Everything had come to a standstill. The throb of the motor engines sounded like a pulse irregularly drumming through an entire body… Traffic accumulated. And there the motor car stood… It is I who am blocking the way, he thought.

— *from* Mrs. Dalloway, *by Virginia Woolf (the inspiration of Michael Cunningham's contemporary novel,* The Hours)

The Hours

Time Savings from Tolling The East River Bridges

By Charles Komanoff and Brian Ketcham, P.E.

Bridge Tolls Advocacy Project [BTAP]

July 2003

Authors' Note

We are, respectively, an economist and a traffic engineer. We have advocated tolling New York City's East River bridges for three decades — as policy analysts in the Lindsay Administration, and subsequently as private citizens.

In this report, we estimate the *time savings* drivers can expect to result from East River bridge tolls. To do so, we had to envision how bridge tolls will change long-standing travel patterns, and estimate the resulting changes in trip durations — not just for bridge crossings but also for trips on streets and highways affected by bridge traffic.

Ordinarily, this kind of analysis relies on a sophisticated computer model, in which estimates of the value of time and other factors are used to "select" travelers' modes and routes; the resulting demand levels determine average travel speeds, and these in turn determine travel choices, with the process iterated until equilibrium is reached. And in fact state and city agencies actually do have such a "Best Practices Model," the product of years of labor and over $10 million in consultant costs. Yet they have refused to apply it to bridge tolls (see Section 9).

Norbert Weiner, the founding father of cybernetics, once mused that if computers had been around for the Manhattan Project, everyone would have insisted afterwards that the atomic bomb couldn't have been developed without them (we tip our hat to Neil Postman for this story). Encouraged by this thought, we decided to model the effects of bridge tolls without the $10 million software, instead employing maps, spreadsheets and our years-in-the-making knowledge of the complexities of NYC transportation.

The result is this report. Our primary finding is that the time savings will total some 16.3 million vehicle-hours — or 37.5 million person-hours — worth $650 million a year to drivers and passengers. We believe that this conclusion is well-founded. In fact, we've probably erred on the side of conservatism. For one thing, we've assumed that half of the trips that are "tolled off" the bridges are lured back by the improved traffic flow. We also assumed flat-rate tolling rather than a "value pricing" toll varying by time of day. (Modeling value pricing wasn't possible within the time available; but we believe the additional time savings would be substantial.)

To make our methodology transparent without burdening the text, we are making our computer spreadsheet available to other researchers (see p. 19); we urge readers to follow the text along with the spreadsheet. We welcome criticisms, comments and suggestions.

As we went to press, there were reports that Mayor Bloomberg was abandoning efforts to seek East River bridge tolls. We hope this report will help revive such efforts — if not this year, then next. As we document here, the benefits of tolling include improved mobility as well as expanded municipal revenue and services — benefits that our great but sorely pressed city can't afford to pass up.

— *Charles Komanoff*
— *Brian Ketcham, P.E.*
July, 2003

1. Summary of Findings

Tolling the East River bridges will induce drivers to shift some trips to less heavily-used MTA toll facilities and to forego some other auto trips altogether. This rearrangement and reduction in driving will improve traffic flow in some of the most congested parts of New York City, saving drivers considerable time with a significant monetary value.

> Note: All findings in this report assume flat-rate tolling rather than tolls varying by time of day. “Value pricing” would add to the time savings from East River bridge tolls, perhaps significantly.

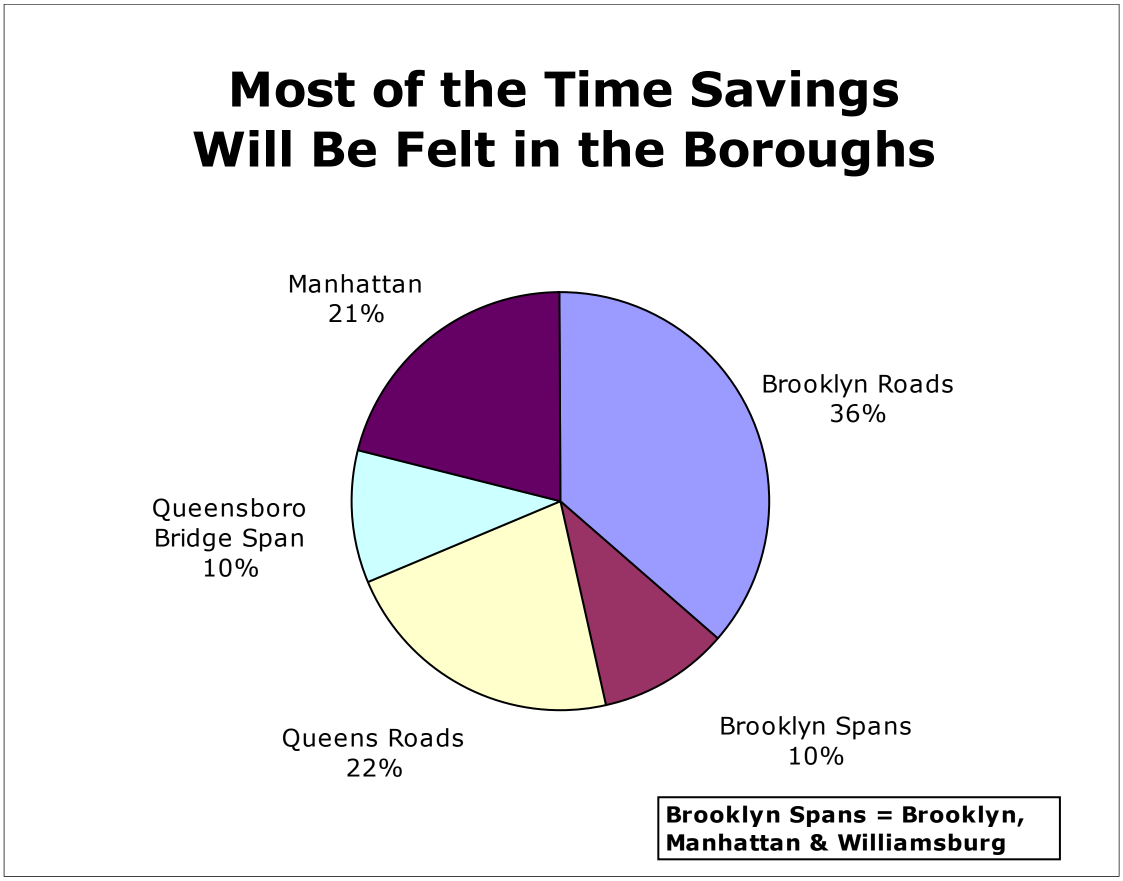
Key Finding #1: By reducing traffic volumes, **bridge tolls will raise motor vehicle speeds significantly on the bridge spans — by an estimated 24% on the Williamsburg Bridge, 29% on the Manhattan Bridge, 41% on the Brooklyn Bridge, and 47% on the Queensboro Bridge.** (See Table 1.) Overall, **bridge tolls will shorten typical travel times significantly for trips using the East River bridges —** by 6 minutes for round trips on the Queensboro Bridge (yielding a 6.5% improvement in the total door-to-door travel time), by 5½ minutes for round trips on the Williamsburg Bridge (a 5.2% improvement), and by 4½ minutes on the Manhattan and Brooklyn Bridges (around 5% improvements in both cases).

Key Finding #2: By increasing average vehicle speeds on connecting roads as well as on the bridge spans, **East River bridge tolls will do away with more than 9% of the idle time that motorists, truckers and bus riders now lose in traffic tie-ups throughout New York City.** The estimated 16,300,000 “vehicle-hours” saved annually will be realized as follows: <u>3.6 million vehicle-hours on Queens</u> streets and highways (22% of the total); <u>5.9 million vehicle-hours in Brooklyn</u> (36%); <u>3.4 million vehicle-hours in Manhattan</u> (21%); and <u>3.3 million vehicle-hours on the bridge spans themselves</u> (20%). (**To convert to “person-hours,” multiply vehicle-hours by 2.3**; note that these figures take into account the anticipated *lengthening* of travel times on the three tolled MTA East River spans due to the “resettlement” of some East River bridge trips to those crossings.)

Key Finding #3: Half of the aggregate time savings from bridge tolls will be realized on trips that aren’t even using an East River bridge, due to the “ripple effects” from reduced or redirected bridge traffic. Indeed, since fewer bridge-crossing trips will be made, and those that remain will be more evenly distributed, an indirect but powerful effect of bridge tolls will be to improve travel speeds across large areas of the city through which East River bridge traffic moves. **Speeds will increase by an average of 1.5% through much of Queens and 2-3% across most of Brooklyn. In Manhattan, the tolls will speed up travel by an average of 0.5% in a 2-mile arc extending from the Queensboro Bridge, and by an average of 2.7% in a similar arc around the three East River bridges in lower Manhattan.** (See precise estimates in Table 2.)

