

Elections and earnings management: Further evidence from Benford's law

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Abstract

Purpose: This study re-examines the extent to which municipally-owned entities (MOEs) engage in earnings management around the time of local elections.

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Design/methodology/approach: The study analyses the total revenue figures for 506 unlisted Italian MOEs from 2009 to 2014 using Benford's law to detect signs of low data quality or manipulated numbers in financial statements.

Findings: The findings reveal that entities owned by local governments engage in earnings management practices during pre-electoral seasons, which is consistent with the political cost hypothesis. Accounting numbers are rounded to the closest key cognitive reference point by overusing and underusing specific revenue digits. This aligns with the performance expectations hypothesis as well.

Originality/value: This study adds evidence to the existing issue of earnings management in the public sector during elections by using a less conventional approach, highlighting the need for increased transparency in financial reporting before these critical periods.

Practical implications: Auditors, forensic accountants, and judicial bodies that endeavour to protect public finances can also employ Benford's law to scrutinise the financial statements of hybrid entities at such times.

Keywords: Benford's law, cosmetic earnings management, forensic accounting, local elections, municipally-owned entities, public sector accounting

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1. Introduction and research objectives

Numerous research areas are experiencing replication crises because most studies cannot be replicated or are the consequence of too many variables being tested in many ways. These include psychology, experimental economics, management, and more recently financial economics (Jensen et al., 2023). However, replication studies have the potential to either validate or extend prior findings, opening the door to fresh, fruitful discussions on certain topics of greater interest to the public and research community. To respond to this credibility crisis and to the call for papers on this specific issue, our paper expands the findings of previous consolidated accounting literature by re-examining the issue of earnings management in public sector entities driven by electoral environments. In particular, this paper tests the political cost hypothesis of Watts and Zimmerman (1978, 1986) and Jones (1991) by re-examining the research question of the seminal work by Ramanna and Roychowdhury (2010), which first tested the hypothesis in an electoral context. To put it another way, this paper re-examines the question of whether

politically-connected firms, which constitute a unique setting full of incentives to investigate, manage their earnings during pre-electoral seasons.

More specifically, Capalbo and Menale (2020) highlight the importance of a distinctive framework within the landscape of Italian businesses which requires particular attention. This framework refers to businesses with substantial state involvement, characterised by complex control structures distributed across various government levels. These entities are often categorised under the umbrella of State capitalism and commonly referred to as State-owned enterprises (SOEs), they traditionally occupy pivotal positions in the national economy. In recent times, a profusion of organisations instituted by local government administrations has emerged as well. However, a substantial portion of these entities has exhibited a notable lack of independent market viability, frequently operating as mere extensions of the parent administration. They have demonstrated a persistent tendency to accumulate financial losses, ultimately facing insolvency (Capalbo & Menale, 2020). In this context, our research endeavours to assess the quality of earnings in Italian Municipally-Owned Entities (MOEs).

Earnings management, intended as the strategic exercise, with or without restrictions, of the discretion granted to managers over accounting numbers (Watts & Zimmerman, 1986), is one of the most frequently investigated issues in accounting literature. Although this phenomenon has been thoroughly examined in privately-owned companies, Bisogno and Donatella (2021) propose that, more recently, it has gained growing consequence within the public sector. According to Capalbo et al. (2024), it is crucial to address this, as earnings management practices pose a significant threat to transparency within the public sector, which we argue can ultimately damage the citizen and wider society. It is, therefore, of utmost importance to tackle the issue of earnings management in public-sector entities. The aim of this paper is to fill the gap that has been identified in existing literature by specifically re-examining the study by Capalbo et al. (2021). The authors do this by using the same public-sector setting, data, and time period but applying a different, less conventional empirical approach to identify potential indicators of accounting data manipulation within this distinctive organisational context¹. This enables boundary conditions to be created for results that are robust with a particular statistical technique, suggesting new areas of research to harmonize findings across a specific setting, namely MOEs.

¹ For a detailed literature review on elections and earnings management in MOEs and the hypotheses development see Capalbo et al. (2021).

A significant amount of research has focused on detecting earnings management by estimating normal accruals that are not publicly observable (*e.g.*, Dechow et al., 1995; Jones, 1991). However, in the past three decades, there has been a notable shift towards examining the distribution of accounting numbers to evaluate managerial influence on reported earnings. Two parallel streams of research have emerged to address the potential noise in accruals estimation. One approach examines digit patterns in financial statements to investigate managers' incentives in avoiding losses, earnings declines, or falling short of market expectations (*e.g.*, Das & Zhang, 2003). The other approach considers the perspectives of valuation (Carslaw, 1998) and contracting incentives (Thomas, 1989), assuming that managers engage in rounding up behaviour when reported earnings are slightly below key cognitive reference points.

However, even this body of literature examining 'cosmetic² earnings management' (hereafter CEM) with the use of Benford's (1938) law focuses mostly on privately-owned listed firms. This includes studies examining listed companies in New Zealand (Carslaw, 1988), the USA (Guan et al., 2006; Thomas, 1989), the UK (Van Ganeghem, 2002-2004), Finland (Niskanen & Keloharju, 2000), Japan (Skousen et al., 2004), Taiwan (Lin & Wu, 2014), Korea (Lacina et al., 2018), Romania (Istrate, 2019), Germany (Lebert et al., 2021), and even in 18 different countries (Kinnunen & Koskela, 2003). The purpose of this paper, however, is not to evaluate the merits of Benford's law for the detection of manipulated accounting data *per se*, but rather to revisit the issue examined by Capalbo et al. (2021) through the application of this emerging approach in a public sector setting. We choose this approach for two main reasons: i) it has the advantage of not needing robust econometric identification or stringent statistical modelling assumptions; and ii) it is free of other influencing factors³. This paper therefore contributes to prior research on CEM by extending the use of Benford's law as an analytical procedure to spot anomalies in accounting numbers to a public sector context, specifically to entities owned by local governments. Moreover, it amplifies the stream of literature mentioned above by also analysing unlisted companies.

To establish the efficacy of Benford's law in identifying potential accounting data manipulation within the realm of public sector organisations,

² The word 'cosmetic' has been used by the extant literature (*i.e.*, Guan et al., 2006; Kinnunen & Koskela, 2003; Lacina et al., 2018; Lebert et al., 2021; Lin & Wu, 2014; and Niskanen & Keloharju, 2000) to describe the type of earnings management detected by the specific Benford's law-based approach, namely the rounding behaviours described by Carslaw (1988), Thomas (1989), and Van Caneghem (2004), among others.

³ Other confounding effects would actually increase the probability that a dataset conforms to the law so that any different force would not steer the results of earnings manipulation.

this study uses the unique dataset from Capalbo et al. (2021), focusing on Italian MOEs. In doing so, it delves into the political dimension inherent in the ownership structure of these firms and examines whether the financial statements of MOEs serve as a conduit for local incumbents to capture public attention. Specifically, the data are gathered to provide evidence of political connections in state ownership by documenting a positive relationship between MOEs' earnings management activities and elections. The results do indeed provide evidence consistent with the political cost hypothesis of Watts and Zimmerman (1978), which also corroborate the findings of Capalbo et al. (2021): managers of Italian MOEs manipulate their financial statements which refer to the year before a local election as a consequence of the rising political cost. This implies that, during such delicate periods, the managers of those entities might engage in earnings management activities as they perceive pressure from incumbent politicians who wish to improve the economic performance of MOEs in order to alter voters' perception of their governing efficiency. In particular, the findings of this study show a statistically significant overuse and underuse of certain total revenue digits in financial statements drawn up during pre-electoral periods. Managers of MOEs seem not to like using revenue numbers starting with 59 and 99 during election years. This evidence is consistent with the proposition made by Carslaw (1988) that those in charge of preparing financial statements round numbers off to the closest cognitive reference point in order to meet some performance expectation due to the pressure exerted on management executives. This study, therefore, ultimately aims to provide further evidence to demonstrate the relationship between accounting figures and political processes, and extends the work of Capalbo et al. (2021) by shedding additional light on the nature of the upward earnings management practices evident in the financial statements of MOEs in electoral seasons.

