Chaos, Solitons and Fractals 173 (2023) 113752

Contents lists available at ScienceDirect

Chaos, Solitons and Fractals

journal homepage: www.elsevier.com/locate/chaos

Local elections and the quality of financial statements in municipally owned entities: A Benford analysis

Francesco Capalbo [a], Luca Galati [b,c], Claudio Lupi [a,*], Margherita Smarra [a]

[a] University of Molise, Department of Economics, Italy
[b] University of Wollongong, School of Accounting, Economics and Finance, Australia
[c] Rozetta Institute, Derivatives Markets Research Centre, Australia

ARTICLE INFO

Keywords:
Benford's Law
Data quality
Data science
Econophysics
Elections
Pre-tax income

ABSTRACT

Benford's Law has been widely used in the literature to assess data quality and reliability. This paper examines the impact of local elections on financial reporting quality in entities controlled by local governments using a data science approach. By applying Benford's Law on financial statements published by Italian municipally owned entities operating in utility industries, we find diffuse data anomalies around election seasons. This does not automatically means that illegal manipulation or fraud are widespread in those periods, but it implies that (i) auditors need to pay particular attention to the quality of accounting data in those crucial periods and specific environments; and that (ii) voters and media have to be critical in assuming municipally owned entities' indicators of financial performance as proxies of the administrative efficiency of incumbent politicians.

1. Introduction

In this paper we investigate the quality of municipally owned entities (hereafter MOEs) financial statements in pre-electoral seasons using a data science approach based on Benford's Law. This approach has a consolidated tradition in the auditing and fraud detection literature and has the advantage of not requiring strong econometric identification or statistical modelling assumptions: furthermore, it can be used in the presence of large datasets. In this paper we take the view that the totality of MOEs' financial statements is a complex economic system whose behaviour depends on different incentives set at the micro level.

Previous literature has advocated that morality and fraud are neither personal nor universal but are located within specific social and historical contexts [1]. We argue that this is also the case for data manipulation and financial statement quality. A particular context could favour data manipulation and in turn reduce financial statement quality. In particular, we believe that in contexts where there are individuals who have an interest in the publication of specific financial statement results and are in a position to exercise power over financial statement preparers, they might decide to use it to have the latter acting immorally or fraudulently, possibly engaging in data manipulation [1].

Public choice theory has gathered sufficient evidence to suggest that incumbent politicians, to increase their own chances or the chances of the governing party of winning again, may engage in the pre-electoral manipulation of any measure of economic performance that, perceived as a sign of administrative efficiency, can alter the perception of their governing efficiency [2–9]. Although the first studies in this field dealt typically with macro-economic measures, we believe that MOEs' financial results are also likely to be perceived by politicians and voters as relevant measures of economic performance. This is consistent with the results of existing literature on the influence of listed State owned entities' results on voters' opinions [5,7,10,11] and with the constant increase in the amount of public resources managed by MOEs [12]. Incumbents might be willing to manipulate those results even if they cannot do it directly. Indeed, in the Italian institutional settings, local politicians do not have a direct involvement in the preparation of MOEs' financial statements. Nevertheless, they are in the position to exercise power over MOEs' executives both through their ability to decide, as representatives of the majority shareholders, on MOEs' managers re-appointment, and through their ability to influence, as political members, the amount of resources that can be transferred to the managed entity.

Hence, around local election times politicians might be willing to use their power to make MOEs' managers accommodate financial statement results in a way that may favour their political ambitions, with a reduction of the quality of published financial statements data. We also believe that the above scenario is likely to occur especially with respect to those MOEs that are more socially relevant and of greater interest to the media and the public opinion. In this paper, we focus on MOEs operating in specific utility industries (e.g., public transport,

* Correspondence to: Department of Economics, University of Molise, Via F. De Sanctis, 1 I-86100, Campobasso, Italy.
E-mail address: lupi@unimol.it (C. Lupi).

https://doi.org/10.1016/j.chaos.2023.113752
Received 7 June 2023; Accepted 20 June 2023
Available online 10 July 2023

provision of gas, water and electric energy, environmental hygiene). We hypothesize that accounting manipulations in MOEs operating in these industries is positively associated with the occurrence of an election in the controlling municipality, and we test this proposition in the context of the Italian utility sector.

We carry out our analysis using a large sample of Italian MOEs operating in the utility sector, spanning a 10-year period ranging from 2010 to 2019. We then examine the distribution of pre-tax income numbers, in line with, e.g., Van Caneghem [13] and Herteliu et al. [14]. We test our conjecture using conformity tests for the first-digit Benford's Law. In order to compare results from samples of different size we use chi-square homogeneity tests as well as resampling techniques [15]. We confirm that MOEs' pre-tax income numbers conform to Benford's Law in ordinary times, but we find signs of misleading financial reports concentrated in pre-electoral times, with even greater alteration in the financial statement data of utility sector MOEs entirely controlled by the local government (i.e., when the municipality owns 100% of the firm's shares).

This paper provides some important policy implications. First, auditors and forensic accountants will need to pay close attention to the quality of financial statements near electoral periods in particular environments (i.e., MOEs operating in economically and socially relevant industries). Second, it seems necessary to isolate managers from political influences, perhaps following the indications of the OECD and making the process of appointing managers more transparent. Third, the quality of financial statements should always be at the core of new and focused international policies, following the ongoing and recent debate around accrual-based accounting adoption by governments and state-owned entities. Finally, voters and media should be critical in assuming MOEs' indicators of financial performance as proxies of the administrative efficiency of incumbent politicians.

