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## Abstract

This research examines citizen acceptance of tolls and road pricing, and specifically focuses on determinants of the individual's expressed willingness-to-pay tolls to use a tunnel express lane that would be free of traffic delays. We answer the research question "What factors influence citizens' willingness-to-pay tolls" by empirically estimating a four factor model of willingness-to-pay: (a) direct benefit to the respondent; (b) relative cost over time; (c) community concern; and (d) political and environmental liberalism. We use data about citizen perceptions from the Life in Hampton Roads Survey, a survey of residents of Hampton Roads, Virginia. We find that willingness-to-pay is primarily driven and motivated by self-interest, through a balancing of benefit to cost relative to individual income and frequency of use. . In addition, concern for the community also contributes to willingness-to-pay tolls. The individual's perception of government's trustworthiness, a reflection of political and environmental beliefs, also influences the extent to which an individual is willing to pay tolls. Keywords: Willingness-to-pay, tolls, road pricing, tunnel congestion

## 1. Introduction

For most urban areas in the U.S., traffic congestion and subsequent travel delays have become significant problems. For example, statistics from the Texas Transportation Institute indicate that congestion, measured as delay per commuter (in hours) has increased from 16 hours in 1982 to 38.0 hours in 2011 (Shrank, Eisele, & Lomax, 2012). In recent years, there has been a significant and wide-spread interest in the use of tolls and other forms of road pricing as a source of funding, a means of managing congestion, and a way of providing additional traveler options. Tolls have become increasingly attractive to state and local governments in the current fiscal environment in which they face significant demands for services, but possess limited (even decreasing) resources to meet these demands. Many states in the U.S. are experiencing shortfalls in transportation funding, along with growing needs for surface transportation system improvements to manage congestion. "Tolling and road pricing have become part of contemporary transportation planning and policy making vernacular out of the need to address traffic congestion and infrastructure funding short-falls" (Zmud & Arce, 2008, p. 49).

Despite the potential advantages of tolling, much of the existing empirical research in transportation indicates that public acceptance of tolls has been low. Yet there are reasons to believe that latent support for tolls may exist among the general public, as tolling can confer benefits desired by many voters, including the many who rarely drive or infrequently use the tolled facility. Among the potential benefits, revenue for needed infrastructure and public transportation projects, less congestion for drivers, less pollution and reduced auto dependence for environmentalists and smart growth advocates, just to mention a few. Thus, the benefits are many and only those who pay the toll will bear the cost. The latter, of course, gain the benefit of reduced congestion and faster travel.

This research examines the willingness of residents in a community ( Hampton Roads, Virginia) to pay a $3.00 toll to access a tunnel express lane that would be free of traffic delays the majority of the time. We answer the research question "what factors influence citizens' expressed willingness-to-pay a toll" by empirically estimating a four-factor model of willingness-to-pay. Our approach is similar to that of Hamilton (2012), who studied the factors predicting support for congestion pricing in three European cities. He looked at the impact of five factors on support: self-interest, fairness, political ideology, trust in government, and previous experience with congestion pricing. Our model includes measures of three of these factors. Our model also includes measures of community concern along with measures of the direct benefit to the respondent (e.g., congestion relief and commute time), trust in government, and political and environmental liberalism. We use data about citizen perceptions from the Life in Hampton Roads Survey, which is a survey of 700 residents of the Hampton Roads region in Southeastern Virginia

Our study uses a textbook static model of congestion pricing with homogeneous values of time, thus assuming a single value of time and a single road link. We do not include a direct measure of the value of time in our model, as we assume that drivers will use the tunnel at different times for a variety of reasons and the value of time will in all likelihood vary with the reasons for travel. Moreover, some supporters of a toll may not use it very often, if at all (Gaunt, Rye, & Allen, 2007; Jaensirisak, Wardman, & May, 2005). We do however have a measure of individual income; and, as research on the value of time suggests, residents with more income are more likely to be willing to pay the toll. But many other factors can influence support for a toll. It is well-documented that the value of time varies by trip purpose, day of week, and type of traffic encountered, which is to say that the value of time is more than a function of income and

chronological time saved (Hamilton, 2012; Wardman & Nicolás Ibáñez, 2012). And, of course, many low income residents of a city, such as those who rely on transit, may support a toll because they are not likely to pay the toll or pay it infrequently and the toll, itself, can serve as an alternative to a possible tax increase for infrastructure that they would have to pay. Others with a low value of time may support the toll for political or environmental reasons (Eliasson & Jonsson, 2011; Jaensirisak, et al., 2005). Thus, this study is designed to capture the factors beyond income and time saved that lead to support for a toll. A city seeking to impose a toll can design its campaign for support so that it clearly informs each subgroup of residents of their specific benefits. Given the increasing reliance on user fees and user charges by governments in the U.S., this study has implications for the research on citizen acceptance of (and willingness to pay) similar fees or charges.

