Small Business Administration: Evaluation Support Task Order 2

Evaluation of Surety Bond Guarantee Program

FINAL REPORT

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Submitted to:

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EXECUTIVE SUMMARY

Purpose of the Evaluation

The U.S. Small Business Administration's (SBA) Surety Bond Guarantee (SBG) Program guarantees bid, payment, and performance bonds for small and emerging businesses that cannot obtain traditional commercial surety bonds. The SBG Program guarantees up to 80 or 90 percent of the surety's losses when a small business defaults on a contract. From fiscal year (FY) 2006 to 2018 the SBG Program charged sureties 26 percent of the bond premium and small businesses $7.29 per thousand dollars of the contract amount. These fees were deposited into a revolving fund that covered the cost of guarantees and program expenses. The growth of the revolving fund (under this fee structure) contributed to SBA's decision to announce a temporary fee reduction for the period of October 1, 2018, through September 30, 2019. The reduced fee structure was later extended for an additional year to September 30, 2020, but the data analyzed for this evaluation only covered the period ending on December 31, 2019. Accordingly, the evaluation utilizes a "Post-Intervention Period" of October 1, 2018, to December 31, 2019, to evaluate the impacts of the fee reductions. The new fees reduced the charges to sureties from 26 percent of the bond premium to 20 percent and the charges to small business contractors from $7.29 to $6.00 per thousand dollars of the contract amount.

SBA contracted with 2M Research (2M) to evaluate the effects of these fee reductions and the implications for participating small businesses, surety firms, and agents; and to provide actionable recommendations for the SBG Program. To accomplish this, 2M designed an evaluation to answer the research questions identified in **Exhibit ES-1**. These questions focus on understanding how the fee reductions affect program use, the size and characteristics of participating small businesses, and the possible effects of future fee reductions.

Exhibit ES-1: Overview of the Evaluation's Research Questions

Research Questions
1. How do the fee reductions affect program use by surety firms, surety agents, and small businesses, and how do the fee reductions affect the number and aggregate value of bonds guaranteed? a. Do external factors (i.e., business cycles; local economic conditions; federal, state, and local policies; conditions in the general surety bond market) contribute to the differences between the predicted and observed number and value of bonds guaranteed in the Post-Intervention Period?
2. How do the fee reductions affect the size and characteristics of small businesses in the portfolio?
a. How do the fee reductions affect the characteristics of small businesses in the portfolio?
b. How do the fee reductions affect the portfolio of participating surety firms and agents?
3. How do the fee reductions affect the risks associated with guaranteeing bonds?
a. How do the fee reductions affect defaults in the program?
4. How did surety firms and agents view the fee reductions and their potential value for expanding their clientele and the number and value of bonds they approve?
5. Based on the outcomes of this study, what are the predicted effects of future fee reductions, and what do the results imply for recommendations to maintain, modify, or rescind the fee changes?

This evaluation employed a multi-method sequential explanatory design (Morse, 2003), in which the findings from the evaluation's statistical modeling component informed the design and analysis of a survey component:

1. **Statistical Modeling Component:** The first phase of the evaluation utilized Interrupted Time Series (ITS) models to generate predictions of the number of bonds guaranteed and the total contract values of the guaranteed bonds if the fee reductions were never adopted (i.e., a counterfactual). These counterfactual predictions were then compared to data on the actual number and aggregate value of the bonds guaranteed under the fee reductions to determine the fee reduction's impacts.
2. **Survey Component:** The second phase of the evaluation drew upon the insights obtained from the statistical modeling results to conduct online surveys of surety agents and surety firms participating in the SBG Program. These surveys included questions on how the reductions affected bonding practices, the risks associated with guaranteeing bonds, how surety firms and agents viewed the fee reductions and their potential value, and how maintaining or changing the fee reductions over the next 2 years might affect their practices.

Together, the findings from the two components provide a picture of the impacts of the fee reductions that is more comprehensive than from either component alone, and therefore provides a stronger foundation for the actionable information and insights SBA will need moving forward on fee-related issues. The sections below detail the findings from the evaluation's statistical modeling and survey components as they pertain to the evaluation's research questions. The executive summary concludes with a set of recommendations based on the evaluation's findings for SBA to consider when examining future fee changes.

Findings

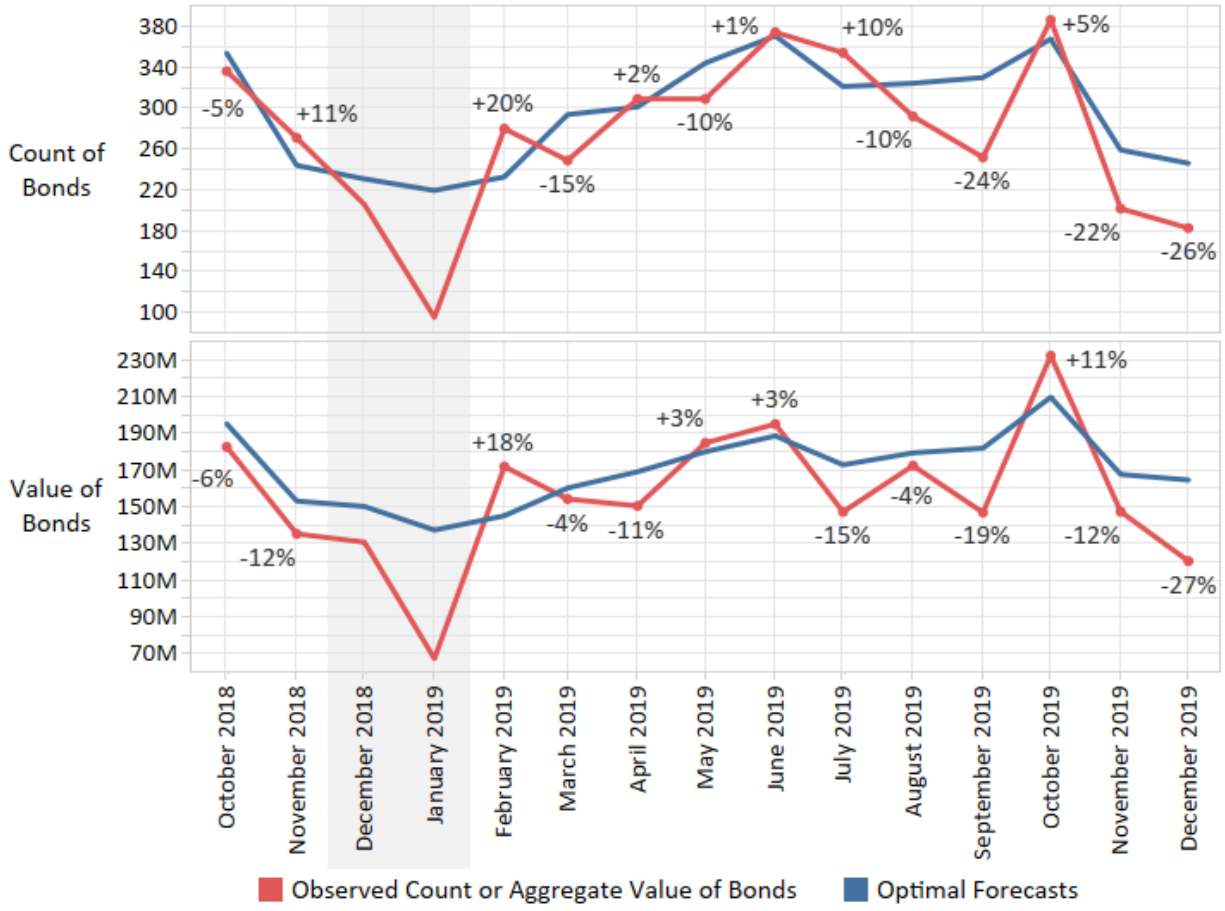
1. How do the fee reductions affect program use by surety firms, surety agents, and small businesses, and how do the fee reductions affect the number and aggregate values of bonds guaranteed?

Findings from the pair of surveys demonstrate that vast majorities of participating surety firms and agents (88.7 and 95.4 percent, respectively) were knowledgeable about the fee reductions. Participating firms and agents expressed notable differences in their beliefs about the fee reductions' expected impacts on the number of bond applications: 59.0 percent of agents stated that the reductions would have "no effect" and the number of applications would remain the same while 57.8 percent of firms expected an increase in the number of bond applications processed. However, firms and agents showed strong agreement on the expected impacts of the fee reductions on the contract values of the bond applications with 63.4 percent of agents and 78.4 percent of firms reporting that they expected "no effect."

The synthesized findings from the ITS models and the surveys provide strong empirical evidence that the fee reductions did not have the intended impact of increasing the number or values of bonds during the Post-Intervention Period. **Exhibit ES-2** shows that the number of new bonds processed under the fee reduction was lower than the counterfactual predictions generated by the optimal ITS models in 7 of the

13 months[1] (54 percent) in the Post-Intervention Period. Survey findings demonstrated that majorities of agents and firms (57.7 and 49.9 percent, respectively) saw "no effect" in the number of applications after the implementation of the fee reduction. Meanwhile, the aggregate values of the new bonds processed under the fee reduction were lower than the counterfactual predictions of the optimal ITS models in 8 of the 13 months (62 percent) while the survey findings demonstrated that 61.5 percent of agents and 59.1 percent of firms saw "no effect" on the contract values of bond applications. Finally, survey findings provide evidence suggesting that the fees are not a primary factor associated with the decisions of agents and firms to write SBG Program bonds. Only 11.2 percent of responding agents identified "the fees associated with processing an application" as a primary factor, and none of the responding firms identified the fees as a primary factor in their decisions to write SBG Program bonds.

Exhibit ES-2: Comparison of the Number of Bonds and Associated Contract Values Under the Fee Reduction (Truncated)



Source: SBA Form 994

Note: The shaded area indicates months when the Government experienced a lapse in appropriations but does not necessarily reflect the exact end and start dates.

[1] Although the fee reduction period covers a span of 15 months, the 2 months associated with a lapse in government appropriations were excluded from analysis. The month following the lapse in appropriations (February 2019) showed a noticeably high count of new bond guarantees, but a closer examination of daily counts showed similar patterns to previous Februarys. The exclusion of February 2019 would not alter the findings or broad conclusions reached in this report.

One caveat to the evaluation's findings is that firms and agents that guaranteed a higher proportion of the bonds in the SBG Program were more likely to report increases in the number and contract value of bonds and were more supportive of keeping the fees at reduced levels. The findings when weighted by proportion of bonds show that 48.7 percent of firms reported an increase in the number and value of bond applications processed under the fee reduction. The findings using the alternative weights also show that a majority of firms (67.1 percent) and a plurality of agents (36.9 percent) believed that keeping the fees at the reduced levels would increase the number of bonds issued under the program. In contrast, a plurality of firms (40.8 percent) believed that keeping the reduced fees would also increase the contract values of the bonds while a plurality of agents (42.9 percent) believed that the fee levels were not likely to affect the value of the bonds. Further research is needed to explore why firms and agents with higher levels of activity in the SBG Program were more likely than their peers to experience increases in the number and value of bonds and were more likely to support keeping the fees at the reduced levels.

2. How do the fee reductions affect the size and characteristics of small businesses in the portfolio?

The synthesized findings from secondary analyses on the characteristics of participating small businesses and the surveys of firms and agents suggest that the fee reductions did not have a significant impact on the size and characteristics of small businesses participating in the SBG Program. The additional descriptive analyses of administrative data from the SBG Program demonstrate only marginal differences in the characteristics of participating small businesses between the Pre- and Post-Intervention Periods. Furthermore, strong majorities of agents and firms (58.4 percent and 53.2 percent, respectively) reported that they saw no change in the types of small businesses submitting applications and no change in the types of small businesses submitting applications for higher contract values (64.7 percent of agents and 57.2 percent of firms).

3. How do the fee reductions affect the risks associated with guaranteeing bonds?

The surveys of agents and firms examined the impacts of the fee reductions on the risk associated with guaranteeing bonds, in the form of the number and sizes of defaulted contracts. Strong majorities of agents and firms (68.6 and 81.8 percent, respectively) reported that there was no change in the number of defaults under the fee reductions and no change in the size of the defaulted contracts (66.7 and 73.4 percent of agents and firms). These findings suggest that the fee reductions did not have a significant impact on the risks associated with guaranteeing bonds, though this finding may be moderated by the factors associated with the decisions of firms and agents to write SBG Program bonds and the subsequent impact on the composition of small businesses participating in the program. Notably, agents and firms stated that risk of default was a third-order factor associated with decisions to write bonds, while the creditworthiness of the applicant, whether the applicant had adequate working capital, and the applicant's project experience and ability were cited as primary factors.

4. How did surety firms and agents view the fee reductions and their potential value for expanding their clientele and the number and value of bonds they approve?

The surveys asked participating agents and firms questions focused on their perceptions of the fee reductions and the potential value for their clientele. A majority of firms (50.4 percent) expressed that keeping the fees at the reduced levels would increase the number of bonds while a plurality of agents (39.2 percent) agreed that "fee levels are not likely to affect the number of bonds processed." Firms and

agents demonstrated greater agreement on the fees' impacts on contract values, with pluralities of agents and firms (41.6 and 36.3 percent, respectively) noting that the fee values were unlikely to affect the value of the bonds processed.

A final pair of questions asked agents and firms about various fee-level scenarios that would increase respondents' likelihood of processing more and fewer SBG Program bonds. Across both sets of questions, pluralities of agents (40.8 to 47.1 percent) and firms (37.8 to 45.1 percent) suggested, "Fee levels are not likely to affect the number of bonds processed." However, the answers from a subgroup of firms and agents provide important insight into support for various fee levels. A combined 44.6 percent of agents suggested that reducing the principal fees to a range of 0.40 to 0.50 percent would result in more bonds and a combined 54.55 percent suggested that increasing the principal fees to between 0.65 and 0.80 would result in fewer bonds. Among firms, a combined 50.5 percent suggested that reducing the surety fees to between 8 and 14 percent would result in more bonds while a combined 55.1 percent suggested that increasing the surety fees to between 23 and 32 percent would result in fewer bonds being processed. Together, these questions provide critical insight into support for various fee-level scenarios. Future research is necessary to explore why these subgroups of firms and agents support further reductions of fees.

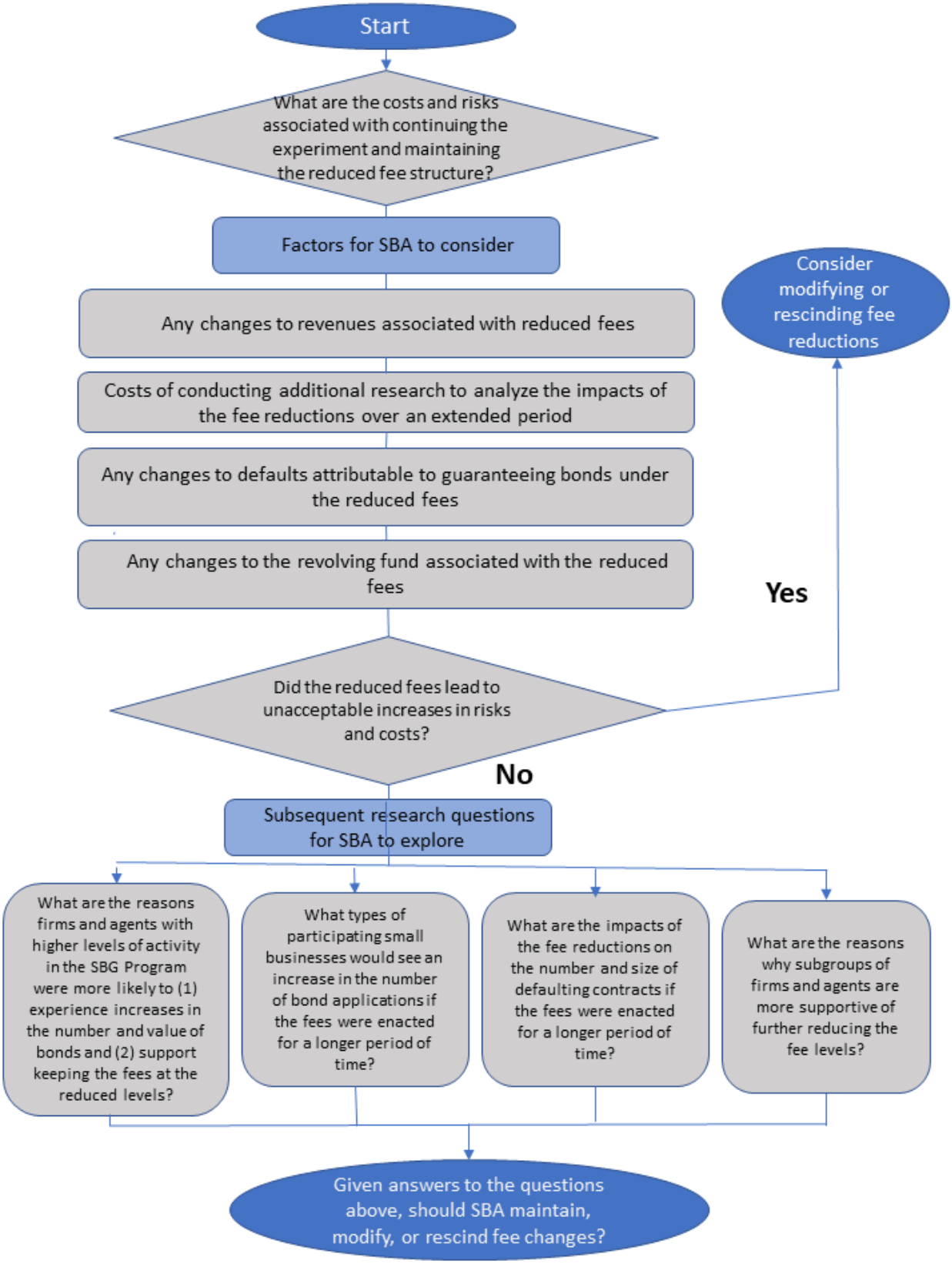
5. ***Based on the outcomes of this study, what are the predicted effects of future fee reductions, and what do the results imply for recommendations to maintain, modify, or rescind the fee changes?***

The results of the statistical models provided no evidence that the fee reductions helped increase either the number or value of bonds guaranteed through the SBG Program. Meanwhile, the findings from the surveys of surety firms and agents point to at least two major and divergent approaches to interpreting the results from the ITS models and to addressing future decisions on fee levels.

1. The first line of interpretation takes the clear findings of the statistical models that the fee reductions did not increase the number or value of bonds guaranteed through the SBG Program and adds supporting evidence from the surveys that neither surety agents nor firms see fee levels as a primary factor in their processing of applications or expected the fee reductions to increase the number of bond applications processed.
2. The second line of interpretation relies on responses from a subpopulation of surety firms and agents who reported increases in the number or value of bonds or who felt that the reduced fees would have to be larger or maintained over a longer time period to increase their processing of applications for bond guarantees.

In consideration of these points, the flow chart on the following page lists recommended factors for SBA to consider when determining fee changes. Careful consideration of the factors will support SBA in its subsequent discussions of future fee changes, including those on whether to maintain, modify, or rescind the fee reductions.

Exhibit E S-3: Recommended Factors for SBA to Consider When Considering the Fee Reductions



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ACKNOWLEDGEMENTS

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1 OVERVIEW OF EVALUATION

The U.S. Small Business Administration's (SBA) Surety Bond Guarantee (SBG) Program guarantees bid, payment, and performance bonds for small and emerging businesses that had difficulty obtaining surety bonds under reasonable terms through conventional commercial markets. SBA's guarantee assumes up to 80 or 90 percent[2] of the surety's losses should a small business default on a bonded contract and, therefore, provides sureties with an incentive to bond small businesses. To cover reimbursable losses incurred by the sureties, SBA charges both the small business and the surety firm a fee, which is deposited into a revolving fund. From fiscal year (FY) 2006 to 2018, the SBG Program charged 26 percent of the bond premium to sureties and $7.29 per thousand dollars of the contract value to small business contractors. Prior to FY 2006, the charges were 20 percent of the bond premium for sureties, and $6.00 per thousand dollars of the contract value to small businesses. The higher fees from 2006 to 2018 was one of several factors that helped increase the size of the revolving fund and build financial strength that enabled SBA to announce a temporary fee reduction for the period of October 1, 2018, through December 31, 2019 (later extended to September 30, 2020[3]).

SBA contracted with 2M Research (2M) to evaluate the fee reductions' effects and provide SBA with actionable recommendations for maintaining or modifying the fee structure. The evaluation began with a comprehensive review of the peer-reviewed academic and grey literatures (i.e., government or industry reports) on surety bonds and with the development of a logic model for the SBG Program (**Appendix A**). These efforts provided the foundation for evaluation planning and the development of the multi-method evaluation design.

Background and Objectives of the SBG Program

SBA supports small businesses, including businesses owned by minorities, women, veterans and service-disabled veterans, by administering several programs that enhance small businesses' access to capital and opportunities to secure government and private-sector contracts. The SBG Program was developed to improve the ability of small business contractors to bid on and win contracts by guaranteeing the surety bonds these contracts require. A timeline of the SBG Program, including the implementation of key policies and regulations, is included in **Appendix A**.

A surety bond is a legally binding contract between three parties—the principal (the business seeking the bond), the surety (the insurance company that backs the bond), and the obligee (the entity requiring the bond)—to guarantee future work performance (National Association of Professionals in Surety Bonding, n.d.). Many public and private contracts require surety bonds for companies to be eligible to compete for contracts. The surety bonds prequalify the principal (i.e., assess the small business' *bonding*

[2] To incentivize higher rates of participation among key populations, SBA will guarantee up to 90 percent of the surety's losses for small businesses owned by minorities, women, veterans, and persons with disabilities.

[3] The Post-Intervention Period originally consisted of the 12-month span of October 1, 2018, through September 30, 2019 (i.e., Federal FY 2019). However, SBA elected to extend the fee reduction for an additional 3 months due to the lapse in government appropriations, which spanned December 22, 2018, through January 25, 2019. The period without appropriations posed a notable validity threat to the evaluation, as it occurred roughly 11 weeks after the enactment of the fee change and produced a significant reduction in the number of bonds issued under the SBG Program. As a result, the extension of the fee reduction was enacted, in part, to provide additional data to evaluate the fee reduction. The study used data through only December 31, 2019, however.

capacity) based on financial strength and experience (Schubert, 2003). Types of surety bonds include the following:

- **Bid bonds** guarantee that the bidder on a contract will enter the contract and furnish the required payment and performance bonds if awarded the contract.
- **Payment bonds** guarantee that suppliers and subcontractors will be paid for work performed under the contract.
- **Performance bonds** guarantee that the small business contractor will perform the contract in accordance with its terms and conditions.
- **Ancillary bonds** ensure completion of requirements outside of performance or payment, such as maintenance.

Many small businesses lack either the financial strength or the experience needed to obtain bonds through traditional commercial channels. The SBG Program was authorized by the Housing and Urban Development Act of 1970 (P.L. 91-609) (hereafter "the Act") to address this challenge. The Act enables SBA to provide a guarantee to incentivize sureties to offer bonds to small businesses that cannot obtain surety bonds through commercial channels (U.S. Small Business Administration [SBA], n.d.). The SBG Program guarantees individual contracts of up to $6.5 million for non-federal contracts and, with the certification of a Federal Contracting Officer, up to $10 million for federal contracts. If a default occurs, the guarantee ranges from 80 to 90 percent of the surety's loss. The 90 percent guarantee applies to final contracts of $100,000 or less and declines to 80 percent by 1 percent for each $5,000 increase in the contract value. The 90 percent guarantee also applies to small businesses owned by minorities, women, veterans, and persons with disabilities.

The primary funding sources for the program include the following:

Congressional appropriations to the Revolving Fund,[4] which SBA uses to cover the guaranteed portion (ranging historically from 70 percent to 90 percent) of the losses incurred by surety companies through claims. These appropriations also cover the costs of losses from guaranteed bond defaults to surety firms that are not covered by the revenue that bond rates and fees generate. Congress provided the Revolving Fund between $2.86 and $3 million annually from FY 2005 to FY 2008. In 2009, Congress appropriated $2 million and the American Recovery and Reinvestment Act (P.L. 111-5) appropriated an additional $15 million to support a temporary increase in the program's bond limit to $5 million, and up to $10 million for federal contracts if a federal contracting officer certified in writing that a guarantee in excess of $5 million was necessary. In FY 2010, Congress appropriated the Revolving Fund $1 million. Since then, the Revolving Fund has had sufficient reserves to cover the cost of anticipated claim defaults and has not received further appropriations from Congress.

1. Fees charged to small business contractors and to surety firms to cover the costs of guaranteeing the surety bonds. When first established in 1971, the SBG Program charged small business contractors a premium of 2 percent of the contract value while surety firms were charged 10 percent of the bond's premium. Fees were increased over the ensuing decades. In FY 2006, the program raised the fees charged to small business contractors from $6.00 to $7.29 per thousand

[4] Congressional appropriations to the Revolving Fund differ from the appropriations that SBA receives to administer the SBG Program.

dollars of the contract value and raised the charge to surety firms from 20 percent to 26 percent of the bond's value.

2. Claim costs recovered from small business contractors. In issuing a bond, the surety firm ensures that the project is completed according to contract, and that workers, subcontractors, and suppliers are paid (Congressional Record Service [CRS], 2018). The surety bond legally obligates the contractor to repay the surety company all costs incurred in satisfying claims, including legal expenses, and underwriting of the bond is based upon the contractor pledging corporate and personal assets sufficient to make this repayment. The small business is, therefore, usually able to repay a substantial portion of the claim owed the surety firm. Since the SBG program guarantees to pay the surety firm 80 to 90 percent of the default, most of the claim costs recovered reimburse the Revolving Fund for its payment to the surety firm.