The remainder of the paper is structured as follows: Section 2 provides a description of the institutional setting and of the data; Section 3 is dedicated to the discussion of the method used in the empirical analysis; findings are presented in Section 4; Section 5 offers some conclusions.

2. The institutional setting and the data

In Italy a mayor and a council are elected, for each municipality, through an election process held every five years. Mayors last for five years in their role and have a limit of two consecutive terms. New municipal elections can be held before the end of the term in three cases: (i) when more than half of the councillors resign; (ii) when the mayor resigns; and (iii) when the local government is dissolved after a court verdict because of *mafia* infiltration. Consequently, local elections are not synchronized nation-wide and Italian municipalities have different election periods over the years. Every year, a decree issued by the Minister of the Interior establishes the precise day of the municipal elections, selecting one of the Sundays in the period from 15 April to 15 June. This day is the same for all municipalities in which elections are scheduled to be held in that year. Fig. 1 reports for each year in the decade 2011–2020 the number of municipalities involved in local elections and the number of utility sector MOEs related to those municipalities.

Although Italian MOEs operate in many sectors, they are nevertheless generally responsible for the provision of local public transport, water, electricity, gas, local road maintenance, and environmental hygiene. Most of these companies are partly or wholly owned by municipalities, which entrust these entities with most of the public services provided to their citizens [16–18]. The owning municipality, in most cases, is not just the majority shareholder but also the most prominent client, paying a substantial part of the entity's revenues through a service contract, so that any of its decisions can have a significant impact on the resources to be transferred to the participated entity. When the municipal ownership is larger than 50% of the total shares of the participated entity, the mayor has full power to appoint or remove the MOE's director, and can do so with an extremely high level of discretion.

The empirical investigation is based on the AIDA (Analisi Informatizzata delle Aziende Italiane) database and the Shareholdings PA (Public Administration) Open data, available through the Department of Treasury of the Italian Ministry of Economics and Finance (MEF). Created and distributed by Bureau van Dijk, the AIDA database contains the financial statements of both active and bankrupt Italian companies, including privately held and state-owned firms with Central, Regional, Local (Municipal) or any other government level ownership, except for public bodies. In contrast, the Italian MEF database provides 262,315 observations on shareholdings and representatives in the governance bodies of companies and entities through seven editable files, which we merged and cleaned of duplicates and multiple firms' owners (by leaving only the largest). Then, we created a single dataset by merging these two databases. This merged dataset consists of several balance sheet items, along with the reference calendar year of the same balance sheet, the name of the municipality owning the shares, the municipality in which the firm is based, and the percentage of the entity's shares owned by the municipality. All data manipulations and the empirical analysis have been carried out using R, version 4.1.2 [19].

The dataset also includes a variable indicating the exact date of each election held in each municipality, retrieved from the election archive of the Italian Ministry of the Interior. Since data were once again open access from the same source and merged from different files, we checked for missing information and manually imputed the dates for firms experiencing one or no election in the overall period. At this stage we found it useful to update the municipality names with their current ones, for more accurate matching between the databases. We define "pre-election data" as the financial statements related to the year prior to the local elections but published just before the elections were held. Election dates in Italy are ordinarily put towards the middle of the year and are normally known well in advance, whereas financial statements are usually approved 90 days after the 31 December by the board of directors and 120 days after the end of the reference year by the shareholders' meeting. For example, a company would approve its financial statement by the end of March and publish it by the end of April at the shareholders' meeting, whereas the elections would commonly take place soon after in May or June. Of course, our database includes also elections held in later months, as some of them could have been postponed. This does not affect the underlying theoretical concept of manipulation incentive referred to the financial statement of the year preceding an election, as financial results could have been adjusted in view of the already announced election.

We filtered from the extrapolated 9,091 entities included in the central government database those contained in AIDA, obtaining a dataset of 6,495 observations per year. We further defined as MOEs those entities whose shares were owned by a municipality with a quota larger than 50% and selected the sample accordingly. This left us with 1,877 observations per year. We then restricted our attention to the 717 MOEs operating in the utility sector (covering five major industries, including public transport, the provision of gas, water and electric energy, and environmental hygiene), where a greater political component in terms of visibility and relevance for voters is expected. Finally, we focused on those MOEs for which we had information on their pre-tax income figures: this further reduced the sample to 6,261 observations (an average of approximately 626 entities per year).

3. Statistical method

Being mostly concerned with data quality, we base our empirical analysis on the application of Benford's Law [20]. The main statement of Benford's Law is that, contrary to what might be intuitively anticipated, the frequency of the first digit of many quantities in a number of real situations is not uniform, but rather follows a distribution such that

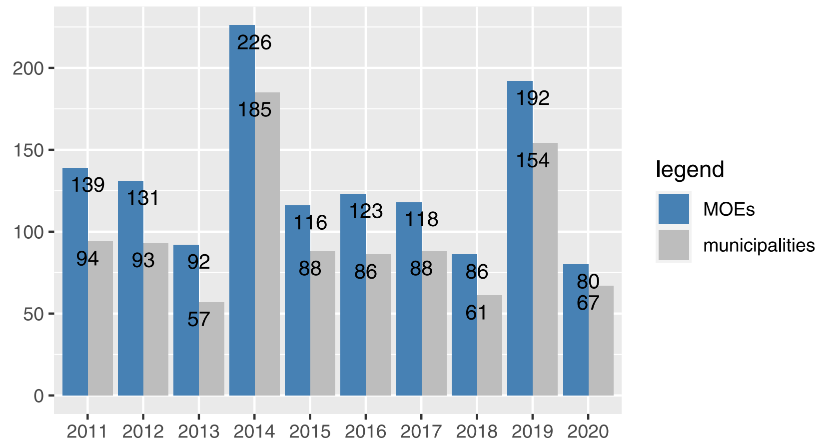

Fig. 1. The blue bars represent the total number of utility sector MOEs attached to municipalities experiencing an election in each year from 2011 to 2020; the grey bars represent the number of municipalities that had elections in the same years. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

