GETTING UNSTUCK

Washington, D.C., is notorious for congestion. Can smarter pricing provide a way out of clogged highways, packed parking, and overburdened mass transit?

BY HELEN FESSENDEN

For millennia, philosophers have wrestled with the question, "What is time?" For economists, finding the answer is a bit easier: Time is whatever people are willing to pay for it, whether it's a hotel or flight during peak season, an Uber cab on a busy Friday or Saturday night, or express package delivery.

In Washington, D.C., however, the challenge of valuing time has become an acute problem that affects everyone: traffic chaos. In the last decade, metro D.C. has ranked close to or at the top of national congestion surveys. According to the most recent annual study by the Texas A&M Transportation Institute and INRIX, Inc., for example, the District continues to beat Los Angeles, San Francisco, and New York as the national leader in gridlock. The report calculated that the average commuter in the D.C. region who drives during peak times frittered away 82 hours, or almost three and a half days, in 2014 due solely to congestion.

Many residents assume that increased gridlock is a price to pay for several positive trends in the last two decades, namely, strong population and job growth. In the greater D.C. region, the population surged from 4.2 million in 1990 to 6 million in 2014, while total employment jumped from 2.9 million to 4.1 million. Helped by falling crime rates in the city and, until recent years, robust government spending and plentiful federal jobs, the local economy also held up far better than most cities during the recession.

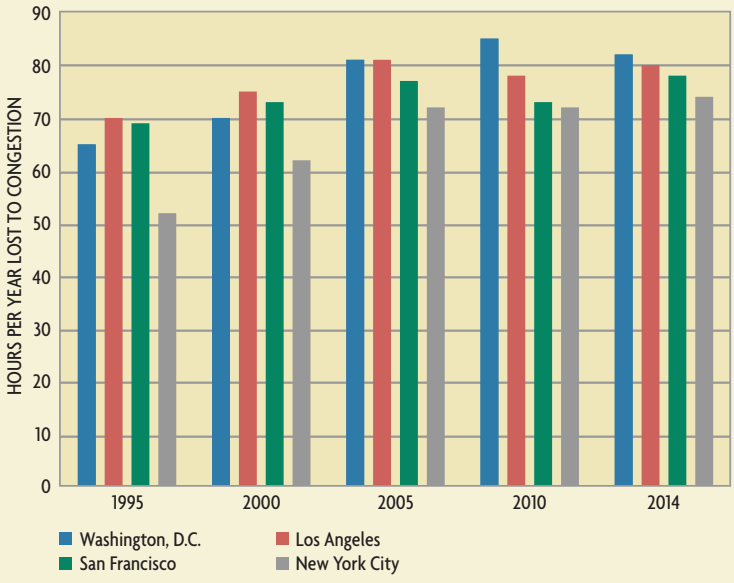
In principle, the region's extensive network of mass transit options could help absorb some of these stresses. The D.C. Metrorail system is the second-busiest in the nation. The area is also served by regional rail and local and commuter bus options. Around 700,000 riders use Metrorail daily, while another 700,000 use bus or regional rail. But transit ridership is actually falling, amid widespread woes with Metro service, reliability, and safety. And the aggregate rise in congestion suggests that the transit capacity that has been built out hasn't been enough to handle rising demand and evolving commuting patterns, including for those residents in farther reaches of D.C.'s suburbs. Economists have long argued that putting a price on congestion is the way to produce more efficient outcomes. Washington, D.C., can provide a textbook example of both the challenges and potential solutions.

Free Riders

To economists, one basic reason for the congestion crisis is a market failure. Any road, as long as it's un-tolled, presents a classic problem of externalities: All drivers can access it without fully bearing the additional costs that arise when that particular road gets crowded. Each added driver imposes externalities on others by adding to congestion that slows traffic and cuts into productive working hours. In addition to externalities imposed on other drivers, there are other costs imposed on society via higher emissions that hurt the environment. (By some estimates, driving accounts for a third of carbon emissions from energy use.)

D.C. Traffic Congestion: A Comparison

Despite a slight improvement since 2010, the average Washington-area commuter still loses more hours per year to traffic jams than commuters in the next three most congested very large urban areas, defined as those with more than 3 million in population.



