THE NEW JERSEY TURNPIKE ROAD PRICING INITIATIVE: ANALYSIS OF TRAFFIC IMPACTS

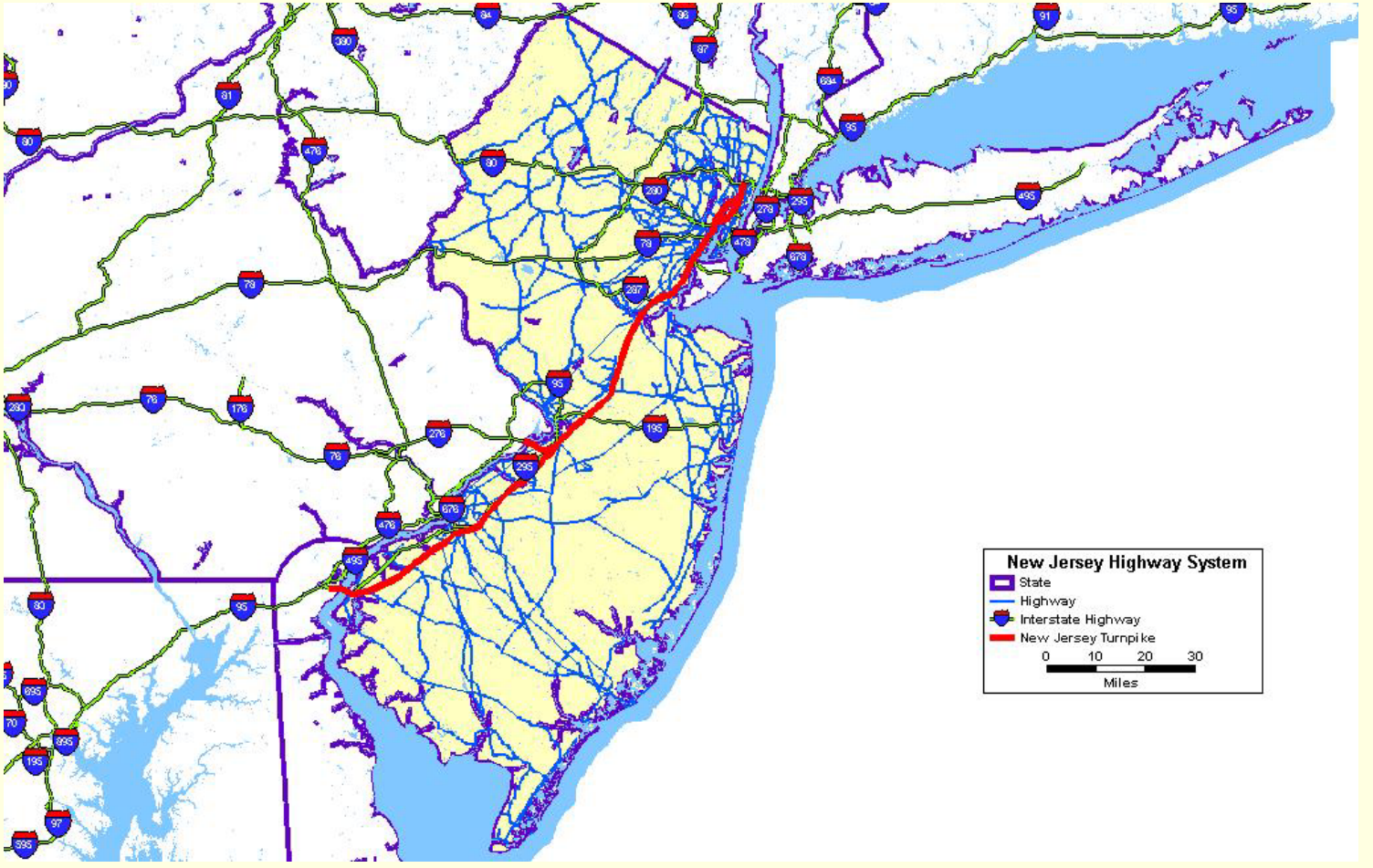
Dr. Kaan Ozbay

Rutgers University

OUTLINE

1. Overview of the New Jersey Turnpike
2. Methodology
3. Analysis of possible sources of variation
4. Aggregate level traffic impact analysis
5. Disaggregate level traffic impact analysis
6. Conclusions and discussions