Key Finding #4: Based on an average value of $40 for each vehicle-hour (a weighted average of a range spanning $7.50 an hour for solo off-peak car trips to several hundred dollars an hour for 18-wheelers and commuter buses), **the 16.3 million “saved vehicle-hours” equate to $650 million a year**, enough to offset over 90% of the assumed $700 million out-of-pocket costs to drivers that the tolls will impose.

Key Finding #5: The 15% anticipated increase in use of the MTA crossings (the Brooklyn-Battery and Queens Midtown Tunnels, and the Manhattan leg of the Triborough Bridge), some 38,000 trips per day, should **boost MTA toll revenues by $50 million a year**, a windfall for the agency's transit and commuter-rail service.



These estimates reflect three important assumptions:

- They assume that all four East River bridges — the Brooklyn, Manhattan, Williamsburg and Queensboro Bridges — **are tolled at the same rates as the MTA's East River crossings** (the Brooklyn-Battery Tunnel, the Queens Midtown Tunnel, and the Triborough Bridge). Lower toll rates would reduce the speed gains and time savings.
- They assume **flat-rate tolling rather than variable or "value" pricing** in which higher rates are charged during peak-usage periods with lower rates at other times. It is virtually certain that variable pricing would compound the speed improvements and time savings to the point that the aggregate time savings to New York City drivers and car and bus passengers from East River tolls would significantly exceed the costs of the tolls.
- They assume that one-half (50%) of the trip reductions that would be expected based on price-sensitivity factors will be eroded by new trips "attracted" by the easing of traffic; absent this "induced travel," the speed gains and time savings would be 80% greater than the above results.

Variations on these and other assumptions are discussed in Section 6.

A downside of East River bridge tolls is that speeds will decline on the three MTA crossings that will absorb some of the traffic now using the free bridges. Nevertheless, these speed reductions will cancel out only a fraction of the speed gains on the newly-tolled bridges. Traffic flow will improve overall, with an **average 11.6% increase in driving speeds on all four spans linking Brooklyn with Manhattan, and a 5.5% increase on the three spans connecting Manhattan with Queens.** Similarly, although trip times for the MTA crossings will lengthen by an average of 1.8 minutes per round trip, those crossings carry only half as much traffic as the East River bridges, on which the average round trip will be shortened by more than 5 minutes; the aggregate time gain on the East River bridges will therefore swamp the total loss on the MTA crossings by more than 3-to-1.

The other direct cost of tolling is the loss to drivers and passengers of the "utility" or value of the trips — some 34,000 a day, by our estimates — that will be "tolled off the road," i.e., that will switch to transit or ridesharing or will be foregone altogether. This aggregate cost is actually quite small, just $25 million a year, an estimate that derives from the observation that the net value of each such trip must be under $3.50 (else the addition of a $3.50 toll wouldn't dissuade the driver from continuing to make the trip). Using an average net value of $2 per trip yields $25 million annually for all eliminated trips, a relatively small sum compared to the overall toll revenues and time savings.

2. Introduction

This report, the second on East River tolls by the Bridge Tolls Advocacy Project (BTAP), examines the *time savings* that motorists and others can expect to reap from the changes in traffic flow that will result from tolling New York City's East River bridges.

We find that **East River bridge tolls will save drivers each year an estimated 16,300,000 "vehicle-hours"** (or 37.5 million "person-hours") they now lose in traffic tie-ups on the East River crossings and connecting highways and roads. In a single stroke, **tolls will do away with more than 9% of the idle time that truckers, car drivers, car passengers and bus passengers now lose annually in traffic jams throughout New York City**. If each vehicle-hour is valued at $40 (an estimate derived in Section 8), then **the time savings from tolling the East River bridges amount to $650 million a year**, offsetting more than 90% of the $700 million out-of-pocket cost to drivers of the tolls.

The Hours follows BTAP's March 2003 report on the "incidence" of bridge tolls on motorists, *Who Will* Really *Pay?* That report established that daily East River bridge commuters constitute a very small fraction (2%) of adult New Yorkers and are predominantly higher-income workers who can better afford to pay. The other 98% of city residents age 18 to 80 will, on average, pay less than $50 a year each in East River tolls. *Who Will* Really *Pay?* also placed bridge tolls in a broader fiscal context, and showed that their aggregate impact on residents of Brooklyn and Queens will be less than the costs already being borne by Manhattanites as a result of higher real estate taxes. (*Who Will Really Pay?* may be downloaded from BTAP's Web site at http://www.bridgetolls.org/whowillpay/.)

With our findings here on the time savings, we can highlight the costs and benefits of tolling the Brooklyn, Manhattan, Williamsburg and Queensboro Bridges, as follows:

East River Bridge Tolls: Costs and Benefits to NYC

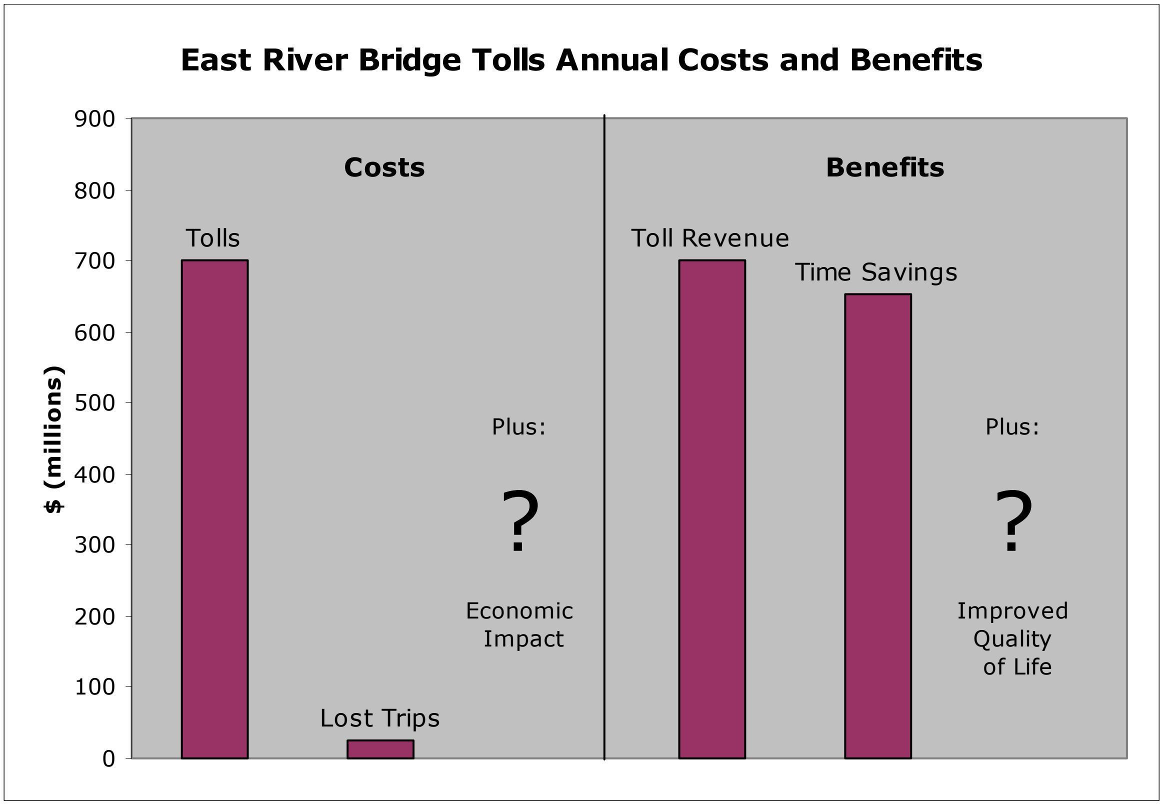
Costs	Benefits
NYC drivers to pay $550 million in tolls (non-residents to pay another $150 million). Nevertheless, the 98% of NYC adults who do *not* now commute on a free East River bridge will average less than $50/year each in tolls.	NYC to receive close to $700 million in revenues to finance bridge maintenance, transit and other vital municipal services.
Somewhat more than 6% of trips on the East River bridges (4% of all East River crossings, taking the MTA crossings into account) will disappear, depriving drivers and passengers of $25 million a year in "utility."	Aggregate motorist time losses in NYC traffic decline by 9%, as drivers gain 16.3 million "vehicle-hours" (or 37.5 million "person-hours") annually through improved traffic flow — time worth $650 million a year.
Hard-to-quantify "multiplier" effects associated with elimination of those trips.	Improved air quality, better and safer pedestrian and bicyclist movement, and a host of other hard-to-quantify "quality of life" benefits associated with reduced vehicular traffic congestion in much of NYC.