A key SBA objective is to maintain sufficient funds in the SBG Revolving Fund to pay (pending recovery) the cost of claims the SBG Program has guaranteed while not imposing cost burdens that might reduce small business contractors' and sureties' participation in the program or relying on Congressional appropriations. The primary reason cited for the fee increases in FY 2006 was the need to increase the self-sustaining flow of revenues into the SBG Revolving Fund. Conversely, the growth of reserves in the fund permitted the reduction of fees back to the pre-2006 levels of $6.00 per thousand of contract value for applicant small businesses and 7.29 percent of the bond value for sureties. SBA has also used increases in contract limits and reductions in paperwork (most notably by establishing the Preferred Surety Provider program) to attract or retain surety firms.

Organization of the Report

The remainder of this report is structured in three sections. The next section summarizes the multi-method evaluation design. A second section details the findings from the evaluation's statistical modeling and survey components and integrates their findings to provide a comprehensive interpretation of the study's findings. The final section discusses the evaluation's findings and provides recommendations for SBA on approaches to considering continuing or ending the fee changes.

2 EVALUATION DESIGN

This study employed a multi-method evaluation design to evaluate the impacts of the fee reductions. To address the evaluation's research questions, the design combined statistical modeling of SBA administrative data with surveys of surety firms and agents participating in the SBG Program. This section provides an overview of the evaluation design, beginning with the research questions, and then discusses the design's statistical modeling and survey components.

Research Questions

To provide SBA with a detailed understanding of the impacts of the fee reductions, the evaluation was designed to answer the research questions identified in **Exhibit 1**. These questions focus on understanding how the fee reductions affect program use, the size and characteristics of the program's portfolio, the risks of the program, and the predicted effects of future fee reductions.

Exhibit 1: Overview of the Evaluation's Research Questions

Research Questions
1. How do the fee reductions affect program use by surety firms, surety agents, and small businesses, and how do the fee reductions affect the number and aggregate value of bonds guaranteed?
a. Do external factors (i.e., business cycles; local economic conditions; federal, state, and local policies; conditions in the general surety bond market) contribute to the differences between the predicted and observed number and value of bonds guaranteed in the Post-Intervention Period?
2. How do the fee reductions affect the size and characteristics of small businesses in the portfolio?
a. How do the fee reductions affect the characteristics of small businesses in the portfolio?
b. How do the fee reductions affect the portfolio of participating surety firms and agents?
3. How do the fee reductions affect the risks associated with guaranteeing bonds?
a. How do the fee reductions affect defaults in the program?
4. How did surety firms and agents view the fee reductions and their potential value for expanding their clientele and the number and value of bonds they approve?
5. Based on the outcomes of this study, what are the predicted effects of future fee reductions, and what do the results imply for recommendations to maintain, modify, or rescind the fee changes?

The evaluation's research questions required a flexible evaluation design utilizing multiple analysis methods. The following section presents the multi-method evaluation design for nontechnical audiences. A more detailed discussion of the evaluation design can be found in the Evaluation Methodology Report previously developed for this study, and in **Appendices B-D**.

Multi-Method Evaluation Design

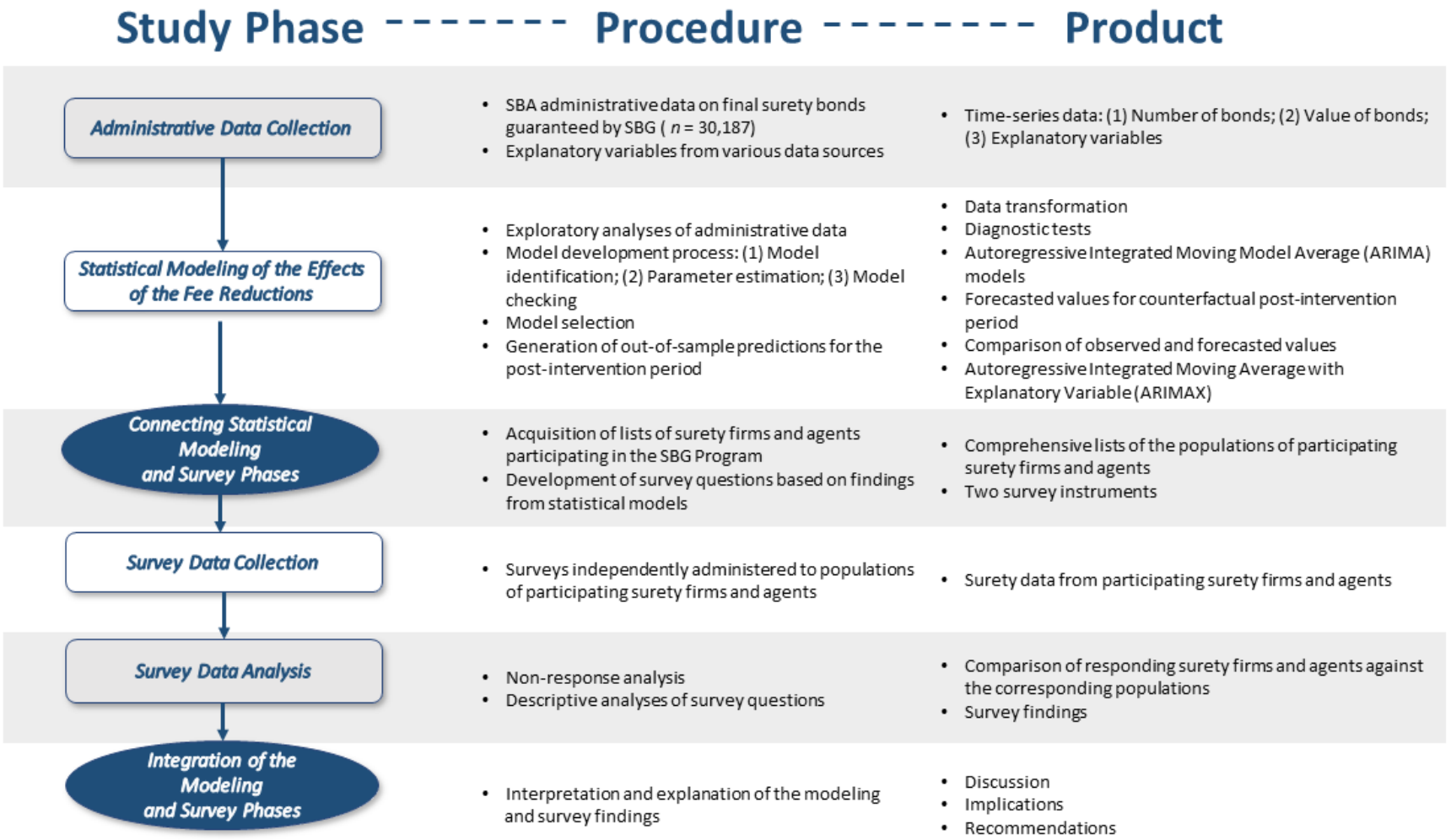
The evaluation employed a multi-method design that sequentially integrated statistical modeling and survey methods to answer the evaluation's research questions. Multi-method evaluation designs are valued for their ability to broaden a study's dimensions and scope and to produce a more comprehensive picture of a program's effectiveness by integrating several research methods into a single

study (Morse, 2003). An important strength of multi-method evaluation designs is that they enable one to address research questions that are essential to a study's purpose but are too different in nature and content to be addressed through a single methodology (Fielding, 2008; Morse, 2003). Multi-method designs are especially valuable within applied settings, where they can compensate for the limitations of individual methods while providing opportunities to triangulate findings and develop more comprehensive understandings (Fielding, 2008). A multi-method evaluation design seems especially appropriate for understanding the impacts of fee reductions on the SBG Program and for developing actionable recommendations for SBA.

This evaluation employed a sequential explanatory design (Morse, 2003), a specific type of multi-method design in which the findings from the evaluation's statistical modeling component informed the design and analysis of the survey component. A form of Interrupted Time Series (ITS) models, Autoregressive Integrated Moving Average (ARIMA) models, were used to answer the first research questions, which focused on determining whether the fee reductions implemented in October 2018 affected the number and value of bonds guaranteed through the SBG Program. This question was addressed through ARIMA statistical models (described in the next section) that used the number and value of bonds guaranteed prior to the fee reductions to forecast corresponding values for the 15-month Post-Intervention Period after the fee reductions. This quasi-experimental design provides a rigorous method for evaluating the effects of the fee reductions on the number and value of bonds guaranteed through the SBG Program. A multivariate form of ARIMA models known as Autoregressive Integrated Moving Average with Explanatory Variable (ARIMAX) models was used to test whether any external factors contribute to the differences between predicted and observed outcomes in the ARIMA analysis.

While the statistical models provided rigorous analyses of the impacts of the fee reductions, these analyses could not provide insights into the decision-making processes that may have led surety firms and agents to solicit applications or approve applications differently than before the fee reductions. Understanding the plans that surety firms and agents developed in anticipation of the fee reductions, and their explanations of how these reductions affected their bonding practices and processes, was deemed critical for SBA's decisions on extending or modifying the fee reductions in the future, and for SBA's communication with surety firms and agents about the options under consideration. To address these key questions and inform future decisions, the evaluation used findings from the statistical modeling component to develop survey instruments for surety firms and agents participating in the SBG Program. Sequentially conducting the statistical modeling and survey components facilitated the development of survey questions that were more informed about respondents' perceptions of the fee reductions, in addition to yielding a more robust analysis of the program's effects. **Exhibit 2** provides a visual model of the evaluation's multi-method design.

Exhibit 2: Visual Model of the Study's Multi-Method Sequential Explanatory Evaluation Design



Collecting information on these decision-making processes, and especially information about the fee reductions' effects on the perceptions and processes affecting guarantee assessment practices, required well-crafted survey questions on surety firms' and agents' perceptions. While the statistical modeling methods were needed to provide rigorous quasi-experimental evidence on *whether* the fee reductions affected the number, value, and characteristics of bonds guaranteed through the program, only survey methods could provide critical insights into *why* such changes may have occurred. Together, the statistical modeling and survey methods provided a more comprehensive picture than either method could provide alone and, therefore, the combined methods also provide a stronger foundation for the actionable information and insights that SBA needs.

STATISTICAL MODELING COMPONENT

The evaluation's statistical modeling was designed to rigorously evaluate the effects of the SBG Program fee reductions by examining changes in the program utilization and in the portfolio of bonds the program guaranteed after fees were reduced. ITS models were estimated to evaluate the effects of the SBG Program's fee reductions by comparing predictions based on trends during the Pre-Intervention Period (October 2008 through September 2018) with values observed in the Post-Intervention Period (October 2018 through December 2019). The quasi-experimental approach of ITS models measures each outcome variable at regular time intervals (i.e., the number and aggregate value of bonds on a monthly basis over a Pre-Intervention Period) to predict the values of each outcome variable on the assumption that the process continued uninterrupted. Pre-Intervention Period measurements are used to identify stability in processes over the Pre-Intervention Period, and to project the trajectory of change over the Post-Intervention Period. The continuity of measurements, and the pattern of responses on the outcome variables, are used to control for threats to validity (Mertens & Wilson, 2012) and to generate accurate forecasts of predicted outcomes under the counterfactual in which the intervention did not occur.

This section reviews the SBA administrative data and external factors used to build the ITS models, the ITS model development process and robustness checks, and the fit of the models. More detailed technical information on the ITS models is provided in **Appendix B**.

Data

The ITS models were estimated from outcome variables available in SBA administrative data. The primary variables used in the ITS models consisted of the total number of final[5] surety bonds guaranteed by the SBG Program and the aggregate value of the associated contracts. The secondary variables analyzed include the industrial classification of guaranteed bonds and key characteristics of bonded small businesses such as business size; minority, female, veteran, and disability ownership; and business locations. The primary and secondary outcome variables were constructed using bond-transaction administrative data collected over the Pre-Intervention Period through the Surety Bond Guarantee Agreement (SBA Form 990) and the Application for Surety Bond Guarantee Assistance (SBA Form 994).

Data for the external explanatory variables analyzed to address Research Question 1a were drawn from several data sources, including the Bureau of Economic Analysis (BEA), Bureau of Labor Statistics (BLS),

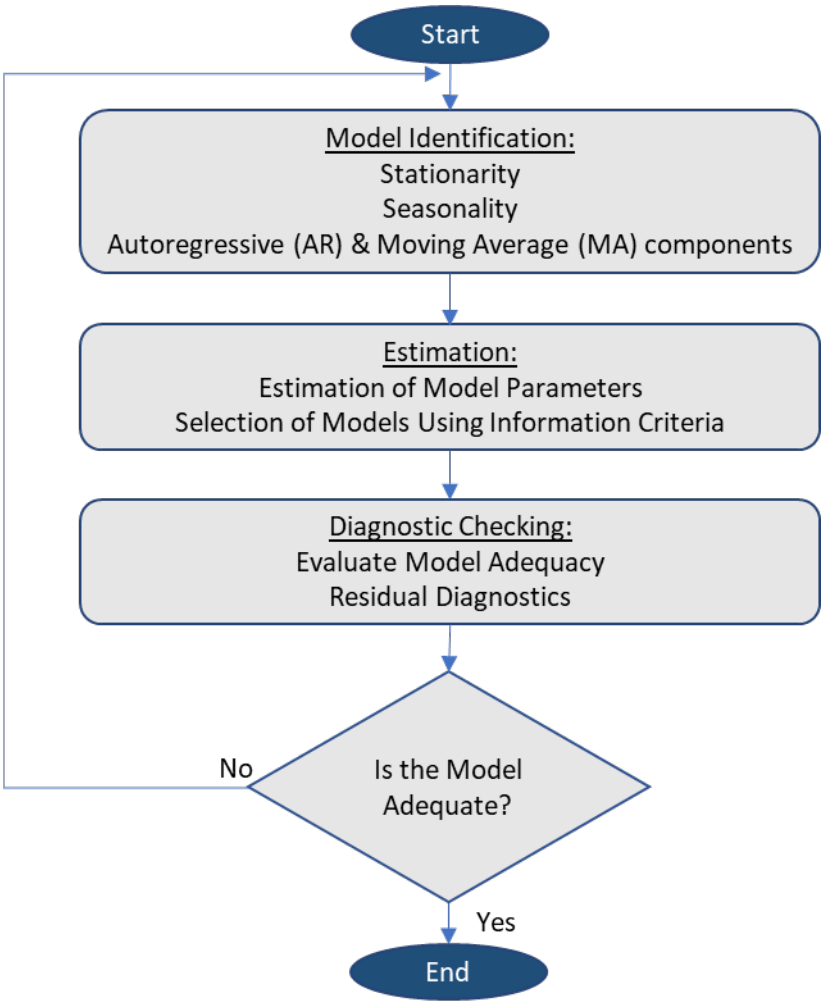
[5] "Final" surety bonds refer to either payment or performance bonds.

National Federation of Independent Business (NFIB), and the U.S. Census Bureau (Census), and from summaries of important legislative and regulatory changes in the history of the SBG Program.[6]

Model Development

The study team employed a three-stage iterative model-building procedure developed by Box and Jenkins (1976) to develop, test, and apply robust ITS models that predict the outcome variables under the counterfactual condition for the Post-Intervention Period. This process is depicted in **Exhibit 3** (a detailed overview of this model-development process is included in **Appendix C)**. Under this process, ARIMA models (a form of ITS model) were developed to compare predictions of the number and values of bonds guaranteed based on trends during the Pre-Intervention Period (October 2008 through September 2018) with the values observed in the Post-Intervention Period (October 2018 through December 2019).

Exhibit 3: Diagram of the ARIMA Model-Building Process



[6] *Program Policy – Regulation History 2006-2019.xlsx*, provided by Jermaine Perry Jermaine Perry, CAPM Management Analyst, Office of Surety Guarantees, Office of Capital Access, U.S. Small Business Administration.

ARIMA models are univariate and rely on a linear combination of past dependent variable values and past values of an error term. After the assessment of stationarity, potential ARIMA models are constructed by examining autocorrelation functions (ACF) and partial autocorrelation functions (PACF) of the dependent variable. These correlational plots between the dependent variable and previous time points provide insight into how many past values, known as autoregressive (AR) terms, and past errors, known as moving average (MA) terms, to include in the models. Pre-Intervention Period line plots of monthly guaranteed bond counts and the aggregate values showed consistent yearly peaks occurring in early summer months and in September and October, and troughs during winter months. To account for these patterns, the study team used a specialized form of ARIMA known as Seasonal Autoregressive Integrated Moving Average (SARIMA) models. The hypothesized SARIMA model notations are distinguishable by their counts of AR, MA, seasonal AR, and seasonal MA terms:

$$SARIMA\ (p, d, q)\ (P, D, Q)$$

In which *p* is the number of AR terms; *d* the differencing order to establish stationarity;[7] *q* the number of MA terms; seasonal AR terms, *P*; seasonal differencing, *D*; and seasonal MA terms, *Q*.

A combination of univariate and multivariate SARIMA models were estimated to examine the sensitivity of model findings and control for validity threats. The forecasting literature has extensively documented that univariate models often forecast more accurately than their multivariate counterparts (as discussed further in **Appendix B**). The univariate SARIMA models were, therefore, deemed the primary model for examining the impacts of the fee reduction. To generate multivariate models of similarly high predictive power, the study team designed an ARIMAX model building algorithm similar to Andrews, et al. (2013) to examine external factors identified in the section below on Modeling External Factors. This ARIMAX algorithm was run under different specifications that narrowed down 248 potential explanatory variables individually through correlational requirements and model performance metrics to assess added value. These multivariate models helped test whether and how external factors affected variations in model parameters.

Fit of the Initial Models

Four candidate SARIMA models for both primary outcomes were deemed adequate and subsequently scrutinized for fit. Model accuracy statistics were used to evaluate how accurately SARIMA models predicted outcomes under the old fee structure and to identify an "optimal model" for predicting each outcome under the counterfactual scenario. Three measures of prediction error were used: root mean square error (RMSE), mean absolute error (MAE), and mean absolute percentage error (MAPE). Each measure produces an averaged error score but differ based upon differences in calculations and interpretation important to the selection of optimal models. For example, the RMSE formula squares prediction errors, which places more weight on large errors than both MAE and MAPE. In contrast, MAE and MAPE are easier than RMSE to interpret, as differences between predicted and actual values are not transformed by squaring. MAPE adds interpretive value by measuring the error as a percentage of the

[7] First differencing was required across all models for both variables to establish stationarity. Thus, all SARIMA equations will have a value of 1 for the *d* term of their notation.

actual value, but this gives greater weight to prediction errors at time points with lower denominator values, inflating the overall MAPE score.[8]

Model accuracy statistics displayed in **Exhibit 4** show that the candidate bond count models produced errors ranging from 11.46 to 12.52 percent of the actual monthly bond count. The exclusion of models based on accuracy statistic rankings resulted in two remaining models. While the SARIMA (1,1,1) (1,0,1) model had the smallest RMSE score, the SARIMA (0,1,1) (1,0,1) model had better unweighted averages error statistics (MAE and MAPE). The study team deemed the SARIMA (0,1,1) (1,0,1) to be the optimal model as the lower RMSE score for the SARIMA (1,1,1) (1,0,1) model is likely attributable to a small number of time points.

Exhibit 4: Accuracy Measures for the Count of Newly Guaranteed Bonds, FY 2010-2018

Model	RMSE	MAE	MAPE
SARIMA (0,1,1) (1,0,1)	**30.5977**	**24.3786**	**0.1146**
SARIMA (1,1,1) (1,0,1)	30.4762	24.4452	0.1150
SARIMA (1,1,1) (1,0,0)	34.4616	26.4817	0.1228
SARIMA (0,1,1) (1,0,0)	34.7586	27.1567	0.1252

Notes: The first fiscal year of data was not included in the model performance calculations. To account for the monthly seasonality in the count of new bonds, the model equations require data points from the previous year.

Predicting monthly aggregate contract values proved to be more challenging than bond counts due to the variation in values across bonds. All three accuracy statistics scores had a smaller range across the final models for contract values than for the count of bonds (**Exhibit 5)**. Despite marginal differences, the SARIMA (1,1,1) (1,0,1) model had the lowest RMSE (19.36), MAE (15.09), and MAPE (18.09 percent) scores and consistently outperformed its competitors. The SARIMA (1,1,1) (1,0,1) model was therefore deemed the optimal specification to forecast post-intervention values.

Exhibit 5: Accuracy Measures for the Value of Newly Guaranteed Bonds, FY 2010-2018

Model	RMSE	MAE	MAPE
SARIMA (1,1,1) (1,0,1)	**19.3634**	**15.0930**	**0.1809**
SARIMA (0,1,1) (1,0,1)	19.4033	15.1338	0.1818
SARIMA (1,1,1) (1,0,0)	20.4630	15.6649	0.1866
SARIMA (0,1,1) (1,0,0)	20.9128	15.8905	0.1890

Notes: RMSE and MAE values in millions. The first fiscal year of data was not included in the model performance calculations. To account for the monthly seasonality in the aggregate value of newly guaranteed bonds, the model equations require data points from the previous year.

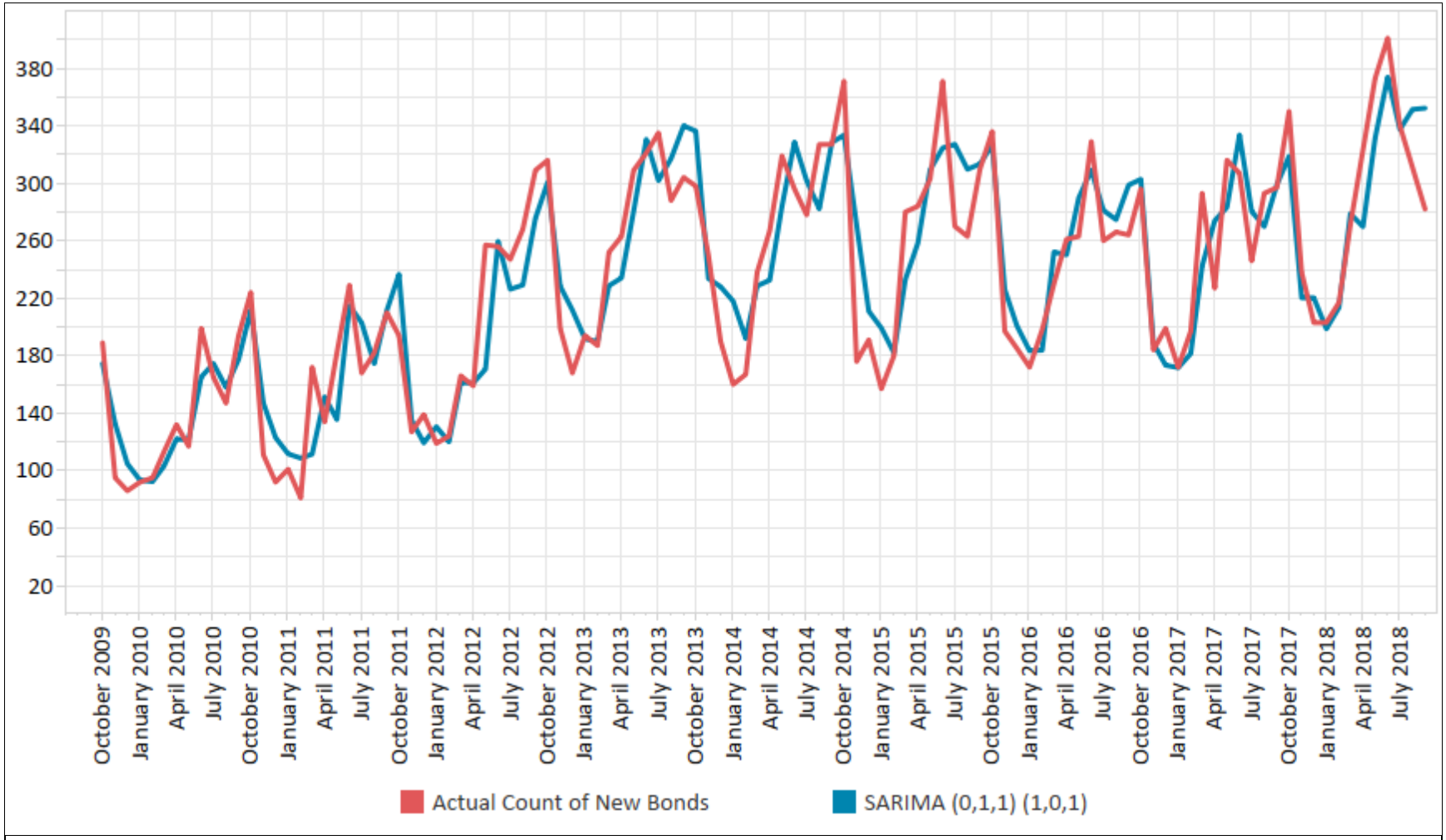
The optimal models for the number and values of bonds were then visually examined to confirm the validity of the accuracy statistics. The model predictions plotted in **Exhibits 6** and **7** suggest that optimal models for both the number and value of bonds accurately captured broader seasonal trends but had some difficulties in estimating yearly maximums and minimums. The actual count of new bonds followed a uniformly upward seasonal pattern across the Pre-Intervention Period. This uniformity in seasonality was less apparent in later months, with the 2017 calendar year having a more trimodal shape and 2018 showing a large summer decrease prior to the new fiscal year. The selected model presented a

[8] Lower denominator values reflect months with smaller counts or aggregate values of guaranteed bonds, including the noted winter troughs and the earlier fiscal years of the Pre-Intervention Period.

previously observed bimodal shape for the 2017 calendar year and failed to anticipate the aforementioned summer decrease.

