



Exploratory analysis of public perceptions of innovative financing for infrastructure systems in the U.S.



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ABSTRACT

While traditional financing approaches such as federal and state grants funded by taxation are insufficient to address the existing need, innovative financing such as novel public private partnership models, credit enhancement tools, and new bonding instruments has emerged to expand the fiscal space of public agencies for infrastructure development. Formulating innovative financing approaches is one of the challenges faced by policymakers to address the ever growing need for restoring the failing civil infrastructure in the U.S. Public support/opposition is one of the major drivers/disruptors of innovative financing. Assessment of public perceptions is a major component towards gaining public support and developing sustainable infrastructure financing policies. The objective of this study is to investigate the determinants of public perceptions of innovative financing. Data obtained from public survey of 616 individuals from 50 states in the U.S. is analyzed to investigate the effects of: (a) economic factors, (b) infrastructure conditions, and (c) personal characteristics of the public on the knowledge, awareness, perceptions, and attitudes of the public towards innovative financing. The findings reveal that the likelihood of public support of innovative financing is insensitive to economic conditions and is affected by the factors related to infrastructure condition such as the level of need for infrastructure renewal, the ability to protect the public against natural disasters, and the history of using innovative financing for infrastructure renewal. The findings also show that 57% of the sample population in the U.S. were not knowledgeable about different methods for financing infrastructure projects and 77% of the sample population in the U.S. were not aware of the activities of public organizations for finding innovative financing solutions for infrastructure projects. Based on the findings, two main strategies have been proposed for infrastructure agencies to enhance their efforts towards gaining public acceptance of innovative financing: (i) enhance strategies to facilitate learning for the public about innovative financing in infrastructure projects and (ii) improve marketing and citizen involvement strategies to get the public to buy-in to innovative financing methods. The findings can enhance the current efforts of public agencies related to educating the public and citizen involvement strategies by incorporating public preferences in policy development to enhance the likelihood of public support of innovative financing methods. Potential improvements can be made in changing the key messages in educating the public, using more effective

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strategies for communicating complicated financing concepts, and highlighting the success stories and benefits of innovative financing in other states and countries.

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1. Introduction

In 2013, the American Society of Civil Engineers (ASCE) gave U.S. infrastructure a grade of “D+” (deficient). An investment of \$3.6 trillion was estimated to be required between 2013 and 2020 to improve the current condition of the infrastructure to a functionally good condition (ASCE, 2013). The fiscal space for infrastructure development made available by traditional financing approaches is not sufficient to meet the needs (the fiscal space refers to “as the room in a government’s budget that allows it to provide resources for a desired purpose” (Heller, 2005)). The National Academy of Science (NAS) has also emphasized the significance of the need for infrastructure renewal in the U.S. to enhance the quality of life of Americans in the 21st century. For instance, (i) transportation systems require about \$20 billion more annually to keep services at current levels (CBO, 2008), (ii) the electric utilities industry will need to make a total investment of at least \$1.5 trillion between 2010 and 2030 to keep pace with demand (Chupka et al., 2008), and (iii) drinking water and wastewater systems need an average annual investment of \$24.6 billion to \$41 billion for the years 2000 through 2019 (CBO, 2002). According to National Academy of Sciences, 2009, to enhance infrastructure systems, there will a need for substantial public- and private sector investments. On a similar note, ASCE, 2013 states that, the available fiscal space is only sufficient to meet 50% of the need for restoring infrastructure.

In the context of the U.S. infrastructure, transportation infrastructure has been traditionally financed using state and federal grants, funded by taxation, and delivered by public agencies. According to Egger and Dovery (2007), traditional financing includes two main methods used by government agencies for their infrastructure needs: pay-as-you-go financing and debt financing (also known as public bonding). Three categories of financial innovation could exist: (a) different use of traditional financing and funding tools (e.g., earmarking property taxes for capital investments); (b) creation of new tools (e.g., new public-private-partnership (PPP or P3) models); and (c) use of familiar financing and funding tools employed in other sectors (Walton and Euritt, 1990; Ploeg, 2006; Chapman, 2008; Pagano and Perry, 2008; Mostafavi and Abraham, 2010; Mostafavi et al., 2014). According to American Association of State Highway and Transportation Officials (2014), “innovative finance is a broadly defined term that encompasses a combination of techniques and specially designed mechanisms to supplement traditional financing sources and methods. Innovative finance for surface transportation includes such measures as:

- New or non-traditional sources of revenue
- New financing mechanisms designed to leverage resources
- New fund management techniques
- New institutional arrangements

Innovative financing techniques are intended to maximize the ability of states to leverage Federal capital, attract new sources of funds to transportation investment, accelerate project completion dates, and more effectively utilize existing funds” (American Association of State Highway and Transportation Officials, 2014). While traditional infrastructure financing has been mainly based on federal grants and fuel taxes, innovative financing provides tools and institutional arrangements as alternatives or augmentations to traditional, grant-based funding strategies (American Association of State Highway and Transportation Officials, 2014). Examples of innovative financing techniques includes private finance and delivery. Two characteristic of innovative financing could lead to the increased likelihood of public oppositions to innovative financing methods: (i) innovative financing could entail more fees (either user-fees or additional taxation), to be paid by the public (Agrawal and Nixon, 2013); and (ii) public may object to private involvement in project delivery. The latter could lead to public opposition due to the sensitivity of the public to private entities making profit from taxpayers’ money (Savas, 2000). In this study, the focus is on these two aspects in which the public could be affected, and not on any particular innovative financial structure.

There are many potential obstacles to innovative financing approaches from a public acceptance perspective. For example, studies such as Mostafavi et al. (2011a) have shown that many financial innovations are barely understandable to the public – possibly triggering public opposition and increasing the probability of unsuccessful implementation. Vonk Noordegraaf et al. (2014) identified public support as a prominent factor in road pricing cases. Public pressure driven by attitudes and perceptions has been found to greatly influence the priorities and actions of policymakers (Polsby and Wildavsky, 1988). However, proactive measures can help reduce potential public opposition. Such measures include public information campaigns and developing policies that give careful consideration to public perceptions (Vives, 1997; Garvin, 2010; Mostafavi et al., 2012a,b). The key to take effective proactive steps to enhance the public perception of innovative financing is exploring the underlying determinants. The objective of this paper is to systemically investigate the underlying determinants of the dimensions of public perceptions regarding infrastructure development and financing in the U.S. This study is geared to answer the following questions: (i) what is public’s level of knowledge about financing and agency efforts related

to infrastructure renewal? What factors affect the public support of/opposition to innovative financing methods? How public agencies can get the public to buy-in to innovative financing methods? The answer to these questions will provide the decision-makers with the information required for educating the public regarding innovative financing of infrastructure to increase the likelihood of public support of innovative financing.

In the following sections, first, a review of the existing literature pertaining to the public perceptions of infrastructure financing is presented. Then, the processes for collection and analysis of data through a public survey in the U.S. are discussed. Finally, the findings are used in identifying strategies for enhancing the public perceptions of innovative financing in infrastructure systems.