This paper is of interest for several other reasons. Firstly, the authors intend to contribute to prior research examining CEM through a Benford's law-based analysis (see, *e.g.*, Das & Zhang 2003; Guan et al., 2006; Kinnunen & Koskela, 2003; Skousen et al., 2004; and Van Ganeghem, 2002) by investigating a new dimension, namely the public sector context, and, more specifically, the case of local government-owned entities. In contrast with Capalbo et al. (2023a, 2023b) who use Chi-squared tests on the first digit of MOEs' pre-tax and net income numbers, this study runs different statistical tests on the first two digits of MOEs' total revenue numbers, enabling inference of whether, why, and around which numbers, managers engage in accounting data manipulation. Secondly it extends previous works on the impact of elections on earnings management in MOEs (*e.g.*, Capalbo et al., 2021; Capalbo

et al., 2023a) as it provides further evidence of cosmetic data manipulation during pre-electoral periods by documenting which accounting numbers are likely to be refined. Thirdly, unlike the bulk of the previous studies mentioned above, conducted on privately-owned companies, this paper uses total revenues as a control variable to infer the discretion used over managed earnings, which is in line with the Stubben's (2010) model. Furthermore, this paper contributes to the growing trend for interdisciplinary research in accounting studies (Avallone et al., 2022) by providing a quantitative approach that can easily be used when dealing with large datasets – the so-called 'Big Data' (Gabrielli et al., 2022).

Lastly, this paper carries important implications. In the context of certain social environments, such as local elections, there are incentives to make the financial performance of MOEs look better. This phenomenon is related to political costs, and such costs translate into pressure on management, which in turn exacerbates accounting numbers following well-documented psychological behaviour. Particular attention has to be paid in auditing such accounts, especially in terms of analysing rounded-off numbers, so as to avoid any threats to public finances, and to public attention being deviated in electoral decisions. Consequently, auditors of public finances are encouraged to adopt and therefore apply the interdisciplinary approach used in this study to scrutinise financial reporting of entities owned by governments during such socially delicate periods like elections.

The remainder of the paper proceeds as follows. Section 2 provides a background to the literature on Benford's law. Section 3 describes the data and section 4 the empirical method adopted. Section 5 provides a discussion of the major findings. The final section concludes with future research avenues.

2. Research background on Benford's Law

2.1. Benford's Law: A background

“People always find the law to be interesting because we like learning secrets and the fact that there is some underlying order to what seems like chaos is like discovering a secret code” (Nigrini, 2012, p. 313).

The first significant digit of a number is commonly intended as the left-most non-zero digit. Regardless of the length of the number, the digits 1, 2, 3, ..., and 9 all consistently appear with different probabilities when considering almost all the natural numbers that exist in real-world events. This is in

contrast with the common thought that a digit is equally likely to be observed first in a numeric element (exactly $1/9$ of the time with hence a probability of 11.11%). The first person to raise the question of whether the first significant digit of numbers that generally occur in nature might follow a non-trivial or random distribution pattern was the Scottish astronomer and mathematician Simon Newcomb (see Newcomb, 1881), although the law passed into history 57 years later and was named after the American electrical engineer and physicist Frank Benford (see Benford, 1938).

Newcomb (1881, pp. 39-40) questioned how often a digit could emerge first in natural numbers by noticing an unusual pattern in one of his daily routines:

“That the ten digits do not occur with equal frequency must be evident to any one making much use of logarithmic tables, and noticing how much faster the first pages wear out than the last ones. The first significant figure is oftener 1 than any other digit, and the frequency diminishes up to 9 . . . The law of probability of the occurrence of numbers is such that all mantissæ of their logarithms are equally probable”.

The mantissa, which refers to the fractional part of a logarithm, should not be conflated with leading digits, as their probability of occurrence follows an evenly distributed pattern. In his seminal note, Newcomb (1881) draws up a table of the probability distribution of the first two significant digits. Interestingly, at the time he may not have fully comprehended the myriad applications that his discovery would eventually find in diverse fields such as statistics, economics, physics, medicine, engineering, computer science analytics, and, most notably, forensic accounting.

Benford (1938), on the other hand, was a pioneer in offering empirical evidence of the ‘anomalous number’ law. Drawing inspiration from the peculiar observation made by Newcomb regarding the attrition of pages in logarithmic tables, Benford (1938) assembles a diverse and extensive dataset comprising information from twenty different and unrelated sources. These sources include data on various subjects such as river lengths, n^{-1} , \sqrt{n} , $n!$, newspaper items, death rates, and population figures, encompassing approximately 20,000 first digits. He proceeds to calculate the mean digit occurrence probability by deriving the expected frequency of first significant digits from the probability function $P(X = x_i)$ within the context of the logarithmic relationship:

$$P(X_1 = a) = \log_{10} \left(\frac{a+1}{a} \right); \quad a \in \{1, 2, \dots, 9\} \quad (i)$$

$$P(X_2 = b) = \sum_{a=1}^9 \log_{10} \left(\frac{ab+1}{ab} \right); \quad b \in \{0,1, \dots, 9\} \quad (\text{ii})$$

where X_1 and X_2 are the first and second position of the digits a and b respectively. Benford (1938) then computes the probability function for a digit to occur in the q^{th} position. In subsequent years, the literature on the forensic accounting applications of Benford's law further developed by deriving a logarithmic equation for the probability occurrence of the first two digits (where the digits $\in \{10, 11, \dots, 99\}$). This logarithmic equation, built upon functions 1 and 2, is considered a more reliable foundation for analysing accounting datasets.

In summary, Benford's law is a mathematical phenomenon that aids the detection of white-collar crimes, particularly when it involves manipulated financial statements⁴. This is achieved through an analytical procedure that identifies anomalies in certain digit patterns. According to Benford's law, the leading digit of real-world numerical data follows a precise logarithmic distribution which is not random. As we describe further in the following sections, accounting datasets have been proven to be a setting in which Benford's law is considered the norm (Nigrini, 2012). Therefore, the distribution of the leading digits in financial statement numbers is expected to obey the law, and so any significant deviations are taken as manifestations of low data quality or symptoms of possible data manipulations. Forensic accountants, auditors, and even legal authorities responsible for safeguarding public financial integrity can utilize Benford's law as a valuable analytical tool to uncover processing inefficiencies, manipulative biases, or potential fraud.

2.2. Forensic accounting applications of Benford's Law

The first documented use of Benford's law in accounting was by Carslaw (1988), who explored a hypothesis rooted in human psychological behaviour. He suggested that individuals, including accountants and managers, might round numbers up or down to the nearest cognitive reference point due to

⁴ We acknowledge the blurred line between earnings management and accounting fraud, given that manipulating digits seems closer to the latter than the former. However, the extant literature has consistently defined the practice detected by Benford's law as cosmetic earnings management. In line with prior research, we see Benford's law as a tool to investigate the quality of accounting data and, therefore, we limit our inference to signs of low-quality data in firms' reported earnings.

pressure to meet performance expectations. This behaviour, he argued, is motivated by the potential rewards associated with surpassing key benchmarks. In the context of accounting, this often leads interpreters of financial statements and budget setters to round estimates up to exceed these performance targets. To test this hypothesis, Carslaw analysed a sample of 220 major companies listed on the New Zealand Stock Exchange. His findings revealed an unusual distribution in the 'second-from-the-left' digits of ordinary and net income figures, with a noticeable scarcity of 9s and an excess of 0s. This skewed pattern supports his hypothesis that individuals tend to round up income figures just above certain psychological thresholds.

A year later, Thomas (1989) conducted a study that revealed similarly unusual patterns in net income data and earnings per share (EPS) figures of companies listed on U.S. stock exchanges. He argued that financial statement interpreters are influenced by incentive rewards linked to a company's stock price trajectory. As a result, even slight rounding-up of earnings figures can significantly boost the company's stock price and valuation, which in turn can greatly impact a manager's compensation and contract terms. Building on Carslaw's (1988) findings, Thomas proposed that income figures in managerial contracts, budgets, and compensation structures are often rounded to whole numbers. His research provided empirical evidence of an excessive occurrence of second-digit 0s in positive earnings and second-digit 9s in negative earnings, along with an overrepresentation of EPS figures ending in 5s and 0s. These findings suggest that managers tend to round off income numbers strategically due to their influence on stock prices and managerial compensation.