smaller numbers are more frequent than larger ones. This behaviour has been observed in many different contexts, notably in accounting, economics, and finance [see, e.g.,14,21–35]. The theoretical reasons behind such a widespread compliance of real datasets with Benford's Law has been investigated, and a number of explanations have been found [see, e.g.,36–47]. In particular, Hill [37] shows that Benford's Law naturally arises when the quantities of interest are the result of heterogeneous processes. Furthermore, Fewster [40, p. 28] argues that "any distribution arising in nature that is reasonably smooth and covers several orders of magnitude is almost guaranteed to obey Benford's Law".[1] Durtschi et al. [24, p. 23] go so far as to state that "Most accounting-related data can be expected to conform to a Benford distribution, and thus will be appropriate candidates for digital analysis".

In settings where Benford's Law is the norm, significant deviations from Benford's Law are taken as manifestations of low data quality, or symptoms of possible data manipulations or even fraud.

Benford's first digit law takes a surprisingly simple form:

$$\Pr(X = d_i) = b_i = \log_{10}\left(1 + \frac{1}{d_i}\right) \tag{1}$$

where X denotes the first significant digit of the item and $d_i \in \{1,\dots,9\}$. We will denote by b_i the probability defined in (1).

Conformity of data with Benford's distribution can be tested using different statistics [see, e.g.25,48–50]. One of the most commonly used statistics is Pearson's chi-square:

$$\chi^2 = n\sum_{i=1}^{9}\frac{\left(p_i - b_i\right)^2}{b_i} \tag{2}$$

where n is the number of observations and p_i represents the proportion of the first digits $(1,\dots,9)$ in the sample. Despite its widespread use, the χ^2 has been criticized by some authors on the grounds that it has "excessive power" – i.e., it tends to reject the null of conformity with Benford's Law even in the presence of tiny unimportant deviations – when the number of observations is very large [25,51]. For this reason, Drake and Nigrini [23] and Nigrini [25] proposed using the Mean Absolute Deviation (MAD) criterion, a measure of the average distance between the relative frequencies of the observed digits with Benford's theoretical frequencies:

$$MAD = \frac{1}{9}\sum_{i=1}^{9}\left|p_i - b_i\right| . \tag{3}$$

[1] This claim should not be read as a necessary condition for data to follow Benford's Law. A counterexample is the random variable $X = k10^Y$, where Y is a standard uniform variable and $k > 0$. In this case, X is exactly Benford but does not necessarily span several orders of magnitude.

In the proponents' intentions, this criterion should be independent of the number of observations, n, and this should help overcome the "excess of power" problem. However, Cerqueti and Lupi [50] show that when data conform with Benford's distribution, the MAD statistic depends on n and is $O_p\left(n^{-\frac{1}{2}}\right)$. These features make the MAD criterion unfit to be used as a statistical test and to be applied to compare conformity with Benford's Law in samples of different size.

In order to take into account these issues, our empirical investigation is structured as follows. We start from a visual comparison of the empirical and theoretical frequencies. We proceed by computing the standard χ^2 test and the adjusted MAD statistic proposed in Cerqueti and Lupi [50], a scaled version of the MAD:

$$MAD^* = \frac{\sqrt{n}}{9}\sum_{i=1}^{9}\frac{\left|p_i - b_i\right|}{\sqrt{b_i(1-b_i)}} . \tag{4}$$

Cerqueti and Lupi [50] show that under the null of data conformity with Benford's Law

$$MAD^* \xrightarrow{d} \mathrm{N}\left(\sqrt{\frac{2}{\pi}}, \frac{1}{9^2}\sum_{i=1}^{9}\sum_{j=1}^{9} r_{ij}\right) \text{ as } n \to \infty \tag{5}$$

where

$$r_{ij} = \frac{2}{\pi}\left[\rho_{ij}\arcsin(\rho_{ij}) + \sqrt{1-\rho_{ij}^2}\right] \tag{6}$$

and

$$\rho_{ij} = -\sqrt{\frac{b_i b_j}{(1-b_i)(1-b_j)}} . \tag{7}$$

Therefore, when appropriately standardized, the adjusted MAD is asymptotically distributed as $\mathrm{N}(0,1)$ under the null.

The standardized adjusted MAD and Pearson's χ^2 are the first choice to detect departures from Benford's Law in many situations characterized by a random contamination of the law [50]. Of course, comparison of the results from samples of different size remains problematic, due to the different power of the tests in the presence of few or many observations. In fact, consistent tests (such as those used in this paper) may reject the null hypothesis even for tiny and practically unimportant deviations from the null, when $n \to \infty$. Therefore, following a suggestion in Cerqueti and Lupi [50], we use subsampling bootstrap [15]. Subsampling bootstrap (or simply subsampling) draws samples without replacement of size m from the original sample of size n, where $m < n$. Subsampling guarantees that, provided the statistic of interest has a proper distribution, the subsampling statistics have the same distribution. Therefore, we can compare the statistics computed in the smaller sample with those consistent with the larger sample by subsampling from the larger one.

