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Savings Lost:
The Damage of Taxable Advance Refundings to Taxpayers

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Refinancing ("refunding") outstanding debt for interest savings represents a significant amount of annual issuance in the $4 trillion municipal securities market. We conduct a "counterfactual" analysis of select taxable advance refundings by state and local governments between 2018 and 2020. Instead of advance refunding their not-yet-callable tax-exempt bonds with taxable bonds, municipal issuers could have waited until the call date and then refunded these bonds with tax-exempt bonds. A comparison of the actual savings to the "counterfactual" savings reveals that waiting until the call date would have been substantially more beneficial, providing over 58% more savings. We estimate that in aggregate taxable advance refundings cost taxpayers billions of dollars. We introduce the notion of proficiency to assess the effectiveness of debt management ex-post. The counterfactual methodology and the resulting proficiency measure should be of interest to both the chief executives and taxpayers of state and local governments. Routine counterfactual analysis, combined with reported proficiency, is certain to result in more disciplined and systematic debt management practices.

Keywords: Bond Refunding, Counterfactual Analysis, Refunding Efficiency

The refinancing ("refunding") of outstanding debt for interest cost savings represents a significant amount of annual issuance in the $4 trillion outstanding municipal securities market.[1] For example, municipal borrowers in 2020 sold $483 billion in total debt, with $149 billion of that amount consisting of refunding bonds, which represents almost one-third of the total market (Bagley et al., 2021). As such, refunding outstanding indebtedness represents a major component of these borrowers' capital market activities.

Prior to the Tax Cuts and Jobs Act of 2017 (the 2017 Act), which was signed into law on December 22, 2017, municipal borrowers could "advance" refund their outstanding bonds on a

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tax-exempt basis more than 90 days before the actual call date. These transactions were known as "tax-exempt advance refundings." The federal government allowed one tax-exempt advance refunding over the life cycle of the bond issue as a means of minimizing the foregone federal tax revenue afforded by tax exemption (Johnson et al., 2021).[2] However, the 2017 Act prohibited previously eligible borrowers from using tax-exempt bonds to advance refunds. This restriction led many borrowers to use taxable, rather than tax-exempt, bonds to refund their not-yet-callable debt.

It is important to note that advance refunding with taxable bonds was optional. Municipal issuers could have waited until the call date (i.e., retain the call option) and then refund with tax-exempt bonds at potentially lower interest rates. Previous research has stressed the importance of comparing the forfeited value of the call option to the cash flow savings from the refunding to assess whether to refund (Boyce & Kalotay, 1979; Kalotay et al., 2007).

According to Kalotay (2021), the efficiency of the typical taxable advance refunding transaction after the 2017 Act's passage was barely 70%, indicating that the *ex-ante* waste was 30% of the option value. The *actual* waste (if any) can only be determined by examining interest rates as of the call date of the refunded bonds when the debt could have been refunded with tax-exempt bonds. This paper performs exactly such "counterfactual" ex-post analysis for 14 taxable advance refunding transactions between 2018 and 2020.

Although the savings from taxable advance refundings were significant, waiting until the call date would have been more beneficial. Specifically, we estimate "waiting" would have provided almost 58% more savings. We propose the 'proficiency' measure, defined as the ratio of the actual savings to the counterfactual savings, to assess how effectively the debt has been managed. In this paper, the proficiency calculation is limited to refunding decisions. However, the proficiency concept applies to other areas of debt management. The corresponding average proficiency ratio was roughly 63% for these 14 transactions.

Based on our results, we estimate that taxable advance refunding has cost taxpayers billions of dollars in the aggregate. We believe that ex-post counterfactual analyses, such as the ones conducted here, would lead to more disciplined municipal debt management practices in general and to more efficient refunding decisions in particular. From a policy perspective, the results suggest that the current metrics advocated by professional organizations and employed by government finance managers and their financing teams are insufficient to ensure these entities efficiently manage their bond portfolios on behalf of taxpayers.

Management of Interest Rate Risk

The objective of debt management is to minimize the suitable defined cost of debt, subject to constraint (not considered here). For a simple example, suppose the municipality needs a given loan between today and some future date, and it intends to raise the required amount by issuing a single bond.

The bond's coupon rate depends on both the general level of interest rates and the structure of the bond. Attributes of the latter include maturity, embedded call options, and coupon structure (fixed or floating rate). Fixed-rate bonds can be sold at a premium over par by raising the coupon rate or at a discount. If the bonds are sold at a premium, the principal payment at maturity will be less than the proceeds at issue; in the case of a discount, the principal will be

larger than the proceeds. Either structure would generate the desired loan amount, but the issuer's resulting cashflow obligations would differ.

The call option benefits the municipality from lower rates by calling and refunding the bond. From the investors' perspective, the call option is undesirable, and therefore, the market price of a callable bond is lower than that of an otherwise identical options bond. As a result, the face amount of the issue needs to be increased. Investors will demand a higher coupon if the issuer wishes to lower the call price (say, keep it at par). In either case, the call option has a quantifiable upfront cost to the issuer. Conceptually, the call option is a risky investment, which may pay off handsomely if rates decline or will be a waste if rates rise.

Option-based analysis allows issuers to quantify the opportunity cost of refunding the bonds. Municipal debt managers, at the minimum, should be aware of the option value at the time, be it an issuance or a refunding. As mentioned above, option-based analysis of the taxable advance refundings after the 2017 Act indicated that these transactions were premature because they captured barely 70% of the option values. One may argue that option value is 'just a theory,' but as we show in this paper, the taxable advance and refunding performed even worse than expected on an ex-post basis.

Overview of Methodology

The waste from taxable advance refunding can only be determined by comparing the savings it generates to the savings generated by refunding the bonds with tax-exempt bonds at the call date. We use the methodology known as counterfactual analysis to estimate the difference. The term counterfactual describes what could have happened if the municipal issuer waited until the call date to refund with tax-exempt bonds. Thus, we compare the savings from the actual taxable advance refunding transaction to the counterfactual savings from refunding with tax-exempt bonds at the call date.