As the right-hand column shows, a key benefit of East River tolls is the almost $700 million in annual net revenue they will contribute to maintain the bridges and help finance transit and other municipal services. **The sum of that benefit and the estimated $650 million in anticipated motorist time savings, is roughly double the direct cost to drivers of the tolls.** Other benefits and costs, such as the improved quality of life, on the one hand, and the lost multiplier effect due to the trips that are foregone or shifted to other modes, are less tangible and are harder to estimate. Still, it seems highly likely that the positives from eliminating 9% of New York City's total traffic delays would far outweigh any negatives associated with eliminating or mode-shifting less than 1% of the city's total vehicular travel.

Tolling the East River bridges — or, more accurately, *re-tolling* them, since all four crossings were built and operated as tolled facilities until 1911 — can be expected to affect travel in two major ways:

- Drivers will redirect some trips to the Triborough Bridge and Brooklyn-Battery and Queens Midtown Tunnels operated by the Metropolitan Transportation Authority (MTA), once bridge tolls eliminate the opportunity to save money by "diverting" from these tolled crossings to free ones. <u>We estimate that tolling will cause 7.4% of current vehicle trips on the free East River bridges to switch to an MTA crossing.</u>
- Some trips on the bridges will disappear, as the cost of tolls provokes drivers to consolidate some trips across the bridges, to shift some to other modes (principally subways, buses and carpools) and to eliminate some trips to or from Manhattan altogether. We estimate the sum

of all these effects at 6.6%. That is, in addition to switching 7.4% of trips on the free East River bridges to an MTA crossing, tolling will eliminate outright another 6.6% of the trips that otherwise would be using a free East River bridge. (We actually estimate trip-elimination at 13.2% of current trips, but we assume that half of these trips reappear more or less immediately, as faster travel times "attract" some trips back onto the highways and bridges.)



Some toll opponents have raised the specter of congestion at East River bridge toll plazas. But this is a non-issue; high-speed electronic toll collection via in-car E-ZPass transponders read from overhead gantries has done away with the need for toll plazas. (Drivers without E-ZPass will purchase per-use E-Z "cards" from third parties, or re-route to an MTA crossing, all of which have cash toll booths.) Note too that much or all of the modest increases in times to cross the MTA facilities could be offset by converting them to high-speed collection in which vehicles are tolled at highway speeds.

3. Detailed Findings

More than half-a-million motor vehicles each day crossed the free East River bridges (the Brooklyn, Manhattan, Williamsburg and Queensboro Bridges) in 1999 and 2000, the last "normal" traffic years before September 2001. These trips accounted for 8% of all vehicle-miles traveled in New York City, although the mileage registered on the bridge spans themselves was less than one-fifth of that amount, or around 1.5% of the city's VMT. After meticulously analyzing travel patterns on these crossings, as well as those on the MTA's Triborough Bridge and Brooklyn-Battery and Queens Midtown Tunnels, we have reached the following conclusions:

- Tolling the four East River bridges will reduce their use by an estimated 72,000 vehicles (mostly private cars) a day — 14% of the baseline daily vehicle total of 516,000. Close to 38,000 of these (7.4%) will transfer to the three MTA crossings, while 34,000 (6.6%) will stay at home. ***See Table 1.***

Table 1: Bridge span vehicle volumes and speeds, before and after bridge tolls

Crossing	Daily	Change	% Chng	MPH (w/o)	MPH (w/)	% Chng
Queensboro Bridge	**186,516**	**– 29,058**	**– 15.6%**	**15.0**	**22.0**	**+ 47%**
Triborough Br (Manh. Plaza)	100,816	+ 5,595	+ 5.5%	25.0	22.6	– 10%
Queens Midtown Tunnel	80,910	+ 14,436	+ 17.8%	30.0	23.3	– 22%
Williamsburg Bridge	**108,159**	**– 10,361**	**– 9.6%**	**20.0**	**24.8**	**+ 24%**
Manhattan Bridge	**83,998**	**– 9,727**	**– 11.6%**	**20.0**	**25.8**	**+ 29%**
Brooklyn Bridge	**137,417**	**– 22,783**	**– 16.6%**	**20.0**	**28.3**	**+ 41%**
Brooklyn-Battery Tunnel	63,275	+ 17,942	+ 28.4%	37.5	26.9	– 28%
4 East River bridges	**516,090**	**– 71,930**	**– 13.9%**	**18.2**	**24.9**	**+ 37%**
3 MTA crossings	245,001	+ 37,973	+ 15.5%	29.1	23.7	– 18%
All 7 East River crossings	761,091	– 33,957	– 4.5%	22.0	24.6	+ 12%

East River crossings are shown **in bold**. Other crossings are MTA bridges and tunnels. Daily volumes are 1999-2000 averages. Speed data are annual averages (24/7) and are weighted by volumes to reflect a typical trip rather than the speed for an hour picked at random.

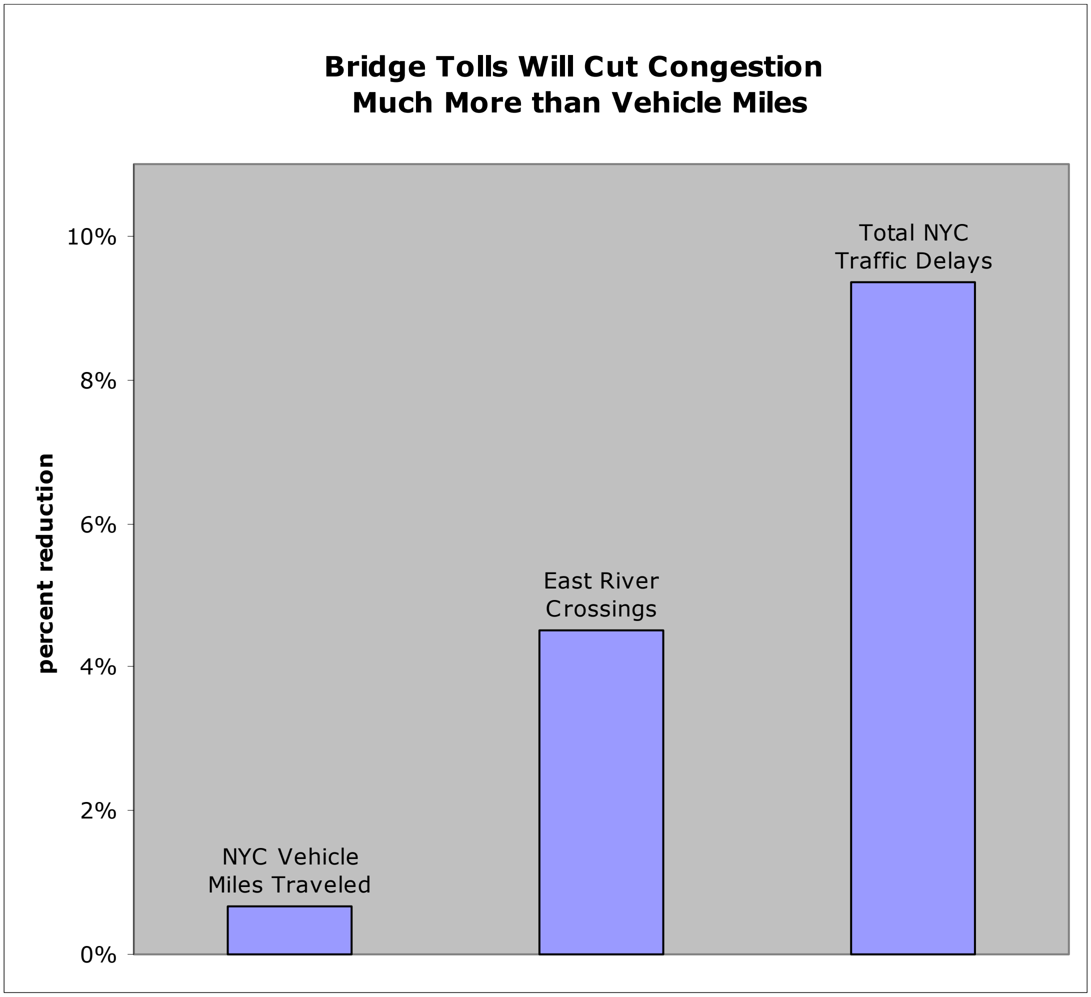
- Collectively, these trip re-assignments and eliminations will reduce vehicle-miles traveled (VMT) in New York City by 140 million vehicle-miles a year, or just seven-tenths of one percent of the estimated 19 billion miles of total citywide VMT. Contrary to popular perception, then, tolling the East River bridges will barely put a dent in total vehicle travel in New York City. Yet this minimal reduction will eliminate more than 9% of the idle time now lost in traffic congestion citywide — a 13-to-1 leveraging of reduced traffic into saved time.