SOURCE: Texas A&M Transportation Institute and INRIX, Inc. Annual Mobility Scorecard, 2015

In short, the market failure occurs because drivers are underpaying for that good by not fully internalizing the social costs of their decisions. For their part, planners could meet higher demand for roadways with extra supply by building more lanes, but those solutions take money (from the taxpayer) and require years to execute — and more importantly, additional lanes generally don't ease congestion in the long run because they don't correct the market failure. Finally, there is the issue of parking, which suffers from a similar set of issues: A driver who searches for an open spot produces externalities while cruising around (more emissions and more traffic).

Addressing these inefficiencies, then, many economists and planners focus on the demand side — namely, establishing a pricing system that requires people to internalize the costs they impose on others when they commute. This way, a scarce resource is allocated more efficiently to those who value it the most. In both the United States and abroad, experiments in demand management have been underway for decades, but advances in technology, such as smartphones and GPS, now give people far more information to use in making transportation decisions. And these innovations are taking root in the Washington metro region, as are efforts to overhaul mass transit so that it's more responsive and efficient as an alternative.

Name Your Price

The origins of demand management go back about a century, in the work of economists Arthur Pigou and Frank Knight. Pigou formalized the idea of externalities and proposed tolls as a solution for restoring efficiency on a road suffering from congestion externalities, such as wasted time and productivity, wear and tear on roads, and more accidents. Knight built on this idea but argued for private road tolling as a way to force drivers to pay the marginal cost that they impose on others. If private firms owned these roads, he argued, a proper application of property rights would set toll pricing efficiently. In the 1950s and 1960s, their work influenced a new generation of transportation economists, including William Vickrey, who promoted congestion pricing for public transit and, later, for roads. In contrast to Knight, he saw a government role in setting the toll and argued that efficient pricing should, among other things, reflect the trip's impact on all other traffic from start to finish. Tolling, in other words, makes the driver pay a price closer to the social cost of road maintenance, plus externalities such as emissions and congestion affecting others.

Congestion arises not just from tangible factors such as population growth, city size, or even density, but also from the failure to manage demand across existing capacity. Generally speaking, any given mode of transportation isn't being used to full capacity all the time, whether it's by highways, buses, or bike paths. Even in the case of roads, Federal Highway Administration research shows that more than half of rush-hour drivers are not commuters, but people with some discretion as to when and how to travel. The same research concludes that you don't need to remove many of those noncommuting drivers to make a difference — diverting just 5 percent of vehicles from a clogged roadway can substantially improve traffic.

More Lanes, More Problems?

For decades, the most popular solution to congestion was building additional lanes or roads. The problem is that creating additional road capacity doesn't reduce traffic in the long run, because it simply encourages more people to take the roads rather than seek alternatives to road commuting, a dilemma known as "the fundamental law of road congestion." A study by economists Gilles Duranton at the University of Pennsylvania and Matthew Turner at Brown University estimated that a 10 percent expansion of interstate lanes causes, over time, a roughly equal percentage increase in the vehicle-kilometers traveled, and that any congestion-reduction benefit gained by a new lane tends to disappear after 10 years. In addition, expanding lanes is expensive, between $10 million and $15 million per mile in urban areas. Still, the approach remains politically appealing, including in the D.C. region. As a case in point, Virginia lawmakers recently struck a deal in which I-66, one of the busiest highways in the area, will get one more lane inside the Beltway, possibly costing up to $140 million, as part of a mix of enhancements intended to better regulate traffic.

This is where demand management comes in. One way to shape demand is to give incentives for drivers to carpool, in exchange for faster speeds. Across the country, many states have established high-occupancy vehicle (HOV) lanes to discourage single-occupancy driving and take more vehicles off the road. In HOV lanes, only vehicles with multiple passengers, such as carpools, vanpools, and buses, are allowed access during peak times, while all other traffic is confined to general-purpose lanes.

HOV lanes are now widespread, but they pose new problems. Catching cheaters can be difficult, for example. But the biggest challenge is that HOV lanes are often underutilized while the general-purpose lanes remain congested. One reason: HOV rules affect only a small subset of drivers — those who are willing or able to carpool. A far greater share of the population lives alone, has a commute that doesn't lend itself to sharing, or simply prefers driving alone.

