Taming New York City's E-Delivery Gridlock

Time-Based Charges for Street Space

A report to the New York City Council
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November 2021

SUMMARY

Travel delays caused by trucks occupying road and curb space while delivering e-commerce parcels to New York City residents and businesses cost New Yorkers time worth more than $400 million annually. This report proposes an antidote: charging these vehicles for the time they occupy that space.

That dollar figure — literally the cost to drivers, truckers and bus riders of the time they lose in city traffic because of the competing presence of e-commerce delivery vehicles — arises from a meticulous analysis that breaks down e-commerce deliveries in New York City by neighborhood, time of day and day of week, and assigns to each a "congestion cost" based on the extent to which trucks conveying the parcels are slowing down motor traffic. For conservatism, we propose charging the delivery vehicles only half (50 percent) of their calculated congestion causation.

TABLE 1:
PROPOSED E-COMMERCE
DELIVERY-VAN CHARGES

	DISTRICT 1	DISTRICT 2	DISTRICT 1	DISTRICT 2
AREA COVERED	MANHATTAN SOUTH OF 60TH STREET (CBD)	CBD-ADJACENT AREAS OF MANHATTAN, BK, BX & QUEENS	MANHATTAN SOUTH OF 60TH STREET (CBD)	CBD-ADJACENT AREAS OF MANHATTAN, BK, BX & QUEENS
WEEKDAY CHARGES	PER HOUR THAT VAN IS ON STREET IN DISTRICT		SAME CHARGE, ALTERNATIVELY EXPRESSED AS AVERAGE CHARGE PER DELIVERY	
6 AM – 12 NOON	\$ 36.50	\$ 10.60	\$ 0.95	\$ 0.30
12 NOON – 8 PM	\$ 62.50	\$ 16.70	\$ 1.65	\$ 0.45
8 PM – MIDNIGHT	\$ 28.60	\$ 6.30	\$ 0.75	\$ 0.15
MIDNIGHT – 6 AM	\$ 4.10	\$ 1.40	\$ 0.10	\$ 0.05
WEEKEND & HOLIDAY CHARGES				
6 AM – 12 NOON	\$ 16.90	\$ 5.30	\$ 0.45	\$ 0.15
12 NOON – 8 PM	\$ 33.30	\$ 7.90	\$ 0.85	\$ 0.20
8 PM – MIDNIGHT	\$ 14.70	\$ 2.90	\$ 0.40	\$ 0.10
MIDNIGHT – 6 AM	\$ 6.90	\$ 1.20	\$ 0.20	\$ 0.05

SEE MAP ON P. 8 FOR VISUAL REPRESENTATION OF DISTRICTS. HOURLY VAN CHARGES ARE CALCULATED AS 50% OF CONGESTION CAUSATION COSTS FOR A PENSKE "HIGH-ROOF CARGO VAN" WITH 350 CUBIC FEET STORAGE CAPACITY. CHARGES FOR DIFFERENT SIZE E-COMMERCE DELIVERY VEHICLES WOULD VARY PROPORTIONATELY. VEHICLES IN REST OF CITY, WITH LESSER TRAFFIC CONGESTION, WOULD NOT BE CHARGED.

We propose applying these e-commerce vehicle charges only in Manhattan and adjacent neighborhoods in Brooklyn, Queens and the Bronx. The exempted neighborhoods, in central and outlying parts of Brooklyn, Queens and the Bronx and all of Staten Island, generally aren't congested enough to warrant charging delivery vehicles there. The more congested areas in which we propose to charge the vehicles account for around half of city households and slightly more than half of e-commerce deliveries.

THERE ARE MANY COMPELLING REASONS TO CHARGE E-COMMERCE VEHICLES FOR OCCUPYING STREET SPACE:

1. To incentivize e-commerce purveyors to right-size their packages and thus reduce packaging waste while cutting down on unnecessary truck volumes.
2. To speed and expand the transition to zero-emission, low-congestion cargo bike deliveries.
3. To expand the customer option of picking up deliveries at neighborhood walk-in distribution facilities.
4. To help level the playing field for traditional "brick-and-mortar" businesses that pay property taxes and often function as neighborhood anchors.
5. To generate revenues that can be used to ameliorate truck impacts, enhance the city's streetscapes and improve transportation.

Time-based charging of e-commerce delivery vehicles will also introduce an innovative form of congestion pricing that would supplement the New York State-mandated congestion pricing program that will be implemented for vehicles entering Manhattan south of 61st Street. Fleet vehicles in widespread use in New York City — UPS and FedEx trucks, ride-hail services such as Uber and Lyft, and traditional yellow taxicabs — could easily be equipped (as ride-hail and taxi vehicles already are) with software-based trip monitoring technology, enabling them to be tolled according to the minutes and seconds that they occupy heavily used streets and roads. Once this "dynamic" and granular form of traffic pricing has been proven on fleets, it could be extended incrementally to cars and trucks, eventually superseding "binary" congestion pricing.

KEY DETAILS

E-COMMERCE VOLUMES

We rely on a published estimate from a reliable source that in New York City 2.4 million parcels are purchased and delivered via e-commerce each weekday. Adding weekends and holidays but accounting for their lower delivery volumes, we estimate that e-commerce accounts for the delivery of an estimated 692 million parcels per year in New York City.

TRUCK VOLUMES

We employ a Penske "High-Roof Cargo Van" as our physical unit for analysis. By our calculations, which we have detailed in the Appendix, each van carries slightly more than 300 parcels on a typical eight-hour delivery run. Delivering the weekday payload of 2.4 million e-commerce parcels thus entails 7,830 such vehicles occupying city streets and roads for eight hours. Reflecting their size, we assign to each a congestion-causation 1.5 times as great as for the average passenger car.

THE TRUCK CHARGES RECOMMENDED IN THIS REPORT ARE BASED ON CARGO VANS SUCH AS THE ONE ABOVE, WITH APPROXIMATELY 360 CUBIC FEET OF LOADING SPACE. DIFFERENT-SIZE DELIVERY VEHICLES WOULD BE PRICED PROPORTIONATELY.

ADMINISTRATION

Charging e-commerce delivery vehicles for occupying city streets and roads will require mandating them to maintain continuous, real-time wireless connectivity to a digital platform that tracks their movements. This connectivity can be provided through an in-vehicle digital apparatus with Global Positioning System (GPS) capability that uploads the vehicle's location in timed intervals to the digital platform.

DELIVERY THRESHOLD

Legislation mandating connectivity for e-commerce vehicles should specify a delivery-volume threshold above which vehicles would be required to comply with the connectivity and charging rules. The threshold should be low enough to discourage large companies from attempting to game the system, but high enough to avoid burdening small, occasional operators. For discussion purposes, that threshold might be on the order of 50 parcels a week.