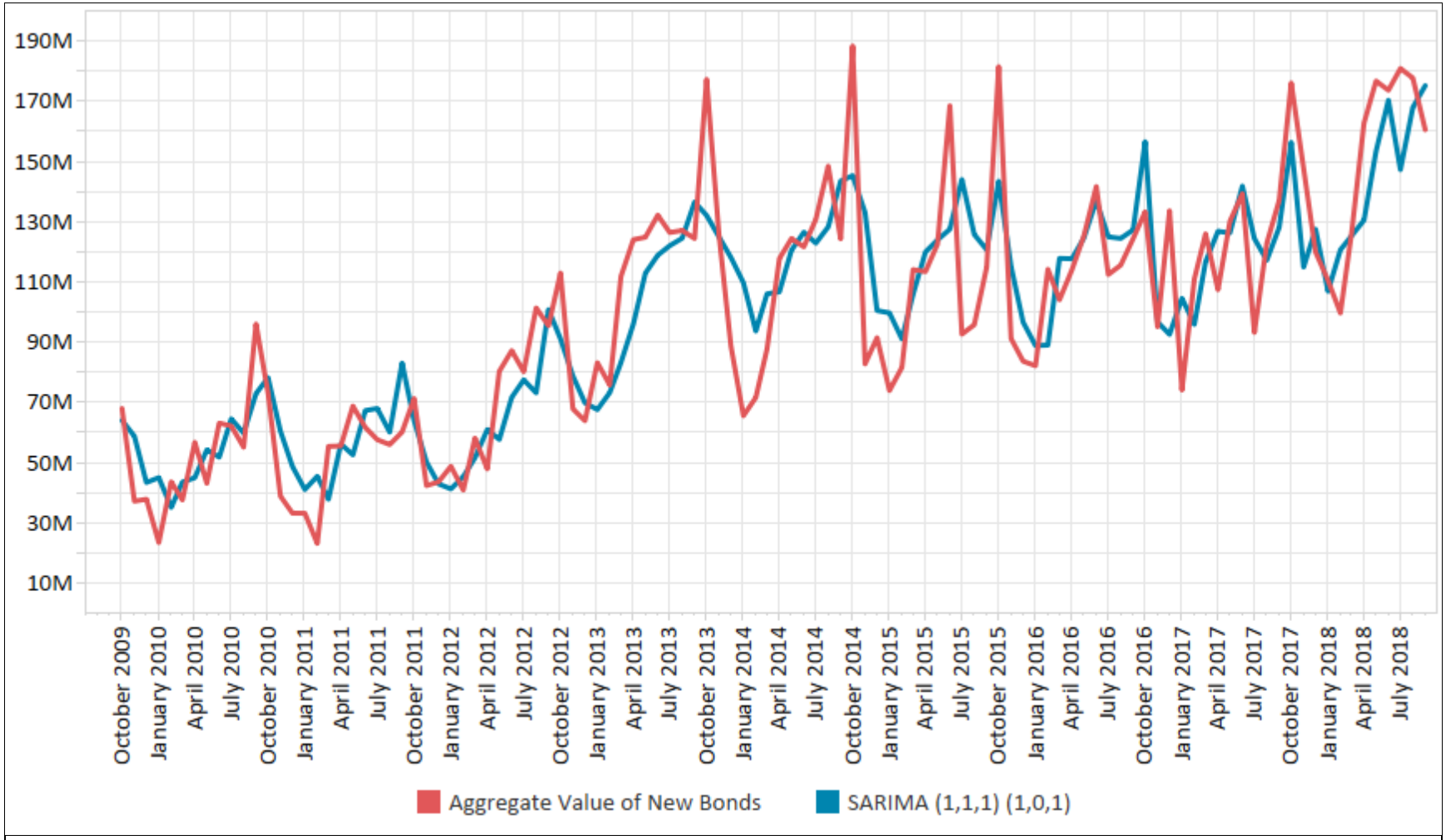
The actual aggregate bond values followed a similar pattern during the early years of the Pre-Intervention Period, but the 2013 calendar year began to show greater volatility and a less marked upward trend. The optimal model predicted but underestimated the relative peaks occurring in October 2013, 2014, and 2015. The optimal model also had trouble following the uncharacteristic fluctuations occurring in the 2016 and 2017 calendar years.

Exhibit 6: Count of Newly Guaranteed Bonds for the Pre-Intervention Period



Source: SBA Form 994

Exhibit 7: Value of Newly Guaranteed Bonds for the Pre-Intervention Period



Source: SBA Form 994

SURVEY COMPONENT

The survey component of the evaluation involved developing and administering online surveys to surety agents and firms participating in the SBG Program to collect insights into how and why the fee reductions affected the perceived risks and benefits of guaranteeing bonds and the potential value of fee reductions (Research Question 4). The sections below detail the processes used to develop and administer the instruments, the response rates, the cleaning of the survey data, the non-response analysis, and the data analysis.

Instrument Development

Two independent web-based survey instruments were developed to collect data from participating surety firms and agents on Research Questions 4 and 5, based on results from the ITS models and discussions with SBG Program staff. The questions included on the instruments were similar for surety agents and firms and focused on the expected and actual effects of the fee reductions on the number and value of bonds guaranteed through the SBG Program, the types of businesses in surety portfolios, the perceived risks of bond defaults, and anticipated effects under future fee reduction scenarios.

Cognitive interviews were conducted with three surety firms and four agents selected in close consultation with SBA to pretest the survey. Cognitive interviewing is a form of instrument pretesting that focuses on respondents' thought processes as they answer survey questions (Singleton & Straits, 2010). Participants completed the pre-test survey one section at a time and read their responses aloud to the interviewers. The interviewers timed each section and asked respondents debriefing questions to assess whether respondents understood the meaning of the questions; had difficulty answering the questions; and found the response options applicable, clear, and comprehensive. The findings from the pretests resulted in minimal revisions to the instruments. Most participants thought the ordering of the survey questions was appropriate, had no difficulty answering any of the questions, and encountered no terms with which they were unfamiliar.

Administration of instruments to respondents

SBA provided the study team with contact information for the universes of the 39 surety firms and 325[9] surety agents that participated in the SBG Program during the period of analysis. The study team emailed these contacts links to the web surveys with a letter explaining the purpose and importance of the survey, and instructions for completion. The surveys were administered over an 8-week period from May 19, 2020, to July 6, 2020. SBG Program staff sent weekly follow-up email notices and conducted phone calls to non-respondents to improve the response rates to the surveys.

Response rates for firm and agent instruments

Before finalizing the data for analysis, the study team reviewed the responses to the survey to identify cases that could be considered as partial completes. The study team defined surveys as complete if a firm or agent answered at least 80 percent of the questions. Surveys were successfully completed by 23

[9] Contact information for 41 participating surety firms and 381 surety agents was originally provided to the study team. However, the email addresses and/or phone numbers for 2 surety firms and 56 surety agents were determined to be invalid after sending the survey notification emails. In each of these instances, SBA staff attempted to provide alternate contact information. When alternate contact information did not lead to contact, SBA and the study team agreed to remove the corresponding surety firm or agent. This resulted in the revised sample frame of 39 participating surety firms and 325 surety agents.

surety firms and 138 surety agents, yielding response rates of 59.0 percent for surety firms and 42.5 percent for surety agents.

Data cleaning and nonresponse

The study team prepared and cleaned the surveys for potential data entry errors. Most of the survey questions were close-ended items with binary or multiple-response formats. Programs were run to minimize data entry errors and additional checks were conducted after data collection ended to ensure the consistency of responses. Responses to open-ended questions were also reviewed to ensure the values provided were valid. For questions with an "other" response option, the open text-field responses were manually reviewed to determine whether the entry should be reassigned to one of the response options provided in the survey.

The U.S. Office of Management and Budget (OMB) calls for an analysis of nonresponse bias when the response rate is less than 80 percent. The response rates for these surveys were 59.0 percent for firms, and 42.5 percent for agents. A multi-step nonresponse bias analysis was conducted using SBA administrative data on how survey respondents differed from non-respondents in the mean numbers of pre-intervention and post-intervention bonds they guaranteed per year, the obligee type guaranteed (federal, state, local, district, and private), the number of years participating in the SBG Program, and the number of agents employed by each firm. T-tests with 95 percent confidence intervals found statistically significant differences between responding and non-responding agents in the number of bonds guaranteed, the average number of pre-intervention bonds guaranteed and the number of bonds involving the state, local, and private obliges (see **Exhibit 8**). The mean differences among responding and non-responding firms were not statistically significant (**Exhibit 8**).

Exhibit 8: Means, Difference of Means, and Confidence Interval of Difference of Means

Characteristics	Respondents	Non-Respondents	Difference	Confidence Interval of Difference
Agents				
Average number of bonds guaranteed each year – pre-intervention*	48	19	-28	(-50, -7)
Average number of bonds guaranteed each year – post-intervention	36	20	-16	(-32, 1)
Number of years in SBG Program	6	5	-1	(-2, 0)
Number of bonds by obligee type				
Federal	40	22	-18	(-40, 4)
State*	25	78	-53	(-95, -10)
Local*	226	74	-152	(-259, -46)
District	15	28	13	(-30, 56)
Private*	26	12	-14	(-27, -2)
Firms				
Average number of bonds guaranteed each year – pre-intervention	390	137	-254	(-858, 350)
Average number of bonds guaranteed each year – post-intervention	346	75	-271	(-749, 207)
Number of years in SBG Program	6	7	1	(-2, 4)
Number of bonds by obligee type				
Federal	375	141	-233	(-802, 336)
State	635	298	-337	(-1321, 648)
Local	2088	516	-1572	(-4907, 1764)
District	281	43	-238	(-760, 284)
Private	248	71	-177	(-553, 199)
Number of agents employed by the firm	39	21	-18	(-63, 27)

Notes: Asterisks indicate statistically significant findings at the following levels *p <.05, **p <.01, ***p <.001 from t-tests of means.

Exhibit 9: Correlation Coefficients and P-Values

Characteristics	Pearson's Correlation Coefficient	*P*-Value
Agents		
Number of pre-intervention bonds guaranteed	0.19	0.0146*
Number of state obligee bonds	0.16	0.0215*
Number of local obligee bonds	0.18	0.0085**
Number of private obligee bonds	0.15	0.0308*
Firms		
Number of post-intervention bonds guaranteed	0.18	0.3123
Number of local obligee bonds	0.15	0.4001
Number of private obligee bonds	0.15	0.4012
Number of pre-intervention bonds guaranteed	0.14	0.4439

Notes: Asterisks indicate statistically significant findings at the following levels *p <.05, **p <.01, ***p <.001.

Although statistically significant, the magnitude of the correlates of survey completion among agents were weak; correlations between responding and nonresponding firms were also nonsignificant, indicating a lack of nonresponse bias in the firm survey (**Exhibit 10**). The study team ran logistic regression models to examine the effects of the four significant variables on completion of the agent survey. No covariates were statistically significant determinants of completing the agent survey. Exhibit 10 displays the odds ratio of the covariates, which are very close to 1. Each confidence interval includes 1, which suggests that these covariates have no effect on survey completion, and that there was no nonresponse bias in the agent survey.

Exhibit 10: Odds Ratio and Confidence Interval of Odds Ratio

Characteristics	Odds Ratio	Confidence Interval
Number of pre-intervention bonds guaranteed	1.004	(0.99, 1.02)
Number of state obligee bonds	1.000	(0.99, 1.01)
Number of local obligee bonds	1.001	(1.00, 1.00)
Number of private obligee bonds	0.998	(0.99, 1.01)

Analysis methods

Before conducting the analysis, the study team created survey weights to adjust for firms and agents that did not complete the survey. While the study team found no evidence of nonresponse bias in either survey, the variables examined in the nonresponse bias analysis were used to make weighting adjustments. Logistic regressions on these variables were used to calculate propensity scores for each respondent, and the inverse of the propensity score became the weight for all the completed cases. The study team then applied a ratio adjustment factor based on the inverse of the propensity score to the completed cases so that the sum of the weights equaled the population total.

Firms and agents varied in the number of SBG Program bonds they guaranteed across the years. The study team investigated how the perceptions of the reduced fees varied among agents and firms that processed more compared to fewer bonds. Weighting responses by the proportion of all bonds each respondent guaranteed gave proportionately greater weights to higher volume firms and agents. The results using these proportional weights are reported in **Appendix E.**

3 FINDINGS

This section presents the major findings from the statistical modeling and survey components of the evaluation.

Statistical Modeling Results

The optimal SARIMA models for predicting monthly bond counts and aggregate bond values in the Pre-Intervention Period were used to forecast figures for the 15 months of the Post-Intervention Period. The SARIMA models rely on equations that input recent monthly observations and data points from the previous year to account for seasonality. To produce forecasts naïve to the fee reduction, the SARIMA equation inputs actual monthly values from the Pre-Intervention Period up until September 2018 and assumes these would continue through the Post-Intervention Period. **Exhibit 11** compares monthly records of the forecasted bond counts and associated contract values with the values actually observed in the Post-Intervention Period. The number and value of bonds predicted for the Post-Intervention Period exceeded the values actually observed. This indicates that the fee reductions did not increase the number or value of SBG bonds guaranteed.

Exhibit 11: Forecast Values for the Count of Newly Guaranteed Bonds and Aggregate Values

Time Point	Bond Count			Bond Values (in millions)		
	Actual	Forecast	Difference	Actual	Forecast	Difference
October 2018	335	353	-18	182.51	195.06	-12.55
November 2018	270	244	26	135.14	153.01	-17.87
December 2018	205	230	-25	130.60	150.06	-19.46
January 2019	95	219	-124	67.22	137.20	-69.98
February 2019	279	232	47	171.77	145.00	26.76
March 2019	248	293	-45	154.11	160.11	-5.99
April 2019	308	301	7	150.36	168.97	-18.61
May 2019	308	344	-36	184.65	179.86	4.78
June 2019	373	370	3	194.92	188.46	6.46
July 2019	353	321	32	147.13	172.72	-25.60
August 2019	291	324	-33	172.27	179.23	-6.97
September 2019	251	330	-79	146.75	181.78	-35.04
October 2019	385	367	18	232.11	209.56	22.55
November 2019	201	259	-58	147.21	167.50	-20.29
December 2019	182	246	-64	120.31	164.48	-44.17
Total	**4084**	**4434**	**-350**	**2337.05**	**2553.01**	**-215.97**
Excluding Shutdown Months	**3784**	**3984**	**-200**	**2139.22**	**2265.75**	**-126.52**

Source: SBA Form 994

Notes: Figures reflect Form 994 records of original-instance final bonds. Shutdown months refers to the 2 months associated with the government shutdown that occurred from December 22, 2018, through January 25, 2019.

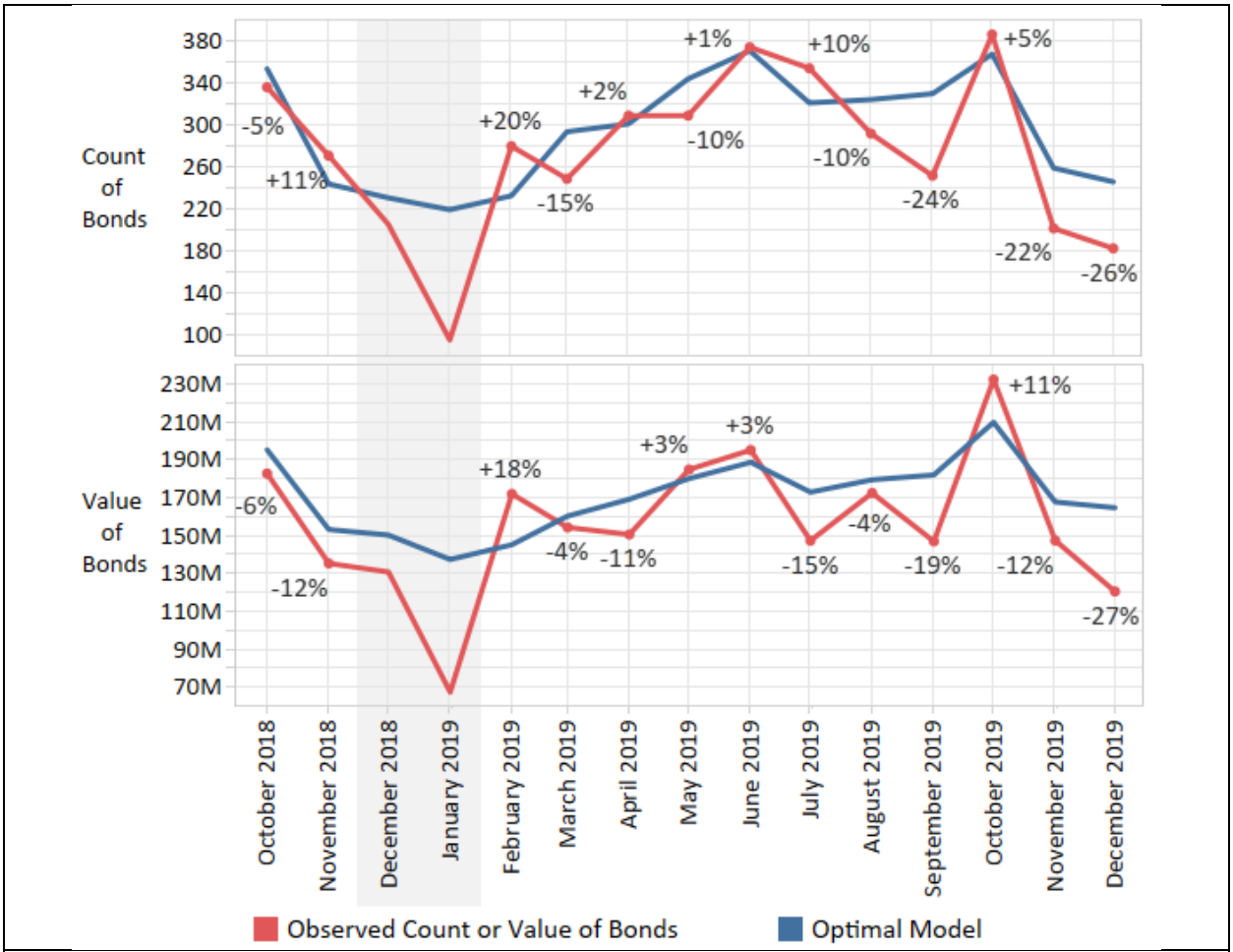
Exhibit 12 provides a visual comparison of the Post-Intervention values forecast by the optimal models (plotted in blue) against the observed number and value of bonds guaranteed under the fee reduction (plotted in red). The optimal model for the number of bonds forecast a shape similar to pre-intervention observations, including the usual early summer and fall peaks with troughs in winter months. However, the optimal model for aggregated contract values produced a smoother and more conservative forecast[10] with gradual monthly increases from January 2019, and peaking in June, followed by another expected October peak, and ending with a winter trough higher than in previous years.

Forecasts of both the number and values of bonds frequently predicted larger monthly values than the actual values observed under the fee reduction. Excluding the 2 months associated with the 2018–2019 government shutdown, the bond count forecast exceeded the observed count in 7 of 13 months, and the overestimates were greater than in months that were underestimated. Observed monthly counts were 5 to 26 percent lower than the forecast (in October 2018 and December of 2019, respectively). Observed bond counts exceeded the number forecast by a maximum of 20 percent (in February 2019[11]), which may reflect the completion of applications that could not be processed during the lapse of federal appropriations. The forecast of aggregate bond values exceeded the observed values in 9 of 13 months and also tended to generate proportionally larger overestimates than in the 4 months of underestimates.

[10] Both Y-axes in the Exhibit 12 plots were scaled relative to the observed minimum and maximum values and do not suggest an origin value of 0.

[11] The month following the lapse in appropriations (February 2019) showed a noticeably higher count of approved bonds than previous years. A closer examination of timing of daily counts showed patterns similar to previous Februarys, where the counts were fairly evenly distributed throughout the month rather than higher counts in early February that might result from delayed completions.

Exhibit 12: Comparison of the Number of Bonds and Associated Contract Values Predicted and Observed Under the Fee Reduction (Truncated)[12]



Source: SBA Form 994
Note: The shaded area indicates months when the government was shut down but does not necessarily reflect the exact end and start dates.

The two visual plots show closer movements of forecasts and observed lines in earlier months, but greater deviations toward the end of the Post-Intervention period. The counts and values forecast for later months are noticeably higher than for earlier months, but these forecast points come with greater uncertainty since the equation then relies on values predicted for the post-intervention rather than on observed data from the Pre-Intervention Period. The higher count and value forecasts for the Post-Intervention Period might be caused by the values input into the forecasting equation from an uncharacteristically high number of bonds and bond values in FY 2018.

Despite this caveat, the numbers and values of bonds count and values produced by the monthly forecasts exceeded the observed values in the Post-Intervention Period, implying that the lower fee structure did not increase utilization of the SBG Program. Excluding the 2 months associated with the 2018–2019 government shutdown, the total observed count of bonds under the fee reduction was 200

[12] Note: While the SARIMA models were developed using data from the entire Pre-Intervention Period (i.e., FY 2006 to 2018), Exhibit 12 provides a truncated depiction of the Pre-Intervention Period to improve readability.

fewer than the counterfactual forecast, and the observed aggregate contract values were $126 million less over the 13 months than the counterfactual forecast. Since both optimal forecasts were naïve to programmatic changes in the Post-Intervention Period and the underlying models accurately captured the variation of bond counts and contract values in the Pre-Intervention Period, the optimal SARIMA models do not support the hypothesis that reducing the fees would increase the number or value of SBG bonds guaranteed.

MODELING EXTERNAL FACTORS

The study team also formulated ARIMAX models to select and test for external factors that the literature review and logic model (**Appendix A)** identified as potentially affecting the number and value of bonds guaranteed over time. These included business cycles; local economic conditions; federal, state, and local policies; and conditions in the general surety bond market. Summaries of the factors and data sources are included below; more detailed information is available in the literature review and evaluation methodology deliverables.

Business Cycle

Business cycles reflect increases and decreases in the production of goods and services in an economy. Preliminary analyses of data from the Congressional Research Service (CRS) reports on the number and total value of final surety bonds guaranteed by the SBG Program (CRS, 2015), and from the National Bureau of Economic Research's (NBER) record of U.S. Business Cycle Expansions and Contractions (NBER, n.d.) showed substantial drops in the number and value of final surety bonds guaranteed through the SBG Program 1 to 2 years after the onset of a recession, followed by gradual increases to new—though often lower—plateaus. Expansions and contractions of the national economy were measured here by both real and nominal gross domestic product. The availability of credit (measured here by both expected conditions and interest rates) are also critical to the ability of small businesses to bid on contracts. **Exhibit 13** details the external variables tested for business cycle effects on bond outcomes.

Exhibit 13: External Business Cycle Variables

Source	Variable
IHS Markit	Nominal gross domestic product Real gross domestic product
U.S. Department of Commerce, BEA	Construction industry gross output
BLS, Current Population Survey (CPS)	National unemployment rate
NFIB, Small Business Economic Trends (SBET)	Average actual interest rate paid by small businesses on short-term loans[13] Credit conditions expected by small businesses[14]

[13] This variable was derived from a survey item asking, "If you borrowed within the last three months for business purposes, and the loan maturity (pay back period) was 1 year or less, what interest rate did you pay?"

[14] This variable was derived from a survey item that asked regular borrowers, "Do you expect to find it easier or harder to obtain your required financing during the next three months?" The reported figures reflect the difference between the percentage of small businesses expecting it will be "easier" to obtain required financing in the next 3 months minus the percentage expecting it will be "harder."

Local Economic Conditions

The evaluation's Pre-Intervention Period (2008 to 2018) includes the descent into and recovery from the 2008 Great Recession. The economic recovery varied dramatically across industries and across local and regional economies. The study included external variables (shown in **Exhibit 14**) measuring national trends in the value of new construction, construction employment by employer, and construction employment by industry divisions defined by the North American Industry Classification System (NAICS). Employment variables by NAICS codes are reported either across the entire construction sector, represented by the 2-digit code "23," or by the three sub-industry components known as "subsectors," classified by 3-digit codes starting with "23."

Exhibit 14: Local Economic Conditions Variables

Source	Variable
Census Bureau, Value of Construction Put in Place Survey (VIP)	Value of new construction put in place: *Private construction* *Public construction* *Total private and public construction*
BLS, Current Employment Statistics (CES)	Employment in the 2-Digit NAICS Construction sector Employment in each of the smaller 3-Digit subsectors: *236: Construction of buildings* *237: Heavy and civil engineering construction* *238: Specialty trade contractors*
BLS, Quarterly Census of Employment and Wages (QCEW)	Employment in the 2-Digit NAICS Construction sector by employer type: *Local governments* *State governments* *Private enterprises* *Total federal, local, state, and private employment*[15,16]

Federal, State, and Local Policies

The literature reviews (peer-reviewed and program-specific), and discussions with SBA staff identified several federal, state, and local policies that could impact the SBG Program's inputs, activities, outputs, and outcomes. These include Congressional appropriations and legislation such as the American Recovery and Reinvestment Act of 2009, which temporarily revised (for the period between February 17, 2009, and September 30, 2010) the Small Business Investment Act's (1958) industry-specific standards for defining "small businesses" and began automatic adjustment of these thresholds for inflation. Another example is the National Defense Authorization Acts for FY 2013 and FY 2016, which increased the maximum value of bonds that the SBG Program could guarantee. Changes in thresholds defining "smallness" and in the maximum bond values that can be guaranteed have typically been enacted to expand eligibility for the bond guarantees through the SBG Program; therefore, these changes can be expected to affect the number and value of the bonds issued, as well as the profiles of small businesses

[15] The federal employment count was not examined as a standalone variable. Across the entire United States, the reported federal construction industry employment count was at most eight persons and at minimum three. Correspondence with BLS personnel confirmed that these are single-digit values and not scaled (e.g., numbers in thousands).