While the counterfactual analysis may not be common in the finance literature, it is regularly used to assess the effectiveness of government policies through various formal program evaluation approaches (Reichardt, 2022; Weiss et al., 2014). In this line of research, the government policy is evaluated by looking at the difference in the outcome of interest between the entity that received the policy treatment (treated outcome) and the entity that did not receive the policy treatment (counterfactual outcome) (Reichardt, 2022; Weiss et al., 2014).

As it relates to our study, the government policy is the decision to advance refund debt using taxable bonds. Thus, the savings from the actual taxable advance refunding represent the treated outcome, and the savings from the hypothetical tax-exempt current refunding represent the counterfactual outcome. This paper converts the difference between these savings to a proficiency ratio to determine how effectively these municipal issuers managed the debt refunding decision.

The study considers 14 taxable advance refundings sold between 2018 and 2020. We initially focused solely on the ten largest taxable advance refunding transactions. However, because four of these refundings had call dates beyond late 2023, we could not construct the counterfactual refundings for those financings. That left us with six of the top ten taxable advance refundings. We added eight other clear-cut taxable advance refundings, avoiding complex transactions such as those with several call dates, and issues sold for multiple purposes.

The 14 transactions consist of various government issuers across geography, type (city, state, special purpose), credit ratings (AAA, AA, and A), size, and timing (issuances in 2018, 2019, and 2020; refunded bond call dates in 2019, 2020, 2021, and 2022). The aggregate par amount of the taxable advance refunding issues amounted to $5.69 billion.

Background

Given the budgetary benefit of refinancing, researchers have studied municipal refunding transactions for decades. Some of this research focused on describing a general framework for assessing bond refundings (Dyl & Joehnk, 1976; Joehnk & Dyl, 1979; Luby, 2014). Other research has explored the factors associated with the refunding decision (Moldogaziev & Luby, 2012; Vijayakumar, 1995). Another subset of studies quantified the impact of bond refundings on the finances of governments (Ang et al., 2017; Luby, 2012).

Most germane to our study, there is a strand of rich literature that details the importance of explicitly valuing the call option, rather than just focusing on the cash flow savings, in assessing whether to refund (Boyce & Kalotay, 1979; Kalotay & May, 1998; Kalotay et al., 2007; Kalotay & Raineri, 2016; Zhang & Li, 2004). Specifically, this research advises borrowers to quantify the value of this call option and compare it to the savings. The savings ratio to the option value, the so-called refunding efficiency, provides specific guidance (Kalotay, 2007, 2011). The maximum refunding efficiency is 100%, and refunding is not generally advisable unless the efficiency is approximately 90%, which should be viewed as a "floor." As discussed in Kalotay (2021), the efficiency of the typical taxable advance refunding was barely 70%.

The Municipal Market Landscape

Over the last couple of decades, the institutional tax-exempt municipal market has been dominated by 5% coupon bonds callable at par (100%) in 10 years (i.e., "5% bonds") (Khang et al., 2023).[3] Because tax-exempt interest rates have been significantly below 5%, 5% bonds are sold at substantial premiums over par.[4] The above-par price appeals to institutional investors, who understandably want to avoid the underperformance of bonds purchased near par in the event rates rise due to the de minimis tax treatment (Kalotay, 2020; Kalotay & Davidson, 2021; Kalotay & Fennell, 2022).[5] Because over the last couple of decades, the borrowing cost of investment-grade government issuers has been far below 5%, the par call in year ten has virtually guaranteed that 5% bonds would be called and refunded even if rates increased if they stayed below 5% (Kalotay, 2012a). This is evident by observing that there are virtually no outstanding investment-grade 5% callable bonds over ten years old.

As discussed above, until the passage of the 2017 Act, tax-exempt municipal bonds were eligible for advance refunding with tax-exempt bonds. In a tax-exempt advance refunding transaction, the borrower would issue new tax-exempt bonds and use the proceeds to purchase an escrow fund. The escrow fund would be invested to cover the interest and principal payments of the refunded bonds until the call date. The lower the escrow fund's invested interest rate, the greater the refunding bond issue size necessary to ensure enough in the escrow fund to pay the interest and principal payments on the refunded bonds. Thus, in low interest rate environments, the interest cost savings of advance refundings are reduced by the greater amount of refunding bonds necessary to satisfy the refunded bond escrow requirements. Also, advance refunding

resulted in the proliferation of tax-exempt bonds because the refunded bonds remained outstanding until their call date.

The 2017 Act prohibited the issuance of tax-exempt advance refunding bonds (Kalotay, 2018). A possible alternative was to advance refund with taxable bonds instead of tax-exempt bonds. Because interest rates remained relatively low from 2018 until 2022, investment-grade municipal borrowers could issue taxable bonds well below the 5% coupon rate of their outstanding tax-exempt bonds and report large savings despite the very low escrow interest earnings.

As the relative cost savings of refunding at call with tax-exempt bonds versus advance refunding with taxable bonds depends on the unknown future interest costs, a cost-based decision to advance refund rests on assessments of future interest rates. The taxable borrowing rate of a municipal issuer is obviously higher than its tax-exempt rate, typically by 50 to 100 basis points, depending on maturity. Consequently, if interest rates were to remain near their level at the time of the taxable transaction, refunding with tax-exempt bonds at the call date would result in significantly greater savings. The likely rationale for advance refunding with taxable bonds would be the concern that by the time the bonds became callable, interest rates could substantially rise to the point where refunding would not realize cost savings.

