STATUS QUO BIAS IN MUNICIPAL BOND UNDERWRITER SELECTION

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ABSTRACT

Status quo bias is the tendency to select a previously chosen alternative disproportionately often in decision-making. Selecting the status quo when the current state is not objectively superior to other available alternatives results in a suboptimal outcome. This article extends the concept of status quo bias to municipal debt issuance. It analyzes a specific behavioral decision-making situation involving a state government that repeatedly uses the same underwriting firm disproportionately often, even when use of the same underwriter continually returns higher interest costs. The article uses data on California state general obligation bonds and Monte Carlo simulation techniques to analyze several paths of interest costs that deviate from a hypothetical optimal outcome. The analysis offers useful insights for state government debt management in complex and evolving markets where, in some cases, repeated use of the same underwriting firm might result in continually higher interest costs and limit interest cost savings.

Keywords: status quo bias; municipal debt; underwriter; interest costs; simulation; optimization

1. INTRODUCTION

When a municipal government repeatedly uses the same underwriting firm in new debt issuance, it can have major implications for municipal borrowing costs. Repeat use may lower borrowing costs if it makes it possible for an issuer to accumulate relevant information and lower information costs from repeated use of the same underwriter over multiple debt issues; however, repeat use can also raise interest costs if organizational learning is limited and an issuer and underwriter together persist with previous mistakes in issuance strategy and accumulate greater risks and more inefficiency (Miller and Justice 2012; Liu 2015).

Over the years, researchers have used different theories to explain the ways that repeated use of same underwriting firm in new debt issuance affects municipal borrowing costs. Debt network theory and the notion of stability (Miller 1993) explains that repeated use of the same set or network of underwriters in new debt issuance can affect municipal borrowing costs positively or negatively through channels of risk-taking, learning, innovation, and adaptation. Bank hold-up theory (Rajan 1992)

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and the relationship lens suggests that an issuer's repeated use of the same underwriter in new debt issuance, and the relationship that forms between the issuer and underwriter due to repeated use of the same underwriter, might enable the underwriter to obtain an information advantage relative to other underwriting firms, which can lead to the underwriter charging continually higher rents and fees that raise municipal borrowing costs exponentially. Transaction cost theory (Williamson 1989) supports the view that underwriters incur search and information costs on an issuer when structuring a bond sale; therefore, as an issuer repeatedly uses the same underwriter for multiple debt issues, average cost of underwriting (hence borrowing costs) would eventually decline because fixed costs are spread across more and more debt issues.

This article proposes that another way to conceptualize repeated use of the same underwriter in new debt issuance and understand better its impact on municipal borrowing costs is to frame the topic in the context of status quo bias. Status quo bias is the tendency to select a current or previously chosen alternative disproportionately often in decision-making, even when the current or previous state is not objectively superior to other available alternatives, resulting in a suboptimal outcome (Kahneman and Tversky 1979; Samuelson and Zechauser 1988; Gilboa and Wang 2019). The concept of status quo bias is part of a family of constructs in prospect theory that deviate from conventional neoclassical economic theory. Neoclassical economic theory assumes that decisionmakers are rational agents and they assess all available information sets to determine preferences and act consistently to achieve optimal decisions that maximize expected utility (Weintraub 1985). On the contrary, status quo bias and related constructs in prospect theory are based on observed models of human behavior that show the decisionmaker as a bounded rational agent relying on heuristics to determine an appropriate course of action when faced with decision-making under uncertainty (Kahneman and Tversky 1984; Tversky and Kahneman 1991).

The present study frames repeated use of the same underwriter as status quo bias using insights from Kriz (2004). Kriz showed the ways that prospect theory, including status quo bias, can be applied to municipal bond markets and highlighted several behavioral anomalies in municipal debt issuance, including the tremendous status quo bias in favor of using the same underwriter as in the previous issue even though shifting away from the status quo might generate interest cost savings. The present study analyzes a specific behavioral decision-making situation involving a municipal issuer that selects an underwriter from a set of underwriting firms and operates with the goal of maximizing interest cost savings in complex and evolving debt markets where information capture and rent-seeking by underwriting firms persist. The paper undertakes a prospective analysis of how repeated use of the same underwriter, in other words status quo bias, may affect municipal borrowing costs. A prospective, or ex ante, analysis differs from a retrospective, or ex post, analysis in that a prospective analysis specifies a range of policy parameters and decision alternatives and evaluates potential outcome scenarios prior to taking policy actions (Dunn 2016).

The analysis uses data on California state general obligation debt and employs Monte Carlo simulation to examine several potential outcomes of municipal interest costs that deviate from a hypothetical optimal outcome. Results show significant deviations of potential interest costs from an efficient frontier that envelopes the sample data while accommodating the presence of a random statistical noise. Specifically, given underlying model inputs that accommodate status quo bias in municipal underwriter selection as well as bond-specific factors, issuer-related variables, municipal market-wide conditions, and macroeconomic trends, the mean of the sampling distribution of true interest costs is 3.80%, and there is a 95% probability that the mean interest cost will lie between 3.43% and 4.32%. Additionally, results from a sequence of optimization procedures show that the mean true interest cost of 3.80% deviates significantly from an optimal true interest cost of 2.84%, reflecting an efficiency index that is less than unity.

We can understand the results to mean that Monte Carlo simulation and optimization applying different choices, other than the choices public managers made that resulted in the original data, produces expected interest cost outcomes that are, on average, objectively superior to outcomes actually experienced, and this finding persists despite modelling that introduces sets of shocks to the random processes that can affect municipal interest costs. The findings offer useful insights for state debt management in complex and evolving financial markets where, in some cases, the status quo bias from repeated use of the same underwriting firm might result in significant deviations from more efficient outcomes and limit interest cost savings. The next section of the article presents a theoretical framework that links status quo bias, repeated use of the same underwriter, and municipal borrowing costs. Section 3 discusses related studies, Section 4 explains the data and methodology, Section 5 presents empirical results, and Section 6 discusses policy insights.

2. THEORY

Neoclassical economic theory assumes that economic decisionmakers are unboundedly rational, meaning they gather complete information on alternative choices, assess all available information to determine their preferences, and act in a consistent way to make optimal choices (Weintraub 1985; 2002). The theory portrays individuals and households as making optimal decisions that maximize their utility or satisfaction from consumption in that they increase the quantity of a good or service they buy until the utility they derive from an extra unit of the item (marginal utility) is just equal to the price they pay for the item. In a similar way, firms produce more units of a good or service until the cost of producing an additional unit (marginal cost) is just equal to the marginal revenue the firm generates.

The neoclassical perspective suggests that as demand and supply decisionmakers all interact in an unboundedly rational and optimizing way, the economic system will attain pareto efficiency–an optimal allocation of goods and services such that no one actor can improve their own situation without worsening the situation of other actors in the system (Samuelson 1947; Mas-Colell, Whinston, and Green 1995; Colander, Holt, and Rosser 2004). Neoclassical theory also accommodates market intervention but asserts that it is only necessary when there is market failure, which would require government use of taxes and subsidies to alter relative prices and incentives and realign agents' behavior towards market equilibrium (Mazzucato and Penna 2016).