Another solution is tolling, popular with economists but widely hated by drivers. In some international cases, such as London, Singapore, and Stockholm, an anti-congestion "cordon" toll applies to all drivers heading into those cities during peak times. This solution has little political backing in the United States, however. Meanwhile, interstates have certain restrictions in using federal public money to set up new lanes that are "pure" tolls. At the same time, cash-strapped states are keen to find revenue for infrastructure maintenance and improvements. So policymakers are taking a new approach: using variable pricing for designated lanes on high-demand roadways. These are most commonly known as "high occupancy tolling" or HOT lanes. In some cases, they are also termed "express lanes."

Early morning traffic on I-95 near Washington, D.C., splits off into toll and free lanes.

PHOTOGRAPHY: TRANSURBAN

Some Like It HOT

Under this approach, a lane is designated as an HOV/toll lane, but the toll varies constantly during peak times, depending on how full the road is. HOV drivers may still use the lane without paying, but solo drivers now have a choice to either pay for that lane or stay in the general-purpose lane. Typically, that driver has a few minutes to see the real-time fare and decide which lane to take. Payment and enforcement is handled through transponders (such as an E-ZPass) so that traffic is not held up at toll booths. In effect, a certain amount of congestion in the general lanes is required to incentivize at least some drivers to leave the general-purpose lanes. But in theory, welfare should improve for the entire driving population, because all lanes are better utilized once the HOV/HOT lanes absorb more traffic.

Private companies generally manage these schemes but frequently some revenue is set aside for the public, often for improving mass transit. One well-known case is San Diego's I-15, which saw sharp jumps in bus ridership and carpooling after it adopted HOT lanes as part of a mix of improvements. Proponents note that a core element of this strategy was adding more transit options to help people who don't have a car — including low-income groups and the nondriving elderly — which in turn raised popular support for the tolling component.

The Intercounty Connector in Maryland has used all-electronic, variable tolling since 2011. In Northern Virginia, some of the busiest arteries have converted, or will soon convert, their HOV lanes into HOT lanes. In 2014, the Virginia Department of Transportation (VDOT), along with a private firm, Transurban, transformed the 29-mile barrier separating HOV lanes on I-95 into HOT lanes south of the Beltway, collecting variable tolls during all hours. In 2015, VDOT and Transurban issued a preliminary "snapshot" study showing that average speeds during peak hours did rise substantially in the un-tolled lanes while staying largely unchanged (i.e., relatively fast) in express lanes. In some stretches, especially farther out from D.C., that speed increase ranged from 57 to 81 percent. VDOT and Transurban are proposing to extend the HOT lanes northward on I-395 inside the Beltway, and VDOT is also moving forward with HOT lanes on I-66.

There remains, however, the question of whether tolling is economically fair in light of its distributional effects. The time savings that congestion pricing brings are likely to be worth more to affluent individuals, who tend to have a higher opportunity cost of time in terms of wages. For lower-income individuals, the toll they are forced to pay is more likely to exceed the benefit they receive from reduced congestion. A highway divided into both HOT and general-purpose lanes addresses this by giving drivers the choice between paying with time versus paying with money, although this trade-off may strike some as unfair. These distributional effects can be offset when the revenues are used to fund commuting alternatives, including those that benefit lower-income groups, and this helps gain public support as well. In a 2013 survey, the Metropolitan Washington Council of Governments and National Capital Region Transportation Planning Board found that participants in both upper- and lower-income groups supported congestion pricing by substantial majorities, provided that it offered in return more transportation options that made a difference to their commute.

The Myth of Free Parking

Once drivers finish their trips, an all-too-common problem in any city is crowded metered street parking. The traditional on-street pricing approach sets a flat hourly rate, payable at all meters all day long. But this price doesn't adjust to demand at peak times. Drivers then encounter blocks

and blocks of full parking, forcing them to spend extra time and fuel looking for a spot. Economist Don Shoup at the University of California, Los Angeles has spent decades researching the inefficiencies of the parking market — including the high cost of minimum parking requirements — but he is probably best known for his work on street parking. In 2011, San Francisco applied his ideas in a pilot project to set up "performance pricing" zones in its crowded downtown, and similar projects are now underway in numerous other cities — including, later this spring, in D.C.

To Shoup, the optimal rate, or "right price," as he calls it, for on-street parking responds to demand, similar to the approach behind variable tolls. The right price for on-street parking is the lowest price that will leave one or two spaces open on every block, thereby dramatically reducing the amount of time spent cruising, a chief source of urban congestion.