Overview of Taxable Advance Refundings

Between January 1, 2018, and January 1, 2022, well over 200 tax-exempt bond issues were advance refunded with taxable bonds (Thomson Reuters). Based on our preliminary review of these transactions, the typical refunding occurred one to three years before the refunded bonds' call date. The taxable refunding bonds were sold near par, and some of them are callable in ten years (and some with a make-whole call).[6] During this period, Treasury rates were exceptionally low, resulting in very low escrow yield, typically well below 1%. Low yields increased the size of the escrow, thus reducing the interest costs savings from the taxable advance refunding (Kalotay, 2019). Table 1 displays the ten largest taxable advance refunding transactions. The table reveals the significance of this financial strategy by observing the large size of the transactions ($539 million to $1.2 billion), usage across multiple states (Arizona, California, Florida, Massachusetts, New York, Ohio, and Texas) and diversity in the types of borrowers (state, city, county, toll road, community college, public utility, and building authorities, both school and dormitory).

Analytical Approach

We analyze the actual interest cost savings from the 14 taxable advance refunding transactions to the counterfactual savings that would have been realized if the issuer had waited until the call date to refund. Because the interest cost savings are quantified in present value terms, they depend on various assumptions listed below. In addition to the dollar amounts, we are also interested in their relative size as a percentage, defined by us as the proficiency ratio. Our specific analytical approach follows.

Assumptions on present value calculations:

- The common present value date is the date of the taxable refunding

Table 1. Ten Largest Taxable Advance Refunding Issues, January 1, 2018 to January 1, 2021, millions of dollars

	Issuer	Description	Series	Size	Issue Date
1	State of California	GO Refunding Bonds	Series 2018	1,200.00	04/25/18
2	NYS Thruway Authority	General Revenue Bonds	Series M	857.63	10/30/19
3	Broward County, Florida	Airport System Revenue Refunding Bonds	Series 2019 C	719.94	11/21/19
4	Massachusetts School Building Authority	Subordinate Dedicated Sales Tax Bonds	2019 Series B	715.42	11/20/19
5	San Diego Community College District	GO Refunding Bonds	2019 Series A & B	693.44	10/16/19
6	San Francisco City/County Public Utility Commission	Water Revenue Bonds	2019 Subseries A, B and C	656.96	01/09/20
7	NYS Dorm Authority	Facilities Revenue Bonds	Series 2019B	560.80	12/03/19
8	Houston City, Texas	Utility Revenue Refunding Bonds	Series 2019C	539.14	09/17/19
9	Arizona Transportation Board	Highway Revenue Refunding Bonds	Series 2020	510.28	02/12/20
10	Ohio Turnpike & Infrastructure Authority	Senior and Junior Lien Revenue Refunding Bones	Series 2020A	472.47	02/13/20
			Total	6,926.08	

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- The discount rate is *the* cost of *taxable* debt. Municipal issuers should use their taxable cost of borrowing, whether the bonds being valued are taxable or tax-exempt (Kalotay & Tuckman, 1999). Therefore, we use the taxable advance refunding bonds' true interest cost (TIC) for discounting purposes. We parenthetically observe that TIC is a 'callable' rate because the portfolio on which it is based may include callable bonds. Theoretically, option-adjusted TIC (Kalotay, 2012b) would be preferable to conventional TIC, although it would have a negligible effect on the results.[8]

Savings From Taxable Advance Refunding

The first step is to calculate the size of the advance refunding by deriving the amount of the tax-exempt bonds that were refunded with taxable bonds. The transaction size can be ambiguous because some of the funds deployed in the taxable advance refunding transaction may have come from sources other than the taxable issue. For example, in the Massachusetts School Building Authority (MSBA) transaction featured below, the issuer deployed the debt service reserve fund of the refunded bonds. We exclude such funds from the analysis for an 'apples to apples' comparison.

The proceeds of the taxable issue are known, and this allows us to determine how much of the outstanding tax-exempt issue was refunded with taxable bonds. This calculation is based on the size of the escrow, which is reported in the official statement. We determine the percentage of the escrow funded with taxable bond proceeds and then scale down the outstanding tax-exempt bonds to determine the amount refunded with the taxable issue. This is the amount that was refunded with the taxable issue. Based on the amount that was refunded with the taxable issue, we determine the cash flow savings from the taxable advance refunding in the usual manner by calculating the present value of leaving these bonds outstanding until maturity and the present value of the taxable advance refunding bonds.[9] The savings from taxable advance refunding is the difference.

If some of the bonds in the taxable issue are callable at par, we estimate the value of the call option ("Option Value Acquired") and increase the savings by that amount. Estimating the Option Value Acquired is necessary since the call could be used to refund the taxable bonds for interest cost savings. Thus, ignoring such optionality would understate the savings from the taxable advance refunding. We use the industry standard (Bloomberg) log-normal interest rate process (Black-Karasinski, with 0 mean reversion) to estimate the Option Value Acquired. Option Value Acquired assumes the bonds may be refunded with taxable bonds. Refinancing the taxable refunding bonds prior to maturity with tax-exempt bonds or through tender could be considered in a future study.[10]

The market-implied volatility can be estimated from the difference between the prices of similar (in terms of credit and maturity) callable and optionless bonds. In the case of a log-normal interest rate process, such as the one used in this study, the higher the level of interest rates, the lower the interest rate volatility. Between 2019 and 2021, interest rates were exceptionally low; therefore, their implied volatility was unusually high. Analysis of callable taxable bonds indicated that 20% volatility was reasonable for investment-grade taxable bonds, and therefore, we valued their options at 20% interest rate volatility.

Savings From Counterfactual Tax-Exempt Current Refunding

What if instead of advance refunding with taxable bonds, the outstanding issue was left outstanding until the call date and then refunded with tax-exempt bonds? This is the counterfactual analysis. The resulting debt service has two components: the known payments on the outstanding bonds until the call date and the payments on the tax-exempt refunding bonds after the call date. The payments on the counterfactual tax-exempt refunding bonds are based on the borrowing rates at the pricing date (usually a couple of weeks before the call date of the refunded bonds), and for the analysis, we need to estimate those rates.

The issuer's tax-exempt borrowing rates (yield curve) can be estimated from the MSRB's EMMA database. This yield curve is based on the yields to call at par in year ten of 5% bonds. If we refund with 5% bonds, we also must account for their option values – as discussed earlier, 5% bonds are virtually certain to be refunded at the end of year ten. Instead of refunding with 5% callable bonds, we have taken a conceptually simpler approach. The approach entails converting the callable 5% bond yield curve to a par optionless curve by the coupon-stripping method, as detailed in the appendix and Kalotay (2017).