After providing some background information on the issue of tolling, we discuss the importance of public support. We then present our four-factor model of support for tolling followed by our study methods and results. The conclusion offers implications for future efforts to gain public support for tolls, road pricing and similar user fees.

### *1.1 Some background on tolling and road pricing*

According to the U.S. Department of Transportation's Federal Highway Administration, as of January 1, 2011, toll facilities in the U.S. totaled 5,365 miles (Federal Highway Administration, 2011). These toll facilities, which range from congested urban facilities to toll roads linking rural areas, include not only highways, but also tunnels, bridges, and ferries. The tolling structures vary widely, from multi-tiered price structures with discounts according to

frequency of use, carpooling, and time of day discounts, to flat rate structures in which the only differentiation is made on the basis of the number of axles per vehicle.

Tolls are a direct user fee charged for use of road capacity and services to the motorist. Toll financing has a long tradition in the U.S. as a supplemental source of revenue to meet transportation needs. In the late nineteenth century, toll road development tapered off as toll evasion as well as rail travel increased. However, by the 1930s, some states began developing public toll road programs to respond to growth in automobile ownership, the rising needs of commerce, and the absence of significant Federal-aid for highways. While private tollway companies dominated the "turnpike" industry in the earlier centuries, the toll facilities of the twentieth century have largely been authorized, constructed, and managed by quasi-public authorities established by state and local governments. The pursuit of toll roads declined after 1956, when the Federal Highway Act established a Federal gasoline tax to support the interstate highway system and prohibited tolling on new, federally-funded highways.

In recent decades, increased transportation needs and public funding constraints have fueled new interest in tolls as a revenue source to support transportation investment. The interest in toll roads today is an outgrowth of federal legislation giving states greater flexibility to implement tolling and road pricing. But it also reflects the multiple benefits derived from tolling, of which three are prominent: (a) creation of adequate funds for urgently needed projects; (b) a shift in the burden of capital, operating, and maintenance costs to specific users; and (c) the generation of an immediate and direct source of revenue to discharge bond and other financing obligations (Rusch, 1984). There is also an environmental argument for road pricing in that it may reduce driving and its related externalities. While not commonly acknowledged as a key

driver for imposing tolls, these environmental benefits have sometimes been included as part of the case for a toll project.

The three prominent financial goals of tolling do not always coincide with the goals of reducing congestion. However, as Santos and Fraser (2006, p. 266) note, it is common "to confuse schemes that were designed to finance infrastructure with schemes designed to reduce congestion." The economic case for road pricing argues that absent pricing at the point of use, the demand for road use will exceed its capacity, resulting in congestion (Vickrey, 1969). This is true for most tolling cases where road pricing and imposition of tolls do not automatically lead to expanded capacity. As such, tolling that was originally seen as a method for reducing congestion, may also be seen as a source of funds for infrastructure. Similarly, tolling schemes intended to finance transportation projects may also, with appropriate structuring of toll rates, become traffic demand management tools. Thus, in today's transportation environment, traffic congestion and growing resource constraints are driving states towards considering toll pricing as not only a tool to manage demand but also to ensure a sufficient revenue stream. This shift in purpose has made tolls not just a simple financial calculation but a potentially powerful instrument of public policy— of interest to constituencies with divergent interests. But, this shift in emphasis means the toll must be priced high enough to discourage many drivers from using the tolled facility, leading to the conundrum that as the toll goes up political support for it goes down. It is necessary, therefore, to identify and reach out to potential supporters of a toll (in addition to those whose value of time is high enough to pay the toll) if sufficient public support is to be found for instituting the toll.

In this study, we focus on the public's willingness-to-pay tolls for the direct benefit of using an express lane that is free of traffic delays the majority of the time. While this implies an

explicit purpose of using tolls for congestion management, as the previous discussion suggests, it is often difficult for the public (and policymakers) to separate the congestion purpose from the financial purpose of the toll. As such, our study does not confine itself solely to the congestion benefits of the toll.

### *1.2 The importance of public support for tolls*

Against a backdrop of growing transportation needs and declining resources, the net result of changing policies and technological developments has been the need for increasing public and political acceptance of toll financing for roads, bridges and tunnels. However, popular discourse suggests that the public is opposed to tolling and road pricing. Similarly, research using public opinion data has generally found low levels of support for a variety of tolling mechanisms (Schade & Schlag, 2003). This public opposition poses challenges to advocates of tolls and road pricing, despite the increasing awareness of the need for toll revenues and the need to address congestion and traffic delays. While the technical aspects of the tolling scheme (for example the toll rate, use of toll revenues, boundary limits, etc.) are important, political will is also crucial. As Sumalee (2001) found from interviews with local officials in the UK considering the implementation of congestion pricing, policymakers often emphasize public acceptance as a decision criteria. Similarly, in discussing the possible extension of the London Congestion Charging Scheme, Santos and Fraser (2006) note that political factors, and more specifically constituent views, should be an important element in any policy decision of that magnitude.