2. Literature review

The economy, the environment, and society – all impact the design, operation, management, and maintenance of infrastructure system-of-systems (Mostafavi et al., 2011b; Mostafavi, 2013). As shown in Fig. 1, financial innovations affect the environmental, economic and social sustainability measures (for instance resource exploitation in environmental sustainability, unemployment and economic production in economic sustainability, and public awareness and public support of infrastructure investment in social sustainability). The changes in sustainability measures entail outcomes (desirable or undesirable) which provide information to or apply pressure on policy-makers. Social attitudes are drivers of future policies and legislation Valentin et al. (2012).

2.1. Studies related to public perceptions of infrastructure development

Social attitudes regarding infrastructure development affect the ability to create and adopt innovative financing systems. According to Grout and Stevens (2003) and Ortiz and Buxbaum (2008) financial innovations may appear to be complex to the public and can trigger public opposition, thereby increasing the probability of unsuccessful implementation of financial innovations. As a case in point, innovative financing of the *Presidio Parkway* using foreign investment led unionized state engineers, who were left out of much of the design work and would have a lesser role in the construction and maintenance of the project, to sue to stop the project (The Wall Street Journal, 2010). The proposed leasing of the Pennsylvania Turnpike is another example of the role of public perception and the impact of public and political objections. In 2007, the Governor of Pennsylvania announced his intention to lease the Pennsylvania Turnpike and implement tolls on I-80. When the

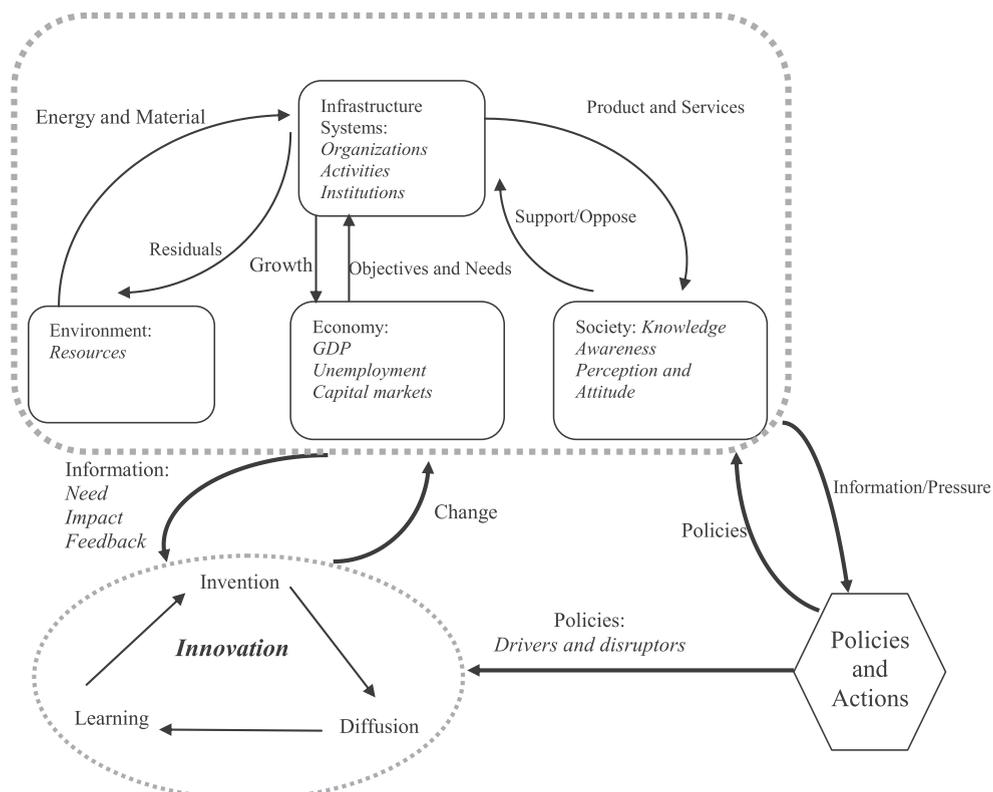


Fig. 1. Interaction of infrastructure, economy, environment, and society.

Pennsylvania Turnpike Commission (PTC) applied to FHWA to permit tolling of I-80, there was objection among community and business groups to the increased costs to travel on the roadway as a result of leasing the Turnpike as well as the distribution plan of the upfront concession payment. Subsequently, there was political opposition and a state senator requested the U.S. Secretary of Transportation to turn down the application for leasing the Turnpike. Ultimately, the concession plan was rejected by the Pennsylvania legislature and the tolling application was not accepted by FHWA. The possibility of public opposition can be reduced by (i) educating the public, and (ii) developing policies that account for differences in social attitudes towards issues related to infrastructure development and investment. Through education, the public can develop a sense of concern regarding the challenges related to infrastructure systems at regional, national, and global levels, and thus encourage them to support needed actions.

Public perceptions toward a policy can be viewed as having four dimensions: knowledge, awareness, perception, and attitude (Sudarmadi et al., 2001). In the context of infrastructure development and financing, the knowledge dimension measures the public understanding of a body of facts and principles concerning infrastructure. The awareness dimension measures the attention of the public to the issues concerning infrastructure development and financing. The perception dimension measures the public concerns and sensitivities to the infrastructure development and financing issues. The attitude dimension evaluates the feelings and values of the public regarding the issues related to infrastructure financing that would affect public support or opposition.

Despite the importance of considering public perceptions in infrastructure financing policy analysis and educating stakeholders, there are very few studies in this area. There are studies on the public acceptance of road pricing in different countries; for instance, Verhoef et al. (1997), Taylor and Brook (1998), Rienstra et al. (1999), Schade and Schlag (2000), Harrington et al. (2001), Podgorski and Kockelman (2006), and Yusuf et al. (2014), developed predictive statistical models to assess determinants of the public acceptance regarding road pricing. Agrawal and Dill (2007) investigated public opinion in California on support for a range of revenue options to fund transportation, including taxes and fees, bonds, and tolling. In another study, Jaensirisak et al. (2005) considered the effects of personal characteristics and travel characteristics, such as travel time and distance, on the public acceptance for road pricing in the United Kingdom. This study did not evaluate other underlying determinants of public acceptance such as the economic and infrastructure conditions. Hamideh et al. (2008) studied public acceptance of new sales tax initiatives to fund transportation improvements by examining factors that affect observed and likely voting behavior on these financing initiatives. They found that many factors statistically affect voting behavior on new sales-tax initiatives to fund infrastructure improvements. These factors include perceptions of infrastructure condition, economic status, political party affiliation, and beliefs about how the additional funds will likely be administered and spent. In a synthesis study, Zmud and Arce (2008) analyzed 110 studies related to public opinion surveys of tolling of transportation infrastructure projects around the globe. They concluded that most of these studies were project-specific and investigated whether the public agreed on imposing tolls on a new or existing road. Further, the studies analyzed by Zmud and Arce (2008) were limited to the assessment of public perception regarding road pricing and did not consider other dimensions of public perceptions such as awareness and attitude nor other aspects of infrastructure development such as the effects of financing structure (private delivery, etc.).

2.2. Gap in knowledge and contribution of the study

The review of the existing literature pertaining to citizen involvement (e.g., Stich and Eagle, 2005) indicates that previous studies have emphasized the importance of understanding the public preferences and perceptions for formulating citizen involvement strategies. However, there are few studies which have strived to facilitate such understanding. Most of the studies related to public perceptions of infrastructure planning and financing were project-specific and investigated whether the public agreed on imposing tolls on a new or existing road. Further, the studies were limited to the assessment of public perception regarding road pricing and did not consider other dimensions of public perceptions such as awareness and attitude nor aspects of infrastructure development such as the effects of the financing structure (private delivery, collection of user-fees, etc.). Also, many of the previous studies (such as Verhoef et al. (1997), Taylor and Brook (1998), Rienstra et al. (1999), Schade and Schlag (2000) and Harrington et al. (2001)) were implemented for countries other than the U.S. and thus their findings may not be representative of public perceptions in the U.S.