Further support for applying Benford's law to accounting data comes from Christian and Gupta (1993). They analysed cross-sectional data and uncovered secondary tax evasion among U.S. taxpayers, where individuals strategically reduced their taxable incomes to just below government thresholds. These thresholds were meant to clarify tax calculations, not to facilitate avoidance. Christian and Gupta linked this behaviour to various tax policy variables using regression models, demonstrating persistence over time across different tax brackets. In the same year, Nigrini (1993) made significant contributions to forensic accounting by applying Benford's law to accounting datasets. Building on his earlier work, Nigrini developed a new method for assessing taxpayer compliance, which could be used by revenue agencies. His research laid the groundwork for future forensic accounting studies that utilize Benford's law as a tool for detecting anomalies and irregularities in financial data.

A well-known study applying Benford's law to forensic accounting is Nigrini's (1996) work. Nigrini aimed to detect tax evasion fraud by introducing

a goodness-of-fit test against Benford's law, using the first large dataset analysed in this context. He differentiated between planned and unplanned evasion, and introduced a distortion factor to model digit distribution patterns. This approach helped identify whether tax returns were manipulated upwards or downwards. Nigrini's findings revealed a significant prevalence of low digits in interest-received amounts, indicating an understatement of these items, and an excessive occurrence of higher digits in paid interest, suggesting an overstatement. These results pointed to a tendency among low-income U.S. taxpayers to overtly manipulate taxable incomes, while high-income individuals might use more sophisticated methods to conceal tax fraud.

Nigrini and Mittermaier (1997) examined the use of Benford's law as a tool for internal and external auditors during the planning stages of an audit to evaluate the reliability of accounting data. Their study introduced various digit and numerical tests based on Benford's algorithm, which proved effective in detecting issues like underestimated debts, overvalued inventories, revenue overestimations, and expense under-accruals. By comparing the actual frequency of each digit with the expected distribution, auditors could identify biases or irregularities, helping to assess the legitimacy of the data being audited.

Busta and Weinberg (1998) introduced a novel application of Benford's law by training an artificial neural network model with 800 datasets of 200 two-digit numbers to predict deviations from Benford's digit distribution. This innovation significantly advanced digital analysis in the 1990s. Benford's law gained further recognition when Nigrini (1999) published an article in the *Journal of Accountancy*, offering technical guidance for Certified Public Accountants (CPAs) to detect irregularities. As a result, a mathematical concept originally embraced by accounting researchers evolved into a widely-accepted tool for assessing the accuracy of tabulated accounting data, becoming a valuable resource for professional auditors and accountants (Nigrini, 2020).

Another influential study in the field of forensic accounting that utilizes Benford's law is by Durtshi, Hillison, and Pacini (2004). They proposed a more refined approach to the application of the law in auditing, they provided guidance on interpreting results from digital analysis tests and emphasised areas where caution is necessary. Durtshi et al. (2004) acknowledged that academic literature has been cautious about asserting the effectiveness of Benford's law-based procedures in detecting fraud. They pointed out that a dataset failing to conform to Benford's law might signal operating inefficiencies or system flaws rather than fraud. However, they also recognised that, when applied correctly, a Benford's law-based approach could be a valuable tool for identifying suspicious accounts that warrant further investigation.

2.3. Cosmetic earnings management

Benford's law has been used extensively in forensic accounting literature, particularly in the detection of CEM. Van Caneghem's (2002) study builds on Carslaw's (1988) work by showing how managers of U.K. listed companies often engage in "rounding-up behaviour" when reporting pre-tax income. Specifically, they tend to increase the first digit by one when a nine appears in the second-from-the-left position. Das and Zhang (2003) further explore this rounding-up process, focusing on reported earnings per share (EPS). Their research extends Thomas's (1989) findings in two ways: by providing additional evidence and analysing the digit immediately to the right of the decimal place for EPS calculated in cents, and by identifying unusual earnings patterns that are more likely to occur in firms with higher working capital accruals. This rounding behaviour is seen as a strategy for managers to boost reported profits.

Skousen, Guan, and Wetzel (2004) conducted a noteworthy study that extends previous research on detecting earnings management in several significant ways. They tackle two unresolved issues: first, the idea that financial statement users may focus on more than just the first digit of reported earnings, and second, how managers' incentives are linked to the proximity to key cognitive reference points. Skousen et al. (2004, p. 215) also argue that "if the benefits of rounding do not justify the costs of earnings manipulation, management may decide not to report round earnings". Their research presents extensive evidence that managers round earnings numbers not only to achieve key reference points but that they also manipulate the second, third, and even fourth digits to reach these targets.

A notable case study in the field of earnings overstatements within forensic accounting literature is Nigrini's 2005 work. His study examines the financial thresholds of the Enron Corporation leading up to its bankruptcy, spanning the period before this event and the subsequent conviction of Arthur Andersen for obstruction of justice. By applying Benford's law, Nigrini (2005) identifies manipulated revenue numbers, specifically the overuse of second-digit 0s, which were altered to avoid reporting losses, exceeding the expected frequency. This era, highlighted by the Enron-Andersen scandal and the enactment of the 2002 Sarbanes-Oxley Act, was also analysed in other studies to evaluate its effect on earnings quality (see Guan et al., 2006; Johnson, 2009).

Another significant study in this field is the work of Lin and Wu (2014), who analysed 84,870 observations of positive earnings from publicly listed companies in the U.S. and Taiwan. Their goal was to determine whether

CEM also occurs in emerging markets. They found that managers in emerging markets often have stronger incentives to manipulate earnings, raising concerns for smaller contexts, such as unlisted companies. Building on this research, more recent studies have identified persistent unusual patterns in reported earnings across various international contexts, including during the Korean financial reforms (Lacina et al., 2018), among Romanian listed companies (Istrate, 2019), and within German firms (Lebert et al., 2021).

3. Data description

The dataset employed for this empirical analysis is derived from the research conducted by Capalbo et al. (2021) and is sourced from the AIDA database (*Analisi Informatizzata delle Aziende Italiane*). This unique dataset encompasses a range of financial information, including balance sheet items, the municipality's name (representing the location of the state-owned firms), the identification code for the MOEs, as well as the precise day, month, and year of local municipality elections. However, this study narrows its focus to the total revenue figures, in alignment with the approach outlined by Stubben (2010). Specifically, it concentrates on firms where a single municipality holds more than 50% of the total shares. This scenario denotes a considerable level of control vested in the municipality, as elucidated by Capalbo et al. (2021): when a municipality commands a majority in the shareholders' meeting, both the capacity of incumbents to influence the accounting decisions made by the managers of MOEs and the potential for political costs are likely to intensify.

The Italian MOEs under consideration primarily operate within the utility sector, namely public transport, provision of gas, water and electricity, and environmental hygiene. This choice mirrors the expectation articulated by Capalbo et al. (2021) that within these sectors, a greater political dimension is at play in terms of visibility and relevance to the stakeholders, particularly the voters and users of these services. Considering a period of five years covering the interval from 2009 to 2014, the final panel sample comprises a comprehensive dataset of 3,036 individual observations. These observations pertain to 506 municipally-owned utilities. Moreover, this dataset encompasses a total of eight distinct election dates, two elections per entity on average, spanning time intervals between 2010 and 2015⁵. Consistent with Capalbo et al. (2021), the definition of 'election year financial statements' is

⁵ For further information, description, and visualisation regarding the sample selection, elections, municipalities, and dates data see Capalbo et al. (2021).

established as financial statements that are published in the same year as the municipal election occurs and refer to the preceding calendar year.

