

PLAYING THE NUMBERS GAME

EXAMINING STRATEGIC ROUNDING OF EPS DATA IN SWEDEN

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Abstract:

This thesis explores strategic rounding in earnings per share (EPS) in Sweden from 2003 to 2023 by analyzing the frequency of the third decimal digit in EPS data, with an in-depth focus on the digit 4. Contrary to previous US data research, we find no proof that a rounding bias exists in the third decimal place. We test our findings over time, by firms, and for firm factors, being size, EPS magnitude, and growth-value dynamics, where none show signs that rounding occurs. We consider whether currency affects rounding incentives by applying a comparative approach with other Nordic countries but fail to find support. Examining the second decimal place indicates that rounding might occur as zeroes are overrepresented and nines are underrepresented, which could be analyzed further in future research. Our findings contribute to the research field by showcasing different results in another geographical market compared to previous literature, as well as examining the potential effect currencies have on rounding incentives.

Keywords:

Earnings per share, Rounding, Earnings Management, Financial Manipulation

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I. Introduction

Within financial reports, earnings per share (generally denoted as EPS) is a mandatory measure that enables external parties to efficiently compare the firm's performance internally throughout periods and externally between peers in the same industry. Basic EPS is, according to IFRS, defined as the following:

Basic earnings per share shall be calculated by dividing profit or loss attributable to ordinary equity holders of the parent entity (the numerator) by the weighted average number of ordinary shares outstanding (the denominator) during the period.

EPS, commonly rounded to two decimals, is essential for investors when deciding which investment projects to allocate capital to. Driven by incentives such as meeting analysts' expectations and being more attractive to new investors and financial enterprises, managers might be tempted to manipulate a firm's reported net earnings or number of shares to push the calculations so that the reported EPS becomes rounded one additional cent higher than its actual value. Although rounding of EPS does not necessarily infer that an accounting policy has been violated, as it can occur naturally, finding consistent non-random trends in underlying rounding behavior could help identify firms with an aggressive accounting culture. Such firms are more likely to engage in potentially risky or problematic accounting practices that can lead to enforcement proceedings and litigation in the future.

This has been covered in past research. Most recently, a research paper by Malenko, Grundfest, and Shen ([2023](#)) named "Quadrophobia: Strategic Rounding of EPS Data" has gained quick breakthroughs within the practical field. They analyze the frequency of the number 4 in the third decimal place, as this digit requires the least effort to round up to receive one additional cent in the reported EPS. They show that persistent avoidance of reporting a 4 holds predictive power on companies found guilty of accounting misconduct. Building on their research, the SEC (United States Securities and Exchange Commission) has introduced departments to control for similar signs of accounting malpractice. Litigation action against some companies has taken place as a direct result of its implementation, proving the method's practical usefulness.

Expanding on the methodology established by Malenko et al. ([2023](#)), our paper explores the presence of rounding-up bias in the Swedish enterprise environment by looking at the distribution of the third decimal digits from 2003 to 2023. We pay additional attention to the presence of the number 4 as the third decimal digit due to its ease of rounding up EPS by an extra second decimal digit. By running our experiment using Swedish data, we expand the research field to new geographics as all previous research has been done on US data. We calculate EPS manually by dividing net income by the weighted average number of shares outstanding and extracting the third decimal digit. The frequency of each digit is calculated for diluted EPS, where the total occurrences of each digit are divided by the total sample size. The results show no signs of a rounding bias. We compare the results with other variables by performing the same methodology for revenue per share, gross profit per share, and operating income per share. These confirm that our null hypothesis, that each digit should occur with a 10% chance, is reasonable.

We run a robustness test on our findings for firm-specific rounding by following the novel method proposed by Malenko et al. (2023) regarding the variable *Quadrophobia-score* (*Q-score*), where the digit 4 is in focus. The binary variable takes on the value of 0 if the firm has a third decimal digit being 4 in any previous quarters and 1 if there are zero occurrences of the digit 4. The exclusion of the digit 4 indicates non-randomness in reporting numbers, potentially due to strategic and persistent rounding of EPS. We calculate the difference in frequency of reporting the digit 4 between the firms with a Q-score of 0 and those with 1 and examine the results for different periods. The results show that historical reporting patterns cannot prove that potential rounding of the third decimal digit occurs within specific firms.

Next, time-specific rounding is analyzed to see whether there have been periods where potential rounding occurred more often than other periods. We plot the frequency of digit 4 in the third decimal place on an annual basis and find no empirical evidence that some periods had more potential rounding than others.

Continuing our analysis, we test the importance of specific firm factors deemed important in prior literature concerning rounding incentive structures. These are limited to firm size, EPS magnitude, and price-to-book ratio. The data is sorted based on each factor and split into 10 groups, from which we calculate the frequency of reporting the digit 4 and implement a low-minus-high strategy between group 1 and group 10. We also run a probit regression to see if the factors can predict when digit 4 occurs or, in our case, when it fails to occur. Our analysis shows that none of the firm factors examined are related to a rounding bias in EPS.

In our analysis, we use the Swedish currency *krona* (SEK), and its counterpart to the cent, *öre*. For reference, SEK is valued at approximately 1/10th of a US dollar. This discrepancy results in a difference between the intrinsic value of the third decimal place between the two currencies, implying that the incentive gains of manipulating financial data in Sweden could differ from those in the US. To examine whether currency affects rounding incentives, we run similar tests as before on the third decimal place on datasets from Finland, Denmark, and Norway. The benefit of this is that we can fix effects related to culture and geography while changing the currency between Norway's NOK, Denmark's DKK, and Finland's EUR. We don't find proof that different currencies impose different distributions in the third decimal digits. Moreover, we examine whether potential rounding exists in the second decimal place as a lower-valued currency could increase interest to round a higher-valued decimal position. We find that rounding in the second decimal place is potentially occurring, but no proof that currency is the sole explanation.

We compare our findings to past literature to understand why our results differ. We argue that diverging incentive packages or cultural differences are the most probable causes of the contradicting results, but these have not been tested quantitatively. In conclusion, we cannot establish any empirical evidence that rounding in the third decimal digit in EPS took place in Sweden in any way between the years 2003 to 2023.

II. Background

Accounting Standards in Sweden

Contrary to the United States, which accepts GAAP as its national accounting standard, Sweden, per its membership in the EU, is required to use IFRS as its national accounting standard for public companies since IFRS was adopted into European law in 2005. IFRS is the most common accounting standard in the world, having been adopted by 168 different jurisdictions. GAAP and IFRS share many similarities, but the major differences lie in the reporting on inventory, intangibles, and recognition of revenue.

Earnings per share was introduced in the International Accounting Standards Committee in 1997 before being adopted by the International Accounting Standards Board in 2001 as part of the IFRS foundation. Comparing the distinction of EPS between IFRS and GAAP, there are no significant differences in how the ratio is reported relevant to the research performed in this paper. However, *Reported EPS* (or *GAAP EPS*) is a specific reporting instrument related to the SEC in the US, which has been used in the research by Malenko et al. (2023) to measure which EPS ratio is of more interest to analysts between diluted and basic EPS by comparing it to the reported EPS. GAAP EPS is a measurement that we are, to the best of our knowledge, unable to gather based on Swedish data, which has a slight negative effect on the reliability of our data in questions relating to which of the stated EPS figures are more in focus in Sweden.

Role of EPS in Sweden

The strategy of using fundamental valuation is well-established in the financial sector. EPS is a key ratio analysts use to determine whether companies are performing well or poorly, an intuition that translates into demand for investing in the company or avoiding it. Given that EPS is used by analysts globally, there should be no difference in the usage of EPS in Sweden versus the US. The main difference between the usage of EPS between the two countries is again that of GAAP EPS in the US. However, as Govindarajan, Srivastava, and Zhao (2021), mention in their Harvard Business Review article, there is an increasing trend for companies to report a “Non-GAAP” EPS, where 95% of the S&P 500 companies reported a non-GAAP EPS to enhance transparency and comparability by removing costs that are non-recurring or translate some intangible expenses into investments. This trend is also analyzed by Malenko et al. (2023), who compare cases where GAAP EPS is equal to Pro-Forma EPS (Non-GAAP EPS) and when it is not. Although there is a potential difference in where analysts pay their attention between the countries, this recent trend of implementing non-GAAP EPS points to increased demand for comparability. Conclusively, there shouldn’t be any difference in the usage of EPS between countries or accounting standards.

Accounting Malpractice

The meaning behind accounting malpractice is broad. Tutino and Merlo (2019) write “It consists of intentional manipulation of financial statements, which are done to create an illusion about a company’s wealth”. Malenko et al. (2023) state that the production of financial information is influenced by managerial judgments and subjective determinations, which can potentially lead to various distortions in financial reports.

Amar, Chen, Gaviious, and Weihs (2022) further describe how managers who engage in earnings management can use various techniques to affect the company's financial statements to better coincide with their self-interest. They describe how misconduct can undermine trust between companies, regulators, and market participants, potentially resulting in reduced stock prices, increased cost of capital, and reduced future earnings. In this paper, we will investigate if public firms in Sweden systematically use earnings management to round the third decimal digit in EPS. Rounding of EPS is not an illegal practice per se and does not necessarily infer that an accounting policy has been violated. However, the methods used to round and the persistence of rounding EPS in a firm can indicate an aggressive accounting culture. Those companies, as described by Malenko et al. (2023), are more likely to use risky accounting practices that result in litigation.