Behavioral economics challenges the core assumptions of neoclassical economic theory. It describes economic agents as limited in their cognitive ability and influenced by persistent biases such that, when faced with decision-making under uncertainty, agents consider heuristics, framing, representativeness, and other patterns, and take actions that satisfice rather than optimize or maximize expected outcomes (Kahneman, Slavic and Tversky 1982; Kahneman and Tversky 1984; Tversky and Kahneman 1991; Thaler 1994). Heuristics are the rules of thumb in specific decision-making scenarios; framing refers to the notion that the way a concept is presented to an agent matters; representativeness emphasizes that agents tend to weight more their recent experience; and other cognitive patterns might include conservatism and overconfidence (Ritter 2003).

Drawing from behavioral economics, prospect theory explains the behavioral biases that influence financial decision-making. It is a family of theories of decision-making under risk, uncertainty, and ambiguity that is based on observed models of human behavior in experimental settings. A key idea in prospect theory is that when faced with a prospect or expected outcome, an agent derives utility from changes in the expected outcome relative to a reference outcome, or status quo, such that the agent will assign an expected outcome to the domain of gains if it is equal to or greater than the status quo, but assign the expected outcome to the domain of losses if it is less than the status quo (Dhami 2016). Additionally, agents tend to select the status quo disproportionately, indicating status quo bias, due to endowment effects and loss aversion. Endowment effects arise when an agent's valuation of a good or service increases once the agent receives it, whereas loss aversion refers to an agent placing higher weight on losses relative to equivalent gains (Knetsch 1989; Kahneman, Knetsch, and Thaler 1991; Sokol-Hessner and Rutledge 2019). Consequently, decision-makers may have a strong bias towards the status quo even when available alternatives might be objectively superior to the status quo.

This article develops a theoretical framework that lies in behavioral economics and prospect theory with a specific emphasis on status quo bias. The article focuses on a specific decision-making situation involving a state government issuer that selects an underwriter from a set of underwriting firms and, given the state government's goal of maximizing interest cost savings (and minimizing interest costs), makes critical decisions under risk, uncertainty, and ambiguity in complex and evolving debt markets.

Table 1 presents a numerical illustration of the impact that status quo bias may have on municipal borrowing costs relative to an optimal outcome. The illustration is guided by the example in Filiz, Nahmer, Spiwoks and Bizer (2018) with some modifications. Assume that there is a state government issuer that issues bonds four times in a year, and for each issuance activity the state issuer can select one of two underwriters A and B. The issuer aims at achieving minimum interest costs whereas underwriters aim at maximizing profits. Also, assume that underwriter A's performance is independent of underwriter B's performance. Based on these assumptions, we can identify five possible combinations of underwriting activity in the given year, namely: AAAA, AAAB, AABB, ABBB, and BBBB. Assume further that state government use of each underwriter is associated with potential interest cost savings of either ±0 or $5 million dollars and that each of these two potential outcomes occurs with a 50% probability and follows a random process. Under these numerical conditions, underwriters A and B would each be associated with expected interest cost savings of $2.5 million and, given an issuance year consisting of four underwriting activities, the state issuer would be expected to generate interest cost savings of $10 million per year.

However, as Table 1 shows, the five random debt issuance events might have the same expected annual interest cost savings, *E(r)*, but the exposure to risk, *SD*, is different for each random event. Accordingly, a rational, risk averse state issuer should always choose the combination of underwriter-use represented as AABB in a given year because that combination has the least variance (*SD*=7.1), or risk exposure, in expected interest cost savings. Therefore, it could be argued that the combinations AAAA and BBBB depict status quo bias because in each of these cases, the state government repeatedly uses either underwriter A or B, but each case represents a suboptimal outcome and yields the largest exposure to risk (*SD*=10) among the system of random events.

Table 1. Expected Savings and Risk Exposure from State Government Use of Underwriters

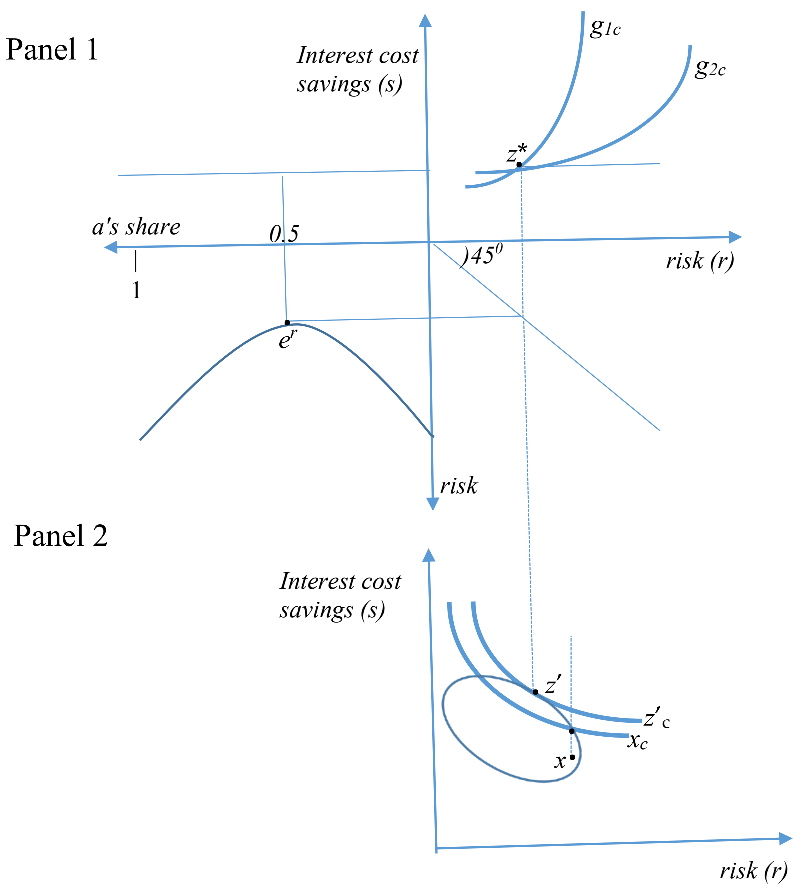
Random events	A=+5 B=+5 *(p=0.25)*	A=+5 B=±0 *(p=0.25)*	A=±0 B=+5 *(p=0.25)*	A=±0 B=±0 *(p=0.25)*	*E(r)*	*SD*
AAAA	+20	+20	±0	±0	10	10.0
AAAB	+20	+15	+5	±0	10	7.9
AABB	+20	+10	+10	±0	10	7.1
ABBB	+20	+5	+15	±0	10	7.9
BBBB	+20	±0	+20	±0	10	10.0

Note. Expected interest costs savings are expressed in million U.S. dollars.

Figure 1 panels 1 and 2 present another way to theoretically demonstrate status quo bias in municipal underwriter selection and its relationship with interest costs. The geometric illustration is based on Gubaydullina and Spiwoks (2015) and Filiz et al. (2018) but with some modifications. Assume that there are two state government debt issuers; one is a strongly risk-averse issuer, g_1, and the other is a less risk-averse issuer, g_2. The issuers select from two entirely uncorrelated underwriting alternatives, namely underwriting firms *a* and *b*, and both underwriters are identical regarding expected risk and interest cost savings. Based on these assumptions, Figure 1 Panel 1 depicts the efficient frontier as a single point z^* at which the ideal combination of underwriters is an exactly equal mix of *a* and *b* underwriting services. The equal mix of *a* and *b* underwriting services is portrayed as the midpoint (0.5) of *a*'s share of underwriting services, and at that point expected risk reaches its optimum (e^r), meaning that any change in *a*'s share of underwriting service would alter the ideal mix of expected risk and interest cost savings that establishes z* as the efficient frontier. g_{1c} and g_{2c} are indifference curves associated with g_1 and g_2, respectively, but at the optimal point z^*, it would not matter whether a strongly risk-averse or less-risk averse issuer selects the mix of underwriters.