- Traffic reductions and re-assignments caused by East River bridge tolls will improve vehicle speeds on the spans themselves, in the vicinity of the bridges in Brooklyn, Queens and Manhattan, and in the larger areas of Brooklyn and Queens in which many of the crossings originate or through which they pass. The speed improvements range from one or two percent near the bridges to 47% on the Queensboro span itself. ***See Tables 1 and 2.***

Table 2: Highway and street speeds (in mph), before and after bridge tolls

	Brooklyn crossings (combined)				Queens crossings (combined)			
	Before	After	Gain	%	Before	After	Gain	%
The spans	23.6	26.3	+ 2.8	+ 11.6%	21.3	22.5	+ 1.2	+ 5.5%
Near borough	15.3	15.6	+ 0.3	+ 2.1%	19.5	19.8	+ 0.3	+ 1.5%
Further borough	16.4	16.9	+ 0.5	+ 3.2%	25.4	25.8	+ 0.4	+ 1.5%
Manhattan	12.8	13.2	+ 0.4	+ 2.7%	11.2	11.3	+ 0.1	+ 0.5%

All speeds are annual averages (24/7) and are weighted by volumes on local roads, arterials and expressways to reflect a typical trip rather than the speed for an hour picked at random. Brooklyn crossings are the Williamsburg, Manhattan and Brooklyn Bridges and the Brooklyn-Battery Tunnel. Queens crossings are the Queensboro and Triborough Bridges (Manhattan Plaza) and Queens Midtown Tunnel. Near borough is Brooklyn or Queens area within 3 or 4 miles (respectively) of the East River bridges. Further borough is the 8-mile area in each borough, excluding the near zone. Manhattan is area in that borough within 2 miles of the bridges. See map, p. 14. Gain may not equal difference between before and after due to rounding.



- The improved speed of travel will translate to savings in "vehicle-hours" — the total time that cars, trucks and buses must spend traveling — of 16.3 million vehicle-hours a year. The prospective savings are greatest in Brooklyn, with the remaining savings distributed almost equally in among Queens, Manhattan, and the bridge spans themselves. On the other hand, if the spans are viewed as extensions of the respective boroughs, then Brooklyn and Queens together collect the vast majority of the time savings, with only one-fifth of the saved hours realized in Manhattan. ***See Table 3.***

- These 16.3 million vehicle-hours of saved time equate to 37.5 million "person-hours," given that vehicles crossing the bridge carry an average of 2.3 people. (Although vehicle occupancy averages only 1.6 for private cars, the presence of vanpools and buses in the bridge traffic mix lifts the overall average to 2.3; ***see Table 6***.) By way of comparison, the Texas Transportation Institute, whose annual surveys of metropolitan gridlock are widely cited, estimates that the New York, NY – Northeastern NJ region loses 400 million person-hours annually in traffic congestion on expressways and major arterials. If we take this figure as a proxy for traffic congestion losses on all streets and roads in New York City alone (i.e., if we posit that the necessary upward and downward adjustments to the TTI figure are offsetting), we find that **East River bridge tolls will eliminate more than 9% of all hours that motor vehicle users currently lose in traffic congestion in New York City.** (The relevant page from the current TTI *Urban Mobility Study* is at http://mobility.tamu.edu/ums/study/appendix_A/exhibit_A-5.pdf.)

Table 3: Annual vehicle-hours saved with East River bridge tolls

	Brooklyn crossings		Queens crossings		All 4 crossings	
	Hours	%	Hours	%	Hours	%
Near borough	2,500,000	26%	2,300,000	35%	4,800,000	29%
Further borough	3,400,000	35%	1,400,000	21%	4,800,000	29%
All borough (w/o spans)	5,900,000	61%	3,600,000	55%	9,600,000	59%
Bridge spans	1,600,000	16%	1,700,000	26%	3,300,000	20%
All borough (w/ spans)	7,500,000	77%	5,400,000	82%	12,900,000	79%
Manhattan	2,200,000	23%	1,200,000	18%	3,400,000	21%
All areas	9,700,000	100%	6,600,000	100%	16,300,000	100%

See Table 1 for definitions of crossings and borough zones, and map on p. 14. Sums may not agree with totals, or percents with 100, due to rounding. "All borough" denotes the sum of the "near" and "further" borough zones, and encompasses 85% of all vehicle-miles traveled in Brooklyn, and 63% in Queens. To convert to person-hours, multiply vehicle-hours by 2.3.

- Half of these time savings will be experienced by drivers and passengers who aren't even using the bridges, due to a "ripple effect" from reduced or redirected bridge traffic. An estimated 50% of the time to be saved from tolling the three Brooklyn crossings, and 47% for the Queensboro Bridge, will be realized in such non-bridge trips (with a weighted average for all crossings of 49% of time savings being captured by non-bridge trips.)

4. Tolls and Trips

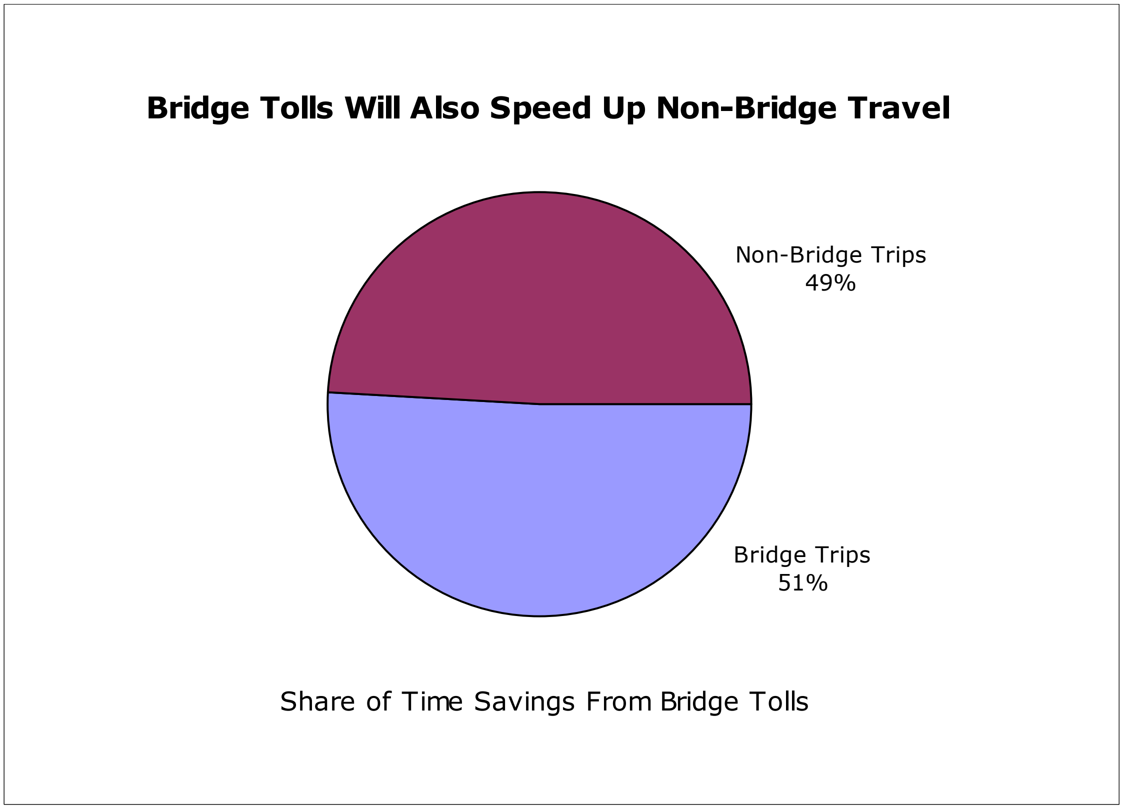
We have estimated that bridge tolls will have these effects on trips on the East River bridges:

- An estimated 13.2% of current trips will disappear "overnight";
- Half of these trips will return, attracted by the faster speeds on streets and highways; the net elimination of trips is then 6.6%;
- Between 3% and 10% of current trips (the percent varies from bridge to bridge, with an average of 7.4%) will "re-settle" to the nearby MTA bridges.

Table 4: Trip Elimination and "Re-settlement" Rates with Bridge Tolls

	Elim. I	Elim. II	To Trib.	To QMT	To BBT	To MTA	Total
Queensboro	13.2%	**6.6%**	3%	6%		**9%**	**15.6%**
Williamsburg	13.2%	**6.6%**		3%		**3%**	**9.6%**
Manhattan	13.2%	**6.6%**			5%	**5%**	**11.6%**
Brooklyn	13.2%	**6.6%**			10%	**10%**	**16.6%**
4 bridges combined	**13.2%**	**6.6%**	**1.1%**	**2.8%**	**3.5%**	**7.4%**	**13.9%**

"Elimination I and II" columns are, respectively, without and with "bounceback" — the return of some old trips, or attraction of new ones, due to faster travel times resulting from reduced traffic volumes. Figures in the second column, shown in bold, were used to calculate the traffic, speed and time impacts in this report. Totals in last row are weighted averages reflecting varying volumes on the bridges.