"I had always thought parking was an unusual case because meter prices deviated so much from the market prices," says Shoup. "The government was practically giving away valuable land for free. Why not set the price for on-street parking according to demand, and then use the money for public services?"

Taking a cue from this argument, San Francisco converted its fixed-price system for on-street parking in certain zones into "performance parking," in which rates varied by the time of day according to demand. The idea was that as demand rose during peak times on popular blocks, and fell during off-peak times on less popular blocks, drivers would factor parking prices into their decisions about where to park and how long to stay. If prices were too high for drivers on some blocks, they could park on lower-priced blocks nearby.

Hitting the Target

In its initial run, the project, dubbed SF*park*, equipped its meters with sensors and divided the day into three different price periods, with the option to adjust the rate in 25-cent increments, with a maximum price of $6 an hour. The sensors then gathered data on the occupancy rates on each block, which the city analyzed to see whether and how those rates should be adjusted. Its goal was to set prices to achieve target occupancy — in this case, between 60 percent and 80 percent — at all times. There was no formal model to predict pricing; instead, the city adjusted prices every few months in response to the observed occupancy to find the optimal rates.

The results: In the first two years of the project, the time it took to find a spot fell by 43 percent in the pilot areas, compared with a 13 percent fall on the control blocks. Pilot areas also saw less "circling," as vehicle miles traveled dropped by 30 percent, compared with 6 percent on the control blocks. Perhaps most surprising was that the experiment didn't wind up costing drivers more, on net, because demand was more efficiently dispersed. Parking rates went up 31 percent of the time, dropped in another 30 percent of cases, and stayed flat for the remaining 39 percent. The overall average rate actually dropped by 4 percent.

SF*park* has become the most well-known of these experiments, but other cities, especially in California, have also adopted this approach. And this spring, Washington will join the list as well. The neighborhood of Penn Quarter/Chinatown will soon launch a pilot project similar to SF*park* but with fewer sensors; it will use a broader mix of parking data from spot sampling, parking enforcement data, and cellphone payment data to estimate pricing per block. A driver can use an app to see what the probability of finding a spot would be on any given block, and rates will be adjusted every three months if needed.

"Penn Quarter is an ideal environment because we can study the interaction between performance parking and an array of modes — whether Metro, bus, or bike-share," explains Soumya Dey, director of research and technology transfer at the District Department of Transportation. "And as part of this, we're also doing a study to see just how much congestion in D.C. is caused by cruising."

Incentivizing Mass Transit

Once people opt to leave their cars, of course, they need mass transit or other alternative modes, such as biking, walking, or car-sharing. And in D.C., where a large plurality of city residents use transit daily and substantial numbers use it to commute from the suburbs, transit is an essential part of daily life. This is one reason why the increasing woes of Metrorail — frequent delays due to deferred maintenance issues, declining reliability, and safety concerns — have dominated headlines. Under a new general manager, the Washington Metropolitan Area Transit Authority (WMATA) is launching an initiative to rebuild ridership and restore reliable service. Following a system-wide safety audit, it is launching a yearlong overhaul addressing deferred maintenance that will require disruptions.

For all of these problems, however, the presence of such an extensive transit system opens up a way for economists to look at the challenge of externalities and demand management in reverse. For example, there is no additional cost to adding one more rider to an underutilized, half-empty subway or bus during off-peak hours. Furthermore, transit can produce a positive externality by reducing passengers' carbon footprint and taking vehicles off the road. By extension, demand management can work the other way by encouraging riders with more flexible schedules to take transit at different times, including at peak-shoulder and off-peak times. This approach, in theory, could not only take potential drivers off the roads, but also spread out transit ridership more evenly.

Metrorail has long used a variable pricing system that takes both distance traveled and peak/off-peak times into account. And a few years ago, it temporarily tried a "peak of peak" plan that added an extra pricing tier for the busiest times, both to shape demand and bring in extra revenue. The plan was unpopular and seen as overly complicated, so it was dropped. But now, WMATA is launching a pilot project to see how a discounted, unlimited-access pass will

work in lieu of raising fares, with the chief aim being to increase ridership.