Table 1 – Descriptive statistics of MOEs' total revenues

	Overall Sample	Non-Elections Sample	Elections Sample
Minimum	€ 1,618	€ 1,618	€ 11,910
1st Quartile	€ 1,161,000	€ 1,155,000	€ 1,260,000
Median	€ 3,140,000	€ 3,048,000	€ 3,562,000
Mean	€ 16,160,000	€ 16,060,000	€ 16,680,000
3rd Quartile	€ 9,669,000	€ 9,625,000	€ 10,310,000
Maximum	€ 1,115,000,000	€ 1,115,000,000	€ 1,043,000,000
Standard Deviation	€ 69,792,671	€ 69,264,253	€ 72,547,094
Skewness	€ 10.75	€ 10.82	€ 10.39
Kurtosis	€ 133.85	€ 136.17	€ 122.41
No. of observations	3,036	2,546	490

Table 1 illustrates the descriptive statistics of the total revenue amounts of the MOEs analysed in this paper. The overall sample is also divided into election-related and non-election-related samples, which comprise, respectively, the firms facing election dates and the same firms during normal periods. The samples appear to be roughly balanced in terms of total revenue amounts. Lastly, the results in this paper have been obtained using the R statistical software version 3.6.3 (see R Core Team, 2023), and the “benford.analysis” R package, version 0.1.5 (see Cinelli, 2018).

4. Research methodology

The assessment process of the Benford's law-based approach may appear straightforward initially. However, complexities arise when considering statistical tests. Indeed, a perfect correlation between the statistical null hypothesis, indicating conformity to Benford, and the practical null hypothesis of accurate financial statement numbers is elusive. This disparity exists because adherence to Benford's law does not guarantee the absence of anomalies or material errors in the data analysed (Nigrini, 2020). As argued by Nigrini (2020), nonconformity to Benford serves as an indicator of potential errors, stemming from four possible factors: (i) the data might not be expected to conform to Benford's law; (ii) other influencing factors could lead to abnormal repetition of the first two digits in certain cases; (iii) the time period examined may not be representative of the typical data distribution; (iv) some numbers within the dataset might be fraudulent. Nigrini emphasises the im-

portance of scrutinizing the first two digits when analysing accounting data. To start with, this is due to the possibility that the first-digit test might fail to detect accounting overstatements, as illustrated by the ‘bluntness’ issue discussed by Skousen et al. (2004). Secondly, recent research has demonstrated that individuals can invent numbers that surprisingly follow Benford’s law, even if they are not genuine accounting figures and are not expected to adhere to this distribution law (Nigrini, 2016). Lastly, Nigrini notes that “the first-digit test will yield large audit samples that are highly inefficient” (Nigrini, 2020, p. 109). Consequently, this paper primarily focuses on the analysis of the first two digits, as this is considered the most reliable method for the examination of accounting data according to the existing literature (e.g., Nigrini, 2020).

To offer a straightforward and efficient means of assessing the conformity of the total revenue sample from MOEs with Benford’s law, we calculate the mean absolute deviation statistic, as proposed by Nigrini (2012). This statistic is widely utilised in scholarly literature for such purposes. It represents the average positive deviation of the digit distributions within the accounting dataset from Benford’s law, as illustrated below:

$$\text{Mean Absolute Deviation} = \frac{\sum_{i=1}^k |p_i - \hat{p}_i|}{k}$$

where p_i indicates the observed (or actual) proportion, \hat{p}_i is the expected proportion, and k represents the number of bins (which equals 90 for the first-two digits combinations). Thus, if the first-two digits test is carried out, and the actual frequency of, say, 99 is 0.002, then the absolute deviation is $|-0.002|$, since the Benford expected frequency of 99 as the first-two digits of a number is 0.004.

With approximately four decades of experience in Benford research and a substantial body of published studies, Nigrini (2020) offers valuable insights and recommendations regarding the implications of the Mean Absolute Deviation (MAD) exceeding specific threshold values when testing data conformity. Table 2 presents these critical values and outlines the corresponding conclusions regarding the conformity of digits. Once the MAD surpasses these reference points, the empirical dataset under examination is categorised as nonconforming. Consequently, this nonconformity raises suspicions of potential manipulation in the numbers.

Table 2 – Critical values for the MAD test of Benford conformity

Digits	Range	Conclusion
First-Two Digits:	0.0000 to 0.00012	Close conformity
	0.0012 to 0.0018	Acceptable conformity
	0.0018 to 0.0022	Marginally acceptable conformity
	Above 0.0022	Nonconformity

Source: Nigrini (2020)

Although the Mean Absolute Deviation (MAD) is considered a robust and dependable indicator, it is noted for the absence of stringent, statistically-based criteria. The approaches for assessing conformity to Benford's law have exhibited some variation within the research field. Previous studies have relied on a range of statistical tests for their analyses. Therefore, consistent with Carslaw (1988), Thomas (1989), Van Caneghem (2002, 2004), Skousen et al. (2004), Guan et al. (2006), and Lin and Wu (2014), a Z-statistic test is also carried out on each observed deviation from the expected proportions, calculated as follows:

$$Z = \frac{|p_i - \hat{p}_i| - \frac{1}{2n}}{\sqrt{\frac{\hat{p}_i(1 - \hat{p}_i)}{n}}}$$

where p_i denotes, again, the observed (or actual) proportions, \hat{p}_i is the expected proportion, n is the total number of observations recorded in the sample, and $1/2n$ is a correction term. As Thomas (1989) remarks, in the numerator of the equation the second term $1/2n$ should not be computed when it is higher than the first term of the numerator $|p - \hat{p}|$, as this is useful when there is a need to adjust some biases. The null practical hypothesis (H_0 : *no managerial efforts are made on financial statements to round earnings*) would be rejected at the 10, 5, and 1 percent significance levels if the Z values exceed 1.64, 1.96 and 2.57, respectively.

To ensure thoroughness, the Kolmogorov-Smirnov (K-S) test is also conducted on the first two digits of the election sample. Alongside the default MAD test, which assesses overall conformity, and the Z-statistic tests, which analyse revenue numbers on a digit-by-digit basis, the K-S test offers a non-parametric method to examine the shape of sample distributions. This test is based on the cumulative sum of expected Benford's proportions, calculating the one-sided K-S statistic as the distance between the reference Benford's function and the empirical distribution function of the first two digits in the election sample. The corresponding equation is as follows:

$$D_n = \sup_{-\infty < x < +\infty} | \widehat{F}_n(x) - \widehat{F}_0(x) |$$

where n denotes the total number of observations, \sup is the upper bound of the set of distances, *i.e.* the maximum difference (in absolute value) between the empirical distribution function $\widehat{F}_n(x)$, and the theoretical distribution function $\widehat{F}_0(x)$ (assumed to be true since $H_0: \widehat{F}(x) = \widehat{F}_0(x), \forall x$). Instead, the null practical hypothesis tested in this study is that the first two digits of the total revenue numbers, and thus the actual proportions, conform to Benford's law. Given that the D critical value varies with different levels of *alpha* (when n is higher than 40), in this specific case (namely $1.36/\sqrt{n}$) D equals 0.06144, with α equal to 0.05 and n , the election sample observations, at 490 (corresponding to the elections held by the 422 MOEs analysed).

Additionally, other statistical tests, such as the Chi-squared statistic and Cramer's V test used by Lin and Wu (2014), can also be performed when detecting anomalies in financial statements using a Benford-based approach. These are conducted sequentially as a post-test for significance. However, when applying Benford's law, all these statistic-based tests are prone to the 'excess of power' issue. As the sample size increases, the calculated values almost always exceed the cut-off critical statistics values (Nigrini, 2020), leading to conclusions of nonconformity even when the deviation from Benford's distribution is moderate. In some instances, the results from different tests may even contradict each other or the MAD value. The ambiguity resulting from these differing outcomes should be addressed in future research.

5. Empirical findings

Table 3 provides an overview of patterns observed for specific digits within the full sample. In the first column, we present the first-two digits under analysis, followed by the count of occurrences of each digit in the second column. The third and fourth columns present the observed proportion of digit occurrence and the expected proportion according to Benford's law, respectively. Additionally, the table displays the difference between these two proportions (empirical and theoretical) and their absolute values, with the last column presenting the Z-statistics computed for each category.