The precise figures are shown in Table 4. These estimates underlie our calculations of speed improvements and time savings from bridge tolls.

Most of our bullet assumptions along with the numbers in Table 4 were derived through economic modeling, as follows:

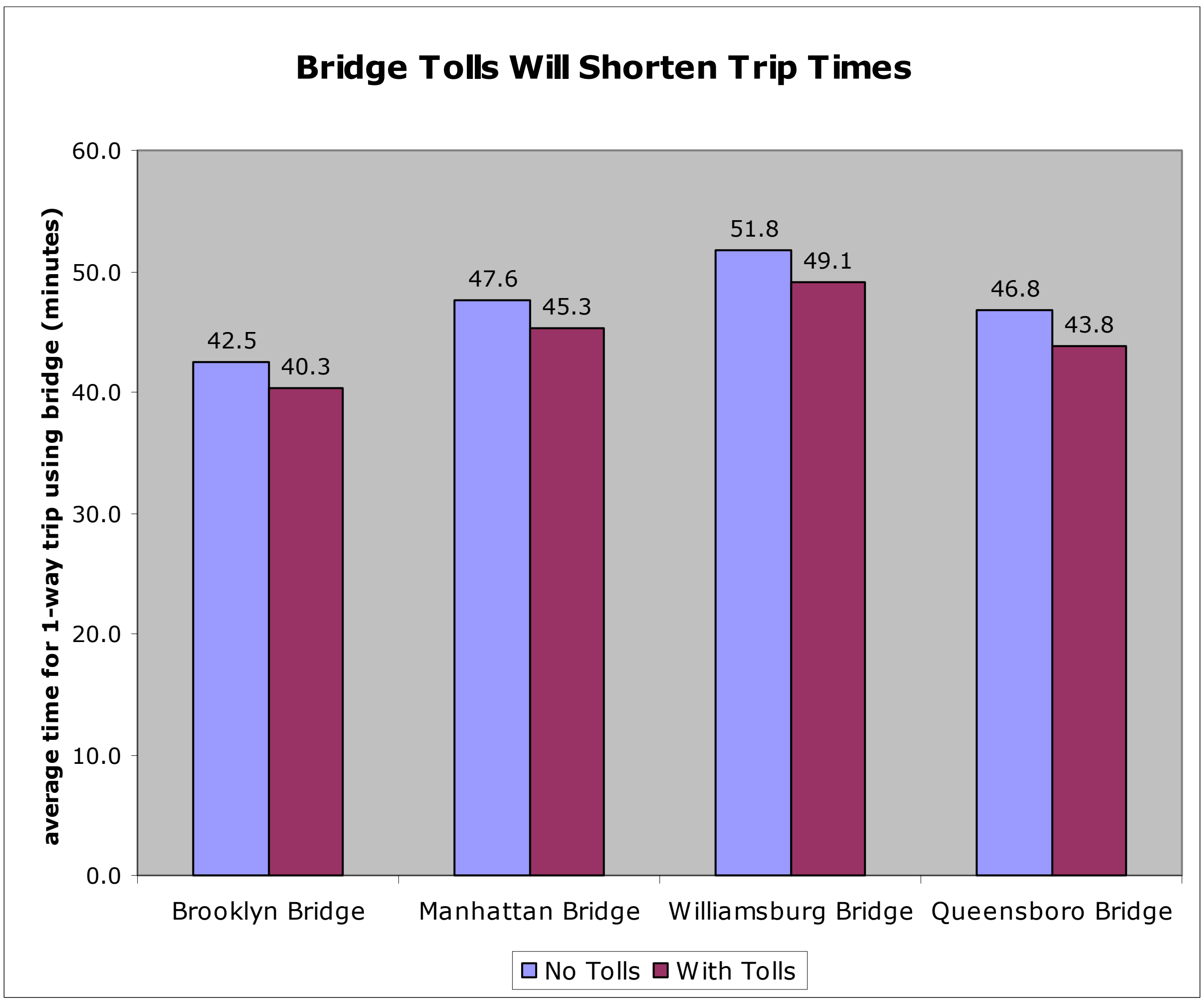
> Note: Our trip elimination and re-settlement rates are fully derived in the spreadsheet for this report. Please see p. 19 for info on obtaining a copy.

Trip Resettlements: We estimated the volume of current trips on the (free) East River bridges that will resettle to the (tolled) MTA crossings by calculating the “excess” increase in usage of the free bridges that has built up over the past 30 years, as MTA tolls have been raised a half-dozen times while the East River bridges have remained untolled. From January 5, 1972, when tolls on the MTA crossings were doubled (after more than two decades with no increase), through 2000, daily crossings in either direction on all seven East River bridges and tunnels grew by an average of more than 5,500 vehicle trips each year. Based on the pre-1972 split in traffic between the MTA crossings and the free bridges, around 40% of the annual increase should have been realized on the MTA facilities; the actual average share has been only 20%, indicating an annual shortfall of 1,300 trips per day.

By 2000, or some 30 years later, the cumulative “diverted” traffic had reached 38,000 trips per day, a phenomenon we attribute to the cost differential between the two sets of crossings. We expect that when the East River bridges are tolled, this diverted traffic will resettle to its “natural” routes using an

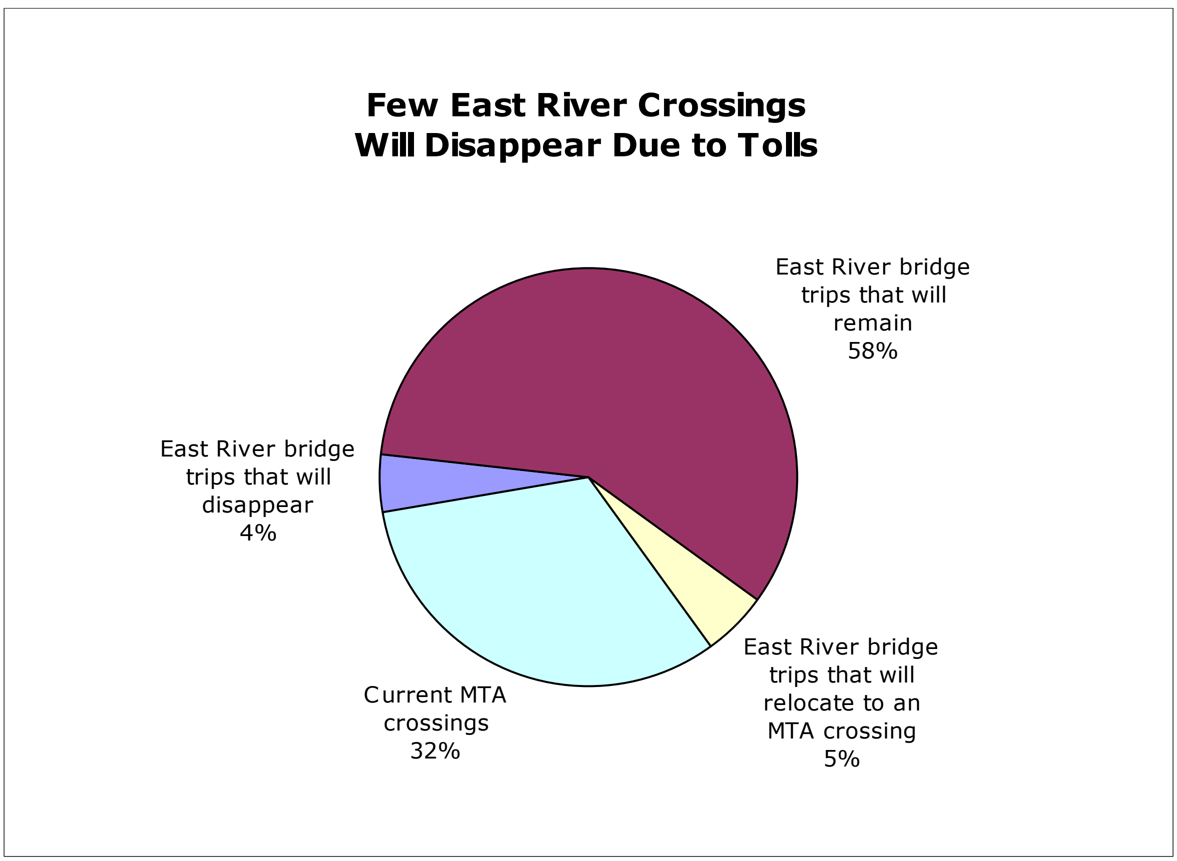
MTA bridge or tunnel. These 38,000 daily trips amount to 7.4% of current trips on the four East River bridges, and 5.0% of trips on all seven East River crossings including the three MTA facilities.