LOCATION OF THE NJ TURNPIKE



NJ TURNPIKE TIME OF DAY PRICING PROGRAM

Toll	Passenger Cars			Tractor Trailers		
	1991	September 2000	January 2003	1991	September 2000	January 2003
Cash all day	70%	20%($5.50)	17%($6.45)	100%	13%($20.55)	13%($23.20)
E-ZPass peak	-	8%($4.95)	10%($5.45)	-	8%($19.65)	8%($21.20)
E-ZPass off-peak	-	0%($4.60)	5% (%4.85)	-	8%($19.65)	8%($21.20)
E-ZPass (all weekend)	-	8%($4.95)	10%($5.45)	-	8 %($19.65)	8%($21.20)

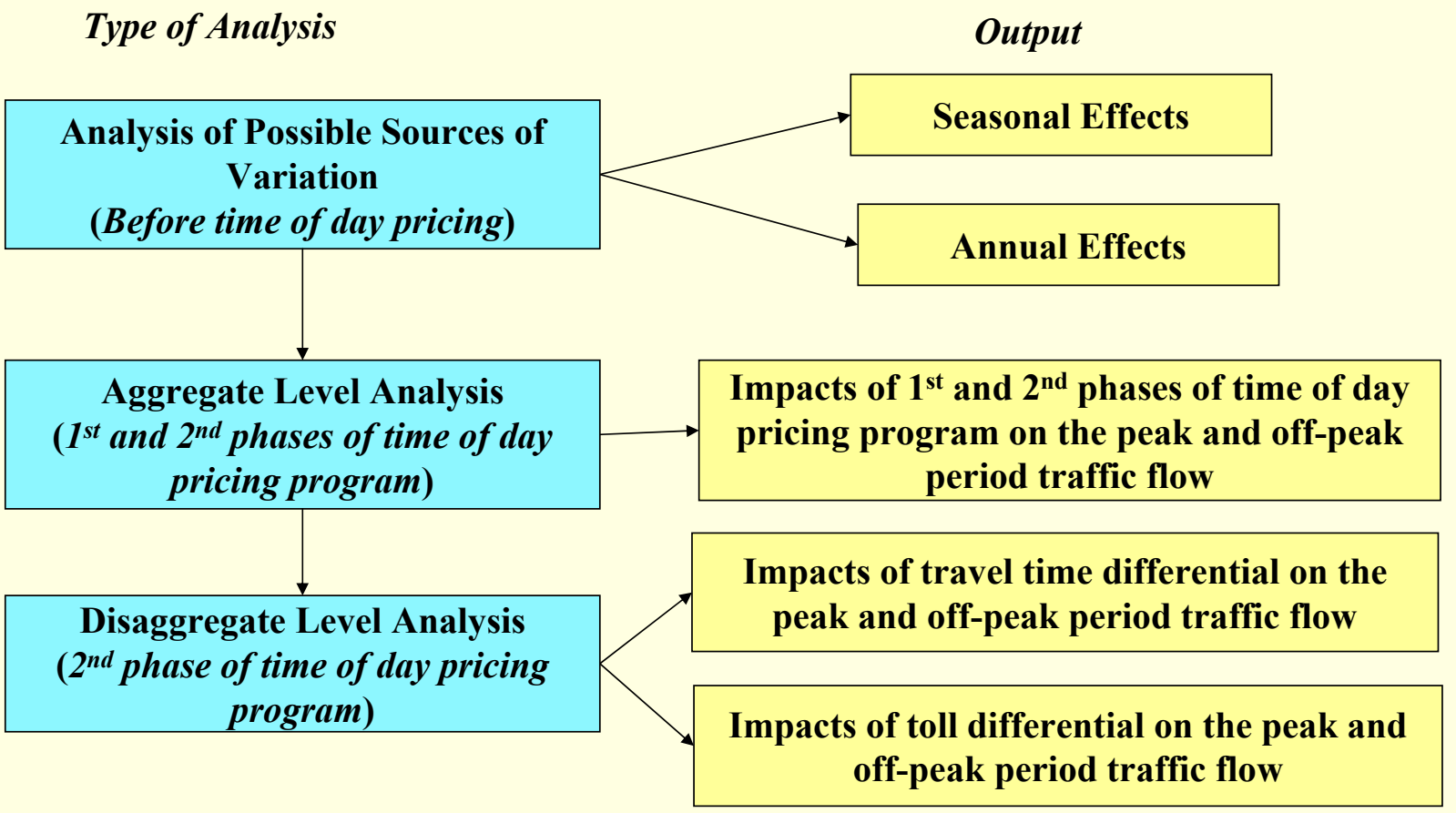
The percentages are the percent of increase in the toll amount.
The values in parentheses are the toll amount between pairs (1,18W)