It is worth noting that there are instances where the first-two digits of the MOEs' total revenue numbers deviate significantly from Benford's distribution at the 1% significance level, as indicated by up to seven high Z-statistics, which contrasts with the MAD value suggesting conformity with Benford's

law. This apparent inconsistency can be attributed to the substantial number of tests conducted, which stands at 90. One plausible explanation for this mixed set of results could be the potential lack of synergy between various statistical and non-statistical tests. However, when applying a Bonferroni correction, none of these Z values emerges as statistically significant. This reinforces the conclusion that, in the overall context, the Mean Absolute Deviation indicates acceptable conformity with Benford's distribution.

Table 3 – First-two digits test on MOEs' total revenues

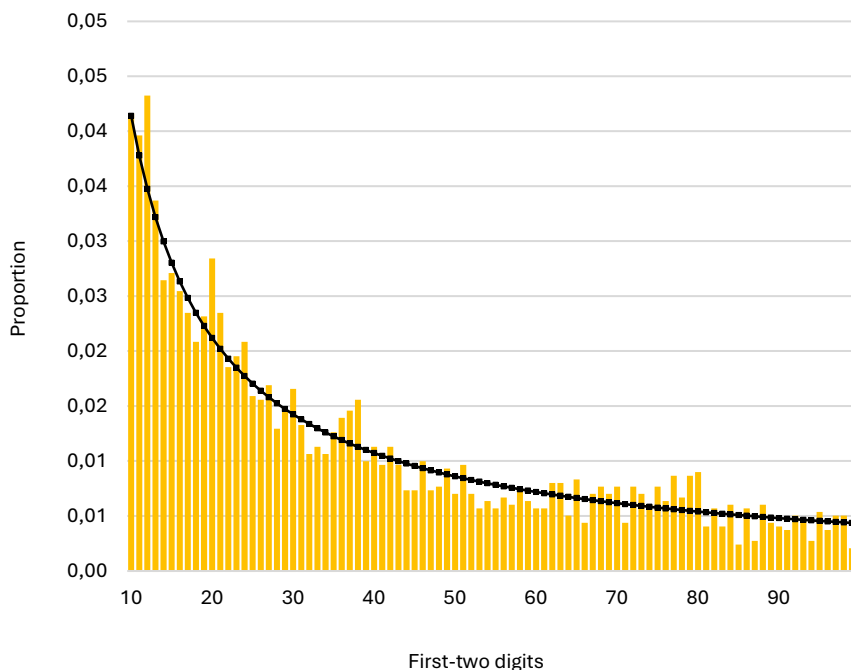
First-two	Count	Actual	Benford	Difference	Abs. difference	Z statistic
10	126	0.042	0.041	0.000	0.000	0.030
11	120	0.040	0.038	0.002	0.002	0.454
12	131	0.043	0.035	0.008	0.008	2.473**
13	102	0.034	0.032	0.001	0.001	0.389
14	80	0.026	0.030	-0.004	0.004	1.114
15	82	0.027	0.028	-0.001	0.001	0.285
16	77	0.025	0.026	-0.001	0.001	0.276
17	71	0.023	0.025	-0.001	0.001	0.451
18	63	0.021	0.023	-0.003	0.003	0.933
19	70	0.023	0.022	0.001	0.001	0.230
20	86	0.028	0.021	0.007	0.007	2.668***
30	50	0.016	0.014	0.002	0.002	0.960
38	47	0.015	0.011	0.004	0.004	2.105**
77	26	0.009	0.006	0.003	0.003	2.063**
78	20	0.007	0.006	0.001	0.001	0.661
79	26	0.009	0.005	0.003	0.003	2.195**
80	27	0.009	0.005	0.003	0.003	2.507**
85	7	0.002	0.005	-0.003	0.003	2.022**
87	8	0.003	0.005	-0.002	0.002	1.696*
90	12	0.004	0.005	-0.001	0.001	0.543
99	6	0.002	0.004	-0.002	0.002	1.859*
MAD =					0.00157	

Notes: Table presents the first-two digits analysed, the count of each first-two digit occurrence, the frequency of observing this digits' occurrence, the expected Benford's proportion, the difference between the two proportions (empirical and theoretical) and their values in absolute terms, and the Z-statistics computed on each bin. The table shows part of the results due to the high number of tests performed and inability to fit them within a page of the manuscript. MAD indicates the overall mean of the absolute differences. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

In this empirical analysis, a total of 90 bins are utilised, encompassing digits ranging from 10 to 99. As depicted in Figure 1 below, the overall findings suggest that there are no anomalies in the occurrence of the first two digits within total revenue numbers. This conclusion is supported by the yel-

low bars, indicating that the distribution of digits closely aligns with the black Benford's function.

Figure 1 – First-two digits of MOEs' total revenues



Notes: Figure 1 illustrates the distribution of the first-two digit of total revenue numbers in yellow and the Benford theoretical distribution in black.

In the analysis of the non-election period sample, Table 4 reveals results that are similar to the previous digit tests conducted on the full sample. Notably, there appears to be an overrepresentation of first two digits such as 12s, 20s, and 80s, while there is a lack of 32s in the total revenues of Italian MOEs during non-election periods. These deviations are reflected in Z-statistics that exceed the critical value of 1.96 (at a five percent significance level) and even 2.57 (at a one percent significance level). However, it is important to exercise caution and not draw hasty conclusions, as the general Mean Absolute Deviation (MAD) is approximately 0.0016. This suggests that acceptable conformity is probably maintained, with only a few outliers present. Indeed, Figure 2 shows the corresponding table, providing a visual representation of the first-two-digits test results on revenue numbers for MOEs during non-election pe-

riods. While there are a few bars that exceed Benford's function, the overall data appear to adhere reasonably well to Benford's law.

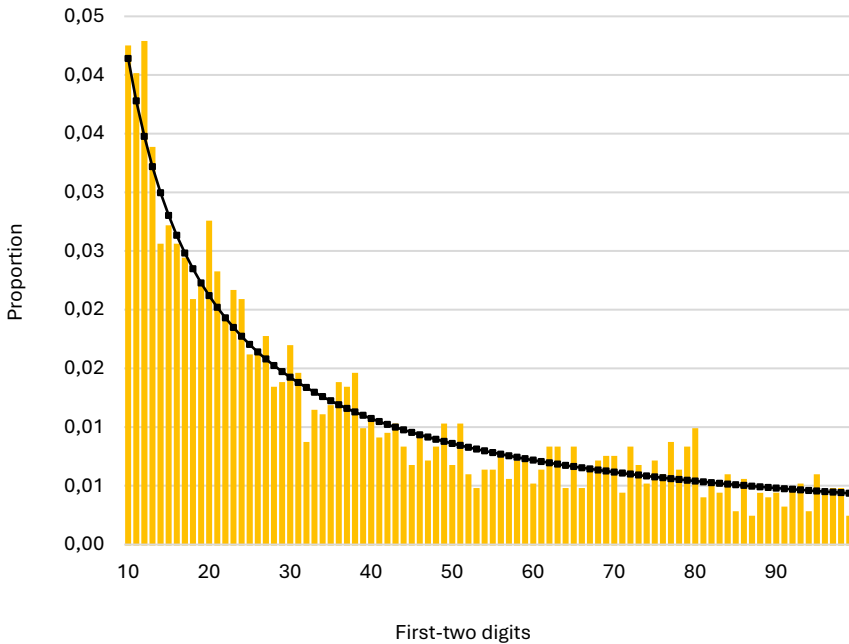
Table 4 – First-two digits test on MOEs' total revenues during non-elections periods

