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DATA VISUALIZATION IN LOCAL ACCOUNTING FIRMS: IS SLOW TECHNOLOGY ADOPTION RATIONAL?

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ABSTRACT

We survey highly-experienced professionals from local accounting firms regarding the adoption of and perceived benefits from data visualization in audit practice. Although the majority of respondents have minimal experience with data visualization, local-firm partners have positive perceptions regarding the value that visualization can have on audit quality and client-related benefits. These perceptions are affected by visualization technology usage: perceived audit quality benefits increase with usage but client benefit perceptions decrease with usage. These results are consistent with competing models of technology adoption. In total, whether one labels a firm a ‘laggard’ or a ‘rational non-adopter’ of visualization technology appears to be driven by whether the firm seeks to adopt technology in order to improve audit quality or to add value for their clients.

Keywords: data visualization, audit quality, data analytics, local accounting firms

*appropriate human subjects approval was obtained.
1. INTRODUCTION

As big data hype continues to grow (Hampton and Stratopoulos 2016) and the benefits of data analytics in auditing are increasingly articulated (Boomer 2018; Farr 2018; Tysiac and Drew 2018), firms are experiencing increasing pressure to incorporate data analytics into their practices. Data visualization is a popular data analytics tool (AICPA 2017) that can allow auditors to better identify anomalies and trends in data. We survey local accounting firm partners regarding their current data visualization perceptions and practices. Local firms are particularly interesting to study in this context because they are prevalent in the audit market, important to the capital allocation process (because local firm audits enable many private companies to obtain financing), and likely differ from larger firms with respect to their technology environments (Janvrin, Bierstaker, and Lowe 2008). As such, general encouragement to use data visualization could affect how local firms conduct audits in unique and possibly unexpected ways. Aside from the fact that they ‘are different’ from larger firms (Lowe et al. 2018), little is known about the technology use and technology perceptions of local firms. Therefore, assessing the perceptions and the use of data visualization in local firms can inform academics, practitioners, and standard setters who are seeking insights from practice regarding the current state of data visualization in auditing (AICPA 2017; PCAOB 2017; IAASB 2018).

We consider the use and perceived benefits of data visualization by local firms in the context of competing models of technology diffusion. On one hand, the epidemic model largely assumes that a lack of information and/or ability inhibits some firms from adopting new technology (Geroski 2000; Stratopoulos 2016). Although the epidemic model is similar to various

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1 Esposito (2019) provides insight into the prevalence of small firms by noting only 100 of the approximately 14,000 multi-partner CPA firms in the United States have annual revenues of $40 million. Often, local firms are grouped with regional/medium-sized firms for analysis (e.g. Hampton and Stratopoulos 2016), in spite of the fact that local firms can differ from regional firms in their technology choices (Lowe et al. 2018).
theoretical explanations of technology adoption, Rogers’ (1995, 2003) categories of adopters (innovators, early adopters, early majority, late majority, and laggards) overlap with the epidemic model in casting a negative light on slow adopters. In contrast, the probit model of technology diffusion allows for the possibility that economic agents make different choices for rational reasons (Geroski 2000).² Simply put, for some firms, the best choice may be non-adoption of new technology. In other words, some firms may have “rational laggard” status.

We gather survey evidence from 31 partners (and one manager) at local accounting firms concerning their use of, and perceived benefit from, data visualization technology. Consistent with recent research (Lowe, Bierstaker, Janvrin, and Jenkins 2018), we find low usage rates of this ‘newer’ technology among local accounting firms. However, relative to Lowe et al. (2018), we note relatively favorable views regarding benefits that data visualization might offer local firms. Our key findings focus on the associations between visualization use and perceptions of audit quality and client benefits associated with visualization. From a technology adoption perspective, we find divergence between visualization usage and value perceptions. To explain, we find a positive correlation between visualization usage and perceived audit quality benefits from this technology which suggests that many local firms could be characterized as adoption “laggards” who have not yet obtained available value. In contrast, we find a negative association between visualization usage and the perceived benefit that this technology provides the client, which implies many local firms could be characterized as “rational laggards” in terms of technology adoption.