Economic Significance of Rounding

From an economic perspective, rounding by a single cent in EPS can appear insignificant. However, Das and Zhang (2003) argue that an additional cent can sometimes have significant valuation implications. For example, Skinner and Sloan (1999) show that the stock prices of high-growth firms suffer substantial downward adjustments on negative earnings announcements, potentially increasing incentives for managers in high-growth firms to perform rounding activities. Further investigation into the effect of earnings management on security pricing through accruals was conducted by Defond and Park (2001). Their research shows that abnormal accruals, often used to manipulate earnings to increase EPS, play a vital role in shaping the market's responses to earnings surprises. They highlight the connection between earnings management, abnormal accruals, and investors' reactions to the stock market.

An example that underscores the importance of rounding up with something as small as a cent is illustrated by McGough (2000) through discount retailer Dollar General. On May 9th, 2000, Dollar General reported earnings of 17 cents a share for its fiscal quarter. Precisely what security analysts had forecasted, resulting in investors bidding the stock up 50 cents on the day of the report. However, the company earned only 16.575 cents a share, which was below analysts' projections. Because of the possibilities resulting from rounding, Dollar General was able to round up to 17 cents and satisfy investors' expectations. McGough (2000) argues that due to the financial world's obsession with hitting earnings targets, even minor differences in earnings can give stocks a valuable boost.

Literature Review

The search for anomalies within financial statements has been a research topic for several years. Carslaw (1988) investigated how income numbers might mirror a pricing strategy often seen in retail, where prices just below a round figure (like \$1.99 instead of \$2.00) appear much cheaper. He suggested that companies might avoid reporting earnings that are just below such rounded figures, as they would appear much lower than they are, which might result in lower demand from investors. His theory suggests that in income figures, you can see a lot more zeros and fewer nines in the second-leftmost digit. After studying data from New Zealand, he found evidence supporting his theory.

Thomas (1989) built on Carslaw's paper to broaden the field of research to US datasets and ran a similar analysis using, among others, EPS data. Thomas' research showed that a similar smoothing effect is also in place for EPS data, where multiples of 5 cents occur at a higher frequency than expected when looking at the second decimal value.

Das and Zhang (2003) expanded on the results from Thomas (1989) by looking at the distribution of the third decimal digit in EPS, as the ability to round up should be less transparent. They conclude that digits between 5-9 occur more often than digits between 0-4, indicating that rounding of the last reported decimal number is likely. Additionally, they broaden the field by trying to understand the different incentives for why institutions and managers would manipulate their financial reports in such a fashion. They present evidence that firms are more likely to round up when they anticipate it will contribute to meeting analysts' forecasts, reporting positive profits, or sustaining recent performance. Further evidence is provided that firms are likely to use working capital accruals to round up earnings to meet analysts' benchmarks and thresholds. This combination of evidence and reasoning presented by Das and Zhang (2003) paved the way for further research into how firms manipulate their financial data, especially regarding analysts' forecasts.

A recent article within the same field was published by Malenko et al. (2023), in which the prevalence of the number 4 in the third decimal place was examined. The results were that digit 4 was significantly underrepresented in the sample of US firms between 1980 and 2021, indicating that rounding-up bias likely takes place at a systematic level. The authors introduce a "Q-score," measuring how firms fail to report a 4 continuously over different periods, and they show how the method has predictive power on accounting malpractice. Similar to the reasoning presented by Das and Zhang (2003), Malenko et al. (2023) show how firms with larger incentives related to size, meeting projections, and internal compensation packages have a higher likelihood of pursuing accounting misconduct. The findings in their research have motivated SEC's "EPS Initiative Program" and have garnered significant interest from practitioners and regulators. Several settlements arose from this initiative, underscoring the practical usefulness of this field research and the need for continued investigation.

Based on previous research, rounding has been proven likely to exist in the US market, and rounding behavior has practical importance as it could help predict aggressive accounting practices. With an exception for Carslaw (1988), the research field has exclusively focused on the American financial landscape. Although the benefits of reliable and extensive datasets based in the US are large, this results in a gap in the research field as we are currently unaware of the extent to which rounding could be an issue in other economies. We are also unaware of whether the currency used affects rounding, as all previous research has strictly used USD as the currency in focus. Sweden houses a stable economy with advanced regulatory institutions, as well as being part of the EU while maintaining its local currency. Hence, expanding the field into the Nordic markets allows us to examine these factors while maintaining robust results.

Research Questions

In this paper, we focus our analysis on the following questions:

- Q1. Are there signs of a systematic rounding bias in reported EPS in Swedish firms when looking at the distribution of the third decimal digit?*
- Q2. Are such rounding activities in the third decimal place in EPS consistent through time, firms, or firm factors?*
- Q3. Does the reported currency affect incentives to partake in such rounding activities?*

Malenko et al. ([2023](#)) have shown that systematic rounding bias indicates an aggressive accounting culture in firms, sometimes resulting in severe accounting and security law violations. Q1 helps us extend this reasoning by broadening the research field to a new geographical market. If signs of EPS rounding exist, this opens up new regulatory implications that could be applied in Sweden in the same way that the SEC has taken after Malenko's research in the US. Q2 improves the robustness of our assessment and discerning whether the results occur by chance or if the anomalies are consistent among certain firms, periods, or firm factors. Q3 allows us to cover a new aspect within this research field, namely a currency effect. Since we choose to focus on a Nordic country, we can consider different currencies in nearby countries of similar economic size while keeping other factors, such as culture, fixed. To our knowledge, the currency has never been analyzed in this field of research before.

III. Data

Data

Our main dataset is obtained through the Refinitiv Eikon database. Using the Refinitiv Eikon database as the exclusive data source ensures minimal discrepancies and helps enhance data accuracy. We gather quarterly financial fundamentals from publicly listed companies in Sweden between the years 2003 to 2023. From this output, we remove firm observations that lack all values or where the currency is not denoted in SEK. According to the Swedish Companies Registration Office, Swedish companies can report their earnings in SEK or EUR. Since we wish to compare the currency effect, we ensured consistency in currency by manually looking into each company's latest financial report to see which currency is being used. In total, 61 firms (and about 2000 firm observations) were omitted due to not reporting in SEK, which is about 5% of the original data and, therefore, should not affect our data too negatively in terms of reliability. Our final sample contains about 37000 quarterly observations from 824 firms. As we only looked at the currency that was most recently used in the companies' financial reports, we assume that all firms have been consistent in the currency used when reporting their finances over the entire period in focus. Some companies may have changed the currency used throughout this time, but the probability is low and should create a limited amount of noise if that is the case.

Our primary interest is in the variables Net Income Basic including extraordinary items, Shares used to calculate Basic EPS, and Shares used to calculate Diluted EPS. Other relevant variables for our analysis are Market Capitalization, Revenue, Gross Profit, Operating Income, Total Assets, and Price-to-Book Value Per Share. Revenue, Gross Profit, and Operating Income are important variables for us when testing assumptions regarding the distribution of digits for different financial metrics. Additionally, we use Total Assets and Price-to-Book Value Per Share as estimates when investigating if certain firm factors affect the likelihood of rounding practices. The data is skewed somewhat in terms of having more firm observations for more recent quarters, as shown in Figure A1 in the Appendix.

Furthermore, we extract similar datasets for Finland, Norway, and Denmark to measure the currency effect later in our analysis. These variables are also obtained from Refinitiv Eikon, using the same fundamentals and period. We extract the fundamentals using each country's currency. If we were to use a common currency for all countries, this would change the net income and, by doing so, also the EPS and the third decimal digit. If there is a systematic rounding strategy in those countries, the evidence of this would be omitted when changing the currency. Hence, we don't compare the samples relative to each other in any other way except for their distribution of reported decimals. Finland was the latest country to change the national currency out of the Nordic countries, changing to the euro in 1999 after joining the EU in 1995, which falls outside the scope of this paper and is a factor we, therefore, do not need to consider.

Difference in Basic EPS vs Diluted EPS

When examining rounding within EPS, we need to differentiate between Basic EPS and Diluted EPS. Companies and analysts tend to focus more on one of these key ratios, posing a greater risk of manipulation since a larger volume of analyst coverage increases managerial pressure to meet investor expectations, as proven by Yu (2008). Given the limited data on analyst coverage of the companies in our dataset, we choose to follow the results presented in previous research from Malenko et al. (2023), in which diluted EPS showed a closer resemblance to the expected reported EPS from analysts after the year 1997, indicating that the ratio was more interesting for analysts, and hence, for companies to manipulate. As our dataset starts in 2003, and no other materially significant accounting standard related to the reporting of EPS has taken place since 2001 in IAS 33, we assume diluted EPS is under more pressure of manipulation than basic EPS. As discussed previously, there shouldn't be any differences in the accounting standards used for this reasoning not to hold.

Table 1: Summary Statistics of EPS data

Table 1 displays Summary Statistics of our sample's Basic EPS and Diluted EPS. Basic EPS is defined as Net Income divided by Number of Basic Shares Outstanding, and Diluted EPS as Net Income divided by Number of Diluted Shares Outstanding.					
	Mean	Median	Min	Max	SD
EPS-Basic	-6.96	0.05	-66965.82	13197.7	432.82
EPS-Diluted	-6.97	0.05	-66965.82	13197.7	432.78

We also see in our summary statistics reported in Table 1 that the differences between using diluted or basic EPS are minimal for our dataset and shouldn't provide different results in general. Consequently, in our research method and the in-depth experiments tested, diluted EPS will be the focus, often referred to solely as EPS.