Only passenger cars with E-Z Pass pay discounted tolls during off-peak hours.

Weekday peak hour:7:00-9:00 A.M and 4:30-6:30 P.M. (only for passenger cars)

Weekends: Only E-ZPass discount is in place, weekday peak hour tolls effective

METHODOLOGY



ANALYSIS OF POSSIBLE SOURCES OF VARIATIONS

1. Possible Sources of Variation

Factor_1: **Temporal variations based on time of day, days of week and months of the year.** (α_i)

Factor_2: **Fluctuations among years for a specific time period of a day due to the changes in toll amount, travel time, or demand.** (β_j)

Other errors: **Fluctuations due to external factors difficult to capture such as, economic growth, and sampling errors.** (ε_{ij})

The statistical model of the traffic distribution (ANOVA)

$$y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$$

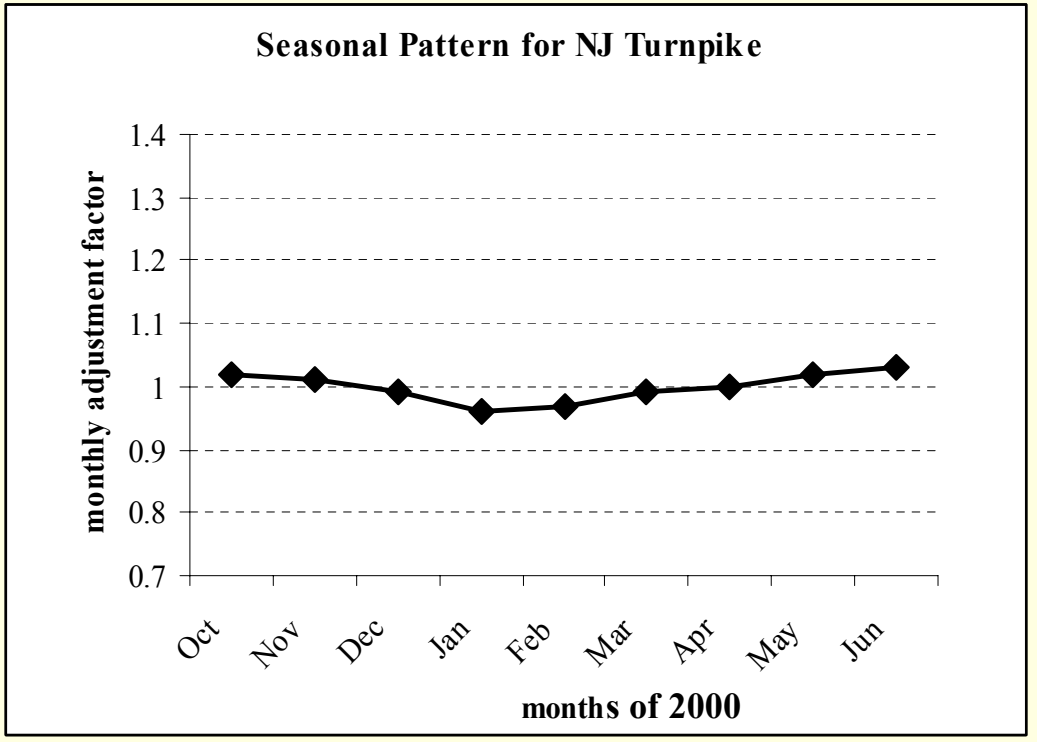
2. Data Set

Data Set	Compared Time Periods	Type of Data
Set1 (Before the 1st toll change)	Oct 1998 – June1999	A.M., P.M., and off-peak percent share
	Oct 1999 – June 2000	A.M., P.M., and off-peak percent share
Set 2 (Before the 2nd toll change)	Oct 2000 – Dec2000	A.M., P.M., and off-peak percent share
	Oct 2002 – Dec 2002	A.M., P.M., and off-peak percent share