However, Figure 1 Panel 2 shows how status quo bias disrupts the ideal environment. The geometric illustration is according to Masatlioglu and Ok (2005) but with some modifications. When there is a status quo *x*, the incompleteness of the state decisionmaker's preferences is manifest as there is a tendency to stick with the same underwriter unless there is another feasible alternative z' that dominates *x* in terms of interest cost savings and, in addition, more than compensates any assumed costs associated with switching to z'. If z' is an alternative underwriting service that is unambiguously superior to *x* in terms of interest cost savings, a state debt issuer *g* would consider the utility corresponding to the status quo (x_c) as irrelevant and resolve the decision-making problem in favor of z' and the corresponding utility z'_c. In sum, both the numerical and geometric illustrations demonstrate that it is plausible to construct state government repeated use of the same underwriter in terms of status quo bias and consider how interest cost outcomes deviate from an optimal outcome.

Figure 1. Geometric Illustration of Status Quo Bias in Municipal Underwriter Selection



3. RELATED LITERATURE

Only a small body of work exists that examines the interest cost implications of issuers' repeated use of the same underwriter in municipal bond markets. Additionally, the few studies on repeat use employ different theoretical lenses to analyze impacts on municipal borrowing costs. This brief review of the literature identifies three theoretical lenses, namely debt networks, relationships, and transaction costs. It also outlines in Box 1 other factors that may affect municipal borrowing costs, including bond-specific factors, issuer-related variables, municipal market-wide factors, and macroeconomic trends.

3.1 DEBT NETWORKS

Debt management networks may be defined as interactions among state and local government debt issuers and financial intermediaries involved in debt issuance (Marlowe 2013). Underwriters, municipal advisors, and bond lawyers all serve distinct roles as financial intermediaries in municipal debt issuance. Underwriters work with issuers to structure the bond sale (Simonsen and Hill 1998; Fruits, Booth, Pozdena, and Smith 2008), municipal advisors offer financial advice on how the municipality should structure the debt sale and invest issuance proceeds (Luby and Hildreth 2014), and bond lawyers provide informed opinions about the legal status of debt securities (Johnson, Luby, and Moldogaziev 2014). The debt management network may provide a mechanism for repeat interactions and long-term relationships among network members in municipal debt markets (Li and Schürhoff 2012).

Municipal finance scholars have used the concept of debt network stability to explain the impacts of repeated use of the same financial intermediary on municipal borrowing costs. Debt network stability is the extent to which a municipal issuer repeatedly uses the same financial intermediaries (e.g., the same underwriters) in new debt issuance (Marlowe 2013). The concept of stability refers to permanence of membership of the network and redundancy of members' ties with other entities both inside and outside of the network (Miller 1993).

Miller and Justice (2012) examined network stability effects, even though they did not provide a formal test of its impact on municipal borrowing costs. They explained that network stability affects municipal borrowing costs through channels of risk-taking, learning, innovation, and adaptation and its impact may be positive or negative. On the one hand, more stable networks provide greater opportunities for learning than less stable networks do, and these greater learning opportunities make it possible for network members to innovate and adapt to new strategies that tend to reduce errors and make outcomes more beneficial for all members of the network. On the other hand, more stable networks have a greater likelihood to yield to the leading of one member of the network and this single member might impose narrow views about the strategies the network should pursue; this would cause more errors in strategy for the network, result in greater risk-taking, and yield less beneficial outcomes such as higher borrowing costs. Thus, the debt network lens is inconclusive about whether repeated use of the same underwriter would lower or raise municipal borrowing costs.

3.2 RELATIONSHIPS

Municipal finance studies have investigated whether, and to what extent, the relationship between an issuer and financial intermediary affects municipal borrowing costs. Robbins and Simonsen (2008) analyzed issuers' persistent (or repeated) use of the same underwriting firm and the impact on municipal borrowing costs. They hypothesized that if a persistent relationship works in favor of an issuer, the issuer's borrowing costs would be lower compared to the costs for issuers who may not have formed and sustained such a relationship, but if the underwriting firm uses the persistent relationship with an issuer to gain a pricing advantage, the issuer's borrowing costs would be higher compared to other issuers who may not have this relationship. The authors' analysis of Missouri bond issuers showed that borrowing costs of negotiated sales increased significantly with more and more repeated use of the same underwriting firm.[1]

Liu (2015) studied "familiarity" (or 'strength' or 'intensity') in the relationship between an issuer and underwriter and found that increased familiarity significantly reduces municipal borrowing costs. The author's estimates showed that one more debt sale involving an issuer and the same underwriter, after using the same underwriter repeatedly in the previous two years, reduced true interest costs by an average of 6 basis points.

Liu also analyzed municipal advisors' repeated use of the same underwriter and the impact on municipal borrowing costs. While the author's focus on the municipal advisor-underwriter relationship differs from the present study's focus on the issuer-underwriter relationship, the findings in Liu's study present interesting insights on the impact of relationships in municipal debt issuance. Liu found that one more debt sale involving the same underwriter and municipal advisor raised true interest costs for the municipality by an average of 4 basis points. Like Liu, Moldogaziev and Luby (2016) examined the strength or intensity of the relationship between underwriters and municipal advisors and the impact on municipal borrowing costs. They found that an increase in the intensity of relationship between a municipal advisor and underwriter is associated with higher borrowing costs for the municipality. Specifically, municipal advisors who had at least 20% of their total yearly debt sales with the same underwriters were associated with municipal

[1] In a related study, Robbins and Simonsen (2016) showed that after controlling for the relationship between an issuer and underwriter, municipal governments still received substantially different interest costs when selecting one underwriting firm over another.

interest costs that were 6 to 11 basis points greater, on average, when compared with municipal advisors who had less than 20% of total yearly sales with the same underwriting firms.

More recently, Dzigbede (2019) used the bank-firm relationship–or bank hold up–theory in corporate finance to explain the interest cost implications of issuers' repeated use of the same underwriter in municipal debt markets. According to the bank hold up theory, as the relationship between a lending bank and borrowing firm grows, the firm may reveal proprietary information to the bank that the firm would not typically reveal to financial markets (Bhattacharya and Chiesa 1995), but the proprietary information that the bank obtains may give the bank an information monopoly such that, over the lifetime of the bank-firm relationship, the bank could impound information, hold-up the borrower, and ultimately charge high (ex-post) loan rates (Sharpe 1990; Rajan 1992; Stein 2015).

Dzigbede (2019) tested the likelihood that over the course of an issuer-underwriter relationship, as the issuer repeatedly uses the same underwriter for more debt sales, the underwriting firm might gain an information advantage relative to other underwriting firms, and impound and use such information to charge continually higher rents and fees, causing municipal interest costs to increase exponentially. The author found that under conditions of information capture and rent seeking by underwriting firms in municipal markets, one more repeated use of the same underwriter, after using the same underwriter repeatedly in the three years preceding the debt sale, increased municipal interest costs by 0.15 basis point higher than before, and interest costs continued to rise at that rate with each repeated use of the same underwriter in new debt sales.

