Transforming Payment Choices by Doubling Fees on the Illinois Tollway

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Thanks due to Illinois Tollway Authority for graciously sharing their data and time with us. We are also grateful to Chin Liu for helping us to tame MapQuest and locate Jewel stores.

Source of Chicago's Economic Dynamism

- Rich and efficient transport background has kept Chicago on world's economic map for over 150 years.
  - 3rd largest intermodal transportation center in the world

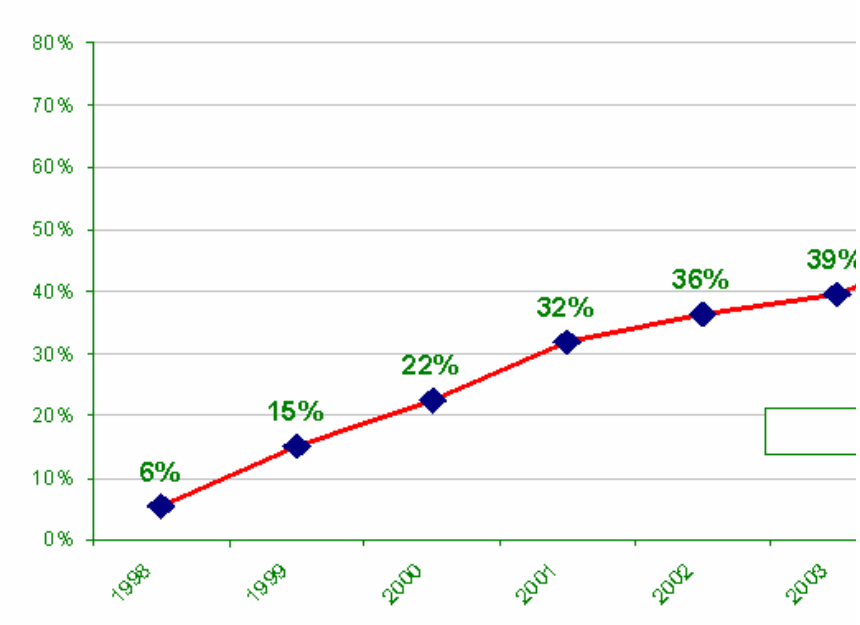
Water	• Erie canal → East Coast, Illinois & Michigan canal → Mississippi • Metro Chicago has two ports capable of handling ocean-going ships and barges
Rail	• 10 major railroad lines by 1850's; 1,000 trains daily by the time of the World's Columbian Exposition (1893) • Remains nation's busiest railway hub with half of U.S. freight passing thru yards
Air	• O'Hare & Midway handle more passenger traffic than any other city in world
Roads	• Interstate highway in 1950s • Tollway added on in late 1950s

Payments– Past and Present

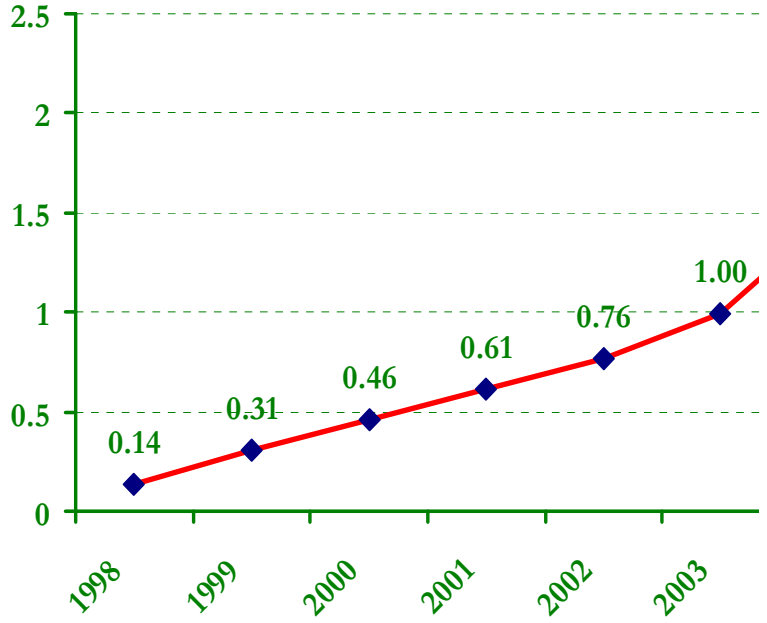
- Toll payments made either as
  - manual change: stop, hand money to an attendant, get change
  - exact change: stop, throw change into bin, drive away
- Then starting in 1993
  - New electronic payment option—a radio frequency identification device (RFID)—brand-named I-PASS
  - I-PASS: the correct toll amount is deducted electronically upon passing through specially equipped toll gates
  - The I-PASS is currently integrated with similar electronic payment schemes in 11 Eastern states (E-Z Pass). Indiana allowed I-PASS recently, but without discounts

The state of the I-PASS prior to 2003

- Electronic toll payments as share of all toll transactions



- Number of I-PASS transponders owned by private individuals (mln.)