A more nuanced conclusion comes from open-ended survey responses and from post-survey discussions with practitioners indicating that the epidemic model (which postulates

² The probit model referenced here is a theoretical model of technology adoption, not the statistical regression model.
adoption “laggards”) may underestimate the decision complexity that local firms face regarding adopting and using data visualization. Specifically, considerations such as profitability and the efficiency of using these tools are especially important to local firms’ technology adoption decisions. In total, our supplemental qualitative evidence is that a lack of resources and/or ability (as outlined in the epidemic model) are not the only reasons local accounting firms do not use data visualization in their audits.

A key implication of our survey is that if local firms intend to use data visualization to provide clients with insights into business operations (as found in Austin, Carpenter, Christ, and Nielson 2019), these firms might be disappointed. Because local firms tend to service smaller and potentially less-complex clients, data visualization may not add value for these clients. In contrast, if local firms intend to use data visualization to benefit audit quality, our evidence suggests these firms will likely be pleased with an investment in technology. Overall, our evidence suggests that caution is warranted when adopting data analytic visualization technology because successful outcomes might depend on the strategic intent of the technology adoption.

Below, we briefly (1) describe data analytics and our choice of data visualization in our survey, (2) review prior research, (3) discuss our survey and results, and (4) conclude and highlight limitations (with emphasis on the fast changing nature of technology).

2. DATA ANALYTICS AND DATA VISUALIZATION

The AICPA (2019, 1) defines data analytics as “the science and art of discovering and analyzing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter of an audit through analysis, modeling, and visualization of planning or performing the audit” (AICPA 2017, 1). Given this broad definition,
we focus only on the data visualization component of the definition because it is the most frequently used form of data analytic technology among accounting professionals. Therefore, we are not examining all types of data analytics and informed participants that data visualization was our specific topic of investigation.

3. PRIOR RESEARCH

Given the emerging consensus that the expected payoffs from data analytics initiatives are substantial (Griffin and Wright 2015, 379), current research has examined various aspects of technology adoption within the accounting profession (e.g., Hampton and Stratopoulos 2016, Lowe et al. 2018, Austin et al. 2019, Brown-Liburd and Walker 2019). While each study cogently documents current technology adoption trends and factors, each is also consistent with the underlying assumption of the epidemic model of technology diffusion, that new technology is “better” and the reason for slow adoption is some form of constraint among non-adopters. For example, Hampton and Stratopoulos (2016, 23) conclude “that firms left behind during the current wave of audit data analytics implementations are more likely to see their situation deteriorate with each new wave of emerging technology”.

Research generally finds that large firms tend to adopt technology earlier than smaller firms (e.g., Geroski 2000). However, the important distinction to draw is whether slow technology adoption is a function of size-related limitations versus decision makers being persuaded that a

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3 Relative to other technological procedures that typically fall under the ‘data analytics’ umbrella (e.g., advanced statistical analysis, optimization, and text mining), the ‘visualization and descriptive statistics’ procedures are 2-to-3 times more common than alternative data analytic procedures among a large (n = 394) sample of Canadian accounting professionals (see Table 2 of Hampton and Stratopoulos 2016).

4 For our purposes, the epidemic model is equivalent to diffusion innovation theory (Lowe et al. 2018), Institution Theory (Brown-Liburd and Walker 2019) and socio-technical systems of innovation theory (Austin et al. 2019) in that all discuss constraints to eventual adoption of technology (e.g., “remove the constraints and all would adopt”).

5 See Geroski (2000), footnote 12 for a list of example articles and for a brief discussion of counter-examples where smaller firms adopt before larger firms.
new technology will provide firm-specific benefits. Casterella, Casterella, and Biswas (2019) provide an in-depth case study example of the latter possibility: a ‘low tech’ firm being both well aware of available new technology, yet being convinced that an investment in new technology would not add value in their business setting. To the extent that diffusion of technology is a process of persuasion rather than a simple process of being ‘informed and able to adopt’, the analogy to epidemics breaks down (Geroski 2000, 9) and the probit model, which assumes agents make different choices for rational reasons, becomes a natural way to interpret technology adoption (ibid, 603).