In sum, municipal finance researchers using the relationship lens have found two different outcomes for the impact of repeated use of the same underwriter on municipal borrowing costs. Liu (2015) found that one more repeated use of the same underwriter reduced municipal borrowing costs by an average of 6 basis points, whereas Dzigbede (2019) showed that each repeated use of the same underwriter raises municipal interest costs by 0.15 basis point higher than before, and interest costs rise exponentially.

3.3 TRANSACTION COSTS

Transaction costs are the exchange costs associated with negotiating and monitoring contracts and trading information among exchange parties in the market system (Coase 1937). Exchange parties in a transaction critically need information to enter and participate in financial markets, but such information can be costly, unequal, and uncertain and may determine whether the exchange would be mutually favorable or unfavorable (Arrow 1969). However, transacting parties can work together to minimize transaction costs and achieve the least cost of investment (Williamson 1989).

In the municipal finance literature, some studies have analyzed scale effects in municipal bond transaction costs with a specific focus on transaction size (e.g., Robbins and Simonsen 2013), but other studies more related to the present study have used transaction frequency, a dimension of transaction costs, to explain municipal market outcomes. Transaction frequency denotes the extent to which transactions are repeated, whether they are one-time, occasional, or recurrent (Williamson 1979). Using the transaction frequency lens, Dzigbede (2019) analyzed the recurrent or repeated use of the same underwriter in municipal debt issuance and the impact on issuance costs. The author hypothesized that as an issuer repeatedly uses the same underwriting firm for new debt sales, municipal interest costs would increase initially, reach a peak, and decrease eventually because an underwriting firm incurs search and information costs about the municipal issuer when structuring a debt sale; therefore, as the issuer repeatedly uses the same underwriting firm, fixed costs from search and information gathering would spread across more debt sales and lower the average costs of underwriting and borrowing. The author found that one more repeated use of the same underwriting firm increased municipal interest costs by 0.31 basis point initially, but each additional repeated use of the same underwriter increased interest costs less than before, and interest costs reached a peak, then decreased at an increasing rate. The author's finding reflects a concave or inverted-u curvature between repeated use of the same underwriter and municipal borrowing costs.

3.4 HYPOTHESIS

The present study uses status quo bias as an alternate theoretical lens to explain repeated use of the same underwriter and its impact on municipal borrowing costs. The study differs from existing studies that use theories of debt management networks, relationships, and transaction costs to explain impacts on borrowing costs. Additionally, the present study analyzes the interest cost implications of repeat use in reference to a hypothetical optimal outcome of municipal interest costs, which makes this study stand apart from previous studies. Consequently, the study tests the following research hypothesis:

Hypothesis: Status quo bias in state government underwriter selection affects municipal borrowing costs and results in a suboptimal outcome.

4. DATA AND METHOD

This article uses Monte Carlo simulation to generate several potential outcome scenarios for municipal borrowing costs under conditions of risk and uncertainty arising from status quo bias in municipal underwriter selection, bond-specific characteristics, issuer-related factors, municipal market-wide trends, and macroeconomic risk factors. Monte Carlo simulation uses random sampling to mimic the underlying data generating process of a mathematical function and, based on repeated random samples, defines a range of potential outcome scenarios to determine the probability distribution of a sampling statistic of the outcome variable (Davidson and MacKinnon 2004; Adkins 2011). Accordingly, outputs from Monte Carlo simulation are probability distributions of the outcome variable and are generated based on a deterministic model of the outcome variable along with underlying sample data. The sample data for this study consist of general obligation bonds the State of California issued between 2005 and 2014, and the data are publicly available from the California Debt and Investment Advisory Commission (CDIAC). The Monte Carlo method also makes it possible to analyze potential outcome scenarios in reference to a hypothetical optimal outcome or efficient frontier, which defines a potential minimum interest cost and shows deviations from the optimized solution that envelopes the sample data and accommodates random statistical noise. Below, the data and analytical approach in this study are explained in more detail and four steps.

Box 1. Other Determinants of Municipal Borrowing Costs

A large body of work already exists on how bond-specific factors, issuer-related variables, municipal market conditions, and economy-wide trends influence municipal borrowing costs: this box provides a brief summary of the expected impacts of these variables on municipal borrowing costs.

Bond-specific factors

Bond-specific factors include method of sale, issue size, term to maturity, type of bond, purpose of bond, insurance status, call provision status, refunding status, and whether the bond is subject to federal income taxation.

On method of sale, some studies have found that using competitive bidding results in lower borrowing costs than negotiated sales (e.g., Bland 1985; Simonsen and Robbins 1996; Marlowe 2009; Guzman and Moldogaziev 2012), other studies have found that using negotiated sales results in similar borrowing costs as competitive bidding (e.g., Stevens and Wood 1998), and still other studies have found that issuers who select and use negotiated sales successfully tend to have no greater, and may even achieve lower, borrowing costs (Kriz 2003).

Also, municipal borrowing costs tend to rise when issue size increases (Marlowe 2011), and increase when term to maturity increases (Peng and Brucato Jr. 2003). Additionally, municipal borrowing costs tend to be higher for revenue bond types than general obligation bonds (Daniels and Ejara 2009) and higher for bonds issued for the purpose of undertaking health care and economic development projects than for the purpose of education, utility, and government general purpose projects (Leonard 1983).

Further, municipal borrowing costs tend be higher for bonds that do not have call provisions compared to those that have provisions, higher for bonds that are not insured compared to those that are insured (Peng and Brucato Jr. 2004), higher for bonds that are not refunding bonds compared to those that are refunding bonds (Robbins 2002), and higher for bonds that have interest income subject to federal taxation compared to bonds that are not subject to taxation (Liu 2015).

Issuer-related factors

Issuer-related variables include credit worthiness of an issuer and municipal fiscal conditions such as unemployment rate, personal income per capita, own-source general revenue per capita, and higher long-term debt outstanding per capita. Bonds that have higher underlying issuer ratings tend to have lower municipal borrowing costs than bonds that have lower underlying credit ratings (Peng and Brucato Jr. 2004; Boot, Milbourn, and Schmeits 2006; Daniels and Ejara 2009). Also, municipal borrowing costs tend to increase when there is an increase in unemployment rate, a decrease in personal income per capita, a decrease in own-source general revenue per capita, and an increase in long-term debt outstanding per capita in the municipality (Johnson and Kriz 2005).

Market condition factors

Municipal market-wide conditions affect municipal borrowing costs as interest costs rise when market conditions worsen (Peng and Brucato Jr. 2004; Moldogaziev 2012). Similarly, an increase short-term interest rates in the national economy reflects macroeconomic risk and may raise municipal borrowing costs (Fama 1975; Bernanke and Gertler 1995; Maio and Santa-Clara 2017).

4.1 DETERMINISTIC MODEL FOR MONTE CARLO SIMULATION

A first step is to model the data generation process and define a deterministic model of municipal interest costs. The deterministic model is based on the specification in Dzigbede (2019). The author modeled true interest costs as a mathematical function of repeated use of the same underwriter and other bond-specific, issuer-related, municipal market-wide and macroeconomic factors. The model specification in that study used Box-Cox transformation to identify the optimal power transformation for each of the model variables and used the transformed variables to estimate a modified model of municipal interest costs. The model and results from that study mimicked practical situations in municipal debt issuance where it is likely that, if information capture and rent seeking by underwriting firms persist, repeated use of the same underwriter may increase municipal borrowing costs exponentially. The present study finds the model specification in Dzigbede (2019) to be suitable for analyzing repeated use or status quo bias than the models in related studies such as Liu (2015), which did not focus on non-linear effects in the relationship between repeated use of the same underwriter and municipal borrowing costs. Consequently, the present study uses the model specification in Dzigbede (2019) and makes some modifications.