[16] Although this theoretically measures the same information as "Employment in the 2-Digit NAICS Construction sector" variable, differences in values can be caused by employee-type definitions, issues in reference period recordkeeping, changing worksites, and other less frequent factors (Fairman et al., 2009).

issued guarantees. The study team also conducted a thorough search for changes in comparable state and local regulations but could not identify any changes likely to affect the national number or value of bonds guaranteed. **Exhibit 15** details the external policy variables identified by the study team and SBA.

Exhibit 13: Federal, State, and Local Policies Examined

Source	Variable
SBG Program Policy – Regulation History Documents	Changes in small business size standards Inflation adjustment to monetary-based size standards in October 2010 and June 2014 Prior approval program (streamlined applications)
CRS Reports	American Recovery and Reinvestment Act of FY 2009 National Defense Authorization Act for FY 2013 National Defense Authorization Act for FY 2016 (enacted and effective date)

Conditions in the General Surety Bond Market

Conditions in the general surety bond market represent a final set of external factors to test. Small businesses may be less likely to use the SBG Program when they can secure surety bonds under reasonable terms in the conventional market, and small businesses may be more likely to use the SBG Program when using the conventional market becomes difficult. A recent CRS report (2019) noted that the early peaks in SBG Program guarantees may have reflected the relatively small number of surety bonding firms then available and the lower likelihood that a small business rejected by one firm might find another firm willing to issue the bond. The paperwork and processing burdens associated with applications may also contribute to the decisions of firms and agents on whether to participate in the SBG Program and of small business contractors on whether to apply.

Exhibit 14: Variables for the Conditions in the General Surety Bond Market

Source	Variable
Other SBG Program documents	SBG revolving fund cashflow[17] Number of surety firms and agents participating in the SBG Program
SBG Program Policy – Regulation History Documents	Statutory changes in maximum contract amounts

MULTIVARIATE ARIMAX MODELS

The study team constructed ARIMAX models to test whether any of the external variables identified above contribute to the differences between predicted and observed outcomes in the SARIMA models. The forecasting literature has firmly established that multivariate ARIMA models are often less accurate than univariate ARIMAs due to the added complexity of estimating more parameters and the potential influence of outliers. To address these problems, the ARIMAX model building algorithm was run under

[17] The monthly net cash flow was calculated by subtracting the claims paid from the sum of fees, recoveries, and claim refunds.

four filtering designs that used strict correlation requirements and model performance metrics[18] to eliminate redundant external variables that could hinder forecast performance when compared to the optimal SARIMA specifications.

The ARIMAX model building filtering steps following the introduction of a seasonal AR and non-seasonal MA components resulted in one model with a few external variables, and three with no external variables remaining.[19] The accuracy measures reported in **Exhibits 17** and **18** show that none of the ARIMAX models performed markedly better, and usually performed worse, than the optimal univariate SARIMA model in predicting the number and value of bonds guaranteed during the Pre-Intervention Period. These findings indicate that the external variables likely do not contribute to explanations of the number and value of bonds guaranteed in the Post-Intervention Period or to explanations of the lower than predicted number and value of bonds guaranteed under the reduced fee structure.

Exhibit 17: Accuracy Measures for the Count of Newly Guaranteed Bonds, FY 2010–2018

Models	RMSE	MAE	MAPE
Optimal Univariate Model			
SARIMA (0,1,1) (1,0,1)	30.5977	24.3786	0.1146
Multivariate Models			
ARIMAX process 1A, (0,1,1) (1,0,0)	35.1468	27.6093	0.1351
ARIMAX process 1B, (0,1,1) (1,0,0)	34.7586	27.1567	0.1252
ARIMAX process 2A, (0,1,1) (1,0,0)	34.9435	28.3776	0.1433
ARIMAX process 2B, (0,1,1) (1,0,0)	34.7586	27.1567	0.1252

Notes: The first fiscal year of data was not included in the model performance calculations. To account for the monthly seasonality in the count of new bonds, the model equations require data points from the previous year. Processes 1B and 2B filtered out all external variables, resulting in SARIMA (0,1,1) (1,0,0) models.

Exhibit 18: Accuracy Measures for the Value of Newly Guaranteed Bonds, FY 2010-2018

Models	RMSE	MAE	MAPE
Optimal Univariate Model			
SARIMA (1,1,1) (1,0,1)	19.3634	15.0930	0.1809
Multivariate Models			
ARIMAX process 1A, (0,1,1) (1,0,0)	19.1234	15.1260	0.1850
ARIMAX process 1B, (0,1,1) (1,0,0)	20.9128	15.8905	0.1890
ARIMAX process 2A, (0,1,1) (1,0,0)	19.6416	15.0576	0.1800
ARIMAX process 2B, (0,1,1) (1,0,0)	20.1440	15.8942	0.1916

Notes: RMSE and MAE values in millions. The first fiscal year of data was not included in the model performance calculations. To account for the monthly seasonality in the aggregate value of newly guaranteed bonds, the model equations require data points from the previous year. Process 1B filtered out all external variables, resulting in a SARIMA (0,1,1) (1,0,0) model.

[18] The four ARIMAX process specifications are referred to as "1A," "1B," "2A," and "2B." The two processes that start with "1" required a correlational probability value between the dependent variable and potential explanatory variables equal to or less than 0.1 whereas the processes titled "2" required a value equal to or less than 0.2. The processes with the letter "A" utilized the Akaike information criteria to assess model performance and eliminate redundant variables while the processes with "B" utilized the more punitive Bayesian information criterion. **Appendix D** describes the ARIMAX filtering processes in greater detail.

[19] Variable redundancy filters removed all remaining external factors for count processes 1B and 2B, and aggregate process 1B.

The analysis of the external factors identified through the literature review and logic model clearly indicates that no external factors sufficiently affected the number or value of bonds guaranteed in the Post-Intervention Period to improve upon the predictions of the univariate SARIMA model. To further confirm this, additional monthly forecasts for the ARIMAX models and runner-up SARIMA models were generated. **Exhibit 19** displays the optimal SARIMA models in dark blue, additional SARIMA forecasts in lighter shades of blue, ARIMAX forecasts in green, and observed count of bonds and associated contract values in red. The monthly counts predicted by the ARIMAX models were typically higher than both the optimal model's predictions and the counts of bonds observed under the reduced fees. The aggregate contract values predicted by the ARIMAX models were also consistently larger than the values predicted by the optimal model and the values observed in the Post-Intervention Period but show a clearer division between SARIMA and ARIMAX. The three ARIMAX forecasts routinely predicted higher monthly aggregate values than the SARIMA models, as well as an irregular peak in August.

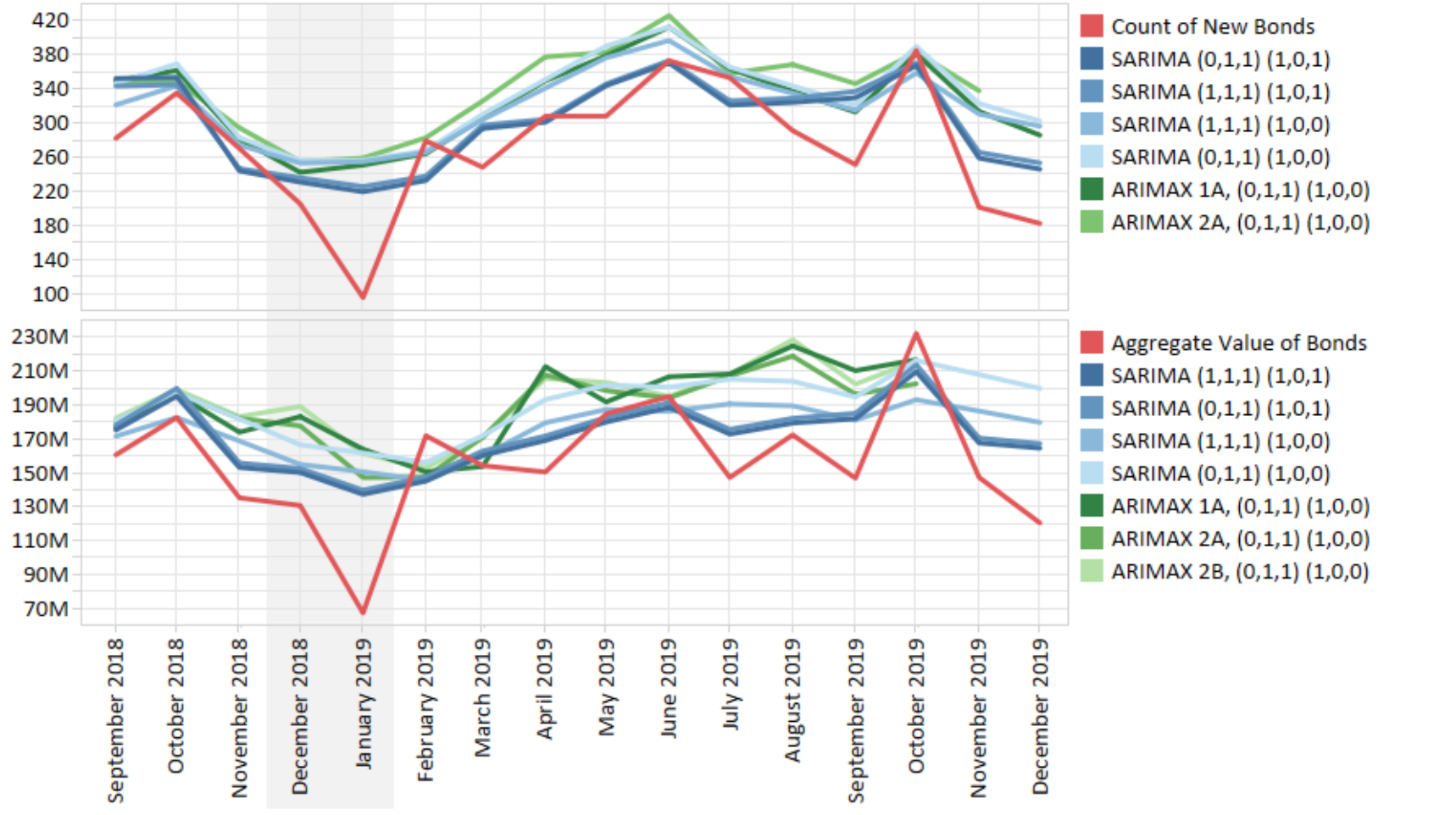
Neither the optimal SARIMA models nor the ARIMAX forecasts provide evidence that the reduction in fees resulted in a significant increase in the number and aggregate contract value of bonds guaranteed by the SBG Program. In both the count and value plots, the forecast lines for the optimal runner-up SARIMA models (shown in the second darkest shade of blue) follow the optimal models closely, lending credence to the conclusions drawn from the optimal model. Within both sets of candidate models, the distinguishing factor between the top two and bottom two performing SARIMA models was the inclusion of a single seasonal MA component. This single seasonal MA component appeared to stabilize the forecasts, as the bottom two models exceeded the monthly values of the top two models in almost every month. The ARIMAX forecasts often projected even higher counts and aggregate contract values than the univariate models, implying that external factors may have been ideal for increased program participation. The ARIMAX forecasts support the conclusions that the reduced fee structure did not generate increases in the count or aggregate contract value of SBG bonds guaranteed in the Post-Intervention Period.

While the SARIMA forecasts had no data inputs after the start of the Post-Intervention Period, the ARIMAX equations required non-missing values from external variables to produce predictions.[20] The ARIMAX models could thus take into account data on external factoring occurring in the Post-Intervention Period. Since the ARIMAX forecasts predicted higher values than the optimal models, it could be hypothesized that external conditions in the fee-reduction period were favorable to increased bond counts and contract values.[21]

[20] The need for non-missing values explains why ARIMAX forecasts did not cover the entire Post-Intervention Period. For example, the ARIMAX process 2A model for the count of bonds ended November 2019, since that was the last month with data available on all external variables. The SARIMA terms for the ARIMAX models all utilized predicted values after the fee reduction.

[21] The effects of external variables were likely marginal compared to the SARIMA components in the ARIMAX models. The introduction of SARIMA components in the ARIMAX processes often resulted in filtering out several external variables that added little explanatory power to the models.

Exhibit 19: Comparison of Secondary Forecasts of Number of Bonds and Associated Contract Values Under the Fee Reduction



Source: SBA Form 994, NFIB SBET, IHS Markit, and SBG administrative data

Notes: The shaded area identifies months in which the government was shut down but does not necessarily reflect the exact start and end dates. Some ARIMAX forecasts do not cover the full 15-month Post-Intervention Period because the equations require data that were not publicly available to the study team at the time of estimation. The forecasts for ARIMAX processes 1B and 2B for the count of bonds and 1B for the aggregate value of bonds are not shown because the filtering processes deemed all external variables redundant, which resulted in SARIMA (0,1,1) (1,0,0) models already shown in both plots.

Limitations

The primary limitation of ARIMA models typically lies in meeting the requirements of stationarity (i.e., having a constant mean and variance over time), including a lack of regular and predictable seasonal changes at specific points in a calendar year. Initial analyses of the SBA administrative data showed seasonality and other forms of non-stationarity. The standard means for addressing these problems are, respectively, estimating a seasonal ARIMA or SARIMA model and substituting *differences* between the values at each point interval for the points themselves until difference functions are found that overcome non-seasonal variability. The study team's application of these approaches proved successful in overcoming these limitations.

A limitation of the SARIMA modeling that affects the interpretation of the results is the possibility that predicted outcomes for the Post-Intervention Period were skewed higher because the counts and values forecast for later months in the Pre-Intervention Period were noticeably higher than for earlier months. The higher count and value forecasts for the Post-Intervention Period might therefore reflect the values input into the forecasting equation from an uncharacteristically high number of bonds and bond values in FY 2018.

A second major assumption of ARIMA and SARIMA models is that no exogenous forces should affect the outcomes, so the AR terms and the Integrated Moving Average of errors, assumed to be linear, are the only determinants of the process. Usually, this assumption is taken as met if goodness-of-fit statistics are sufficiently high for the ARIMA or SARIMA models, since the effects of important exogenous forces would reduce a model's goodness-of-fit. The review of the literature on bond guarantees and the logic model built upon it suggested, however, that one might expect several external variables to have exogenous effects on the number or value of bonds guaranteed. The research design therefore required a component that could determine whether any of several external variables had exogenous effects on these outcomes. ARIMAX modeling was conducted to address the possible effects of external factors even though the forecasting literature has extensively documented that univariate models usually forecast more accurately than multivariate models. Although multivariate models might be expected to achieve a better fit by incorporating the effects of important exogenous effects, univariate models often outperform multivariate models for three major reasons. First, because multivariate models have a greater number of parameters than their univariate counterparts, they also require the estimation and prediction of a greater number of unknown quantities, which introduces additional error into the model. Second, the selection of optimal multivariate models involves a greater number of candidate models and is more susceptible to modeling errors that affect the accuracy of predictions. Third, outliers can have a stronger effect on the predictions generated by multivariate models, as it is decidedly more difficult to identify and control for outliers in models with a greater number of parameters.

There are clear limitations in requiring multivariate models to outperform an optimum univariate model as a condition for concluding that external variables had effects on the number or value of bonds guaranteed when there are strong statistical reasons to expect that multivariate models will seldom outperform univariate models. The finding that the multivariate ARIMAX models did not outperform the optimal SARIMA models and the implication that the external variables tested, therefore, did not statistically improve predictions of the number or value of bonds guaranteed is subject to this important limitation. The fact that the ARIMAX models predicted higher numbers and values of bonds than the optimal SARIMA model suggests, however, that while the fit of the ARIMAX is not as good as the

SARIMA, external conditions in the Post-Intervention Period should have led to even higher numbers and values of bonds than the SARIMA models predicted. This reinforces the conclusion that the fee reductions did not increase the number or value of bonds guaranteed even though external conditions seemed favorable, and it suggests there may well be value in measuring any effects of continued or larger fee reductions not only against predictions based on the counterfactual that fees were not reduced but also against what external conditions might have led one to expect. External conditions could easily arise where observed numbers and values of bonds in extended Post-Intervention Periods might be closer to predictions from a multivariate ARIMAX than an optimal univariate SARIMA model.

RESULTS OF SECONDARY DESCRIPTIVE ANALYSES ON THE CHARACTERISTICS OF SMALL BUSINESSES IN THE SBG PROGRAM PORTFOLIO

The study team conducted additional descriptive analyses that compared differences in bonding rates, characteristics of participating small businesses, industry concentration, and regional output in the Pre- and Post-Intervention Periods. **Exhibit 20** presents numbers and rates of original bid and original final bonds approved in each fiscal year. The most noticeable growth in bid bonds and final bonds across both the Pre- and Post-Intervention Periods occurred in FY 2013. Following this spike, counts of bid bonds declined yearly for the remainder of the Pre-Intervention Period. The count of final bonds grew marginally in the 2 years following the 2013 spike, however. In the year prior to the fee reduction, the count of final bonds rose noticeably despite a lower approval rate.

Both guaranteed bid (768 bonds) and final bonds (126) decreased in the first 12 months of the Post-Intervention Period. This decrease in bid bonds and final bonds may in part reflect the lapse in government appropriations, but this closure occurred during a time of the year that is typically slow for bond guarantees. In addition, the low count of guaranteed final bonds (93) in the few operational days in January 2019 was followed by the highest number of approvals (280) for any February in the study. This information suggests that many bond approvals were delayed rather than lost.

Exhibit 20: Counts and Rates of Approved Bid and Final Bond Applications

Fiscal Year	Bid Bonds		Final Bonds	
	Approved	Approval Rate	Approved	Approval Rate
2009	4,945	96.96%	1,249	96.45%
2010	6,761	96.27%	1,624	98.96%
2011	6,780	98.78%	1,886	99.47%
2012	7,180	99.79%	2,365	99.79%
2013	9,790	99.58%	3,136	99.49%
2014	9,324	98.76%	3,117	98.55%
2015	8,379	98.65%	3,156	98.47%
2016	7,507	99.01%	2,961	98.67%
2017	7,418	99.04%	3,027	99.12%
2018	7,354	98.66%	3,512	97.56%
Pre-Intervention Period	75,438	98.65%	26,033	98.70%
2019	6,586	97.35%	3,386	97.64%
2020	1,413	99.02%	768	98.71%
Post-Intervention Period	7,999	97.64%	4,154	97.83%

Source: SBA Form 994

Notes: Figures reflect 994 records of original-instance bid and final bonds. The approval rate is the share of approved bonds to approved and declined bonds.

The firm size, ownership, and SBA program participation of businesses issued final bonds guarantees in the Post-Intervention Period differ only marginally from those in the pre-intervention years (**Exhibit 21**). The differences in firm small business characteristics between the two periods are not statistically significant except for a statistically significant 3.51 percentage point decrease in the proportion of 8(a) program participants ($p < 0.001$). It is not clear, however, that this decline in bonds guaranteed to 8(a) small businesses can be attributed to the reduced fee structure. First, the number of both 8(a)- and HUBZone-certified firms in the SBG portfolio has steadily decreased over time, from 8,827 8(a) small businesses in FY 2009 to 5,581 in FY 2017, a decline of 37 percent. This analysis treated a small business as 8(a) if it held that status at any time within the Pre-Intervention or the Post-Intervention Period: it did not try to adjust for entry into and graduation from 8(a) eligibility within each period. Second, one would expect more 8(a) firms to have joined the program over the 10-year Pre-Intervention Period than in the 15-month Post-Intervention Period. Treating 8(a) status as time-invariant within each period and the secular decline in the participation of 8(a) small businesses in the SBG Program, together, could account for enough of the 3.51 percentage point decline between the two periods to leave no statistically significant difference attributable to the reduced fee structure.

Exhibit 21: Characteristics of Bonded Small Businesses

Small Business Characteristics	Pre-Intervention Period	Post-Intervention Period	Difference
Average Size of Small Business (Number of Employees)	13.57 *(N = 5,736)*	13.33 *(N = 1,733)*	-0.24
Small Business Characteristics			
Minority-Owned	31.62% *(N = 4,364)*	33.62% *(N = 1,261)*	+2.00
Women-Owned	19.14% *(N = 5,021)*	18.30% *(N = 1,437)*	-0.84
Veteran-Owned	10.95% *(N = 4,101)*	11.16% *(N = 1,111)*	+0.21
Service-Disabled Veteran-Owned	4.90% *(N = 4,101)*	5.31% *(N = 1,111)*	+0.41
Program Participation			
8(a) Participating Small Businesses	14.13% *(N = 5,859)*	10.62% *(N = 1,733)*	-3.51***
HUBZone Participating Small Businesses	4.28% *(N=5,859)*	3.98% *(N=1,733)*	-0.30

Source: SBA Form 994

Notes: Asterisks indicate statistically significant findings at the following levels *p <.05, **p <.01, ***p <.001 from t-tests of means. Samples include small businesses with original-instance final bonds approved in either Pre- or Post-Intervention Periods, or both. Business size was treated as time-invariant across both periods and determined by the smallest mode value of reported employees. HUBZone and 8(a) status was treated as time-invariant across both periods, regardless of expiration.

Almost all projects issued guarantees in the Pre-Intervention Period (95 percent) and the Post-Intervention Period (94 percent) were in the Construction sector. This difference and the differences in the three Construction subsectors, along with the composite "Other NAICS subsectors" (**Exhibit 22**), were not statistically significant, however. Outside of the Construction sector, projects classified as Administrative and Support Services saw a statistically significant increase of 0.71 percentage points in the Post-Intervention Period ($p < 0.01$). Therefore, the industrial make-up of bonded projects in the two time periods was largely unchanged.

Exhibit 22: Industry Concentration of Final Bonds

NAICS Codes	Pre-Intervention Share of Bonds	Post-Intervention Share of Bonds	Difference
3-Digit Subsectors			
238: Specialty Trade Contractors	47.19% *(N = 12,155)*	45.83% *(N = 1,864)*	-1.36
236: Construction of Buildings	27.70% *(N = 7,134)*	28.89% *(N = 1,175)*	+1.19
237: Heavy and Civil Engineering Construction	20.05% *(N = 5,163)*	19.10% *(N = 777)*	-0.94
561: Administrative and Support Services	2.19% *(N = 564)*	2.90% *(N = 118)*	+0.71**
Other NAICS subsectors	2.87% *(N = 739)*	3.27% *(N = 133)*	+0.40

Source: SBA Form 994
Note: Asterisks indicate statistically significant findings at the following levels *p <. 05, **p < .01, ***p < .001 from t-tests of means. Figures reflect 994 records of original-instance final bonds approved in either Pre- or Post-Intervention Periods.

In contrast to the relative stability in the industry and characteristics of small businesses bonded in the Pre- vs. Post-Intervention Periods, there were several statistically significant changes in the regional distribution of bonded projects.[22] Both Regions IV (Southeast)[23] and VI (South Central)[24] increased their shares of the national bond count by a statistically significant 2.8 and 4.0 percentage points ($p < 0.001$), respectively. Conversely, Regions III (Mid-Atlantic),[25] V (Mid-West),[26] VIII (Rocky Mountains),[27] and X (Pacific Northwest)[28] had statistically significant decreases in their shares of bonds under the fee reduction ($p < 0.01$ or less).

The largest increases in the shares of bonds occurred in the SBA regions (Regions IV, VI, and IX) associated with the sun belt. Many of these regions experience milder winters and may have increased their shares during the final 3 months of post-intervention data. Differences attributable to seasonal production might be moderated over a complete fiscal year of data. The two regions with the highest share increases (IV and VI) also experienced high population growth rates that in turn require more construction projects. These seasonal and demand factors may have contributed as much or more to the changes in regional bond distributions than lower program fees.

[22] As this table tests multiple hypotheses, interpretation and conclusions reached on these differences in bond shares might be more prone to Type I errors.
[23] States comprising Region IV: AL, FL, GA, KY, MS, NC, SC, and TN
[24] Region VI States: AR, LA, NM, OK, and TX
[25] Region III States: DC, DE, MD, PA, VA, and WV
[26] Region V States: IL, IN, MI, MN, OH, and WI
[27] Region VIII States: CO, MT, ND, SD, UT, and WY
[28] Region X States: AK, ID, OR, and WA

Exhibit 23: Geographic Location of Bonded Small Businesses

SBA Region	Pre-Intervention Share of Bonds	Post-Intervention Share of Bonds	Difference
(I) New England	2.54%	2.67%	+0.13
(II) Atlantic	3.59%	3.08%	-0.51
(III) Mid-Atlantic	13.38%	11.62%	-1.76**
(IV) Southeast	14.59%	17.34%	+2.76***
(V) Great Lakes	11.74%	10.13%	-1.61**
(VI) South Central	10.38%	14.38%	+4.00***
(VII) Great Plains	5.33%	4.99%	-0.34
(VIII) Rocky Mountains	8.91%	5.94%	-2.96***
(IX) Pacific Southwest	24.34%	25.95%	+1.62*
(X) Pacific Northwest	5.21%	3.89%	-1.32***
	(N = 26,098)	*(N = 4,088)*	

Source: SBA Form 994
Note: Asterisks indicate statistically significant findings at the following levels *p <.05, **p <.01, ***p <.001 from t-tests of means. Figures reflect SBA Form 994 records of original-instance final bonds approved in either Pre- or Post-Intervention Periods.

