

# Chicago Fed Letter

## Inducing more efficient payment on the Illinois Tollway

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Historically, an important part of Chicago's economic strength derived from its geographic location at the nexus of the country's transportation networks. Yet, until quite recently, the payment options on the Illinois Tollway seemed incongruous with the remarkably efficient transportation network that has kept Chicago on the country's economic forefront.

All vehicles were required to come to a full stop at many toll plazas and pay with coins or dollars. To combat fraud and improve efficiency, in 1993 the Illinois Tollway<sup>1</sup> introduced an electronic payment option—a radio frequency identification device (RFID)—brand-named

I-PASS. Cars equipped with an I-PASS have the correct toll amount deducted electronically upon passing through specially equipped toll gates. RFID technology has now improved enough to allow I-PASS payments while traveling at highway speeds. Such “open road tolling” is effective in reducing the congestion that often occurs near toll plazas.<sup>2</sup> However,

its success requires a significant capital expenditure by the Tollway, as well as a critical mass of motorists ready to use it.

### Jump-starting I-PASS

A variety of things needed attention on the Tollway at the start of the new millennium: improving collection methods and maintenance, extending the Tollway to accommodate growing regional demands, and widening lanes around

toll plazas. But all of these changes required an infusion of fresh funds. Nominal tolls had only increased by a dime from their initial average level of \$0.30 in the late 1950s. If tolls had been indexed to the Consumer Price Index, motorists would be paying, on average, close to \$2 at each toll plaza. Yet, the idea of an outright increase in tolls generated little enthusiasm among state lawmakers. I-PASS, on the other hand, had the potential to make the Tollway more efficient and serve as a catalyst for reducing congestion.

Still, in 2003, only 41% of rush-hour motorists used I-PASS, far below the 75% target the Tollway had once anticipated, in part because obtaining I-PASS was relatively inconvenient and time-consuming. That autumn the agency took steps to lower the transaction and information costs of getting I-PASS. The Tollway partnered with a prominent grocery chain, Jewel-Osco, which became the volume retailer for transponders. Between November 2003 and December 2005, Jewel-Osco accounted for nearly three-quarters of total transponder sales, as the number of active I-PASS holders increased from 1.1 million to 2.5 million. These sales occur in over 200 outlets across the Chicago area at nominal costs, since Jewel-Osco sells I-PASS transponders at no cost to the Tollway.

### 1. Summary characteristics of driver and Tollway population

Income group	Number of ZIP Codes	Median income	Share of workers that...		
			drive to work	potentially drive on Tollway	potentially drive on freeways
Low	139	\$52,084	73.3	10.3	63.0
Middle	288	\$69,612	83.9	16.1	67.8
High	135	\$92,426	83.6	23.7	59.9

NOTES: Based on the sample of 562 ZIP Codes that lie within a 40-mile radius from the Illinois Tollway system. Driving to work is determined from 2000 Census data. The share of workers driving to work is further decomposed into those who drive on the Tollway (see note 6 for details) and those who drive on other roads. The reported values are averages across ZIP Codes in each income category.

SOURCE: Authors' calculations based on data from the 2000 Census Transportation and Planning Package.

## 2. I-PASS ownership ratios

Income group	Relative to adult population		Relative to commuters who drive to work		Relative to likely Tollway commuters	
	Aug. '04	Feb. '05	Aug. '04	Feb. '05	Aug. '04	Feb. '05
Low	0.027	0.052	0.070	0.136	0.499	0.974
Middle	0.102	0.176	0.196	0.336	1.027	1.760
High	0.273	0.411	0.475	0.715	1.658	2.498

NOTES: I-PASS ownership data are provided at the ZIP Code level by the Illinois Tollway. The ratios are computed relative to all adults aged 16 and over, all commuters driving to work, and all Tollway commuters.

SOURCES: Authors' calculations based on data from the Illinois Tollway and 2000 Census.

To promote I-PASS sales and increase public awareness for its congestion-relief plan, the Tollway also negotiated a partnership with the local NBC station to provide exclusive access to real-time videos of Tollway traffic. In exchange, NBC provided the Tollway with free on-air advertising valued at \$2 million.