Trip Eliminations: In a more detailed analysis, we examined changes over the past 25 years (1975-2000) in East River vehicle volumes, New York City employment, and the out-of-pocket cost to drive into Manhattan. By sifting these data, we were able to infer the *price elasticity* of vehicle trips crossing the East River, to be around negative 0.4. That is, holding other factors constant, a 1% increase in the cost to drive across the East River into Manhattan should reduce the volume of such trips by around 0.4%. In the parlance of economists, a price-elasticity of (negative) 0.4 denotes a usage that is not highly elastic, i.e., it is relatively resistant to minor changes in price (as compared to elasticities of, say, one or greater, which correspond to products or services for which demand is very price-sensitive). This accords well with a common-sense assessment of drivers' unwillingness to forego their cars.



However, the toll will add significantly to the current cost to drive across a free bridge. Even with a relatively low price-elasticity, the effect on demand will be noticeable. We estimate that a typical crossing on a free bridge now costs the driver over $8, a figure that takes into account the wide range of parking costs from zero (for on-street or employer-paid parking) to expensive parking in midtown lots and garages. Based on the estimated negative 0.4 price elasticity, a 43% increase in this cost, via the addition of a $3.50 toll, would be expected to eliminate 13.2% of all such trips now being taken. (The 13.2% result is less than the simple product of 43% and 0.4 because an exponential rather than linear calculation is required to translate elasticities into changes in demand; our assumptions and reasoning, along with the equations themselves, are provided in the companion spreadsheet to this report.) This "gross" estimate was then converted to a net figure to reflect what we call "bounceback."

Bounceback: The one phenomenon for which we could not derive an estimate is the extent to which some trips that disappear — as well as other trips that are not now made because drivers feel they would take too long — will be lured back by the smoother traffic stream. (This is precisely the effect that computer-based regional traffic models are suited to estimate; indeed, it is one of the key rationales for the region's having invested $10 million in developing the Best Practices Model.) But "bounceback" is no less real for our inability to derive its magnitude; the expected time to accomplish a trip (or, conversely, the time the driver anticipates sitting in stop-and-go traffic) is a powerful determinant of the volume of automobile travel. In lieu of a procedure for estimating it, we have conservatively specified a bounceback rate of one-half, i.e., we assume that 50% of the trips that will be tolled off the road will be re-attracted by the improved traffic flow.



With that assumption, the gross 13.2% reduction in trips on the four East River bridges becomes a 6.6% net decrease, equating to approximately 38,000 "disappeared" trips a day. Taking the three MTA East River crossings into account, the share of all East River crossings (on the seven bridges and tunnels) predicted to be eliminated due to tolls on the East River bridges is 4.5%.

That result, which underlies our findings on speed improvements and travel-time savings, jibes with the New York City Department of Transportation's lone detailed analysis of bridge tolls, published a quarter-century ago (*Traffic Impact of Tolls on the East & Harlem River Bridges*, April 1977). A team directed by then-Deputy Commissioner Samuel I. Schwartz — the transportation engineer and consultant popularly known as "Gridlock Sam" — estimated that tolls on the city's East and Harlem River bridges would cause a 4.0% drop in daily traffic volumes across the East River (6.9% on the Harlem River bridges), a figure that agrees closely with our 4.5% estimate.

5. Traffic Volumes, Travel Speeds, and Travel Times

To estimate time savings from East River bridge tolls, we employed the standard sequence employed by travel-demand models such as NYMTC's Best Practices Model (see Section 9):

- ascertain current average speeds and traffic volumes for relevant portions of the road network;
- estimate typical distances for trips using the East River bridges;
- estimate extent of reductions and re-routing of trips due to bridge tolls;
- calculate resultant new traffic volumes for each section of the road network;
- estimate the changes in speeds due to the changes in volumes;
- calculate the old (pre-tolls) and new (with tolls) travel times for each section.

All calculations were disaggregated by three types of roadways: (i) limited-access highways or expressways, such as the BQE or FDR Drive; (ii) wide "arterial" streets or avenues such as Atlantic Avenue in Brooklyn, or most Manhattan avenues; and (iii) local streets.

Note: All traffic volume and speed data are fully derived in the companion spreadsheet to this report. Please see p. 19 for info on obtaining a copy.

Table 5 shows average speeds for each road type for the three boroughs that are the subject of our analysis.

Table 5: Borough-Wide Speeds (without bridge tolls)

	Brooklyn	Queens	Manhattan
Expressways	30 mph	35 mph	25 mph
Arterials	13 mph	17 mph	8 mph
Local streets	9 mph	12 mph	5 mph

Speeds were estimated by Brian Ketcham, based on NYMTC data provided at various times over the past decade in documents required for air quality conformity analyses. They are intended to reflect typical trips rather than speeds for an hour picked at random.

Since speeds vary within each borough, with slower traffic in neighborhoods closest to the bridges — we subdivided Brooklyn and Queens travel into a "near bridge" component (within 3 miles of the

Brooklyn crossings, and 4 miles of the Queensboro), and a "further" component extending up to 8 miles from the bridges (see map overleaf). Based on Census data for 2000, we estimated that 25% of westbound trips destined for the Brooklyn crossings originate in the "near" component, and the remaining 75% from the farther component; for the Queensboro Bridge, we used a split of 37% of westbound trips originating from the near zone, and 63% from the farther area. (We thus ignored VMT outside New York City, a slight conservatism in our analysis.) We separated Manhattan similarly into 2-mile zones around the respective crossings, with slightly lower speeds in Midtown than Downtown. Of course, each trip into Manhattan was assumed to spawn an identical return trip.

Pre-toll speeds on the bridge spans themselves were estimated separately, and were shown in Table 1: 15 mph for the Queensboro Bridge, 20 mph for the three free bridges from Brooklyn, 25 mph for the Triborough, 30 mph for the less heavily traveled Queens Midtown Tunnel, and 37.5 mph for the least-used crossing, the Brooklyn Battery Tunnel.

We then compiled a list of typical routes for each bridge. The number of routes ranged from as many as six for the westbound approach to the Queensboro Bridge, to just two for the eastbound approach to the Williamsburg. Each route was assigned a percentage share of trips, and these were then multiplied by the distances for each route, on each type of roadway, to yield the estimated number of miles traveled on expressways, arterials and local roads for each crossing.

A similar typology was developed for trips that re-route from a free bridge to a tolled MTA facility. These data were organized in our spreadsheet, making it possible to calculate the change in VMT (vehicle miles traveled) due to bridge tolls, for each road type — expressway, arterial and local — in the various zones of each borough defined above.

The final assumption concerned the sensitivity of travel speeds to traffic volumes. Ordinarily, the *speed-volume function* varies across road types and geographical areas. Since it was obviously impossible to determine the value of this function for every applicable segment of the road network (another automatic attribute of the Best Practices Model), we made the simplifying assumption of a linear relationship at a uniform ratio of 1.5, or 150%. This relationship typically applies when highways and major roads operate at 90% of capacity — a reasonable assumption for the roads and highways leading to and from the East River bridges, many of which are frequently filled beyond their design traffic capacity; it means that each 1% reduction in traffic volume is assumed to cause a 1.5% improvement in speed. (The effect of varying this assumption is discussed in the next section.) We applied this ratio to all roads, with one major exception: for the bridge spans themselves, we specified speed-volume ratios of 3.0 for the Queensboro, 2.5 for the other East River bridges, and 1.75, 1.25 and 1.0 for the Triborough, Queens Midtown Tunnel and Brooklyn-Battery Tunnel, respectively, reflecting greater congestion levels on the free bridges compared to the MTA crossings.

6. Effect of Different Assumptions

Here we vary key assumptions to gauge the effects on the estimated time savings due to East River tolls.

