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The short-run impact of gas prices fluctuations on toll road use

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ABSTRACT

The price of gas has fluctuated dramatically since 2008 and travelers' response to this has been generally as expected. Relatively little change in behavior to begin, but as prices continued to rise we have seen a shift to vehicles with higher fuel efficiencies and a shift to alternative modes (transit and bike/pedestrian). One thing that has not been examined is potential route shifts, to or from toll facilities. Many toll facilities offer an uncongested and more direct route to a traveler's destination. In theory, as gas prices increase the use of toll facilities would also increase. However, some toll facilities experienced the opposite effect. The cost of gas increased to a point where some travelers refuse to pay any more for their trip, including paying a toll, despite the fact the toll route may offer significant gas savings.

This research examined the impact of changing gas prices on travelers' choice of routes, focusing on toll route usage. Travel demand elasticity estimates for toll routes with respect to gas price were inelastic and mostly negative. Additionally, the average elasticity (−0.06) was smaller than those found in the literature for non-toll facilities (average approximately −0.25). This would indicate that either (a) toll facility users were less impacted by changes in gas price, or more likely, (b) some travelers were switching to toll facilities as gas prices rise. Thus, toll facilities were more insulated from downturns in traffic volumes resulting from increases in gas price.

1. Introduction

Travelers' response to changes in the cost of travel provides key data to help predict future travel behavior. Recently (particularly in the year 2008), the price of gas increased dramatically – and therefore the cost of travel increased as well. Travelers' response to this has been generally as expected. Relatively little change in behavior to begin, but as prices continued to rise there was a shift to vehicles with higher fuel efficiencies and a shift to alternative modes (transit and bike/pedestrian) (Deakin and Cervero, 2008; Komanoff, 2008; Neuman, 2008). One thing that has not been examined is potential route shifts, to or from toll facilities.

Many toll routes offer an uncongested and more direct route to a traveler's destination. Therefore, the traveler is willing to pay a toll to use the toll facility rather than a toll-free alternative. A substantial amount of research finds this choice primarily depends on (Deakin and Cervero, 2008) travel time savings, (Komanoff, 2008) travel time reliability, and (Neuman, 2008) toll cost (Avineri and Prashker, 2005; Ozbay et al., 2006; Hensher et al., 1990; Odeck and Brathen, 2008; Lake and Ferreira, 2002; Hess et al., 2005). However, as the price of gas increases, the difference in the cost of gas used on an uncongested, shorter, toll route versus a non-toll route may also influence route choice.

In theory, as gas price increases the use of toll facilities would also increase. However, some toll facilities are experiencing the opposite effect. The cost of gas increased to a point where many travelers refused to pay any more for their trip, including paying a toll, despite the fact the toll route may offer significant savings in gas. Additionally, as more travelers shift modes due to higher gas prices, congestion of non-toll routes decreases, eroding the travel time savings offered by the toll facilities.

This study examined traffic trends on several toll facilities around the country over the last few years and these data were used to estimate the impact of changing gas prices on traveler's choice of toll facilities – furthering our understanding of travel behavior in response to prices. Results from this study may help toll facility operating and planning agencies better quantitatively forecast traffic volume and revenue variation in response to a change in travel cost, particularly the price of gas. This study collected monthly toll traffic data and gas price data for the period 2000–2010 from toll facilities operated by 13 agencies around the United States. In addition to investigating the impact of the changes in gas price on the use of toll facility, this research also

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considered other factors that may have influenced the use of the toll facility. These factors included the toll rates, unemployment rate, population and number of registered vehicles in the metropolitan area where the toll facility was located.

2. Literature review

The price elasticity of travel demand provides information on travelers' responsiveness to changes in travel costs. For road transport, factors influencing the level of travel demand include vehicle operating costs, parking fees, travel time costs, ownership costs, accidents and insurance costs. In addition, toll facility users' travel costs include one extra component – the toll paid for using the facility. Literature regarding elasticity estimates of demand on toll roads often focus on how demand changed due to a toll price change. The examination of the literature found only two studies that examined the price elasticity of toll road demand with respect to the price of gas. Therefore, this literature review examined these two studies plus the wealth of information available on how travelers react to price changes – primarily toll rate changes.

There has been increasing interest in using toll revenue to finance new road investment – to relieve ever increasing public budget constraints. An accurate estimate of traffic demand for toll facilities is a vital part of planning for these facilities. Transportation planners and owners of toll facilities need accurate estimates of demand elasticity with respect to price, income, macroeconomic environment, etc. in order to develop traffic and revenue forecasts. To evaluate the impacts of transportation pricing strategies, it is necessary to understand drivers' response to changes in price. A price elasticity of demand measures the responsiveness of demand to a change in price (Lee and Burris, 2004).