- After 10 years in existence, I-PASS use and ownership were still far from universal

I-PASS Benefits as seen from the outside

- Supply Side (the Tollway Authority):
  - Lower costs of handling cash and fraud
  - Reduce congestion:
    - open-road tolling
    - widen lanes around toll plazas
  - More options for the future
    - make congestion pricing feasible
    - raise Tollway value for possible sale/lease
- Demand Side (Tollway drivers):
  - Alleviate cash-carry burden
  - Faster, more predictable commutes

Chicken and egg problem facing Tollway

- Couldn't add I-PASS lanes (supply side) unless had enough I-PASS users
  - Non-trivial costs: $50 million per toll plaza (about 100 plazas)
- Might not be able to get enough motorists to switch to I-PASS (demand side) unless they had "exclusive" lanes to reap potential congestion relief benefits
  - I-PASS acquisition highly inconvenient prior to Nov '03

Tollway Authority acted!

stage 1

- Marketing campaign
  - Jewel/Osco – a big local grocery chain (200+ stores)
    - Exclusive I-PASS distributor starting November 2003
    - Jewel did not charge for this service
  - Local NBC affiliate (quid pro quo)
    - exclusive access to toll cameras in exchange for on-air I-PASS promotion starting in October 2004

stage 2

- Promote I-PASS usage by penalizing cash payments
  - Cash tolls doubled on January 1, 2005
  - But I-PASS tolls remained unchanged!

So what is this study about?

- Did Tollway actions accomplish their stated goal?

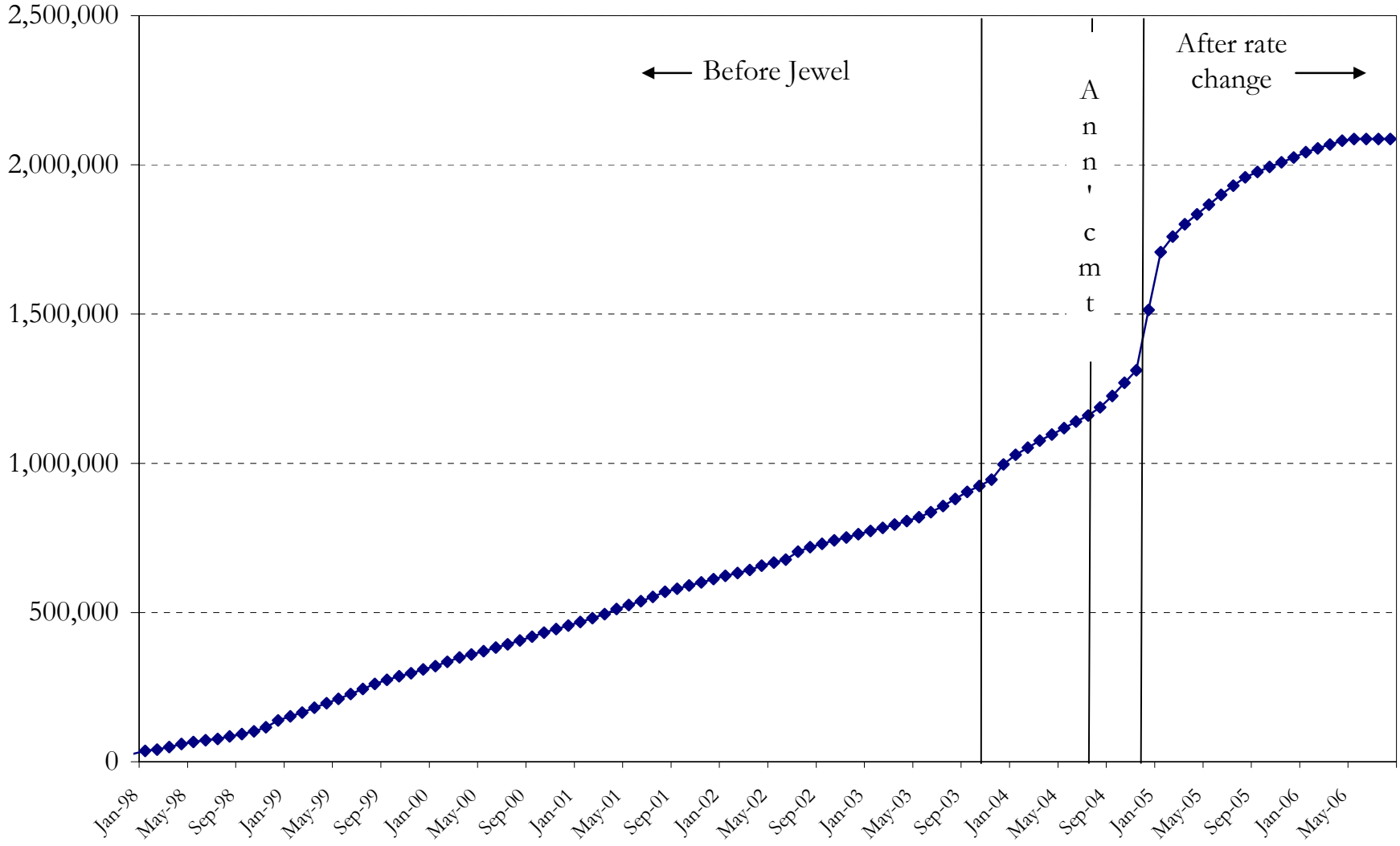
- Which groups of consumers did they affect? Who chose the I-PASS?
  - when it was difficult to obtain, offered no cost savings, and fairly little by way of time savings
  - when it became easier to learn about and obtain (Jewel)
  - when it generated toll savings, was easier to learn about (network effects + ad campaign), and promised greater congestion relief (open-road tolling + network effects)

Empirical questions (continued)

- Did different groups of consumers react to different channels?
  - costs of learning and acquisition (participation costs) v. monetary costs
- Holdouts: a case of high (perceived) participation costs?
  - Preferences for things other than leisure and consumption?
- Can this experience be generalized to other settings?