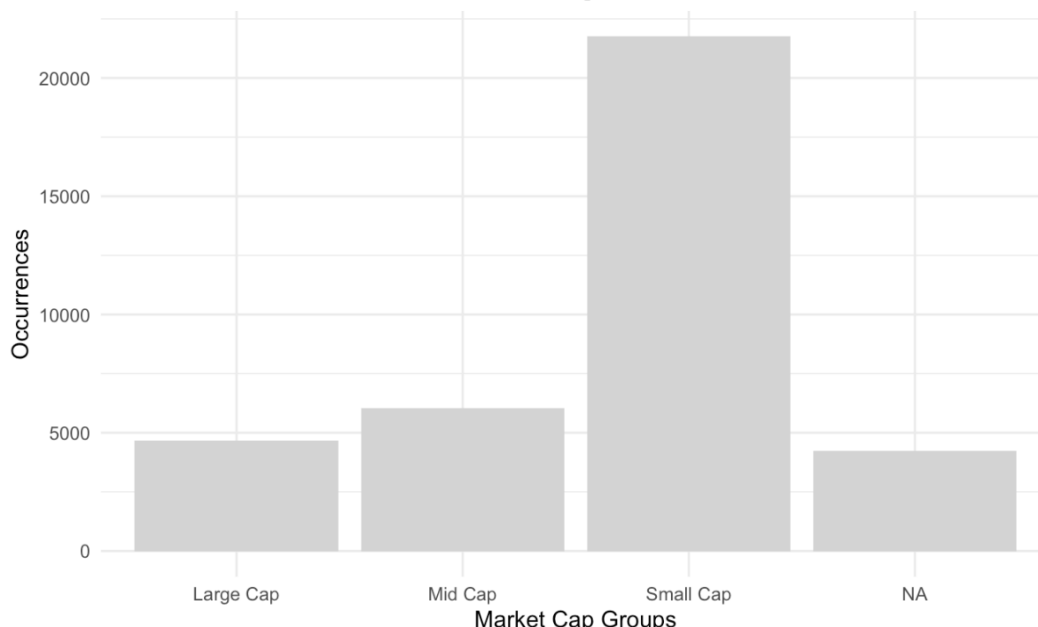
Brief Overview of the Dataset

Before analyzing economic rounding, we want to highlight that the absolute amounts related to rounding are generally small. Looking solely at 2021, the mean (median) amount required to increase the third decimal digit by one unit was 204,220 SEK (49,189), and relative to the net earnings, about 4.1% (0.11%). Comparing these numbers to those presented in Malenko et al. (2023) for the same year, the mean (median) was \$335,000 (\$58,000) or 0.13% (0.22%) of the firms' earnings for that quarter. The Swedish data contains a higher fraction of smaller firms, as the mean rounding required is substantially larger in the US than in Sweden. It is also worth noting that the mean fraction of rounding compared to net earnings in Sweden is substantial, at 4.1% compared to the US' 0.13%. The reason behind this is that there are many firms with extreme outliers, which we can see from the median being lower than the median in the US dataset.

We summarize the firm size in Figure 1 below. Market Cap is used to divide the firm observations into Large Cap, Mid Cap, and Small Cap. On the Swedish stock market, companies are sorted into Large Cap if the market value is above 1 billion EUR, Mid Cap between 1 billion EUR and 150 million EUR, and Small Cap below 150 million EUR. Since our financial data is in SEK, we assume 1 EUR is about 10 SEK and define observations as Large Cap if the Market Cap exceeds 10 billion SEK, Mid Cap between 10 billion SEK and 1.5 billion SEK, and Small Cap below 1.5 billion SEK. We acknowledge that this is not a perfect substitute, as the exchange rate has varied over the period, and this rule isn't sensitive to inflation. Although this may result in a downward bias, where more of our past observations are placed in a lower group than they were in, this is merely a summary statistic and does not affect our results in any way.

Figure 1: Firm Size Overview

Figure 1 displays a visual summary of the dataset, where the firm observations are sorted into groups based on Market Cap. The conditions for a firm to be placed in Large Cap is that the market cap exceeds 10 billion SEK, Mid Cap lies between 10 billion and 1.5 billion SEK, and Small Cap below 1.5 billion SEK.



Our analysis of the sample structure based on Market Cap indicates that the main group of firms examined is the Small Cap segment, as there are more Small Cap firms compared to Large Cap firms. Nonetheless, firm size has been argued by Das and Zhang (2003) to be an ambiguous firm characteristic in terms of affecting rounding incentives and should, therefore, not bias our findings. Firm size will be analyzed later in our paper when we examine the importance of firm characteristics, using total assets as an estimate instead of Market Cap to omit noise from differences in valuation. Lastly, we also examine our data based on industry classification reported in the Appendix as Figure A2.

IV. Methodology

Identification of Rounding in EPS

We begin by trying to see whether signs of rounding up can be identified in our data. The intuition behind identifying rounding is whether an abnormal distribution of third decimal digits can be identified, where numbers 5-9 are overrepresented and 0-4 are underrepresented. Malenko et al. (2023) pay additional attention to the occurrence of the digit 4, as this digit requires the least amount of manipulation to result in a rounded-up digit in the second decimal place. Moving on to our experiment, we divide net income by the weighted average number of shares outstanding for each specific firm for every quarter and extract the third decimal digit. We divide our dataset into two groups: firms with positive net income and firms with negative net income. We made this decision

because if there is a rounding bias, firms with negative EPS would be incentivized to round down their decimals to reduce their losses, compared to those with positive EPS who would like to round up to increase their gains. We follow Malenko et al. (2023) as well as Das and Zhang (2003) by stating that the null hypothesis can be assumed to take on a uniform distribution based on the reasoning from Benford's law¹ where each of the potential 10 decimal numbers is expected to occur in 10% of all observations each. To test whether this null hypothesis is relevant to our test, we run the same experiment using other key values from the income statement that intuitively shouldn't be under pressure of manipulation. The key instruments analyzed are revenues, gross profit, and operating income, all divided by the weighted average number of diluted shares outstanding to get similar ratios such as EPS. According to Malenko et al. (2023), these accounting measures should not be under as much market attention, and therefore, the incentive to manipulate these numbers is lower. Following in the footsteps of previous research, the null hypothesis is tested using a normal distribution, where the reported frequency will differ from the null, being 0.1 (10%). The statistic $z = \frac{p-p_0}{\sqrt{\frac{p(1-p)}{n}}}$ is used for the calculation of the

Z-score, where p is the frequency of the digit in question, p_0 is the frequency of 0.1 which was the assumed null hypothesis, and n is the sample size.

Table 2: Revenue per Share

Table 2 displays the frequency of the different occurring digits in the third decimal place after calculating Revenue divided by Number of Diluted Shares Outstanding, denoted in SEK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either revenue data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1113	0.1033	0.1026	0.0998	0.0980	0.1000	0.0938	0.0998	0.0955	0.0957
Standard Error	0.0019	0.0019	0.0019	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
Z-Score	5.87	1.79	1.37	-0.10	-1.08	0.00	-3.45	-0.08	-2.49	-2.36
Significance	***	*					***		**	**

¹ Benford's law explains how the frequency of numbers often follow the function $F_a = \log\left(\frac{a+1}{a}\right)$ for numbers in the first position of a number. However, as the position of the number increases, the predicted frequency will approach $F_n = 0.1$. Given that we focus on the 3rd decimal value, we hypothesize that the frequency should move closer to 0.1 according to Benford's law.

Table 3: Gross Profit per Share

Table 3 displays the frequency of the different occurring digits in the third decimal place after calculating Gross Profit divided by Number of Diluted Shares Outstanding, denoted in SEK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either gross profit data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1042	0.1014	0.1005	0.0996	0.1009	0.0977	0.0997	0.1010	0.0988	0.0961
Standard Error	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Z-Score	2.11	0.72	0.25	-0.20	0.45	-1.14	-0.15	0.50	-0.60	-1.94
Significance	••									•

Table 4: Operating Income per Share

Table 4 displays the frequency of the different occurring digits in the third decimal place after calculating Operating Income divided by Number of Diluted Shares Outstanding, denoted in SEK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either operating income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1029	0.1046	0.1014	0.0983	0.0996	0.1025	0.0976	0.0955	0.0974	0.1002
Standard Error	0.0024	0.0024	0.0023	0.0023	0.0023	0.0024	0.0023	0.0023	0.0023	0.0023
Z-Score	1.23	1.98	0.61	-0.73	-0.16	1.05	-1.02	-1.92	-1.12	0.07
Significance	••									•

The results in Tables 2, 3, and 4 indicate that the null hypothesis is reasonable and holds for the given instruments, as there is no visible pattern that lower digits occur less frequently than higher digits. Although some frequencies deviate significantly from 10%, all have an opposite effect from that expected from the manipulation of rounding. As the null hypothesis has been examined and deemed appropriate, we continue with the same reasoning, now running the analysis on basic EPS and diluted EPS, both filtered on firms with positive net income. The distribution is also plotted in Figure 2, where only diluted positive EPS is displayed. Basic EPS and Diluted negative EPS are displayed in the Appendix, in Figure A3 and Figure A4, respectively.