The study presented in this paper bridges this gap by implementing a comprehensive research study to gain a systemic understanding of public perceptions and preferences pertaining to infrastructure planning and financing in the U.S. The findings of the study will cast light on strategies to enhance the current efforts of public agencies towards involving the citizens, educating the public, and marketing the benefits of innovative financing.

3. Data collection

A web-based survey was used and deployed through an on-line survey panel service in May 2011. The online survey panel service, Qualtrics, collected data from a sample population of the public (older than 18) in the U.S. The subjects were recruited by Qualtrics from the different states. Qualtrics is a private company in the U.S. with expertise in online data collection. Qualtrics data collection services is used by many academic institutions in the U.S. and there are several studies that reported results based on the data collected by Qualtrics. For this study, Qualtrics used stratified sampling strategy from

a census representative panel to deploy the surveys to the subjects. Stratified sampling was used to ensure that: (i) at least 10 responses are collected from each state, and (ii) the individuals are older than 18 years old. An opt-in mechanism for participation was utilized in the surveys, giving participants the choice to participate or not. The definition of innovative financing was described in the introduction of the survey, and the survey was qualified for IRB Research Exemption by Purdue University. In the survey, infrastructure systems were defined as “network of facilities that are essential to life, economic well-being, and national security such as highways, roads, bridges, water networks, electric grids, etc”. The reliability of the survey was tested through content validity which consisted of a review of the survey’s contents by four subject matter experts (SME) who were not included in the sample of survey respondents. These SMEs had more than 10 years of experience in infrastructure financing, and their input was used to design different sections of the survey to capture the determinants of public perception of infrastructure financing. The survey was pre-deployed to a small selected sample of respondents (10 individuals) to ensure that the questions and the definition of innovative financing were understandable and to measure the minimum time required to complete the survey, which was found to be 10 min. The individuals selected for the pre-deployment of the survey did not have any experience or background related to infrastructure financing. The input from these individuals was used to ensure that the questions in the survey were understandable by those with little or no background in infrastructure financing.

The survey was deployed to 2500 individuals across 50 states in the U.S. The survey was web-based and the invitation for participation was sent via email. 1420 responses were collected. However, not all responses were valid. The responses were tested for validity based on the validity questions that had been designed into the survey and also the time that each respondent had spent on the survey (i.e., responses from individuals who spent less than 10 min completing the survey were eliminated). Six hundred and sixteen (616) valid responses were obtained from all 50 states, and there were at least 10 responses per state (Fig. 2). The response rate without excluding invalid responses was 56.8%. With exclusion of invalid responses, the response rate was 24.6%.

While it is impossible to achieve a sample which perfectly represents the entire population, Qualtrics ensured that the collected sample is representative with respect to dimensions such as gender, age, and marital status. For example, 51% of US population are female and about 50% are married (U.S. Census Bureau, 2011), and in the sample of responses, 56% were female and 54% were married. With a population of 226,200,000 in the U.S. of people over 18 years of age based on data from the U.S. Census Bureau in 2011, this number of responses led to a confidence level of greater than 90% with a confidence interval of 5%.

Table 1 shows the independent variables pertaining to economic indicators, infrastructure conditions, and personal characteristics considered in this study. As shown in Table 1, the collected data included variables related to the dimensions of public perception: knowledge, awareness, perception, and attitude and variables related to the personal characteristics of the individuals. A review of the existing literature revealed that issues such as private delivery, leasing the existing facilities to

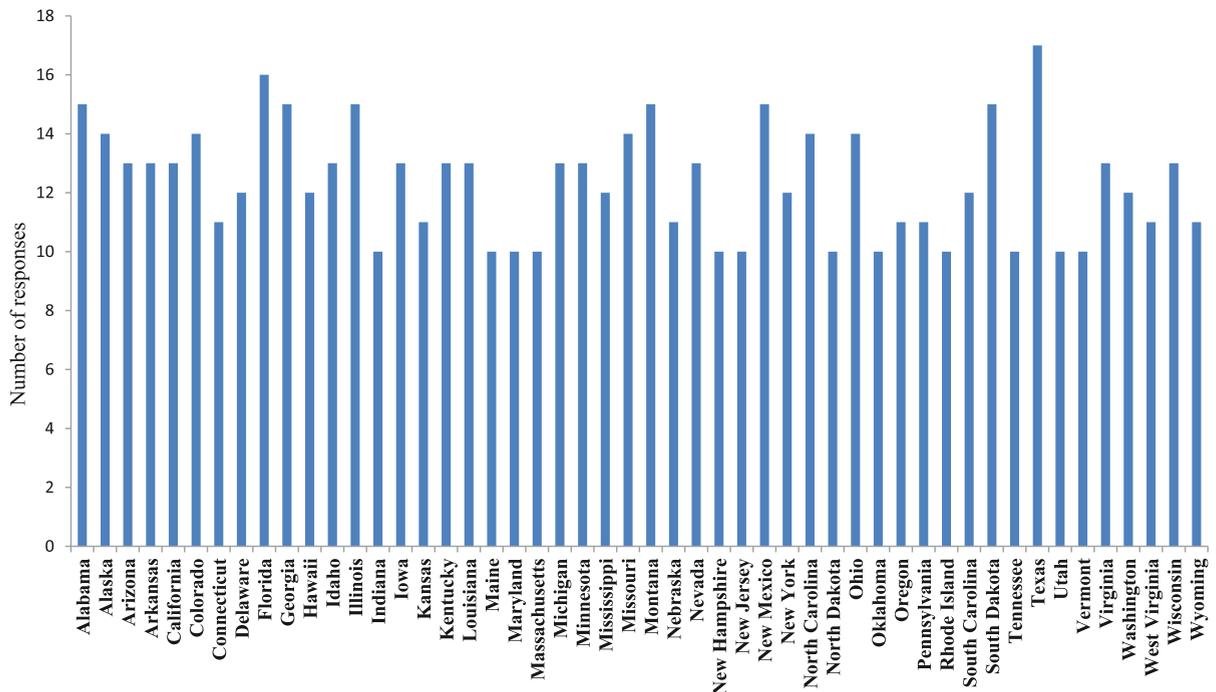


Fig. 2. Number of valid responses per state.

Table 1
Independent variables in the analysis.