Survey of Surety Firms and Surety Agents

The surveys of participating surety firms and agents were designed to provide insights into the "why and how" of changes in expectations and practices attributable to the fee reductions. The surveys shed light on how firms and agents viewed the fee reductions and the opportunities they might offer. This section describes the survey results using weights that adjusted for non-response so that the weighted sum of responses would represent the total population of respondents and non-respondents. Findings from the alternative weights based on the proportion of all bonds guaranteed by each agent and firm are reported in **Appendix E**. The proportionally weighted results indicate that higher volume surety producers were more likely to respond more positively or optimistically to the potential benefits of continuing or increasing the reductions.

EFFECTS OF THE FEE REDUCTIONS ON PARTICIPATING SURETY FIRMS AND AGENTS

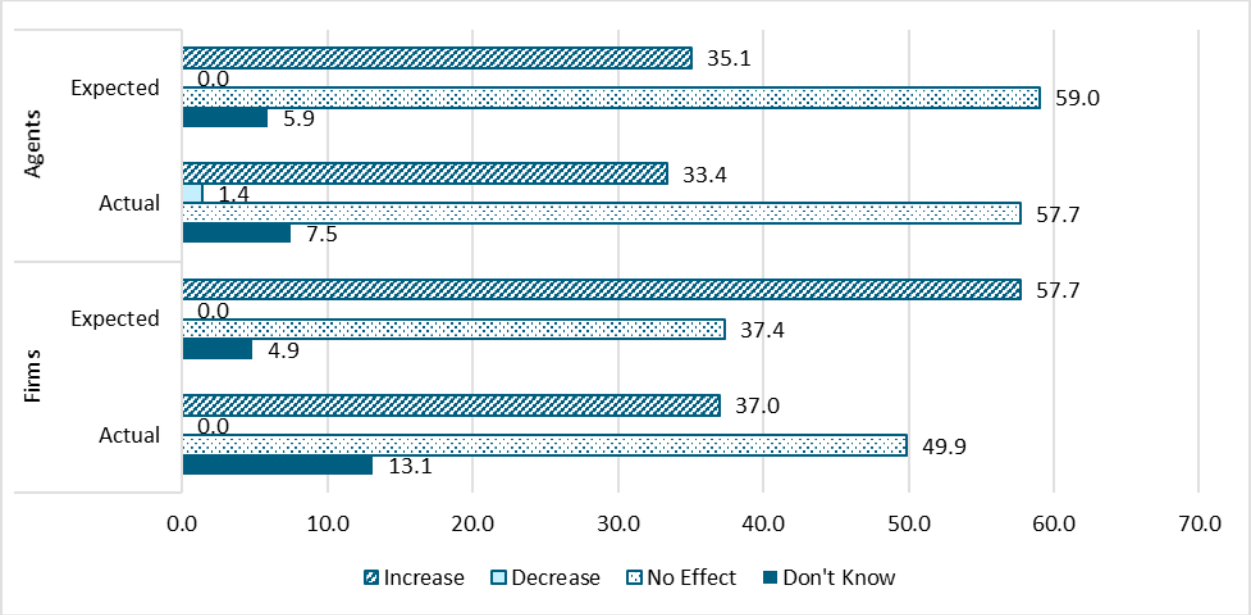
Awareness of Fee Reductions

Both agents and firms had high awareness of the fee reductions implemented by the SBG Program. About 89 percent of agents and 95 percent of firms reported they were "very aware" or "somewhat aware" of the fee reductions.

Expected and Actual Impacts on Number of Bond Applications and Contract Values

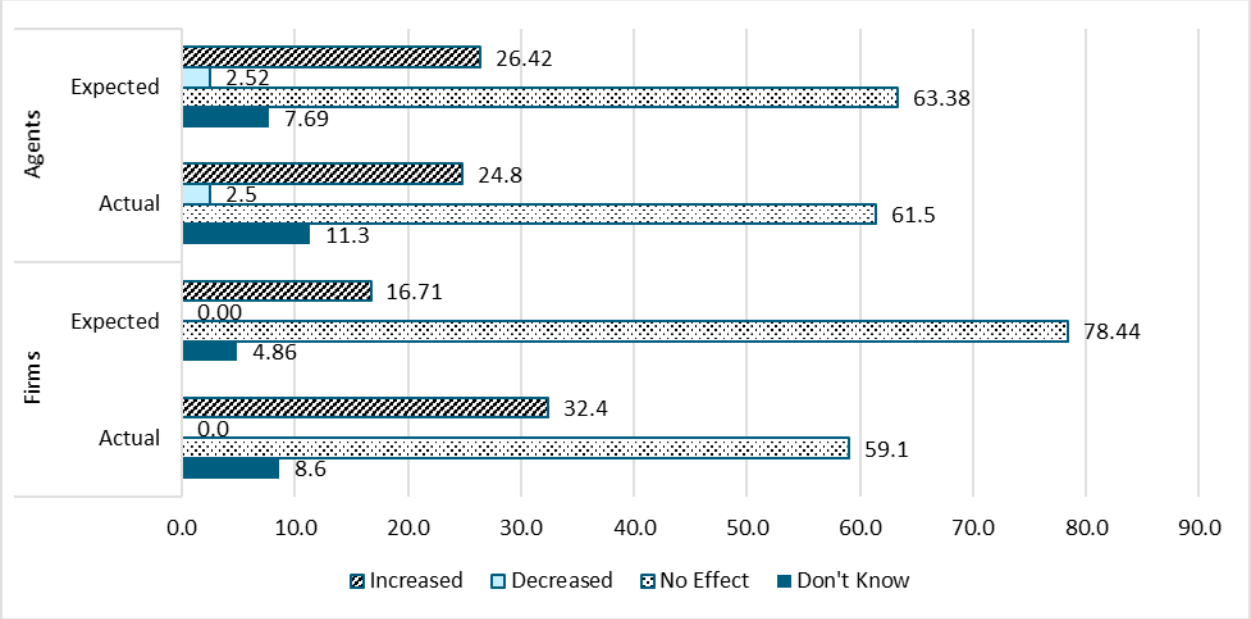
Most agents (59 percent) did not expect the fee reductions to increase the number of bonds processed and 57.7 percent reported no effects on the number of bond applications they processed. In contrast, 57.7 percent of surety firms expected that the reduced fees would increase the number of bonds guaranteed, but half of the firms (49.9 percent) reported the reductions had no effect on the actual number of bonds they guaranteed. When responses were weighted proportionally to the number of bonds each firm processed, 48.7 percent reported that the fee reductions actually increased the number and value of bonds they guaranteed (**Appendix E, Exhibit E-3**).

Exhibit 24: Expected and Actual Impacts on the Number of Bonds Processed by Agents and by Firms



As shown in **Exhibit 25**, large majorities of agents (63.38 percent) and firms (78.44 percent) did not expect the fee reductions to change the contract values of bond they guaranteed. The actual number of bonds guaranteed confirmed these expectations: 61.5 percent of agents and 59.1 percent of firms reported "no effect" on the value of the bonds guaranteed.

Exhibit 25: Expected and Actual Impacts on the Contract Values of Bond Applications



Impacts on the Number and Size of Defaults

Large majorities of agents (68.6 percent) and firms (81.8 percent) did not expect the number of defaults on SBG bonds guaranteed to change (68.6 and 81.8 percent, respectively) or the cost of the defaults (66.7 and 73.4 percent, respectively).

Impacts on the Types of Small Business Submitting Applications

The majority of agents (58.4 percent) and firms (53.2 percent) did not expect the type of small businesses applying for bonds to change or the value of the contracts for which they sought bond guarantees (64.7 percent of agents and 57.2 percent of firms).

EXPECTED EFFECTS OF CHANGES TO THE SBG PROGRAM FEES ON SURETY FIRMS AND AGENTS

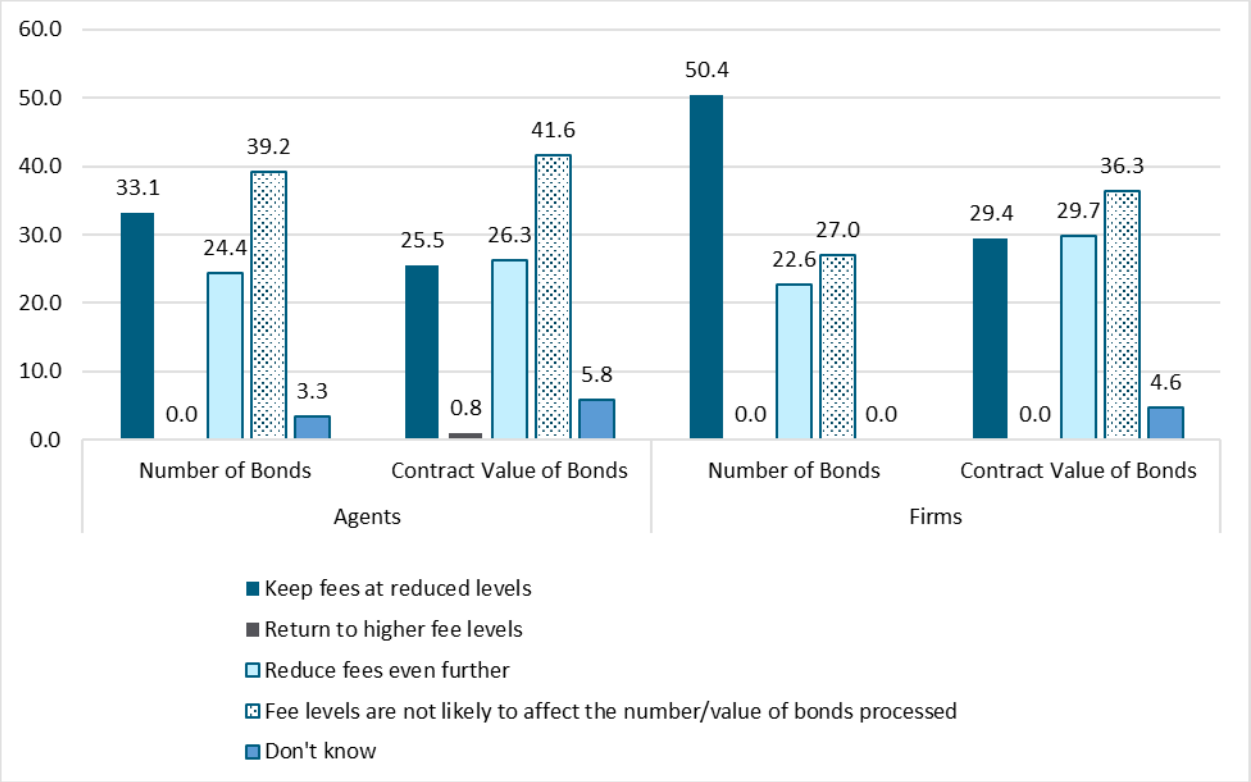
The second section of the survey asked participating surety firms and agents to share their perceptions of how hypothetical changes to SBG Program fees over the next 2 years might affect their production.

Changes in Surety Fees that Would Increase the Number and Value of Bonds Guaranteed

A plurality of agents (between 39.2 and 41.6 percent) reported that changes in fee levels would not likely impact the number or value of bonds processed. However, when weighted proportionally to the number of bonds the respondent guaranteed, 36.9 percent of agents believed that keeping fees at reduced levels would increase the number of bonds they would guarantee (**Appendix E, Exhibit E-6**).

In contrast, 50.4 percent of the firms (under the standard weighting) thought that continuing the reduced fee levels would increase the number of bonds processed, but 36.3 percent thought that this would not change the contract values. However, under the proportional weighting, 40.8 percent of firms thought that keeping the fees at reduced levels would help increase the contract values of the bonds they would guarantee (**Exhibit E-6**).

Exhibit 26: Changes in Surety Fees that Would Increase the Number of Bonds Processed and Associated Contract Values Processed



Effects of Keeping the Reduced Fees on the Surety Premiums Charged to Contractors

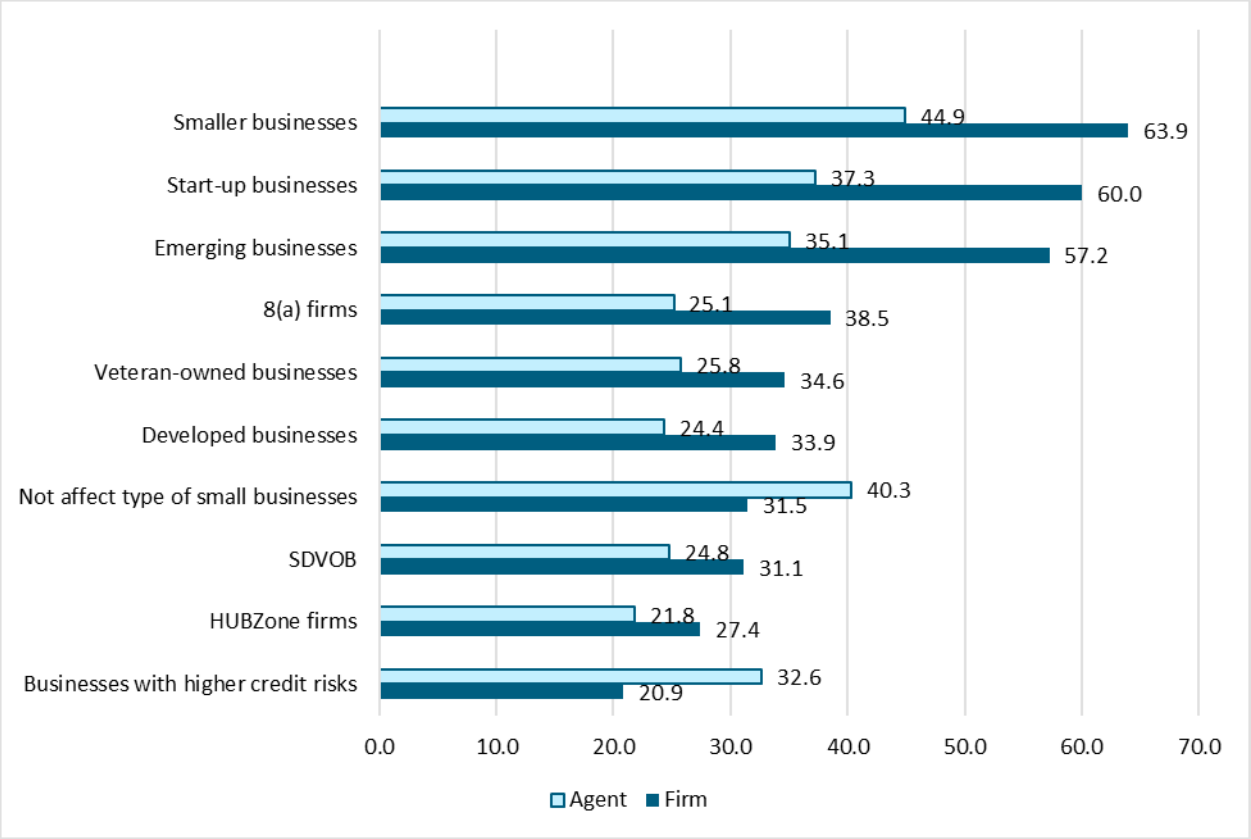
A majority of firms (60.9 percent) expected that keeping the reduced fees would not change the surety premium charged to small business contractors.

Types of Small Businesses for which Surety Firms and Agents Would Expect to See Increases in the Number of Bonds Guaranteed

Almost half of the agents (44.9 percent) expected to see increases in the number of bonds guaranteed to smaller businesses (e.g., lower revenues or fewer employees) and start-ups (37.3 percent), but 40.3 percent did not think that the fee levels would affect the types of small businesses served. Nearly two-thirds (63.9 percent) of firms expected to guarantee more bonds for smaller businesses, start-ups (60.0 percent), and emerging businesses[29] (57.2 percent).

[29] Emerging businesses are defined as companies that are poised for growth. These businesses have moved past the startup phase (i.e., "start-up businesses").

Exhibit 27: Types of Small Businesses for Which Surety Firms and Agents Would Expect to Guarantee More Bonds



Whether Permanently Enacting the Fee Changes Would Impact the Number of Surety Agents and Staff Needed to Process Applications

About 70 percent of both agents and firms agreed that permanently enacting the fee changes would not increase the number of surety agents or internal staff needed to process applications.

Primary Factors Associated with Decisions to Write SBG Program Bonds

The primary factors governing agents' decisions to write SBG Program bond guarantees included the creditworthiness of applicants (83.6 percent), whether the applicants had adequate working capital (78.8 percent), and the applicants' risk of default (46.6 percent). In contrast, the applicants' project experience and ability (67.4 percent), followed more closely by creditworthiness (61.4 percent) and the adequacy of working capital (57.4 percent), were primary factors for firms.

An important question would be knowing how much more risk sureties might be willing to take under the reduced fee structure. The survey provides no direct answer, but for context, on a $500,000 bond with a 1.5 percent premium, the SBG bond guarantee would have cost a surety $1,950 at the Pre-Intervention rate of 26 percent. Under the reduced fees the charge would be $1,500, which is $450 less. A surety could, thus, have four bonds of $500,000 guaranteed for only a little more ($6,000) than they would have been charged to guarantee three bonds ($5,850) at the Pre-Intervention rates. The small business contractor would also save $645 in fees on a $500,000 SBG bond guarantee ($3,000 at the $6.00 per $1,000 of the contract instead of $3,645 at $7.29 per $1,000). This might mean that a small

business would have a little more money available to repay on a default, especially if the SBG Program has guaranteed 80 to 90 percent of the loss, and sureties might then have a larger cushion to absorb risks.

Exhibit 28: Primary Factors Associated with Decisions to Write SBG Program Bonds

Factors	Agent	Firms
Creditworthiness of the applicant	**83.6**	**61.4**
Applicant has adequate working capital	**78.8**	**57.4**
Risk of default associated with the applicant	**46.6**	40.1
The applicant's stage of development (e.g., start-up, 8a or HubZone graduate)	41.7	9.0
Applicant's management team	15.2	4.6
The fees associated with processing an application	11.2	0.0
The bond rate that can be charged to the applicant for the contract	5.6	0.0
The commission that can be earned on an application	2.5	N/A
Trends and projections (for the construction industry) in the local economy of the project	1.5	0.0
Trends and projections (for the construction industry) in the national economy	1.4	0.0
Applicant's project experience and ability	NA	**67.4**
Applicant's character and reputation	NA	45.6
Other	12.0	14.4
Weighted n	*306*	*23*

Note: Percentages sum to more than 100 percent because respondents were asked to rank the top three factors in order of importance. N/A denotes that the factor was not a response option in the corresponding survey.

When responses were proportionally weighted, the factors for agents remained the same but the rank order changed to (1) adequate working capital, (2) creditworthiness, and (3) the risk of default. For firms, the ranking of primary factors switched to (1) the applicant's project experience and ability, (2) the applicant's character and reputation, and (3) his/her creditworthiness (**Appendix E, Exhibit E-10**).

SURETY FEES AND LIKELIHOOD OF PROCESSING SBG PROGRAM BONDS

The next section of the survey asked about agents' and firms' perceptions of what fee levels would impact the number of bonds guaranteed.

Surety and Contractor Fee Levels that Would Cause Firms and Agents to Process More SBG Program Bonds

A plurality of agents (47.3 percent) reported that fee levels are not likely to affect the number of bonds guaranteed, but a combined 44.6 percent of agents believed that reducing the fees to between 0.40 and 0.50 would increase the number of bonds processed. Similarly, 45.1 percent of firms did not believe that fee levels affect the number of bonds guaranteed. However, a combined 50.5 percent of firms felt that reducing the fees to between 8 and 14 percent would cause firms to process more SBG Program bonds. Proportionally weighted results showed only marginal differences for agents, but the combined

percentage of firms that believed that reducing fees to between 8 and 14 percent would increase the number of bonds guaranteed grew to 67.4 percent of firms (**Appendix E, Exhibit E-11**).

Surety and Contractor Fee Levels that Would Cause Firms and Agents to Process Fewer SBG Program Bonds

As a follow-up question, agents and firms were asked about fee levels that would result in the processing of fewer SBG Program bonds. Once again, pluralities of agents (40.8 percent) and firms (37.8 percent) believed that fee levels were not likely to affect the number of bonds guaranteed. Most agents (54.9 percent) believed that increasing the fee levels from 0.60 percent to between 0.65 percent and 0.80 percent (or from $6.50 to $8.00 per thousand dollars of the contract amount) would cause agents to process fewer SBG bonds. Just under 60 percent of firms reported that increasing the fee levels from 20 percent to between 23 percent and 32 percent would cause firms to process fewer SBG Program bonds.

Perceptions of Surety Firms and Agents on Why the Fee Reductions Did Not Affect the Total Number or Value of Bonds Guaranteed through the SBG Program

Finally, nearly 55 percent of agents and 40 percent of firms stated that the primary reason the fee reductions might not affect the number or value of bonds guaranteed was that fees are not a major factor in the decisions to guarantee bonds. The second reason cited by 21 percent of agents and 30 percent of firms was that 1 year was not enough time to implement changes needed to take advantage of the new fee structure.

ADDITIONAL INFORMATION SHARED BY SURETY FIRMS AND AGENTS ON THEIR PARTICIPATION IN THE SBG PROGRAM

The final survey question asked both agents and firms whether there was anything else that they would like to share regarding their participation in the SBG Program. Responding firms and agents used this open-ended question to provide perspectives in several areas. Many agents and firms reiterated their sense that fee levels would did not impact the number of new bonds they would guarantee. Market conditions and the availability of surety credit were cited as major factors in determining how many small business contractors might need SBG Program guarantees. Agents and firms also anticipated processing more applications due to the impending recession brought about by the COVID-19 pandemic. Several responding agents noted that they encountered problems in closing or underwriting bonds in the SBG Program, including completing required paperwork, problems with navigating the application software, and paperwork burdens (e.g., status updates). Each of these issues could result in small business contractors or surety agents and firms electing not to process bond guarantee applications through the SBG Program.

Nevertheless, both firms and agents agreed that lower fees would help currently bonded small business contractors remain competitive by increasing their profit margins on contracts. Agents and firms noted that small business contractors typically include the fees in their bids and could pass on savings to obligees if fees were reduced. These savings could, in turn, result in small business contractors receiving more contracts, and ultimately, more bonds being written and guaranteed under the SBG Program.

Limitations and Caveats Arising from Response Rates

The responses have been adjusted for non-response to represent the populations of SBG Program surety firms and agents, including non-respondents. However, given the lower response rates, caution should

be exercised in interpreting the results and in drawing conclusions. Moreover, responses reflect the personal beliefs, opinions, and other biases (e.g., social desirability) of the respondents rather than the actual impacts of the fee reductions. Finally, weighting proportionally to the number of bonds that each respondent guaranteed suggested that firms and agents that guaranteed more bonds were more likely to believe that the fee reductions had or could have positive effects on the number and value of bonds guaranteed.

4 SUMMARY OF STUDY RESULTS

This evaluation used a multi-method sequential explanatory design (Morse, 2003), in which the findings from the evaluation's statistical modeling component informed the design of a survey component. Multi-method evaluation designs are valued for their ability to broaden the dimensions and the scope of an evaluation and provide a more complete picture than a single method by integrating several research methods (Morse, 2003). Multi-method evaluation designs are especially valuable in applied settings, where they can compensate for the limitations of individual methods while providing opportunities to triangulate findings and develop more comprehensive understandings (Fielding, 2008).

A key strength of a multi-method sequential explanatory design (Morse, 2003) is that it enables one to examine research questions essential to a study's purpose but too distinct in nature and content to be addressed using a single methodology. Under this study's sequential explanatory design, the findings from the ITS (i.e., SARIMA and ARIMAX) models served as the primary source for answering the study's research questions on whether the fee reductions affected the number or value of bonds guaranteed. The models also informed the development of survey questionnaires for surety firms and agents regarding their perceptions of the expected and actual effects of the fee reductions, as well as their potential for increasing the number of SBG bonds guaranteed.

Effectively integrating the statistical modeling and survey findings is a critical component of a robust, multi-method evaluation. This evaluation leverages methodological triangulation, the use of multiple data sources to investigate or better understand a phenomenon and to facilitate the critical task of synthesizing the findings from the statistical modeling and survey components. The remainder of this section details the triangulated findings across the evaluation's first four research questions, while a subsequent section covers in more detail the fifth question on the implications of the evaluation's results and associated recommendations.

1. ***How do the fee reductions affect program use by surety firms, surety agents, and small businesses, and how do the fee reductions affect the number and aggregate values of bonds guaranteed?***

Findings from the pair of surveys demonstrate that the vast majority of participating surety firms and agents were knowledgeable about the fee reductions, with a combined 88.7 percent of agents and 95.4 percent of firms reporting that they were either "very aware" and knew about the specific details and dates of the lower fees or were "somewhat aware" and knew about the lower rates but not specific details. Participating firms and agents demonstrated notable differences in their beliefs on the expected impacts of the fee reductions on the number of bond applications, with 59.0 percent of agents stating that the reductions would have "no effect" and the number of applications would remain the same, while 57.8 percent of firms expected an increase in the number of bond applications processed. However, firms and agents showed agreement on the expected impacts of the fee reductions on the contract values of the bond applications, with 63.4 percent of agents and 78.4 percent of firms reporting that they expected "no effect."