Most importantly, the Tollway also sought to add a financial incentive to induce electronic toll payments—doubling cash tolls for cars, while leaving the price of electronic tolls unchanged.<sup>3</sup> Then, the Tollway conducted a concerted public awareness campaign. It met with dozens of civic groups and editorial boards to convey that congestion relief would be forthcoming if enough drivers switched to electronic payment. That was the carrot; the stick was simple: If car drivers did not switch from cash, their costs would double starting in 2005. This message was featured on electronic Tollway billboards starting in mid-November 2004 and highlighted in various media outlets.

### Aggregate commuter response to the toll increase

On January 1, 2005, the Illinois Tollway doubled the price for car cash payers but left it fixed (at \$0.40 at most toll plazas) for I-PASS users. Here, we look at the relative importance of price, income, and costs of learning about and acquiring I-PASS transponders in shaping consumers' responses to these toll changes.

While the toll hike for cash payers corresponds to a 100% increase in toll outlays, the increase represents a considerably smaller percentage rise in the full cost of commuting, perhaps no more than 3%, when taking into account such relevant economic factors as the tolls paid, the

total cost of operating a vehicle, as well as a measure of the value of time spent on the commute.<sup>4</sup> Compared with the variable costs of the commute alone, the toll increase is somewhat more significant, perhaps on the order of 10%.

Nevertheless, commuters and other travelers quickly began switching to electronic payment in large numbers. The share of I-PASS payers had plateaued at around 45% by mid-2004 and then began to rise steadily following the announcement of the toll increase. By November 2004, I-PASS ownership exceeded 50%, and by early February 2005, it shot up to over 72%, with nearly a 17 percentage point increase occurring in January 2005. By the end of January, over 1.9 million commuters had transponders. As the number of electronic payers rose, the Tollway was able to add nonstop lanes to accommodate them.

The increase in I-PASS ownership addressed a chicken-and-egg problem facing the Tollway. It could not rapidly bring I-PASS-only lanes to toll plazas unless there was enough demand from drivers. Similarly, without such lanes, the benefit from I-PASS ownership would be limited, making commuters reluctant to sign up.

### The economics of payment choice on the Tollway

Prior to the toll price change, the economic choice facing Tollway users was simple: Pay with I-PASS and go faster, or pay with cash and wait in line. They had to choose between a cheaper but less attractive payment mechanism and a costlier but more desirable one.

The convenience of I-PASS and the possibility for faster travel it offered were counterbalanced by the carry cost of the \$10 I-PASS deposit and of the

approximately \$25 balance held on the transponder. Following the change in prices, electronic toll payments offered *both* a cheaper and faster (more reliable, easier) way to travel. Indeed, under the new pricing regime an average Tollway user accustomed to paying \$0.70 in cash on one leg of a daily commute would save about \$336 in tolls over a year by switching to I-PASS. This difference in toll outlays, coupled with the nonmonetary benefits of electronic toll payments, is counteracted by the carry costs of I-PASS balances, as well as costs of learning, acquisition, and installation of a transponder. In a simple cost-benefit analysis, the latter costs would appear to be small relative to the annual out-of-pocket toll payments.

So why have some consumers been reluctant to convert to I-PASS? One possible explanation is fixed participation costs (whether perceived or real), which can preclude or delay the adoption of a superior payment mechanism. These costs derive from having to acquire new information and skills, and they have been shown to play a role in explaining other consumer choices, such as limited participation in equity markets. Privacy concerns constitute another hurdle. Although the Tollway does not use I-PASS data to enforce speed limits, the possibility that information about the exact time and pattern of Tollway travel could be subpoenaed from the Tollway has proven to be off-putting to some drivers.<sup>5</sup>

In sum, it appears that I-PASS ownership will be more prevalent among drivers who incur higher Tollway expenses and who place a higher value on time. Such drivers would typically use the Tollway system more frequently, drive longer distances, and face more congested commutes. I-PASS will also be more appealing to those drivers who can acquire information about it more easily, obtain transponders with greater convenience, and assign less importance to privacy of their driving choices.

