCH

This study examined the relationship between illegal CV parking and the built environment, expressed by the demand for and supply of parking in urban areas. New data were presented on CV parking citations, and it was found that 80% of CV parking citations were issued to vehicles operating during restricted periods. These restrictions are typically active only during peak periods when the full capacity of major arterials is needed to move vehicles. The large percentage of total CV tickets issued for these violations suggests that CVs are a major contributor to congestion on urban arterials in Toronto's CBD.

This study also estimated a distance-decay-weighted linear regression model. The distance-decay function was used to account for spatial interactions of parking citations, parking supply, and parking demand. Variables for effective parking citations, parking supply, and parking demand were created by using this method. The resultant model found that restricted on-street spaces and high numbers of unique business establishments at a single location tend to increase the incidence of illegal CV parking. The number of unique establishments was hypothesized to be a better predictor of CV citations than the estimated number of CV trips from the FTG model or employment because each establishment generates a minimum number of CV trips. This hypothesis means that locations with several unique establishments rather than one large establishment will generate more CV trips and result in more citations. The model also found that only loading facilities and off-street parking facilities are related to decreases in the number of CV citations. The avail-

ability of on-street facilities was not found to have any relationship with the number of citations. Though this study was performed on a relatively small geographic area, these results could be used as an argument to shift policy away from increasing the quantity of on-street parking and toward medium- and long-term efforts to require loading facilities in new buildings. Another effective set of policies may include adjustments to on-street parking prices, to shift passenger vehicles from parking at the curb to using available off-street parking facilities.

Two potential areas of focus for future research on this topic are the transferability of these findings and their potential policy implications. This study was conducted in a North American urban center, but the results may not be applicable to similar North American cities, owing to differences in parking restrictions, supply of and demand for parking, and variations in density and land use. Future studies may apply similar approaches in other cities throughout North America, Europe, and Asia to find whether similar patterns exist in many large urban centers. Further research could also identify the various city planning and parking policies that, according to these results, could have a significant impact on the problems caused by illegal CV parking.

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REFERENCES

1. O'Laughlin, R., D. Thomas, and M. Rinnan. Chicago Downtown Freight Study. Presented at 87th Annual Meeting of the Transportation Research Board, Washington, D.C., 2008.
2. City of Toronto. Reducing Traffic Congestion Parking Regulations Program. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=6711894d49193410VgnVCM10000071d60f89RCRD&vgnextfmt=default>. Accessed July 22, 2014.
3. Haider, M. Challenges Facing Express Delivery Services in Canada's Urban Centres. *Canadian Courier*; 2009. https://canadiancourier.org/uploads/Challenges_Facing_Express_Delivery_Services_in_Canada_s_Urban_Centres.pdf. Accessed July 22, 2014.
4. Han, L. D., S.-M. Chin, O. Franzese, and H. Hwang. Estimating the Impact of Pickup- and Delivery-Related Illegal Parking Activities on Traffic. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 1906, Transportation Research Board of the National Academies, Washington, D.C., 2005, pp. 49–55.
5. Conway, A. J., O. Thuillier, E. Dornhelm, and N. E. Lownes. Commercial Vehicle–Bicycle Conflicts: A Growing Urban Challenge. Presented at 92nd Annual Meeting of the Transportation Research Board, Washington, D.C., 2013.
6. Maclean, G., and C. Graham. *Bikes and Heavy Goods Vehicles*. Combating Terrorism Center Occasional Paper, No. 3, U.S. Military Academy at West Point, N.Y., 1996.
7. *The Big Move Baseline Monitoring Report*. Metrolinx, Toronto, Ontario, 2013. http://metrolinx.com/en/regionalplanning/bigmove/The_Big_Move_Baseline_Monitoring_Full_Report_EN.pdf.
8. Bomar, M., E. Becker, and E. Stolof. *Urban Freight Case Studies—Washington, D.C.* FHWA, U.S. Department of Transportation, 2009.
9. Bomar, M., E. Becker, and E. Stolof. *Urban Freight Case Studies—New York*. FHWA, U.S. Department of Transportation, 2009.

10. Bomar, M., E. Becker, and E. Stollof. *Urban Freight Case Studies—Orlando*. FHWA, U.S. Department of Transportation, 2009.
11. Bomar, M., E. Becker, and E. Stollof. *Urban Freight Case Studies—Los Angeles*. FHWA, U.S. Department of Transportation, 2009.
12. Muñuzuri, J., J. Larrañeta, L. Onieva, and P. Cortés. Solutions Applicable by Local Administrations for Urban Logistics Improvement. *Cities*, Vol. 22, No. 1, 2005, pp. 15–28.
13. *Delivering the Goods—21st Century Challenges to Urban Goods Transport*. Organisation for Economic Co-Operation and Development, Paris, 2003.
14. Visser, J. G. S. N. Urban Freight Transport Policies and Planning in Europe: An Overview and Classification of Policy Measures. Presented at the National Urban Freight Conference, Long Beach, Calif., 2006.
15. Kawamura, K., P. S. Sriraj, H. R. Surat, and M. Menninger. Analysis of Factors That Affect Truck Parking Violations in Urban Areas. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 2411, Transportation Research Board of the National Academies, Washington, D.C., 2014, pp. 20–26.
16. Jaller, M., J. Holguín-Veras, and S. D. Hodge. Parking in the City: Challenges for Freight Traffic. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 2379, Transportation Research Board of the National Academies, Washington, D.C., 2013, pp. 46–56.
17. City of Toronto Open Data Catalogue. Parking Tickets. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=ca20256c54ea4310VgnVCM1000003dd60f89RCRD>. Accessed July 22, 2014.
18. Kwok, J. *Data Collection on Parking and Loading Supply and Truck Driver Demand Survey*. Undergraduate thesis. University of Toronto, Ontario, Canada, 2010.
19. *TPM for Multi-Modal Transportation Forecasting Tools for the Greater Golden Horseshoe: Commercial Vehicle Model Phase 1*. Ministry of Transportation of Ontario, Toronto, Canada, 2007.
20. Wenneman, A., M. Roorda, and K. M. N. Habib. Illegal Commercial Vehicle Parking, Parking Demand, and the Built Environment. *Proc., Canadian Transportation Research Forum*, Windsor, Ontario, Canada, Canadian Transportation Research Forum, Woodstock, Ontario, Canada, 2014.
21. Shoup, D. C. Cruising for Parking. *Transport Policy*, Vol. 13, No. 6, 2006, pp. 479–486.

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