LEGAL AUTHORITY

A 1957 amendment to the state vehicle and traffic law, VTL Section 1642(a)(4), expressly allows New York City to impose "tolls, taxes, [and] fees … for the use of the highway or any of its parts where the imposition thereof is authorized by law." Based on our close reading of this section of the statute and its legislative history, we are confident that the charges proposed here could legally be enacted as a local law passed by the city council and signed by the mayor.

GEOGRAPHICAL COVERAGE

The e-delivery vehicle charges would apply to a swath of the city covering Manhattan and adjacent sections of Brooklyn, Queens and the Bronx. These areas have the city's highest population densities and are home to almost half of the city's households despite covering less than a quarter of the city's land area.

By our estimates, these areas account for slightly more than half of e-commerce deliveries to New York City residences, reflecting their relative affluence. These considerations, along with above-average traffic congestion in most of these districts, underlie our preference for addressing this new policy to those areas, at least initially.

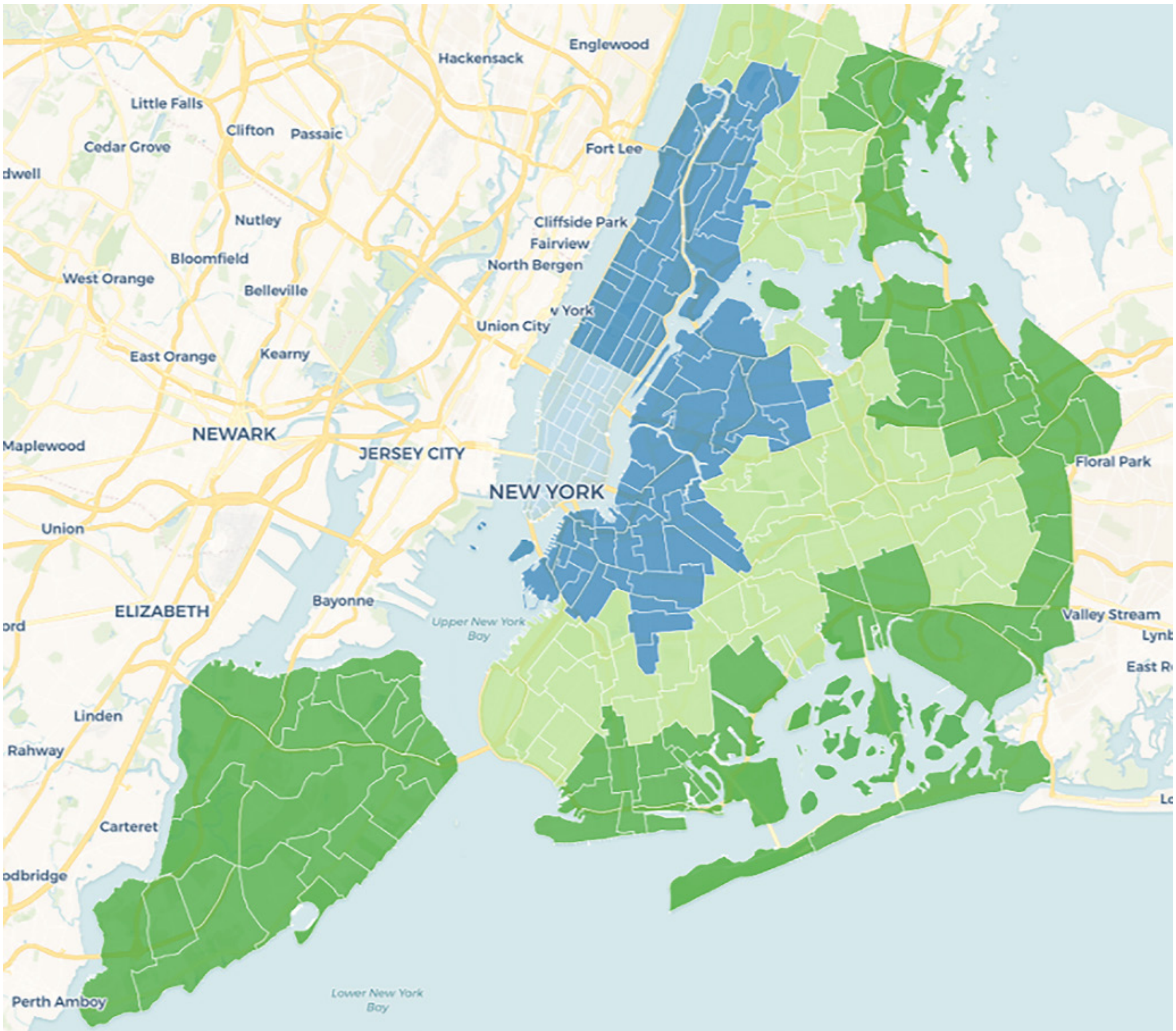
CHARGES ON VEHICLES, NOT PARCELS

The charges would be levied on the delivery vehicles carrying the e-commerce parcels rather than on individual packages or specific customers or delivery destinations. The charges would apply for each minute a delivery vehicle occupies public streets. Because the policy is based on the vehicles' involvement in congestion causation, we propose varying the charges by geographic area, by time of day and day of week, and by the physical size of the e-commerce delivery vehicle, as shown in Table 1, above.

Nothing in this proposal would prevent the e-commerce businesses from adding the charges to prices they charge customers for purchases. That said, we expect that, in the nature of profit-maximizing enterprises, the businesses would be further incentivized to undertake efficiencies and other logistical changes in the interest of retaining market share and reducing the incidence of the charges on their bottom lines.

CHARGING DISTRICTS

We have classified the city into four districts for purposes of this report. This division is based on our estimates of average travel speeds and congestion levels in each of the city's several hundred neighborhoods:



WE HAVE COLLAPSED THE CITY'S 259 TAXI ZONES INTO PROPOSED VEHICLE CHARGING DISTRICTS, BASED ON VEHICLE TRAVEL SPEEDS.

DISTRICT 1 DISTRICT 2 DISTRICT 3 DISTRICT 4

PROPOSED CHARGING DISTRICTS

DISTRICT 1

Manhattan south of 60th Street (pale blue in map, above). This is the Manhattan Central Business District (CBD), the area designated as the congestion pricing zone under the Central Business District Tolling Program enacted by the state legislature in 2019. It accounts for 10 percent of New York City's households and an estimated 13 percent of e-commerce deliveries to households. It is also the most affluent by far of the four districts, with household incomes averaging at least 50 percent greater than the other three districts.