Given that the public, through voting and other forms of political behavior, can (and should) influence decisions to toll, it is important to understand the factors that shape public support for tolling. Specifically, what makes the public more or less willing to pay tolls?

Most of the empirical work explaining public support for tolling has modeled stated preferences (rather than revealed preferences), relying on expressed acceptance of (or support for) tolling. We adopt a similar stated preferences approach, but focus instead on expressed willingness-to-pay a toll, which is one step beyond simply accepting or supporting a toll. Controlling for income as a constraint on willingness to pay, this study proffers a model of willingness-to-pay tolls that includes concern for the community as well as political and environmental beliefs. Thus, it relates support for tolling to existing community values and concerns in the broader social setting.

## 2. A model for explaining willingness-to-pay tolls

As stated above, this study seeks to identify the factors that influence individuals' willingness-to-pay a substantial $3 flat rate toll to bypass delays at tunnels by using an express lane that would be free of delays the majority of the time. We develop and test a model that builds on previous work on road pricing and environmental taxes (Kallbekken & Sælen, 2011; Rienstra, Rietveld, & Verhoef, 1999; Schade & Baum, 2007; Schade & Schlag, 2003).

Using traditional political economy as a starting point, individuals should be willing to pay a toll if the toll (and the subsequent benefits) maximizes their expected utility. However, we argue that this utility is not solely a function of direct congestion relief in time saved to the respondent, but instead also arises from (a) the relative cost of the tolls based on income and frequency of use, (b) concern for the community including its economic health, and (c) liberal

beliefs including trust in government and a concern for the environment. We propose a four-factor model for explaining willingness-to-pay tolls (summarized in Figure 1). The first two factors reflect the individual's perception of the personal consequences of the tax. These factors are motivated by the individual's self-interest and are closely associated with (a) the direct benefits the individual may receive from the toll, and (b) the relative costs imposed by the toll that the individual must bear. The third factor is the individual's concern for the broader community and for the greater good. The final factor of the model reflects the individual's political and environmental leanings, including trust in government.

[Figure 1 Here]

The four factors and their respective variables are discussed next and summarized in Table 1. Using this model, we explain willingness-to-pay tolls as a function of these variables: congestion, tunnel delay, commute time, use of transit, future residential tenure, perception of economic condition, road/congestion problems, income, frequency of tunnel travel, political liberalism, environmental liberalism, trust in government and demographic factors.

[Table 1 Here]

### *2.1 Direct benefits to the respondent*

Research shows that support for, and subsequent willingness-to-pay, tolls is related to personal benefits perceived by users and non-users (Schade & Schlag, 2003; Zmud & Arce, 2008). Specifically, when a concrete benefit is linked to the idea of tolling or charging for road usage, for example the reduction of congestion, support for tolling is higher (Hårsman & Quigley, 2010; Zmud & Arce, 2008). Zettel and Carll (1964) propose that implementation of road pricing would affect individuals according to three categories: (a) Tolled – those who pay

the price because their high values of time and reliability make them better off paying; (b) Tolled-off – Those who divert to parallel arterials or transit, since their gains from the toll are not worth the high cost; (c) Untolled – those already on the parallel arterials. Those individuals in the Tolled group would experience direct benefits from the tolled facility and would be expected to be willing to pay the toll. The second and third groups, however, may perceive themselves as losers from road pricing and therefore exhibit less willingness to pay the toll. But, many in the second and third groups could support the toll either because they do not (or rarely) pay or because they believe it confers other benefits they value, such as pollution reduction or needed revenue for the local government.

Those who have experienced delay and congestion are more likely to be in the Tolled category, and may be more willing to pay a toll in exchange for an improved driving experience. But, their expectations of benefit may depend on their travel behavior, travel experiences, and travel characteristics. We expect, therefore, to find that experience with congestion and delays will lead to higher support for tolling (Jones, 1998; Schade & Baum, 2007; Steg, 2003). In addition, as most individuals value their commuting time, an anticipated decrease in commute time will increase the willingness-to-pay tolls (Hårsman & Quigley, 2010; Podgorski & Kockelman, 2006). One other factor might also influence support for tolling. Transit users may evince greater support for tolling, as they are less likely to routinely pay the toll, yet benefit from the reduction in congestion on the occasions when they do use the toll facility (e.g., to be on time for a doctor's appointment). Odeck and Bråthen (1997) found that those who commute using transit are less negative about tolling than those who commute via automobile.