Variable description	Variable description
<i>Variables related to the economic indicators and infrastructure condition</i>	
Income per capita	Drinking water investment needs (\$ billions)
GDP (\$ millions)	Roads in poor condition (%)
Population	Congested highways in large cities (%)
Unemployment rate (%)	Public transportation spending in 2010 (\$ billions)
Percentage of structurally deficient bridges	Number of years of existence of public private partnership (P3) enabling legislation in the state (years)
<i>Variables related to the personal characteristics of the individuals</i>	
Gender (1: male; 2: female)	Political views (1: democrat; 2: republican, 3: independent)
Marital status (1: single, 2: married)	Own a house (1: yes; 2: no)
Age (1: 18–25; 2: 25–35, 3:36–45; 4:45–60; 5: 60 and older)	Member of a civic organization dealing with safety, health and environmental issues (1: yes; 2: no)
Number of children (1: 3 or more, 2: 1 or 2, 3: none)	Characteristic of where one lives (1: mega city; 2: urban; 3: rural; 4: other)
Household annual income (1: less than \$25 k; 2: \$25 k–\$50 k; 3: \$50 k–\$75 k; 4: \$75–\$100 k; 5: \$100 k or greater)	Frequency of following news (1: at least once a day; 2: once a week; 3: once a month; 4: never)
Number of cars in the household (1: 3 or more; 2: 1 or 2; 3: None)	News theme of interest (1: sports and entertainment; 2: politics; 3: economics and marketplace)
Distance to an interstate highway (1: less than one mile; 2: 1–5 miles; 3: 5–10 miles; 4: greater than 10 miles)	Media for following the news (1: newspaper; 2: magazines; 3: internet; radio and television)
Education (1: high school diploma; 2: college degree; 3: graduate degree)	Traveled to a developed country in Europe and East Asia during the last five years (1: yes; 2: no) (Note: This factor has been considered to measure if the public makes comparisons between the conditions of infrastructure in other developed countries with infrastructure systems in the U.S.)

private entities, additional taxation, and imposing user-fees, are of significance for public policy pertaining to infrastructure investments (Savas, 2000; Gramlich, 1994; Stich and Eagle, 2005; Agrawal and Nixon, 2011). Thus, the questions in the survey were created to capture the public knowledge, awareness, perception, and attitude pertaining to these issues as dependent variables. The description of the dependent variables in the models are explained in the following section. The survey also collected data for independent variables related to personal characteristics. The information related to the statistics of the variables pertaining to personal characteristics is shown in Table 2. Other independent variables in the models were related to the economic indicators and infrastructure conditions of the states (Table 1). The data related to these independent variables were obtained from the U.S. Bureau of Economic Analysis (BEA, 2011) and the American Society of Civil Engineers infrastructure scorecard (ASCE, 2009).

4. Methodology

Four groups of dependent variables related to public knowledge, awareness, perception, and attitude were considered. The descriptions of dependent variables are shown in Table 3. Each group of dependent variable includes two or three

Table 2
Statistics of the variables related to personal characteristics of the respondents.

Variable related to personal characteristics	Statistics
Gender	Male: 43%; female: 57%
Marital status	Single: 46%; married: 54%
Age	18 – 25: 11%; 26–35: 14%; 36–45:12%; 45–60:39%; 60 or higher: 25%
Number of children	3 or more: 23%; 1 or 2: 34%; none: 42%; Prefer not to answer: 1%
Household annual income	Less than \$ 25 k: 23%; \$25 k–\$50 k: 34%; \$50 k–\$75 k: 18%; \$75–\$100 k: 9%; \$100 k or greater: 7%; prefer not to answer: 8%
Number of cars in the household	3 or more: 18%; 1 or 2: 74%, None: 6%; Prefer not to answer: 1%
Distance to an interstate highway	Less than one mile: 18%; 1–5 miles: 44%; 5–10 miles: 14%; greater than 10 miles:24%
Education	High school diploma: 47%; college degree: 34%; graduate degree: 15%; Prefer not to answer: 3%
Political views	Democrat: 29%; republican: 27%, independent: 33%; prefer not to answer: 11%
Own a house	Yes: 59%; no: 39%; prefer not to answer: 2%
Member of a civic organization dealing with safety, health and environmental issues	Yes: 3%; no: 97%
Characteristic of where one live	Mega city: 3%; urban: 39%; rural: 41%; other: 16%; prefer not to answer: 1%
Frequency of following news	At least once a day: 80%; once a week: 15%; once a month: 1%; never: 3%; prefer not to answer: 1%
News theme of interest	Sports and entertainment: 22%; politics: 25%; economics and marketplace: 29%; Other: 22%; prefer not to answer: 4%
Media for following the news	Newspaper: 9%; magazines: 1%; internet: 39%; radio and television: 52%
Traveled to a developed country in Europe and East Asia during the last five years	Yes: 12%; no: 88%

Table 3

Description of the dependent variables in the models.

Model #	Dependent variable
<i>Knowledge</i>	
Model 1	To the best of your knowledge, what are the main outcomes of infrastructure development? (1 if economic development and employment, 0 otherwise)
Model 2	To the best of your knowledge, what are the main approaches for infrastructure construction and operation? (1 if public delivery, private delivery and public private partnership, 0 otherwise)
<i>Awareness</i>	
Model 3	How do you evaluate your awareness regarding the insufficiency of traditional methods for financing infrastructure by state and federal governments to improve the existing deteriorating condition? (1 if aware, 0 otherwise)
Model 4	How do you evaluate your awareness regarding the activities of public organizations for finding innovative financing solutions for infrastructure? (1 if aware, 0 otherwise)
<i>Perception</i>	
Model 5	Do you agree that the public should pay regular user fees for infrastructure development? (1 if disagree strongly, 2 if disagree, 3 if neutral, 4 if agree, 5 if agree strongly)
Model 6	Do you agree that construction cost overrun is the main reason for infrastructure financing deficit? (1 if disagree strongly, 2 if disagree, 3 if neutral, 4 if agree, 5 if agree strongly)
Model 7	Do you agree that construction and operation of infrastructure facilities by private entities is more efficient? (1 if disagree strongly, 2 if disagree, 3 if neutral, 4 if agree, 5 if agree strongly)
<i>Attitude</i>	
Model 8	How likely is it that you oppose infrastructure investments if foreign investors/operators are included? (1 if very unlikely, 2 if unlikely, 3 if neutral, 4 if likely, 5 if very likely)
Model 9	How likely is it that you support infrastructure investments if it includes leases and partnerships with private investors/operators? (1 if very unlikely, 2 if unlikely, 3 if neutral, 4 if likely, 5 if very likely)
Model 10	How likely is it that you support infrastructure investment that entails additional taxes and user fees if it protects the public against natural disasters? (1 if very unlikely, 2 if unlikely, 3 if neutral, 4 if likely, 5 if very likely)

dependent variables to measure different aspects of public perceptions related to innovative financing of infrastructure systems. In total, ten dependent variables were considered. Public knowledge was investigated using two dependent variables. One dependent variable measured public knowledge related to the benefits of infrastructure investment (i.e., Model 1) and the other focused on public knowledge of different approaches for infrastructure financing (i.e., Model 2).

Two dependent variables (i.e., Models 3 and 4) were used for investigation of public awareness related to the inefficiency of traditional financing approaches and the activities of infrastructure agencies for finding innovative financing approaches. Three dependent variables (i.e., Models 5–7) were used to investigate public perceptions towards three important aspects of infrastructure financing: (i) adoption of user-fees (i.e., Model 5); (ii) cost overruns (Model 6); and (iii) private finance and delivery (i.e., Model 7). Finally, three dependent variables were used to investigate public attitudes towards different aspects of innovative financing (focusing on the characteristics of innovative financing such as participation of foreign private institutional investors (i.e., Model 8), private investment and delivery (i.e., Model 9), and additional taxation and user-fees (i.e., Model 10).