DISTRICT 2

The rest of Manhattan along with CBD-adjacent parts of Brooklyn, Queens and the Bronx (dark blue). This district accounts for 37 percent of New York City's households and an estimated 38 percent of e-commerce household deliveries. (Note that Districts 1 and 2 combined — the areas in which we propose to charge e-commerce vehicles — account for slightly less than half (47 percent) of the city's households and slightly more than half (51 percent) of residential e-commerce deliveries.)

DISTRICT 3

Other, more outlying sections of Brooklyn, Queens and the Bronx (light green). This district comprises majorities of the land area in the three boroughs, and accounts for 31 percent of New York City's households and an estimated 27 percent of e-commerce deliveries. As well as being further from Manhattan than District 2, these areas have lesser levels of traffic congestion. District 3's household income is the lowest of the four districts

DISTRICT 4

The remainder of the city, comprising all of Staten Island along with southernmost Brooklyn and Queens, southeast and eastern Queens, and northeast Bronx (dark green). Despite taking up 49 percent of the city's land area, these areas account for just 22 percent of the city's households and e-commerce deliveries. We were unable to generate travel speeds and traffic congestion estimates for the areas in this district, due to the paucity of TLC ride-hail data; anecdotal observation strongly suggests that traffic congestion in District 4 is considerably less than in other parts of the city.

We propose limiting the e-commerce delivery vehicle charges to Districts 1 and 2. These districts have by far the most deliveries per square mile: an astounding 34,700 per day in District 1, and a still high 17,600 in District 2. Districts 3 and 4 receive far fewer e-commerce parcels per square mile, 9,000 and 4,100 per day, respectively.

Zeroing out District 4, for which traffic speeds and, thus, congestion cost figures weren't available, the two districts in which we propose to charge e-commerce delivery vehicles account for more than 90 percent of citywide congestion costs from those vehicles.

CHARGE LEVELS, IN PRINCIPLE

Our proposed charges are pegged to the delivery vehicles' estimated congestion-causation costs — the additional seconds, minutes and hours that other road users must spend in traffic on account of the incremental congestion caused by the delivery vehicles' presence. These costs span a broad range, reflecting variations in "congestion causation" in different places at different times.

The proposed charges would therefore span a broad range as well. However, in the interests of administrative efficiency and public comprehension, we propose making the charges uniform across large districts rather than particularizing them by individual block or neighborhood.

CONSERVATISM IN CHARGING

We propose to charge the delivery vehicles for half (50 percent) rather than all of their estimated congestion-causation costs. This conservatism is intended to reflect methodological uncertainties inherent in calculating the congestion costs, as well as following a cautionary approach suited for a new policy. In a further conservatism, discussed below, our proposed charges do not reflect the delivery trucks' non-congestion externality costs such as localized air pollution, carbon emissions, noise and traffic fatalities and injuries.

PROPOSED CHARGES

The highest charge rate, just over a dollar per minute for a standard e-commerce delivery van distributing around 300 packages in its daily shift, would fall on vehicles in District 1 (the Manhattan Central Business District) on weekdays between 12 noon and 8 p.m. The lowest, around two cents a minute, would apply to delivery vehicles operating overnight (12 midnight to 6 a.m. on both weekdays and weekends) in District 2 (the "covered" sections of Brooklyn, Queens and the Bronx).

PROPOSED CHARGES, EXPRESSED PER PACKAGE

On a per-package basis, and assuming complete pass-through to consumers, the delivery charges would range from a high of around $1.60 per parcel in District 1 on weekdays between 12 noon and 8 p.m.; to a low of just 3 or 4 cents for deliveries in the wee hours (midnight to 6 a.m.) on both weekdays and weeknights in District 2.

TABLE 2:
E-COMMERCE DELIVERIES IN NEW YORK CITY, BY GEOGRAPHICAL DISTRICT

	DISTRICT 1	DISTRICT 2	DISTRICT 3	DISTRICT 4	CITYWIDE
	MANHATTAN SOUTH OF 60TH STREET (CBD)	CBD-ADJACENT AREAS OF MANHATTAN, BK, BX & QUEENS	MORE-CENTRAL AREAS OF BKLYN, BX & QUEENS FURTHER FROM CBD	OUTLYING BKLYN, BX & QUEENS, PLUS ALL OF STATEN ISLAND	
DEMOGRAPHICS					
AREA, SQUARE MILES	8.9	51.4	73.1	130.4	263.8
NUMBER OF HOUSEHOLDS	320,200	1,182,400	972,500	708,100	3,183,200
POPULATION DENSITY (HH PER SQUARE MILE)	36,100	23,000	13,300	5,400	12,100
AVERAGE HOUSEHOLD INCOME	$ 165,700	$ 108,500	$ 81,300	$ 100,100	$ 104,100
DELIVERIES					
E-COMMERCE DELIVERIES PER WEEKDAY	307,300	901,700	657,100	533,700	2,400,000
E-COMMERCE DENSITY (WEEKDAY DELIVERIES PER SQ MILE)	34,700	17,600	9,000	4,100	9,100
WEEKDAY E-COMMERCE DELIVERIES PER HOUSEHOLD	0.96	0.76	0.68	0.75	0.75
ANNUAL DELIVERIES (INCLUDES WEEKENDS & HOLIDAYS)	88,480,000	260,115,000	213,930,000	129,475,000	692,000,000
CONGESTION COSTS AND PROPOSED CHARGES					
ANNUAL COST OF DELAYS CAUSED BY E-COMMERCE VEHICLES	$ 215,000,000	$ 17,400,000	$ 36,600,000	N.A	$ 422,000,000
PER-PACKAGE DELAY COST (24/7 AVERAGE)	$ 2.43	$ 0.66	$ 0.17	N.A	
PROPOSED PEAK PER-HOUR DELIVERY-VEHICLE CHARGE	$ 62.50	$16.70	$ 4.80	N.A	
PROPOSED PEAK PER-MINUTE DELIVERY-VEHICLE CHARGE	$ 1.04	$ 0.28	$ 0.08	N.A	
ANNUAL REVENUE FROM E-DELIVERY-VEHICLE CHARGES	$ 108,000,000	$ 85,000,000	$ 18,000,000	N.A	$193,000,000

SEE MAP ON P. 8 FOR VISUAL REPRESENTATION OF DISTRICTS. FOR READABILITY, DEMOGRAPHIC DATA ARE ROUNDED TO NEAREST HUNDRED, DELIVERY DATA TO NEAREST THOUSAND, AND REVENUE ESTIMATES TO NEAREST MILLION. N.A. ENTRIES FOR DISTRICT 4 ARISE FROM THE ABSENCE OF TRAFFIC SPEED DATA FOR THOSE NEIGHBORHOODS. REVENUE TOTAL (LAST FIGURE IN TABLE, AT LOWER RIGHT) IS SUM OF REVENUES FOR DISTRICTS 1 AND 2 ONLY, REFLECTING PROPOSED EXCLUSION OF DISTRICT 3 FROM DELIVERY CHARGES.