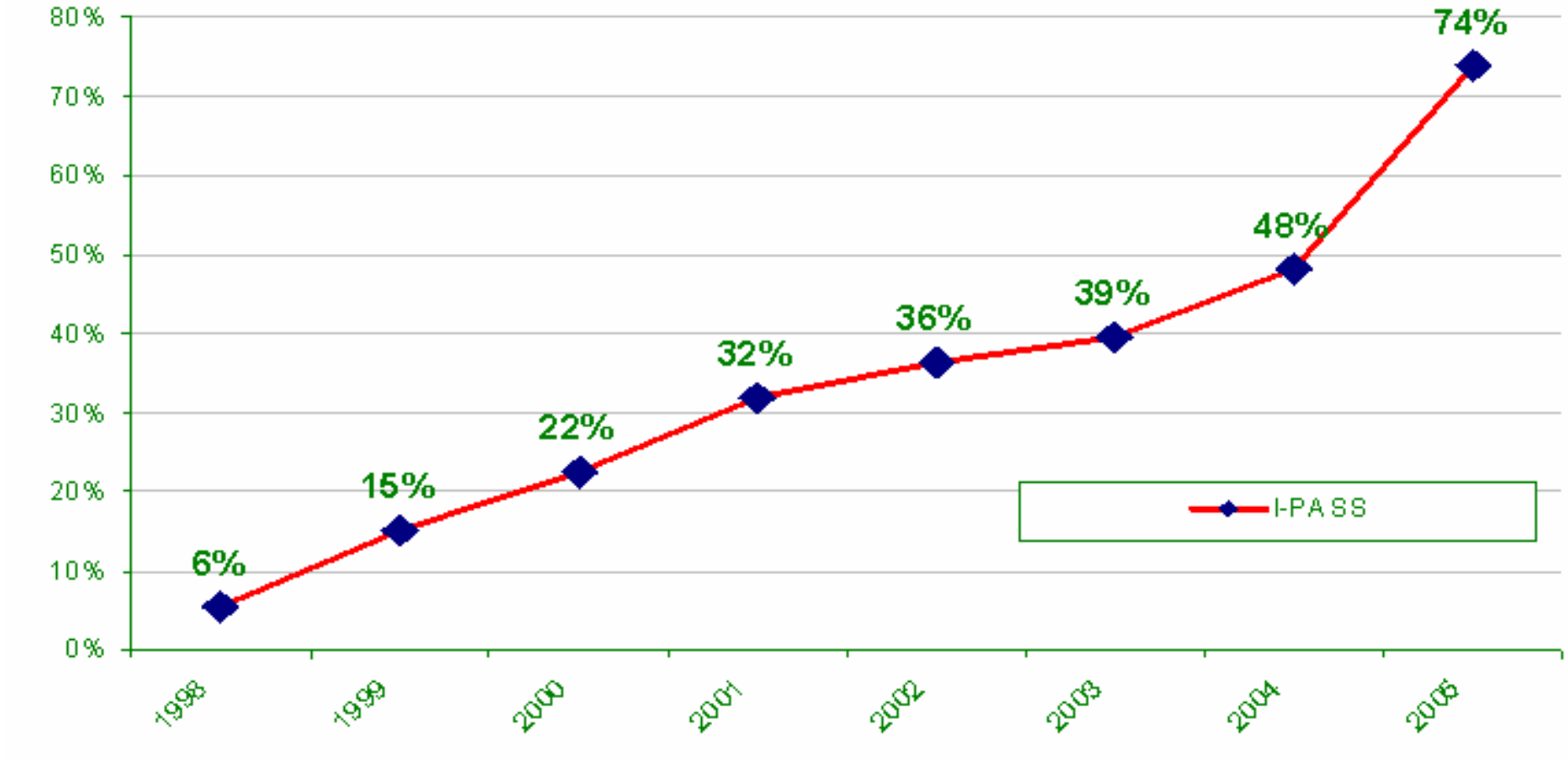
Measures of Success

Number of registered I-PASS transponders for passenger vehicles

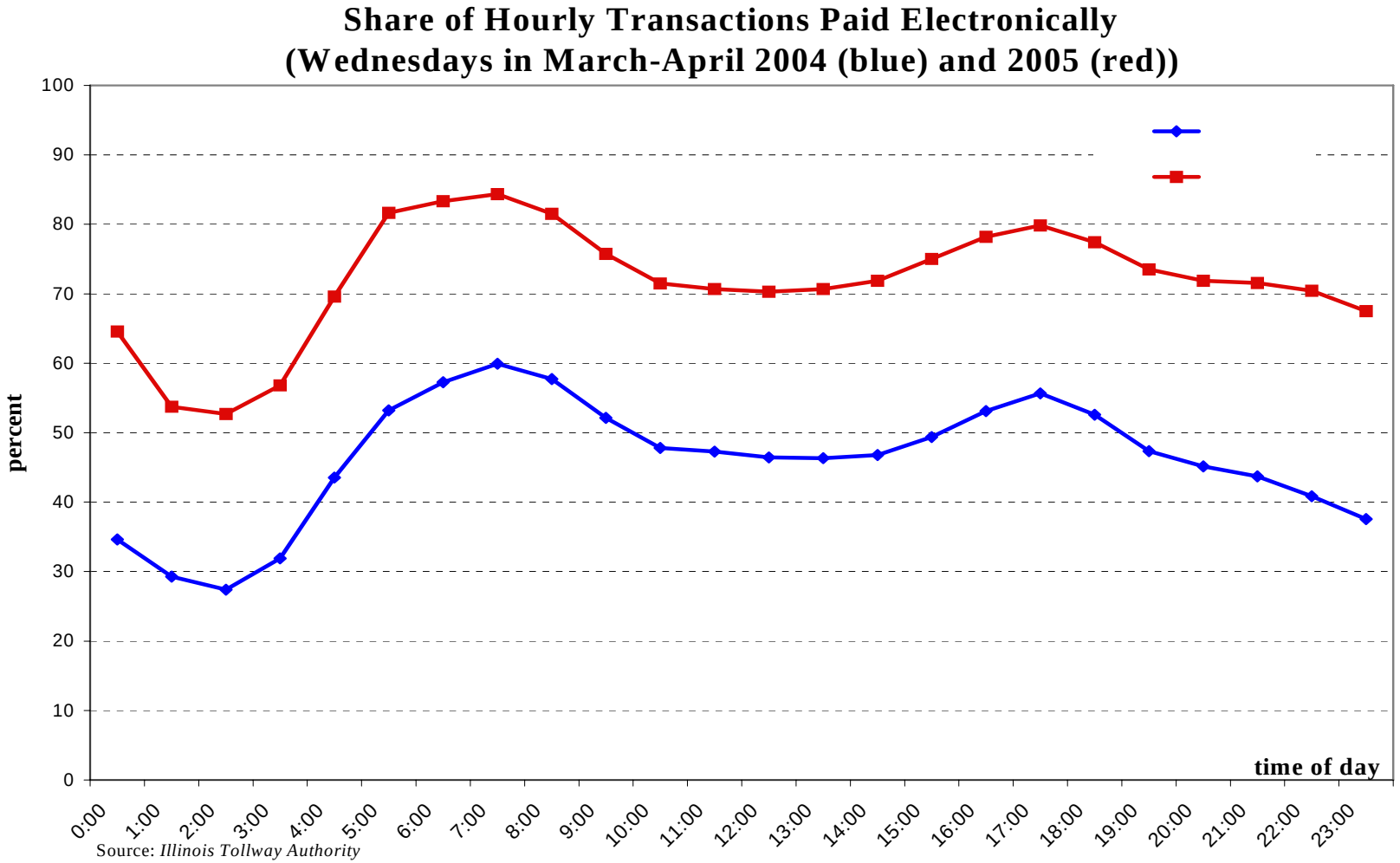