V. Results

Figure 2: Distribution of Third Decimal Digits in Diluted Positive EPS

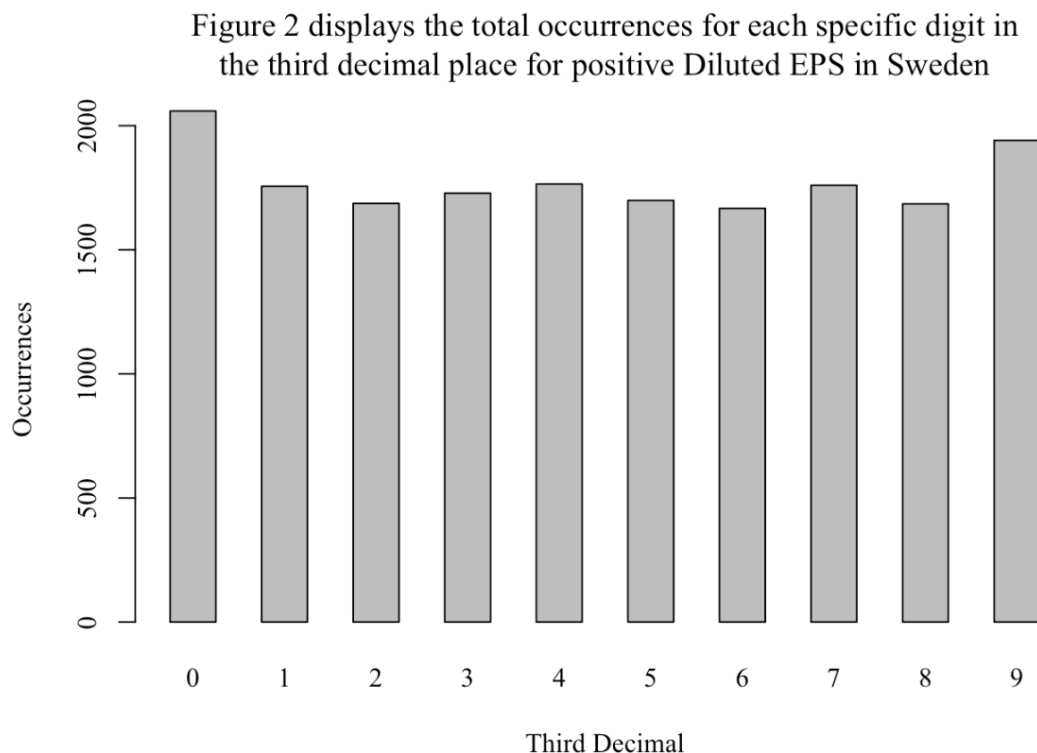


Table 5: Prevalence of Rounding in Diluted Positive EPS

Table 5 displays the frequency of the different occurring digits in the third decimal place after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in SEK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1160	0.0989	0.0951	0.0974	0.0995	0.0957	0.0939	0.0992	0.0949	0.1094
Standard Error	0.0024	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0023
Z-Score	7.11	-0.47	-2.19	-1.17	-0.24	-1.89	-2.69	-0.37	-2.24	4.16
Significance	***		**			*	***		**	***

Based on our initial test results in Table 5, the results differ from those presented by Malenko et al. (2023). First, no significant evidence of rounding in the Swedish stock market can be found. Malenko's method of explicitly paying attention to the frequency of the number 4 cannot show enough evidence to reject the null hypothesis. Second, there is a significant overrepresentation of the numbers 0 and 9. Both decimals are well above the expected frequency, but none of them should affect the manipulation of EPS as

rounding up from the digit 0 requires a lot of manipulation and should, to a larger extent, be avoided, whereas 9 will result in rounding by itself, and should not be the resulting digit of the prior manipulation as this requires excessive rounding. The overrepresentation of the digit 0 as the third decimal digit could be intuitively explained by the fact that if the number of shares is set to an even number (say 5 million), this would always result in a third decimal of 0 if the net income is also somewhat rounded, which is a common practice among larger firms that report in million SEK. However, the high occurrence of digit 9 cannot be as easily explained, as well as why similar results do not appear in previous literature with similar methodologies. Lastly, no decimal above 5, except 9, has a frequency above the expected 0.1, further arguing against a prevalence of systematic manipulation of the Swedish market. For robustness reasons, we also test whether the prevalence of rounding can be shown by comparing the summed frequency of digits 0-4 against digits 5-9, a method implemented by Das and Zhang (2003). We find that digits 5-9 have a summed frequency of 0.4938, which shows no evidence that rounding exists as it does not significantly exceed the frequency of lower digits with a summed frequency of 0.5062.

Firm-specific Rounding of EPS

While previous tests have shown no evidence of systematic rounding in the market, there remains a possibility that certain firms are engaging in such activities and are being hidden in the data of innocent firms. To test this, we adopt the methodology of Malenko et al. (2023) who introduce a new variable in their research paper called “Q-Score,” short for “Quadrophobia Score”:

$$Q_{i,t}^{(N)} = \begin{cases} 0, & \text{if } \sum_{j=1}^N 1_{d_{i,j}=4} > 0 \\ 1, & \text{if } \sum_{j=1}^N 1_{d_{i,j}=4} = 0 \end{cases}$$

Where j will span N quarters back in time to check if the third decimal digit was a 4 in any of the quarters, taking on the value of 0 if a 4 is reported, and 1 if it does not occur over the period. The variable presented is based on the reasoning that firms that, over different periods, fail to report a 4 as their third decimal are more likely to perform manipulation in their EPS results than those firms that are not afraid to report a 4. Based on the outcome of the Q-score dummy variable, the data will be subset into two subgroups, one containing the firms that returned a 0 for their Q-score and another that returned a 1.

Quadrophobia is an advantageous method when researching managerial incentives and earnings management. A strong benefit of quadrophobia is its transparency and ease of use. The underrepresentation of the number 4 directly measures a firm propensity to use aggressive financial reporting techniques. The measure captures the combined use of several techniques used to adjust earnings, which is useful when identifying firms with aggressive accounting cultures. It helps to identify likely violations but cannot show with absolute certainty that earnings management has occurred. Nevertheless, due to the

predictive power of their measure, practitioners and regulators have gained interest in the method. One example is SEC’s EPS initiative, which was partly inspired by the Q-score. As reported Maurer (2021) in the Wall Street Journal, this initiative was built on academic research investigating the unusually high absence of the number 4 in the third decimal in EPS in quarterly financial reports. Michaels (2018) writes that “The paper was widely read within the SEC,” referring to Malenko et al. (2023). Furthermore, in September 2020, the SEC announced enforcement actions against two public companies based on potential accounting violations, including earnings management and improper rounding of reported quarterly EPS figures, highlighting the method’s usefulness.

We calculate the frequency of reporting a 4 for each group and quarter and run Z-statistics on the difference in frequency between the subgroups over different values of N. We filter our data on EPS values above 0.001 SEK to omit firms with negative EPS and firms that have EPS between 0 and 0.001, as these will always result in a 0 as the third decimal digit.

Table 6: Firm-specific Rounding Analysis using the Q-score

Table 6 displays the frequency of the digit 4 in the third decimal place depending on the company having reported a 4 in the same place in the past. For firm-quarter (i,t) the variable Q will be set to 0 if a firm has reported a 4 in any of the previous N quarters, or set to 1 if the firm fails to do so. The sample is divided into 2 sub-samples, one for those with Q = 0 and those for Q = 1. The frequency of the decimal 4 is calculated and compared between the 2 groups using Z-statistics. We sort our data based on firm-quarter observations where the manually calculated diluted EPS exceeds 0.1 Öre, or 0.001 SEK. This is to omit both companies with negative EPS which would rationally want higher frequencies of 4s if the alternative hypothesis is true, and those firms that will always result in a third decimal of 0 which would bias upward the frequency of zeroes, and downward of all other digits.

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	15700	13809	10724	5046	1547
Q=0	0.096	0.098	0.1	0.099	0.101
Q=1	0.1	0.101	0.102	0.101	0.101
Z-test	-0.459	-0.456	-0.322	-0.316	-0.023
Significance					

The results from the implementation of the Q-score show that, overall, there are no significant signs of firm-specific rounding in our sample. The differences in frequency between the two groups are minimal, spanning from -0.4 percentage points for N=1 to 0 percentage points for N = 20. For no N is the quadrophobia group less frequent at reporting a 4, results that differ significantly from those presented by Malenko et al. (2023). When Q = 1 for N = 20, this means that firms have failed to result in a third decimal equal to 4 for five consecutive years. This may seem suspicious, however in theory this should naturally occur in about 12.2% of all cases². The limitation of this method is that as N increases, the sample size for Q=1 decreases. Another factor mentioned by Malenko et al. (2023) is that management and regulatory systems are likely to change over longer periods, creating more noise for higher numbers of N. Unlike Malenko et al. (2023), who used N = 40 as the highest period, we chose to use N = 20 to combat both the noise and the fact that our dataset spans fewer quarters.

² If the null hypothesis that the probability of the digit 4 to occur is 0.1, the probability that a 4 does not occur for 20 consecutive quarters would be $(1 - 0.1)^{20} = 0.9^{20} = 0.1216$.

Time-Specific Rounding of EPS

We run a second robustness test related to time, as there could have been different periods where rounding occurred more often than other periods. Incentives to manipulate financial data should increase if the company in question is at risk of experiencing losses, as mentioned by Das and Zhang (2003). Given that our sample includes the financial crisis that affected Sweden from 2007 to 2010, one potential hypothesis is that rounding occurred more frequently during this period than others. Another consequence of the financial crisis is the increased regulatory environment demanded of companies, particularly banks, to ensure that market stability is prioritized. This transition could lead to increased auditing and, hence, less rounding happening in recent years than in earlier years. We control for this by calculating the frequency of digit 4 every year, where we combine our quarterly observations to get more robust findings every year. If the test showcases a lower frequency of the digit 4 for a specific year, this could indicate more potential rounding is taking place.