Equation 1 outlines the deterministic model of municipal borrowing costs in the present study. *tic* is the dependent variable representing true interest costs: it is Box-Cox transformed using the parameter φ such that: $tic^{(\varphi)} = tic - 1$ if $\varphi = 1$; $tic^{(\varphi)} = ln(tic)$ if $\varphi = 1$; and $tic^{(\varphi)} = 1 - \frac{1}{tic}$ if $\varphi = -1$. Also, λ is a parameter that transforms the interval level independent variables in a similar way as φ, but the categorial independent variables are untransformed.

Equation 1:

$$tic_j^{(\varphi)} = \propto + \beta_1 repeat_j^{(\lambda_1)} + \beta_2 size_j^{(\lambda_2)} + \beta_3 maturity_j^{(\lambda_3)} + \beta_4 AArating_j + \beta_5 AArating_j + \beta_6 negotiated_j + \beta_7 insurance_j + \beta_8 BBIvolatility_j^{(\lambda_8)} + \beta_9 tbill_j^{(\lambda_9)} + \varepsilon_j$$

In the equation, repeated use of the same underwriter, *repeat*, is an interval level independent variable that measures the number of times within the previous 3 years the state government used the same underwriter in new debt issuance. As an example of how *repeat* is measured, consider that the State of California issued a state general obligation bond dated February 16, 2005 and used Citigroup as the underwriting firm for the sale: in the 3 years preceding this new bond sale–that is, going as far back as February 17, 2002–the state government repeatedly used Citigroup as underwriter 29 times in new bond sales; therefore, in the new debt issuance on

February 16, 2005 using Citigroup as underwriter, *repeat* takes the value 29 as a count measure of the number of times within the past three years that the state issuer repeatedly used the same underwriting firm in new debt issuance. Liu (2015) similarly used a count measure of repeat use and the present study recognizes that using a medium-term frame of three years is reasonable for identifying patterns in repeat use of the same underwriter. The present study also considered alternate measures of repeat use, including a relative measure that expresses the count measure as a proportion of all repeated use of underwriters by the state issuer (see Hickling 2004; Moldogaziev and Luby 2016), but the results were not substantially different from what was obtained using the count measure. Also, given that the sample data covers 2005 to 2014, underwriting information starting from 2002 is used to measure repeat use of the same underwriter over the 3 years preceding new debt sale.

Other interval level independent variables in Equation 1 are issue size, term to maturity, municipal market-wide conditions, and macroeconomy-wide interest rates. Issue size, *size*, is the total par value of the bond, measured in million U.S. dollars. Term to maturity, *maturity*, measures the number of years from the date of issuance of a bond to maturity date. Municipal market-wide condition, *BBIvolatility*, is measured using the standard deviation of the Bond Buyer Index over the previous 12 weeks. Robbins and Simonsen (2013) and Moldogaziev and Luby (2016) similarly used the standard deviation of the Bond Buyer Index over previous weeks to measure municipal market condition. This article also uses the standard deviation of the Bond Buyer Index over the previous 4 weeks, and over the previous 8 weeks, as alternate measures of municipal market condition, but these alternate measures yielded results that are not significantly different from the results obtained from using standard deviation over the previous 12 weeks to measure municipal market condition. Macroeconomic trends, *tbill*, is the one-month short-term Treasury bill rate.

Method of sale, credit rating underlying a bond, and insurance status of a bond are measured as categorical independent variables in Equation 1. Method of sale, *negotiated*, is coded 1 for negotiated sale and 0 for competitive sale. Credit rating underlying a bond is measured using three categorical variables because the sample data consists of bonds in three rating categories only: *AAArating* is coded 1 for a bond with AAA rating and 0 if the bond is not AAA rated; *AArating* is coded 1 if the bond is rated AA and 0 if the bond is not rated AA; *Arating* is coded 1 if the bond is rated A and 0 if the bond is not rated A; and A-rated bonds are the reference group in the regressions. Insurance status, *insurance*, is coded 1 if the bond is insured and 0 if the bond is not insured. Also, $\beta_1, \beta_2, \ldots\ \beta_9$ are elements of the vector, $\boldsymbol{\beta}$, of coefficients associated with the independent variables. Finally, i stands for the list of n bonds in the sample data and ε_j is the error term that has mean equal to zero and is uncorrelated with itself or any of the independent variables.[2]

4.2 SAMPLE DATA AND MODEL INPUTS FOR MONTE CARLO SIMULATION

A second step is to define the model inputs for Monte Carlo simulation and scenario analysis. The model inputs derive from the underlying sample data. As mentioned earlier, the sample data are from general obligation bonds the State of California issued between 2005 and 2014. The sample consists of 1,063 California state-issued fixed-rate general obligation bonds and gives details about bond-specific characteristics, issuer-specific factors, municipal market conditions, and macroeconomic trends. Based on the sample data, the study obtains model parameters and estimated coefficients of explanatory variables and these serve as model inputs for Monte Carlo simulation of interest cost outcomes.

Table 2 presents descriptive statistics of the sample data. Median values of the explanatory variables are the model parameters used as a baseline for Monte Carlo simulation of interest cost outcomes. Accordingly, the median values define the model baseline as: a state government fixed-rate general obligation bond issuance that repeatedly used the same underwriter 47 times during the past three years; this bond has total par value amounting to $13.4 million dollars, term to maturity of 24 years and 3 months, A-credit rating, no insurance, and is a negotiated sale; furthermore, the bond issuance occurs at a time the standard deviation (volatility) of the Bond Buyer Index over the previous 12 weeks is 1.32, and the one-month Treasury bill rate is 0.08%.

When the model parameters (*MEDIAN*) combine with the estimated coefficients (β) of the explanatory variables, Monte Carlo simulation of these model inputs produces potential outcomes of municipal interest costs that also accommodate random shocks. Table 3 shows the medians and estimated coefficients of the explanatory variables.[3] The coefficient (β_1) of the main variable

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[2] Several independent variables are not included in Equation 1 because the variables were not significant in the deterministic model of true interest costs. The variables not included are purpose of bond sale, refunding status of bond, federal tax status of bond, and government fiscal condition measured using state unemployment rate and state personal income per capita. Also, the analysis does not include other variables that are known to affect true interest costs, including number of bids for the bond, a measure of duration, and a California general obligation bond index.

[3] See Appendix A for the complete output of estimated coefficients along with model summary statistics. All the explanatory variables have statistically significant coefficients and the signs of these coefficients are as expected *a priori*, except the coefficient of the variable measuring issue size, which was not statistically significant but had the expected sign.

of interest, repeated use of the same underwriter (*repeat*), is *0.0016* meaning that one more repeated use of the same underwriting firm raises municipal interest costs by 0.16 basis point higher than before, and interest costs continue to rise at this rate with each additional use of the same underwriting firm in new debt issuance. This estimate seems to support the bank hold-up, or information capture, theory that as a municipal issuer repeatedly uses the same underwriting firm for more and more bond sales, the underwriting firm could gain an information advantage relative to other underwriting firms and that advantage can cause the underwriting firm to charge higher rents and fees continually, and eventually cause municipal interest costs to rise exponentially.