Our approach eliminates the need to include option values in calculating savings from the counterfactual tax-exempt refunding. The key is to estimate the yields of optionless par bonds of the relevant maturities. This is accomplished by converting the 5% callable curve from EMMA into a par AAA optionless curve at a specified interest rate volatility, creating a yield curve that removes (strips) the call options. The estimation of interest rate volatility is discussed in the appendix. During the exceptionally low interest rates during the 2019 to 2021 period, 30% interest rate volatility was a reasonable choice for our analysis.

Once we estimate the AAA optionless yield curve, we adjust it to the appropriate credit rating yield curve for each counterfactual issue based on MMD yield spreads (AAA, AA, and A) by maturity on the hypothetical pricing date of the counterfactual bonds.[11] In constructing this curve, we use the issuer's credit rating at the time of the taxable advance refunding.[12] We then structure par optionless tax-exempt bonds so that their maturities and amounts resemble those of the outstanding tax-exempt issue to be refunded. We combine the resulting cashflows with the flows of the outstanding issue prior to the call date and determine the present value of the combined flows. The estimated savings from the counterfactual strategy is the difference between the present value to the refunded bonds' maturity and that of the counterfactual tax-exempt refunding bonds (i.e., the 'waiting to the call date' strategy). We reduce the present value savings by 0.50% to adjust for transaction costs.

Sample Analysis

This section details the analysis of one of this study's 14 taxable advance refunding transactions to detail the specifics of our analytical approach. On November 20, 2019, the MSBA refunded its outstanding 2011 Series B Bonds (the "2011B Bonds"), callable at par on October 15, 2021. Table 2 details the portfolio of refunded 2011B Bonds. The face amount of the 2011B Bonds was $747.69 million; the coupons of these bonds varied between 5% and 5.25%. According to the official statement for the 2019 taxable advance refunding bonds (the "2019 Bonds"), the escrow cost to decrease the 2011B Bonds to the call date was $798.89 million.

MSBA refunded its 2011B bonds with a $715.42 million principal of the 2019 Bonds. The 2019 Bonds carried AA+/AA3/AA ratings. $2.65 million issuance expense reduced the

Table 2. Massachusetts School Building Authority, 2011 Series B Bonds

Maturity Date	Refunded Principal
10/15/2022	20,000,000
10/15/2023	20,000,000
10/15/2027	40,750,000
10/15/2031	46,630,000
10/15/2032	49,025,000
10/15/2033	25,345,000
10/15/2033	26,190,000
10/15/2034	26,645,000
10/15/2034	27,535,000
10/15/2035	28,010,000
10/15/2035	28,950,000
10/15/2036	59,880,000
10/15/2037	62,950,000
10/15/2038	66,180,000
10/15/2039	69,570,000
10/15/2040	73,140,000
10/15/2041	76,890,000
Total	$747,690,000

Notes: Tax-exempt bonds refunded by 2019 Series B bonds, federally taxable. Coupon rates 5% except for 2033, 2034, and 2035 split coupons of 5.25%: callable at 100% on 10/15/2021

Table 3. Subordinated Dedicated Sales Tax Refunding Bonds

Sale proceeds of 2019B Bonds	$715,420,000
Less: Cost of issuance (including underwriters discount) of 2019B Bonds	($2,650,200)
Other available funds	$86,119,184
Total deposit to 2011B Bonds Escrow Fund	$798,888,984
Percentage of 2011 Bonds Escrow Fund allocable to 2019B bond proceeds	89.22%

Notes: 2019 Series B, federally taxable, 2011B bonds escrow fund sources

amount available for the escrow to $712.77 million; the remainder needed for the $798.89 million escrow was funded by other means, mainly liquidating the 2011B bonds debt service reserve fund. Thus, as shown in Table 3, the 2019 Bonds provided 712.77/798.89 = 89.22% of the escrow. Applying 89.22% to the $747.69 million principal amount of the 2011B Bonds reveals that the proceeds of the taxable issue were sufficient to refund the $667.09 million principal amount of the 2011B Bonds. Accordingly, the savings calculated below are based on the $667.09 million principal amount of the 2011B Bonds.

To calculate the present value savings, we first determined that the TIC of the 2019 taxable issue was 3.205%, based on the actual maturity dates, par amounts, and coupon rates of the 2019 Bonds. Based on this discount rate, the present value of the outstanding 2011B Bonds was $819.75 million, and the present value of the 2019 Bonds was $715.42 million. Thus, on a ‘

Figure 1. 10-Year AAA MMD, January 1, 2018 to December 31, 2021

present value basis, the cashflow savings amounted to $104.33 million (calculated based on $819.75 million -$715.42 million).

The 2019 Bonds were sold with a ten-year par call date of October 15, 2029. The Option Value Acquired of the 2019 Bonds was $17.30 million, and we increased the savings attributable to the taxable advance refunding by this option value, resulting in total savings of $121.63 million ($104.33 million + $17.30 million.

As shown in Figure 1, the tax-exempt 10-year AAA yield at the time of the refunding in 2019 was roughly 1.52%. Contrary to MSBA's expectations, rates subsequently declined (except for a brief period in March and April 2020 because of the flight to quality effect at the onset of the COVID-19 pandemic), and by the call date on 11/1/ 2021, the 10-year AAA municipal yield fell to 1.22%, about 30 basis points lower than at the time of the advance refunding. Based on the tax-exempt yield curve prevailing as of October 1, 2021, we estimated how much MSBA would have saved by refunding the $667.09 million principal amount of the 2011B Bonds on the call date (the "Counterfactual 2021 Bonds").