### *2.2 Relative cost*

The same research on the personal benefits of tolls also suggests that willingness-to-pay is related to the costs borne by the individual. However, rather than absolute cost, we focus on the relative cost of the toll. The relative cost associated with a toll may decline for the individual as his or her income rises. Thus, as the value of time studies show, the willingness-to-pay may be a function of personal income with the more affluent indicating greater willingness-to-pay. Research on the relationship between income and willingness-to-pay tolls is largely conflicting, with some research finding a positive connection between income and willingness to pay while others find no connection (see for example Odeck & Bråthen, 1997; Rienstra, et al., 1999; Schade & Schlag, 2003; Verhoef, Nijkamp, & Rietveld, 1997). The absence of a clear relationship may be due to the fact that frequent users, no matter their income, pay more over time. In fact, opposition to tolling and congestion pricing may be a function of its impact on disposable income as well as of its effect on total income. We include a measure of frequency of use of the tunnel to test the possibility that frequent use, along with income, will influence the willingness to pay; higher income is expected to increase willingnes-to-pay, while greater frequency of use is expected to depress willingness-to-pay.

### *2.3 Community concern*

In their study of willingness-to-pay for government services, Simonsen and Robbins (1999) found evidence of a "halo" effect, where those who consumed more services had higher willingness-to-pay for collectively consumed services, expressing greater preferences to pay for the greater good. The same can be argued for tolling and road pricing, as support may be driven by concerns greater than those directly related to self, such as concerns for the community,

broader policy concerns about problems facing the local area, and concerns regarding the economy in general.

Research finds that support for tolls increases with public awareness of problems with congestion. Those who view congestion as a problem for their community are more likely to endorse measures to alleviate it (Jaensirisak, et al., 2005; Verhoef, et al., 1997) . Concern for the community is also evident in several studies that find many people who do not use public transit will support a tax to fund it, when they see it as serving the needs of the poor and elderly (Brodsky & Thompson, 1993; Dill & Weinstein, 2007). It is possible that the longer the individual plans to stay in the community (future residential tenure), the greater the concern for the good of the community. This could result in increased willingness-to-pay, as would the belief that traffic and congestion is a serious problem in the community. Tolls and road pricing may also be more acceptable for those individuals who already perceive transportation-related problems, particularly traffic congestion, as major problems facing their community.

In addition, because road pricing and tolls impose economic costs on communities, the willingness-to-pay tolls may be influenced by the individual's perception of the broader economic condition. The more positive the perception of the economic outlook, the less likely the individual will be to believe the toll will have a negative impact on the community's economic wellbeing and, therefore, the greater the likelihood of support for the toll.

### *2.4 Political and environmental liberalism*

Political ideology may also influence the individual's willingness-to-pay (Hårsman & Quigley, 2010). In the U.S., opposition to tolling apparently stems from right-wing populism and conservative concerns over high levels of taxation, infringement on individual liberty, and

government coercion. Therefore, political ideologies that lean toward Republican positions or Conservatism may contribute to greater opposition to tolling and less willingness-to-pay such tolls. Conversely, those with more liberal beliefs tend to be less opposed to government activism, taxes, and policies designed to induce more sustainable behavior (Inglehart, 1997). Those with more liberal beliefs about the environment tend to identify with the Democrat Party. We expect, therefore, that individuals whose political leanings tend toward the Democrat Party and a Liberal ideology to express greater willingness-to-pay tolls.

In reducing traffic and delays (and possibly even discouraging some driving) tolls may, as a byproduct, reduce automobile emissions causing some to view tolls as environmentally beneficial. While congestion pricing and tolling neither have an explicit environmental goal nor are intended to address environmental externalities, they have been associated with some environmental benefits. Jaensirisak et al. (2005) found that the single most important contributor to increased support for tolling (and road pricing more broadly) was its presumed environmental benefits.

Lack of support for tolls could be due to general lack of trust in government, possibly associated with the public having no clear idea of how government resources are spent or the belief that government funds are being spent wastefully. In Europe, Hamilton (2012) found that low trust was associated with opposition to congestion pricing. O'Connell and Yusuf (2011) also acknowledge the importance of trust when it comes to the issue of transportation taxes and user charges. They proposed a model for presenting proposals to increase taxes and charges that includes overt measures to increase trust, such as dedicating the revenue to a specific project. Therefore, it is possible that those who express greater trust in government will be more supportive of a toll. Schmöcker et al. (2011) note that the individual's attitude toward the

government, and trust specifically, also influences acceptance of an environmental tax (which road pricing is sometimes considered), and find that trust in government has both direct and indirect effects on acceptance. The general assertion is that individuals who trust their government are more likely to support its policies (Hardin, 1999).

In sum, we include three indicators of political and environmental liberalism in our model: trust in government, environmental liberalism, and political liberalism. We expect all to be positive predictors of willingness-to-pay tolls.