Table 2. Descriptive Statistics

Variable	Mean	SD	MEDIAN	MIN	MAX
True interest costs	4.32	0.91	4.30	0.96	7.44
Repeat use	57.73	45.5	47.00	0	205
Issue size	70.53	151.25	13.42	0.01	1556
Term to maturity	23.75	6.24	24.23	2.89	35.04
Credit rating					
AAA	0.25	0.43	0	0	1
AA	0.01	0.09	0	0	1
A	0.74	0.43	1	0	1
Negotiated	0.74	0.44	1	0	1
Insurance	0.23	0.42	0	0	1
BBI volatility	1.67	1.03	1.32	0.50	5.55
Treasury bill rate	1.23	1.80	0.08	0.01	5.16

Table 3. Model Inputs for Monte Carlo Simulation

Variable	β	MEDIAN
Repeat use	0.0016	47.00
Issue size	-0.0001	13.42
Term to maturity	0.0399	24.23
Credit rating		
AAA rating	-0.6422	0
AA rating	-0.6983	0
Negotiated	0.2179	1
Insurance	0.2932	0
BBI volatility	0.1803	1.32
Treasury bill rate	0.1461	0.08

In Monte Carlo simulation, some of the independent variables from the underlying model are set as random variables and each random variable draws random numbers from an underlying distribution of the variable to influence model outcomes. Some of the explanatory variables may also be assigned as policy variables to depict the discretion policymakers may have in influencing potential policy outcomes. In this study's analytical framework, the random model inputs are the variables gauging repeated use of the same underwriter (*repeat*), municipal market-wide conditions (*BBIvolatility*), and macroeconomic trends (*tbill*) – in fact, these random inputs may also be viewed as policy inputs to mimic discretionary policymaking amidst uncertainty in state government debt issuance (*repeat*), municipal market regulation (*BBIvolatility*), and macroeconomic management (*tbill*). In other words, the variables *repeat*, *BBIvolatility*, and *tbill* are allowed to vary randomly outside of their actual observed values while the remaining explanatory variables were not allowed to vary. The underlying distribution for each of the random inputs is PERT, a continuous probability distribution that specifies the minimum, most likely, and maximum values that a variable can take (Clark 1962).[4] The PERT distribution was selected for each of the three random inputs based on their sample data properties and using a software-determined ranking of the most fitting continuous probability distribution. Appendix B shows the distribution of each of the variables allowed to vary as a random input in the Monte Carlo simulation. As a way to test the robustness of the study method, simulations were performed using the second and third ranked software-determined continuous probability distribution of each random variable, but the simulation results did not differ significantly compared to the results from using the first-ranked (best fit) statistical distribution of each random variable.

4.3 MONTE CARLO SIMULATION OF THE DETERMINISTIC MODEL

The third step is simulation of the deterministic model using repeated samples and tabulating the statistical properties of potential outcomes. The analysis undertakes 100,000 iterations of the model and obtains a range of statistical properties, including the probability distribution of the mean true interest cost. In determining the number of iterations, the analysis uses a simple formula that computes the least number of iterations needed to achieve a desired level of precision in the sampling distribution of the outcome variable: $n = [(z * s) / m]^2$, where n is the least number of iterations, z stands for the z-score at 95% confidence level (z=1.96), s is the estimated standard deviation (s=0.23) of the sampling distribution of the outcome variable, and m is the desired margin or level of precision of the outcome variable

[4] PERT stands for Program Evaluation and Review Technique.

(see Liu 2017).[5] Based on the formula, the least number of iterations needed for the simulation to be accurate within 0.0015 units of the outcome variable 95% of the time is 90,321 iterations, and the study rounded this number to 100,000 iterations using the nearest integer power of 10 (i.e., $n=10^4$). The analysis also considered simulations with 10,000 and 200,000 iterations, respectively, but these did not produce results significantly different from those obtained from using 100,000 iterations. Another important aspect of the analytical framework is sensitivity analysis, which was performed to show the ways that potential outcome scenarios respond to significant shocks to the model inputs.

4.4 EFFICIENT FRONTIER AND OPTIMIZATION OF TRUE INTEREST COSTS

In the fourth step, the study investigates the potential optimal outcome for true interest costs using optimization techniques and the notion of an efficient frontier. The efficient frontier in neoclassical microeconomic theory is the notion that producers are not always efficient; therefore, actual cost of production (or actual profits) would deviate from the locus of points that define an optimal minimum cost (or maximum profit) owing to technical and allocative inefficiency. Kumbhakar, Wang, and Horncastle (2015) formalized this notion of cost efficiency in a simple stochastic frontier model that is applicable to the present study's focus on optimal municipal borrowing costs. Equation 2.1 outlines the model in Kumbhakar et al. with some modifications. tic^a represents actual true interest costs, x_j lists the explanatory variables of true interest costs, and β_j shows the coefficients of the explanatory variables. The optimal true interest cost is tic^*, which is derived from the unobserved frontier function $C^*(\cdot)$, and $\exp(\eta)$ is the inefficiency factor that raises actual interest costs beyond optimal interest costs. Finally, Equation 2.2 shows the efficiency index relating actual and optimal interest costs.

Equation 2.1:

$$tic^a = \sum_j \beta_j x_j = tic^* \exp(\eta)$$

Equation 2.2:

$$\exp(-\eta) = \frac{C^*}{C^a}$$

[5] s is the standard deviation of the output obtained from a reasonably small number of 1,000 iterations.

5. RESULTS

5.1 BASELINE SCENARIO

Monte Carlo simulation of the true interest cost model in Equation 1 shows that municipal borrowing costs are influenced by a combination of factors, including status quo bias in municipal underwriter selection, bond-specific factors, issuer-related variables, municipal market-wide conditions, and macroeconomic risk factors. Figure 2 shows the cumulative probability density curve associated with the baseline simulation. The results show that given the parameters set for the baseline scenario, and based on the statistical distributions of the variables in the sample data, the mean of the sampling distribution of true interest costs is 3.80%, and there is a 95% probability that the mean interest cost will lie between 3.43% and 4.32%.

Figure 2. Baseline Simulation of Potential True Interest Costs

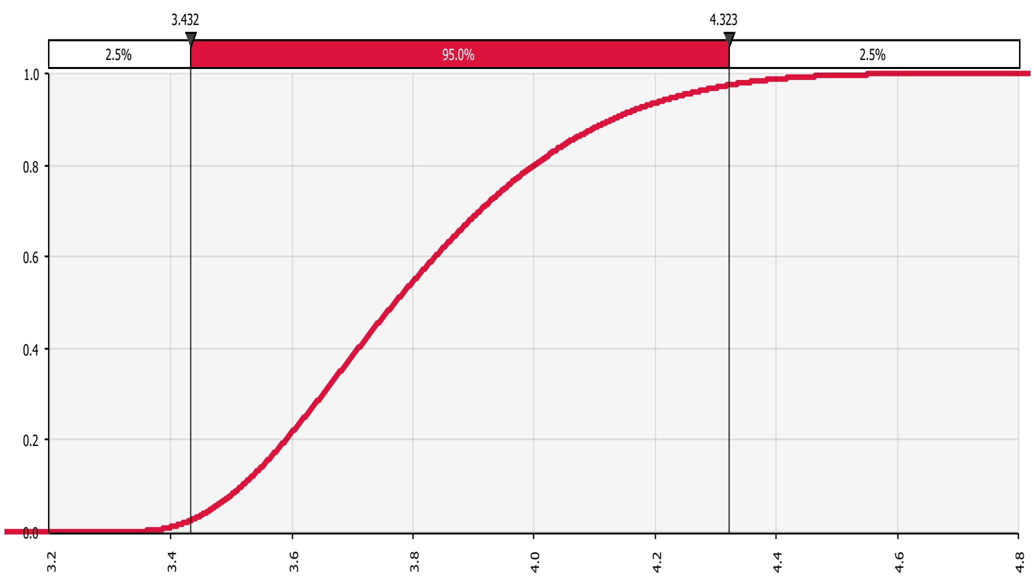

Figure 3. Relative Contribution of Random Inputs towards Total Variance in Mean Interest Costs