Table 1
MOEs' pre-tax income descriptive statistics. Sample 1 represents the financial statements relative to ordinary periods of utility sector MOEs with the municipality owning more than half (>50%) of the total shares; Sample 2 refers to the financial statements of the same MOEs referring to the year preceding local elections; Samples 3 and 4 contain financial statement data of utility sector MOEs entirely controlled by the municipality (the latter owning 100% of the shares), respectively in ordinary periods and during election periods.

	Sample 1 ordinary-time data ownership > 50%	Sample 2 pre-election data ownership > 50%	Sample 3 ordinary-time data ownership = 100%	Sample 4 pre-election data ownership = 100%
n	3,964	1,057	2,353	630
Min.	1	21	1	75
1st Qu.	30,751	30,890	23,386	23,756
Median	126,912	126,329	75,602	84,561
Mean	1,403,922	1,245,837	676,252	750,310
3rd Qu.	484,990	518,644	292,752	352,463
Max.	229,809,000	96,565,837	45,040,000	39,724,000
s.d.	9,398,305	6,349,160	2,562,223	2,623,179

4. Data analysis

In this paper we concentrate on utility sector MOEs' pre-tax income, in line with Van Caneghem [13] who was the first to introduce discretionary accruals in this stream of research. We are not inferring whether entities manage reported earnings upward or downward as we are only interested in detecting whether there are diffuse signals of accounting data manipulations in certain periods, regardless of their signs. Furthermore, given that Benford's analysis can be applied only to positive quantities, and given that different incentives may hold for positive or negative values of income, we selected only positive pre-tax income values.[2]

As shown in Table 1, the sample is made of 5,021 observations over a decade (2011–2020), including an average of two election cycles for each entity. We noted that the data span several orders of magnitude, the minimum value being 1 and the maximum 229,809,000. In line with Fewster [40], this observation confirms that, in the absence of manipulations, the data are very likely to conform to Benford's distribution. The large mean-to-median ratio also suggests the same conclusion [24]. We further split the sample into a pre-election sample (containing the observations relative to the MOEs' financial statements of the years preceding the local elections) and an ordinary-time sample (containing the observations relative to ordinary periods). The pre-election sample consists of 1,057 observations; the ordinary-time sample is nearly four times larger and contains 3,964 observations.

We apply the standard χ^2 and the adjusted and standardized MAD tests to the data in the different sub-samples to check conformity with Benford's first-digit law. We start from the case where the municipality owns the majority (> 50%) of the shares. The analysis reveals that, while in ordinary periods data conform with Benford's Law (Fig. 2, panel B), in pre-election times the empirical distribution of the first digit decreases irregularly, with some important deviation from Benford's Law (Fig. 2, panel A). In fact, both the adjusted MAD and the χ^2 tests reject the null hypothesis (of data conformity with Benford's Law) using a 5% significance level. Since our data include data that may deviate from Benford's Law (pre-election data) as well as a control group whose data are expected not to deviate from Benford's Law (ordinary-time data), we are in the position to run also a chi-square homogeneity test, to check the null hypothesis that the differences between the empirical frequencies in the two samples can be attributed to the effect of chance alone, the underlying distribution being the same across the two populations. The test in this case has a p value equal to 0.064, so that we can reject the homogeneity hypothesis at a significance level just above the conventional 5% level. Despite this rejection, one might still wonder whether the rejection of Benfordness in pre-election data stems from the fact that the empirical frequencies represented in panel A of Fig. 2 are more irregular simply because they are based on fewer observations. However, it should be observed that, despite the fact that the ordinary-time sample is significantly larger (and consequently the power of the tests is higher), both the adjusted MAD and the chi-square tests are unable to reject the null hypothesis that the observed values conform with Benford's Law in the ordinary-time data. On the contrary, the null of conformity with Benford's Law is rejected in the smaller pre-election sample where the power of the tests is lower. Therefore, rejection of the null of conformity in pre-election data cannot be an artefact created by sample size. Furthermore, by subsampling from the ordinary-time data 10,000 independent samples, each made of 1,057 observations (the same sample size as the pre-election sample), it is possible to derive the distribution of the test statistics [15]. If data in the larger sample conform to Benford's Law, we should expect the distribution of the test statistics to approximate their theoretical limit distribution under the null. In fact, this is what happens in panels C and D of Fig. 2, where the subsampling distributions and the theoretical distributions of the test statistics under Benford's Law match almost perfectly. The vertical lines in panels C and D represent instead the values of the test statistics in the pre-election sample and confirm that the realized values of the test statistics are very unlikely under the distribution observed in the ordinary-time data, in samples of the same size as the pre-election data. All these results point towards the existence of significant differences in the quality of financial statements in periods approaching local elections with respect to regular periods.

We also investigate conformity with Benford's Law using a sample made exclusively of entities fully owned by the reference municipalities (i.e., when the municipality owns 100% of the shares of the entity). In this case the sample is made of 2,983 observations. The pre-election sample is made of 630 observations; the ordinary-time sample is again nearly four times larger and contains 2,353 observations. The chi-square test of homogeneity strongly rejects (with a p value equal to 0.008) the null hypothesis that the empirical digit distributions in the pre-election and ordinary-time samples derive from the same underlying distribution.[3] The empirical results point in the same direction as before, confirming data conformity in regular periods, and signalling the presence of anomalies in the distribution of pre-election data (see

[2] The number of negative observations is small and does not allow us to carry out the analysis using only the absolute value of the negatives.

