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## Stockholm's Syndrome

**Hostages to Traffic, Swedes  
Will Vote on High-Tech Plan  
To Untangle Snarls With Tolls**

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Soren Astrom, a 40-year-old advertising executive in Stockholm, spent the first half of this year working later than usual, beginning his drive home after 6:30 p.m. each night. But it wasn't his boss keeping him chained to his desk. He was avoiding the extra tolls charged to drivers using city streets during peak hours.

From January through July, Stockholm tested one of the world's most sophisticated traffic-management systems as part of a plan to reduce gridlock, lower smog levels and improve quality of life in the city. Unlike most other traffic-control plans in place in cities such as London and Rome, Stockholm used a dynamic-pricing system in which drivers were charged different amounts depending on the time of day. If Mr. Astrom, for example, left the city center at the busiest time of the afternoon rush, from 4 to 5:29, he would have paid the equivalent of \$2.76. But by waiting until 6:30 p.m., he traveled toll-free. "People changed their habits," he said.

### Taxing Journey

Fees for travel within Stockholm vary according to peak driving times, with higher tolls during rush hours. A look at the pricing:

|                     |        |
|---------------------|--------|
| 6:30-6:59 a.m.      | \$1.38 |
| 7:00-7:29           | 2.07   |
| 7:30-8:29           | 2.76   |
| 8:30-8:59           | 2.07   |
| 9:00 a.m.-3:29 p.m. | 1.38   |
| 3:30-3:59           | 2.07   |
| 4:00-5:29           | 2.76   |
| 5:30-5:59           | 2.07   |
| 6:00-6:29           | 1.38   |
| 6:30 p.m.-6:29 a.m. | Free   |

Note: Converted from Swedish Krona at current rate

Source: Stockholm Trial Expert Group

The project is essentially a giant behavior-control experiment designed to distribute traffic more efficiently throughout the day and to spur more people to take public transportation. The approach, known as "congestion pricing," first gained attention in the 1950s through work by Nobel-prize winning economist William Vickery. He theorized that billing drivers for driving at peak hours would give them an incentive to modify their routines. Because even small declines in the volume of cars on the road can have a huge impact on the flow of traffic, some economists believe pricing could eliminate some of the worst snarls.

The Stockholm system, implemented by **International Business Machines Corp.** in a contract with the Swedish national government, used small transponder boxes, laser detectors and a network of cameras to track the path of every car in the city.

Each time a car passed through one of 23 tolling points, the system identified the car either from its transponder or by reading its license plate. It then checked it against vehicle-registration information and calculated the appropriate fee depending on the time of day

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Drivers using a windshield-mounted transponder, similar to the E-ZPass in the U.S., had the tolls deducted automatically from their bank accounts.



Cameras and sensors monitor traffic in Stockholm late last fall, in preparation for the trial taxing system.

The Stockholm plan is an experiment in democracy as well as technology. One of its key elements, say urban planners, is how the city government is getting drivers to back the program. Now that the trial period has ended, the city has scheduled a referendum next month to let residents decide whether to continue the system. If the referendum fails, city officials promise to scrap the \$525 million project. But they hope it will pass, and will lead to reduced congestion and smog. A poll done in June found that 52% of voters favor the plan.

Urban planners and city officials from as far away as Bangkok and New York traveled to Stockholm during the trial to review how it might be adapted to their own cities. Dublin and San Francisco are planning similar projects, and Prague and Copenhagen have the plan under consideration.

Preventing traffic tie-ups is one of the great urban puzzles of physics and economics. Solving it is more than an academic question; the time people spend stuck in traffic is essentially wasted economic productivity. "We'd love to see a Stockholm-style demonstration project in the U.S.," said Tyler Duvall, the assistant secretary for policy at the U.S. Department of Transportation.

Mr. Duvall said the referendum approach might help implement an effort in the U.S., where higher tolls are seen as politically unpalatable. "I think people would be willing to pay more if they could see that congestion was meaningfully reduced and that their quality of life improved," he said.

During the Stockholm trial, the city collected data on how the system affected air quality, parking and bus ridership. The results showed that traffic passing over the cordon decreased 22%, while traffic accidents involving injuries fell by 5% to 10%. Exhaust emissions, including carbon dioxide and particles, decreased by 14% in the inner city and by 2% to 3% in Stockholm County.

Greater Stockholm has fewer than two million people. It is made up of an archipelago of islands connected by several bridges, with a single road encircling the center. That makes the central area prone to traffic jams, despite an extensive public-transportation system.