### *2.5 Demographic controls*

In addition to the four factors, we include demographic controls in our analysis. While the "current evidence about the socioeconomic differences in the reaction towards urban road pricing is inconclusive" (Gehlert, Kramer, Nielsen, & Schlag, 2011), some consistent findings have been found in the literature. For example, research has found that women are more likely than men to support road pricing (Golob, 2001; Hårsman & Quigley, 2010; Podgorski & Kockelman, 2006). However, Podgorski and Kockelman (2006) found that older individuals are more likely to support tolls, while Odeck and Bråthren (1997) found younger individuals to be more supportive of tolling. We also include race as a control variable, as previous research suggests that African Americans (and other minority groups) are less likely than whites to drive (Massey & Denton, 1993) and those who drive less often may be more supportive of tolling.

## 3. Methodology

This study relies on data from the Life in Hampton Roads Survey designed and administered by the Old Dominion University Social Science Research Center (Old Dominion

University Social Science Research Center, 2011). The survey was designed to gather a comprehensive description of community concerns. It consisted of 76 questions about media and news consumption; arts, culture, and travel; quality of life; transportation; local and state government and political issues; environmental issues; health and education; housing; spirituality and well-being; neighborhood issues and crime; military life; and basic demographic information. The survey was conducted using a computer assisted telephone interviewing system. A random digit dial telephone sample comprised of telephone numbers with Hampton Roads exchanges was used. A cellphone sample was also utilized based on switch points within the Hampton Roads area. Calls were conducted from May through July 2011. A total of 730 completed interviews were obtained. After accounting for missing data, the sample for analysis was reduced to 693.[1] Responses represented all seven cities in the region referred to as Hampton Roads, Virginia (Norfolk, Virginia Beach, Chesapeake, Suffolk, Portsmouth, Newport News and Hampton).

The survey asked this question: "To bypass delays at tunnels in Hampton Roads would you be willing to pay a toll of $3 to use an express lane, which would be free of delays the majority of the time." (A $3 toll had been under consideration as a remedy for congestion at the tunnels.) The response categories were: Yes, No, or Maybe. The dependent variable—willingness to pay tolls—is derived from this question. The yes and maybe responses were collapsed into one category—those expressing some willingness to pay the toll. Given the dichotomous nature of the dependent variable, logit regression is used to analyze the predictors of willingness to pay.

The logit regression models willingness-to-pay (WTP) as:

WTP = f(direct benefits, relative cost, community concern, political/environmental liberalism, demographics)

= f(congestion, tunnel delay, commute time, use transit, income, tunnel travel, future residential tenure, economic condition, congestion problems, political liberalism trust in government, environmental liberalism, male, white, age, employed)

**4. Results**

Table 2 summarizes the results of the logit regression, presenting the logit coefficients (unstandardized and standardized), odds ratios, and respective p-values. Some, but not all, of the independent variables in each factor category are significant. Overall, the model is relatively strong with good predictive ability. The McFadden's adjusted pseudo-$R^2$ is 0.728 and the model correctly classified the outcome 95.53 percent of the time, correctly predicting the 'yes/maybe' outcome 90.85% of the time and the 'no' outcome 96.98% of the time.

There are four indicators of direct benefits in the model, two of which are significant predictors of willingness to pay the toll: personal experience with congestion ($p < .0001$) and use of transit ($p < .01$). Experience of tunnel delay was a positive predictor, which approached significance ($p = .105$). Commute time was a negative predictor and insignificant.

Two of the three indicators of community concern reached statistical significance, but one unexpectedly was a negative predictor. The positive predictor was an optimistic opinion about economic conditions ($p < .01$). The negative predictor was the perception that traffic congestion was the biggest problem facing the region. It is possible that this is reflects concerns about the severity of the congestion problem and the negative relationship may arise out of the

belief that tolls alone would not address the broader congestion problems in the region. Future residential tenure was not significant.

Both variables representing the relative cost factor were significant predictors and in the expected direction. Higher income respondents were more willing to pay the toll ($p < .05$) and frequent users of the tunnel were less willing ($p < .001$).

In terms of the political and environmental liberalism factor, greater trust in government was a significant positive predictor ($p < .0001$) of greater willingness to pay tolls while concern for the environment decreases the likelihood of being willing to pay tolls ($p < .05$). This result is surprising as tolls and congestion pricing are sometimes viewed as being environmentally-related (such as reducing emissions from less idling and driving). However, environmental liberalism as measured in this study reflects concerns over sea level rise and climate change, and may not be as closely linked to issues such as air pollution that may be more directly related to attitudes and beliefs about transportation. Furthermore, tolls are often not implemented with environmental objectives in mind and rarely produce significant environmental benefits.

