



Risk-based data analytics in the government sector: A case study for a U.S. county

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Highlights

- Proposed a risk-based exception prioritization conceptual framework to improve government audits' quality
- Proposed framework aims to address the problem of information overload, grounded in processing fluency theory
- Framework applied to the duplicate payments in a procurement dataset of a U.S. county
- Results demonstrate substantial improvements compared to both record scanning and traditional sample-based approaches
- The proposed approach has the potential to improve the efficiency and effectiveness of government audits

Abstract

This study explores the use of data analytics for improving the quality of government audits through the lens of processing fluency theory as the driver behind the need for data analytics. Little is known about the benefits of data analytics to government expenditure audits in a data-rich environment. Accordingly, this study proposes a risk-based prioritization framework and applies it to the real procurement dataset of a US county. The results indicate that the framework increases the efficiency and effectiveness of identifying true duplicate payments compared to either the scanning or sampling benchmarks. Specifically, it significantly reduces the number of potential duplicate candidates that require auditor review to approximately 12% of the duplicate records. As such, it enables the capture of true duplicates in a shorter period. These results suggest that the framework offers one way to mitigate the low processing fluency effect of information overload on auditor judgment.

Introduction

Government programs are financed by payments from taxpayers, and as a result, it is essential to assure that their funds are expended appropriately (Appelbaum et al., 2020, Mead, 2008). In fact, government auditors serve as one of the primary governance mechanisms to assure that taxpayers' dollars are not subject to fraud waste and abuse (Deloitte, 2011; Goodwin, 2004; Mead, 2001; Mead, 2002). There is even more scrutiny on holding governments accountable since the 2008 financial crisis (Kozlowski, Issa, & Appelbaum, 2018) from which many government entities continue to recover (WSJ, 2015). Accordingly, it is important to understand how government audits can be improved.

The advent of digitization of business processes and data analytics may be one avenue to achieve more efficient and effective monitoring of government expenditures (Appelbaum, Kogan, & Vasarhelyi, 2017; Gil-Garcia, Helbig, & Ojo, 2014). However, the advent of digitization has also led to the generation, capture, and storage of voluminous data. Large amounts of audit relevant information, including payment records from relational databases that are stored in near-real-time, make it challenging for auditors to process it. Specifically, while data analytics may improve government audits by identifying potentially anomalous expenditures in the population of payment records, auditors may encounter difficulties in the ease of processing such information, i.e., low processing fluency, due to the limited cognitive processing capabilities of humans (Brown-Liburd, Issa, & Lombardi, 2015; Rennekamp, 2012). Low processing fluency, as a result, may lead to suboptimal decisions (Murayama, Blake, Kerr, & Castel, 2016; Andiola, Brink, Lynch, & Ferguson, 2019).

To provide insights into the benefits of data analytics to government audits in a data-rich environment, it is important to consider ways that could increase the ease of information

processing and improve audit quality. Our study explores the following research question: how can the use of prioritization-based data analytics empower the auditor to overcome the challenge of information overload, consequently leading to higher quality audits of government expenditures? To answer this question, we adopt a case study approach that consists of a conceptual risk-based prioritization framework that aims to detect inappropriate government expenditures, hereafter referred to as 'exceptions' and subsequently illustrate its application using the procurement dataset of a U.S. county. More specifically, we use the setting of duplicate payments, as exceptions, to evaluate the framework's ability to improve audit efficiency and effectiveness.

The implementation of data analytics and the concept of continuous auditing (CA) systems, has the potential to improve audit efficiency¹ and assist in the timelier detection of exceptions (e.g., Alles, Brennan, Kogan, & Vasarhelyi, 2006; Alles, Kogan, & Vasarhelyi, 2008; Vasarhelyi & Halper, 1991), which may lead to more effective audits.² While useful, the main drawback of CA systems and other technology-based data analytic audit tools is that they can produce an overwhelming amount of exceptions, making it challenging for auditors to analyze (Alles et al., 2006; Alles et al., 2008; Debreceeny, Gray, Tham, Goh, & Tang, 2003; Perols & Murthy, 2012).

A couple of studies have proposed conceptual frameworks that can help auditors prioritize exceptions into varying levels of risk, such as riskier and less risky exceptions (Issa, 2013; Li et al., 2016). Issa (2013) proposes a conceptual framework that leverages risk-based criteria and expert elicitation to prioritize duplicate payments. Similarly, Li, Chan, & Kogan, 2016 propose a framework that leverages risk-based criteria and belief functions to prioritize them. However, the usability of these frameworks has not been applied to real datasets, and they are not clearly grounded in theory, i.e., the need to develop the research artifact to address the challenge of cognitive processing in a voluminous data environment. Hence, it is vital to explore the use of prioritization-based data analytics to enhance the ease to which auditors can process large volumes of payments.

Government audits present the optimal opportunity to explore the usability of a prioritization framework that could mitigate the adverse effect of information overload on auditor judgment. As a result, this case study proposes and applies an innovative data analytic technique to the procurement dataset of a U.S. county. Doing so could lead to not only more efficient but also more effective and higher quality audits since the use of the proposed analytic technique should improve judgments about inappropriate government expenditures.