First-two	Count	Actual	Benford	Difference	Abs. difference	Z statistic
10	108	0.042	0.041	0.001	0.001	0.210
11	102	0.040	0.038	0.002	0.002	0.550
12	109	0.043	0.035	0.008	0.008	2.163**
13	86	0.034	0.032	0.002	0.002	0.400
14	65	0.026	0.030	-0.004	0.004	1.254
15	69	0.027	0.028	-0.001	0.001	0.223
16	65	0.026	0.026	-0.001	0.001	0.190
17	62	0.024	0.025	0.000	0.000	0.089
18	53	0.021	0.023	-0.003	0.003	0.822
19	56	0.022	0.022	0.000	0.000	0.029
20	70	0.027	0.021	0.006	0.006	2.140**
32	22	0.009	0.013	-0.005	0.005	1.989**
53	12	0.005	0.008	-0.003	0.003	1.804*
77	22	0.009	0.006	0.003	0.003	1.920*
79	21	0.008	0.005	0.003	0.003	1.772*
80	25	0.010	0.005	0.004	0.004	2.912***
99	6	0.002	0.004	-0.002	0.002	1.387
MAD =					0.00158	

Notes: Table presents the first-two digits analysed, the count of each first-two-digit occurrence, the frequency of observing this digits' occurrence, the expected Benford's proportion, the difference between the two proportions (empirical and theoretical) and their values in absolute terms, and the Z-statistics computed on each bin. The table shows part of the results due to the high number of tests performed and inability to fit them within a page of the manuscript. MAD indicates the overall mean of the absolute differences. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

The analysis conducted on the full sample has provided robust evidence supporting the reliability of the Benford-based method. It indicates a near-perfect conformity to Benford's law, affirming that the data examined in this study adheres closely to this distribution. Additionally, the examination of the sample pertaining to non-election periods not only reaffirms the method's efficacy but also suggests that the somewhat surprising findings in the subsequent analysis of election periods are not influenced by other factors directly or indirectly related to the non-election sample. In simpler terms, the abnormal deviations observed in total revenue numbers during election periods may not be attributed to other influencing factors associated with the selection of the non-election period sample.

Figure 2 – First-two digits of MOEs’ total revenues during non-election periods



Notes: Figure 2 illustrates the distribution of the first-two digit of total revenue numbers in yellow and the Benford theoretical distribution in black.

The main focus of this research centres on the first-two-digits test conducted on the total revenues of Italian MOEs during election periods. As reported in Table 5, the results indicate a significant nonconformity with Benford’s law, with a Mean Absolute Deviation of 0.00354 that surpasses the critical limit value of 0.0022. Consequently, the statistical null hypothesis of Benford conformity is rejected, implying a rejection of the practical null hypothesis suggesting no managerial efforts to round earnings in financial statements.

Furthermore, at the 0.05 significance level, there is clear evidence of an overuse of 88s as the first two digits in firms’ total revenues during election periods. Similarly, a statistically significant overrepresentation of 42s is observed, with a Z value of 2.018 (at the five percent significance level). Another noteworthy aspect of these findings is the absence of 99s and 59s as the first two digits in these financial statements, indicating a tendency for rounding behaviour just above key cognitive reference points (*i.e.*, $N \times 10^k$), a phenomenon theoretically discussed by Carslaw (1988). This pattern is also observed for 85s and 96s as the first two digits.

In line with the compelling evidence presented by Capalbo et al. (2021), this study provides further support for the assertion that managers of Italian MOEs engage in earnings manipulation. Notably, these rounding manipulation behaviours appear to occur just prior to local elections taking place in the relevant municipalities. This may suggest that pre-electoral cosmetic earnings management is “a consequence of the opportunistic behaviour of the incumbent politician willing to improve SOEs’ earnings so as to try to alter voters’ perception of their economic performance” (Capalbo et al., 2021, p. 20). However, it is important to note that this study does not explicitly address the responsibility of incumbent politicians or the firms’ directors for earnings management. Nevertheless, a clear political connection exists within these firms, and its potential influence cannot be discounted. Investigating this aspect could be a promising avenue for future research.

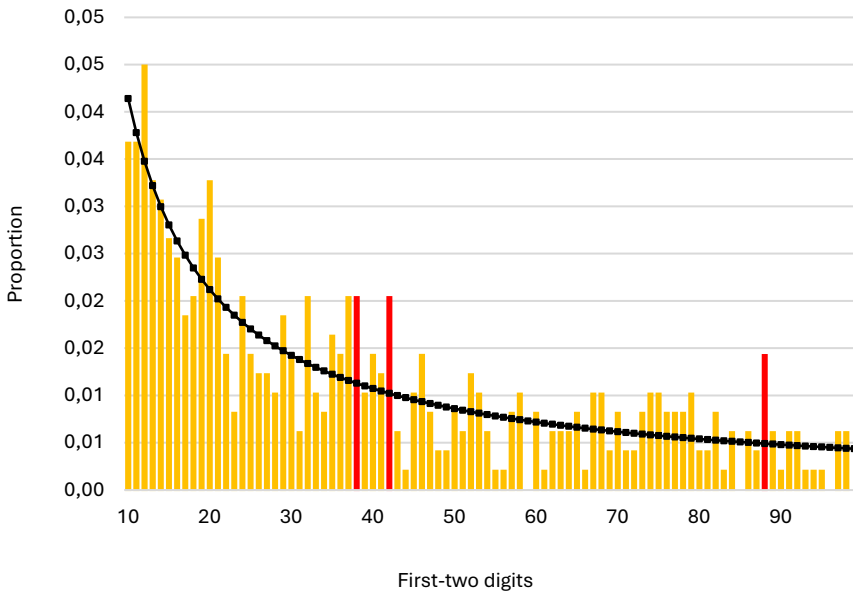
Table 5 – First-two digits test on MOEs’ total revenues during elections periods

First-two	Count	Actual	Benford	Difference	Abs. difference	Z statistic
10	18	0.037	0.041	-0.005	0.005	0.404
11	18	0.037	0.038	-0.001	0.001	0.004
12	22	0.045	0.035	0.010	0.010	1.102
13	16	0.033	0.032	0.000	0.000	0.059
14	15	0.031	0.030	0.001	0.001	0.084
15	13	0.027	0.028	-0.001	0.001	0.064
16	12	0.024	0.026	-0.002	0.002	0.113
17	9	0.018	0.025	-0.006	0.006	0.773
18	10	0.020	0.023	-0.003	0.003	0.300
19	14	0.029	0.022	0.006	0.006	0.791
20	16	0.033	0.021	0.011	0.011	1.605
37	10	0.020	0.012	0.009	0.009	1.615
38	10	0.020	0.011	0.009	0.009	1.699*
42	10	0.020	0.010	0.010	0.010	2.018**
44	1	0.002	0.010	-0.008	0.008	1.508
59	0	0.000	0.007	-0.007	0.007	1.633
85	0	0.000	0.005	-0.005	0.005	1.264
88	7	0.014	0.005	0.009	0.009	2.648***
96	0	0.000	0.005	-0.005	0.005	1.151
99	0	0.000	0.004	-0.004	0.004	1.123
				MAD =	0.00354	

Notes: Table presents the first-two digits analysed, the count of each first-two-digit occurrence, the frequency of observing this digits’ occurrence, the expected Benford’s proportion, the difference between the two proportions (empirical and theoretical) and their values in absolute terms, and the Z-statistics computed on each bin. The table shows part of the results due to the high number of tests performed and inability to fit them within a page of the manuscript. MAD indicates the overall mean of the absolute differences. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Figure 3 depicts the results reported in Table 5 graphically. The bar chart provides a visual representation of numerous anomalies in the first two digits of MOEs’ total revenues, characterised by substantial fluctuations that signal manipulated accounting numbers departing significantly from Benford’s law. The red bars specifically indicate instances of statistically significant deviation from Benford’s distribution. Once more, the utilisation of specific revenue numbers by the managers of MOEs managers during pre-electoral periods appears to align with the performance expectations hypothesis.