Figure 3: Frequency of Third Decimal Place Digit 4 Over Time in Sweden

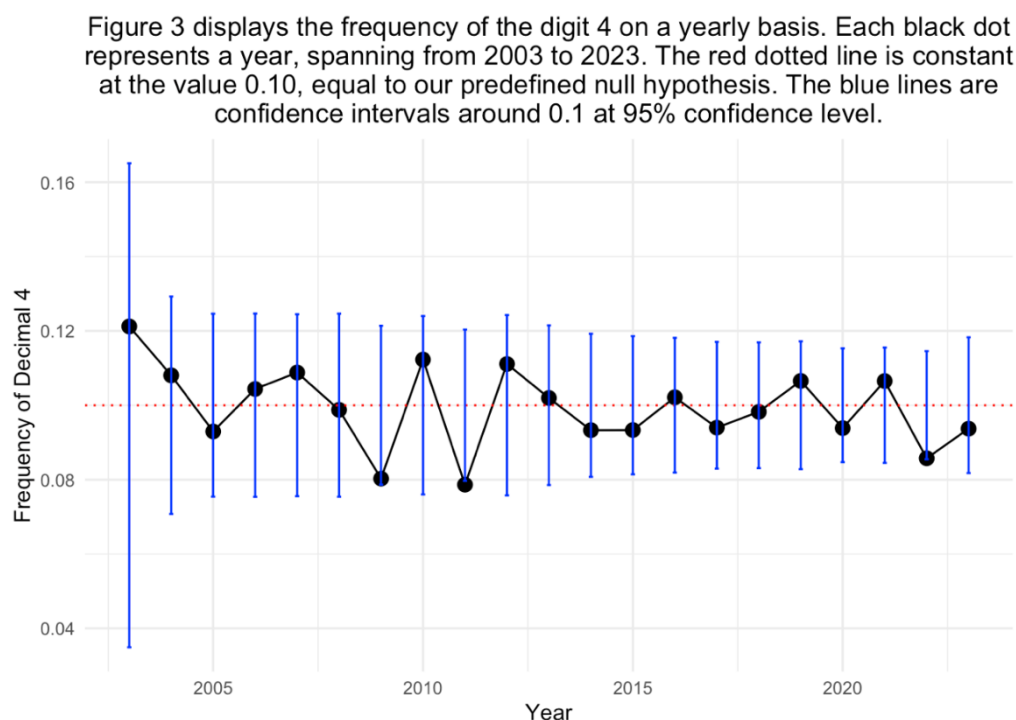


Figure 3 shows that the digit 4 consistently appears close to the expected frequency of 0.1, with some occasionally lower frequencies. The observed frequencies failed to deviate more than the 95% confidence level in all years except for 2011. Therefore, no specific period appears to have had more potential manipulation than another. Even though the frequency of the digit 4 shows a decreasing trend from 2007 to 2009, the results aren't significant enough to argue that this is solely due to the market environment and could

instead occur by chance. Additionally, we cannot argue that early years had more manipulation than recent years based on the provided results.

Factor-Specific Rounding of EPS

In a third robustness test, we investigate if certain firm factors can help predict which companies will participate in rounding activities. Malenko et al. (2023) and Das and Zhang (2003) show that strategic rounding responds to economic incentives using basic firm characteristics.

Skinner and Sloan (1999) show that high-growth firms are more harshly penalized by investors if unexpected negative results are reported. Consequently, managers in high-growth firms are more motivated to meet analysts' expectations, and, as a result, have a higher incentive to manipulate earnings. Das and Zhang (2003) test the association between growth and the propensity of rounding up using the market-to-book value of equity ratio and conclude that high-growth firms are indeed more likely to round up earnings compared to low-growth firms. Based on this, we hypothesize that managers in high-growth firms should have greater incentives to round up earnings. Another predictive factor for rounding is a lower magnitude of EPS, which implies that rounding the second decimal one digit higher makes the percentual gain larger compared to a similar change for a higher magnitude in EPS. Financial results would inflate more recognizably for companies with small EPS, enhancing the appeal to investors and, therefore, increasing incentives for managers to round up. Another discussed firm factor is firm size, whose role has previously been argued as ambiguous. On the one hand, rounding in a larger company would likely result in a more significant absolute gain, both on the firm level through a higher valuation and on a managerial level through their incentive packages due to the increased firm value. On the other hand, large firms are covered by more analysts and accountants, which could make mistakes more likely and costly. We focus on these three main factors in our examination of firm characteristics that could affect rounding. Due to the lack of relevant data regarding analyst coverage and manager incentive packages in Sweden compared to the US, we avoid these to maintain as high of validity in our results as possible.

We begin our examination of these three firm factors by applying a low-minus-high strategy to our data. Depending on which variable is in focus, we sort our sample on the variable and divide it into ten equally sized groups, where group 1 contains the lowest values and group 10 the highest. We extract the third decimal digit for all firm observations and calculate the frequency for the digit 4 to occur in each group. We compare the frequency between group 1 and group 10 by using a Z-statistic as we have previously performed in our Q-score calculations. To spot evidence of rounding, we check whether the difference in frequency between group 1 and group 10 is significant and in line with our previous intuitive reasoning. We measure firm size based on total assets, EPS magnitude based on our manually calculated diluted EPS, and high-growth firms based on the price-to-book ratio that is often used to evaluate companies, where higher price-to-book ratios are correlated with overvaluation and growth firms, and lower values related to undervalued firms.

Table 7: Prevalence of Rounding with Specific Factors in Sweden

Table 7 displays the frequency of the digit 4 in the third decimal place, after dividing the sample into 10 groups sorted based on the factor: Assets, EPS Magnitude or Price-To-Book ratio respectively. Group 1 contains the firm-quarter observations that report the lowest values depending on the factor sorted on, and Group 10 contains the firm-quarter observations with the highest values for the same factor. The frequency of the digit 4 is calculated for each specific sub-group, and compared using Z-Statistics to see the significance of their difference, reported in the Z-test variable. The sample consists of firms which have a Diluted EPS exceeding 0.1 öre, and omits firm-quarter observations that doesn't contain the relevant factor data

	Assets	EPS Magnitude	Price-To-Book Ratio
Group 1	0.101	0.107	0.099
Group 10	0.092	0.09	0.096
Z-test	0.834	1.618	0.299
Significance			

The results in Table 7 show no significant results that the firm factors examined are related to a rounding bias. Large firms and firms with higher EPS magnitude report lower frequencies of digit 4; however, these are in the opposite direction of what is intuitively logical. This result does not argue that manipulation of the third decimal digit exists, but at the same time, the results contradict previous research provided by Das and Zhang (2003).

We continue the analysis by implementing a new variable, which we name “DUMMY4”, following a similar methodology as Malenko et al. (2023). The variable is binary and takes on the value of 0 if the firm-quarter observation does not have a 4 as the third EPS decimal and the value of 1 if it does. We wish to examine whether the previously mentioned factors could help predict when a 4 will or will not occur as the third decimal digit. If any of the results have a significant effect, this would indicate that the distribution of digit 4 may not be random and that the factors could predict what type of firms are more likely to perform rounding. A negative coefficient would indicate that rounding is more likely to occur for the independent variable in question. We run a regression on the DUMMY4 variable as the dependent variable, using the factor-specific variables as independent variables, while filtering our data on observations where EPS is bigger than 0.001 SEK. Additionally, we only include the firm observations where all the firm factors are available. We use the logarithm of assets to make the results more normalized and easily interpreted.

Table 8: Regression of the Occurrence of the Digit 4

Table 8 displays the output from the probit regression $DUMMY4 \sim \log_Assets + epsd + Price\text{-}to\text{-}Book$. DUMMY4 is defined as a binary variable that takes on the value of 0 if the digit on the third decimal place is not a 4, and 1 if it is. Log_Assets is defined as the logarithm of total assets for a firm. Price-to-Book is defined as the Market Cap divided by the Book value of Equity, which is a measurement often used to display if a company is overvalued or undervalued on the market related to its intrinsic value. EPS Magnitude is our variable for the calculated diluted EPS and is reported in SEK. The dataset excludes rows where the values in focus are missing and where EPS is larger than 0.1 öre.

	Estimate	Std. Error	z value	Pr(> z)
Intercept	-1.2536221	0.1076357	-11.6469004	0.0000000
Log Assets	-0.0014770	0.0050543	-0.2922303	0.7701106
EPS Magnitude	-0.0000551	0.0001144	-0.4818124	0.6299392
Price-to-Book	0.0000283	0.0000845	0.3350204	0.7376097

Our results show no evidence that these factors can predict when the digit 4 occurs and that the distribution is random regarding these factors. We also attempted to add the Q-score variables when $N = 4$ (found in the Appendix named Figure A5), but this had no explanatory effect and did not change the estimates of the other variables. When Malenko et al. (2023) performed the same test, both with and without the Q-score variable, they found strong significance for all variables. The result from the regression is in line with the outcome presented in Table 7, that is, none of the firm factors are related to a rounding bias.

Currency's Effect on Rounding Incentives

All our previous results have implied that there is no empirical evidence that rounding in the third decimal place exists in Swedish firms. We continue by considering the potential prevalence of a currency effect. The reasoning behind this is that the intrinsic value of the third decimal position differs depending on the currency used to report the earnings. Even though a relatively “more valuable” currency should result in lower EPS magnitudes, this effect fails to translate when considering a specific decimal position. Consider the case where we have two firms with EPS equal to 1.234, denoted in two currencies, USD and SEK, where 1 USD is assumed to be 10 SEK, and the number of shares is 1 million for both firms. As only two decimals are reported, both would, in this case, report an EPS of 1.23. If the firms wanted to add one additional unit to the last reported decimal, this would imply a gain in value of $0.01 * 1 \text{ million} = 10,000$. As the USD is worth 10x that of SEK, this would mean that the firm with earnings in USD, denoted in SEK, would receive an additional value of $10,000 * 10 = 100,000$ SEK, compared to the firm that reports in SEK, which only added 10,000 SEK. The above scenario proves that we fix our interest in a specific position rather than the economic value of the digit. It could help explain why evidence for rounding is found in the US compared to Sweden, as the third digit holds a larger economic value and, thus, increases the benefit of rounding.

However, this argument works both ways. Considering the same scenario, for the firms to round up their second decimal by one unit, both need to increase their third decimal digit 4 to the digit 5 (that is, requiring an increase in earnings by $0.001 * 1 \text{ million} = 1,000$). We can consider this a measure of risk, where the more earnings you need to

“make up,” the higher the probability that an external party might find these overestimated earnings. In this scenario, the firm denoting earnings in USD would be risking $1,000 * 10 = 10,000$ in SEK, whereas the Swedish firm only risks 1,000 SEK. For both firms, the ratio between costs and gains is the same, being that the cost is one-tenth of the potential gain in valuation. So, could the currency effect be ambiguous?