The variables used to measure public awareness and knowledge yielded two outcomes (“aware/unaware” and “knowledgeable/uninformed”). The dependent variables used to measure perception produced multiple outcomes, ranging from “strongly agree” to “strongly disagree.” The dependent variables used to measure public attitudes provided multiple outcomes ranging from “very unlikely” to “very likely.” For analyzing dependent variables with two outcomes, binary probit models were used, and ordered probit models were used for dependent variables with multiple ordered outcomes. The independent variables in the models include those related to economic factors, infrastructure conditions, infrastructure investment, and personal characteristics.

5. Data analysis

For each of the dependent variables related to public perception, the best statistical model was estimated through trials of the multiple independent variables based on log-likelihood at convergence values. The process of finding the best model included sequential addition of independent variables in the model to improve the log-likelihood values. The process included multiple trial and error steps to find a model with the lowest log-likelihood value. Since the process included trials of different combinations of all independent variables, the probability that potentially relevant variables had been excluded was unlikely.

Typical studies related to econometric analysis present details related to log-likelihood values, adjusted *R*-square, and *F*-statistic pertaining to one dependent variable only. In this study, the econometric analysis included ten dependent variables. It is difficult to include all the information related to the econometric analysis, due to the page limitations of this paper, and hence, the paper focuses primarily on the interpretation of the models. For each of the dependent variables related to public perception, the best statistical model was estimated through trials of the various independent variables based on log-likelihood at convergence values. The best model was selected based on improvement in the value of log-likelihood in different iteration of a model.

The objective of the models was to identify the significant variables and their effects on public knowledge, awareness, perception, and attitude. Table 3 shows the dependent variables for each model and Table 4 summarizes the statistical information related to public knowledge and awareness. As shown in Table 4, a large percentage of the sample population is knowledgeable and aware of the deteriorating condition of infrastructure and urgency of the need for infrastructure investment. However, a small percentage of the sample population is aware of the innovative financing approaches for infrastructure development. Thus, there is a need to enhance public knowledge and awareness regarding the innovative financing approaches. The key question to be answered is: what factors affect the knowledge and awareness of the public regarding infrastructure financing? Models 1 through 4 investigated the factors affecting the knowledge and awareness of the public towards issues related to infrastructure financing. For the binary probit models (Models 1 through 4), the sign of the parameter vectors determined the effect of the independent variables on the dependent variable. A positive sign for the parameter vectors indicated an increase in value of the independent variable, which increased the probability that the respondent was knowledgeable or aware of the issues related to infrastructure financing and development or vice versa.

Based on the collected responses, the sample population showed varying perceptions and attitudes towards the issues related to infrastructure financing. The fundamental question to be answered is: what are the factors leading to varying perceptions and attitudes of the public regarding innovative financing? Models 5 through 10 investigated the factors affecting the perception and attitude of the public towards issues related to infrastructure financing. Interpretation of the results of the ordered probit models (Models 5 through 10) was made based on the sign of the parameter vectors. In the assessment of public perception and attitude regarding infrastructure financing, the objective of creating the models was to identify the significant factors and their effects (positive or negative). The sign of parameter vector could be used to identify the effect of the independent variables on only the highest integer ordered response, such as “strongly agree” or “very likely.” It could not be used for identifying the effect on interior categories such as “neither agree nor disagree” or “neutral.” This limitation is due to the way the parameters of the model were estimated. Washington et al. (2011) have described the interpretation of statistical models in detail.

Table 5 is a summary of the models with only the significant independent variables shown. All the variables shown in Table 5 are significant. No independent variables with t -statistics below the 90% confidence level were included in the best models. In the following sub-sections, an overview of the main findings is presented. Then, the statistical information obtained from the models is used to make observations related to the effects of economic factors, infrastructure conditions, current financing practices, and personal characteristics on the public perception of innovative financing.

5.1. Overview of findings

The findings of the survey highlights a gap in public’s knowledge and awareness regarding the current practices related to innovative financing of infrastructure. According to the survey results, sixteen percent (16%) of the sample population perceived current communication practices related to infrastructure development and financing to be clear. In addition, forty-three percent (43%) of the sample population were informed about different financing methods. However, 23% of the sample population was aware of the activities of public agencies regarding the use of innovative financing to address infrastructure needs.

The findings of the study also show that the factors related to infrastructure conditions affect the public support of innovative financing in different ways: (i) the conditions of infrastructure and the level of need for infrastructure renewal increases the likelihood of public support of innovative financings. This effect is named as “the need effect” in this study; (ii) the ability of infrastructure facilities to protect the public against natural disasters enhances the likelihood of public support of innovative financing. This effect is named as “the loss aversion effect”; and (iii) the history of using innovative financing in infrastructure renewal increases the likelihood of public support. This effect is named as “the social learning effect” in this study. To summarize, the main findings from the data analysis include:

- The economic factors (such as GDP and unemployment rate) does not have a significant impact on the likelihood of public support of or opposition to innovative financing methods; thus, the strategies to get the public to buy-in to innovative financing techniques may not differ under different economic conditions;
- Poor conditions of infrastructure increases the likelihood of public support of innovative financing methods. Hence, obtaining public support of innovative financing techniques may be more likely in states with poor infrastructure conditions and greater needs for investments;

Table 4

Summary of statistical information related to public knowledge and awareness of innovative financing.

Variable description	Statistics
To the best of your knowledge, what are the main outcomes of infrastructure development?	Knowledgeable: 82%
To the best of your knowledge, what are the main approaches for infrastructure construction and operation?	Knowledgeable: 43%
How do you evaluate your awareness regarding the insufficiency of traditional methods for financing infrastructure by state and federal governments to improve the existing deteriorating condition?	Aware: 79%
How do you evaluate your awareness regarding the activities of public organizations for finding innovative financing solutions for infrastructure?	Aware: 23%

- A longer experience of the state transportation agencies with innovative financing tools enhances the likelihood of public support of new financing techniques. Thus, successful implementation of innovative financing and public education is critical in enhancing the learning process of the public. The effect is characterized as social learning effect (Bandura, 1977). Based on social learning effect, the extent of exposure to and awareness of a practice affects public's perception of it. Thus, successful implementation of innovative financing and public education is critical in enhancing the learning process of the public;
- Peer effect increases the likelihood of public support of innovative financing methods. Communicating the successful implementation of innovative financing in other states and developed countries increases the likelihood public support of new financing techniques.
- Loss-aversion behavior increases the likelihood of public support of innovative financing methods. The public is more likely to support innovative financing in projects that enhance the resilience of communities against natural disasters. The loss-aversion behavior of the public can be used to educate the public and gain public support of innovative financing.

These findings could help the agencies involved in innovative financing of infrastructure to improve their strategies for educating the public and marketing to get the public to buy in to innovative financing. Potential improvements can be made in changing the key messages in educating the public, using more effective strategies for communicating complicated financing concepts, and highlighting the success stories and benefits of innovative financing in other states and countries. The following sub-sections discuss the details based on which these findings have been made.