[3] On the other hand, the same homogeneity test applied to the empirical distributions for different ownership quota show that in pre-election data the digit empirical distributions for the two ownership levels are compatible with the same underlying distribution (p value equal to 0.965); the same result holds also for ordinary-time data (p value equal to 0.907).

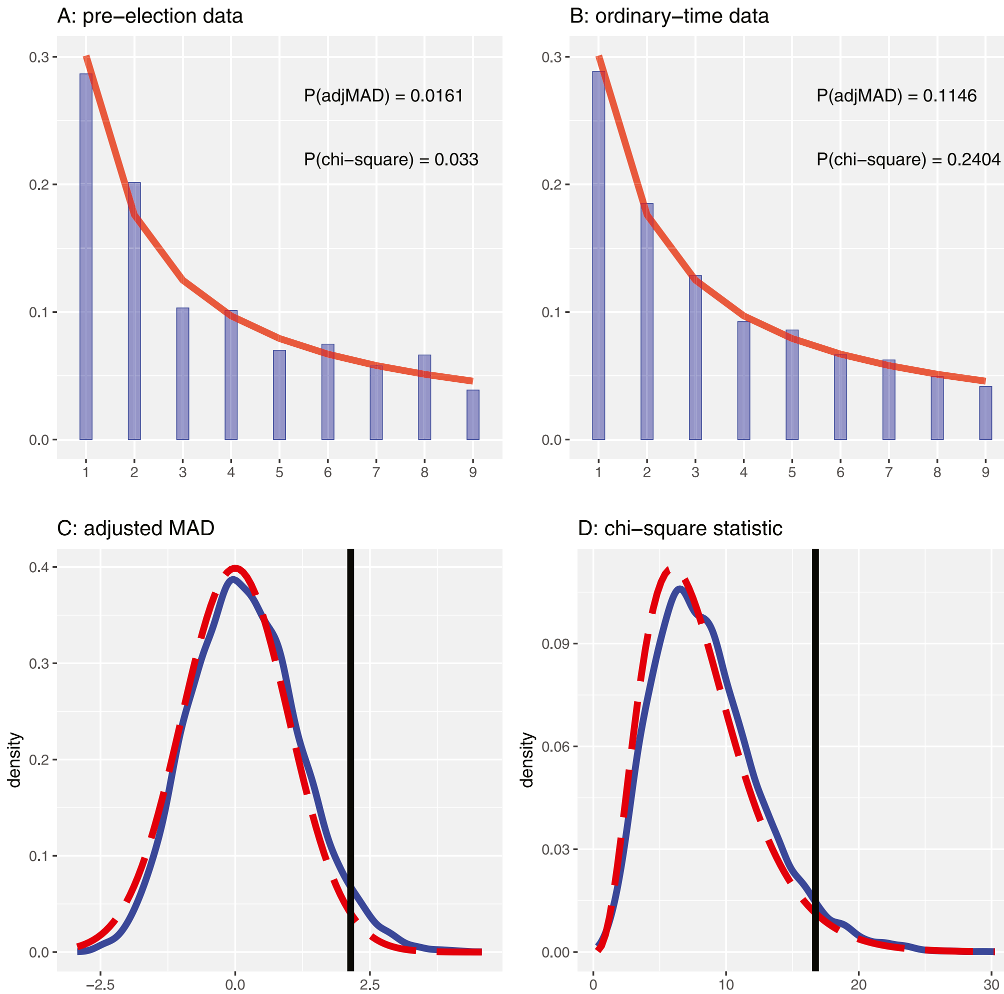

Fig. 2. MOEs with at least 50% ownership on the part of the municipalities. Panels A and B report the empirical (blue bars) and Benford's (red curves) values of the first digit frequencies for pre-election data and ordinary-time data, respectively. $P(\cdot)$ denotes the p value of the corresponding test. Panels C and D report the densities of the relevant statistics estimated using 10,000 subsamples from the ordinary-time data (blue solid curves) and the theoretical densities under the null hypothesis that Benford's Law is valid (red dashed curves). The vertical lines indicate the value of the relevant statistics in pre-election data. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 3). Furthermore, despite being based on fewer observations, in this case the evidence against Benford's distribution in pre-election data is even stronger.

5. Discussion and conclusions

This paper deals with the crucial problem of the possible existence of political manipulation of microeconomic data before local elections. We use a data science approach based on Benford's Law that avoids strong modelling assumptions. Specifically, we examine the first-digit distribution of pre-tax income numbers of a sample of Italian municipally owned entities (MOEs, with the municipality holding more than 50% of the firms' total shares) operating in the utility sector. We confirm that pre-tax income numbers conform to Benford's Law in regular periods. However, we find signs of financial statement manipulation around election periods, especially for entities entirely controlled by the municipality (i.e., with the latter owning 100% of total shares). Chi-square tests of homogeneity of the empirical first digit distributions in pre-election and in ordinary-time data support the same conclusion by rejecting the null hypothesis that the first digit distributions are the same across the samples, irrespective of the Benfordness of the relevant variables. Arguably, this is another symptom of a change in data quality or of the presence of data manipulations.

It should be stressed that by "manipulation" we do not necessarily mean that managers engage in *illegal* activities: manipulation can occur also without trespassing the boundaries of general accepted accounting principles (GAAP) when managers, required to use their judgement to assess financial statement discretionary items, do so to achieve desired specified goals rather than to offer a faithful and fair view of the company's financial position.