We begin our analysis of the existence of a currency effect by focusing on the specific currency used. We extract three additional datasets to analyze, each containing similar firm-quarter-specific observations as our previous data but now containing Finnish, Norwegian, and Danish firms. By doing so, three additional currencies are introduced: the Norwegian kronor (NOK), Danish kronor (DKK), and Euro (EUR). All of these are traded at different exchange rates compared to SEK, where EURSEK is about 1:11 DKKSEK 1:1.5, and NOKSEK 1:1. An alternative data that could be examined would be the previously omitted dataset on Swedish firms that report their earnings in EUR (or any other currency). We deem this dataset as inappropriate for analysis as it only consisted of about 2000 firm observations, which would not be sufficient to calculate robust Q-scores, as well as it is not consistent in using the same currency, where not only EUR has been the currency used to report financials, but also GBP and USD in some instances.

We repeat our initial methodology by manually calculating EPS for each country’s dataset, extracting the third decimal digit, and calculating the frequency for each digit while filtering our data only to include firm observations containing positive EPS values. If it is the case that the currency effect is positive (that is, more valuable currencies like USD and EUR have a positive effect on occurrences of earnings management), this would be shown in our tables by Finland having lower frequencies of lower digits and higher occurrences of higher digits, while Denmark and Norway wouldn’t deviate much from the expected frequency of 10%, as we have seen in our Swedish data previously.

Table 9: Persistence of Rounding in Diluted EPS in Finland

Table 9 displays the frequency of the different occurring digits in the third decimal place in Finland after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in EUR. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford’s law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1259	0.0966	0.0981	0.0951	0.0917	0.0949	0.0946	0.0927	0.0842	0.1261
Standard Error	0.0046	0.0041	0.0041	0.0040	0.0040	0.0040	0.0040	0.0040	0.0038	0.0046
Z-Score	6.29	-0.82	-0.45	-1.18	-2.01	-1.23	-1.32	-1.78	-3.84	6.33
Significance	***				**			*	***	***

Table 10: Persistence of Rounding in Diluted EPS in Norway

Table 10 displays the frequency of the different occurring digits in the third decimal place in Norway after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in NOK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1180	0.0938	0.0972	0.0888	0.0966	0.0907	0.0964	0.0900	0.0977	0.1309
Standard Error	0.0036	0.0033	0.0033	0.0032	0.0033	0.0032	0.0033	0.0032	0.0033	0.0038
Z-Score	5.36	-1.85	-0.84	-3.34	-1.03	-2.78	-1.06	-2.97	-0.69	9.20
Significance	***	*		***		***		***		***

Table 11: Persistence of Rounding in Diluted EPS in Denmark

Table 11 displays the frequency of the different occurring digits in the third decimal place in Denmark after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in DKK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1388	0.0887	0.0955	0.0895	0.0879	0.0930	0.0932	0.0852	0.0875	0.1407
Standard Error	0.0050	0.0041	0.0042	0.0041	0.0041	0.0042	0.0042	0.0040	0.0041	0.0050
Z-Score	9.01	-2.62	-1.04	-2.43	-2.81	-1.62	-1.57	-3.44	-2.91	9.44
Significance	***	***		**	***			***	***	***

Our results in Tables 9, 10, and 11 indicate no significant strategic rounding in either Finland, Norway, or Denmark. Regardless of comparing numbers 0-4 to 5-9 or specifically looking at number 4, no evidence can be found that aligns with what has been found in previous literature in the US. This result provides evidence contradictory to our hypothesis that the value of currency should affect the likelihood of rounding the third decimal. The results do once again indicate that numbers 0 and 9 are overrepresented. To maintain robustness, we perform the previous tests on time-specific, firm-specific, and factor-specific rounding for these countries in the Appendix in Figures A6, A7, and A8. It is important to acknowledge that the sample size containing the publicly traded firms is small in each of the three countries, resulting in decreasing power to detect the true effect size in this case.

Currency's Effect on the Second Decimal Place

Based on our previous reasoning, if incentives to round the third decimal digit are lower in Sweden, there might be an increased interest in manipulating the second decimal digit instead. By doing so, the effect mimics the pricing strategies used when the currency is USD or EUR. Assuming 1 USD = 10 SEK, if the price of a good in the US is \$1.99, it would be priced in Sweden at 19.90 instead of 19.99, deviating somewhat from pricing a good just below the reference point (in this case, 20.00). If this is the case, those using SEK should value their first decimal place the same as those using USD value their second decimal place, and Swedes increasingly ignore the value of the second decimal place. This implication would allow for increased manipulation of the second decimal digit. However, as the second decimal place is still reported, potential rounding might still be perceived as too visible for firms to perform.

To see evidence of rounding in the second decimal place, the digit 9 should be underrepresented, and the digit 0 should be overrepresented, as firms engaging in earnings management would like to round up the first decimal. Since the second decimal is reported, it is not sufficient to make the decimal place take on a value between 5 and 9 anymore, as this will not change the first decimal place digit. The most efficient way to round up the first decimal is by rounding up from 9 to 0. This strategy is based on the same reasoning provided by Carslaw (1988) and Thomas (1989).

We continue our analysis of the currency effect by examining whether there is a prevalence of rounding in the second decimal place. The second decimal digit is extracted the same way that we did with the third decimal digit. The dataset is filtered by only containing firms with positive EPS and is displayed in Tables 12 to 15.

Table 12: Frequency of EPS Second Decimal Place in Sweden

Table 12 displays the frequency of the different occurring digits in the second decimal place after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in SEK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing second decimals, which removes all cases where either net income data or shares outstanding data is missing.										
	0	1	2	3	4	5	6	7	8	9
Frequency	0.1161	0.1030	0.1052	0.1015	0.0999	0.0996	0.0969	0.0928	0.0957	0.0893
Standard Error	0.0024	0.0023	0.0023	0.0023	0.0022	0.0022	0.0022	0.0022	0.0022	0.0021
Z-Score	7.17	1.34	2.33	0.69	-0.06	-0.18	-1.38	-3.22	-1.93	-4.76
Significance	***		**					***	*	***

Table 13: Frequency of EPS Second Decimal Place in Finland

Table 13 displays the frequency of the different occurring digits in the second decimal place in Finland after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in EUR. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing second decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1223	0.1249	0.1227	0.1037	0.0925	0.0929	0.0933	0.0903	0.0786	0.0788
Standard Error	0.0044	0.0045	0.0044	0.0041	0.0039	0.0039	0.0039	0.0039	0.0036	0.0037
Z-Score	5.48	6.12	5.57	0.92	-1.83	-1.74	-1.65	-2.38	-5.27	-5.22
Significance	***	***	***		.	.	.	**	***	***

Table 14: Frequency of EPS Second Decimal Place in Norway

Table 14 displays the frequency of the different occurring digits in the second decimal place in Norway after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in NOK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing second decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1033	0.1012	0.1100	0.0965	0.1023	0.0959	0.1008	0.0935	0.0981	0.0984
Standard Error	0.0034	0.0034	0.0035	0.0033	0.0034	0.0033	0.0034	0.0032	0.0033	0.0033
Z-Score	0.99	0.36	3.00	-1.05	0.69	-1.24	0.25	-1.94	-0.57	-0.49
Significance			***					.		

Table 15: Frequency of EPS Second Decimal Place in Denmark

Table 15 displays the frequency of the different occurring digits in the second decimal place in Denmark after calculating Net Income divided by Number of Diluted Shares Outstanding, denoted in DKK. The Z-score is a double sided z-statistic calculated with the assumed population mean of 0.1, following the reason from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing second decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1183	0.0934	0.1005	0.0975	0.0934	0.0881	0.0983	0.0987	0.0932	0.1187
Standard Error	0.0046	0.0042	0.0043	0.0042	0.0042	0.0041	0.0043	0.0043	0.0042	0.0046
Z-Score	4.27	-1.54	0.12	-0.59	-1.54	-2.78	-0.40	-0.30	-1.59	4.36
Significance	***					***				***

In Tables 12 to 15, we show that the digit 0 is overrepresented at the 1% significance level for Sweden, Finland, and Denmark. In contrast, the digit 9 is significantly underrepresented in both Sweden and Finland, which is in line with the results presented by Thomas (1989), who also showed an increased prevalence of the digit 0 and a decreased prevalence of the digit 9 in the second decimal place of EPS. One difference is that when Thomas (1989) examined EPS data, he found that 0 and 5 were overrepresented, which we fail to see in our dataset. These results are significant, but they do not necessarily indicate that the reason is due to the currency effect, as both the lowest-valued currency in SEK and the highest valued in EUR showed significant evidence. Another element is that the incentives to round the second decimal and the third differ slightly. Where the third decimal was strictly based on economic incentives, the second decimal also poses a psychological incentive, where meeting a reference point could yield additional benefits. The different “rules of the game” when comparing the second and third decimals do not make this analysis sufficient to single out a currency effect.

This final test, initially considered to solely act as a robustness test on currency effect, has provided us with interesting evidence that could indicate that rounding might exist in Sweden. Although the currency effect cannot explain this, our previous line of reasoning that incentives to round the second decimal digit increase in Sweden due to a lower-valued currency has not been wholly contradicted. Given that the scope of this paper specifically considered the third decimal place, further analysis of the second decimal place and its potential evidence of a rounding bias falls outside of this scope. Hence, we will not analyze the second decimal place further. Instead, we decided to perform all the relevant robustness tests covered in this research (regarding time-specific, firm-specific, and factor-specific rounding) on the second decimal for all countries included in this paper and displayed these in the Appendix in Figures A9, A10, and A11. These results can be of interest to future research.