Finally, only one of the demographic variables was a significant predictor. White respondents were more willing to pay the toll ($p < .0001$). The lack of significance of other demographic variables such as age and gender mirror the generally inconclusive findings of previous research.

[Table 2 Here]

Table 2 also presents the fully-standardized logit coefficients which take into account the standard deviations of the independent and dependent variables. These standardized coefficients, similar to standardized beta coefficients in linear regression, allow for comparison of the strength of the respective independent variables on the willingness-to-pay tolls. In decreasing order of

influence on willingness-to-pay tolls, the variables are: frequency of tunnel use, experience with congestion, being white, perceptions of economic condition, trust in government, income, concern for road/congestion, environmental liberalism, and use of transit.

Overall, the results of the logit regression indicate support for the traditional argument that direct benefits and costs drive support for and willingness-to-pay tolls. The results also support our argument that individuals' willingness-to-pay tolls are motivated, in part, by concerns for the greater community and by political and environmental beliefs. The findings provide validation for our four-factor model of willingness-to-pay that extends beyond direct benefits and costs to include other concerns and beliefs.

## 5. Discussion and Conclusion

This study proposed and tested an explanatory model of willingness-to-pay tolls that includes four factors: (a) direct benefit; (b) relative cost; (c) community concern; and (d) political and environmental liberalism. The results offer support for our four factor model. While not every indicator was a significant predictor of willingness to pay, each of the four factors had a significant indicator. Thus, like Hamilton's (2012) research in Europe on support for congestion pricing, the results suggest that support for tolls is more than a function of direct interest and the time value of money, a measure related to income. Tolls are a type of user tax and attitudes toward the role of government in the life of the community influence the willingness to pay taxes as do variables relating to lifestyle and values. In addition to direct benefit and relative cost we have identified two other factors at work: concern for the community and political and environmental liberalism. The similarity of our results to Hamilton's suggests that the four factor model might apply in Europe as well as the United States.

Only one of our indicators of liberalism was significant—trust in government. Hamilton had two direct measures of liberal attitudes that were significant predictors of willingness to support congestion pricing—belief that traffic damages the environment and belief that more resources should be devoted to the environment. Future research could use these as indicators of liberalism, especially environmental liberalism. It may be the case that the liberal respondents in this study did not view the toll as an environmental reform. Moreover, some liberals may interpret the toll as unfair to low income drivers.

The survey did not have a measure of the value of time. However, income appears to have served as a useful substitute. The combination of income and frequency of tunnel use appears to tease out the importance of the toll's impact on disposable income, implying that those who pay the fee on a regular basis are thinking of the toll's impact on the family budget. This is a finding consistent with the impact of family size on willingness to pay. Hamilton (2012), for example found that people with children were less supportive of congestion pricing even after he controlled for value of time and income. Our finding that transit users are more supportive of tolling has been found in other studies.

In summation, this article makes three inter-related contributions to the study of tolling. First, by connecting the multiple benefits of tolling to different types of supporters as well as different reasons for support, it locates potential support for tolling in the broader community including political liberals, those who pay it infrequently, as well as those who rely on transit. It documents that many who are unlikely to pay the toll on a regular basis may support it for other reasons. Thus support for tolling can be studied as more than a function of an individual's monetary value of time. Second, our four factor model has the implicit advantage of viewing tolling as a tax as well as a user fee. Thus, many residents can be seen as potentially supporting a

toll as a way to improve community life, as tolling can also generate support through the revenue it raises, which can be legally dedicated to services the public favors. In both the U.S. and Europe, the public is more likely to support a tax or toll when the revenue raised is dedicated (sometimes referred to as hypothecating or earmarking) to a purpose the public deems important.[2] Third, it has implications for studying the political process of building support for tolling, as there are a large number of residents who will not need to use the tolled facility on a regular basis, who are potential supporters or value the toll for reasons beyond reductions in travel time.

Another policy implication of our results concerns the opposition of frequent users of the tunnel to paying a toll. They appear to view the toll as too costly, given their regular use of the tunnel. Perhaps they would be more supportive if frequent users received a significant discount, by for example, buying a monthly pass at a reduced rate, such as the rate reductions many central city parking lots and authorities provide to commuters.

There are two key limitations of this study. First, the study used a single-price assumption with all motorists charged the same rate per mile, resulting in an actual price or cost that varies in proportion to time and place (Poole, 2011). Secondly, we did not specify the trip purpose. However, as discussed, researchers have found that the value of time for motorists vary greatly, depending on trip purpose and urgency, time of day and week, distinction between business travel or leisure travel, and individual preferences (Small, Winston, & Yan, 2006). We are unable to specifically capture these value variations in our study. Despite this drawback, our study offers and establishes a framework or model for explaining willingness-to-pay tolls that incorporates factors beyond personal benefits and costs. While this framework appears to work

for the case of a single-price toll, future studies could apply and test this model using more complicated toll structures.