DATA SNAPSHOT

The snapshot at right, excerpted from the spreadsheet we created for this report, lists the 25 neighborhoods with the greatest estimated congestion associated with delivery of each package. The snapshot also includes estimated average traffic speeds (figures are pre-pandemic averages during 6am-12noon on weekdays).

Of the 25 neighborhoods shown, 22 are in Manhattan, with 18 in the city's Central Business District (the portion of Manhattan south of 60th Street).

There is strong though not perfect correspondence between high per-package delay costs and low traffic speeds. The correspondence breaks down slightly in the two Bronx and one Queens neighborhoods. There, the higher (double-digit) travel speeds combine with high volumes of vehicle traffic (not shown in the table) to yield relatively high delay costs.

TABLE 3:
NYC TAXI ZONES RANKED BY CONGESTION CAUSATION

TAXI ZONE	SPEED DISTRICT	BOROUGH	DELAY MINUTES PER PKG 6AM-NOON	ADJUSTED MPH MEAN 6AM-NOON
PENN STATION / MADISON SQ WEST	1	MANHATTAN	5.47	6.55
FORDHAM SOUTH	2	BRONX	4.92	12.36
CROTONA PARK EAST	3	BRONX	4.86	11.73
MIDTOWN SOUTH	1	MANHATTAN	3.72	6.82
MIDTOWN NORTH	1	MANHATTAN	3.48	6.44
MIDTOWN EAST	1	MANHATTAN	3.35	6.15
MURRY HILL	1	MANHATTAN	3.24	6.73
UNION SQUARE	1	MANHATTAN	3.20	7.20
TIMES SQ / THEATER DISTRICT	1	MANHATTAN	3.18	6.63
FLATIRON	1	MANHATTAN	3.00	7.84
SUTTON PLACE / TURTLE BAY NORTH	1	MANHATTAN	2.99	6.33
LENOX HILL WEST	2	MANHATTAN	2.94	7.53
UN / TURTLE BAY SOUTH	1	MANHATTAN	2.86	6.69
UPPER EAST SIDE SOUTH	2	MANHATTAN	2.69	7.19
GRAMERCY	1	MANHATTAN	2.59	7.57
LINCOLN SQUARE EAST	2	MANHATTAN	2.56	8.02
GREENWICH VILLAGE NORTH	1	MANHATTAN	2.38	8.00
CLINTON EAST	1	MANHATTAN	2.38	6.81
WEST VILLAGE	1	MANHATTAN	2.26	8.54
MIDOTWN CENTER	1	MANHATTAN	2.23	5.94
OLD ASTORIA	2	QUEENS	2.23	10.86
LITTLE ITALY / NOLITA	1	MANHATTAN	2.13	8.21
LINCOLN SQUARE WEST	2	MANHATTAN	2.12	8.52
SOHO	1	MANHATTAN	2.11	8.30
EAST CHELSEA	1	MANHATTAN	2.10	7.40

THIS EXCERPT FROM THE SPREADSHEET UNDERLYING THIS REPORT SHOWS THE 25 (OUT OF 259) NYC NEIGHBORHOODS WITH THE GREATEST CONGESTION CAUSATION.

Overall, the table demonstrates that the greatest congestion impacts from e-commerce deliveries occur in District 1 (18 districts among the top 25, as noted), followed by District 2 (6 districts in adjacent sections of Manhattan and the Bronx). Only one district in the top 25 is in District 3. (An analogous snapshot from the bottom of the complete table, which may be seen in the spreadsheet linked in the Appendix, displays the same pattern, in reverse.)

CHARGING E-COMMERCE DELIVERY VEHICLES FOR TIME ON CITY STREETS WILL CUT DELIVERY CONGESTION

The market discipline of charging e-commerce delivery vehicles for occupying New York street space that they now bottle up free of charge will, we expect, lead to myriad changes in e-commerce marketing, pricing, packaging and delivering as companies seek to reduce their cost exposure. The resulting reductions in delivery-vehicle volumes won't eliminate this source of congestion, but they will certainly mitigate it.

Moreover, connecting delivery vehicles to City computer servers — as this new program will require — will give city government new data-based means of regulating and improving traffic rules and flow. This capability will be particularly valuable in high-commerce areas where the need to optimize vehicles' use of street space is greatest.

Following are ways in which charging e-commerce delivery vehicles to occupy street space will bring about lower vehicle volumes and reduced congestion:

THIS 1,008 CUBIC INCH CARTON OUTSIZED ITS CARGO — A 16 CUBIC-INCH BOX AND A 72-CUBIC INCH BAG — BY 11 TO 1.

1. E-commerce vendors will be further incentivized to right-size their packages and minimize the number of trucks they deploy. This will not only reduce traffic congestion (as fewer trucks are needed to accommodate a given number of packages), it will also cut packaging waste, which will save city government trash and recycling collection costs.
2. E-commerce shippers and delivery companies will be incentivized to create more storefronts or mail drops at which customers can pick up their purchases. The avoided delivery charges presumably will be passed along to customers as pricing discounts.
3. Where feasible, shippers will shift some operations to off-peak hours to take advantage of the lower charges.
4. Shippers will shift some deliveries to human-powered vehicles (which would not be charged under our program).
5. If e-commerce purveyors recoup some of the delivery charges through price hikes, price-sensitive consumers may shift some purchases to brick-and-mortar businesses.

POLICY RATIONALE

E-commerce has brought undreamed of convenience to shopping throughout America, including New York City. Yet the delivery vehicles conveying e-commerce purchases to New Yorkers are imposing singular burdens on the urban commons. They fan out across the five boroughs, occupying public roads and streets more or less continuously throughout their shift. During that time they take up space, exacerbating traffic congestion and adding to air pollution and greenhouse gas emissions.

While the Central Business District congestion toll mandated by the legislature will almost certainly prove to be a powerful gridlock-reducing policy, it is unlikely to capture more than a small percentage of e-delivery vehicles' congestion costs. That's by design, insofar as the CBD toll will be collected only once per vehicle per day and is intended to target primarily private autos that enter the CBD and are then moved off-street, into private lots or garages. *Only a time-based pricing mechanism can fully capture the unique congestion costs associated with e-commerce delivery vehicles.*

There is a further distinction to be made between e-commerce delivery vehicles and ordinary trucks carrying goods to supermarkets, retail outlets, restaurants, factories and so forth. Brick-and-mortar establishments pay franchise fees, real estate taxes (as part of rent) and wages. Many are also valued — even treasured — neighborhood anchors. They are now losing market share to e-commerce companies that are able to skirt many of these expenses and exploit scale economies. In some instances, this competitive imbalance may be ameliorated by the proposed vehicle charges.