The entities analyzed in this study operate in socially relevant industries, such as public transport, provision of gas, water and electric energy, and environmental hygiene. The evidence prompts us to argue that when people have both power to exercise over third parties (e.g. politicians on MOEs' managers) and interest in engaging in misleading accounting behaviour (e.g., during pre-electoral periods in order to attract voters), the social context that arises in these given environments and specific periods can lead to a context prone to self-serving use of accounting data and a decrease in the quality of financial statement results. Stated differently, in a pre-electoral context, incumbent politicians can exercise the power they have over MOEs' executives to make them perform accounting manipulatory activities in order to accommodate their political ambitions.

A first direct implication of this study is relevant for external/internal auditors (and perhaps for forensic accountants, or even judicial

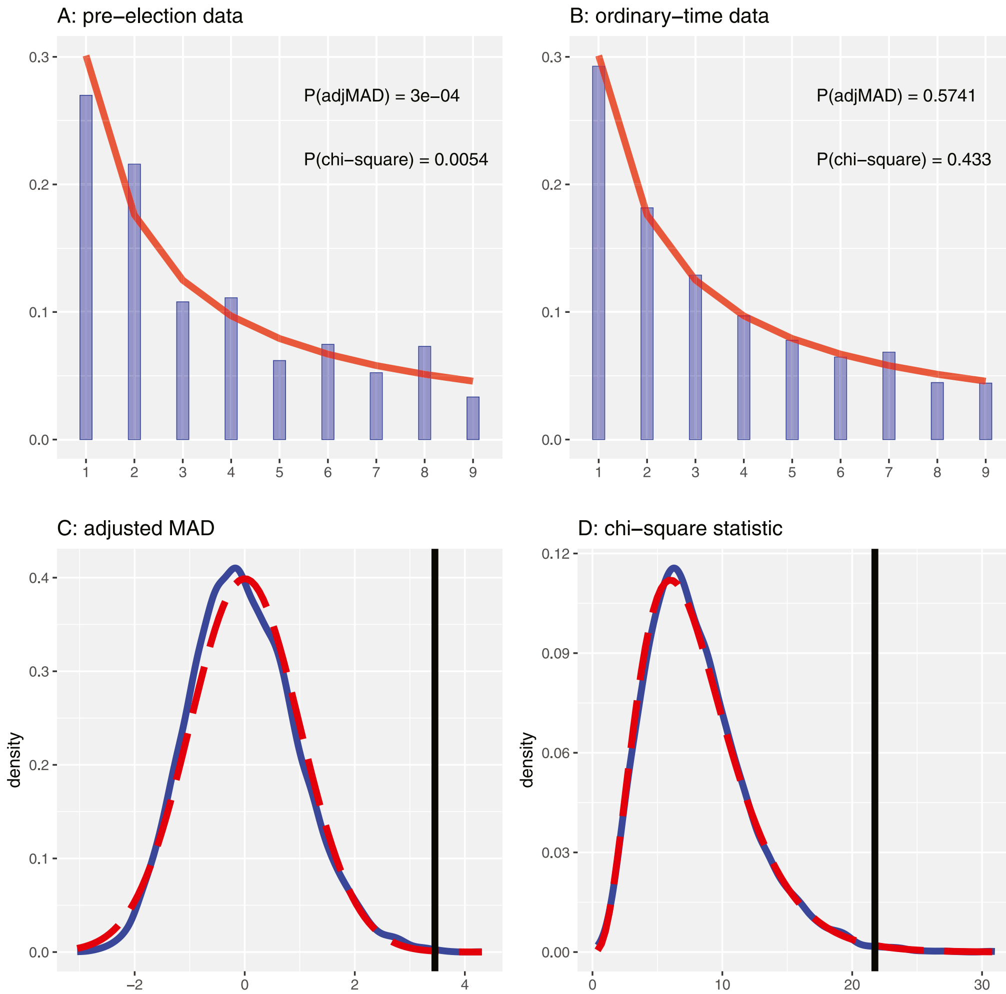

Fig. 3. MOEs with 100% ownership on the part of the municipalities. Panels A and B report the empirical (blue bars) and Benford's (red curves) values of the first digit frequencies for pre-election data and the ordinary-time data, respectively. $P(\cdot)$ denotes the p value of the corresponding test. Panels C and D report the densities of the relevant statistics estimated using 10,000 subsamples from the ordinary-time data (blue solid curves) and the theoretical densities under the null hypothesis that Benford's Law is valid (red dashed curves). The vertical lines indicate the value of the relevant statistics in pre-election data. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

bodies that aim to protect public finance balances), who will need to pay close attention to the quality of financial statements during pre-electoral periods, especially in particular environments (i.e., MOEs operating in economically and socially relevant industries). It also seems necessary to isolate managers from political influences by introducing more transparent appointing procedure as advocated by the OECD Guidelines for the governance of State owned entities. To guarantee administrators' independence, policy makers could create disincentives to incumbent politicians from exercising power over MOEs' managers. Lastly, voters and media will need to be critical in assuming MOEs' indicators of financial performance as proxies of the administrative efficiency of incumbent politicians, although those firms represent economically relevant sectors.

Of course, we cannot exclude the possibility that executives engaging in pre-electoral accounting data manipulation do so for personal reasons and not in response to politicians' pressure. The Positive Accounting Theory predicts that managers engage in earnings management activity to reduce political costs deriving from the choices that politicians make on the basis of financial statement results [52] and definitely around election times, these costs are likely to be perceived higher by all sorts of politically connected entities [53]. Nonetheless, we leave to further research the attempt to untangle the roles that managers' personal motivations and pressure from politicians may have on detected pre-electoral accounting data manipulations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Acknowledgements

Participants at the 2nd EIASM (European Institute for Advanced Studies in Management) workshop on Frauds and Accounting Scandals, the 31st BAFA (British Accounting & Finance Association) Audit and Assurance conference, the 18th CIGAR (Comparative International

Governmental Accounting Research network) Public Sector Accounting biennial conference, the 11th EIASM International Public Sector conference, the 2022 AFAANZ (Accounting and Finance Association of Australia and New Zealand) annual conference, and the 2nd IRSPM (International Research Society for Public Management) Annual General Meeting 2022 gave feedback that was fundamental in improving the paper upon early versions. Insightful comments from Roy Cerqueti are gratefully acknowledged.