In the long run drivers have more opportunities to change their travel behavior in response to a change in price than in the short run. This results in higher long-run elasticities than short-run elasticities. As indicated by Burris et al. (2004), almost all available estimates in the literature suggest that the long-run elasticities were at least twice those of corresponding short-run elasticities. The distinction between long-run and short-run is arbitrary in most transport demand studies (Oum et al., 1992). In general, short-run was considered within 1 year, and long-run was considered within a span of 3–5 years (Lee and Burris, 2004; Burris et al., 2004). As monthly data were used in this research, results from this study can generally be considered as short-run elasticity estimates.

Researchers have studied price elasticities of demand for various transport modes. Several of the most comprehensive surveys included Cervero (1990), Goodwin (1992), Oum et al. (1992) and some of the recent surveys include Graham and Glaister (2004), Goodwin et al. (2004), and Odeck and Brathen (2008). Although this literature is extensive and some studies dealt with toll and fuel elasticities, only two studies examined the price elasticity of toll road demand with respect to the price of gas. One study was in Spain on a system of national toll roads (Matas and Raymond, 2003a). The other compared proportional changes in toll transactions in two months (May and June) in 2006, 2007, and 2008 on the Dallas North Tollway Authority System (NTTA) system (Wilbur Smith Associates, 2008). This study indicated that the toll transactions were relatively inelastic to increases in the price of gas, but did not report the travel demand elasticity with respect to the price of gas.

Oum et al. (1992) summarized empirical price elasticity estimates from over sixty studies which report estimates of own-price elasticities of both passengers and freight demand based on different databases and covering many countries and cities. Their summarized own-price elasticity estimates of demand for transport (automobile usage) with respect to price ranged from −0.52 to +0.09. This indicates that the demand for automobile usage is fairly inelastic. Odeck and Brathen (2008) summarized existing literature and found that transport demand with respect to tolls is also fairly inelastic – most previous studies have found elasticities in the range of −0.50–0.00. Burris (2003) found that the fixed-toll price elasticity of travel demand varies from −0.30 to −0.03.

Graham and Glaister (2004) reviewed 387 short-run and 213 long-run road traffic demand elasticities with respect to fuel costs, and they reported that the mean of the 387 short-run price elasticity estimate was −0.25 with a range of −2.13 to +0.59. The mean of 213 long-run estimates was −0.77, with a range of −22.00 to +0.85. Approximately 2% of each of the studied cases had positive elasticities. Lee and Burris (2004) used a value of −0.16 for short-run travel impacts of fuel price changes and −0.33 for long-run impacts in the calculation of the implied travel demand elasticity with respect to fuel price changes. Crotte et al. (2009) reported estimated medium-run traffic elasticity for fuel prices of −0.12 for Mexico City, Mexico.

Matas and Raymond (2003b) studied the elasticities of demand for various Spanish tolled motorways. The authors used a dynamic model to identify short-term and long-term responses to changes in some key variables with an emphasis on toll costs. They found that the demand was elastic with respect to the level of economic activity – represented by real national gross domestic product (GDP). The study results also indicated that travel demand was less sensitive to gas prices and tolls than it was to GDP. Their study indicated that demand elasticity with respect to gas price for Spanish toll roads was about −0.30. Demand elasticity with respect to toll price varied from −0.83 to −0.21. The authors indicated that differences in elasticities for various tolled roads were related to the availability and quality of the alternative free routes, length of the toll road segment, and location of the road in the neighborhood of a tourist destination.

It is often assumed that the demand for road freight is even less elastic than general traffic. Goodwin et al. (2004), in their review of price and income elasticities of road traffic and fuel consumption, did find that goods traffic was less sensitive to price than private cars. However, Graham and Glaister (2004) found that this may not be the case. The studies they reviewed mostly produced negative, and in many cases above unity, price demand elasticity estimates for freight traffic. From the studies they reviewed, they emphasized that the price elasticity of demand for freight, with a variety of different commodities and countries, was negative and relatively elastic.

As Hirschman et al. (1995) indicated, elasticities can change from one year to another, and their value may even change from one specific site to another within the same city. Our results indicate that gas price elasticity estimates can be significantly different for different months on one toll facility.

Based on the literature, one might expect short-run elasticity of travel demand on non-toll facilities with respect to gas prices to be around −0.25. If the elasticity of travel demand on toll facilities with respect to gas prices found in this study is significantly different, then one of two things is happening: (1) if it is significantly more elastic, then the hypothesis that drivers avoid toll facilities as gas prices rise (despite this being counterproductive) is correct; (2) if it is significantly less elastic, then drivers are using toll facilities more (relatively speaking) as gas prices rise, which makes sense as most toll routes will save drivers gas.

3. Data collection and description

To estimate the elasticity of toll road demand with respect to gas price, this research obtained monthly/quarterly toll traffic data for the period 2000–2010 from toll facilities operated by 13 agencies around the United States (see Table 1). Some operating agencies had monthly traffic data covering the whole study period,