In April, WMATA began offering a new product called SelectPass in which a passenger determines the price of his or her typical daily round trip, multiplies it across 18 days, and then pays that amount as the blanket fare for the entire month. As long as any given trip, no matter when it's taken, doesn't exceed this preset estimate, the cost is covered for the month. (Only if the passenger takes a longer trip is there any additional charge.) The idea is that a passenger taking transit every workday should save at least 20 percent compared to standard fares paid out over the same period, and he or she can adjust daily travel around the benefit of unlimited Metro travel during the day. WMATA is running this pilot project through June and will then assess longer-term strategy, including how to price different tiers of passes. But ideally, in the long term, its proponents say the convenience and cost factors may even grow the ridership population as more people will have an incentive to use Metro "for free," in effect, with their SelectPasses rather than take their cars. In the numerous European cities that have tried similar strategies on discounted blanket pricing, both aggregate ridership and revenue have risen as a result.

"The problem is that Metro does have an all-access rail pass, but it's priced at the maximum fare, so it's prohibitively expensive for most riders," explains Mark Schofield, WMATA's director of financial planning and analysis. "So this pilot will try to address this cost issue in order to grow ridership."

Too Much Of A Good Thing?

Another demand-management issue for economists is how employers structure commuter benefits. In some major cities, including New York, San Francisco, and D.C., an employee in a firm with 20 or more employees can opt for a pre-tax deduction to cover parking or transit; in addition, many employers offer a mix of benefits such as free or discounted parking and transit subsidies. To see how these options interact, two researchers at Virginia Tech, doctoral candidate Andrea Hamre and associate professor Ralph Buehler, recently analyzed data on a representative sample of more than 4,600 commuters from the urban core and inner suburbs of the D.C. metro region: About 70 percent drove alone, 24 percent used transit, and 6 percent walked or biked. The research question: Is it enough to offer incentives to take alternatives to driving, or do you need to directly discourage driving itself if you want employees to take mass transit, bike, or walk?

The results suggested that free parking overwhelmed all other benefits. For example, if commuters were offered both free parking and transit benefits, the probability that they would still opt to drive alone to work was 83 percent — a higher probability, in fact, than if the employer offered no transit benefits at all (76 percent). In the entire mix of benefit transit options, driving alone won out every time as long as free parking was offered. Conversely, if the employer took away free parking but offered help on transit, the probability of driving alone fell to 23 percent, with the rest choosing transit.

As these results and similar findings become better known, some transportation experts are promoting parking "cash out" options for employers to offer employees. Under these schemes, employees who waive their parking benefits get cash back directly. Some groups are working with the D.C. City Council in hopes of having legislation introduced on this proposal later in the year.

"Transit benefits seem to be most effective at encouraging mode shift when they are offered in the absence of free parking," says Hamre. "In the United States, we've done a good job of steadily increasing benefits for alternatives to driving, but we need to put those benefits for alternatives within the overall context of relative prices across all modes — and this means recognizing how they compare to the cost of car parking, and how commuters may respond when offered benefits for both driving and alternatives."

Washington's congestion crisis took years to develop and will likely take years to address. But there are signs of progress in tandem with these new experiments. The National Capital Region's Transportation Planning Board released a survey in early 2016 showing that the percentage of commuters opting for transit, biking, and telecommuting jumped from 15 percent to 21.4 percent between 2000 and 2014, while the share of those driving alone even dropped slightly, from 67.7 percent in 2000 to 65.1 percent in 2014. The growth of car-sharing, the popularity of expanded bike paths, and the prospect of more express bus routes are likely to change commuting dynamics even more in coming years.

"As we look at all these challenges, we see the need to do more pilots, get more experience, and be willing to fail if necessary," says WMATA's Schofield. "This is a brave new world." **EF**

READINGS

"Approaches to Making Federal Highway Spending More Productive." Congressional Budget Office, February 2016.

"Congestion Pricing: A Primer: Overview." U.S. Department of Transportation Federal Highway Administration, October 2008.

Duranton, Gilles, and Matthew A. Turner. "The Fundamental Law of Road Congestion: Evidence from US Cities." *American Economic Review*, October 2011, vol. 101, no. 6, pp. 2616-2652.

Hamre, Andrea, and Ralph Buehler. "Commuter Mode Choice and Free Car Parking, Public Transportation Benefits, Showers/Lockers, and Bike Parking at Work: Evidence from the Washington, DC Region." *Journal of Public Transportation*, 2014, vol. 17, no. 2, pp. 67-91.

"SF*park*: Pilot Project Evaluation Summary." SFMTA Municipal Transportation Authority, June 2014.