The synthesized findings from the ITS models and the surveys provided strong empirical evidence that the fee reductions did not have the intended impact of increasing the number or values of bonds during the Post-Intervention Period. After the exclusion of the 2-month lapse in government appropriations (December 2018 and January 2019), the number of new bonds processed under the fee reduction was

lower than the counterfactual predictions generated by the optimal ITS models in 7 of the 13 months (54 percent) comprising the Post-Intervention Period. Survey findings demonstrated that majorities of agents and firms (57.7 and 49.9 percent, respectively) saw "no effect" with the number of applications remaining the same after the implementation of the fee reduction. Meanwhile, the aggregate values of the new bonds processed under the fee reduction was lower than the counterfactual predictions of the optimal ITS models in 8 of the 13 months (62 percent). Similarly, survey findings demonstrated that 61.5 percent of agents and 59.1 percent of firms saw "no effect" with the contract values of bond applications remaining the same. Finally, survey findings provide critical evidence suggesting that the fees are not a primary factor associated with agents' and firms' decisions to write SBG Program bonds. Only 11.2 percent of responding agents identified "the fees associated with processing an application" as a primary factor while none of the responding firms identified the fees as a primary factor in their decisions to write SBG Program bonds.

One caveat to the evaluation's findings is that firms and agents with a higher proportion of bonds were more likely to report increases in the number of bonds and contract values and were more supportive of keeping the fees at reduced levels. **Appendix E** provides the survey findings with alternative weights adjusting for non-response and the proportion of bonds guaranteed by firms and agents. The findings when weighted by proportion of bonds show that 48.7 percent of firms reported an increase in the number and value of bond applications processed under the fee reduction. In contrast, the findings for agents demonstrate that majorities saw "no effect" with the number of applications and contract values remaining the same. The findings using the alternative weights also show that a majority of firms (67.1 percent) and a plurality of agents (36.9 percent) believed that keeping the fees at the reduced levels would increase the number of bonds issued under the program. In contrast, a plurality of firms (40.8 percent) believed that keeping the reduced fees would also increase the contract values of the bonds while a plurality of agents (42.0 percent) believed that the fee levels were not likely to affect the value of the bonds. Further research is needed to explore the reasons why firms and agents with higher levels of activity in the SBG Program were more likely than their peers to experience increases in the number and value of bonds and to support keeping the fees at the reduced levels.

2. How do the fee reductions affect the size and characteristics of small businesses in the portfolio?

The synthesized findings from the secondary descriptive analyses on the characteristics of participating small businesses and the surveys of surety firms and agents suggest that the fee reductions did not have a significant impact on the size and characteristics of small businesses participating in the SBG Program. The findings from the additional descriptive analyses of administrative data from the SBG Program demonstrate only marginal differences in the characteristics of participating firms between the Pre- and Post-Intervention Periods. No statistically significant differences were found across a variety of business size or ownership characteristics except for a statistically significant 3.51 percentage point decrease in the proportion of 8(a) program participants ($p < .001$). However, as noted when this finding was presented in the section that presented "Descriptive Analyses on the Characteristics of Small Businesses," the expected result is some decrease in the representation of 8(a) small businesses between the Pre-Intervention and Post-Intervention Periods for two reasons: first, the number of 8(a) small businesses participating in the SBG Program declined by 37 percent between 2009 and 2017; second, since a small business was treated as 8(a) if it held that status at any time within the Pre- and Post-Intervention Periods, the expectation is that the number of small businesses treated as 8(a) in the Pre-Intervention Period will exceed the number in the Post-Intervention Period due to the large

difference in duration. For these two reasons, it does not seem advisable to statistically attribute the 3.51 percentage point decline to the reduced fee structure.

The surveys asked firms and agents about their perceptions regarding the types of small businesses that submitted bond applications due to the fee reductions. Strong majorities of agents and firms (58.4 percent and 53.2 percent, respectively) reported that they saw no change in the types of small businesses submitting applications and no change in the types of small businesses submitting applications for higher contract values (64.7 percent of agents and 57.2 percent of firms). Finally, agents and firms were asked about the types of small businesses that they would expect to process more applications if the reduced fees were kept in place over the next two years. A plurality of agents (44.9 percent) and a majority of firms (63.9 percent) expected to see an increase in the number of smaller businesses with lower revenues or fewer employees. Given the hypothetical nature of this question, future research conducted over a longer period of analysis may want to examine whether these perceptions about an increase in the number of participating smaller businesses came to fruition.

3. How do the fee reductions affect the risks associated with guaranteeing bonds?

The surveys of agents and firms examined the impacts of the fee reductions on the risk associated with guaranteeing bonds, in the form of the number and sizes of defaulted contracts. Strong majorities of agents and firms (68.6 and 81.8 percent, respectively) reported that there was no change in the number of defaults under the fee reductions. Similarly, strong majorities of agents and firms (66.7 and 73.4 percent) reported that they saw no change in the size of the defaulted contracts. These findings suggest that the fee reductions did not have a significant impact on the risks associated with guaranteeing bonds, though this finding may be moderated by the factors associated with the decisions of firms and agents to write SBG Program bonds and the subsequent impact on the composition of small businesses participating in the program. Notably, agents and firms stated that risk of default was a third-order factor associated with decisions to write bonds; agents stated that creditworthiness of the applicant and whether the applicant has adequate working capital as first- and second-order factors, while firms stated that the applicant's project experience and ability, and their creditworthiness were first- and second-order factors. In this regard, the combination of the applicant's creditworthiness, degree of adequate working capital, and project experience and ability as primary factors driving the decisions of agents and firms to write bonds could suggest that the small businesses participating in the SBG Program may have a notably low level of default risk. Once again, future research conducted over a longer period of analysis may be needed to examine the long-term impacts of any fee reductions on the number and size of defaulting contracts.

4. How did surety firms and agents view the fee reductions and their potential value for expanding their clientele and the number and value of bonds they approve?

The surveys asked participating agents and firms a collection of questions focusing on their perceptions of the fee reductions and the potential value for their clientele. These questions first asked about changes in surety fees, including keeping the fees at the reduced levels, returning to higher fee levels, reducing the fees further, or none of the above scenarios, that would increase the number of bonds processed and the associated contract values. A majority of firms (50.4 percent) expressed that keeping the fees at the reduced levels would increase the number of bonds while a plurality of agents (39.2 percent) selected "none of the above; fee levels are not likely to affect the number of bonds processed." Firms and agents demonstrated a greater level of agreement on the impacts on contract values, with

pluralities of agents and firms (41.6 and 36.3 percent, respectively) noting that the fee values were unlikely to affect the value of the bonds processed. Subsequent questions asked agents and firms about whether permanently enacting the fee changes would impact the number of surety agents and internal staff needed to process bond applications. Nearly 71 percent of agents responded that permanently enacting the fee changes would not increase the number of internal staff while 69.6 percent of agents stated that the fee changes would not increase their number of surety agents or internal staff.

A final pair of questions asked agents and firms about various fee-level scenarios that would increase their likelihood of processing more and fewer SBG Program bonds. Across both sets of questions, pluralities of agents (ranging from 40.8 to 47.1 percent) and firms (ranging from 37.8 to 45.1 percent) suggested that neither increasing nor decreasing the fees would have an effect as "Fee levels are not likely to affect the number of bonds processed." However, the answers from a subgroup of firms and agents provide important insight into the range of support for various fee levels. A combined 44.6 percent of agents suggested that reducing the principal fees to a range of 0.40 to 0.50 percent would result in a greater number of bonds while a combined 54.55 percent suggested that increasing the principal fees to between 0.65 and 0.80 would result in a fewer number of bonds. Among firms, a combined 50.5 percent suggested that reducing the surety fees to between 8 and 14 percent would result in a greater number of bonds while a combined 55.1 percent suggested that increasing the surety fees to between 23 and 32 percent would result in a fewer number of bonds being processed. Together, these questions provide critical insight into the level of support for various fee-level scenarios. Future research is necessary to explore the reasons why these subgroups of firms and agents are more supportive of further reducing the fee levels.

5 POLICY RECOMMENDATIONS AND DISCUSSIONS

A major reason for SBA reducing the fees charged to small business contractors from $7.29 per thousand dollars of contract value to $6.00 per thousand, and those to sureties from 26 percent of the bond premium to 20 percent effective October 1, 2018, was the expectation that the reductions might stimulate increases in the number and value of bonds guaranteed under the SBG Program and increases in the number of smaller and less advantaged small business in the SBG Program portfolio. If this expectation had been supported, the observed number and value of bonds guaranteed after the fee reductions should have been higher than the number and value of bonds predicted by ITS models under the counterfactual condition (i.e., that the fees had remained at the higher levels).

The results of the primary statistical models (i.e., SARIMA) provided no evidence that the fee reductions helped increase either the number or value of bonds guaranteed through the SBG Program. To the contrary, the observed number of guaranteed bonds was lower than predicted in 7 of the 13 months of the Post-Intervention Period (excluding the government shutdown months), and the value was lower in 9 of the 13 months. When the value was lower, the difference between observed and predicted numbers and values of bonds was greater than in the months when observations exceeded predictions. The differences between the observed number and value of bonds guaranteed and the number and value predicted by ARIMAX models were even greater, suggesting that trends in external variables should have generated increases in bond numbers and values even higher than expected had the fees not been reduced.

Findings from the surveys of surety firms and agents point to at least two major and divergent approaches to interpreting the results from the ITS models and to addressing future decisions on fee levels.

a. The first line of reasoning suggests that the fee reduction did not increase the number or values of bonds guaranteed in the Post-Intervention Period for the following reasons:
    a. Fees are not a major factor in the decisions of surety firms or agents to process and approve applications: Given a list of 14 potential factors, only 11 percent of surety agents and no surety firms identified fee levels as a primary factor in their decisions to write SBG Program bonds. By contrast, 86 and 79 percent of agents cited an applicant's creditworthiness and their having adequate working capital as primary factors, and 67 percent of firms cited the applicant's project experience and ability.
    b. Furthermore, the fee reductions did not change the types of small businesses (e.g., smaller, less experienced, minority- or women-owned) for which a majority of agents and firms processed bond guarantees (58 percent of agents and 53 percent of firms) or the size of those bonds (65 percent and 57 percent, respectively).
    c. Most agents expected changes in neither the number (59 percent) nor the value (63 percent) of bonds they would process and did not observe such changes (58 percent and 61 percent, respectively).
b. However, a second approach to interpreting the results and their implications would build upon the following findings:
    a. Although more than three-fourths (78 percent) of surety firms did not expect changes in the value of bonds, 58 percent expected to produce more bond

guarantees and half (50 percent) reported that they actually produced more bonds with higher values in the year after the fee reductions were adopted.

b. Seven to 28 percent of agents and 8 to 23 percent of firms reported they increased the number and/or value of bonds they guaranteed for smaller businesses (e.g., with lower revenues or fewer employees); less experienced businesses (e.g., more recently founded or fewer prior contracts of this size); 8(a) businesses; and Veteran and Service-Disabled Veteran-owned businesses.
c. About 21 percent of agents and 30 percent of firms believed that 1 year does not allow sufficient time for them to implement the changes needed to take advantage of the new fee structure.
d. About 37 percent of surety agents and 67 percent of firms believed that they would increase the number of bonds guaranteed if the fee reductions were maintained or increased for the next 2 years.
e. Just under half of responding agents (45 percent) and about half (50 percent) of responding firms believed they could increase the number of bonds produced if fee levels were reduced to between 0.40 and 0.50 percent, and to between 8 and 14 percent of the current reduced levels, respectively.

The first line of interpretation takes the clear findings of the statistical models that the fee reductions did not increase the number or value of bonds guaranteed through the SBG Program and adds supporting evidence from the surveys that neither surety agents nor firms saw fee levels as a primary factor in their processing of applications or expected the fee reductions to increase processing levels. This interpretation of the findings from the models and surveys suggests that maintaining the reduced fee structure would not be a promising strategy for increasing the number or value of bonds that surety firms and agents will guarantee through the SBG Program.

The second line of interpretation relies on responses from sizable numbers of surety firms and agents that reported increases in the number or value they produced or felt the reduced fees would have to be larger or maintained over a longer period of time for them to increase their processing of applications for bond guarantees. Higher percentages of firms than agents reported these findings, and analyses weighting responses by the number of bonds each agent and firm guaranteed showed that higher volume producers were more likely to give these answers than lower volume producers. This suggests that firms may have been better positioned than agents to take advantage of the fee reductions and/or to see themselves doing so in the future; higher volume producers shared similar perspectives. This is a familiar pattern in research on the adaptation of innovations: early adopters often have greater awareness of the innovation and are better prepared or resourced to make use of it.

The flow chart on the following page lists recommended factors for SBA to consider on the fee structures, including discussions about whether to maintain, modify, or rescind the fee reductions.

Exhibit 29: Factors for SBA to Consider on the Future of Fee Reductions

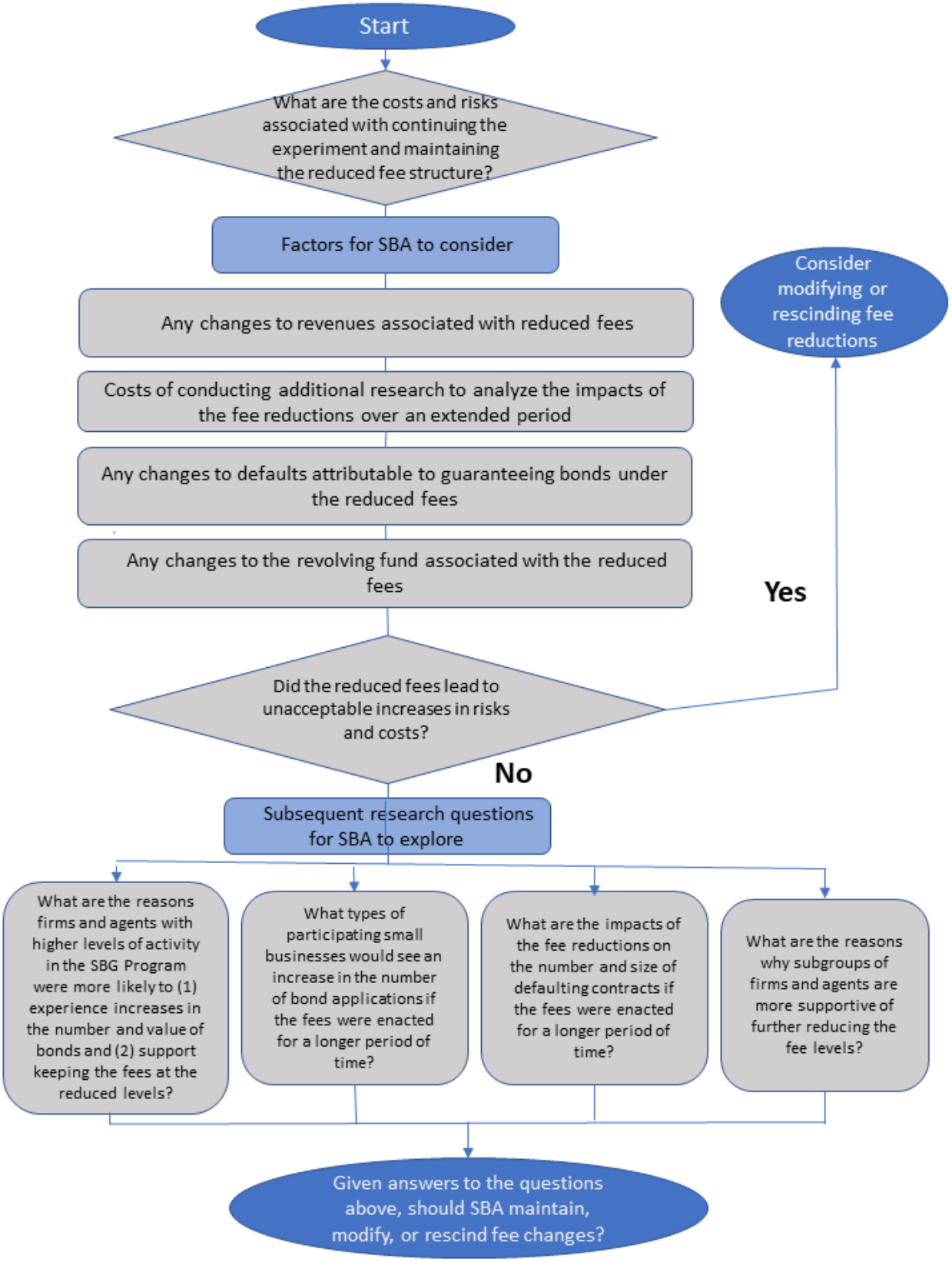


Exhibit 29 outlines the logic of the questions that SBA must sequentially address in deliberating on whether to maintain or modify the reduced fee structures or return fees to pre-intervention levels. The decision logic is based on the findings reported on the research questions the evaluation was designed to address. The fundamental question involves weighing the value of further studying the potential of reduced fees to increase the size, value, or diversity of bonds guaranteed in the SBG portfolio against the costs and risks of continuing research given this study's consistent finding that the fee reductions did not affect these outcomes. Some key factors involved in this deliberation are discussed in the paragraphs that follow.

The decision logic begins with the expected costs and risks of continuing or expanding the reduced fee structures for a specified period of time. The costs include the appropriations required for additional research on fee reductions and the development of tools to monitor their effects, and the lower revenues produced under the reduced fee structure. These costs were evidently deemed acceptable enough to initiate the current study, but the SBG Program, working with other offices in SBA, will also need to identify the levels that the Reserve Fund must maintain to cover, without additional appropriations from Congress, the cost of claims arising when small businesses default. The second rhombus in Exhibit 29 suggests that under advice from the Office of the Chief Financial Officer, SBA might determine that the risk and/or costs of defaults could rise too much or the reduced fee structure could provide insufficient revenues to maintain the Reserve Fund at a level SBA determines is needed. This line of reasoning might lead SBA to decide against extending the reduced fee structure for a period long enough to determine whether the Post-Intervention Period was not long enough for sureties and agents to implement changes in their practices that might increase their production of bonds guaranteed through the SBG Program.

If, however, the risks of defaults and costs of maintaining adequate reserves are not so high as to militate against continuing research on reduced fee structures in the context of monitoring the risks and costs of defaults, the findings and broader thinking on SBA's objectives suggest four key questions that SBA may find useful for guiding its thinking on when and how to monitor and adjust fee structures.

1. What is the minimum length of time for which SBA would need to guarantee an optimal fee structure? Many sureties and agents indicated that they would need a period longer than announced for the current fee reductions to invest in changing their operations to increase the number or value of bonds they process for guarantees, and/or the number of target population small businesses in their portfolios.

2. What is the optimal fee structure? In other words, what fee structures would enable the SBG Program to best help small businesses to secure the bonding they need while maintaining the Revolving Fund at levels that will enable SBA to fulfill its guarantees?

3. How can SBA use the administrative data analyzed in this study to monitor and adjust fee structures based on how they affect (a) the number, value, and small business diversity of bonds guaranteed and (b) Revolving Fund revenues, and monies lost and recovered from defaults?

4. How can SBA utilize regulatory mechanisms to reduce and mitigate risk and liability (e.g., Default Notifications and Updates, Quarterly Contract Completion Reports) and develop data collection and underwriting standards for application approvals that can reduce risk and liability?

Insights on how to address these key questions might well be gained by further probing into important results from the current study, including

- why firms and agents that produced greater shares of the bonds guaranteed in the Post-Intervention Period reported that they did guarantee more or higher value bonds and were more likely to support continuing the reductions; and
- what types of small businesses might be approved for more guarantees if the reduced fee schedule were continued.

The costs of defaults attributable to fee reductions, both directly in reimbursements to sureties and indirectly in maintaining sufficient reserves, has already been noted in decisions about whether to continue studies of reduced fee structures. Acknowledging these costs is critical to identifying sustainable and optimal fee structures should SBA extend its research on these issues.