### Empirical results

While we cannot directly measure the value of privacy, we do have data bearing on other important determinants of payment choices by Tollway drivers.

In particular, the Census Transportation and Planning Package provides detailed information on daily commuting patterns by pairing place of residence and place of work. With these data, we estimate the number of people commuting between any two ZIP Codes, their time spent in commuting, as well as their mode of transportation. We also compute the daily commuting distance and the cost of the commute. In addition, we have Census data on income, education, and other demographic characteristics. Finally, we use information on the location of Jewel-Osco stores (the primary I-PASS retail outlets) and on I-PASS ownership among neighbors and co-workers to gauge the ease of acquiring and learning about I-PASS. With these data, we try to explain I-PASS ownership before the doubling of cash tolls and afterward.

A particularly important task is to identify *likely* Tollway users in each ZIP Code, whom we infer on the basis of Census commuting patterns data. In particular, for each of the unique permutations of the 562 ZIP Codes in our sample, we used an Internet mapping program along with a simple heuristic algorithm to classify whether a Tollway commute between this pair of ZIP Codes is a viable alternative.<sup>6</sup> If the answer was affirmative, we classified drivers commuting between this pair of ZIP Codes as likely Tollway users.

The strong positive association between income and likelihood of Tollway use is one of the most dramatic features in the data. As shown in figure 1 on the front page, high-income ZIP Codes (median income among working households above \$80,000) have more than twice as high a share of likely Tollway drivers as low-income ZIP Codes (less than \$60,000).<sup>7</sup> The contrast between high- and middle-income (between \$60,000 and \$80,000) groups is less dramatic, though there is still a nearly 50% difference in shares of likely Tollway drivers. The clear tendency for potential Tollway use to rise with income reflects the strategic choice of many higher-income households to live in neighborhoods that are close to the Tollway and convenient for their workday commutes.

Figure 2 compares I-PASS choices for these income groups (before and after the price change) by presenting ratios of active I-PASS accounts to different population counts: the entire adult population (16 and over), commuters who drive to work, and commuters who likely take the Tollway to and from work. The results for these population slices tell a similar story, and thus, we focus on those driving to work for simplicity. In the summer before the price change (August 2004), I-PASS ownership was quite high among households in middle- and high-income ZIPs, with ratios of about 0.20 and 0.48, respectively. In contrast, the ratio of number of I-PASS accounts to drivers in low-income ZIPs was only 0.07. Much of this difference could be attributed to the higher propensity of Tollway usage among higher-income households. Yet, as shown in the last set of columns, the stark difference in I-PASS ownership was evident even for the subset of drivers likely to use the Tollway in their daily commute.

The dramatic relative price change and the corresponding public awareness campaign were sufficient to boost I-PASS ownership ratios across *all* income groups. In fact, by February 2005 the number of I-PASS accounts nearly equaled the number of the most intensive Tollway users—those likely to be using it for their everyday commute—in the lowest income group, and exceeded it for the other two groups, as indicated by ownership ratios above 1. Put differently, a ratio of 1 would reflect full participation based on our determination of likely Tollway use and on Census surveys of where people work and live. Beyond getting to work, the Tollway is a convenient gateway for going to many regional destinations: the airports, suburban and downtown shopping venues, downtown eateries, parks and shows, and the like. Thus, a rate greater than 1 is indicative of wide non-commuting uses of the Tollway.<sup>8</sup> Indeed, the very high ratios of I-PASS ownership in the more affluent neighborhoods underscore the strong appeal of the electronic payments choice even for the occasional toll drivers in those areas.

The importance of nonwork destinations in influencing I-PASS ownership

is corroborated by another feature of the data. We find that the doubling of cash tolls had a roughly similar impact on the increase in I-PASS usage among rush-hour drivers—the vast majority of whom are commuting to work every day—and among midday or nighttime drivers that include a large share of shoppers and students, whose driving patterns are typically much more irregular than those of rush-hour commuters.