Moreover, the e-commerce delivery sector is dominated by fleets that can easily equip vehicles with the digital interface to maintain connectivity and administer the charges. In contrast, conventional deliveries are more often handled by mom-and-pop businesses that lack the expertise and equipment needed to establish and maintain the data interface.

RATIONALE FOR TIME-BASED CHARGING

The proposed charge is neither a "cordon" toll paid on entering a particular district, nor a VMT levy on vehicle-miles traveled. Rather, it is time-based, calculated on the full duration that each e-commerce delivery vehicle occupies city streets and roads. To be clear, it applies equally whether the vehicle is moving or standing, and whether or not it is parked curbside or in a travel lane. (The sole exception would be off-street parking, which delivery vehicles rarely use, especially in the more congested Districts 1 and 2 neighborhoods we have selected for charging.)

WHILE NOT ALL DELIVERY VEHICLES ARE PARKED AS CARELESSLY AS THIS AMAZON VAN SNAPPED ON A BROOKLYN STREET IN MARCH, THEIR OCCUPATION OF STREET SPACE COMES AT A COST, WHETHER THEY ARE MOVING OR STATIONARY. *PHOTO: DAVE ABRAHAM.*

The rationale is straightforward: empty street space is generally so scarce, and traffic levels so high, that every vehicle's physical presence slows down other vehicles on the road. Even a vehicle occupying curbside space is forcing other vehicles searching for curb space to double-park and thus is indirectly but palpably contributing to congestion.

While it is likely that a stationary vehicle generally slows down traffic less than does a moving vehicle — I assumed a 1-to-2 ratio of congestion causation for standing vs. moving ride-hail vehicles in my report for the Council earlier this year on curbing Uber and Lyft "stockpiling" in the Manhattan taxi zone — there is no empirical data or modeling to support any particular numerical factor. For simplicity, in this report we impute the same congestion causation to standing as to moving delivery vehicles.

OMISSIONS

The congestion costs that underlie our proposed charges are calculated on, and limited to, the additional time that other vehicle users spend stuck in traffic due to being incrementally slowed by the delivery vehicles' presence on New York City streets and roads. This construct excludes ancillary costs such as these:

- delay costs for pedestrians, cyclists and other non-vehicle users;
- emissions from the delivery vehicles themselves, along with the additional emissions from all other vehicles that operate slightly slower and, thus, less efficiently;
- other vehicle externalities such as additional crashes and noise;
- discouragement of healthful "active transportation" (cycling, walking) due to heavier-than-otherwise vehicle volumes.

Our body of work quantifying congestion pricing's benefits for New York City suggests that these omitted costs are substantial. We found that for each dollar's worth of saved motorist time from reducing vehicle volumes in and around the Manhattan core, the environmental benefits (less carbon emissions, less "conventional" pollution, less noise, fewer crashes, reduced oil dependence) are worth an additional 37 cents, while the added longevity from the likely increase in healthful active transportation due to the lesser volumes of motorized traffic adds another 29 cents. Adding these elements would thus increase by two-thirds the time impacts that are the sole basis of our proposed charges; excluding them, as we've done for simplicity, constitutes a sizeable conservatism.

OUR E-DELIVERY COST CALCULATIONS EXCLUDE INCIDENTS SUCH AS THIS AMAZON VAN DRIVER'S JUNE 16 CRASH INTO A BUILDING AT 43RD AVE AND 41ST ST IN SUNNYSIDE, QUEENS. *COURTESY @CURBJUMPINGNYC.*

CURRENT TICKETS AND TOLLS ON E-COMMERCE DELIVERY VEHICLES SHOULD REMAIN

Commercial and other vehicles are of course subject to New York City parking rules and regulations as well as tolls on MTA bridges and tunnels (and, soon enough, the Central Business District tolls authorized by the legislature which are expected to take effect in 2023).

These charges are not insubstantial. According to a trade publication, UPS paid the city $23 million in 2019, and FedEx paid nearly $10 million, to satisfy a combined half-a-million parking violations recorded by traffic agents under the city's "Stipulated Fine" program. These and other freight haulers also pay tolls to use any of the MTA's seven bridges and two tunnels.

While it might be tempting to lower the adjudicated charges once the e-commerce charging program goes forward, we do not believe such netting is warranted. For one thing, the stipulated fine charges cover the entire city, whereas our e-commerce charge would accrue only in the most congested areas. More fundamentally, the two sets of charges apply to different actions: occupying scarce street space, in the case of our e-commerce charge; and occupying areas of the street deemed detrimental to safety or traffic flow, in the case of the fines. The two charging regimes are more complementary than redundant.

CHARGING E-COMMERCE DELIVERY VEHICLES IS PROGRESSIVE PUBLIC POLICY

Considering just Districts 1 and 2, which comprise the Manhattan Central Business District plus adjacent sections of four of the five boroughs (excepting Staten Island), e-commerce delivery vehicles are today costing New York residents and businesses an estimated $385 million a year in time now swallowed up by traffic congestion. (District 3 suffers an additional $37 million in annual costs; District 4's delay costs couldn't be measured due to data limitations.) The lost time equates to more than a million dollars a day. Based on our proposal to charge the delivery vehicles for half of their congestion causation, the delivery companies would be charged around $190 million annually, although that amount would be expected to decrease somewhat as the e-commerce sector adapts its operations to cut its exposure to the charge.

The ultimate cost of these charges would be borne by a combination of e-commerce consumers and suppliers. While we cannot forecast how much of the costs would fall on either group, we can say fairly certainly that the customers bearing the e-commerce delivery charges will be disproportionately affluent; that is on account of their outsize use of e-commerce combined with the higher per-vehicle charges proposed in more prosperous neighborhoods. (Recall from Table 2 that in District 1, the Manhattan CBD, household incomes average nearly 60 percent higher than in the city as a whole; and note also that our proposed per-truck charges in District 1 are nearly quadruple the charges we propose for District 2.) *In its disproportionate incidence on affluent households, then, the proposed charge qualifies as a progressive measure.*

THE PER-MINUTE CHARGES NEED NOT ENCOURAGE SPEEDING

Would the per-minute vehicle fees proposed here incentivize e-commerce drivers to speed and otherwise operate recklessly? Not if city officials deploy the connectivity described in the next section to track the vehicles' driving speeds and issue fines for exceedances. Ideally, the fines would be charged on a sliding scale based on "integrated" speeding (the product of the miles over the speed limit and the duration of each exceedance).