Table 4 details the actual 5% tax-exempt 10-year callable yields and the corresponding optionless par bond yields based on 30% interest rate volatility as of October 1, 2021. The optionless par bond yields include an adjustment for the credit spreads between AAA and AA bonds in years 1 through 20 that ranged from 7 to 20 basis points. In order to cover the issuance expense, we grossed up the refunding issue by $3.35 million (0.50% of the par amount), to $670.44 million. Table 4 also details the maturity dates and par amounts for the Counterfactual 2021 Bonds. Based on this counterfactual portfolio, we determined that refunding with tax-exempt bonds at the call date would have resulted in present value savings of $221.63 million.

To recap, MSBA saved $121.63 million by advance refunding the 2011B Bonds with its taxable 2019 Bonds. By waiting until the call date in 2021 and then refunding with tax-exempt bonds on a current refunding basis, MSBA would have saved $221.63 million. The $100 million 'savings lost' ($221.63 million - $121.63 million) from advance refunding with taxable bonds will be borne by the Massachusetts taxpayers.

It is informative to consider the savings ratio through what we call the "proficiency ratio," which is the percent of actual savings to the counterfactual savings. The proficiency ratio

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Table 4. Counterfactual Tax-Exempt Current Refunding Bonds

Date	Principal	5% Callable Yield	Par Optionless Yield*
10/15/2022	17,935,000	0.153%	0.173%
10/15/2023	17,935,000	0.161%	0.181%
10/15/2027	36,540,000	0.676%	0.809%
10/15/2031	41,810,000	1.117%	1.298%
10/15/2032	43,960,000	1.178%	1.485%
10/15/2033	22,725,000	1.219%	1.606%
10/15/2033	23,485,000	1.219%	1.606%
10/15/2034	23,890,000	1.253%	1.687%
10/15/2034	24,690,000	1.253%	1.687%
10/15/2035	25,115,000	1.286%	1.764%
10/15/2035	25,960,000	1.286%	1.764%
10/15/2036	53,695,000	1.315%	1.824%
10/15/2037	56,445,000	1.347%	1.881%
10/15/2038	59,345,000	1.381%	1.947%
10/15/2039	62,380,000	1.406%	1.987%
10/15/2040	65,585,000	1.442%	2.059%
10/15/2041	68,945,000	1.461%	2.063%
Total	$670,440,000		

*Calculated from 5% callable yields using 30% interest rate volatility

indicates how proficient the issuer was in capturing savings that would have been available by waiting for a refund at the call date. A higher ratio indicates a smaller loss in savings relative to delaying the refinancing decision to the call date. The break-even proficiency ratio is 100%. The MSBA proficiency ratio was $121.63 million / $221.63 million, or 54.88%, indicating that MSBA captured less than 55% of the savings that could have been realized by waiting until the call date. While the reported savings may depend on questionable assumptions pertaining to discounting and option valuation, these ratios are robust and provide an excellent indication of how well or poorly the issuer's debt is managed.

Results

We applied the approach used in the MSBA case study to 13 more transactions to explore the scope of 'savings lost' and the proficiency across other government issuers.[13] Table 5 details the 14 taxable advance refundings in our sample. The TICs on these financings ranged from 2.46% to 4.10%, with an unweighted average TIC of 3.13% (shown in Table 7). The aggregate savings on these transactions was $845.00 million, and the savings from the Option Value Acquired was $143.37 million, for a total option-adjusted present value savings of $988.37 million. This represents 18.46% savings as a percent of refunded bonds. This is much higher than the static refunding heuristics employed by many governments, such as 3% or 5% minimum thresholds (Government Finance Officers Association [GFOA], 2019). While the actual taxable advance refunding savings levels were significant on an absolute basis, we focus on how these savings compare to the savings if these governments waited a couple of years to refinance on a tax-

Table 5. Actual Taxable Advance Refunding Bonds Transaction Details and Refunding Results, millions of dollars

	Issuer	Description	Refunding Bond Size	Refunding Issue Date	Refunded Call Date(s)	Refunded Bond Size	Credit Ratings	Cashflow PV Savings	Option Value Acquired	Total Savings
1	State of California	GO Refunding Bonds	1,200.00	4/25/18	4/1/19	1,209.29	Aa3/AA/ AA-	254.10	60.30	314.40
2	NYS Thruway Authority	General Revenue Bonds, Series M	857.63	10/30/19	1/1/22	784.87	A1/A	91.71	13.16	104.87
3	Massachusetts School Building Authority	Subordinated Dedicated Sales Tax Bonds, Series 2019B	715.42	11/20/19	10/15/21	667.08	AA+/Aa3/ AA	104.33	17.30	121.63
4	San Francisco City/County Public Utility Commission	Water Revenue Bonds, Subseries 2019A	656.96	1/9/20	11/1/20 11/1/21 5/1/22	611.44	AA-/Aa2	85.90	24.50	110.40
5	Houston, Texas	Utility Revenue Refunding Bonds, Series 2019C	539.14	8/19/20	11/15/21 11/15/22	491.02	Aa2/AA	93.91	7.48	101.39
6	Arizona Transportation Board	Highway Revenue Refunding Bonds, Series 2020	510.28	2/12/20	7/1/21 7/1/22	472.96	AA+/Aa1	45.57	2.58	48.15
7	Harris County Metro Transportation Authority	Sales & Use Tax Refunding Bonds, Series 2020A	304.13	2/27/20	11/1/21	281.33	AAA/AAA	68.27	5.88	74.15
8	California State University Trustees	Systemwide Revenue Bonds, Series 2020B	207.76	2/27/20	11/1/21	192.35	Aa2/AA-	39.09	4.27	43.36
9	Pennsylvania State Public School Building Authority	School Lease Revenue Refunding Bonds, Series 2019	188.29	11/20/19	4/1/22	172.07	A2/A+	9.40	0 (MWC)	9.40
10	Kent State University	General Receipts Bonds, Series 2020B	172.83	1/29/20	5/1/2022	158.17	Aa3/A+	20.38	2.68	23.06
11	City of Philadelphia	GO Refunding Bonds, Series 2020A	118.03	1/16/20	7/15/21	111.05	A-/A/A2	14.63	0.95	15.58
12	South Central Connecticut Reg Water Authority	Water System Revenue Bonds, 34th Series B	83.43	7/2/19	8/1/22	74.07	Aa3/AA-	7.04	1.58	8.62
13	Miami-Dade Co-Florida	Prof Sport Franchise Facilities Bonds, Series 2018	77.15	9/5/18	10/1/19	72.50	AA/A+	6.21	1.12	7.33
14	Virginia Port Authority	Commonwealth Port Fund Refunding Bonds, Series 2018	60.35	7/26/18	7/1/20	57.14	AA+/Aa1/ AA+	4.46	1.57	6.03
		Aggregate Results	$5,691.40			$5,355.34		$845.00	$143.37	$988.37