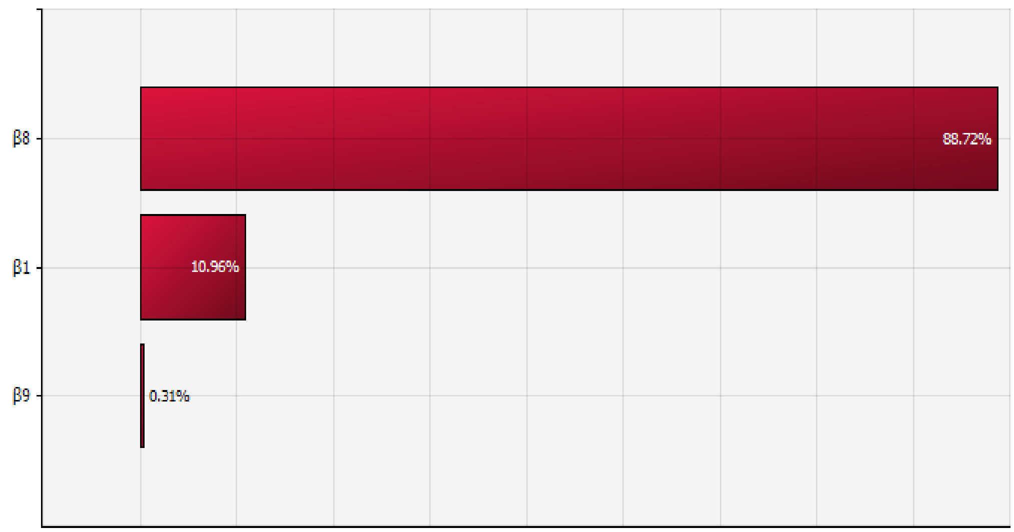

Figure 3 shows the model random inputs ranked by their relative contribution to total variance in mean true interest costs. The chart shows that the random input gauging municipal market-wide conditions, β_8, contributes the largest (88.72%) variance towards total variance in mean interest costs. Repeat use of the same underwriter contributes the second largest (10.96%) variance, and the input measuring macroeconomic risk factors contributes the least (0.31%) towards variation in mean interest costs.

5.2 SENSITIVITY TESTS

Stress tests of the baseline simulation give additional insights on the ways that municipal borrowing costs respond to risk and uncertainty. Two separate stress tests were conducted. The first test is a single shock related to the random input measuring status quo bias in municipal underwriter selection (β_1). On the other hand, the second test is a simultaneous shock related to all random inputs, namely repeated use of the same underwriter (β_1), municipal market-wide risk (β_8), and macroeconomic risk (β_9). Both stress tests restrict samples drawn from the distribution of a random variable to high values in the 95th percentile to simulate the worst outcomes for true interest costs. Table 4 shows results from the two sensitivity tests. In the first scenario, a single shock related to repeated use of the same underwriter resulted in a mean true interest cost of 3.99%, which is higher than the 3.80% simulated in the baseline scenario. Also, the second stress scenario involving a simultaneous shock to all three random inputs resulted in a mean interest cost of 4.54%.

Table 4. Baseline Simulation and Sensitivity Tests for True Interest Costs

Statistic	Baseline Simulation (%)	Stressed Simulation (%)	
		β_1 only	*β_1, β_8, and β_9*
Mean	3.80	3.99	4.54
Minimum	3.32	3.57	4.39
Maximum	4.78	4.89	4.95
5th percentile	3.47	3.68	4.42
Median	3.77	3.95	4.52
95th percentile	4.24	4.40	4.71
Standard deviation	0.24	0.22	0.09
Skewness	0.57	0.62	0.89
Kurtosis	2.93	2.89	3.52

5.3 EFFICIENT FRONTIER AND OPTIMIZATION OF TRUE INTEREST COSTS

The efficient frontier is determined using optimization techniques. The optimization procedure sets a target goal, lists the bounds associated with that target, and solves a sequence of optimizations, one for each bound listed, to determine the optimal solution. An optimization software package was used to undertake the sequence of optimizations that produced an optimal solution. The solution is termed optimal and efficient in the sense that it is the minimum true interest cost that envelopes the sample data and accommodates the presence of random statistical noise.

Table 5 shows the optimized solution along with the target goal and constraining values. The results show that the optimal true interest cost is 2.84%. This is the optimal and efficient outcome for true interest costs in a deterministic model that accommodates status quo bias in municipal underwriter selection, bond-specific factors, issuer-related variables, municipal market-wide conditions, and macroeconomic trends. It is noteworthy that the mean true interest cost in the baseline scenario ($tic^a=3.80$) deviates significantly from the optimal true interest cost ($tic^*=2.84$) and this reflects how status quo bias and other risk factors together contribute to a suboptimal outcome in municipal debt issuance. The optimization results show an efficiency index of 0.747 (tic^*/tic^a) that is less than 1.

Table 5. Optimization Results for True Interest Costs

Constraining value (%)	*Optimal solution (%)*
0.96	-
1.68	-
2.40	-
3.12	-
3.84	2.84
4.56	2.84
5.28	2.84
6.00	2.84
6.72	2.84
7.44	2.84
Statistic to Optimize	Mean
Number of Trials	100
Target Value	0.96
Number of Iterations	10,000
Sampling Type	Latin Hypercube
Solving Method	Recipe

6. CONCLUSION AND POLICY INSIGHTS

This article is a prospective analysis of status quo bias in municipal underwriter selection. It formulates state government repeated use of the same underwriter as status quo bias–the tendency to select a current or previously chosen alternative disproportionately often, even as the current or previous alternative gives a suboptimal outcome. The article tested the hypothesis that status quo bias in state government underwriter selection affects municipal borrowing costs and results in a suboptimal outcome. Monte Carlo simulation results support the study hypothesis: status quo bias in underwriter selection, together with other risk factors arising from bond-specific characteristics, issuer-related variables, municipal market conditions, and macroeconomic trends, influence state government borrowing costs and result in a suboptimal outcome. The simulation and optimization results show that the mean true interest cost of 3.80% deviates substantially from a hypothetical optimal outcome of 2.84%, and the efficiency index of 0.747 reflects a suboptimal outcome. These results portray that Monte Carlo simulation and optimization using different choices (other than the choices public managers made that resulted in the original data) produces expected interest cost outcomes that are, on average, objectively superior to the outcomes actually experienced, and this finding persists despite modelling that introduces a combination of shocks to the random processes affecting municipal borrowing costs.