Measures of Success

Share of I-PASS transactions (annual average)



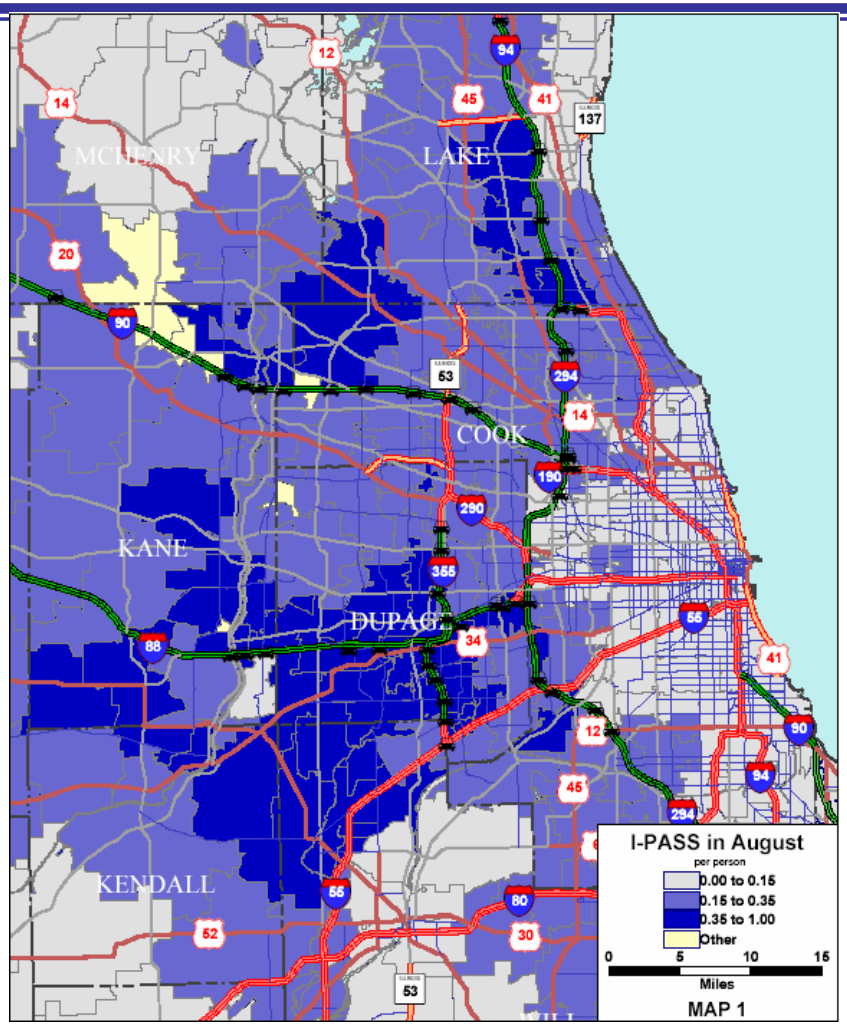
I-PASS shift was uniformly spread throughout the day