VI. Discussion

Rounding Practices: Sweden vs the US

One possible explanation for why our findings differ from previous research on US data is differences in the possibilities of engaging in earnings management practices.

In this article, we focus strictly on the rounding activities related to EPS while avoiding diving deeper into what specific part of EPS is being manipulated. The reason behind this is because many different options exist. Das and Zhang (2003) show findings indicating that managers use working capital accruals to inflate earnings, thus enabling them to round up the EPS numbers. They also mention the other possibility of manipulating the denominator in the EPS calculation (that is, reducing the number of shares outstanding, for instance, through share repurchases). However, their analysis provides no significant results for this method of rounding shares through manipulation of the number of shares outstanding. Contrary to what Das and Zhang (2003) find, Robert, Lee, and Lobo (2024) demonstrate evidence that abnormal stock repurchases are an effective way to manipulate the number of outstanding shares and, therefore, to round EPS. They argue that working capital accruals are not an effective tool to round diluted EPS but cannot dismiss the possibility that accruals can be used for this purpose.

The calculation of EPS under IFRS and GAAP is similar and should not significantly affect how companies in Sweden and the US report EPS. As Das and Zhang (2003) show, when manipulation of EPS occurs, it is most likely through earnings management using working capital accruals. Hypothetically, if there were large differences between the calculation of these instruments, it could affect the possibilities of engaging in earnings management in Sweden, thus reducing companies' opportunities to round EPS using this method. However, despite having small differences in the classification of assets, such as the treatment of debt as current or noncurrent in IAS 1 (IFRS) and ASC 470 (GAAP), there should not be any major obstacles for firms in Sweden to use this method to round EPS. Reducing the number of shares outstanding through a share repurchase program is also a viable option for rounding EPS. However, regardless of other possibilities, rounding EPS should theoretically be equally possible under IFRS and GAAP. Therefore, differences in accounting regulations should not be the main factor for why rounding of the third decimal digit in EPS occurs with less frequency in Sweden compared to the US.

Understanding Rounding: Timing and Motives

As we cannot argue that differences in accounting standards allow the US, to a greater extent, to manipulate their earnings, we revisit the incentive structure that drives companies to increasingly take part in aggressive accounting practices to see whether these could explain our results.

The intuition between why managers and companies would decide to pursue rounding activities is, in theory, straightforward: if the benefits outweigh the cost of getting caught firms should be more tempted to partake in such rounding practices. Das and Zhang (2003) report that the benefits of rounding, such as meeting analysts' expectations, reporting profits, and sustaining previous performance levels, will likely attract managers to perform aggressive accounting practices. These findings are supported by evidence provided by Burgstahler and Dichev (1997), Skinner and Sloan (1999), and Degeorge et al. (1999). In their paper, Amar et al. (2022) show that, almost 20 years after Das and Zhang (2003), pressure to meet expectations results in managers focusing on short-term benefits, which directly influences their decision to engage in earning management practices, proving its relevance today. Another reason could be in the M&A field, where Davis and Khadivar (2024) find evidence that earnings management in accruals occurs before the publication of takeover rumors.

Das and Zhang (2003) suggest that firms are more inclined to manage earnings when doing so can help meet analysts' forecasts, report profits, and sustain previous performance. The incentives for managers to round up are particularly strong when the pre-rounded figure is close to its benchmark, implying that strategic rounding occurs more frequently in firms with analyst coverage, which establishes such benchmarks, compared to those without. As we find no evidence for strategic rounding in Sweden, one possible explanation for this is that fewer analysts cover the Swedish stock market compared to the US. However, Fang Yu (2008) provides evidence that contrasts the findings of Das and Zhang (2003). Instead, his findings suggest that firms followed by more analysts manage their earnings less. His findings point towards the fact that experienced analysts from top brokerage firms contribute to a more transparent information environment for firms, thus reducing asymmetric information.

Considering these findings, the difference between the US and Sweden could be differences in incentive packages. A reason for earnings management is provided by Burns and Kedia (2006). They show evidence that CEOs with option portfolios sensitive to stock prices are significantly more likely to use aggressive accounting approaches. The incentive to misreport is greater with stock options than with other types of compensation for two main reasons: options limit the risk if the misreporting is discovered and facilitate easy exit strategies for CEOs. Kim, Lee, and Lobo (2024) investigate the relationship between EPS and managerial insider selling and suggest that managerial trading incentives may be an explanation for the observed rounding in EPS in earlier literature, as insiders who round the EPS have a higher propensity to sell shares after the announcement of reported earnings. As most of our data is based on small-cap firms, incentive packages offered for managers in these roles might not be as beneficial as those offered in the US if previous datasets examined contain a bigger share of larger firms. As we are unable to find trustworthy data on incentive packages for Sweden, this leaves room for potential extensions to compare incentive package structures.

The Impact of Cultural Hierarchies on Accounting Integrity

One last explanation could be cultural differences. We hypothesize that Sweden generally has a less hierarchical organizational culture than the US. The flat structure incentivizes employees to a greater extent to make their voices heard in decision-making processes, making unethical decisions regarding rounding practices more difficult to justify.

Cooper, Dacin, and Palmer (2013) show in their study that accountants likely follow the “tone at the top” and adhere to senior management’s directives when engaging in fraudulent behavior. This behavior is influenced by their respect for hierarchical power structures, as highlighted by Wong-on-Wing and Lui (2013). This result aligns with the findings of Lord and DeZoort (2001), who show that auditors are more likely to approve an accounting post that is materially misrepresentative when complying with pressure from authorial superiors but not when it comes from pressure to conform to equals. Pickerd, Summers, and Wood (2014) strengthen the reasoning by providing evidence that entry-level staff, especially auditors, are more influenced by the tone set by their supervisor compared to their peers, suggesting that supervisors strongly impact ethical choices made by auditors. Moreover, Murphy and Free (2016) underscore that accounting fraud often involves entire organizations working in collective action rather than individual decision-making, further making the Q-score a valuable measure due to its practical use in detecting aggressive accounting cultures in firms.

Murphy and Free (2016) reference a survey of employees and bosses in the US, showing that 43 percent of employees perceive the working climate within their organization to follow leadership by coercion. Furthermore, in their Global Competitiveness Report (2018), the World Economic Forum ranked Sweden in second place in an index measuring “Willingness to delegate authority.” However, the US ranked seventh, scoring 78.4 out of 100. Sweden scored 83.8, making the difference noticeable but not large. In an article in Harvard Business Review, Erin Meyer (2017) describes the work culture in the US as top-down, stating, “align quickly with the boss and support the decision even if it conflicts with the opinion, you previously expressed. At this stage, if you show disagreement— especially in front of others—you may be viewed as difficult to work with.” In contrast, she describes leadership in Sweden as consensual, noting, “Don’t

expect the boss to jump in and decide for the group. The boss is a facilitator, not the decider.”

Sweden’s flat organizational culture and emphasis on consensual decision-making can imply that more people are involved in the process of making decisions, resulting in “hiding” a misstatement of earnings may be more a complex matter in Sweden than in the US. Based on the small contrasts in work and organizational culture between Sweden and the US, at least part of the differences in our results compared to earlier research in the US can potentially be explained.

Limitations

There are some limitations regarding using our Swedish data. The dataset is significantly smaller than those used on American markets gathered by the likes of Compustat and I/B/E/S. However, given that the dataset used covers 824 public firms for 20 years, it remains large enough to draw robust conclusions comparable to the results of previous studies. Another limitation is that, unlike previous research, there is limited data related to managerial behavior aspects and analytical forecasts on our stocks, which have previously been used to explain why this rounding bias could be present. In our case, we stick to the original quantitative aspects of previous research and build qualitative arguments based on what has previously been established in the research field where it is deemed fit. One final limitation is when comparing Swedish data to data from other Nordic countries. First, Finland, Norway, and Denmark’s datasets are smaller than Sweden’s, so the validity of the results from each country should be considered. To measure this, we run power statistics where power is 80%, effect size 2%, and significance 5%. We find that the necessary sample size is 19622, something we only get from the Swedish data. The sample sizes from positive EPS firms in Finland, Norway, and Denmark are 5481, 8110, and 4980, respectively, resulting in effect sizes of 3.8%, 3.1%, and 4.0%. Given these power tests, we should be slightly worried about the robustness of our findings. Second, we base our comparisons on the assumption that the countries are ideal substitutes for each other, even though this might not be the case. The countries also differ in regulations, which perhaps have not been adequately considered and could lead to misleading results. How extensively the financial regulation systems operate and punish aggressive accounting practices is subjective to each country, affecting the incentives construction for the firms for each country differently. However, EPS manipulation should still be an issue outside of the US, as the incentive structure for when it pays off to participate in aggressive accounting practices should be the same regardless of country and accounting standard. Hence, it is still relevant for us to study other countries than Sweden.

VII. Conclusion

In this paper, we analyze whether there is evidence in the Swedish market of rounding in the reported EPS using an approach that looks at the distribution of the third decimal digit. Our findings indicate that no significant systematic anomalies can be found in the dataset, which contradicts previous research evidence based on US data.

The findings are tested using three robustness tests: time-specific, firm-specific, and factor-specific methodologies. We fail to find evidence of potential rounding in all these tests on the third decimal digit.

We consider that currency could explain why our results differ from previous literature and expand our experiment to other Nordic countries with different currencies. We find mixed results from the other Nordic countries for the distribution of the third decimal digit but cannot link these specifically to a currency effect. Additionally, we examine whether rounding might occur in the second decimal place. Rounding potentially occurs for the second decimal place, but the currency is not likely to be the sole explanation.