## END NOTES

1. The missing data were determined to be missing completely at random, and therefore are not expected to influence the results and findings.
2. The impact of dedicating the revenue can be substantial. In a recent study on attitudes toward increasing the federal gas tax in the United States, Agrawal et al. (2013) found that support for the tax increase rose from 20 to 58 percent when it was earmarked for road maintenance, to 54 percent when earmarked for improvements in road safety, and to 49 percent, when spent to reduce local air pollution.

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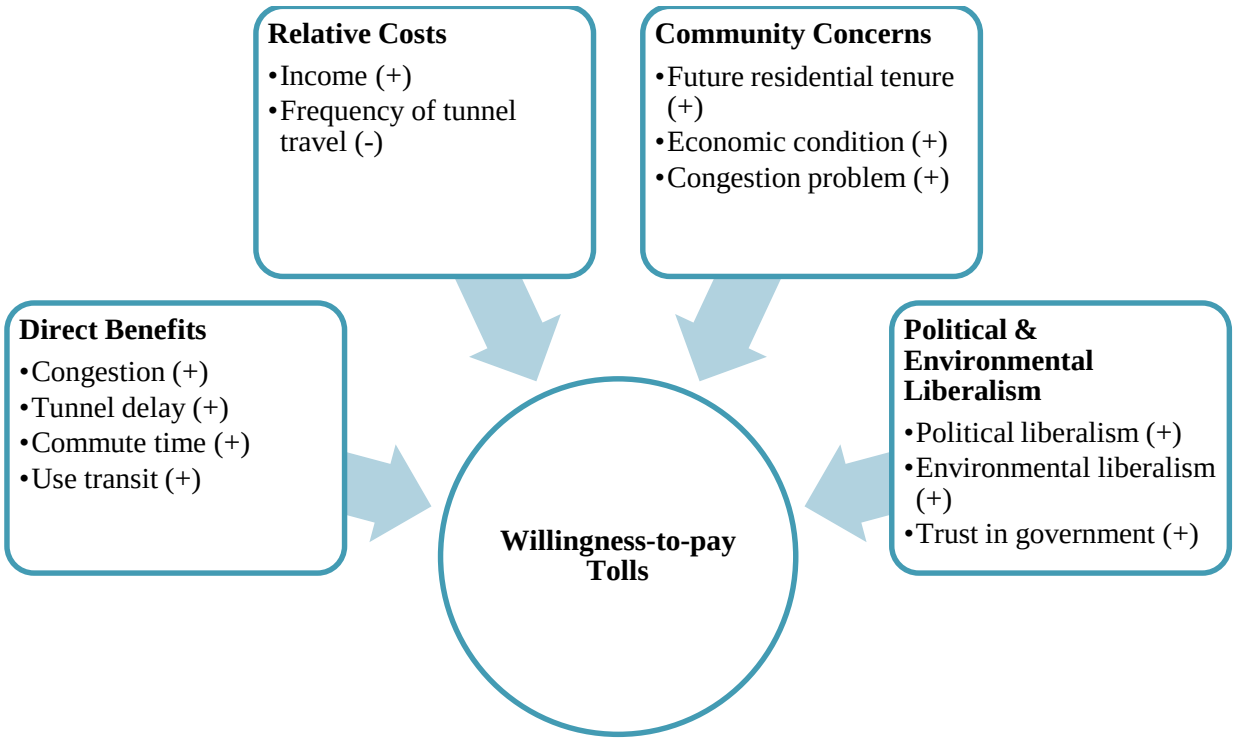
**Fig. 1. Four-Factor Model for Explaining Willingness-to-pay Tolls**