5.2. *Insensitivity to economic conditions*

The analysis of the results from the models revealed that economic factors do not significantly affect the awareness and attitude of the public towards infrastructure financing and development. Hence, obtaining public support of innovative financing techniques may be more likely in states with poor infrastructure conditions and greater needs for investments. In this study, the GDP and the unemployment rate of each state are the variables representative of the economic conditions in a state. As shown in Table 5, neither GDP nor unemployment rate were found to be significant in models related to public attitude. Unemployment rate was only significant in two out of ten models. As shown in Models 2 and 5, the unemployment rate was the only economic factor found to be affecting public knowledge and perception. For example, according to Model 2, the probability that individuals would be knowledgeable about different infrastructure financing systems is increased by 4.67% with 1% increase in the unemployment rate. This could be due to frequent discussions in the news media and political debates related to alternative financing systems during unfavorable economic conditions (Munnell, 1992).

5.3. *Need effect and loss aversion behavior*

The results of the models highlighted the significance of need in affecting the public support of innovative financing. Based on the results, a greater need for infrastructure investment and the deteriorating condition of infrastructure increases the probability of public support of and decreases the probability of opposition to infrastructure financing. In addition, the ability of infrastructure to provide protection against natural disasters could enhance the likelihood of public support for innovative financing systems that entail additional taxation and user fees. Variables such as the percentage of structurally deficient bridges, the percentage of roads in poor condition, and the investment needed to address drinking water infrastructure needs were used as indicators of the infrastructure condition in each state. The percentage of structurally deficient bridges only affects the variables related to public attitudes and perception. According to Model 6, the probability that the public attribute the financing deficit for infrastructure to construction cost overruns is increased by an increase in the percentage of structurally deficient bridges and the need for drinking water infrastructure. According to Model 8, the probability that the public opposes infrastructure investments that include foreign investors decreases with an increase in the percentage of structurally deficient bridges. Based on Model 9, the probability that the public would support infrastructure investments that include leases and partnerships with foreign investors increases with an increase in the investment to address the need for drinking water infrastructure. According to Model 10, the probability that the public would support infrastructure investments that entail additional taxes and user fees if it protects the public against natural disasters increases with an increase in the percentage of roads in poor condition and the percentage of congested highways. Thus, the likelihood of public support of innovative financing is affected by the level of need for infrastructure improvements and the severity of infrastructure deterioration. The greater the need for infrastructure improvements and the more severe the infrastructure deterioration, the higher the likelihood of positive public perception towards private infrastructure financing. Regarding the public attitude, Models 8 through 10 showed that the greater the need for infrastructure improvements and the more severe the infrastructure deterioration, the higher the likelihood of public support and the lower the likelihood of public opposition to innovative financing systems.

Another finding based on Model 10 is that the likelihood of public support of innovative financing approaches that include additional taxation and user-fees increases with an increase in the ability of infrastructure to protect the public against the natural disasters enhances. This finding might be related to the loss-aversion behavior of the public. According to Kahneman and Tversky (1984), loss aversion behavior refers to people's tendency to prefer avoiding losses to acquiring gains. Thus, when the use of innovative financing is linked with avoiding losses due to natural disasters, people prefer

avoiding losses due to natural disasters over the gain obtained from not paying additional taxes and user-fees and the likelihood of public support of innovative financing increases.

5.4. Social learning effect

The results of the analysis revealed that a longer history of the use of public private partnership (P3) enhances public awareness regarding available approaches for infrastructure financing. In addition, a longer history of the use of P3 enhances the public perception and attitude towards innovative infrastructure financing. Further, the results showed that public knowledge and awareness related to the benefits of infrastructure development and financing increase as the public learns about the current financing systems in other developed countries. The current public spending on transportation infrastructure and the history of practicing public–private partnership (P3) are used as indicators of the current financing practices in the states. According to Model 8, one additional year of the use of P3 in the state reduces the probability that the public opposes infrastructure investments that include foreign investors. Individuals from the states that have established P3 legislation (e.g., Texas, Virginia, and Florida) were more likely to be aware of: (i) the ineffectiveness of traditional financing systems for addressing the existing need for infrastructure investment, because of failures to raise the tax level and (ii) the alternative approaches for infrastructure financing. As shown in Table 6, there is a high percentage of respondents being aware of the insufficiency of traditional financing and the alternative financing systems in states which have a long history of practicing P3. In addition, according to Model 1 and 3, individuals who have travelled to other developed countries are more likely to be knowledgeable of the benefits of infrastructure development and to be more aware of the insufficiency of traditional financing systems for enhancing the deteriorating condition of U.S. infrastructure. This result implies that individuals learn about the benefits of modern infrastructure in other developed countries as they make comparisons between the conditions of infrastructure in these countries with the conditions of the infrastructure systems in the U.S. This could be due to social learning effect (Bandura, 1977). Based on social learning effect, the length of exposure to and awareness of a practice affects public's perception of it. Thus, the longer the history of practicing P3 and the greater the experience of individuals with infrastructure systems in other developed countries, the higher the likelihood of public support of innovative financing.

5.5. The effect of personal characteristics

The focus of this paper is mainly on assessing the impacts of economic factors, infrastructure conditions, and financing approaches. The impacts of demographic factors (e.g., age, gender, proximity to project) are not considered in this study. Nonetheless, some observations could be made regarding the link between the personal characteristics (e.g., political views and level of education) on the public perceptions towards the issues related to infrastructure financing. The results of the models revealed that public knowledge and awareness are significantly affected by the frequency of news follow-up and news themes of interest to the individuals. In addition, the education level and political views do not significantly affect the knowledge and awareness of the public. The results of the analysis also showed that the education level and political views significantly affect the perception and attitude of the public towards issues related to infrastructure financing and development. Based on the analysis of Models 1 through 4, the level of public's knowledge and awareness regarding the issues related to infrastructure financing and development increases with an increase on the frequency of following up with political and economic news. Due to the way that the survey was designed and the responses were collected, negative values of the coefficient related to the frequency of news follow up could be interpreted as follows: more frequent follow-up with news could have a positive impact on the dependent variable. The study showed that the knowledge and awareness of the public are not significantly affected by: (i) the level of education and the political views, and (ii) household income of the individuals.

6. Discussion

Formulation of strategic communication for gaining the public's interest in infrastructure projects is a major challenge that requires systemic analysis (USDOT, 2002; Calabrese, 2008). Strategic communication “helps to avert failure by identifying current and potential sources of both support and opposition. This information is crucial not only in setting priorities for communication objectives, developing sound messages, and selecting the best possible communication channels, but also in using those channels effectively and creating new ones if needed” (Calabrese, 2008). The findings of the analysis have important implications for practitioners related to different dimensions of formulating strategic communication programs.

Table 6
Awareness regarding innovative financing in states with long history of P3.

State	% Of respondents who are aware of the inefficiency of traditional financing systems	% Of respondents who are aware of the alternative approaches for infrastructure financing
Florida	100	81
Texas	88	76
Virginia	100	77

According to [Stich and Eagle \(2005\)](#), the current practices of public agencies (in Virginia) for citizen involvement are more focused on advocacy (e.g., preempting potential problems to gain support for specific projects) rather than transparency (e.g., learning about public preferences and communicating the efforts of the public agencies to meet the preferences of the public). Based on the findings presented in this paper, the agencies involved in innovative infrastructure financing could focus on two main strategies to enhance their efforts towards transparency and advocacy: (i) enhance strategies to facilitate learning for the public about innovative financing in infrastructure projects and (ii) improve marketing and citizen involvement strategies to get the public to buy in to innovative financing.