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APPENDIX A: SBG PROGRAM LOGIC MODEL AND PROGRAM TIMELINE

Exhibit A-1: Logic Model of SBG Program

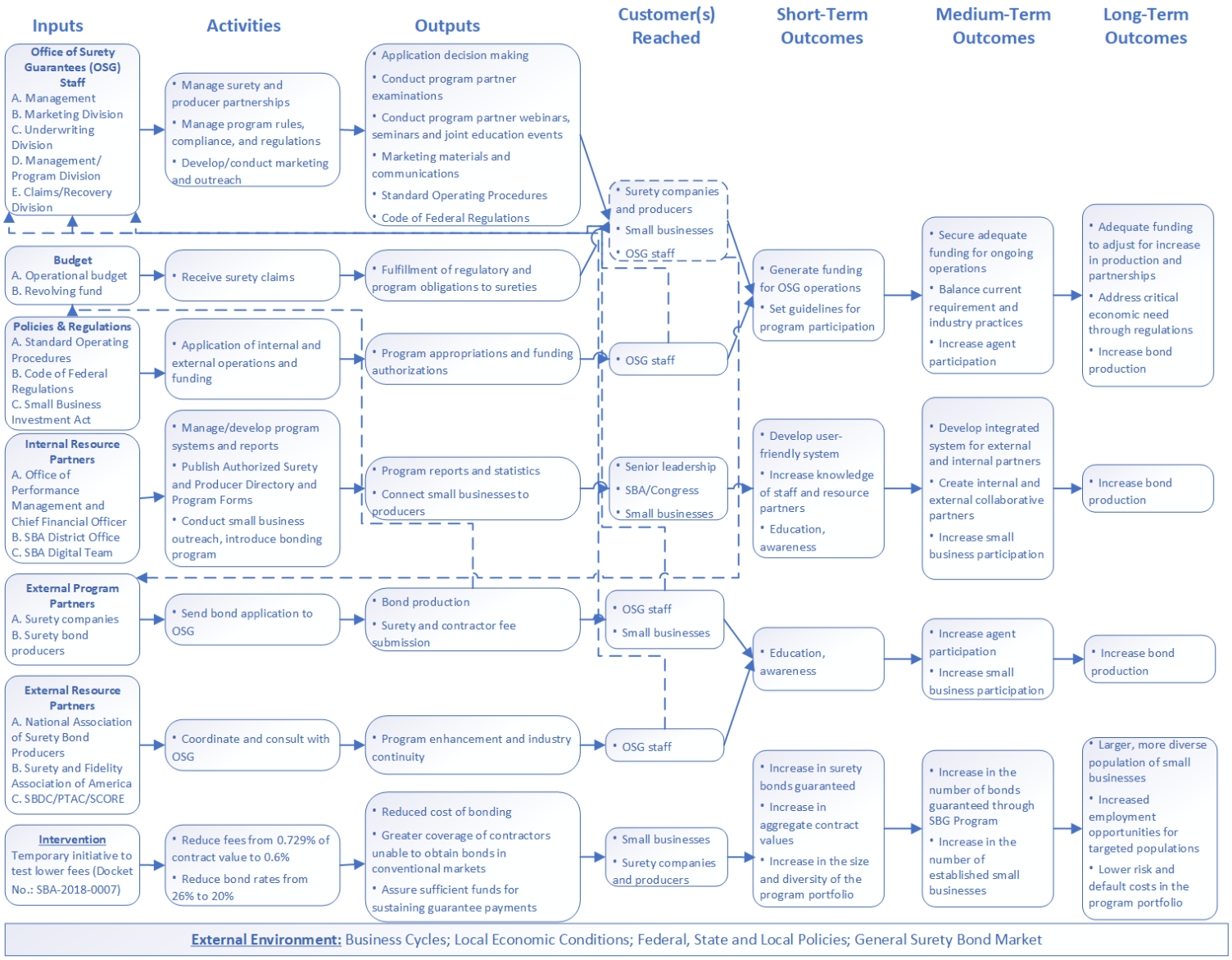
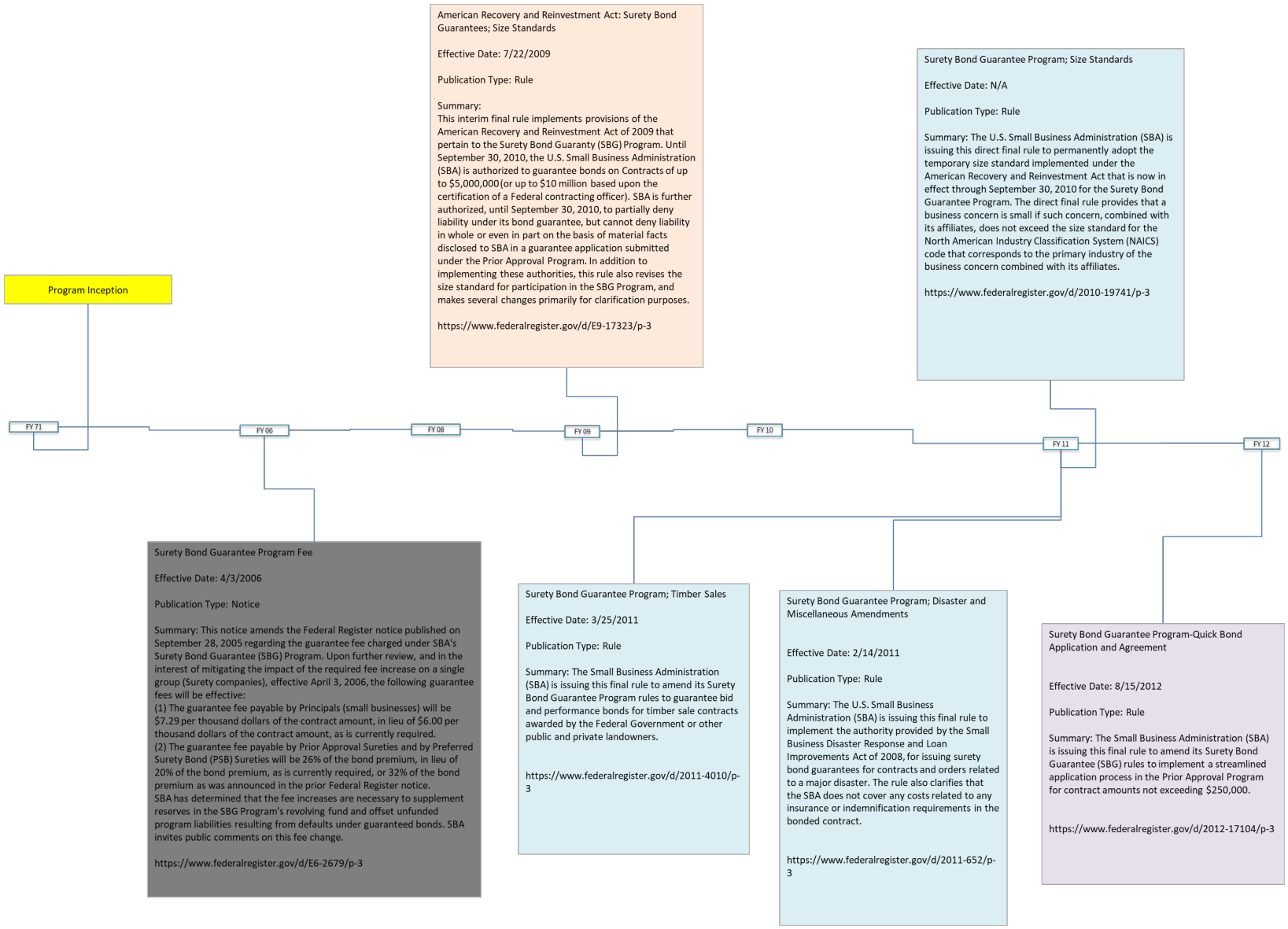
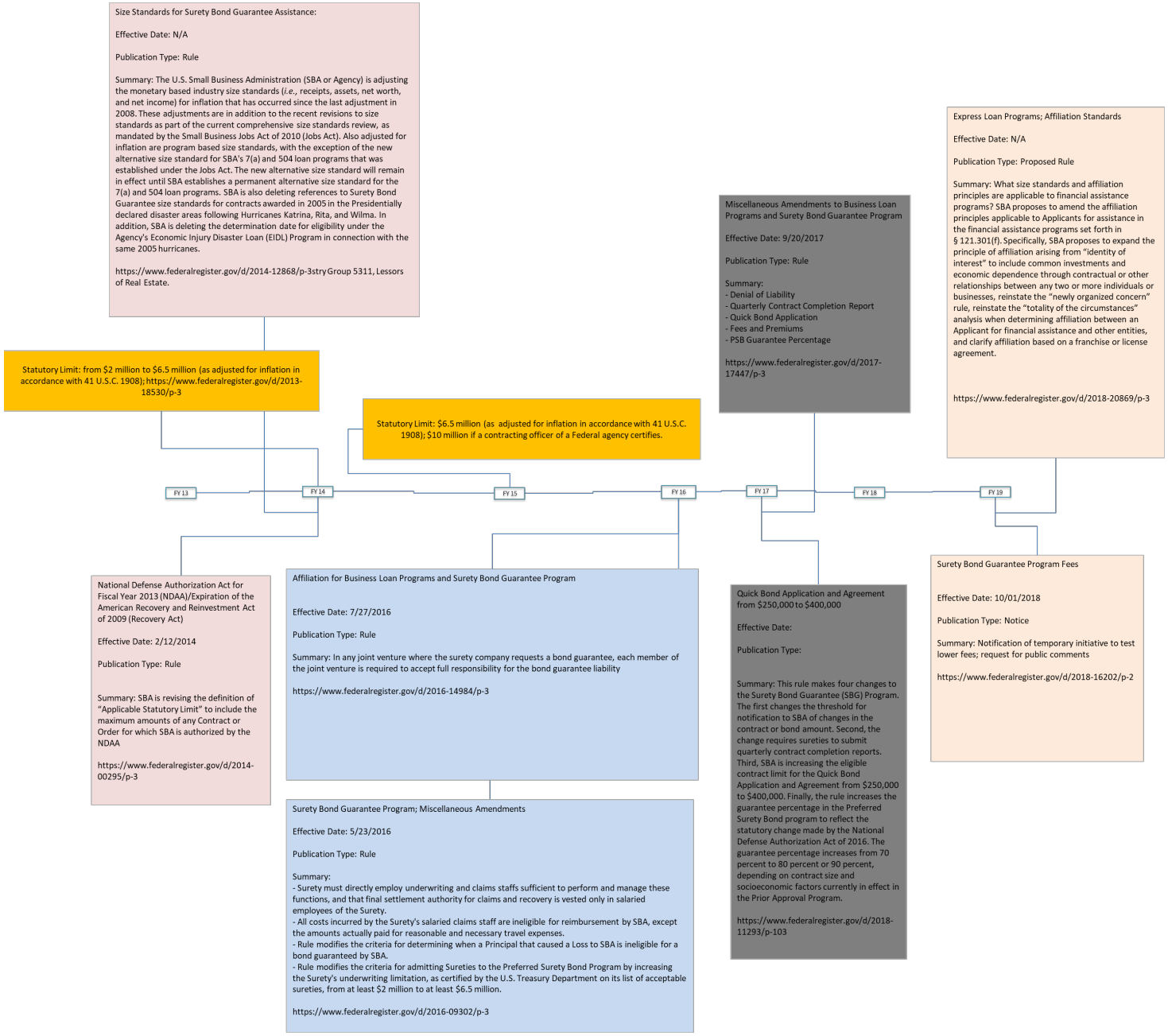


Exhibit A-2: SBG Program Timeline




Size Standards for Surety Bond Guarantee Assistance:
Effective Date: N/A
Publication Type: Rule
Summary: The U.S. Small Business Administration (SBA or Agency) is adjusting the monetary based industry size standards (*i.e.*, receipts, assets, net worth, and net income) for inflation that has occurred since the last adjustment in 2008. These adjustments are in addition to the recent revisions to size standards as part of the current comprehensive size standards review, as mandated by the Small Business Jobs Act of 2010 (Jobs Act). Also adjusted for inflation are program based size standards, with the exception of the new alternative size standard for SBA's 7(a) and 504 loan programs that was established under the Jobs Act. The new alternative size standard will remain in effect until SBA establishes a permanent alternative size standard for the 7(a) and 504 loan programs. SBA is also deleting references to Surety Bond Guarantee size standards for contracts awarded in 2005 in the Presidentially declared disaster areas following Hurricanes Katrina, Rita, and Wilma. In addition, SBA is deleting the determination date for eligibility under the Agency's Economic Injury Disaster Loan (EIDL) Program in connection with the same 2005 hurricanes.
https://www.federalregister.gov/d/2014-12868/p-3stry Group 5311, Lessors of Real Estate.
Statutory Limit: from $2 million to $6.5 million (as adjusted for inflation in accordance with 41 U.S.C. 1908); https://www.federalregister.gov/d/2013-18530/p-3
Statutory Limit: $6.5 million (as adjusted for inflation in accordance with 41 U.S.C. 1908); $10 million if a contracting officer of a Federal agency certifies.
Miscellaneous Amendments to Business Loan Programs and Surety Bond Guarantee Program
Effective Date: 9/20/2017
Publication Type: Rule
Summary:
- Denial of Liability
- Quarterly Contract Completion Report
- Quick Bond Application
- Fees and Premiums
- PSB Guarantee Percentage
https://www.federalregister.gov/d/2017-17447/p-3
Express Loan Programs; Affiliation Standards
Effective Date: N/A
Publication Type: Proposed Rule
Summary: What size standards and affiliation principles are applicable to financial assistance programs? SBA proposes to amend the affiliation principles applicable to Applicants for assistance in the financial assistance programs set forth in § 121.301(f). Specifically, SBA proposes to expand the principle of affiliation arising from "identity of interest" to include common investments and economic dependence through contractual or other relationships between any two or more individuals or businesses, reinstate the "newly organized concern" rule, reinstate the "totality of the circumstances" analysis when determining affiliation between an Applicant for financial assistance and other entities, and clarify affiliation based on a franchise or license agreement.
https://www.federalregister.gov/d/2018-20869/p-3
FY 13
FY 14
FY 15
FY 16
FY 17
FY 18
FY 19
National Defense Authorization Act for Fiscal Year 2013 (NDAA)/Expiration of the American Recovery and Reinvestment Act of 2009 (Recovery Act)
Effective Date: 2/12/2014
Publication Type: Rule
Summary: SBA is revising the definition of "Applicable Statutory Limit" to include the maximum amounts of any Contract or Order for which SBA is authorized by the NDAA
https://www.federalregister.gov/d/2014-00295/p-3
Affiliation for Business Loan Programs and Surety Bond Guarantee Program
Effective Date: 7/27/2016
Publication Type: Rule
Summary: In any joint venture where the surety company requests a bond guarantee, each member of the joint venture is required to accept full responsibility for the bond guarantee liability
https://www.federalregister.gov/d/2016-14984/p-3
Surety Bond Guarantee Program; Miscellaneous Amendments
Effective Date: 5/23/2016
Publication Type: Rule
Summary:
- Surety must directly employ underwriting and claims staffs sufficient to perform and manage these functions, and that final settlement authority for claims and recovery is vested only in salaried employees of the Surety.
- All costs incurred by the Surety's salaried claims staff are ineligible for reimbursement by SBA, except the amounts actually paid for reasonable and necessary travel expenses.
- Rule modifies the criteria for determining when a Principal that caused a Loss to SBA is ineligible for a bond guaranteed by SBA.
- Rule modifies the criteria for admitting Sureties to the Preferred Surety Bond Program by increasing the Surety's underwriting limitation, as certified by the U.S. Treasury Department on its list of acceptable sureties, from at least $2 million to at least $6.5 million.
https://www.federalregister.gov/d/2016-09302/p-3
Quick Bond Application and Agreement from $250,000 to $400,000
Effective Date:
Publication Type:
Summary: This rule makes four changes to the Surety Bond Guarantee (SBG) Program. The first changes the threshold for notification to SBA of changes in the contract or bond amount. Second, the change requires sureties to submit quarterly contract completion reports. Third, SBA is increasing the eligible contract limit for the Quick Bond Application and Agreement from $250,000 to $400,000. Finally, the rule increases the guarantee percentage in the Preferred Surety Bond program to reflect the statutory change made by the National Defense Authorization Act of 2016. The guarantee percentage increases from 70 percent to 80 percent or 90 percent, depending on contract size and socioeconomic factors currently in effect in the Prior Approval Program.
https://www.federalregister.gov/d/2018-11293/p-103
Surety Bond Guarantee Program Fees
Effective Date: 10/01/2018
Publication Type: Notice
Summary: Notification of temporary initiative to test lower fees; request for public comments
https://www.federalregister.gov/d/2018-16202/p-2

APPENDIX B: DESIGN AND DEVELOPMENT OF INTERRUPTED TIMES SERIES MODELS

The evaluation's statistical modeling methods evaluated the effects of the Surety Bond Guarantee (SBG) Program's fee reductions on the number and value of bonds guaranteed in the 15-month Post-Intervention Period. The Interrupted Time Series (ITS) models evaluated the effects of the program's fee reductions by comparing predictions based on trends during the Pre-Intervention Period (October 1, 2008, through September 30, 2018) and values observed in the Post-Intervention Period (October 1, 2018 through December 31, 2019).

Interrupted Time Series Design

ITS models provide a quasi-experimental evaluation design that can examine the effects of an intervention using measures of an outcome variable at regular time intervals. This evaluation measured the number and aggregate value of bonds on a monthly basis over the Pre-Intervention Period to predict the values of both outcome variables under the assumption that the pre-intervention series had continued uninterrupted. These measures were used to identify stability in Autoregressive Integrated Moving Average (ARIMA) processes over the Pre-Intervention Period. The trajectory of change over the Post-Intervention Period was tracked through repeated measurements. The continuity of measurements, along with the pattern of responses on the outcome variables, were used to control for threats to validity (Mertens and Wilson, 2012) and to generate accurate forecasts of predicted outcomes under the counterfactual condition that the fee reduction did not occur. ITS models enable the identification of a causal effect by comparing the difference between the observed outcomes after the fee reduction intervention against the effects predicted by a counterfactual in which the intervention was never implemented.

The evaluation used a collection of ITS models to estimate the effects of the fee reductions on the number and contract values of bonds issued under the SBG Program. First, the study used a specialized form of ARIMA known as Seasonal Auto Regressive Integrated Moving Average (SARIMA) models to account for consistent yearly peaks occurring in early summer months and in September and October (i.e., the end and beginning of federal fiscal years) and troughs during winter months. Univariate SARIMA models[30] were estimated to determine whether the number and aggregate values of bonds guaranteed in the 15-month Post-Intervention Period differed from what was expected. Second, the study team developed an algorithm to produce several Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) models[31] to determine which of a large set of external factors (see **Appendix D** "Modeling External Factors" section) might affect the number and value of bonds guaranteed. The candidate external variables, and lagged monthly values of those variables, were assessed on their ability to explain variation in the number and value of bonds guaranteed with and without the inclusion of ARIMA components. The variables remaining after a filtering process designed to eliminate redundancy were incorporated into the final ARIMAX models (see **Appendix D**) to determine whether some

[30] Univariate ITS models operate under the assumption that a given outcome point is a linear combination of its own past values and of the current and past values of an error term.

[31] Multivariate ITS models build upon their univariate counterparts by incorporating external factors shown to have statistically significant relationships to the outcome variables of interest and yield non-redundant explanatory power in modeling.

combination of the external variables contributed to the differences between the observed and predicted bond guarantee outcomes.

FORMULATION OF ITS MODELS

The study team employed robust univariate and multivariate model development processes to construct ITS models to test for the effects of the reductions in surety fees. In the univariate process, SARIMA models were generated and compared to predict the number and aggregate value of bonds in the Post-Intervention Period as a linear combination of its own pre-intervention values and current and past values of an error term (Box and Jenkins, 1976). The study team formulated four univariate models to serve as benchmarks in which the number or aggregate value of bond guaranteed, Y_t, is predicted by lagged monthly values up to time point, Y_{t-p}, and lagged monthly error terms up to e_{t-q} :

$$Y_t = a + \emptyset_1 Y_{t-1} + \cdots + \emptyset_p Y_{t-p} + \theta_1 e_{t-1} + \cdots + \theta_q e_{t-q} + \varepsilon_t$$

The forecasting literature has extensively documented that univariate models often forecast more accurately than multivariate models. While multivariate models can effectively incorporate important interdependencies and achieve a better fit within a given sample, univariate models often outperform multivariate models in making out-of-sample predictions (in this case, predictions for the Post-Intervention Period). Univariate models outperform multivariate models for three major reasons. First, because multivariate models have a greater number of parameters than their univariate counterparts, multivariate models require a greater number of unknown quantities to be predicted, which introduces additional error into the model. Second, the selection of optimal multivariate models is a more complex process that involves a greater number of candidate models and is more susceptible to modeling errors that affect the accuracy of predictions. Third, outliers can have a stronger effect on the predictions generated by multivariate models, as it is notably more difficult to identify and control for outliers in models with a greater number of parameters.

These limitations considered, the study team developed a robust model-building algorithm similar to Andrews, et al. (2013) to maximize the likelihood of selecting a multivariate model that optimally predicts the number and values of surety bonds guaranteed. The constructed multivariate model, where X_{t-h} represents a vector of potential external variables and their monthly lags, combined with univariate modeling components have the form:

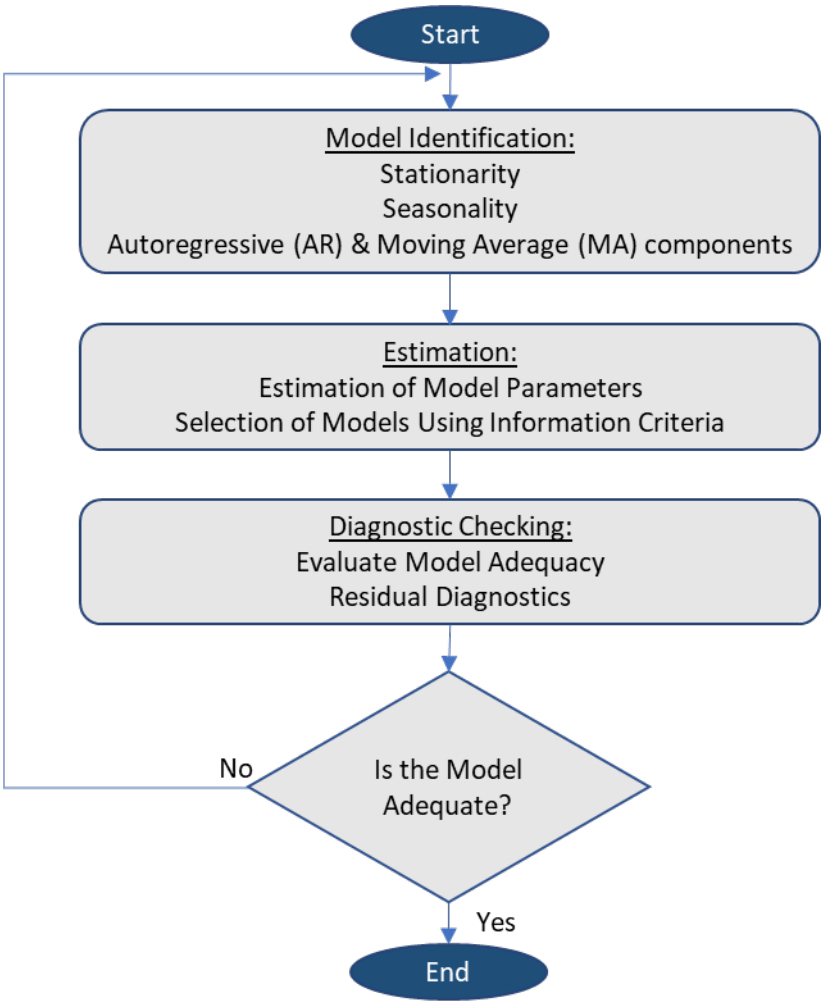
$$Y_t = a + \beta X_{t-h} + \emptyset_1 Y_{t-1} + \cdots + \emptyset_p Y_{t-p} + \theta_1 e_{t-1} + \cdots + \theta_q e_{t-q} + \varepsilon_t$$

The multivariate model-building algorithm was conducted under different specifications that attempted to mitigate the three multivariate pitfalls. Like the SARIMA models, the data utilized in the multivariate processes included all months in the Pre-Intervention Period and did not require the prediction of unknown quantities. Second, the study team limited the model building to produce only four candidate models for each primary outcome that utilized the same univariate modeling components. These selected univariate lag components were more parsimonious than those used in SARIMA models, which also lessened the possibility that the models overfit the data. Lastly, the study team assumed that irregular outlier values in external variables would have some effect on the primary outcomes of interest if the candidate variable had useful explanatory power. The multivariate model-building processes also imposed strict correlational requirements to filter out external variables with extreme outlier values.

APPENDIX C: UNIVARIATE MODEL DEVELOPMENT PROCESS

The ARIMA model-building process followed the three-stage iterative model development procedures developed by Box and Jenkins (1976) and shown in **Exhibit C-1**. The first stage, model identification, involved identifying model parameters to address key features of the data including stationarity, seasonality, and autocorrelation. The estimation stage involved the estimation of parameters identified in the first stage and an initial selection of the models. In the final stage, the study team performed diagnostic checks to identify potential inadequacies in the remaining candidate models and to assist in selecting optimal models. The sections that follow describe these stages in further detail.

Exhibit C-1: Overview of the Box and Jenkins (1976) Model Development Process



Model Identification

The first stage of the model development process closely examines the structure of the time series and ends by identifying initial ARIMA models that effectively capture the dynamic features of the data. ARIMA models divide patterns of time series data into three parameters. A key requirement of ARIMA models is that the time series data are stationary, which implies that the data have a constant mean and

variance over time and are not heavily influenced by trends or seasonality. The time series data for both outcome variables was tested for stationarity (against unit roots) and seasonality to determine whether the mean, variance, and autocovariances were independent of time. Initial visual plots for the outcome variables showed clear seasonal trends, with the lowest annual values occurring in winter months and with relative maxima occurring in early summer months and September or October. These clear seasonal peaks and troughs are best addressed by employing a special form of ARIMA models, known as SARIMA, that utilizes the lagged monthly values and/or error terms from the previous year.

Visual plots provided additional insights into the general trend and prominence of seasonal peaks in the Pre-Intervention series. Stationarity appeared unlikely as both outcome variables showed a general upward trend, and the growing prominence of peaks in the aggregate values suggested a non-constant variance. The study team also employed three formal tests of stationarity: the Augmented Dickey-Fuller test, the Kwiatkowski-Phillips-Schmid-Shin test, and the Dickey-Fuller Generalized Least Squares test. These tests confirmed a lack of stationarity and normality that could be mediated by taking the first difference for both variables. This differencing was incorporated into the SARIMA models via a differencing component, *d*.[32]

The study team then examined the remaining two components of the ARIMA models. First, the autoregressive (AR) parameter, *p*, was estimated to describe how observations are related to each other due to their closeness in time. Second, a moving average (MA) component, *q*, was calculated to account for external "shocks" within the data. The study team used correlograms to examine the level of autocorrelation, defined as the correlation between a variable and its previous values. The autocorrelation functions (ACF) and partial autocorrelation functions (PACF) correlograms provide insight into appropriate lag lengths of previous monthly values, *p*, and error terms, *q,* to include in potential models. Correlations at the annual lags in both correlogram plots also provide insights into seasonal AR terms, *P*, and seasonal MA terms, *Q*, to examine in potential models.[33] Thus, potential SARIMA model notations are distinguishable by their counts of AR, MA, seasonal AR, and seasonal MA terms:[34]

$$SARIMA\ (p, d, q)\ (P, D, Q)$$

The following stages of the ARIMA process would examine the varying lag terms to find models with high explanatory power through smaller counts of variables. Too few lag components in a model could exclude pertinent information, while too many lags could increase the risk of "overfitting" the data, which results in out-of-sample forecasts without much monthly variation. All potential models were validated using "training" and "testing" data sets to verify that the final SARIMA models could accurately model the variation in primary outcomes and produce sufficient forecasts.

[32] Both series could arguably require seasonal differencing to control for the persistent annual autocorrelation. Due to the small sample size of the Pre-Intervention Period, the study team chose not to use seasonal differencing because it would entail the loss of a year of data. Instead, the study team chose to include more seasonal ARMA terms.

[33] As our Pre-Intervention dataset was small in terms of years, potential models should not include more than a single seasonal AR and/or single seasonal MA term.

[34] As differencing results in transformed outcome values, it is not appropriate to compare models of different differencing terms. Differencing terms were the same across all ITS models in which integration order, *d*, is fixed at 1 and seasonal differencing term, *D*, was 0.

Parameter Estimation

The primary goal of the second stage of the model development process was to assess several specifications of ARIMA models with different values of *p, d, q, D,* and *Q* parameters. The PACF and ACFs examined in the previous steps showed strong support for modeling a single seasonal AR component and a single MA term for both primary outcomes. The study team found other supporting evidence of potential added benefit in adding non-seasonal AR terms, not exceeding two, and a single seasonal MA term.

The study team estimated all hypothesized combinations using maximum likelihood estimation built on training set data from the first 8 fiscal years of the Pre-Intervention Period. The models were then validated on their ability to capture the variation of the training set data through the Schwartz's Bayesian Criterion (BIC) and Akaike's information criterion (AIC). Both information criteria measure the prediction errors of models and seek to penalize the use of too many variables that might result in overfitting. Models with the top three lowest BIC and AIC score would advance to the Diagnostic Checking steps. While the selection of three top performing models using two measures implies up to six models, both primary outcome models had only four models advancing to diagnostic checking.

Diagnostic Checks

The final stage of the model development process assessed the adequacy of the selected models in modeling the dynamic features of the data. This stage sought to ensure that the models extracted all relevant information from the time series data. If parts of the data remained unexplained by the models, in the form of residuals, the study team conducted checks to ensure the residuals were small and devoid of systematic or predictable patterns. The study team used model diagnostic checks, consisting of Ljung-Box tests on the residuals, to determine whether any patterns remain unaccounted for. The study team deemed a model adequate if the residuals were "white noise," with no significant or lowly significant correlations present among the fitted residuals. The study team then verified the adequacy of the models graphically to ensure lowly significant variables were infrequent and autocorrelation was not present.