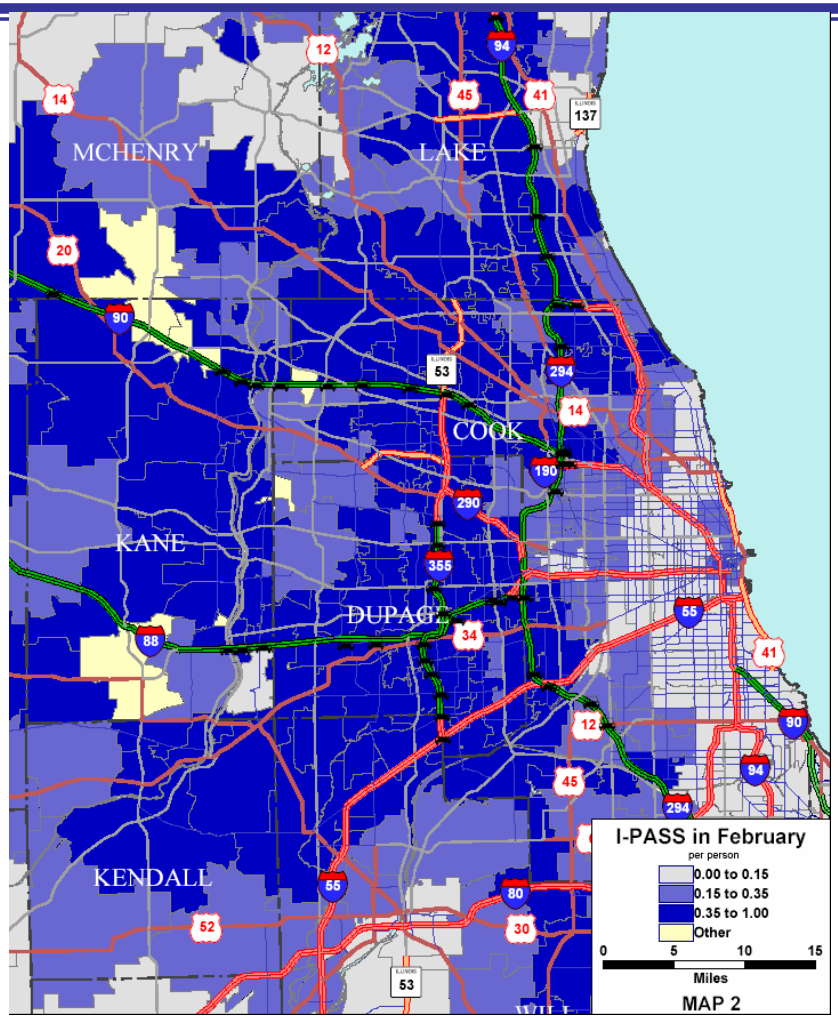


Source: *Illinois Tollway Authority*

Notes: 1) Excludes Plaza 3 due to measurement issues; 2) Data reflects only passenger vehicles without trailers (class 1)

I-PASS ownership before and after price change





I-PASS ownership increased uniformly not only throughout the time of day but also geographically

A simple model of consumer choice

- The Tollway chooses lane configuration and sets tolls
- Drivers take this as given, choose payment method

- Drivers care about consumption and leisure, compare costs and benefits:

Costs:

- Fixed time costs
  learn, acquire, install
- Fixed dollar costs
  deposit, carry cost
- Extra variable toll costs
  (could be 0 or <0)

Benefits:

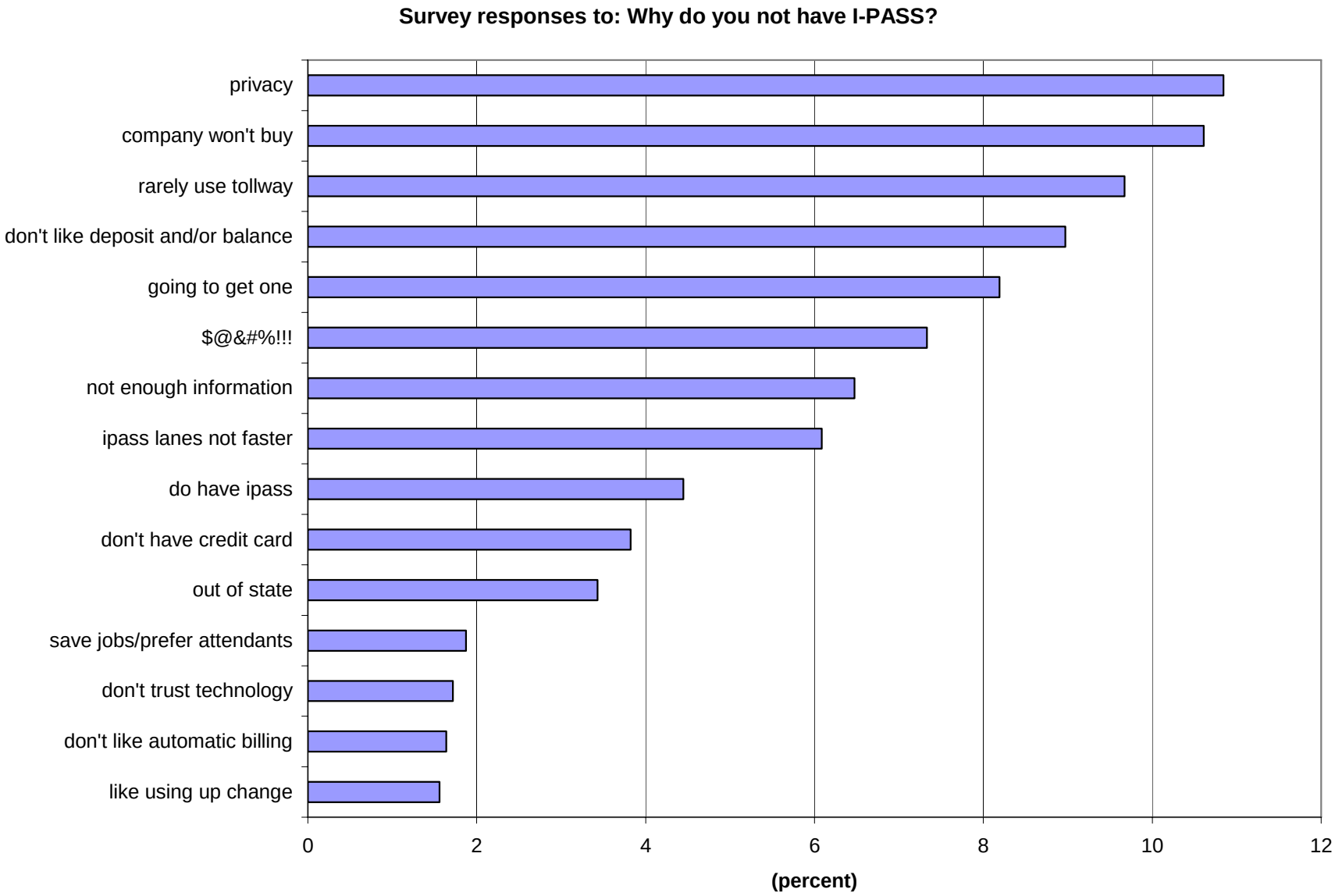
- Faster commutes
- More predictable commutes
- Lower tolls