Figure 3 – First-two digits of MOEs’ total revenues during election periods

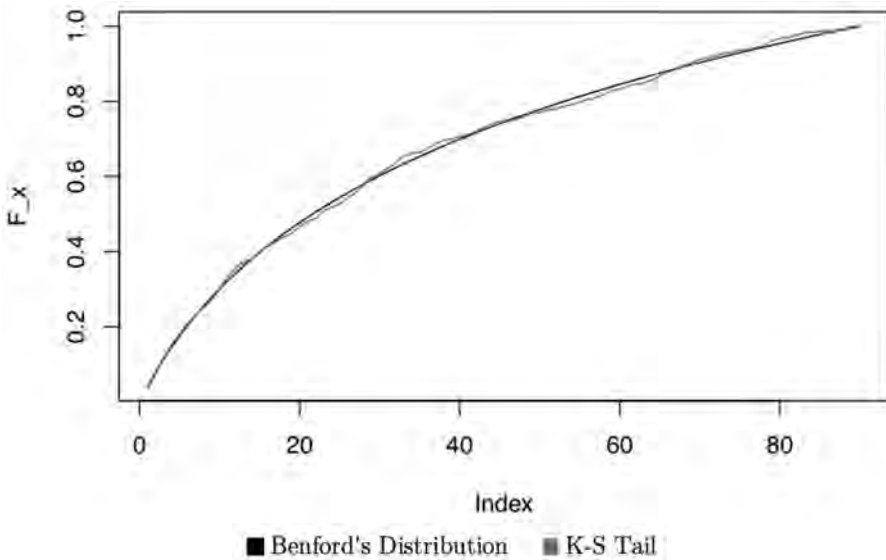


Notes: Figure 3 illustrates the distribution of the first-two digit of total revenue numbers in yellow and the Benford theoretical distribution in black. Red indicates statistical significance.

A last statistical test is carried out on the first-two digits of the accounting dataset analysed during election periods. Figure 4 illustrates the Kolmogorov-Smirnov test on the first two digits of total revenues in Italian MOEs during election periods. The black line denotes the theoretical distribution function $\hat{F}_0(x)$, which represents Benford’s distribution, while the red line denotes the empirical distribution $\hat{F}_n(x)$ function analysed, namely the distribution of the first two digits over the total revenue numbers of the Italian MOEs during election periods. The so-called K-S test analyses the distance between those two distribution functions, giving a result on the deviations of

the empirical from the theoretical function. The K-S test points out a value of 0.0216, while the critical value is 0.0614, prompting one to argue that there might not be signals of earnings management. With such results, the null hypothesis of having Benford conformity is rejected. This statistical result is again in contrast with preceding tests. Despite the slight ambiguity introduced by these contrasting findings, there is a clear abnormality in the total revenue digit patterns of Italian MOEs prior to local elections. The irregularities identified in this study leave little room for doubt, and such distorted digit patterns should not appear in the financial statements of these MOEs, particularly during such critical periods.

Figure 4 – K-S test on the first-two digits of MOEs' total revenues during election periods



Notes: Figure 4 illustrates the Kolmogorov-Smirnov test on the first-two digits of total revenues in Italian MOEs during election periods. The black line denotes the theoretical distribution function $\hat{F}_0(x)$, which represents Benford's distribution, while the red line denotes the empirical distribution $\hat{F}_n(x)$ function analysed.

6. Discussion and conclusion

This paper has addressed the current credibility crisis in replication studies and has adhered to the call for papers of this specific issue. The focus has been on a rigorous re-examination of the issue of earnings management

within public sector entities operating under the influence of electoral seasons. In particular, the study has tested the political cost hypothesis of Watts and Zimmerman (1987, 1986) and Jones (1991), firstly studied by Ramanna and Roychowdhury (2010) during electoral seasons and then extend by Capalbo et al. (2021) in a public sector context. The examination was conducted within the same setting used by Capalbo et al. (2021), employing their dataset, and covering the same time period, but it introduced a fresh empirical approach, a departure from the previous studies, to provide a new perspective on the matter. In contrast with the approaches of Capalbo et al. (2023, 2024), which employ Benford's law to examine earnings management by Italian MOEs in different periods and contexts, this study conducted distinct statistical tests to shed light on the intricacies of accounting data manipulation. This extension of the work of Capalbo et al. (2021) has documented consistent evidence on which accounting numbers are likely to undergo refinement, offering valuable insights for both academia and practitioners alike in navigating the complex landscape of earnings management within public sector entities influenced by electoral contexts.

Specifically, this analysis examined the digit distributions of firms which would be facing an election soon after their financial statements were approved by the board of directors, and therefore published at the shareholders' meeting, finding an overuse of 88s and 42s as the first two digits of revenue amounts. While it is somewhat difficult to provide an economic justification for the tendencies regarding those digits, MOEs' managers seemed to not like total revenue numbers initiating with 59 or 99 at all, suggesting rounding up behaviours. The results have therefore provided evidence of a positive relationship between elections and earnings management in MOEs, although this paper does not attempt to prove politicians' involvement in these practices, and ultimately it places responsibility with the managers instead. Nevertheless, as Capalbo et al. (2021) argue, there is a reasonable doubt as to whether pre-electoral earnings manipulation, derived from the growth in MOEs income numbers, might be due to the political opportunity of incumbents in altering voters' perception of their efficiency in governing.

Overall, this research contributes to the growing stream of literature on the integral approach based on Benford's law, by documenting evidence of earnings manipulation in the distribution of accounting digits within unlisted public sector organisations. Around election periods from 2010 to 2015, managers of Italian MOEs were under pressure from political cost, which ultimately led them to round off reported total revenues to the nearest cognitive reference point in the period just before elections were held. The empirical method adopted appears to accurately detect unusual patterns in those

numbers in financial statements. This can be seen in the fact that the full sample fits perfectly with Benford's distribution. Moreover, although the approach outlined in this paper may not be considered an accurate fraud detector, it is still considered a good tool that can spot red flags relative to financial misstatements and provide a first indicator of irregularities, errors, or manipulative behaviour. A direct implication would be to urge institutional and judicial bodies, such as the Italian *Corte dei Conti*, to adopt this interesting, simple analytical procedure, along with other tools, as a means to prevent such opportunistic behaviours from occurring in crucial and delicate periods like those around local elections. This, of course, would lead to an increasingly more efficient way of protecting public finances. Lastly, a further policy implication is represented by the ensuing increase in the transparency of financial reporting by MOEs.

A number of limitations need to be noted regarding this study. First of all, the findings cannot be exported to the broader context of state ownership (and so to SOEs). Secondly, there could be an easily-explained attribute of the accounting data that can lead the digits of these numbers to be repeated abnormally (Nigrini, 2020). In this case, Benford's law may not be useful in spotting CEM. Thirdly, the time period examined might not be representative of the norm, or, more precisely, a single, short timeframe might produce a narrow view of the result. Lastly, the revelation of ambiguity emerging from contrasting statistical conclusions that arose from the different tests performed in this study still needs to be addressed. This leaves room for future research investigating statistical foundations in Benford's law tests.

To conclude, there are several potential future research directions to extend this contribution by also referring to its constraints. Further works could: (i) examine in greater depth whether the firms' earnings have certain unusual patterns due to features such as standardised commercial contracts, in order to prevent any biases in the results; (ii) take into account a longer timeframe, first to avoid the period representation issue, and second to try to overcome the problem of ambiguity in the statistical tests; (iii) try to prove whether incumbent politicians effectively display opportunistic behaviours influencing managers' decisions regarding earnings and if they exercise pressure directly on controlled MOEs. What is also needed is broader research on how to use the digits distribution law without facing statistical ambiguity in diverse testing approaches. However, the Benford-based analysis on pre-electoral earnings management in Italian MOEs carried out in this study provides some useful initial indications.