6.1. *Enhancing strategies to facilitate learning for the public*

The findings of the analysis highlighted multiple ways to facilitate learning for the public regarding innovative infrastructure financing. The first dimension is related to clear discussion and understanding of the impact of infrastructure development on the economy. According to *Observation 1*, economic factors do not affect public attitudes. This economic insensitivity could be due in part to the lack of appropriate public education regarding the benefits of infrastructure financing. A potential approach for enhancing the efforts for educating the public is related to the key messages to be delivered. At present, the key message has been related to the deteriorating condition of infrastructure in the U.S. and the insufficiency of state and federal grants to enhance the conditions of infrastructure. However, the findings of the analysis have shown that there is a need for educating the public regarding different alternative methods that could be used for financing, funding, and delivery of infrastructure. Twenty-three (23%) of the sample population was aware of the activities of public agencies regarding the use of innovative financing to address infrastructure needs. Thus, there is a potential to enhance the public knowledge in this dimension by shifting the focus of the key messages to the explanation of innovative financing methods. In addition, implementation of innovative financing and educating the public should be done in parallel. Due to the social learning effect, public perceptions of innovative financing improve with experience. The efforts should also be focused on finding ways for communicating complicated financing approaches to the public. The use of visualization tools has been shown to be an effective way for communicating complex concepts related to infrastructure projects with the public ([Bailey et al., 2002](#)). For example, data related financing gap, the current condition of the infrastructure, the success of innovative financing in other states and developed countries, and the impacts of using innovative financing on the resilience of communities against extreme events could be visualized to enhance communication with the public.

6.2. *Improving strategies for marketing and citizen involvement*

According to [Stich and Eagle \(2005\)](#), marketing can facilitate a transition to meaningful public participation if the priorities and preferences of the public are acknowledged and communication is transparent. The study by [Stich and Eagle \(2005\)](#) highlighted multiple marketing strategies based on the public perceptions pertaining to innovative financing. Unlike advocacy efforts, which focus on preempting potential problems to gain public support, marketing strategies are focused on transparency to communicate the benefits of innovative financing to the public and highlighting how innovative financing methods help meeting the preferences of the public. A potential approach is to communicate examples of successful projects delivered using a similar innovative financing structure in the region or in other states. In our study, Sixty-seven percent (67%) of the sample population indicated that they would support innovative financing systems that have been successful in other states. If innovative financing of a project includes increased taxation or user-fees, the previous approaches (e.g., communicating the success stories of innovative financing in other states) may not be sufficient to enhance the likelihood of public support. The finding related to loss-aversion behavior showed that public agencies could increase the public support for innovative financing systems that entail taxation and user fees by communicating the benefits of the project for protection against natural disasters. Thus, public agencies could implement investigations to identify the benefits of a project on the regional resilience of infrastructure networks and its impacts on the safety of the public during extreme events.

7. **Concluding remarks**

The findings of this study explored novel perspectives towards the impacts of economic factors, infrastructure conditions, and personal characteristics on the public knowledge, awareness, perceptions, and attitudes towards infrastructure financing. The contribution of this study is threefold:

- (i) The findings identified the hitherto unexplored connections between the economic factors, infrastructure conditions, and personal characteristics with the knowledge, awareness, perception, and attitude of the public towards infrastructure financing.
- (ii) The findings provide an insight related to the perceptions of the citizens across the U.S. rather than focusing on a specific geographical region.
- (iii) The findings cast light on potential strategic communication approaches to enhance efforts towards educating the public and marketing the benefits of innovative financing in infrastructure, as a step towards the successful deployment of innovative infrastructure financing.

The findings of this study is based on the data obtained from the U.S. Due to the unique socio-political environment in the U.S., the findings might not be directly transferable to assessment of public perception of innovative financing in other countries. Nevertheless, the study presented in this paper has important implications for global infrastructure. First, the findings of this study highlighted the importance of considering public perceptions towards innovative financing of infrastructure. There are different issues (e.g., sustainability, financing, and use of innovative technologies) pertaining to infrastructure systems for which obtaining public support is critical, and the framework and findings of this study could be used for assessment of public perceptions in different contexts and countries. For example, factors such as the insensitivity to economic conditions, social learning effect, need effect, and loss aversion might also impact public perceptions towards different issues related to infrastructure systems in other countries. Second, there are different global institutional investors and infrastructure operators who seek investment opportunities in the infrastructure sector in the U.S. The findings of this study could inform these entities regarding strategies to obtain public support of innovative financing in the U.S.