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Table 6. Counterfactual Tax-Exempt Current Refunding Bonds, millions of dollars

	Issuer	Description	Bond Size	Issue Date	TIC	Savings
1	State of California	GO Refunding Bonds	1,215.37	4/1/19	2.827%	444.21
2	NYS Thruway Authority	General Revenue Bonds, Series M	788.82	1/1/22	1.635%	226.91
3	Massachusetts School Building Authority	Subordinated Dedicated Sales Tax Bonds, Series 2019B	670.44	10/15/21	1.819%	221.63
4	San Francisco City/County Public Utility Commission	Water Revenue Bonds, Subseries 2019A	614.51	11/1/20, 11/1/21 5/1/22	0.220% 1.904% 2.627%	179.81
5	Houston, Texas	Utility Revenue Refunding Bonds, Series 2019C	493.47	11/15/21 11/15/22	1.686% 3.526%	142.56
6	Arizona Transportation Board	Highway Revenue Refunding Bonds, Series 2020	475.33	7/1/21 7/1/22	0.360% 2.856%	53.03
7	Harris County Metro Transportation Authority	Sales & Use Tax Refunding Bonds, Series 2020A	282.75	11/1/21	1.734%	109.30
8	California State University Trustees	Systemwide Revenue Bonds, Series 2020B	193.31	11/1/21	1.731%	61.07
9	Pennsylvania State Public School Building Authority	School Lease Revenue Refunding Bonds, Series 2019	172.93	4/1/22	2.201%	22.88
10	Kent State University	General Receipts Bonds, Series 2020B	158.97	5/1/22	2.785%	28.68
11	City of Philadelphia	GO Refunding Bonds, Series 2020A	111.60	7/15/21	1.259%	28.14
12	South Central Connecticut Reg Water Authority	Water System Revenue Bonds, 34th Series B	74.45	8/1/22	2.709%	12.26
13	Miami-Dade Co-Florida	Prof Sport Franchise Facilities Bonds, Series 2018	72.86	10/1/19	2.039%	17.44
14	Virginia Port Authority	Commonwealth Port Fund Refunding Bonds, Series 2018	$57.44	7/1/20	1.680%	17.62
		Aggregate Results	$5,382.25		1.978%	$1,565.54

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exempt basis (i.e., the counterfactual).

Table 6 details the results of the counterfactual analysis for the 14 transactions in our sample. The par amount of the counterfactual tax-exempt refunding bonds was $5.382 billion. As a point of comparison with the 3.133% TIC of the taxable transactions, the unweighted average TIC of the counterfactual transactions was 1.978%, indicating that the cost of financing with tax-exempt bonds would have been roughly 1.15% lower than the actual cost of the taxable bonds. The aggregate savings resulting from these counterfactual transactions was $1.566 billion. This represents 29.23% savings of the face amount of the refunded bonds, which should be compared to the 18.46% actual savings from the taxable refundings.

Table 7 compares the results of the actual taxable advance refundings and the counterfactual tax-exempt current refundings. The counterfactual savings ($1.566 billion) was $577 million greater than the actual option-adjusted present value savings from the taxable advance refundings ($988.37 million). The proficiency ratio of every taxable advance refunding transaction was below 100%, indicating that considerably larger savings would have been achieved if these governments waited until the call date to refinance. Most transactions performed poorly; the arithmetic average proficiency ratio was 61.25%. Weighted by the size of the counterfactual transactions, the proficiency ratio was 63.13%. (measured as the ratio of $988.37 million in actual savings to $1.566 billion in counterfactual savings). In the aggregate, these government issuers realized only 63% of the savings that they would have received if they had waited until the call date to refund the bonds. Equivalently, they could have realized 58% more in savings than they did. The 'savings lost' resulting from these taxable refinancings amount to $577 million.

Discussion

We have considered 14 taxable advance refundings of tax-exempt bonds between 2018 and 2020. Although these transactions resulted in considerable savings, option-based analysis at the time of the transaction suggested that they were premature. The typical refunding efficiency was roughly 70%, indicating that the savings captured only 70% of the savings that would be expected by waiting until the call date (Kalotay, 2021). Of course, waiting entails interest rate risk – the actual rates by the call date could be higher or lower than expected, resulting in smaller or greater savings than indicated by the option value at the time of the advance refunding. In the case of these 14 transactions, we found that the actual refunding savings if these issuers waited until the call date would have been greater, as measured by our computed proficiency ratio of 63%.

An unlikely explanation for accepting a 70% refunding efficiency is extreme risk aversion. Based on the interviews of responsible government officials, which include references to not having a crystal ball, these questionable refunding decisions are more likely to be made in an analytical vacuum (Braun, 2023). Indeed, nobody has a crystal ball, but option-based analysis is a reasonable and readily available alternative. It is puzzling why municipal issuers continue to make refunding decisions based on savings thresholds rather than using option-based analytics, even though the latter approach has been around for several decades (Boyce & Kalotay, 1979; Finnerty et al., 1988) and is widely used by corporate issuers and financial institutions.