References

- Avallone, F., Quagli, A., & Ramassa, P. (2022). Interdisciplinary research by accounting scholars: An exploratory study. *Financial Reporting*, 2, 5-34. Doi: 10.3280/FR2022-002001.
- Benford, F. (1938). The law of anomalous numbers. *Proceeding of the American Philosophical Society*, 78(4), 551-572. -- <https://www.jstor.org/stable/984802>.
- Bisogno, M., & Donatella, P. (2021). Earnings management in public-sector organizations: a structured literature review. *Journal of Public Budgeting, Accounting and Financial Management*, 34(6), 1-25. Doi: 10.1108/JPBAFM-03-2021-0035.
- Busta, B., & Weinberg R. (1998). Using Benford's law and neural networks as a review procedure. *Managerial Auditing Journal*, 13(6), 356-366. Doi: 10.1108/02686909810222375.
- Capalbo, F., & Menale, A. (2020). Le società a partecipazione pubblica in Italia e all'estero: numeri e incidenza sull'economia. In F. Fimmanò & A. Catricalà (Eds.), *Le società pubbliche* (2nd ed., pp. 93-119). Edizioni Scientifiche Italiane.
- Capalbo, F., Galati, L., Lupi, C., & Smarra, M. (2023). The Impact of Elections on the Quality of Financial Statements in Municipally Owned Entities. *Chaos, Solitons & Fractals*, 173. Doi: 10.1016/j.chaos.2023.113752.
- Capalbo, F., Galati, L., Lupi, C., & Smarra, M. (2024). Proportional Appropriation Systems and the Quality of Financial Statements in Municipally Owned Entities. *Journal of Public Budgeting, Accounting & Financial Management*, 36(3), 343-362. Doi: 10.1108/JPBAFM-01-2023-0015.
- Capalbo, F., Lupi, C., Smarra, M., & Sorrentino, M. (2021). Elections and earnings management: evidence from municipally-owned entities. *Journal of Management and Governance*, 25, 707-730. Doi: 10.1007/s10997-020-09523-z.
- Carslaw, C. A. P. N. (1988). Anomalies in income numbers: evidence of goal oriented behavior. *The Accounting Review*, 63(2), 321-327. -- <https://www.jstor.org/stable/248109>.
- Christian, C. W., & Gupta, S. (1993). New evidence on "Secondary Evasion". *Journal of the American Taxation Association*, 15(1), 72-93.
- Cinelli C. (2018). benford.analysis: Benford analysis for data validation and forensic analytics. R package version 0.1.5.
- Das, S., & Zhang, H. (2003). Rounding-up in reported EPS, behavioral thresholds, and earning management. *Journal of Accounting and Economics*, 35(1), 31-50. Doi: 10.1016/S0165-4101(02)00096-4.
- Dechow, P. M., Sloan, R. G., & Sweeney, A. P. (1995). Detecting earnings management. *Accounting Review*, 70(2), 193-225. -- <https://www.jstor.org/stable/248303>.
- Durtshi, C., Hillison, W., & Pacini, C. (2004). The effective use of Benford's law to assist in detecting fraud in accounting data. *Journal of Forensic Accounting*, 5(1), 17-33.
- Gabrielli, G., Medioli, A., Andrei, P., & Marchini, P. L. (2022). Accounting and Big Data: Trends, opportunities and direction for practitioners and researchers. *Financial Reporting*, 2, 89-112. Doi: 10.3280/FR2022-002004.

- Guan, L., He, D., & Yang, D. (2006). Auditing, integral approach to quarterly reporting, and cosmetic earnings management. *Managerial Auditing Journal*, 21(6), 569-581. Doi: 10.1108/02686900610674861.
- Istrate, C. (2019). Detecting earnings management using Benford's law: the case of Romanian listed companies. *Journal of Accounting and Management Information Systems*, 18(2), 198-223. Doi: 10.24818/jamis.2019.02003.
- Jensen, T. I., Kelly, B., & Pedersen, L. H. (2023). Is There a Replication Crisis in Finance? *Journal of Finance*, 78, 2465-2518. Doi: 10.1111/jofi.13249.
- Johnson, G. C. (2009). Using Benford's law to determine if selected company characteristics are red flags for earnings management. *Journal of Forensic Studies in Accounting & Business*, 1(2), 39-65.
- Jones, J. J. (1991). Earnings management during import relief investigation. *Journal of Accounting Research*, 29(2), 193-228. Doi: 10.2307/2491047.
- Kinnunen, J., & Koskela M. (2003). Who is Miss world in cosmetic earnings management? A cross-national comparison of small upwards rounding of net income numbers among eighteen countries. *Journal of International Accounting Research*, 2(1), 39-68. Doi: 10.2308/jiar.2003.2.1.39.
- Lacina, M., Lee, B. B., & Kim, D. W. (2018). Benford's law and the effects of the Korean financial reforms on cosmetic earnings management. *Journal of International Accounting, Auditing and Taxation*, 30, 2-17. Doi: 10.1016/j.intaccaudtax.2017.12.002.
- Lebert, S., Mohrmann, U., & Stefani, U. (2021). Rounding up performance measures in German firms: Earnings cosmetics or earnings management on a larger scale? *Journal of Business Finance & Accounting*, 48(3-4), 564-586. Doi: 10.1111/jbfa.12494.
- Lin, F., & Wu, S. (2014). Comparison of cosmetic earnings management for the developed markets and emerging markets: some empirical evidence from the United States and Taiwan. *Economic Modelling*, 36, 466-473. Doi: 10.1016/j.econmod.2013.10.002.
- Newcomb, S. (1881). Note on the frequency of use of the different digits in natural numbers. *American Journal of Mathematics*, 4(1), 39-40. Doi: 10.2307/2369148.
- Nigrini, M. J. (1992). *The detection of income tax evasion through an analysis of digital distributions*. Ph.D. dissertation, Carl H. Linder College of Business, University of Cincinnati.
- Nigrini, M. J. (1993, June). Can Benford's law be used in forensic accounting? (*The Balance Sheet*), 7-8.
- Nigrini, M. J. (1996). A taxpayer compliance application of Benford's law. *Journal of the American Taxation Association*, 18(1), 72-91.
- Nigrini, M. J. (1999). Fraud detection: I've got your number. *Journal of Accountancy*, 187(5), 79-83.
- Nigrini, M. J. (2005). An assessment of the change in the incidence of earnings management around the Enron Andersen episode, *Review of Accounting and Finance*, 4(1), pp. 92-110. Doi: 10.1108/eb043420.
- Nigrini, M. J. (2012). *Benford's law: applications for forensic accounting, auditing and fraud detection*. Wiley. Doi: 10.1002/9781119203094.

- Nigrini, M. J. (2020). *Forensic analytics: methods and techniques for forensic accounting investigations* (2nd ed.). Wiley.
- Nigrini, M. J., & Mittermaier, L. J. (1997). The use of Benford's law as an aid in analytical procedures. *Auditing: A Journal of Practice and Theory*, 16(2), 52-67.
- Niskanen, J., & Keloharju, M. (2000). Earnings cosmetics in tax-driven accounting environment: evidence from Finish public firms. *The European Accounting Review*, 9(3), 443-452. Doi: 10.1080/09638180020017159
- Ramanna, K., & Roychowdhury, S. (2010). Elections and Discretionary Accruals: Evidence from 2004. *Journal of Accounting Research*, 48, 445-475. Doi: 10.1111/j.1475-679X.2010.00373.x.
- R Core Team, (2023). R: A language and environment for statistical computing. *R Foundation for Statistical Computing*. -- <https://www.R-project.org/>.
- Skousen, C. J., Guan, L., & Wetzel, T. S. (2004). Anomalies and unusual patterns in reported earnings: Japanese managers round earnings. *Journal of International Financial Management & Accounting*, 15(3), 212-234. Doi: 10.1111/j.1467-646X.2004.00108.x.
- Stubben, S. R. (2010). Discretionary revenues as a measure of earnings management. *The Accounting Review*, 85(2), 695-717. Doi: 10.2308/accr.2010.85.2.695.
- Thomas, J. (1989). Unusual patterns in reported earnings. *The Accounting Review*, 64(4), 773-787. -- <https://www.jstor.org/stable/247861>.
- Van Caneghem, T. (2002). Earnings management induced by cognitive reference points. *British Accounting Review*, 34(2), 167-178. Doi: 10.1006/bare.2002.0190.
- Van Caneghem, T. (2004). The impact of audit quality on earnings rounding-up behaviours: some UK evidence. *European Accounting Review*, 13(4), 771-786. Doi: 10.1080/0963818042000216866.
- Watts, R. L., & Zimmerman, J. L. (1986). *Positive accounting theory*. Prentice-Hall.
- Watts, R. L., & Zimmerman, J. L. (1978). Towards a positive theory of the determination of accounting standards. *The Accounting Review*, 53(1), 112-134. -- <https://www.jstor.org/stable/245729>.