## Table 1 Factors and Variables (N=693)

| Variables | Definition | Mean | SD |
|---|---|---|---|
| Willingness-to-pay toll | Willing to pay toll of $3 to use an express lane that would be free of delays. 0 (No), 1 (Yes/maybe) | 0.237 | 0.425 |
| Congestion | Index based on agreement (0-No, 1-Yes) with:<br>a) Traffic congestion in Hampton Roads during the morning peak (6-9am) is a major problem for me.<br>b) Traffic congestion in Hampton Roads during the evening peak (3-6pm) is a major problem for me.<br>c) Within the past month, did you avoid visiting a business in a neighboring city due to concerns about traffic congestion?<br>Ranges from 0 (congestion is not a problem) to 3 (congestion is a major problem) | 1.931 | 1.104 |
| Tunnel delay | Have experienced some delays at tunnels. 0 (No), 1 (Yes) | 0.903 | 0.296 |
| Commute time | How long is your average one-way commute, in minutes, to work or school? | 22.831 | 13.294 |
| Use transit | In the past week, have you used public transportation (including buses or taxis) in Hampton Roads? 0 (No), 1 (Yes) | 0.004 | 0.066 |
| Future residential tenure | Do you plan to still live in the region five years from now? 0 (No), 1 (Yes) | 0.469 | 0.499 |
| Economic condition | Perceptions of the region's economic conditions and the country's economic conditions. Ranges from 0 (low) to 3 (high) | 0.719 | 0.730 |
| Road/congestion problems | Traffic congestion or roads/bridges maintenance are the biggest problem facing the region today. 0 (No), 1 (Yes) | 0.206 | 0.405 |
| Income | Family household income. Values: 1 (less than $10,000), 2 (more than $10,000 to $20,000), 3 (more than $20,000 to $30,000), 4 (more than $30,000 to $40,000), 5 (more than $40,000 to $50,000), 6 (more than $50,000 to $60,000), 7 (more than $60,000 to $70,000), 8 (more than $70,000 to $80,000), 9 (more than $80,000 to $90,000), 10 (more than $90,000 to $100,000), 11 (more than $100,000) | 5.413 | 3.154 |
| Frequency of tunnel travel | How often have you traveled through a tunnel in Hampton Roads during the last month? 2 (once or twice), 3 (3-4 times), 4 (5-6 times), 5 (more than once a week) | 3.126 | 1.407 |
| Political liberalism | Index based on:<br>a) Democrat political party affiliation (0-No, 1-Yes)<br>b) Liberal political ideology (0-No, 1-Yes)<br>c) Support for the Tea Party movement (0-Yes, 1-No)<br>Ranges from 0 (low) to 3 (high) | 1.560 | 0.837 |

| | | | |
|---|---|---|---|
| Environmental liberalism | Index based on agreement with the following:<br>a) Global warming is an environmental problem<br>b) Rising sea levels in the rest of the world is a concern<br>Ranges from 0 (no environmental concerns) to 2 (serious environmental concerns) | 1.719 | 0.505 |
| Trust in government | Index based on agreement (0-No, 1-Yes) with:<br>a) Most of the time the local government can be trusted to do what is right<br>b) Local government uses public resources wisely<br>c) State government uses public resources wisely<br>Ranges from 0 (low) to 3 (high) | 0.297 | 0.580 |
| Male | | 0.214 | 0.410 |
| White | | 0.266 | 0.442 |
| Age | | 49.935 | 11.740 |
| Employed | | 0.430 | 0.495 |

## Table 2 Logistic Regression of Willingness-to-pay Tolls

| | Logit Coeff. | Odds Ratio Coeff. | Standardized Logit Coef. | p-value | Expected Sign |
|---|---|---|---|---|---|
| **Direct Benefits** | | | | | |
| Congestion | 1.541 (0.333) | 4.671 | 0.446 | <0.0001 | + |
| Tunnel delay | 1.327 (0.819) | 3.769 | 0.103 | 0.105 | + |
| Commute time | -0.030 (0.023) | 0.971 | -0.104 | 0.202 | + |
| Use transit | 5.004 (1.856) | 149.003 | 0.086 | 0.007 | + |
| **Community Concerns** | | | | | |
| Future residential tenure | -0.829 (0.905) | 0.436 | -0.109 | 0.359 | + |
| Economic condition | 1.649 (0.590) | 5.201 | 0.316 | 0.005 | + |
| Road/congestion problems | -1.249 (0.589) | 0.287 | -0.133 | 0.034 | + |
| **Relative Costs** | | | | | |
| Income | 0.303 (0.137) | 1.354 | 0.251 | 0.027 | + |
| Frequency of tunnel travel | -1.240 (0.386) | 0.289 | -0.458 | 0.001 | - |
| **Political & Environmental Liberalism** | | | | | |
| Political liberalism | -0.248 (0.313) | 0.781 | -0.054 | 0.429 | + |
| Environmental liberalism | -0.986 (0.427) | 0.373 | -0.131 | 0.021 | + |
| Trust in government | 1.663 (0.318( | 5.276 | 0.253 | <0.0001 | + |
| **Demographics** | | | | | |
| Male | -0.189 (0.746) | 0.828 | -0.020 | 0.800 | |
| White | 2.879 (0.697) | 17.788 | 0.334 | <0.0001 | |
| Age | -.0034 (0.019) | 0.967 | -0.104 | 0.072 | |
| Employed | -0.905 (0.692) | 0.404 | -0.118 | 0.191 | |
| Constant | -1.651 (1.934) | | | 0.393 | |
| N | 693 | | | | |
| $X^2$ | 584.35 | | | <0.0001 | |
| Pseudo-$R^2$ | 0.771 | | | | |
| McFadden's Adjusted $R^2$ | 0.728 | | | | |