Recent studies focus on data analytics practices of larger firms (Brown-Liburd and Walker 2019; Austin et al. 2019), but these practices may differ from smaller firms. Hampton and Stratopoulous (2016) survey firms of all sizes about data visualization but do not report what is specifically learned about local firms. Lowe et al. (2018) also survey different firm sizes (in 2014) and find that local firms (n = 25) lag other accounting firms (regional, national, and Big 4) on IT use and the perceived importance of IT for audit procedures and client applications. They conclude that these results are consistent with diffusion theory (i.e., the epidemic model) but note that a lack of resources may not be driving their results because auditors from local firms may not perceive IT applications to be important to their business or their clients. Therefore, whether local firms are adoption laggards because of resource constraints or because of rational choice is an empirical question that we examine in this study.

While we expect local firms will have relatively low usage rates of data analytics technology, we also expect the ‘hype’ in recent years regarding the value of data analytics (Hampton and Stratopoulous 2016) might change the perceived benefits that local accounting firm personnel believe they could obtain from technology adoption. Variation in technology use,
coupled with an assessment of perceived benefits from technology adoption enables examination of why local firms are generally slow to adopt technology. Specifically, the decision not to use data visualization may be a reasoned, conscious choice given the business environment, or it may be due to resource constraints (e.g., knowledge, ability, or lack of “deep pockets” for investment). This distinction can offer useful insight to local accounting firms regarding future technology implementation, and to standards setters when developing guidance about data visualization use in audits (AICPA 2017; PCAOB 2017; IAASB 2018).

4. SURVEY AND RESULTS

Our survey explores auditors’ use and perceptions of data visualization in practice at local public accounting firms. The survey was administered during a 2019 data analytics conference primarily attended by partners from local accounting firms. Partners are the appropriate participants for our study, as they are the key decision makers of local firms. Potential respondents were asked to complete the survey, place it in a provided envelope, and return it to the researcher (a coauthor who was also a speaker at the conference). A research assistant transferred responses into Excel, and the data entry was reviewed for accuracy.

We received 34 responses; however, two were excluded because participants did not answer the majority of questions (both respondents wrote “not applicable” for all questions dealing with audits and audit clients). Of the 32 usable responses, 31 were from partners and one was from a manager. We note a broad range of industry specialization with construction and manufacturing mentioned most often (six each), followed by real estate (four participants). Eight respondents did

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6 One participant responded that they were a tax partner. In smaller firms, professionals often provide audit and tax services (given that they tend to service private clients and are not bound to the SEC independence rules), so our participants are knowledgeable of the data visualization practices in audit. Our results are unchanged if this participant is removed.
not identify an industry specialization. Almost all respondents’ clients are private companies (only three participants have publicly-traded clients).

Following work-related demographic questions (e.g., experience, rank and client type), we asked about the extent of data visualization use during different stages of the audit (i.e., planning and risk assessment, testing of controls, substantive procedures, and review procedures) on a 1-10 scale, where 1 = minimal/no use and 10 = extensive use of data visualization. The average standard deviation was .401 on these 10-point Likert scale questions. Given minimal within-subject variation, we analyze each respondent’s data visualization usage (henceforth, UseVisual) by averaging the four category scores.

Next, we asked participants about their perceptions of how data visualization could benefit or currently benefits their firm’s: audit quality; ability to identify audit risks; compliance with auditing standards; testing of client’s systems; ability to understand clients’ financial situations; judgments during the audit engagement; and audit documentation. These different considerations represent audit areas where regulators suggest data visualizations and technology could provide benefit (e.g., PCAOB 2017). Finally, we asked participants how data visualization could benefit or currently benefits their clients’ understanding of their financial situations and clients’ perceptions of the value added by the audit. We measured each of the preceding ‘benefit’ considerations on a 1-7 scale, where 1 = no benefit and 7 = significant benefit.