Just as per-minute congestion charging for e-commerce vehicles could be extended to other vehicles, this integrated speeding scheme could eventually be applied to for-hire vehicles, other fleet vehicles and, ultimately, ordinary cars and trucks. The objective, of course, is not revenue collection but enhanced street safety through engineered compliance.

DATA-CONNECTIVITY FOR E-COMMERCE DELIVERY VEHICLES

E-commerce delivery vehicles' time and location on city streets and roads can be metered seamlessly and definitively by requiring every such vehicle operating in the five boroughs to maintain continuous, real-time wireless connectivity to dedicated computer servers deployed for this purpose.

This connectivity can be provided by equipping each vehicle with a "smart tracking device" — a digital apparatus with Global Positioning System (GPS) capability that uploads the vehicle's location in timed intervals to a digital platform. The device can be mounted under the vehicle dashboard or under the hood, from which it is connected to the vehicle's power supply. (Should the device be disconnected from the vehicle's power supply for any reason or the battery removed from the vehicle, an internal battery allows it to continue reporting data for up to 30 minutes.)

GPS and telematics technology make it possible to precisely record the movement of tracker-equipped vehicles throughout New York City, even amidst the "canyons" created by tall buildings in District 1 (the Manhattan CBD) or built-up parts of the adjacent District 2. The mandated connectivity would ensure that during every minute a licensed e-commerce delivery vehicle is inside Districts 1 or 2, its location data is continuously logged and uploaded in real time to the dedicated servers.

There is a well-established precedent to mandating and implementing connectivity for e-commerce delivery vehicles. New York's yellow cabs have been connectivity-enabled since 2008, when the City's Taxi and Limousine Commission implemented rules that were dubbed T-PEP (Taxicab Passenger Enhancement Program). Although the T-PEP program was motivated by the need to bring credit card payment systems to taxicabs and to promote passenger safety, it has had the side benefit of publicly accessible pickup and drop-off records for all taxi trips, which the TLC has enabled by posting the data online. The City Council later added the requirement that ride-hail vehicles also report pickup and drop-off data (though without full location specificity), creating the trove of data that we have used in this report to calculate average vehicle speeds and traffic densities in each of the city's 259 taxi zones.

CHARLES KOMANOFF

Komanoff began his career in policy analysis under New York City Mayor John Lindsay, specializing in electricity economics and air pollution. He rose to prominence in the late 1970s with penetrating analyses of cost escalation in the U.S. nuclear power industry, leading to expert-witness assignments in administrative proceedings for state agencies in New York, California and a dozen other states to hold utility companies accountable for reactor cost overruns.

From 1986 to 1992, as volunteer president of Transportation Alternatives, Komanoff led spirited campaigns that overturned a midtown bicycle ban, won access to area roads and bridges, and framed cycling as key to livable cities. Shortly after, he turned his attention to the societal costs of motor vehicle use and policies to internalize these costs through congestion pricing.

In 2007, with the sponsorship of renowned civic activist Theodore W. Kheel, Charles began developing his Balanced Transportation Analyzer — the kaleidoscopic spreadsheet model used by transit advocates and state officials to optimize congestion pricing.

Komanoff's publications include books (*Power Plant Cost Escalation, Killed By Automobile, The Bicycle Blueprint*), scholarly articles, and journalism for outlets ranging from Streetsblog to The New York Times. An honors graduate of Harvard and married parent of two grown sons, Charles lives in lower Manhattan.

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ACKNOWLEDGMENTS

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REPORT URL
http://www.komanoff.net/cars_II/Taming_NYC's_E-Delivery_Gridlock.pdf

EXCEL SPREADSHEET URL
http://www.komanoff.net/cars_II/DTA.xlsx

Appendix: Calculations

HOW WE DERIVED THIS REPORT'S FACTS AND FIGURES

TRAFFIC SPEEDS, ZONE BY ZONE

TAXI ZONES

For purposes of analysis and record-keeping, the New York City Taxi and Limousine Commission maps the city's 303 square mile expanse into 259 taxi zones. These zones average slightly more than one square mile in area, though less in dense Manhattan, especially south of 60th Street, and considerably more in more sparsely settled Staten Island and much of Queens.

These taxi zones are an ideal unit for analysis — large enough to contain a substantial number of households and travel activity, yet small enough to correspond to well-defined neighborhoods, such as East Tremont in the Bronx, Clinton Hill in Brooklyn, Midtown South in Manhattan, Jamaica Estates in Queens, and West Brighton in Staten Island.

Since the mid-2010s, under the TLC's Taxicab & Livery Passenger Enhancement Programs (TPEP/LPEP), yellow and green taxis have recorded and reported each fare trip's pick-up and drop-off dates, times and locations, and trip distances (along with fare data that is not of interest here).

The TLC also maintains a parallel dataset for trips by ride-hails vehicles. However, that dataset does not include the trips' precise pick-up and drop-off locations, though it does record each location's taxi zone.

Together, the two datasets, encompassing some two billion trips from 2015 through 2019, provide a means to calculate average vehicle speeds and volumes for each city neighborhood at different times of day. The distance figures for taxi trips not only allow us to calculate average taxi speeds; by ascribing those distances to the more numerous ride-hail trips, we can calculate average speeds for ride-hail vehicles as well. This is important because the ride-hail data are distributed far more widely across the city than are the taxi data, due to the taxi sector's traditional (but now perished) monopoly on for-hire trips in Manhattan south of 96th Street. Applying taxi trip distances to ride-hail trips enables us to calculate vehicle volumes, as we show below.

DATASET DETAILS

We began by importing two sets of trip-level records files from the TLC's website using the nyc-taxi-data GitHub repository database schema:

1. Yellow + green taxi files from Jan 2018 through Dec 2019 (one per month, 24 files total)
2. High-volume FHV (Uber and Lyft) files from three representative months: June 2019, October 2019, and February 2020 (three files total)

We then deployed the taxi dataset to measure the average distance traveled from zone A to zone B for every pair of zones [A & B] in the city. We removed some extreme outliers, e.g. trips where the apparent average speed was over 80 miles per hour, or for which the distance traveled was suspiciously large. (The exact details of our outlier calculations are available on GitHub via this link.) We then assumed that ride-hail trips from zone A to zone B had the same average distance as corresponding (A => B) taxi trips, and used that distance to calculate speeds.

Why not estimate speeds from the taxi trips alone? Because we needed more data to be able to segment along several dimensions, including time of day and weekends vs. weekdays. Increasing the number of dimensions makes the taxi data sparse for many regions, especially in the outer boroughs. By using the much larger ride-hail datasets, and assuming that distances traveled from zone A => B don't vary greatly between ride-hails and taxis, we can use the former to expand the geographic coverage for our speed calculations.