Although our study is closely related to the Issa (2013) and Li et al., 2016 studies in that it proposes a risk-based prioritization framework to improve audit efficiency and

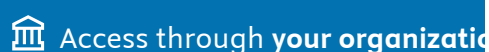
effectiveness, it more closely reflects the Issa (2013) framework while establishing several additional perspectives. Issa (2013) employs a weighting system derived from an expert panel, whereas Li et al., 2016 utilize belief functions for the prioritization of accounting records, which is not directly observable.³ As a result, the main drawback of the Li et al., 2016 framework is that it lacks interpretability (transparency) with respect to the derivation of the weights assigned to risk-based criteria. To facilitate the documentation of audit evidence, which is paramount in the conduct of audits, our study modifies and expands the Issa (2013) framework as it is the more interpretable approach. In particular, we expand on Issa (2013) by 1) modifying some of the existing criteria, 2) incorporating additional criteria, and 3) by applying it to a real dataset.⁴

This study examines the application of data analytics in the government sector. As such, it contributes to the government accounting literature by proposing a risk-based framework to improve the efficiency and effectiveness of audits of government expenditures. Moreover, the application of the proposed prioritization approach has the potential to mitigate the problem of information overload and low processing fluency that exposure to large datasets can create. Finally, this study suggests several promising research avenues that future studies can explore.

The remainder of this study is organized as follows. The next section presents a review of the literature related to internal audit and data analytics in the government sector. The third section describes the methodology. The fourth section presents the results of the application of the framework. The fifth section discusses the results. Finally, the last section concludes the paper and discusses its limitations as well as avenues for future research.

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Section snippets

Literature review

Since the 2008 financial crisis, constituents have demanded better accountability in regards to government reporting (Kozlowski et al., 2018). Therefore, it is vital for auditors in the public sector to provide high-quality audits. The integration of data analytics in various audit tasks has the potential to improve government audit efficiency and

effectiveness by detecting improper expenditure of government funds in a timelier manner while analyzing the entire population of records. However, ...

Duplicate payment prioritization framework

Fig. 1 illustrates the conceptual prioritization framework, which consists of three phases. In Phase 1, a rule-based system (comprising of a set of data analytics) performs the duplicate detection test by performing a 2-way match. In Phase 2, the identified duplicate instances are prioritized using risk-based criteria. Finally, in Phase 3, the prioritized instances are reviewed by the internal auditor to determine whether the model captures true duplicate payments. The latter are the duplicate ...

Results

This section reports the main findings of our analysis. The discussion and interpretation of these results will follow in Section 5. ...

Discussion

The risk-based prioritization framework can be used as an innovative approach to improve the efficiency and effectiveness of government audits. Consequently, this can help auditors better understand how taxpayer's funds are expended and mitigate the risk that taxpayer's funds are subject to fraud, abuse, and waste.

With respect to audit efficiency and effectiveness, it is clear that the framework can assist in reducing the number of records that would have to be investigated and yet be able to ...

Summary

This study is motivated by the digitization of business processes in the Now-Economy, which has led to a data-rich environment, and the increased demand for higher quality audits by constituents. Extant research calls for further examination of the impact of data analytics on audits in the public sector. In this paper, a risk-based prioritization framework is proposed to demonstrate the improvement that data analytics can bring to improve the quality of government audits including improvements ...

Declaration of Competing Interest

None. ...

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...Therefore, limited audit budgets and resources bring government audits under challenge, and there is a strong demand to adopt novel approaches to address these challenges in government audits. Although audit data analytics may be one path to achieve more efficient and effective monitoring of government spending, this is still a largely neglected area for research and applications, compared to the private sector (Appelbaum *et al.*, 2017; Rozario & Issa, 2020). Continuous audit and monitoring, as one example of audit data analytics, can assist in the timely detection of exceptions and anomalies (Vasarhelyi & Halper, 1991)....

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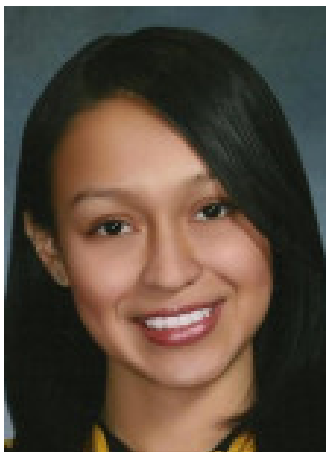
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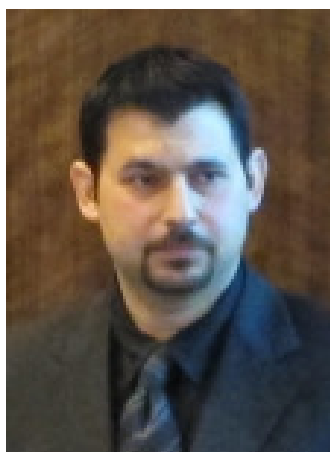
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Hussein Issa received his PhD in Accounting Information Systems from Rutgers University in October 2013. He led numerous research projects with banks, large multinational consumer products companies, a telecommunication company, one of the Big Ten university's internal audit department, among others. His research focused on the applications of artificial intelligence and machine learning to identify and prioritize exceptions (which was the topic of his dissertation "Exceptional Exceptions"). In these projects, Hussein developed various statistical and machine learning models to address business problems, such as fraud detection, outlier identification, pattern recognition, operational efficiency, customer profiling, continuous control monitoring of procurement systems, among others. Hussein has also recently taken interest in text mining and sentiment analysis. Hussein also serves on the dissertation committees of several PhD students. Hussein teaches/taught Advanced Design and Development of Information System (Masters in Accountancy in Governmental Accounting), Design and Development of Information System (Masters in Accountancy in Governmental Accounting), Information Technology in the Digital Era (Professional Accounting MBA), Introduction to Financial Accounting (Undergraduate). He also co-teaches a PhD level course discussing current topics in AIS Research. Hussein is fluent in Arabic, English, and French, and intermediate in Russian and Wolof (Senegalese dialect).

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