As with data visualization use, we find minimal within-subject variation for audit benefit questions (average standard deviations of .902) and for client benefit questions (average standard deviations of .343). In an untabulated factor analysis, we find that the responses to the audit benefits load onto one factor with an Eigenvalue of 4.807 and correlations of 0.648 or more exist between each audit question. Therefore, we construct a variable, BenefitAudit, based on the
average responses to the seven audit benefit questions. Untabulated factor analysis for the client benefit questions also reveals that responses load onto one factor with an Eigenvalue of 1.454 and correlation of 0.853. Therefore, we construct the variable BenefitClient, based on the average responses to client benefit questions.7

Table 1 displays visualization usage rates among our respondents’ firms. Specifically, 23 respondents reported minimal visualization use (a “1” on our scale), seven reported moderate visualization use (2 through 5 on our scale), and only two reported high visualization usage (above 5 on our scale).

[Insert Table 1 About Here]

Participants also responded to open-ended questions about who performs the visualization, the types of visualizations and software used, and challenges of using these tools on audits. At firms where data visualization is being used to some extent, we find in our open-ended responses that associates or seniors (16 firms), and managers (19 firms) are the primary personnel using the tool (these rates suggest ‘minimal use’ is distinct from ‘zero use’ of visualization). Visualization usage among lower-ranking employees is higher than use at more senior ranks (e.g., senior managers, directors, and partners each use visualization less often than lower-ranked personnel; p-values all less than 0.05). Only three respondents noted use of an internal data specialist.

Two additional observations about Table 1 are warranted. First, contrary to Lowe et al.’s 2014 sample (which reported muted perceived benefit from information technology), we observe relative enthusiasm about the value/potential value of data visualization. This is broadly consistent

7 We also analyzed each audit benefit and client benefit question rather than the aggregate variables, finding the perceived audit benefits from using visualization are driven by benefits to understanding the clients’ financial situation (p = 0.009), overall audit quality (0.054), and documentation (0.083); all other perceived audit benefits have p-values greater than 0.10. Further, the negative relationship between perceived client benefits and data visualization use is influenced by how data visualization affects client’s understanding of their financial situation (p = 0.021) versus perceptions of value added (p = 0.121).
with audit partners at local firms believing in the ‘hype’ of data analytics, although they use data visualization at relatively low rates. Second, we notice diverging relationships between visualization use and the perceived benefits of visualization: a positive relationship for audit quality benefit and a negative relationship for client benefit. To aid interpretation, we further explore these patterns using multiple regression.

Using BenefitAudit as our dependent variable, and controlling for visualization use, years of audit experience, and perceived client benefit, we verify that the patterns observed in Table 1 are significant at conventional levels. The results presented in Table 2 indicate that greater use of visualization tools is associated with enhanced perceptions of how this technology benefits audit quality (p < .04). We also note a significant association between perceived client benefits and perceived audit quality benefits, which is consistent with participants having ‘general benefit’ beliefs about the value of data visualization (p < .01).

[Insert Table 2 About Here]

Using open-ended survey questions, we asked participants about challenges or concerns they perceive in using data visualization tools. Respondents noted the following reasons in response: lack of authoritative guidance; learning how to earn a profit from using the tools; where efficiencies could be gained relative to the cost of implementing the tools. Other survey responses focus on in-house resources (e.g., time and expertise; consistent with the epidemic model documented in other research) and being able to gather reliable data from client systems. Local firms’ clients tend to be less sophisticated than clients of larger firms. As such, data extraction can be challenging and there may not be a significant need for data visualization (e.g., these clients may have many manual processes; may not have a significant volume of transactions to analyze; and/or the audit already involves significant substantive procedures). To supplement our survey
results, we spoke to three partners from local firms who did not participate in the survey. The partners echoed similar reasons for limited data visualization use at their firms (e.g., difficulty in making new technology profitable and lack of client sophistication). While some of the preceding comments (e.g. lack of resources) are consistent with the epidemic model, other comments reinforce the idea that local firms are potentially rational non-adopters. That is, the benefits of data visualization may not outweigh the costs to effectively and efficiently use these tools in audit contexts in all situations that local firms face.