Once we calculated the average A => B distances based on 2018 and 2019 taxi trips, we applied those distances to the three representative months of ride-hail trips (6/2019, 10/2019, 2/2020), and calculated estimated average speed for each ride-hail trip. We further filtered based on these conditions:

- Uber and Lyft ride-hail bases only
- No shared-ride trips
- No trips whose estimated distance exceeded 3 miles (to eliminate possible highway usage)
- No trips where pickup and drop-off were in different boroughs (same rationale as above)

Our dimensions for aggregating were:

- Location, based on pickup zone
- Weekday vs. weekend (treating holidays as weekends)
- Time of day, split by 6am-noon, noon-8pm, 8pm-midnight, midnight-6am

For simplicity, we did not assign trips to their drop-off or "intermediate" zones. For example, a trip from Manhattan's East Village to the West Village would likely pass through one or both of the Greenwich Village North/South zones, but we would assign that trip's speed to the East Village aggregate. (Filtering trips to under 3 miles helped keep the data within the same general geographic region.)

ADJUSTMENTS

We also made an important adjustment to the data: we decreased the average trip duration (the interval between reported pickup and drop-off) calculated for each data subset (say, weekday 6am-noon trips in West Concourse, in the Bronx) by 60 seconds, except that for the "graveyard" period (midnight-6am) we decreased the average durations by 120 seconds.

The impetus for this adjustment was that the unadjusted speed calculations appeared to us to be uniformly slightly slower than other external measurements, e.g., the TLC's estimate of 7 MPH average speeds in the Manhattan Central Business District during business hours (as reported in NYC DOT's August 2019 New York City Mobility Report, pp 18-19). Moreover, these adjustments were supported by the knowledge that ride-hail trips often involve idle time while the driver waits for the passenger to arrive; even though the trip itself hasn't actually commenced, this idle time is recorded as pickup time and thus counted toward trip duration.

Following these adjustments, we generated a heat map of weekday noon-8pm speeds by zone. Aided by this visualization, we assigned all 259 zones into four districts of roughly similar speed; this assignment involved several tweaks to promote geographic cohesiveness. These "speed districts" serve as the basis of the charges we propose to apply to the time that the e-commerce delivery vehicles occupy public streets and roads.

VARIATION IN E-COMMERCE AMONG ZONES

From the American Community Survey, Table B19001, we obtained estimated distributions of household incomes for every census tract in NYC, i.e., the number of households with incomes less than $10k per year, $10k-$15k per year, and so on. There are 16 "income buckets" in all, with the highest being households earning more than $200k per year.

We then performed a geospatial calculation to assign each of the 2,165 census tracts to a taxi zone. This enabled us to aggregate the number of households in each income bucket in each taxi zone.

Presumably, e-commerce usage varies with household income; but how closely? It seemed excessive to posit direct proportionality, such that a 10 times higher income would imply 10 times greater purchases via e-commerce. Instead, we posited that e-commerce participation is proportional to the square root of household income; thus, if household income increases by a factor of 10, e-commerce usage increases by a factor of 10^(½), or roughly 3.2.

We then took the mean of each income bucket's income (so that, for example, the $30k-$35k bucket was assumed to have a mean income of $32,500; we assigned a mean income of $5k to the $10k-and- under bucket, and $400k to the $200k+ bucket). Next, using the square root proportionality just described, we computed relative e-commerce usage for all of the taxi zone's income buckets. Multiplying each zone's number of households per bucket by the relative usage figures yielded each taxi zone's estimated share of citywide residential e-commerce deliveries. For example, Bayside, with 0.48% of the city's households (15,234 out of a total of 3,183,452) was found to have 0.54% of total deliveries, due to its higher-than-average income levels.

NUMBER AND DAILY DISTRIBUTION OF E-COMMERCE DELIVERIES

City officials do not maintain figures on the number of packages and parcels delivered to New Yorkers via e-commerce on a typical day. Their elaborately designed, 100-page May 2021 report, "Delivering New York: A Smart Truck Management Plan for New York City," does not include an estimate. Nor have any of the city's think tanks or transportation advocacy organizations put forth a figure.

A March, 2021 New York Times article on the city's burgeoning e-commerce sector reported a figure of 2.4 million such deliveries per day, a number furnished by a research unit at Rensselaer Polytechnic Institute, near Albany. The data and methodology underlying the figure are proprietary. Notably, the 2.4 million figure surpasses by a wide margin an estimate of 1.5 million from the same source that appeared in an earlier Times story on e-commerce in New York City in October 2019; the difference presumably reflects rapid growth in e-commerce since the start of the Covid pandemic.

This report employs the 2.4 million figure. While the March Times story notes that "80 percent of [the] deliveries are to residential customers," we include the entire figure on the premise that the "other" 20 percent likewise require trucks which contribute to traffic congestion — even if their geographical distribution may not perfectly match that of residential deliveries. We assume that the figure applies to weekdays, and we further assume that the average weekday sees three time as many deliveries as the average weekend day or holiday. These assumptions translates to just under 700 million deliveries annually.

If deliveries were spread evenly across day and night, every hour would register 4.17% of each day's deliveries (4.17% is the reciprocal of 24). In reality, mornings and afternoons see disproportionately more deliveries than evenings and overnight hours. We assign 34%, 56%, 7% and 3% of the 24-hour deliveries to our 6am-12noon, 12noon-8pm, 8pm-12midnite and midnite-6am periods, respectively. (These odd-seeming shares, which are rounded, arise from straightforward assumptions about each period's over- and under-representation in deliveries, which are shown in our spreadsheet.)

E-COMMERCE TRUCKS

We estimate that delivering those 2.4 million parcels per weekday to their destinations requires 7,800 truckloads dedicated exclusively to e-commerce. That figure arises from our assumption that the vehicle of choice is a cargo van, and our estimate that it carries 307 parcels. That figure in turn arises from a series of assumptions re truck size (358 square foot loading space), loading-space utilization (2/3), and of course parcel size (0.78 cubic feet average, based on assumed typical box dimensions of 14 x 12 x 8 inches). We believe the latter assumption errs on the side of conservatism; more truckloads would be required if parcels trend larger.