Tax-exempt municipal bonds have more embedded optionality per capita than any other bond market sector. Unfortunately, many municipal debt managers are unfamiliar with option

Table 7. Actual Taxable Advance Refunding Results vs. Counterfactual Tax-Exempt Current Refunding Results, millions of dollars

	Issuer	Description	Counter-factual TIC	Actual TIC	Counter-factual Savings	Actual Savings	Savings Lost	Proficiency Ratio
1	State of California	GO Refunding Bonds	2.827%	4.097%	444.21	314.40	129.81	70.78%
2	NYS Thruway Authority	General Revenue Bonds, Series M	1.635%	3.162%	226.91	104.87	122.04	46.22%
3	Massachusetts School Building Authority	Subordinated Dedicated Sales Tax Bonds, Series 2019B	1.819%	3.205%	221.63	121.63	100.00	54.88%
4	San Francisco City/County Public Utility Commission	Water Revenue Bonds, Subseries 2019A	0.220% 1.904% 2.627%	3.322%	179.81	110.40	69.41	61.40%
5	Houston, Texas	Utility Revenue Refunding Bonds, Series 2019C	1.686% 3.526%	2.633%	142.56	101.39	41.17	71.12%
6	Arizona Transportation Board	Highway Revenue Refunding Bonds, Series 2020	0.360% 2.856%	2.464%	53.03	48.15	4.88	90.80%
7	Harris County Metro Transportation Authority	Sales & Use Tax Refunding Bonds, Series 2020A	1.734%	2.732%	109.30	74.15	35.15	67.84%
8	California State University Trustees	Systemwide Revenue Bonds, Series 2020B	1.731%	2.700%	61.07	43.36	17.71	71.00%
9	Pennsylvania State Public School Building Authority	School Lease Revenue Refunding Bonds, Series 2019	2.201%	3.018%	22.88	9.40	13.48	41.08%
10	Kent State University	General Receipts Bonds, Series 2020B	2.785%	2.993%	28.68	23.06	5.60	80.47%
11	City of Philadelphia	GO Refunding Bonds, Series 2020A	1.259%	2.748%	28.14	15.58	12.56	55.37%
12	South Central Connecticut Reg Water Authority	Water System Revenue Bonds, 34th Series B	2.709%	3.037%	12.26	8.62	3.64	70.31%
13	Miami-Dade Co-Florida	Prof Sport Franchise Facilities Bonds, Series 2018	2.039%	3.908%	17.44	7.33	10.11	42.03%
14	Virginia Port Authority	Commonwealth Port Fund Refunding Bonds, Series 2018	1.680%	3.836%	17.62	6.03	11.59	34.22%
		Aggregate Results	1.978%	3.133%	$1,565.54	$988.37	$577.17	61.25%

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valuation, relying on municipal advisors who also need to gain adequate knowledge of fixed-income analytics. As a result, decisions tend to be made on amateurish interest rate expectations, rather than on rigorous analytics. Along the lines of the Euclid quote above, there is a dire need for educated debt managers and no shortcuts for these professionals to expertise themselves in this technical area. Those who are currently ignorant of option-based analysis should avoid option-based transactions. Thus, the short-term solution to this problem is to reduce the issuance of callable bonds, and issue optionless bonds instead. In fact, the expected cost of optionless bonds is lower than that of correctly managed callable bonds (Kalotay, 2022). The longer-term answer is greater education of our public sector finance professionals.

Some municipal issuers are primarily interested in realizing whatever savings are available in the current market due to political constraints on increasing revenues or cutting expenses in a current budget cycle. And, perhaps for some short-sighted citizens, their preference would be greater long-term interest costs in exchange for lower taxes and maintained services in short-term budgets. This study does not evaluate an issuer's political motivation to refund debt or citizen preferences regarding short- and long-term budget tradeoffs. However, even if accepting a lower refunding efficiency is preferred, elected officials and debt managers should be cognizant of the specific opportunity cost associated with refunding debt early, and citizens should be aware of what their government gave up because of the specific debt management decisions made on their behalf. The use of refunding efficiency metrics ex-ante and production of ex-post counterfactual analyses, such as the one used in this study, would both be helpful to improve financial decision-making and enhance the transparency of these issuers' actions related to debt refunding.

Callable bonds entail interest rate risk, which must be properly valued and managed. State and local governments acquire the call options at a cost, although the up-front cost of the call option has yet to be recognized or acknowledged. The issuer's rationale for acquiring the call option is to benefit from potentially lower interest rates, by calling and refunding the bond. The savings to the issuer would occur at an offsetting loss to the investors, and therefore investors extract a charge for the call option. The cost of the call option is the difference between the market price of the callable bond and the theoretical value of an otherwise identical optionless bond.

For example, when the market price of a long-term callable bond is 100, the fair value of a non-callable bond might be 105, and the estimated cost of the call option to the issuer is 5 points. However, in the case of the 5% bonds considered in this study, the call option was considerably more costly, because the 5% coupon rate far exceeded prevailing interest rates. As such, the probability of a call was much greater. For example, when the market price of a 5% callable bond is 120, the theoretical value of a similar optionless bond may be 140, and the cost of the call option is 20 points. Unfortunately, municipal issuers are seemingly unaware of this considerable upfront cost. They consider only the savings from refunding, without acknowledging that the savings from refunding are entirely attributable to the presence of the call option, which was acquired at a considerable cost.

As interest rates vary following issuance, the value of the call option changes accordingly. In the case of 5% bonds, issuers have various economically beneficial refunding opportunities even before the call date. The taxable advance refunding featured in this paper is one example. In the process of refunding, the issuer automatically forfeits possibly more favorable refunding opportunities in the future. The value of the call option quantifies these

opportunities. Thus, the savings from refunding should be compared to the forfeited option value.

Today, with hindsight, we can observe the tax-exempt rates as of the call dates of the refunded bonds and determine the counterfactual savings resulting from refunding with tax-exempt bonds. In other words, we can quantify what the issuer lost or gained by refunding early. We have shown that the issuer would have realized considerably greater savings by waiting in each case. For example, in the featured MSBA transaction, the savings would have been roughly $100 million more (i.e., 82% greater). In aggregate, the savings on just these 14 transactions would have been $577 million more, or 58% greater.