Mapping model predictions to data

- I-PASS is more likely for households with
  - more time spent in commute
    - likelihood of tollway travel, distance, time (CTPP), congestion (GCM)
  - lower participation costs
    - education, English fluency, proximity to Jewel stores, information spillovers from neighbors and colleagues (Census, CTPP, Mapquest)
  - higher wages and/or higher wealth

- I-PASS distribution through Jewel stores
  - Lowers fixed entry costs, should matter most to occasional drivers
- Change in relative toll prices
  - Improves tradeoff at the margin, should matter most to drivers with high marginal value of consumption

Other preferences



Note: The rest of the responses (13%) were not easily classified.
Source: Illinois Tollway Authority

Role of Income

- Most variables related to I-PASS ownership bear some relationship to income
  - location relative to tollway (value of time)
  - commuting distance and duration to work
  - level of education to learn about I-PASS
  - neighborhood influences

- Thus, organizing our results by income captures a number of these relationships

Commuting characteristics for different income groups

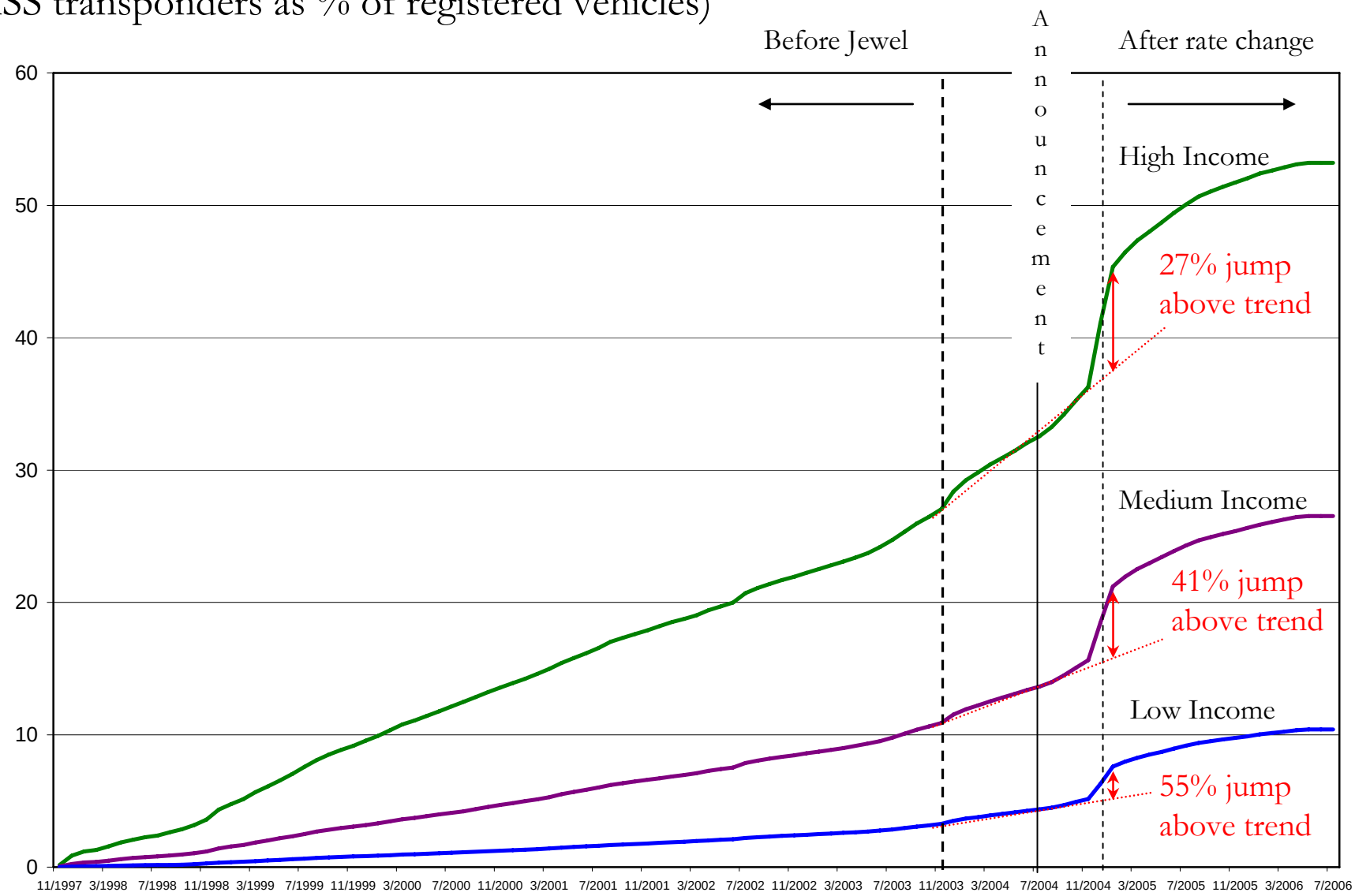
Table 2. Income group summaries

Income group	*Number of workers (mln)*	*Share driving to work*	*Share likely driving to work on a tollway*	*Median commute if likely toll driver (miles)*	*Median annual toll costs if likely toll driver*	*Median distance to nearest toll exit (miles)*	*Mean distance to I-PASS sales outlet*
Low	1.30	0.74	0.11	36.0	$286	13.4	7.1
Middle	2.11	0.85	0.16	34.1	$314	11.0	6.4
High	1.70	0.82	0.23	29.2	$267	6.6	2.4

- a much higher fraction of workers in high-income could use the tollway
- their commutes are shorter, but toll costs are about the same
  - tollway travel constitutes a higher fraction of the overall trip
- they live closer to I-PASS retail outlets and are more likely to use the tollway for things other than work-related commute

Ownership response by income group

(I-PASS transponders as % of registered vehicles)



I-PASS ownership for different income groups

Table 4. I-PASS ownership ratios by income group

(percentage points)

	Relative to adult population			Relative to likely toll commuters		
Income group	*Nov'03*	*Aug'04*	*Feb'05*	*Nov'03*	*Aug'04*	*Feb'05*