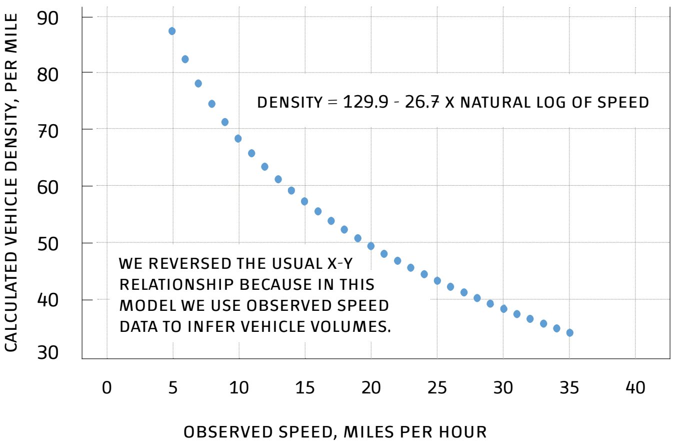
VEHICLE VOLUMES, BY ZONE

We then estimated, for each of the 259 taxi zones, daily (24-hour) vehicular travel, expressed as the amount of physical space taken up by all motor vehicles on the streets and roads in each taxi zone. (The more standard metric of VMT, vehicle miles traveled, comes into play below.) This spatial quantity lets us establish baseline vehicle volumes for each zone for weekdays and weekends for each of the four periods of each day. With these volumes, we can estimate the amount of travel-delay currently (in 2021) caused by e-commerce delivery vehicles.

We began this process by estimating the number of "moving lane-miles" (linear lane-miles not given over to curbside parking) of streets and roads in each taxi zone. Through a series of simplifying assumptions regarding street geometries (e.g., the Manhattan CBD averages 20 streets and 7 avenues per mile; the rest of the city averages slightly fewer — 15 and 6), we calculated the average number of moving lane-miles per square mile in the CBD and outside: 58 and 47, respectively. Multiplying those figures by each taxi zone's square mileage yielded the number of miles of moving lanes in each taxi zone — a broad range of numbers averaging around 50.

Recall that from the taxi and ride-hail data described earlier, we have each taxi zone's average speed for each of the eight time periods. The next step was calculating, from each zone's number of moving lane-miles, the number of vehicles per lane-mile. We did this by applying a "speed-volume equation" we previously developed in the course of modeling congestion pricing for New York City.

HOW WE TRANSLATED OBSERVED SPEEDS TO ETIMATED VEHICLE VOLUMES



The equation, shown above, is derived and sourced in the Excel spreadsheet that is a companion to this report. Essentially, it translates observed speeds into calculated vehicle densities per lane-mile. Thus, a 20 mph speed implies that each moving lane-mile contains an average of 50 vehicles, whereas the lane density at 30 mph is 39 vehicles.

Multiplying each taxi zone's vehicles per lane-mile by its number of moving lane miles yields its estimated number of moving vehicles at any time. (Keep in mind that this figure will vary across the four different times of day and between weekdays and weekends.)

VEHICLE MILES TRAVELED (VMT), BY ZONE

VMT figures are needed here to translate the delay costs imposed by e-commerce delivery vehicles (and the corresponding delay reductions from proposed vehicle charges) into hours lost (or gained).

From NYMTC, the New York-area transportation planning consortium (full name, New York Metropolitan Transportation Council), we have each borough's estimated weekday miles driven, broken down among "freeways" (limited access highways), arterials (essentially avenues or broad, higher-volume streets) and local roads. While the figures, from NYMTC's 2017 "Congestion Management Process Report," are imperfect, they appear to be the most accurate available.

For this report, we set aside the freeway figures and combined each borough's arterial and local VMT. (The sums of the arterial plus local mileages are more than half of total mileages for Brooklyn, Manhattan and Staten Island; less than half for the Bronx and Queens, which are laced with highways.) We then allocated each borough's sum among its taxi zones, based on each zone's percentage share of ride-hail mileage from the TLC data discussed earlier.

PUTTING THE NUMBERS TOGETHER: AN ILLUSTRATIVE EXAMPLE

Consider Tribeca, where I live. Its TLC taxi zone, Tribeca / Civic Center (#231 in TLC's alphabetical list of zones; we'll refer to it as Tribeca), occupies 0.429 square miles. Over half of its households, 4,697 of 8,676, are in the highest census income bracket, $200,000 or more per year, while only 181 fall into the lowest, less than $10,000. Factoring each bracket's relative e-commerce delivery propensity vis-à-vis the same for the other 258 taxi zones (via the relationship between income and e-deliveries described earlier) leads to the result that Tribeca, with 27/100 of one percent of NYC's households, accounts for 46/100 of one percent of the city's 2.4 million weekday e-commerce deliveries.

Tribeca's percentage gives it 10,996 e-commerce deliveries per day, an average of 1.27 per household, of which 34.2%, or 3,762, are made during the 6am-12noon period we employ in this illustration. Continuing, we apply Tribeca's 2.9% share of Manhattan ride-hail vehicle trips to calculate its share of Manhattan VMT. This results in a figure of 32,962 daily miles traveled in Tribeca during this morning period, which we set aside.

Speed data that we computed from the ride-hail trip dataset translates to average vehicle speeds in Tribeca of 8.93 mph during 6am-12noon on weekdays. This corresponds to an average of 72 vehicles per moving lane-mile, or 1,779 vehicles (72 vehicles x 25 moving lane-miles, rounded) traveling at any moment. On average, 12.3 of these are e-commerce delivery vehicles — a figure we calculated by dividing the 3,762 e-commerce parcels being delivered in Tribeca in this period by the per-truckload average of 307 parcels. These trucks are larger in size than the automobiles that comprised most of the vehicles whose volumes and speeds gave rise to the speed-volume equation by which we translated observed speeds into estimated volumes. To compensate, we added 50 percent to the number of delivery truckloads (12.3), giving them an effective weight of 18.4. That in turn is 1.03 percent of the average Tribeca vehicle volume of 1,779 just noted.

Zeroing out that volume, i.e., reducing the vehicle volumes in Tribeca by that percent, and plugging the result into our speed-volume equation yields a hypothetical average speed (if no e-commerce vehicles) for Tribeca of 9.17 mph. The actual speed, 8.93 mph, is 2.69 percent less, indicating that the presence of e-commerce delivery vehicles is indeed materially slowing vehicular traffic in Tribeca.

Recall that we estimated that Tribeca averages 32,962 vehicle-miles traveled during that six-hour interval; using the zone's average 8.93 mph travel speed during that time interval, that number of vehicle-miles equates to 3,692 vehicle-hours. At the hypothetical zero-delivery speed of 9.17 mph, the same mileage would have required somewhat fewer hours, 3,593. The difference in the respective number of hours, 99, denotes lost travel time — the extra hours expended by all motor vehicles in Tribeca during 6am-12noon because e-commerce delivery vehicles are occupying road space and slowing motor traffic.