The aggregate 'savings lost' of taxpayers resulting from the well over 100 taxable advance refunding transactions between 2018 and 2020 is likely to amount to billions of dollars. The municipal finance community and the stakeholders should be aware of this enormous waste and consider how to avoid such in the future.[14] Although the call option is a common feature of tax-exempt bonds, the option value is seldom considered explicitly in structuring and refunding transactions (Kalotay, 2011). The rules of thumb for refunding decisions, such as 3% or 5% present value savings, are inadequate for any bond because they need to consider the forfeited option value. These naive present value savings heuristics are virtually deceitful for 5% bonds issued at a high premium because the above-market coupon rate enables a government to refund 5% bonds immediately after issuance for substantial "savings" (Kalotay, 2012a).

Conclusion

The results reported here suggest the need for reform of best practices for debt managers. Professional associations and federal regulators have a role to play here. Unfortunately, the GFOA contributes to the preservation of simplistic refunding heuristics through its "Best Practices: Refunding Municipal Bonds" statement (GFOA, 2019). Specifically, GFOA identifies five specific refunding savings approaches, all of which utilize variations on net present value metrics in determining when to refund bonds. It relegates "refunding efficiency" to a section on "additional considerations" (GFOA, 2019). The text on refunding efficiency in the GFOA's best practices reads as follows:

> *Refunding efficiency. Governments should understand that the call feature included in most municipal bonds has economic value. Consequently, they may want to set a minimum percentage of the potential call option value to be captured with an advance refunding before proceeding with the refunding. These estimates of the value of the call option depend on complex calculations that should be requested from a municipal advisor (GFOA, 2019).*

While the language and description is correct, we offer a few revisions for consideration. First, the GFOA should identify/suggest a minimum percentage refunding efficiency or at least a range of acceptable refunding efficiency. This would provide specific and actionable financial policy guidance to municipal issuers. Also, the wording of "potential call option value" is misleading and should be changed since the call option definitively, not potentially, has value. However, the precise amount is dependent on certain assumptions.

Most importantly, GFOA should consider elevating "refunding efficiency" to a primary approach in determining when to refund bonds rather than as a marginal "additional consideration." With the regulation and certification of municipal advisors post-Dodd-Frank, government issuers should be able to request analyses such as refunding efficiency from their fiduciary advisors. In addition, the Municipal Securities Rulemaking Board (MSRB) should mandate through its regulatory processes and competency examinations that municipal advisors possess such technical expertise. These recommendations to the GFOA and MSRB would likely lead to 1) municipal issuers receiving less vague refunding advice along the lines of "you can go either way," "not a bad answer here," or "go with whatever you are comfortable with," and 2) fewer refunding decisions made as a "gut call." In turn, this should reduce harmful financial waste, such as what was estimated by this study.

This study illustrates how the lack of attention to option value and the resulting poor managerial decisions have cost taxpayers dearly. Improving the municipal debt management process will require the participation of several parties, including issuers, advisors, regulators, and trade associations. Ex-post counterfactual analysis and proficiency measures, such as the one introduced in this paper, will shed greater light on the need to improve financial policymaking at the state and local levels in the United States.

Endnotes

[1] The municipal securities market uses the term "refinancing" to describe a refunding of a government or tax-exempt borrower's outstanding debt.

[2] Per federal tax law, one tax-exempt advance refunding was allowed for bonds issued after 1985 (more than one tax-exempt advance refunding was allowed before 1985). The 2017 Act did not restrict using "current refundings" with tax-exempt bonds (i.e., refunding within 90 days of the call date).

[3] The coupon rate (e.g., 5%) determines a bond's semi-annual interest payment to investors (i.e., 2.5% of the par amount every six months for a bond with a 5% coupon). Municipal bonds with maturities greater than ten years are typically callable in 10 years from issuance at 100% of the par amount. This paper describes these bonds as "5% bonds."

[4] An investor must pay a premium price for the bond to receive a coupon rate higher than current interest rates.

[5] The de minimis tax treatment for municipal bonds determines whether the gain resulting from purchasing a bond at a discount is taxed as ordinary income or capital gain. Due to the "de minimis market effect," bonds purchased near par experience larger than expected declines in prices when interest rates rise (see Kalotay and Fennell [2022] for an example and more detailed explanation of this bond pricing phenomenon).

[6] A make-whole call allows issuers to retire bonds before their final maturity and/or the conventional call date. The make-whole price is intended to compensate the investor for the early call and is usually equal to the present value of the foregone coupon payments.

[7] While universities, hospitals, and other non-profit organizations also actively used the taxable advance refunding strategy, the top ten largest transactions only include government entities. In addition, governments represent the entire sample of transactions we use in this paper. As such, going forward, our language will only refer to "state and local governments," recognizing that our results and recommendations likely apply to all types of tax-exempt borrowers.

[8] Option-adjusted TIC adjusts the proceeds in calculating TIC to account for the refunding option on the callable bonds. This likely results in a lower cost of borrowing, reflecting the high likelihood that the callable bonds will be redeemed before maturity.

[9] Since the discount rate is the taxable rate, the present value of the taxable refunding bonds is simply the sale price of the bond issue.

[10] There is insufficient information regarding the legality and economics of these types of financings.

[11] The optionless yield curve for each counterfactual refunding was adjusted for issuers not rated AAA by computing the yield spread between the AAA MMD yield at each maturity and the AA or A MMD yield, dependent on the issuer's actual credit rating. MMD is the municipal market data yield curve that includes yields on 5% coupon rate bonds non-callable before ten years and callable ten years after. It is a widely referenced yield curve to determine the pricing of primary market municipal bond issuances.

[12] Between the taxable advance refunding and the counterfactual tax-exempt refunding, no material rating changes were made for any of the issuers in our sample.

[13] While our sample is certainly not generalizable in statistical inference, it reflects a good cross-section of government issuers, including some of the largest and presumably financially most sophisticated issuers in the United States.

[14] We leave it to the interested reader to determine who benefited from this enormous waste.

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