References

[1] Cooper DJ, Dacin T, Palmer D. Fraud in accounting, organizations and society: Extending the boundaries of research. Account Organ Soc 2013;38(6–7):440–57. http://dx.doi.org/10.1016/j.aos.2013.11.001.
[2] Buchanan JM, Tullock G. The calculus of consent: Logical foundations of constitutional democracy. Ann Arbor, MI: University of Michigan Press; 1962.
[3] Mueller DC. Public choice: A survey. J Econ Lit 1976;14(2):395–433.
[4] Rogoff K, Sibert A. Elections and macroeconomic policy cycles. Rev Econom Stud 1988;55(1):1–16. http://dx.doi.org/10.2307/2297526.
[5] Besley T, Case A. Does electoral accountability affect economic policy choices? Evidence from gubernatorial term limits. Q J Econ 1995;110(3):769–98. http://dx.doi.org/10.2307/2946699.
[6] Black EL, Sellers KF, Manly TS. Earnings management using asset sales: An international study of countries allowing noncurrent asset revaluation. J Bus Finance Account 1998;25(9–10):1287–317. http://dx.doi.org/10.1111/1468-5957.00238.
[7] Brender A, Drazen A. Political budget cycles in new versus established democracies. J Monetary Econ 2005;52(7):1271–95. http://dx.doi.org/10.1016/j.jmoneco.2005.04.004.
[8] Chen X, Lee CWJ, Li J. Government assisted earnings management in China. J Account Public Policy 2008;27(3):262–74. http://dx.doi.org/10.1016/j.jaccpubpol.2008.02.005.
[9] Arrow KJ. Social choice and individual values. 3rd ed. New Haven, CT: Yale University Press; 2012.
[10] Drago F, Nannicini T, Sobbrio F. Meet the press: How voters and politicians respond to newspaper entry and exit. Am Econ J Appl Econ 2014;6(3):159–88. http://dx.doi.org/10.1257/app.6.3.159.
[11] Repetto L. Political budget cycles with informed voters: Evidence from Italy. Econ J 2018;128(616):3320–53. http://dx.doi.org/10.1111/ecoj.12570.
[12] OECD. OECD guidelines on corporate governance of state-owned enterprises. 2015 ed. Paris: OECD; 2015, http://dx.doi.org/10.1787/9789264244160-en.
[13] Van Caneghem T. The impact of audit quality on earnings rounding-up behaviour: Some UK evidence. Eur Account Rev 2004;13(4):771–86. http://dx.doi.org/10.1080/0963818042000216866.
[14] Herteliu C, Jianu I, Dragan IM, Apostu S, Luchian I. Testing Benford's Laws (non)conformity within disclosed companies' financial statements among hospitality industry in Romania. Physica A 2021;582:126221. http://dx.doi.org/10.1016/j.physa.2021.126221.
[15] Politis DN, Romano JP. Large Sample Confidence Regions based on subsamples under minimal assumptions. Ann Statist 1994;22(4):2031–50. http://dx.doi.org/10.1214/aos/1176325770.
[16] Bognetti G, Robotti L. The provision of local public services through mixed enterprises: The Italian case. Ann Public Coop Econ 2007;78(3):415–37. http://dx.doi.org/10.1111/j.1467-8292.2007.00340.x.
[17] Grossi G, Reichard C. Municipal corporatization in Germany and Italy. Public Manag Rev 2008;10(5):597–617. http://dx.doi.org/10.1080/14719030802264275.
[18] Monteduro F. Public-private versus public ownership and economic performance: evidence from Italian local utilities. J Manag Gov 2012;18(1):29–49. http://dx.doi.org/10.1007/s10997-012-9235-4.
[19] R Core Team. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2022, URL: https://www.R-project.org/.
[20] Benford F. The law of anomalous numbers. Proc Am Phil Soc 1938;78(4):551–72.
[21] Nigrini MJ, Mittermaier LJ. The use of Benford's Law as an aid in analytical procedures. Auditing J Pract Theory 1997;16(2):52–67.
[22] Nigrini MJ. I've got your number. J Account 1999;187(5):79–83.
[23] Drake PD, Nigrini MJ. Computer assisted analytical procedures using Benford's Law. J Account Educ 2000;18(2):127–46. http://dx.doi.org/10.1016/s0748-5751(00)00008-7.
[24] Durtschi C, Hillison W, Pacini C. The effective use of Benford's Law to assist in detecting fraud in accounting data. J Forensic Account 2004;5(1):17–34.
[25] Nigrini MJ. Benford's Law: Applications for forensic accounting, auditing, and fraud detection. Hoboken, NJ: John Wiley & Sons; 2012, http://dx.doi.org/10.1002/9781119203094.
[26] Ausloos M, Castellano R, Cerqueti R. Regularities and discrepancies of credit default swaps: A data science approach through Benford's Law. Chaos Solitons Fractals 2016;90:8–17. http://dx.doi.org/10.1016/j.chaos.2016.03.002.
[27] Ausloos M, Cerqueti R, Mir TA. Data science for assessing possible tax income manipulation: The case of Italy. Chaos Solitons Fractals 2017;104:238–56. http://dx.doi.org/10.1016/j.chaos.2017.08.012.