Low	1.9	2.7	5.2	34.2	48.2	95.0
Middle	8.4	10.6	18.3	82.5	104.3	179.1
High	22.4	26.6	40.0	140.1	166.2	249.6

- At all points in time, higher incomes were associated with higher I-PASS rates
- Even before I-PASS was easy to obtain or offered any cost savings, the number of transponders among residents of high-income zip codes exceeded the number of workers in those zip code who could take the tollway to work
- Residents of low-income zip codes are only now beginning to approach "saturation" levels for likely tollway drivers

Regressions

- I-PASS demand for all drivers is a function of
  - Likelihood of tollway use, whether work or leisure (proximity to tollway)
  - Learning costs
  - Income and wealth (income distribution)

- For tollway commuters, I-PASS demand is also a function of
  - commute time, toll costs, congestion along the route (percentage difference between AM and midday travel times)
  - these matter for all drivers, but are observable only for tollway commuters

Change in I-PASS adoption from changes in key variables

Change in "new" I-PASS adoption rate (in ppt) from change in:	Regime		
	Pre-Jewel	Jewel but same toll price	Different toll prices
Distance to the nearest Tollway exit (miles)	**-0.41**	**-1.11**	**-1.04**
Fraction of likely tollway commuters (ppt)	**0.14**	**0.31**	**0.58**
Distance to the Tollway HQ (home or work)	**-0.10**	-0.02	-0.01
Distance to the nearest Jewel store (miles)	0.00	**-0.30**	**-0.20**
Recent immigrants (ppt)	**-0.07**	0.00	0.03
I-PASS in neighboring ZIPs (ppt)	**0.15**	**0.31**	**0.17**
Average travel time (10 min)	**0.28**	0.06	**-1.56**
Average toll costs (dollars)	-0.59	-1.21	**3.36**
Avg. tollway congestion (ppt difference)	NA	**-0.03**	**-0.17**
reference: "new" I-PASS adopton rate (ppt) during …	*7.5*	*3.5*	*6.4*

- Income distribution and college education matter in all periods (not shown)
- Since Nov 03, distance to Jewel and not the Tollway HQ is an influential factor
- Costs of commute begin to matter only after the hike in cash tolls
- Time in commute was relevant only for the earliest adopters, becomes negative in the last regime, indicating that those commuters had already gotten the I-PASS
- Congestion measure is counterintuitive: bad proxy or "bad" time period?

Did all income groups react similarly to toll hike?