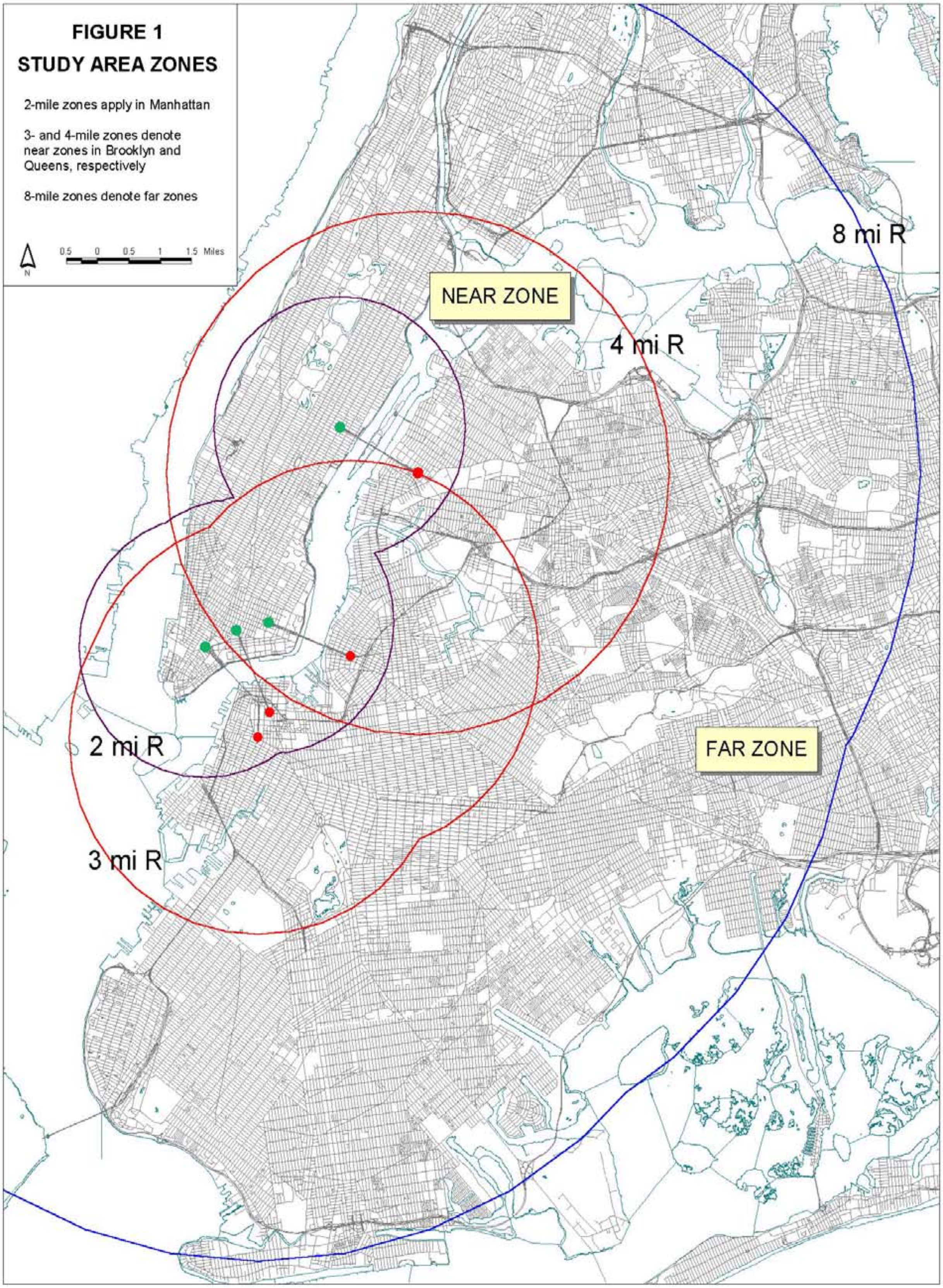


FIGURE 1
STUDY AREA ZONES
2-mile zones apply in Manhattan
3- and 4-mile zones denote near zones in Brooklyn and Queens, respectively
8-mile zones denote far zones
0.5 0 0.5 1 1.5 Miles
N
8 mi R
NEAR ZONE
4 mi R
2 mi R
FAR ZONE
3 mi R

A. "Bounceback"

We noted in the previous section that we regard *bounceback* — the return of some of the eliminated trips (or the advent of new ones) "attracted" by the newly freed-up bridge and highway capacity — as a real phenomenon that belongs in any traffic analysis of bridge tolls. But we have no evidence on which to base an estimate of its strength. Accordingly, we used 50% as a middle ground, and that assumption is reflected in our "base" estimate of 16,300,000 vehicle-hours a year saved by bridge tolls.

If the share of eliminated trips that return to the roads is set lower, at 25% (so that one-fourth rather than one-half of eliminated trips reappear), then vehicle-hours saved each year increase by 40% to 22,900,000. Eliminating bounceback altogether lifts the time savings to 29,500,000 vehicle-hours, an 81% increase over the base estimate of 16,300,000 hours. The improvements in vehicle speeds and travel times would become larger as well.

B. Speed-Volume Factor

As noted above, we assume that each 1% reduction in traffic volume engenders a 1.5% improvement in speed. While this assumption is thought to reflect the congested nature of street and highway travel on both sides of the East River bridges, lower assumptions could be considered. With a speed-volume factor of 1.0 rather than 1.5, the number of hours saved by bridge tolls shrinks by 26%, to 12,000,000 vehicle-hours a year. Also applying a 1.0 factor to the bridge (and tunnel) spans cuts the savings further, to just 9,700,000 vehicle-hours, which is 40% less than the 16,300,000 base estimate. However, a uniform speed-volume factor on all seven crossings would leave average speeds considerably higher (by a range of roughly 20 to 40 percent) on the MTA crossings than on the East River bridges, whereas one would expect speeds to be roughly uniform once all crossings are tolled; this paradoxical result suggests that a uniform speed-volume factor of 1.0 for all East River crossings is unrealistically low.

The new congestion charging system in central London provides strong support for the speed-volume factor of 1.5 used in this report. There, an average 17% reduction in vehicle volumes in the congestion-charging area has been accompanied by an average 30% improvement in vehicle speeds. Dividing the first percent into the second yields an average speed-volume factor of 1.7 or 1.8, indicating that each 1% reduction in traffic volume is engendering a 1.7% or 1.8% improvement in speed.

C. Price-Elasticity of East River Trips

As would be expected, the effect of bridge tolls on traffic volumes, and the resulting time savings, are sensitive to the estimated price-elasticity of bridge trips, though not overwhelmingly so. We inferred an elasticity of 0.4 from empirical data on bridge usage and travel costs. If that figure is reduced to 0.3, the share of current trips that disappear (after allowing for bounceback) drops from 6.6% to 5.1%, and the associated vehicle time savings shrink by 3.2 million hours to 13.1 million. Conversely, raising the elasticity to 0.5 (note of course that all elasticities are actually negative) raises the eliminated share of trips above 8% and the saved vehicle-hours to almost 20 million, a level 20% above the base. Interested readers may make further sensitivity calculations with the spreadsheet.

7. Value Pricing

We have assumed a flat rate for East River bridge tolls — a single rate applying at all hours. Yet "variable" or "value" toll pricing is clearly a better idea, and the idea is gaining ground. In the New York metropolitan area, both the New Jersey Turnpike and the Port Authority charge higher rates for their roads, bridges and tunnels in peak-use periods and offer lower rates at other times. And the agencies appear to be getting what they hoped for: drivers are shifting many peak trips into less-congested off-peak times or onto other travel modes. The Port Authority reports that the $1 on-peak premium it instituted in early 2001 is reducing peak volumes on its Hudson River crossings by 4.7%.

Within New York City, the Metropolitan Transportation Authority has resisted value pricing on its nine toll bridges and tunnels. In raising tolls by a uniform 50 cents earlier this year, the MTA rejected entreaties from the Tri-State Transportation Campaign and others to raise peak tolls by $1.50 while freezing non-peak tolls — a move that would have generated the same revenue as the smaller flat increase, according to our report for the campaign (available at http://www.tstc.org/MTApricing.pdf). Ironically, some of the MTA's hesitancy appeared to stem from concern that value pricing would lead to catastrophic gridlock during peak hours on the untolled East River crossings as even more drivers "diverted" to the free bridges. Co-ordinated tolling on all crossings by the City and the MTA would eliminate this worry. Similarly, installation of state-of-the-art electronic toll collection systems at MTA bridges and tunnels allowing drivers to pay at highway speeds could offset much of the traffic impact of trips resettling from the East River bridges.

Regrettably, we weren't able to model the traffic and time aspects of value pricing on the East River bridges; this additional layer of complexity would have vastly exceeded our budget and schedule. Note, however, that our report on MTA tolling concluded that the value-pricing plan outlined above would have saved drivers roughly five times as many hours as the MTA's uniform $0.50 increase. While that finding, involving an increase to an existing toll, cannot be extrapolated to the East River bridges, which now have no toll at all, it strongly suggests that under a value-pricing regime drivers would save considerably more than the 16,300,000 vehicle-hours estimated here for a flat toll.

8. Value of a Vehicle-Hour Saved via Bridge Tolls

How much value do travelers attach to a vehicle-hour saved in traffic? (We say *vehicle-hour* rather than *hour* because the "units" in this analysis are vehicles, which can contain more than just the driver.) The answer is, It depends — on the nature and purpose of the trip. A trucker bringing fresh food to Midtown restaurants, or a tradesperson en route to Tribeca to service elevators or air conditioners, regards time saved (or stuck) in traffic differently than, say, a car full of teenagers bound for a night of partying in lower Manhattan.