[28] Villas-Boas SB, Fu Q, Judge G. Benford's Law and the FSD distribution of economic behavioral micro data. Physica A 2017;486:711–9. http://dx.doi.org/10.1016/j.physa.2017.05.093.
[29] Riccioni J, Cerqueti R. Regular paths in financial markets: Investigating the Benford's Law. Chaos Solitons Fractals 2018;107:186–94. http://dx.doi.org/10.1016/j.chaos.2018.01.008.
[30] Shi J, Ausloos M, Zhu T. Benford's Law first significant digit and distribution distances for testing the reliability of financial reports in developing countries. Physica A 2018;492:878–88. http://dx.doi.org/10.1016/j.physa.2017.11.017.
[31] Kaiser M. Benford's Law as an indicator of survey reliability – Can we trust our data? J Econ Surv 2019;33(5):1602–18. http://dx.doi.org/10.1111/joes.12338.
[32] Miranda-Zanetti M, Delbianco F, Tohmé F. Tampering with inflation data: A benford law-based analysis of national statistics in Argentina. Physica A 2019;525:761–70. http://dx.doi.org/10.1016/j.physa.2019.04.042.
[33] Nigrini MJ. Forensic analytics: Methods and techniques for forensic accounting investigations. 2nd ed. Hoboken, NJ: John Wiley & Sons; 2020.
[34] Ausloos M, Ficcadenti V, Dhesi G, Shakeel M. Benford's Laws tests on S&P500 daily closing values and the corresponding daily log-returns both point to huge non-conformity. Physica A 2021;574:125969. http://dx.doi.org/10.1016/j.physa.2021.125969.
[35] Parnes D. Banks's off-balance sheet manipulations. Q Rev Econ Finance 2022;86:314–31. http://dx.doi.org/10.1016/j.qref.2022.07.011.
[36] Raimi RA. The first digit problem. Amer Math Monthly 1976;83(7):521–38. http://dx.doi.org/10.2307/2319349.
[37] Hill TP. A statistical derivation of the significant-digit law. Statist Sci 1995;10(4):354–63. http://dx.doi.org/10.1214/ss/1177009869.
[38] Pietronero L, Tosatti E, Tosatti V, Vespignani A. Explaining the uneven distribution of numbers in nature: the laws of Benford and Zipf. Physica A 2001;293(1–2):297–304. http://dx.doi.org/10.1016/s0378-4371(00)00633-6.
[39] Gottwald GA, Nicol M. On the nature of Benford's Law. Physica A 2002;303(3–4):387–96. http://dx.doi.org/10.1016/s0378-4371(01)00497-6.
[40] Fewster RM. A simple explanation of Benford's Law. Amer Statist 2009;63(1):26–32. http://dx.doi.org/10.1198/tast.2009.0005.
[41] Formann AK. The Newcomb-Benford Law in its relation to some common distributions. In: Morris RJ, editor. PLoS One 2010;5(5):e10541. http://dx.doi.org/10.1371/journal.pone.0010541.
[42] Eliazar II. Benford's Law: A Poisson perspective. Physica A 2013;392(16):3360–73. http://dx.doi.org/10.1016/j.physa.2013.03.057.
[43] Kossovsky AE. Benford's Law: Theory, the general law of relative quantities, and forensic fraud detection applications, vol. 3. Singapore: World Scientific; 2014.
[44] Berger A, Hill TP. An introduction to Benford's Law. Princeton, NJ: Princeton University Press; 2015.
[45] Miller SJ, editor. Benford's Law: Theory and applications. Princeton, NJ: Princeton University Press; 2015.
[46] Whyman G, Ohtori N, Shulzinger E, Bormashenko E. Revisiting the Benford law: When the Benford-like distribution of leading digits in sets of numerical data is expectable? Physica A 2016;461:595–601. http://dx.doi.org/10.1016/j.physa.2016.06.054.
[47] Fang G, Chen Q. Several common probability distributions obey Benford's Law. Physica A 2020;540:123129. http://dx.doi.org/10.1016/j.physa.2019.123129.
[48] Lesperance M, Reed WJ, Stephens MA, Tsao C, Wilton B. Assessing conformance with Benford's Law: Goodness-of-fit tests and simultaneous confidence intervals. PLoS One 2016;11(3):1–20. http://dx.doi.org/10.1371/journal.pone.0151235.
[49] Barabesi L, Cerasa A, Cerioli A, Perrotta D. Goodness-of-fit testing for the Newcomb-Benford law with application to the detection of customs fraud. J Bus Econom Statist 2018;36(2):346–58. http://dx.doi.org/10.1080/07350015.2016.1172014.
[50] Cerqueti R, Lupi C. Some new tests of conformity with Benford's Law. Stats 2021;4(3):745–61. http://dx.doi.org/10.3390/stats4030044.
[51] Kossovsky AE. On the mistaken use of the chi-square test in Benford's Law. Stats 2021;4(2):419–53. http://dx.doi.org/10.3390/stats4020027.
[52] Watts RL, Zimmerman JL. Positive accounting theory: A ten-year perspective. Account Rev 1990;65(1):131–56.
[53] Ramanna K, Roychowdhury S. Elections and discretionary accruals: Evidence from 2004. J Account Res 2010;48(2):445–75. http://dx.doi.org/10.1111/j.1475-679x.2010.00373.x.