- Interact key coefficients with income group, repeat the regression for transponders acquired after the toll hike

	Regression coefficients for …		
Variable name	Low-income	Medium-income	High-income
Distance to the nearest Jewel store (in miles)	-0.01	-0.01**	-0.03***
Average toll costs * Share of LTC	7.78***	0.79	1.10
Average travel time * Share of LTC	-0.26***	-0.06***	-0.08***
Avg. tollway congestion * Share of LTC	3.95	-2.54	-9.42***
N (zip codes)	152	271	138

- Drivers in low-income zip codes were the ones responding to price increase
- Others were still motivated by ease of acquisition
- All drivers with longest commutes seem to have acquired I-PASS well before

I-PASS drivers: changes over time

	Share of toll drivers paying less than 6 tolls/week	
	Before Jewel	After Toll Change
High income	58%	70%
Medium income	52%	60%
Low income	55%	55%

- The distribution of toll expenses in high-income shifted to the left – evidence of more leisure drivers acquiring I-PASS transponders
- In contrast, low-income drivers distribution changed relatively little and there remain substantially more "workers" among low-income I-PASS owners

Conclusions

- I-PASS pricing experiment appears to be highly successful
- Tollway increased I-PASS participation among all income groups with a high proportion of all commuters in each group that should take the tollway paying electronically
- Both the reduction in costs of learning and acquisition and the change in relative toll prices had a measurable effect on adoption of electronic payments

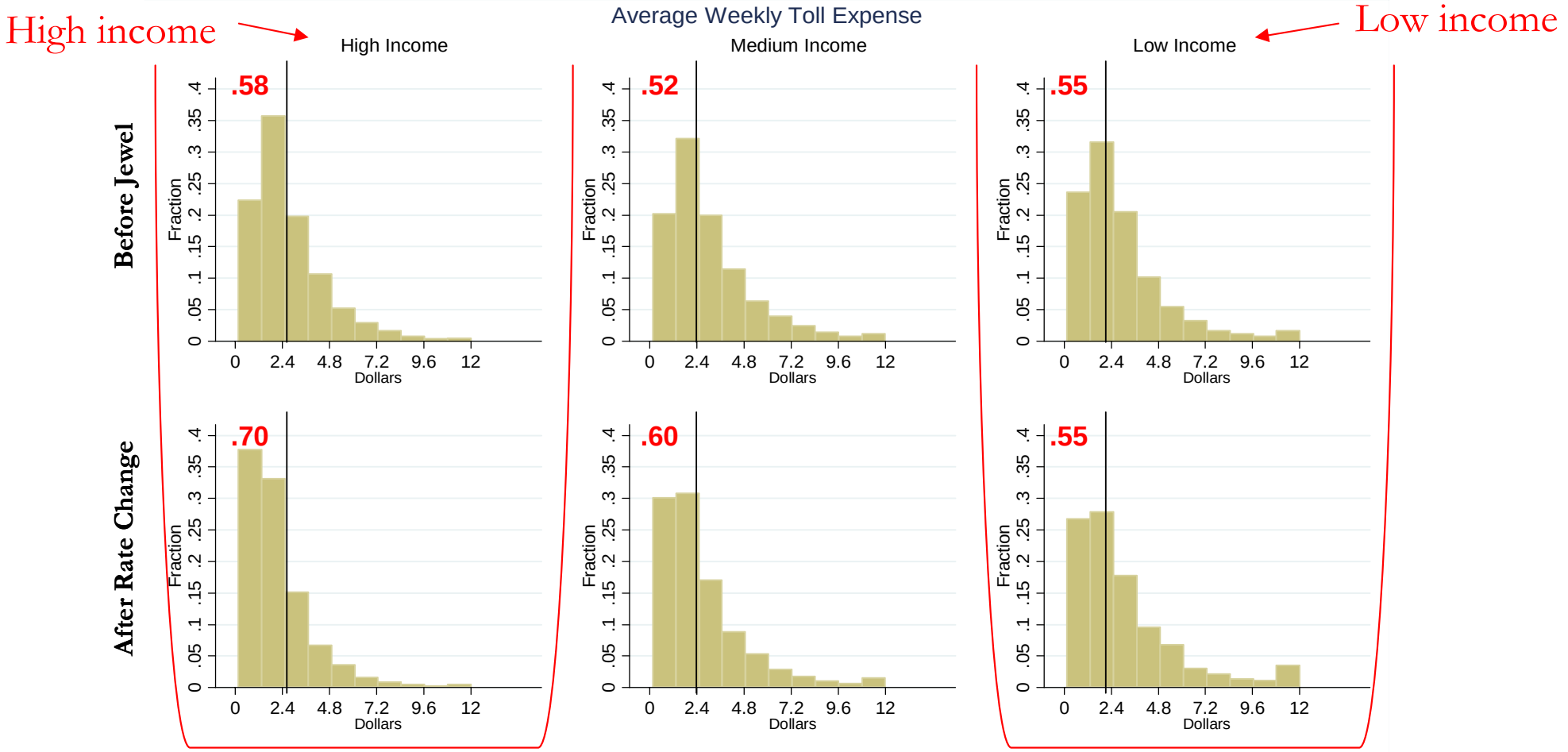
Conclusion (cont.)

- The doubling of cash tolls appears to have had an effect on pushing low-income drivers to electronic payments: couldn't afford to continue paying in cash
- Among the two more affluent income groups, I-PASS ownership exceeds commuting needs by considerable margins reflecting the convenience benefits of electronic payment
- Network dynamics – learning from neighbors and co-workers – appear to play an important role in fostering I-PASS adoption

Our Data

- Illinois Tollway
  - Payment choices by lane, hourly from Jan 1 2004 to June 30 2005
  - I-PASS ownership data, at zip code level (August 2004 & February 2005)
  - I-PASS transactions data, at individual transponder level, for select weeks between February 2004 and May 2006
    - **used to estimate I-PASS ownership in different model regimes**
- 2000 Census
  - Demographic and economic information at zip code level
- Census Transportation and Planning Package (CTPP)
  - where people live and work (by census tract), transportation mode, and commute time
    - **used to estimate the likelihood of tollway commuting**
- Other (Maptitude, Mapquest)
  - Location of retail outlets (Jewel stores), tollway exit and entry points

I-PASS drivers: changes over time



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