We next examine the association between visualization use and perceived client benefits. Using BenefitClient as our dependent variable, and controlling for visualization use, years of audit experience, and perceived audit benefit, we verify that the negative relationship between visualization use and perceived client benefit observed in Table 1 is significant at conventional levels. Table 3 provides evidence that respondents’ greater use of visualization is associated with less perceived benefit to audit clients (p = .03). We again note a significant association between perceived client benefits and perceived audit quality benefits, which is consistent with participants having ‘general benefit’ beliefs about the value of data visualization (p < .01).

Unlike audit benefits, when considering client benefits, the slow adoption of visualization technology at local firms fits the description of the probit model’s rational laggard. Specifically, local firm partners see less benefit to clients as they gain more experience with data visualization software. Therefore, to the extent that non-adopters have thoughtfully considered the business implications of visualization, from a client benefit perspective, it seems rational to be a data visualization ‘laggard’.

CONCLUSION
In spite of the prevalence of local accounting firms, little is known about the current usage and perceptions of information technology in these firms aside from the fact that they ‘are different’ from larger firms (Lowe et al. 2018). Our study provides evidence about the use and value perceptions that local accounting firm partners have about data visualization technology - circa 2019 - using competing technology adoption frameworks. Similar to prior studies, we document relatively low usage rates of information technology in local firms; however, unlike prior studies, we find relatively positive perceptions of the benefits technology could/does have for both audit quality and clients. Our survey responses suggest a positive relationship between visualization use and perceived audit quality benefits, but a negative relationship between use and perceived client benefits. On the surface, this suggests that if a firm seeks to adopt visualization technology to improve audit quality they will be pleased and if they seek to adopt visualization to add value for their clients they will be disappointed. While we feel comfortable concluding that “not adopting new technology” can be a wise decision for local firms in many situations, we caution readers against blanket conclusions based on our survey evidence for reasons discussed below.

First and foremost, the information environment in accounting firms is rapidly changing. Although a number of qualitative responses from practitioners suggest that resource constraints are the reason for slow visualization adoption (consistent with the epidemic model of technology adoption), a number of local partners said that visualization was not widely used in their firm for reasons that do not clearly distinguish between the epidemic and probit technology adoption models that we considered (e.g., “uncertain how to earn a profit from using visualization”; “uncertain where efficiencies could be gained relative to the cost of implementing visualization”). One limitation of our data is that we did not specifically gauge how deeply local firms considered
these issues (to the extent much/little examination of these statements occurred, the probit/epidemic model would be better supported). As time progresses, knowledge of how and when to use visualization (and, likely all data analytic technologies) will evolve rapidly, adoption costs will likely decrease, and the cost/benefit calculus that local firms face will certainly change. Although data visualization is likely to benefit audit clients in the long term; our evidence suggests – in the short term – having a clear idea of how this technology will benefit clients is essential.

In addition, we emphasize that our study is based on a limited sample of local firm partners and we assess value perceptions (rather than value outcomes) which may affect the generalizability of our results. Future research could build on our findings by examining actual outcomes (e.g., client savings, audit efficiencies) and by surveying clients about perceived benefits of their auditor using data visualization (or other data analytic) techniques. Nevertheless, given the prevalence of local firms, we believe our results provide important insights for this understudied segment of the audit market.