We are also interested in learning whether the increase in use of electronic payments was systematically related to specific attributes of the daily toll commute, such as distance, cost, and congestion; we also want to understand the relative importance of the two basic aspects of the price change—higher cash tolls and greater exposure to information—for different income groups.

To answer these questions and to establish statistical significance of multiple explanatory variables, we conducted logit regression analysis of I-PASS ownership before and after the price change. Prior to January 2005, I-PASS toll payments did not bestow any monetary advantages over cash, and hence, I-PASS should have been most appealing to those who placed a high value on time

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and had low acquisition costs. Living close to the Tollway and having high income can be thought of as two indicators of those who place a high value on time, and we found that both had strong independent positive effects on I-PASS ownership. We also found evidence for the importance of learning and acquisition costs. Such costs would be lower if one lived closer to an I-PASS retail outlet (e.g., a Jewel-Osco store) or had more interactions with those who already owned I-PASS (e.g., neighbors and co-workers). In our regressions, ZIP Codes located closer to Jewel-Osco stores as well as those with higher I-PASS ownership by neighbors and co-workers had markedly higher ownership rates.

The doubling of cash tolls in January 2005 was accompanied by a concerted public awareness campaign. We find some evidence that, on average, low- and medium-income neighborhoods responded to the cost doubling aspect of the pricing change while high-income neighborhoods were affected by the convenience of I-PASS acquisition through heavily advertised retail outlets. All income groups responded positively to propagation of I-PASS ownership among their fellow co-workers and neighbors, which made learning about I-PASS easier through everyday social interactions.

## Conclusion

We find that relative to the population of *likely* Tollway users, I-PASS ownership ratios virtually reached or exceeded 1 for all income groups under the new pricing regime. In addition, I-PASS is being increasingly used by other drivers for relatively less frequent trips to the airport, shopping centers, or various leisure destinations. Such users are more prevalent in higher-income neighborhoods, in part because they are often located relatively near to the Tollway. An overall welfare assessment of this electronic payment experiment ultimately awaits the completion of the open road tolling infrastructure. To date, the Tollway's electronic payment system appears to be off to a promising start.

<sup>1</sup> The roads and the Illinois State Toll Highway Authority itself are here referred to as the "Tollway." The Tollway is located in the northern part of the state with spokes going to Wisconsin, Iowa, and northern Indiana from Chicago. We thank the Illinois Tollway for generously sharing data and institutional knowledge with us.

<sup>2</sup> Under the full implementation of open road tolling, cars unable to pay electronically will be diverted to an off-road payment ramp and subsequently have to merge back onto the Tollway. Open road tolling (barrier-free mainline tollway system) will become the standard during 2006.

<sup>3</sup> Governor Rod Blagojevich unveiled the plan on August 25, 2004, and the Board

of Directors for the Illinois Tollway approved it on September 30, 2004.

<sup>4</sup> In analyzing travel demand, we use the concept of the value of time to represent the subjective dollar cost that commuters place on traveling for a unit of time. We quantify this value on the basis of a recent study by Kenneth A. Small, Clifford Winston, and Jia Yan, 2005, "Uncovering the distribution of motorists' preferences for travel time and reliability," *Econometrica*, Vol. 73, No. 4, pp. 1367–1382.

<sup>5</sup> Privacy concerns were the most common response to an open-ended survey question asking respondents to name major obstacle(s) preventing them from getting I-PASS.

<sup>6</sup> MapQuest search provides a yes/no answer with respect to suggested Tollway usage on a given trip segment. The heuristic algorithm consists of comparing a straight line distance between origin and destination points, with the shortest route requiring the Tollway, and rejecting the Tollway if it extends the length of the trip by more than a certain threshold. Both the threshold and the choice of weights for MapQuest and heuristic rules were calibrated on actual Tollway traffic data. As not all routes are reversible, in a given pair of ZIP Codes, we looked separately at trips originating at each ZIP.

<sup>7</sup> This particular income breakdown was used in the study on the value of time referenced in note 4.

<sup>8</sup> When the ratio begins to exceed 1, we start picking up some households that use the Tollway exclusively for leisure trips.