***Factor_1*: Seasonal variation among months when everything else in the system is unchanged**

***Factor_2*: Yearly changes in traffic when everything else in the system is unchanged**

3. Results



1. Statistically significant seasonal variation among winters and summers

2. Statistically significant change in the percent shares of peak and off-peak periods between 2001 and 2002

3.Statistically insignificant fluctuation among the consecutive months

AGGREGATE LEVEL TRAFFIC IMPACT ANALYSIS

1. Data Set

Type	Time interval	Data Type
Aggregate Data Set	October 1998 – June 1999 October 1999 – June 2000 October 2000 – June 2001 October 2002-January 2003	Average percent share of A.M. peak, P.M. peak and off-peak hour traffic

2. Methodology

1. For off-peak periods test the hypothesis that after each time of day pricing program percent share of off-peak period traffic increased using 1 tailed t-test.

$$H_0 : (\mu_{i.})_{before} - (\mu_{i.})_{after} = 0$$
$$H_1 : (\mu_{i.})_{before} - (\mu_{i.})_{after} > 0$$

2. For peak periods test the hypothesis that after each time of day pricing program percent share of peak period traffic decreased using 1 tailed t-test.

$$H_0 : (\mu_{i.})_{before} - (\mu_{i.})_{after} = 0$$
$$H_1 : (\mu_{i.})_{before} - (\mu_{i.})_{after} < 0$$

$\mu_{i.}$ **= mean percent share of period *i*,**

***i*=1, 2, 3 (1=A.M.-peak, 2=P.M.-peak, 3=Off-peak)**

2. Results

Change	Morning peak	Afternoon Peak	Off-Peak
1st phase of the time of day pricing (Oct 98 – June 99) & (Oct 00 – June 01)			
Absolute Demand	**6% increase**	**4% increase**	**10% increase**
Percentage Share	**2% decrease***	**3.8% decrease****	**2% increase****
Statistical Significance	**Yes**	**Yes**	**Yes**
2nd phase of the time of day pricing (Oct 00 – June 01) & (Jan 03 – Mar 03)			
Absolute Demand	**14% increase**	**8% increase**	**4% increase**
Percentage Share	**16% increase****	**15% increase****	**7% decrease****
Statistical Significance	**Yes**	**Yes**	**Yes**

* *90% CL*
***95% CL*

2. Shortcomings of Aggregate Level Analysis

- **Increase in the percent share of off-peak period traffic with lower tolls from 1998 to 2001**
- **Increase in the percent share of peak period traffic with higher tolls from 2001 to 2003**

Source of shift:
- Toll differential?
- Travel time differential?

Disaggregate level data with travel time and toll information is necessary to determine the relative effects of toll and travel time differences between peak and off-peak periods on the traffic

DISAGGREGATE LEVEL TRAFFIC IMPACT ANALYSIS

1. Data Set

Type	Time interval	Data Type
Disaggregate Data Set	October 02 – March 03	Vehicle by vehicle entry/exit travel times and locations, and tolls paid for each E-ZPass vehicle

2. Methodology

1. Determine the OD pairs sharing at least 10% of the total daily traffic

2. Investigate the changes in the travel patterns of OD pairs during the periods where highest traffic flow is observed before and after the 2nd phase of the time of day pricing

3. Investigate the changes in the travel patterns of OD pairs during the periods where highest travel time is observed before and after the 2nd phase of the time of day pricing

4. Investigate the changes in travel patterns of highly utilized OD pairs

3. Results

Period	Sample Size	No Change (%) (1)	Peak with lower travel time (%)(2)	Peak- sh with lower travel time (%) (3)	Highest travel time (%) (4)
Oct-Dec 02	324	64	50	25	10
Jan-Feb 03	324	58	45	23	16
Mar 03	349	60	53	20	11