Accordingly, we divided trips across the East River bridges into nine types and assigned rough per-vehicle-hour values to each, as follows:

Table 6: Value of a Vehicle-Hour

Vehicle Type	#/Veh	Low $	High $	Rationale / Basis	Share
On-peak SOV	1	$15	$30	BTAP research (see notes below)	20%
Off-peak SOV	1	$7.50	$15	Half of on-peak	25%
On-peak Rideshare	2.4	$36	$72	BTAP research (*Who Will* Really *Pay?* report)	5%
Off-peak Rideshare	3	$15	$30	Value passenger's time @ ½ driver's time	25%
Commuter Van	6	$45	$90	Off-peak SOV x 6 (incl. driver)	7%
Bus	21	$190	$340	Off-peak SOV x 20, plus $40/hr driver	2%
Commercial Van	1.25	$50	$100	BTAP assumption	8%
18-Wheeler	1	$150	$300	BTAP assumption	2%
Large Truck	1.25	$75	$150	BTAP assumption	6%
All	**2.3**	**$29**	**$57**	**Weighted average of values in table**	**100%**

SOV = single-occupant vehicle. Percent shares are adapted from NYC DOT, *2000 Manhattan River Crossings*, December 2001, p. 34, for the four East River bridges, slightly adjusting buses (1.6%), commuter van (7.7%) and commercial van (8.6%), and apportioning trucks (7.5%) into 18-wheelers and conventional large trucks in a 1-to-3 ratio. Passenger-vehicle shares are based on BTAP's *Who Will* Really *Pay?* report, which has their combined share at 75%, with one-third for commuting, the rest for other travel (see Fig. 3). Since solo East River commuters outnumber ridesharers 2-to-1 (ibid., Table 6), SOV's must outnumber carpools roughly 4-to-1 among commute (on-peak) vehicles. We assume non-commute passenger vehicles (50% of total) are divided evenly between solo travelers and carpools. Number of people per on-peak carpool, 2.4, is from *Who Will* Really *Pay?*, p. 9. Other figures are authors' estimates. Weighted average is 2.36, but we select 2.31, which uses actual vehicle shares given earlier in this note, including 1.6% for buses. Value of an hour for on-peak SOV is based loosely on *Who Will* Really *Pay?* finding that East River bridge commuters averaged $53,500 income in 2002, which equates to $26.75/hour (less after taxes). Note consistency with 1999 Manhattan East Side Transit Alternatives MIS/DEIS value of out-of-vehicle travel time, e.g., waiting for a train (which equates to being stuck in traffic) of $20.30/hr (in 1997), or $25.70 in 2003 at 4%/yr income growth.

On a vehicle-weighted basis, the low values yield an average vehicle-hour value of $29, vs. $57 for the high values, for an arithmetic mean of $43, which we have rounded down to $40 as the average value of a vehicle-hour. Valued at $40 each, the 16,300,000 vehicle-hours saved each year by bridge tolls translate to an annual value of $650 million, offsetting over 90% of the estimated $700 million that drivers will actually pay in tolls.

Note that this calculation is conservative in several important respects. It omits the additional time savings that presumably would result from varying the toll rate by time of day; and it doesn't count time savings to non-vehicular traffic (pedestrians and cyclists), let alone environmental and safety benefits from reducing VMT in New York City by an estimated 140 million miles a year, much of it in some of the city's most heavily traveled corridors.

Indeed, the comparison of time savings to toll expenditures, while instructive, is potentially misleading; time savings that ease the pain of bridge tolls are welcome, but they need not offset them entirely for the tolls to have a positive net social value. Put another way, society is under no obligation to drivers to ensure that they get back in driver-specific benefits every penny that they pay in tolls and other charges. It is not only permissible but desirable to spread the benefit to society at large, rather than confining it to drivers.

9. The A.W.O.L. $10,000,000 Computer Model

We consider our analysis and findings well-founded. Nevertheless, it would be useful to cross-check our estimate of the time savings that drivers can expect from East River bridge tolls, with the regional, comprehensive travel-demand model. Known as the "Best Practices Model," it incorporates key characteristics of the neighborhoods and districts that are our region's travel "origins" and "destinations," and also includes traveler "choice factors" such as time, price and convenience. After years of labor and taxpayer expenditures of more than $10 million, the BPM is now running under the auspices of the New York Metropolitan Transportation Council (NYMTC), the "metropolitan planning organization" for the New York area.

Yet, at this writing, NYMTC staff have not applied the BPM to estimate the effects on traffic and travel times from bridge tolls. In the spring of 2003, the agency's policy-making directorate, the Policy, Finance and Administration Council (PFAC), rejected our request to use the BPM to assess tolls; this was after we had been encouraged to submit a written analysis protocol, and after several meetings with NYMTC staff to refine the scope. Since PFAC meetings are closed, we aren't privy to the rationale for the agency's refusal. We have only this elliptical rationale from NYMTC's co-chair:

> At this time, NYMTC's members are not ready to use the BPM to evaluate the transportation impacts of a proposal to toll East River Bridges. While this concept is being discussed by the members, there is not enough detail nor a consensus to evaluate it. When the members of NYMTC have a clearer definition of the proposal and have agreed to analyze its impacts, then NYMTC will be ready to use its technical tools to evaluate it.
> *— Joseph H. Boardman,Commissioner, NYSDOT & Co-Chair, NYMTC, May 15, 2003*

From this response, one would never know that New York City is experiencing ever-deepening traffic congestion that saps the city and regional economy; or that the city is facing even larger budget gaps next year than the ones it has just overcome, which portend limited funding for vital transit expansion as well as fundamental services such as public education. The hope is that our meticulously derived if rough-hewn estimates of the potential time savings from East River bridge tolls will embolden city and state officials to secure a consensus of the members of PFAC to run the model. Due to vagaries of the model, however, it should be deployed only with close and knowledgeable public scrutiny of the assumptions and benchmarking of its results.

Readers are therefore urged to write to both Governor Pataki and Mayor Bloomberg, asking them to call upon NYMTC to use the Best Practices Model to test various tolling scenarios as a key step in educating the public as to the traffic and time benefits of East River tolls. Indeed, had the mayor pushed this step in conjunction with his initial expressions of interest in tolling shortly after taking office, in early 2002, he might have been able to shed light on the mobility benefits of bridge tolls and overcome the political inertia that has led him to shelve the idea at this time.

Letters from public officials carry particular weight, of course. Please copy your correspondence to info@bridgetolls.org.

The Bridge Tolls Advocacy Project (BTAP) was established in 2002 to serve and energize the citizens movement to toll the East River bridges. Our Web Site, www.bridgetolls.org, operates as the movement's town hall, presenting the arguments and explaining the benefits. See http://www.bridgetolls.org/faq/ for our set of frequently asked questions and answers about bridge tolls, and http://www.bridgetolls.org/whowillpay to view our March, 2003 report on the incidence of tolls, *Who Will* Really *Pay?* Please contact us at info@bridgetolls.org or by writing to BTAP, 636 Broadway, Room 602, NYC 10012.

Charles Komanoff has been engaged in New York City transportation-reform work since the mid-1980s. He is a founding trustee of the Tri-State Transportation Campaign, the "re-founder" of Transportation Alternatives, a founder of Right Of Way, and author or co-author of *Subsidies for Traffic, The Bicycle Blueprint*, and *Killed By Automobile*. With Steven O'Neill, he founded the Bridge Tolls Advocacy Project in 2002. Komanoff was an energy-policy specialist in the Lindsay Administration (1972-74) and later gained prominence for deconstructing the economics of nuclear power as author-researcher (*Power Plant Cost Escalation*, *Fiscal Fission*) and expert witness for New York City and State and other states and municipalities. His recent energy-policy monographs include *Ending The Oil Age* and *Securing Power Through Energy Conservation and Efficiency in New York*. Komanoff has a B.A. from Harvard in Applied Math and Economics.

Brian Ketcham, a licensed professional engineer in New York State, is in his fourth decade as our region's most innovative transportation analyst and persistent advocate for holistic transportation planning built on public involvement. In the early 1970s, Brian directed the Lindsay Administration's then-revolutionary *transportation control plan* to optimize the city's traffic and improve air quality that opened the debate on East River bridge tolls. He also created the nation's first municipal vehicle-emissions testing facility, at Frost St. in Brooklyn, where his validation of tailpipe controls led to widespread use of catalytic converters that have significantly reduced vehicular pollution throughout the United States. Brian is executive director of the not-for-profit Community Consulting Services (www.communityconsulting.org) and was a leading force in forming the Tri-State Transportation Campaign and the Gowanus Expressway Community Coalition. Throughout, he has pioneered the concept of full-cost accounting for commercial development, highway expansion and motor vehicle use.

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To Obtain The Underlying Spreadsheet — Contact BTAP at info@bridgetolls.org. The spreadsheet is a mere 300 KB and has been designed for transparency. The various modules — *Distances, Elasticities, Speeds,* etc. — are mutually linked. We are eager for it to be widely examined. Write us.

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