After residual assessment, the models were then scrutinized on their ability to accurately predict values of the final two fiscal years of the Pre-Intervention Period (or the test set). Using the same equation coefficients from the training period, forecasted values of the final year of the Pre-Intervention Period and compared against the test set. The recycling of equation coefficients was intended to parallel the eventual forecast of the fee-reduction period which seeks predicted values naïve to changes in program conditions. Model accuracy statistics including RMSE and MAE were then used to assess the accuracy of candidate model forecasts on the test set data.[35] All candidate models appeared to produce accurate forecasts, and visual plots showed agreeable fluctuations between months, suggesting overfitting was likely not an issue. The last step in assessing model performance would be to assess the overall fit of the entire Pre-Intervention Period. This assessment was accomplished by estimating predicted differenced

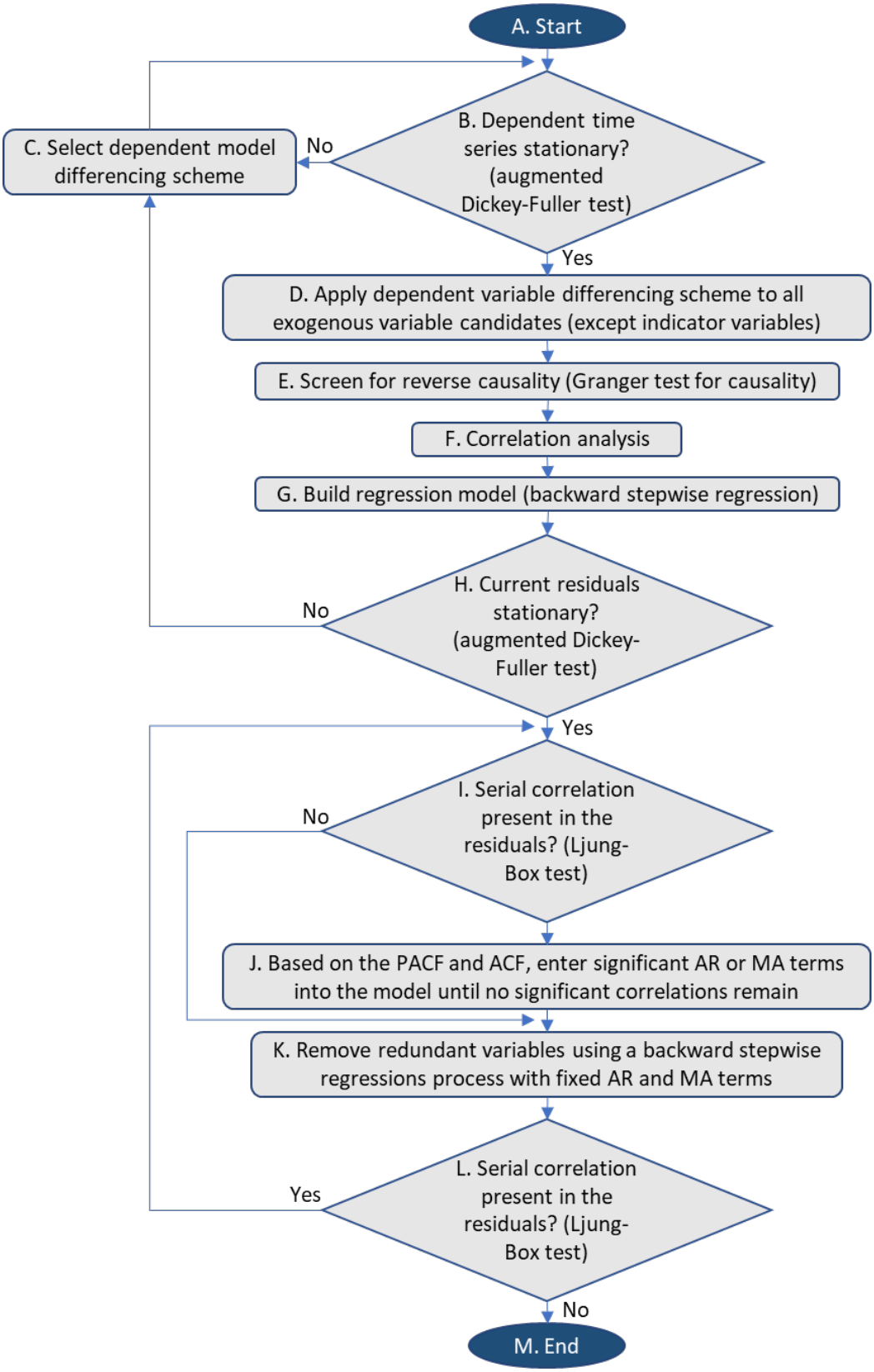
[35] As these data were differenced, MAPE is not an ideal accuracy statistic to assess performance due to low denominator values. For example, if an actual difference in month-to-month bond counts was only 1 between months and the model produced an estimate of 4, the error of that single time point would have been 200 percent and would greatly inflate the overall MAPE score.

values and applying them to the actual monthly values to produce monthly bond and aggregate values. The resulting monthly bond counts and final diagnostic check are outlined in the “Fit of the Initial Models” subsection in the second chapter of the report.

APPENDIX D: MULTIVARIATE ARIMAX MODEL DEVELOPMENT PROCESS

The study team developed an ARIMAX model-building algorithm designed to optimize predictive power in multivariate models to the magnitude of SARIMA models and to verify the conclusions reached on the forecasts produced by the optimal models. Following a similar framework to Andrews, et al. (2013), the algorithm filtered 248 explanatory variables to find external factors that would provide added explanatory power to significant SARIMA components. The 11-step model-building process shown in **Exhibit D-1** was divided into two main segments that first scrutinized all external variables in a more traditional regression-building fashion, and a second part that applied SARIMA components and verified the added explanatory value of surviving external variables.

Exhibit D-1: Overview of the ARIMAX Model Building Algorithm



Assessment of External Variables

The first seven steps of the model-building algorithm assess the relevance of external variables using more traditional regression-building methods. In addition, as ARIMAX models rely on AR and MA components, many of the same necessary rules and assumptions of univariate modeling would be applied to external variables. **Exhibit D-2** details all potential variables and their associated data sources. As these variables would be used in forecasting, lagged values for each variable would need to be generated to ensure explanatory variables cause primary outcomes and ensure naivety in forecasting Post-Intervention Period values. This process entailed the generation of 12 lagged versions of all continuous variables that resulted in 240 potential continuous variables. Lagged versions of federal policies, modeled as indicator variables, were not generated.

Like univariate models, all ARIMAX variables needed to follow stationarity requirements imposed on the outcome variables. The study team differenced all continuous external variables to establish stationarity in both the count of bonds and aggregate values. Following the differencing conducted in step D of the ARIMAX model-building algorithm (**Exhibit D-1**), the study team screened the variables for reverse causality through a Granger test to ensure that both primary outcomes did not cause the external variables in question. Variables that passed this step were advanced to step F of the model, which examined individual correlations between surviving variables and the outcome variable. Initial runs showed that imposing high probability thresholds (such as alpha values of 0.95 or more) would leave very few external variables and could result in the exemption of variables that hold joint significance when modeled with others. To ensure that these potentially jointly significant variables were not left out, the correlation analysis considered two significant thresholds at significance level of 0.90 and a more forgiving level of 0.80.[1] This step resulted in 2 sets of surviving variables distinguished by their correlational threshold of either “20” or the stricter “10.”

Step G of the model marked the first attempt at modeling the variation of the study’s primary outcomes using combinations of external variables. All surviving variables in the two sets were then subjected to a backward stepwise regression process that utilized either AIC or BIC model performance measures for filtering. The backward stepwise process iteratively eliminated variables by estimating a model using all surviving variables. Within these iterations, the study team assessed each explanatory variable by producing a model with all other remaining explanatory variables and recording the associated performance metric score. After running all models within the iteration, the study team compared the performance score of each variable exemption model to the overarching model of all surviving variables. If any variable exemption models outperformed the overarching model, the study team exempted the variable from the list of external variables and began the next iteration. The backwards stepwise process ends once an iteration’s over-arching model outperforms all exemption models, signaling that any further filtering would result in a less accurate prediction.

Eliminating potential external variables using information criteria helped the study team assess the performance of models and impose a penalty for using too many variables. Information criteria was preferred to model accuracy statistics such as root mean square error (RMSE), MAE, or MAPE because they seek to penalize the use of too many variables. Through limiting variable redundancy, the information criteria also helped to lessen the likelihood of a final model with some degree of

[1] Significance thresholds of 0.9 and 0.8 are relative to two-sided *t*-tests.

multicollinearity. Similar to the correlation analysis, the use of either performance metric again resulted in a varying degree of strictness. While both measures are intuitively similar and based on underlying log likelihood values, the BIC is typically regarded as more punitive for models with a high number of variables. The use of either AIC or BIC meant that the two sets of variables would then be divided into two more subsets for a total of four specifications distinguishable as "a10," "b10," "a20," and "b20."

To ensure stationarity was not breached, the study team conducted a second stationarity check before incorporating SARIMA components. A second round of Augmented Dickey-Fuller tests were employed in which all residuals appeared to reject the null hypothesis of a unit root, implying stationarity. Had stationary assumptions been broken, the algorithm would have restarted from the beginning.

Exhibit D-2: Data Sources for External Variables

Category	Source	Variable
Business Cycles	IHS Markit	Nominal gross domestic product* Real gross domestic product*
	U.S. Department of Commerce, Bureau of Economic Analysis (BEA)	Construction industry gross output*[2]
	BLS, Current Population Survey (CPS)	National unemployment rate
	National Federation of Independent Businesses (NFIB), Small Business Economic Trends (SBET)	Average actual interest rate paid by small businesses on short-term loans[3] Credit conditions expected by small businesses[4]
Local Economic Conditions	Census Bureau, Value of Construction Put in Place Survey (VIP)	Value of new construction put in place: *Private construction* *Public construction* *Total private and public construction*
	U.S. Bureau of Labor Statistics (BLS), Current Employment Statistics (CES)	Employment in the 2-Digit NAICS Construction sector Employment in each of the smaller 3-Digit subsectors: *236: Construction of buildings* *237: Heavy and civil engineering construction* *238: Specialty trade contractors*

[2] Construction industry gross output is reported quarterly. The study team disaggregated the quarterly gross output value using non-seasonally adjusted monthly values of *construction put in place*, published by the Census Bureau. This was accomplished by calculating the monthly share of the quarterly *construction value put in place*. The monthly share was then applied to the quarterly gross output value to generate monthly level data.

[3] This variable was derived from a survey item asking, "If you borrowed within the last three months for business purposes, and the loan maturity (payback period) was 1 year or less, what interest rate did you pay?"

[4] This variable was derived from a survey item that asks regular borrowers, "Do you expect to find it easier or harder to obtain your required financing during the next three months?" The reported figures reflect the difference between the percentage of small businesses that expected it will be "easier" to obtain required financing in the next 3 months minus the percentage expecting it will be "harder."

Category	Source	Variable
	BLS, Quarterly Census of Employment and Wages (QCEW)	Employment in the 2-Digit NAICS Construction sector by employer type: *Local governments* *State governments* *Private enterprises* *Total federal, local, state, and private employment*[5,6]
Federal, State, and Local Policies	SBG Program Policy – Regulation History Documents	Changes in small business size standards Inflation adjustment to monetary-based size standards in October 2010 and June 2014 Prior approval program (streamlined applications)
	Congressional Research Service (CRS) Reports	American Recovery and Reinvestment Act of 2009 National Defense Authorization Act for Fiscal Year 2013 National Defense Authorization Act for Fiscal Year 2016 (enacted and effective date)
Conditions in the General Surety Bond Market	Other SBG Program documents	SBG revolving fund cashflow[7] Number of surety firms participating in the SBG Program Number of agents participating in the SBG Program
	SBG Program Policy – Regulation History Documents	Statutory changes in maximum contract amounts

** Indicates seasonally adjusted variable*

Integration of SARIMA Components

The second phase of the ARIMAX model building algorithm included steps that closely paralleled those of the univariate model development process. This included an initial check of autocorrelation in the residuals through Ljung-Box tests that would dictate whether AR or MA components would be needed. In each of the four variable sets for both outcomes, it appeared that the residuals still had autocorrelation that would need to be accounted for. After an examination of each ACF and PACF, the study team determined that all models would benefit the most from the inclusion of a single seasonal AR component and non-seasonal MA term. Employing more AR and MA terms would likely result in the removal of more external variables in the last filtering step or would leave a less parsimonious final model that risked overfitting.

Following the addition of the two SARIMA components, the models were then subjected to an additional round of backwards stepwise filtering in Step K. This step would remove external variables that provided the same explanatory power of previously absent SARIMA components. The additional filtering step also

[5] The federal employment count was not examined as a standalone variable. Across the entire United States, the reported federal construction industry employment count was at most eight persons and as few as three persons. Correspondence with BLS personnel confirmed that these are single-digit values and not scaled (e.g., numbers in thousands).

[6] Although this theoretically measures the same information as the aforementioned "Employment in the 2-Digit NAICS Construction sector" variable, differences in values can be caused by employee type semantics, issues in reference period recordkeeping, changing worksites, and other less frequent factors (Fairman et al., 2009).

[7] The monthly net cash flow was calculated by subtracting the claims paid from the sum of fees, recoveries, and claim refunds.

ensured that the final model would not contain redundant variables and lessened the risk of overfitting. Each of the four variable sets for both outcomes recycled the same information criteria from the backward stepwise process in Step G for consistency. The last step confirmed that the residuals were small and devoid of systematic or predictable patterns and any prior autocorrelation was accounted for by the added SARIMA components. The results of a second Ljung-Box tests of re-estimated residuals did not show any greatly significant correlations that suggested the need to restart from Step I.

Final ARIMAX Models

The second backward stepwise regression process in Step K removed all remaining external variables in two bond count processes ("1B" and "2B") and a single aggregate process ("1B"), implying the SARIMA components likely hold more explanatory power. Complete omissions of external variables came in the strictest processes for both outcomes ("1B"), in processes that utilized the more punitive information criteria, and more often in the count of bonds processes which were better fit by SARIMA than the aggregate values according to MAPE. **Exhibits D-3** and **D-4** provide a list of surviving variables included in the final ARIMAX models. As the ARIMAX algorithm was engineered for producing higher predictability, the final set of variables may be difficult to make appropriate conclusions regarding their relationships with the two outcomes. A prominent pattern in the lists of remaining variables is the availability of credit for small businesses, either measured by the expected credit conditions or actual average interest rate. Future analyses might want to explore this relationship and other data from NFIB in greater detail in tandem with the perspectives gained from surety firms and agents in this report.

Exhibit D-3: List of Final Variables Included in ARIMAX Models for the Count of Bonds

Process 1A	Process 2A
Expected credit conditions, 9-month lag	Actual interest rate, 11-month lag
Expected credit conditions, 10-month lag	Expected credit conditions, 10-month lag
	SBG revolving fund cashflow, 2-month lag

Exhibit D-4: List of Final Variables Included in ARIMAX Models for the Aggregate Value of Bonds

Process 1A	Process 2A	Process 2B
Real GDP, 7-month lag	Actual interest rate, 3-month lag	Actual interest rate, 3-month lag
Actual interest rate, 3-month lag	SBG revolving fund cashflow, 8-month lag	
Expected credit conditions, 10-month lag		
SBG participating agents, 2-month lag		
SBG revolving fund cashflow, 2-month lag		

APPENDIX E: SURVEY FINDINGS WEIGHTED BY NON-RESPONSE AND PROPORTION OF BONDS GUARANTEED BY FIRMS AND AGENTS

This appendix details the survey findings using an alternative weighting approach for which the study team assigned weights that adjusted for non-response and the proportion of bonds guaranteed by firms and agents. This approach builds upon the non-response weights by assigning a second weighting adjustment to each survey respondent for which firms and agents that processed more bonds throughout the years were assigned larger weights.

Exhibit E-1: Awareness of Fee Reductions

Awareness	Agent	Firms
Very aware; knew specific details and dates of the lower fees	**51.06**	**82.24**
Somewhat aware; knew about the lower rates but not specific details	46.38	17.69
Not aware at all	2.57	0.07
Weighted n	*325*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey question 1.

Exhibit E-2: Expected Impacts on Number of Bond Applications and Contract Values

Expected Impact	Agent	Firms
Number of Bond Applications		
Increase in the number of applications processed	37.32	**72.55**
Decrease in the number of applications processed	0.00	0.00
No effect, number of applications remain the same	**57.38**	27.45
Don't know	5.31	0.00
Weighted n	*317*	*39*
Contract Values of Bond Applications		
Increase in the contract values of bond applications	34.67	37.07
Decrease in the contract values of bond applications	1.91	0.00
No effect, contract values will remain the same	**58.61**	**62.93**
Don't know	4.81	0.00
Weighted n	*304*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey questions 2 and 3.

Exhibit E-3: Actual Impacts on Number of Bond Applications and Contract Values

Actual Impact	Agent	Firms
Number of Bond Applications		
Increase in the number of applications processed	38.03	**48.72**
Decrease in the number of applications processed	2.33	0.00
No effect, number of applications remain the same	**58.24**	36.78
Don't know	1.41	14.50
Weighted n	*322*	*39*
Contract Values of Bond Applications		
Increase in the contract values of bond applications	29.81	**48.70**
Decrease in the contract values of bond applications	0.00	0.00
No effect, contract values will remain the same	**65.80**	37.44
Don't know	4.39	13.87
Weighted n	*325*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey questions 4 and 5.

Exhibit E-4: Impacts on the Number of Defaults and the Sizes of the Contracts that Defaulted

Impact	Agent	Firms
Defaults on Bond Applications		
Increased	0.33	0.00
Decreased	4.77	15.44
Did not change	**77.76**	**84.44**
Don't know	17.14	0.12
Weighted n	*325*	*39*
Size of Defaulted Contracts		
Increased	0.00	0.00
Decreased	2.21	0.00
Did not change	**74.01**	**54.76**
Don't know	23.78	45.24
Weighted n	*321*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey questions 6 and 7.

Exhibit E-5: Impacts on the Types of Small Businesses Submitting Applications*

Impact	Agent	Firms
Processed More Bond Applications from the Following:		
Smaller businesses (e.g., lower revenues or fewer employees)	31.97	17.10
Less experienced businesses (e.g., more recently founded or fewer prior contracts of this size)	27.41	28.79
8(a) businesses	19.80	16.36
Veteran-owned businesses	12.25	16.36
Service-Disabled Veteran-Owned Businesses (SDVOB)	19.10	16.36
HUBZone businesses	3.64	0.96
Others	4.02	11.85
No change	**57.13**	**48.58**
Don't know	4.87	22.52
Weighted n	*325*	*39*
Applications for Higher Contract Values from the Following:		
Smaller businesses (e.g., lower revenues or fewer employees)	27.86	17.06
Less experienced businesses (e.g., more recently founded or fewer prior contracts of this size)	22.09	16.99
8(a) businesses	17.35	16.36
Veteran-owned businesses	15.69	16.36
Service-Disabled Veteran-Owned Businesses (SDVOB)	17.57	16.36
HUBZone businesses	2.66	0.91
Others	0.60	0.00
No change	**59.44**	**46.56**
Don't know	9.14	36.39
Weighted n	*325*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey questions 8 and 9.
*Percentages sum to more than 100 percent because respondents were asked to "Select all that apply." Selecting "No change" or "Don't know" prevented respondents from selecting other response options.

Exhibit E-6: Changes in Surety Fees that Would Increase the Number of Bonds Processed and Associated Contract Values Processed

Changes in Surety Fee	Agent	Firms
Increase the Number of Bonds		
Keeping the fees at the reduced levels	**36.85**	**67.07**
Returning to the higher fee levels	0.00	0.00
Reducing the fees even further	26.19	18.18
None of the above. Fee levels are not likely to affect the number of bonds processed.	36.63	14.75
Don't know	0.33	0.00
Weighted n	*325*	*39*
Increase the Contract Values of the Bond		
Keeping the fees at the reduced levels	29.91	**40.75**
Returning to the higher fee levels	0.00	0.00
Reducing the fees even further	26.83	30.38
None of the above. Fee levels are not likely to affect the value of bonds processed.	**41.99**	28.86
Don't know	1.28	0.00
Weighted n	*322*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020;
Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey questions 10 and 11.

Exhibit E-7: Expectations Regarding the Effects of Keeping the Reduced Fees on the Surety Premiums Charged to Contractors

Changes in Surety Premium Charge	Firms
Expect the surety premiums to increase	28.80
Expect the surety premiums to decrease	0.00
Expect the surety premiums to not change	**71.20**
Don't know	0.00
Weighted n	*39*

Source: Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020; survey question 12.

Exhibit E-8: Types of Small Businesses for Which Surety Firms and Agents Would Expect to See an Increase in the Number of Bonds*

Type of Small Businesses	Agent	Firms
Increase the Number of Bonds Processed		
Smaller businesses (e.g., lower revenues or fewer employees)	**56.31**	**84.29**
Start-up businesses	**50.70**	**70.42**
Emerging businesses	**49.57**	60.67
Developed businesses	39.27	56.77
Businesses with higher credit risks	49.31	41.08
8(a) businesses	31.92	**61.98**
Veteran-owned businesses	32.13	48.11
Service-Disabled Veteran Owned Businesses (SDVOB)	31.80	47.00
HUBZone businesses	25.67	22.90
Other	N/A	0.00
None of the above. Fee levels are not likely to affect the types and number of small businesses served.	36.34	15.62
Don't know	4.30	0.00
Weighted n	*325*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020, survey question 12; Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020, survey question 13.
*Percentages sum to more than 100 percent because respondents were asked to "Select all that apply." Selecting "No change" or "Don't know" prevented respondents from selecting other response options.

Exhibit E-9: Whether Permanently Enacting the Fee Changes Would Impact the Number of Surety Agents and Staff Needed to Process Applications

Type of staff	Percent
Firms	
Increase the number of surety agents	15.01
Increase the number of internal staff	0.05
Increase both the number of surety agents and internal staff	0.00
Increase neither the number of surety agents nor internal staff	**69.06**
Other	15.88
Weighted n	39.00
Agents	
Yes, increase in internal staff	8.55
No, no increase in internal staff	**74.27**
Don't know	17.19
Weighted n	*325*

Exhibit E-10: Primary Factors Associated with Decisions to Write SBG Program Bonds*

Factors	Percentage	
	Agent	Firms
Creditworthiness of the applicant	**84.57**	**52.92**
Risk of default associated with the applicant	**46.02**	28.74
Applicant has adequate working capital	**89.18**	36.68
Applicant's management team	12.72	0.00
Applicant's project experience and ability	n/a	**81.56**
Applicant's character and reputation	n/a	**63.85**
The applicant's stage of development (e.g., start-up, 8A, or HUBZone graduate)	43.31	20.65
Change in the applicant's NAICS or the addition of a NAICS	n/a	0.00
The fees associated with processing an application	6.96	0.00
The commission that can be earned on an application	0.35	n/a
Trends and projections (for the construction industry) in the national economy	2.87	0.00
Trends and projections (for the construction industry) in the local economy of the project	2.07	0.00
The bond rate that can be charged to the applicant for the contract	4.57	0.00
Other	7.37	15.61
Weighted n	*304*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020, survey question 14; Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020, survey question 15.
*Percentages sum to more than 100 percent because respondents were asked to rank the top three factors in order of importance.

Exhibit E-11: Surety- and Contractor Fee-Level Reductions that Would Cause Firms and Agents to Process More SBG Program Bonds

Fee Levels	Percent
Agents	
0.40%	22.08
0.45%	0.33
0.50%	28.87
0.55%	0.00
0.60%	7.87
0.65%	0.00
0.70%	0.00
0.75%	0.33
0.80%	0.00
No effect. Fee levels are not likely to affect the number of the bonds processed.	**40.52**
Weighted n	*317*
Firms	
8%	13.90
11%	**27.34**
14%	26.14
17%	0.00
20%	15.81
23%	0.00
26%	0.00
29%	0.00
32%	0.00
No effect. Fee levels are not likely to affect the number of the bonds processed.	16.81
Weighted n	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020, question 15; Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020, survey question 16.

Exhibit E-12: Surety and Contractor Fee Levels that Would Cause Firms and Agents to Process Fewer SBG Program Bonds

Fee Levels	Percent
Agents	
0.40%	0.28
0.45%	0.00
0.50%	2.18
0.55%	0.27
0.60%	0.33
0.65%	9.46
0.70%	21.62
0.75%	12.45
0.80%	19.92
No effect. Fee levels are not likely to affect the number of the bonds processed.	**33.50**
Weighted n	*317*
Firms	
8%	9.78
11%	0.00
14%	0.00
17%	0.00
20%	15.44
23%	23.43
26%	13.87
29%	**31.33**
32%	0.03
No effect. Fee levels are not likely to affect the number of the bonds processed.	6.12
Weighted n	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020, question 16; Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020, survey question 17.

Exhibit E-13: Perceptions of Surety Firms and Agents on Why the Fee Reductions Did Not Affect the Total Number or Value of Bonds Guaranteed by the SBG Program*

Factors	Percentage	
	Agent	Firms
The fees associated with processing an application are not a major factor in the decision of surety agents to process applications	**49.28**	13.29
Risk of default associated with the applicant	0.00	0.00
The fee reductions do not provide surety agents the incentive to process more applications	18.78	17.01
1 year is not enough time to implement the changes needed for the new fee structure	22.99	29.27
Other	15.90	16.36
Don't know	11.02	**29.92**
Weighted n	*325*	*39*

Source: Survey of Surety Agents Participating in the Surety Bond Guarantee Program, 2020, survey question 17; Survey of Surety Firms Participating in the Surety Bond Guarantee Program, 2020, survey question 18.
*Percentages sum to over 100 percent because respondents were asked to "Select All That Apply." Selecting "Don't know" prevented respondents from selecting other response options.