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References

- Agrawal, A., Dill, J., 2007. How to pay for transportation? A survey of public preferences in California. *Transp. Policy* 14 (4), 346–356.
- Agrawal, A.W., Nixon, H., 2011. What Do Americans Think About Federal Transportation Tax Options? Results from Year Four of a National Survey. Mineta Transportation Institute, San Jose, CA.
- Agrawal, A.W., Nixon, H., 2013. What Americans Think about Federal Tax Options to Support Public Transit, Highways, and Local Streets and Roads? Results from Year Four of a National Survey. Mineta Transportation Institute, San Jose, CA.
- American Association of State Highway and Transportation Officials, 2014. Transportation Funding and Financing. Available from: <http://www.transportation-finance.org/funding_financing/financing/> (accessed on February 1 2014).
- American Society of Civil Engineers (ASCE), 2013. Report Card for America's Infrastructure, Reston, VA.
- American Society of Civil Engineers (ASCE), 2009. Report Card for America's Infrastructure, Reston, VA.
- Bailey, K., Brumm, J., Grossardt, T., 2002. Towards structured public involvement in highway design: a comparative study of visualization methods and preference modeling using CAVE (Casewise Visual Evaluation). *J. Geog. Inf. Decis. Anal.* 6 (1), 1–15, 2001.
- Bandura, A., 1977. *Social Learning Theory*. Prentice-Hall, Englewood Cliffs, NJ, USA.
- Calabrese, D., 2008. Strategic Communication for Privatization, Public–Private Partnerships, and Private Participation in Infrastructure Projects, World Bank Working Paper No. 139. The World Bank, Washington, D.C..
- CBO (Congressional Budget Office), 2002. Future Investment in Drinking Water and Wastewater Infrastructure. Congressional Budget Office, Washington, D.C..
- Congressional Budget Office (CBO), 2008. Investing in Infrastructure: Testimony. Statement of Peter R. Orszag, Director, before the Committee on Finance, United States Senate. Available from: <<http://www.cbo.gov/ftpdocs/>> (July 10, 2012).
- Chapman, J., 2008. The fiscalization of land use: the increasing role of innovative revenue raising instruments to finance public infrastructure. *Public Works Manage. Policy* 12 (4), 551–567.
- Chupka, M.W., Earle, R., Fox-Penner, P., Hledik, R., 2008. Transforming America's Power Industry: The Investment Challenge 2010–2030. Available from: <<http://www.eei.org>> (accessed December 2, 2012).
- Eggers, W., Dovey, T., 2007. Closing America's Infrastructure Gap: The Role of Public-Private Partnerships. A Deloitte Research Study, Deloitte Services, USA.
- Garvin, M.J., 2010. Enabling development of the transportation public–private partnership market in the United States". *J. Constr. Eng. Manage. ASCE* 136, 402–411.
- Gramlich, E.M., 1994. Infrastructure investment: a review essay. *J. Econ. Lit.* 32 (3), 1176–1196.
- Grout, P.A., Stevens, M., 2003. The assessment: financing and managing public services. *Oxford Rev. Econ. Policy* 19 (2), 215–234.
- Hamideh, A., Oh, J., Labi, S., Mannering, F., 2008. Public acceptance of local government transportation sales taxes: a statistical assessment. *State Local Gov. Rev.* 40 (3), 150–159.
- Harrington, W., Krupnick, A.J., Alberini, A., 2001. Overcoming public aversion to congestion pricing. *Transp. Res. Part A* 35, 87–105.
- Heller, P., 2005. Fiscal Space: What Is It and How To Get It? Available from: <<http://www.imf.org/external/pubs/ft/fandd/2005/06/basics.htm>> (accessed on February 14 2014).
- Jaensirisak, S., Wardman, M., May, A.D., 2005. Explaining variations in public acceptability of road pricing schemes. *J. Transp. Econ. Policy* 39 (2), 127–153.
- Kahneman, D., Tversky, A., 1984. Choices, values, and frames. *Am. Psychol.* 39 (4), 341.
- Mostafavi, A., Abraham, D.M., 2010. Frameworks for Systemic and Structural Analysis of Financial Innovations in Infrastructure. In: Working Paper Electronic Proceedings of 2010 Engineering Project Organization Conference (EPOC 2010), November 4 – 6, 2010, South Lake Tahoe, CA.
- Mostafavi, A., Abraham, D.M., Sullivan, C.A., 2011. Drivers of innovation in financing transportation infrastructure: a systemic investigation. In: Electronic Proceedings of the Second International Conference on Transportation.
- Mostafavi, A., Abraham, D.M., DeLaurentis, D.A., Sinfield, J.V., 2011b. Exploring the dimensions of systems of innovation analysis: a system of systems framework. *IEEE Syst. J.* 5 (2), 256–265.
- Mostafavi, A., Abraham, D.M., Lee, J., 2012a. System-of-systems approach for assessment of financial innovations in infrastructure. *J. Build. Environ. Proj. Asset Manage. Emerald* 2 (2), 250–265.
- Mostafavi, A., Abraham, D.M., Mannering, F.L., Vives, A., Valentin, V., 2012. Assessment of public perceptions on innovative financing for infrastructure. In: Proceedings of Construction Research Congress 2012, ASCE, May 21–23, 2012, West Lafayette IN, pp. 2260–2269.
- Mostafavi, A., 2013. Ex-Ante Assessment of Financial Innovation Policies in Infrastructure System-of-Systems (Doctoral Dissertation). School of Civil Engineering, Purdue University, West Lafayette, IN.
- Mostafavi, A., Abraham, D., Sinfield, J., 2014. Innovation in infrastructure project finance: a typology for conceptualization. *Int. J. Innov. Sci.* 6 (3), 127–143.
- Munnell, A.H., 1992. Policy watch: infrastructure investment and economic growth. *J. Econ. Perspect.*, 189–198.
- National Academy of Sciences, 2009. Sustainable Critical Infrastructure Systems: A Framework for Meeting 21st Century Imperatives. The National Academies Press, Washington DC.
- Vonk Noordegraaf, D., Annema, J.A., van Wee, B., 2014. Policy implementation lessons from six road pricing cases. *Transp. Res. A: Policy Pract.* 59, 172–191.

- Ortiz, I.N., Buxbaum, J.N., 2008. Protecting the public interest in long-term concession agreements for transportation infrastructure. *Public Works Manage. Policy* 13 (2), 126–137.
- Pagano, M.A., Pery, D., 2008. Financing infrastructure in the 21st century. *Public Works Manage. Policy* 13 (1), 22–38.
- Ploeg, C.V., 2006. *New Tools for New Times: A Sourcebook for the Financing, Funding and Delivery of Urban Infrastructure*. Canada West Foundation, Canada.
- Podgorski, K.V., Kockelman, K.M., 2006. Public perceptions of toll roads: a survey of the Texas perspective. *Transp. Res. A: Policy Pract.* 40 (10), 888–902.
- Polsby, N., Wildavsky, A., 1988. *Presidential Elections*, seventh ed. The Free Press, NY.
- Rienstra, S.A., Rietveld, P., Verhoef, E.T., 1999. The social support for policy measures in passenger transport: a statistical analysis for the Netherlands. *Transp. Res. D* 4 (3), 181–200.
- Savas, E.S., 2000. *Privatization and Public-Private Partnerships*. Chatham House, Chatham House, NJ.
- Schade, J., Schlag, B., 2000. *Acceptability of Urban Transport Pricing*, Research Report 72. Government Institute for Economic Research, Helsinki, Finland.
- Stich, B., Eagle, K., 2005. Planning to include the Public: transportation policy implementation with effective citizen involvement. *Public Works Manage. Policy* 9 (4), 319–340.
- Sudarmadi, S., Suzuki, S., Kawada, T., Netti, H., Soemantri, S., Tugaswati, A.T., 2001. A survey of perception, knowledge, awareness, and attitude in regard to environmental problems in a sample of two different social groups in Jakarta, Indonesia. *Environ. Dev. Sustain.* 3 (2), 169–183.
- Taylor, B., Brook, L., 1998. Public attitudes to transport issues: findings from the British social attitudes surveys. In: Banister, D. (Ed.), *Transport Policy and the Environment*. Transportation Research Laboratory, UK.
- U.S. Bureau of Economic Analysis (BEA), 2011. Accessed during May–June 2011. Available from: <<http://www.bea.gov/>>.
- Valentin, V., Abraham, D., Mannering, F., Mostafavi, A., 2012. Assessment of public opposition to infrastructure developments: the case of nuclear power projects. *Construction Research Congress 2012*. ASCE, West Lafayette, IN, pp. 1550–1559. <http://dx.doi.org/10.1061/9780784412329.156>.
- Verhoef, E.T., Nijkamp, P., Rietveld, P., 1997. The social feasibility of road pricing: a case study for randstad area. *J. Transp. Econ. Policy* 31 (3), 255–276.
- Vives, A., 1997. Private infrastructure: ten commandments for sustainability. *J. Proj. Financ.* 3 (1), 20–30.
- The Wall Street Journal, 2010. In California, a Road to Recovery Stirs Unrest, December 1, p. C3.
- U.S. Department of Transportation (USDOT), 2002. Public involvement techniques for transportation decision-making. Available from: <<http://www.fhwa.dot.gov/reports/pittdlforeword.htm>>.
- U.S. Census Bureau, 2011. Quick Facts. Available from: <<https://www.census.gov/>> (accessed on June 15 2011).
- Walton, C.M., Euritt, M.A., 1990. Highway finance and the private sector: Issues and alternatives. *Transp. Res. Part A* 24 (4), 265–276.
- Washington, S., Karlaftis, M., Mannering, F., 2011. *Statistical and Econometric Methods for Transportation Data Analysis*. Chapman & Hall/CRC, Boca Raton FL.
- Yusuf, J.E.W., O'Connell, L., Anuar, K.A., 2014. For whom the tunnel be tolled: a four-factor model for explaining willingness-to-pay tolls. *Transp. Res. A: Policy Pract.* 59, 13–21.
- Zmud, J., Arce, C., 2008. *Compilation of Public Opinion Data on Tolls and Road Pricing*, Transportation Research Board, National Cooperative Highway Research Program synthesis 377, Washington, D.C. Available from: <http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_377.pdf> (June 2010).