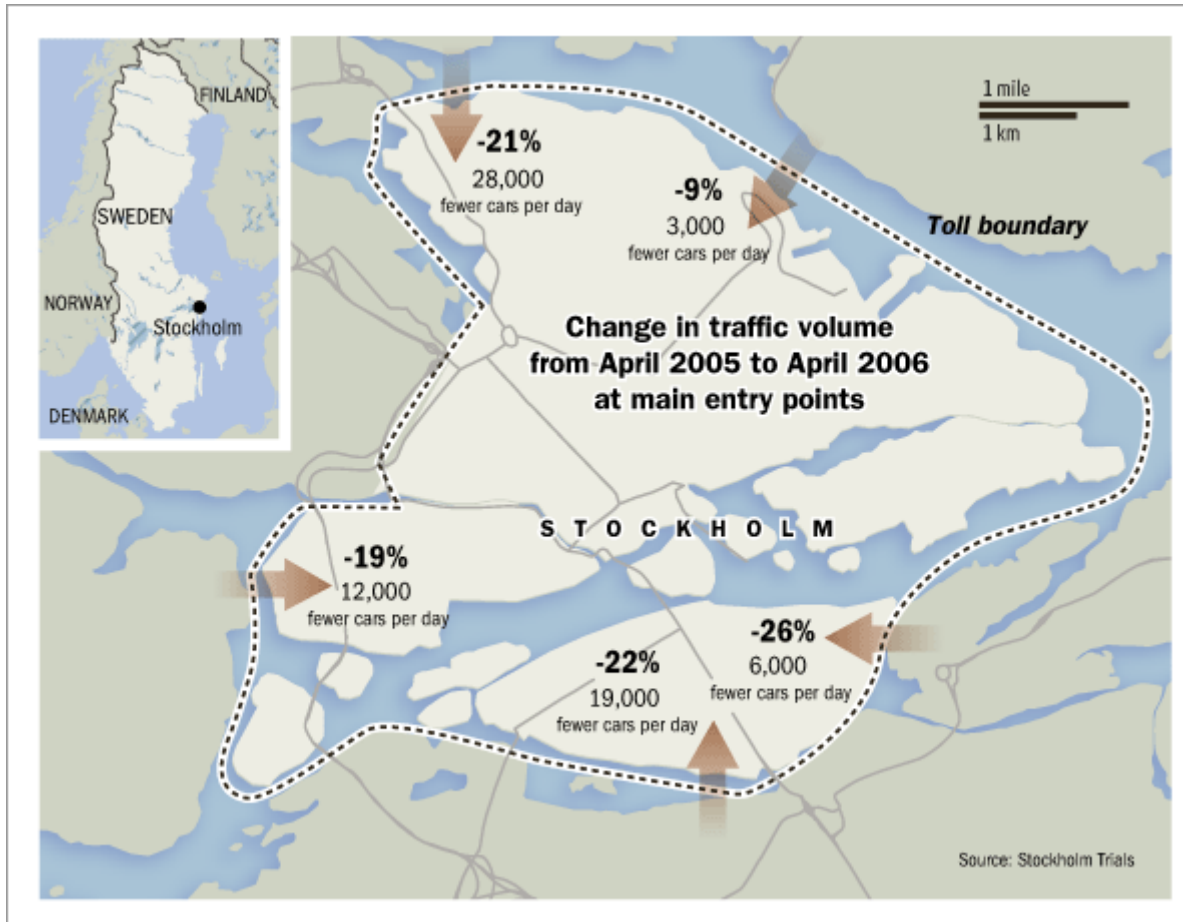
Before the trial, a drive into the city during morning rush hour used to take almost triple the time of a nonpeak trip. By the end of trial, the morning rush was just over double the time of an off-peak ride.

The Stockholm trial produced another insight into a vexing traffic-reduction programs: getting people to use public transportation. Before the trial began, Stockholm spent about \$180 million on improvements to public transportation. It bought about 200 new buses, and added rush-hour trains, express bus routes and more park-and-ride lots. But the changes had little impact on the number of people who left their private cars at home. In spring 2006, however, during the trial, use of all forms of public transportation jumped 6% and ridership on inner-city bus routes rose 9%, compared with a year earlier.

In the trial, about half of the drivers opted for the transponders; cameras checked the others' license plates. People without transponders also could pay at convenience stores, which were connected to the

network. Anyone trying to evade payment had their bill sent to the Swedish tax authorities for collection. Taxis, cars licensed in foreign countries and environment-friendly cars were exempt.

Putting the system in place took four months. Construction teams fanned out at night to build 23 metal archways over the roads at each charging point. The cameras and lasers had to be perfectly calibrated to identify cars as they sped by. "You have a few milliseconds to identify each car," said Johan Westman, a technical architect at IBM who worked on the project.



Mr. Westman worried that the system wouldn't be able to identify cars in the harsh Stockholm winters because of all the salt, snow and dirt on the roads and vehicles. But the trial period went smoothly and the cameras functioned

well in the winter months. IBM's customer-service center, which anticipated 30,000 calls a day, fielded just 2,000 a day; and few appeals of charges were filed to the tax authorities.

Some Stockholmers argue that the whole plan to reduce emissions can backfire. Lars-Inge Svensson changed the route he drove to his job at the postal service to avoid two tolling points. His new way to work was three miles longer, but he avoided about \$8.40 in tolls. "I let out the same amount of exhaust fumes, or more, but at different locations," said Mr. Svensson.

Some of the biggest beneficiaries, however, weren't drivers, but cyclists and bus riders. Astrid Ericsson, a 32-year-old who lives in the city center, said her 35-minute bicycle ride to work in the morning was much less stressful during the trial. She found fewer cars and more bikes on her route. On rainy days, she took the bus, which got to the office 15 minutes faster than usual. "I will vote for it," she said of the referendum.

If Stockholm residents vote against the referendum, it could set back efforts to try congestion pricing elsewhere. "Sweden is a pretty environmentally oriented place and it has good public transport," said

Hani Mahmassani, professor of transportation engineering at the University of Maryland. "If congestion pricing isn't accepted by people there, many other places will balk."

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