The article makes two important contributions to the existing literature. First, it contributes towards a composite theoretical lens for understanding the link between municipal governments' repeated use of the same underwriter in new debt issuance and the impact on municipal borrowing costs. While existing studies use theories in debt networks, relationships and information capture, and transaction costs to explain repeat use of the same underwriter, this article proposes that status quo bias is another way to frame repeat use and understand better its impacts on municipal borrowing costs relative to a hypothetical optimal outcome. The theoretical framework describes a specific financial decision-making situation involving a state government issuer that selects an underwriting firm from a set of underwriting firms and seeks to maximize interest cost savings in complex and evolving municipal debt markets where information capture and rent-seeking by underwriting firms persist amidst risk and uncertainty.

Second, the article presents a useful empirical framework within which to assess the interest cost implications of status quo bias in municipal underwriter selection. Monte Carlo simulation of a baseline scenario of potential interest cost outcomes makes it plausible to use dynamic optimization techniques to determine an optimal solution that envelopes the sample data and shows deviations from an optimal minimum interest cost. In this regard, the empirical findings in this article provide new insights that would enrich the small body of work examining the impact of repeated use of the same underwriter on municipal borrowing costs.

Overall, the article offers useful insights for state government debt management. One policy insight is that status quo bias in municipal underwriter selection may result in interest cost outcomes that deviate significantly from the minimum borrowing cost that the municipality can potentially achieve. It is understandable that a municipality may determine that the interests of citizens are best served by continuing to use a specific set of underwriters over several years. However, if the municipality's goal is to achieve cost efficiency, it may be prudent for municipal debt managers to continually gauge the efficient level of repeated use of the same underwriter that aligns closer with an optimal minimum cost and raises interest cost savings. This may require that the municipality closely monitor underwriting services over time and use effective performance monitoring systems to detect and penalize (through non-repeat use) underwriting firms that amplify rent-seeking behavior and perverse information capture relative to other underwriting firms.

Another important insight is the influence of municipal market factors and macroeconomic trends on municipal borrowing costs. The findings from sensitivity analyses in this study show that status quo bias, municipal market-wide risk, and macroeconomic risk factors together cause severe perturbations in the probability distribution of true interest costs. This statistical evidence emphasizes the roles that municipal market regulators and macroeconomic policymakers can play in moderating risks and uncertainty in municipal debt markets to reduce incentives that might persist for rent-seeking by underwriting firms. A synergy of policymaking efforts between municipal market regulators and macroeconomic policymakers would enhance municipal market efficiency and lower the opportunity costs associated with a municipal issuer using the same underwriting firm disproportionately often in new debt issuance, even when repeated use results in a suboptimal outcome.

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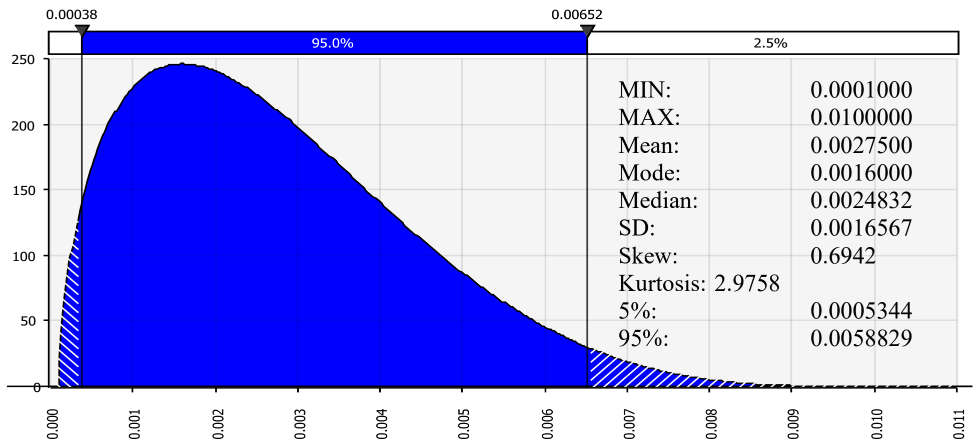
Appendix A. Estimates of the Determinants of True Interest Costs

Variables	Coefficients	Standard Errors
Repeat use	0.0016***	0.00058
Issue size	-0.000079	0.00069
Term to maturity	0.040***	0.0047
Credit rating		
AAA	-0.64***	0.13
AA	-0.70*	0.36
Negotiated sale	0.22***	0.055
Insurance	0.29***	0.041
BBI volatility	0.18***	0.029
Treasury bill rate	0.15***	0.035
Year 2006	-0.097*	0.053
Year 2007	-0.39***	0.066
Year 2008	-0.18	0.15
Year 2009	0.99***	0.19
Year 2010	1.25***	0.24
Year 2011	0.52*	0.29
Year 2012	-0.29	0.20
Year 2013	-0.15	0.24
Year 2014	-0.45*	0.26
Constant	2.78***	0.17
Observations	1,063	
F (18, 1044)	128.77	
Prob >F	0.00	
Adjusted R-squared	0.6799	

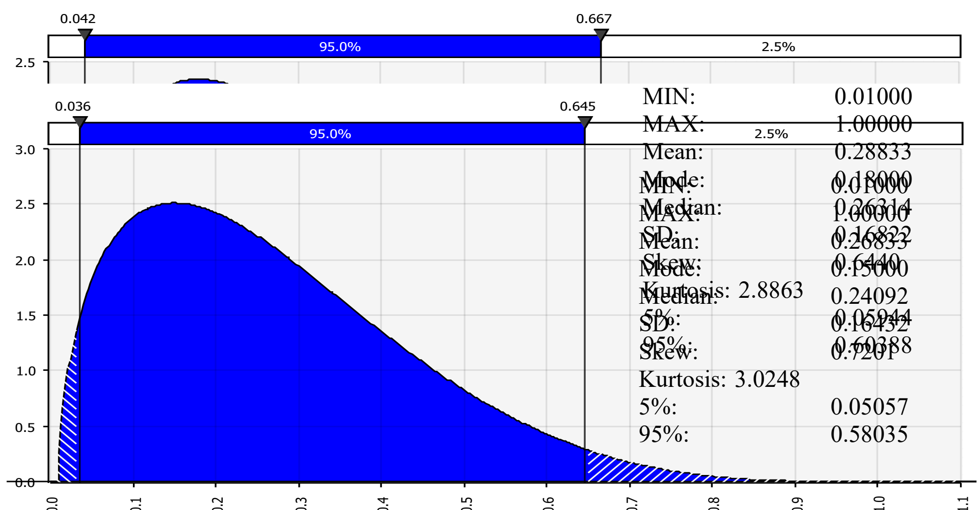
Note. Standard errors are robust to heteroskedasticity. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Also, the estimation uses the functional forms of model variables, and these functional forms are determined using multivariate Box-Cox transformation. The transformations show that the cubic root functional form ($\lambda=1/3$) best represents ‘repeat use’ and the untransformed functional form ($\lambda=1$) is the optimal way to represent ‘true interest costs’. Thus, the estimated coefficient of ‘repeat use’ portrays an exponential relationship between ‘repeat use’ and ‘true interest cost’.

Appendix B. Statistical Distribution of Random Model Inputs

Panel A: Repeat Use



Panel B: BBI volatility



Panel C: Treasury bill rate