Weekday peak: 7:00-9:00A.M and 4:30-6:30P.M.
Weekday peak shoulder: 6:00-7:00A.M., 9:00-10:00A.M., 3:30-4:30P.M, and 6:30-7:30P.M.
(1) Percent of OD pairs for which there is no change in the traffic at period with highest travel time
(2) Percent of OD pairs for which highest traffic flow is observed at peak period where travel time is lower than the peak shoulder period travel time
(3) Percent of OD pairs for which highest traffic flow is observed at peak shoulder period where travel time is lower than the peak period travel time
(4) Percent of OD pairs for which the highest traffic is observed at periods with highest travel time. These pairs either have travel time more than 15 minutes or provide more than 10% gain in travel time when a shift to another period occurs

4. Analysis of highly utilized OD pairs

OD pair	period	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03
11-13A	highest travel time	peak2	peak2	peak1	peak1	peak2	peak1
	highest traffic flow	peak1	peak1	peak1	peak1	pre	peak1
14-16E	highest travel time	peak2	peak2	peak1	post	peak2	post
	highest traffic flow	pre	pre	pre	pre	pre	pre
18W-14	highest travel time	post	pre	post	pre	peak2	pre
	highest traffic flow	peak1	peak1	peak1	peak1	peak1	peak1
18W-16W	highest travel time	pre	post	pre	post	post	pre
	highest traffic flow	peak2	peak2	peak2	peak2	peak2	peak2

Peak1: 7:00-8:00A.M.
Peak2: 8:00-9:00A.M.
Pre:6:00-7:00A.M.
Post:9:00-10:00A.M.

4. Analysis of highly utilized OD pairs-t tests

OD pair	t-test results	period with highest travel time				period with highest traffic flow			
		traffic flow		travel time		traffic flow		travel time	
		before	after	before	after	before	after	before	after
11-13A	Mean	454	378	22.2	13.3	514	520	19.3	13.2
	t Stat	0.728		2.584		-0.345		**3.024**	
	t-critical	2.132		2.920		2.353		**2.132**	
14-16E	Mean	471	430	11.1	17.1	562	605	9.1	12.0
	t Stat	0.555		-1.801		**-2.202**		-0.758	
	t-critical	2.920		2.920		**2.132**		2.920	
18W-14	Mean	369	346	19.3	16.9	560	502	15.8	14.4
	t Stat	0.529		0.533		0.574		0.421	
	t-critical	2.132		2.132		2.132		2.353	
18W-16W	Mean	262	313	9.8	5.5	608	560	4.0	2.8
	t Stat	-0.698		1.379		0.378		2.205	
	t-critical	2.353		2.353		2.353		2.353	

CONCLUSIONS-1

Seasonal Factor Analysis:

1.Statistically significant seasonal variation between winter and summer months

2.Statistically insignificant variation among the consecutive months

Aggregate Level Analysis:

1. **After the 1st stage of time of day pricing program, from 1998 to 2001, the percent share of peak periods decreased (2% for A.M. peak, 3.8% for P.M. peak); whereas the percent share of off-peak traffic (2%) increased. All changes were statistically significant.**

2. From 2001 to 2003 (including the 2nd stage of time of day pricing program) , the percent share of peak periods increase (16% for A.M. peak, 15% for P.M. peak); whereas the percent share of off-peak traffic (7%) decreased. All changes were statistically significant.

CONCLUSIONS-2

Disaggregate Level Analysis:

1. **2nd phase of time of day pricing on January 2003 did not have a major impact on traffic patterns at NJ Turnpike.**
2. **On March 2003, the users of NJ Turnpike return to their traveling routine irrespective of the changes due to the 2nd phase of the time of day pricing program**
3. **Most of the users prefer peak periods with less travel times and higher tolls (53% of the OD pairs) instead of peak shoulders with higher travel times but less toll**
4. **Commuters respond more to congestion (lower travel times) than slightly higher tolls.**
5. **The traffic flow of highly utilized pairs at lower travel time periods increased independent of the time of day pricing program, but this increase is not statistically significant for most of the OD pairs.**

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THANK YOU…