Practitioners, standard setters and academics must all better understand the reasons for slow technology adoption at local firms. Practitioners are undoubtedly interested in the tools and procedures other members of the profession are using when serving clients. Standard setters should consider all constituents when considering guidance and/or regulation concerning the use of data visualization and data analytics in audits. Finally, as they seek to integrate data analytics into the accounting curriculum, many members of the academic community would likely be interested in data analytics practices across the wide range of firms that hire our graduates. In the long run, new hires at local accounting firms may be the driving force in terms of identifying audit and client efficiencies that are possible by incorporating visualization practices into the audit.
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### TABLE 1

Perceived Benefits to the Audit Engagement and to the Client by Visualization Use

| UseVisual | BenefitAudit | BenefitClient |
|-----------|--------------|---------------|
| Low 23    | 1.022        | 4.383         | 5.298         |
| Moderate 7 | 2.571        | 4.776         | 5.143         |
| High 2    | 8.250        | 5.286         | 3.750         |

**Table notes:**

As noted in the text, we note minimal within-subject variation regarding the use of data visualization during different stages of the audit engagement and in the perceived benefits to the audit engagement and client. So, we average each participant’s response to create the following variables:

- **UseVisual** = measured as the average response of data visualization during each of the four audit phases on a 1 to 10 scale, where 1 = minimal/no use and 10 = extensive use of data visualization.

- **BenefitAudit** = measured as the average of each participant’s response to how data visualization could benefit or currently benefits their firm’s: audit quality; ability to identify audit risks; compliance with auditing standards; testing of client’s systems; ability to understand clients’ financial situations; judgments during the audit engagement; and audit documentation. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.

- **BenefitClient** = measured as the average of each participant’s response to how data visualization could benefit or currently benefits their clients’ understanding of their financial situation and clients’ perception of the value added by the audit. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.

Based on the extent of visualization use, we grouped responses into a minimal usage of visualization (a “1” on our scale), seven firms reported moderate use of visualization (2 through 5 on our scale), and only two firms reported high visualization usage (above 5 on our scale).
**TABLE 2**

| BenefitAudit | Unstandardized Coefficient | t-stat  |
|--------------|---------------------------|---------|
| UseVisual    | 0.276                     | 2.187** |
| YearsExperience | -0.009                 | -0.430  |
| BenefitClient | 0.616                     | 4.286***|

$R^2$ = 37.7%

Table notes:

Two-tailed significance is noted by ***, **, and * for 1%, 5%, and 10%, respectively.

$BenefitAudit$ = dependent variable measured as the average of each participant’s response to how data visualization could benefit or currently benefits their firm’s: audit quality; ability to identify audit risks; compliance with auditing standards; testing of client’s systems; ability to understand clients’ financial situations; judgments during the audit engagement; and audit documentation. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.

$UseVisual$ = test variable measured as the average response of data visualization during each of the four audit phases on a 1 to 10 scale, where 1 = minimal/no use and 10 = extensive use of data visualization.

$YearsExperience$ = control variable for the number of years of experience reported by each participant

$BenefitClient$ = control variable measured as the average of each participant’s response to how data visualization could benefit or currently benefits their clients’ understanding of their financial situation and clients’ perception of the value added by the audit. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.
TABLE 3

| BenefitClient | Unstandardized Coefficient | t-stat |
|---------------|-----------------------------|--------|
| UseVisual     | -0.302                      | -2.285** |
| YearsExperience | 0.007                     | 0.346 |
| BenefitAudit  | 0.687                      | 4.286*** |

R² = 38.8%

Table notes:

Two-tailed significance is noted by ***, **, and * for 1%, 5%, and 10%, respectively.

BenefitClient = dependent variable measured as the average of each participant’s response to how data visualization could benefit or currently benefits their clients’ understanding of their financial situation and clients’ perception of the value added by the audit. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.

UseVisual = test variable measured as the average response of data visualization during each of the four audit phases on a 1 to 10 scale, where 1 = minimal/no use and 10 = extensive use of data visualization.

YearsExperience = control variable for the number of years of experience reported by each participant.

BenefitAudit = control variable measured as the average of each participant’s response to how data visualization could benefit or currently benefits their firm’s: audit quality; ability to identify audit risks; compliance with auditing standards; testing of client’s systems; ability to understand clients’ financial situations; judgments during the audit engagement; and audit documentation. The perceived benefit was measured on a 7-point Likert scale, where 1 = no benefit and 7 = significant benefit.