Our results expand previous literature by opening the research field into a new geographical market, providing findings that contradict past research. Further research should be made using more comprehensive datasets including incentive structures of management and analyst coverage to increase understanding of the psychology of accounting malpractice in the Nordics. Given the findings regarding potential rounding in the second decimal place, additional analysis of this area could contribute to the research field.

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AI disclosure:

In this paper, help has been received from two AI modules; being ChatGPT (3.5 version) and Grammarly (Free version). ChatGPT has been used solely to help with coding methodology in R, and Grammarly to make sure that the language in this paper is held formal and correct. We take full responsibility for any potential issues or errors that have resulted from the use of these modules.

IX. Appendix

Figure A1: Firm Observations Over Time

Figure A1 displays the total occurrences of firm observations on an annual basis from our Swedish dataset.

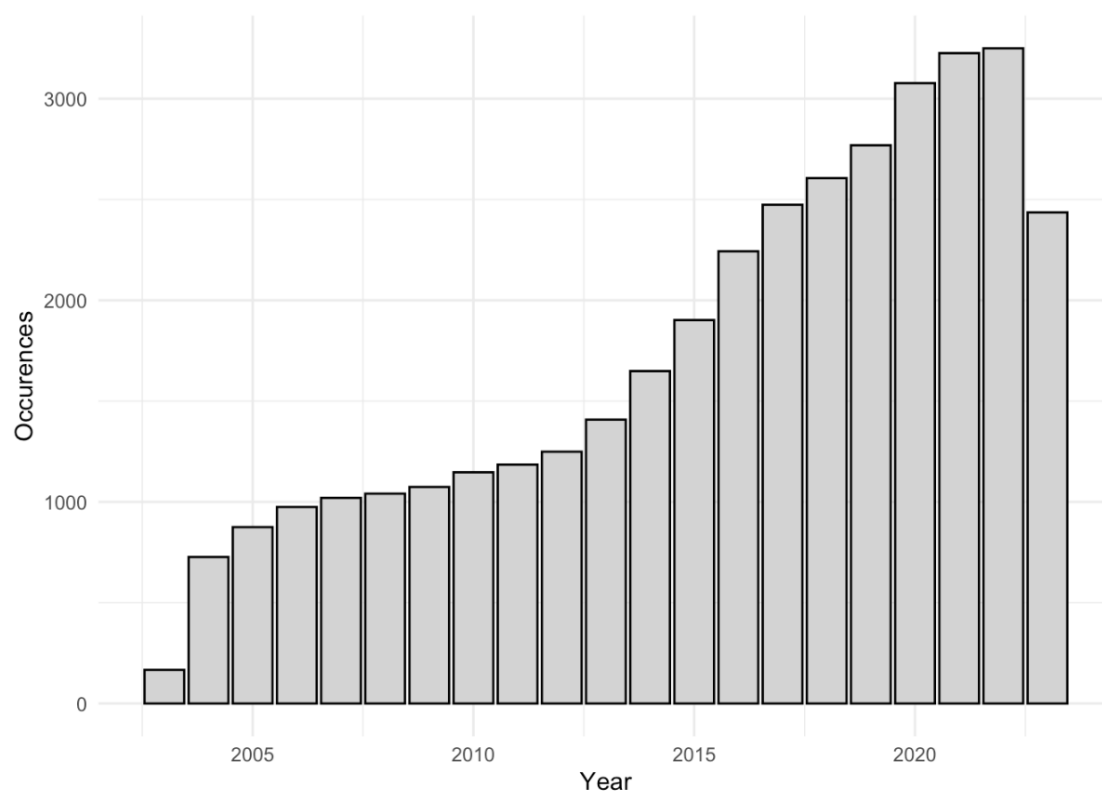


Figure A2: Firm Observations Sorted by Industry

Figure A2 showcases the distribution of the different industries occurring, and how many firm observations that are linked to each industry. We have a total of 63 industries in our sample, varying in the number of occurrences. We also have about 1000 firm observations that can't be placed in a particular industry. Figure A2 is split into 2 figures, where Figure A2-a shows the first 30 industries in alphabetical order, and Figure A2-b shows the remaining industries.

Figure A2-a: Firm Observations by Industries (First 30)

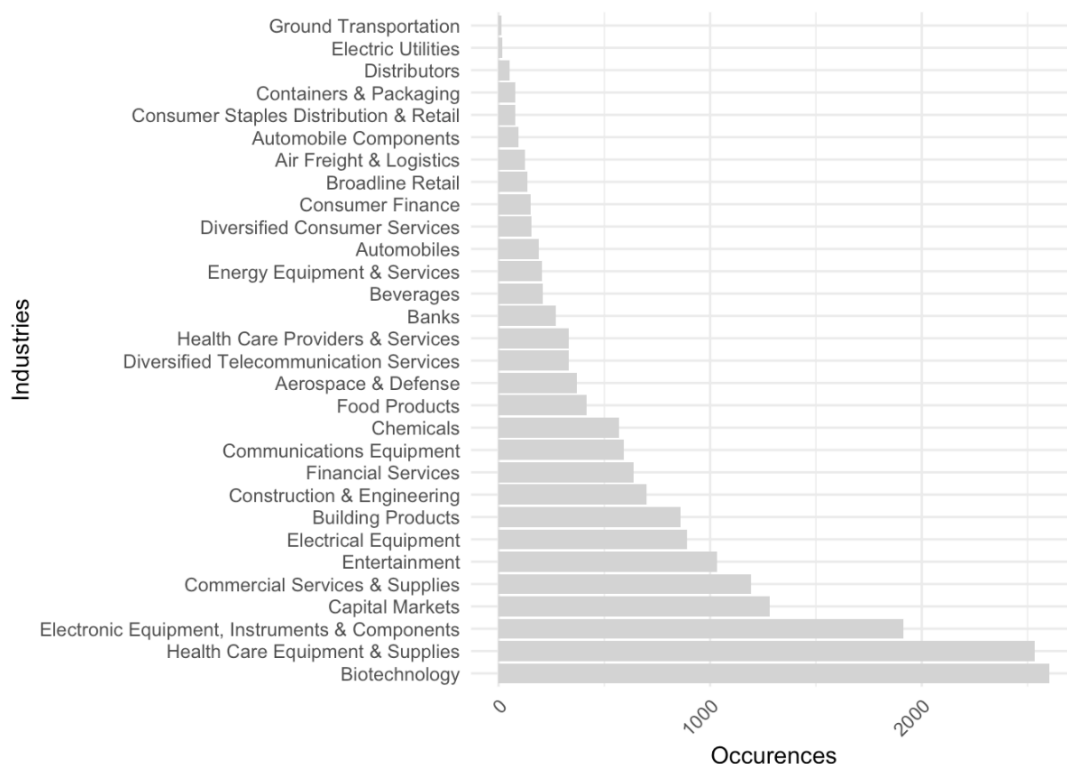


Figure A2-b: Firm Observations by Industries (Remaining)

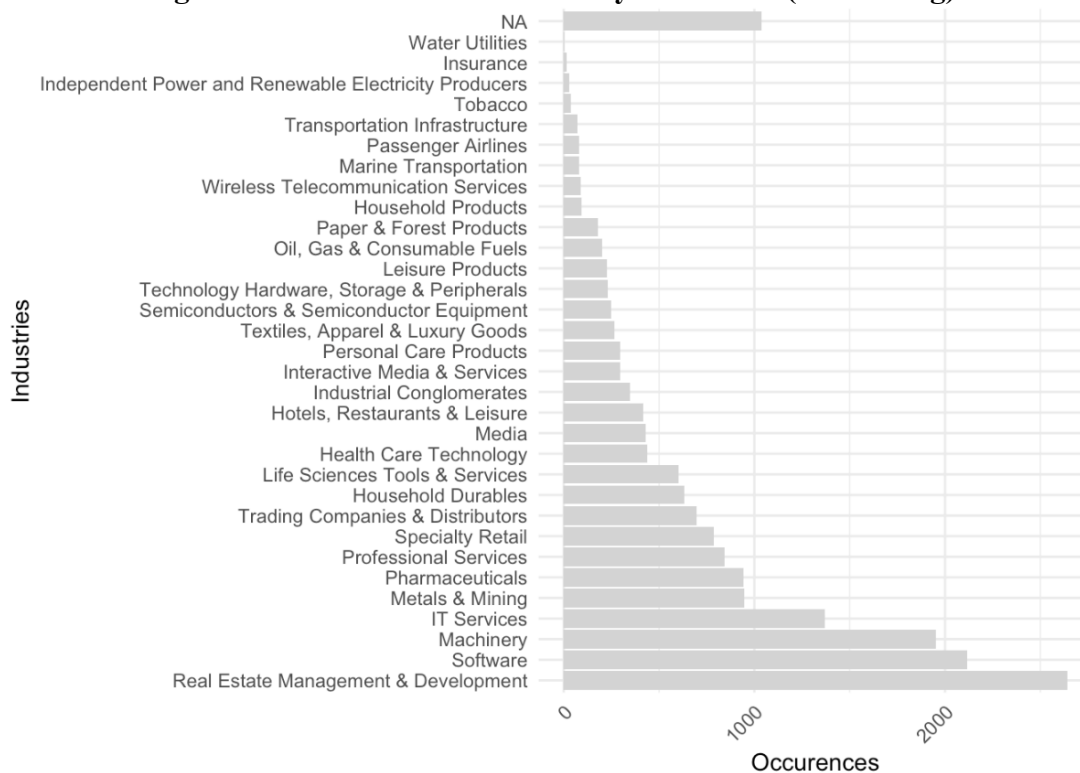


Figure A3: Prevalence of Rounding in Basic Positive EPS

Figure A3 displays the frequency of the different occurring digits in the third decimal place after calculating Net income divided by the Number of Basic Shares Outstanding, denoted in SEK. The Z-score is a double-sided z-statistic calculated with the assumed population mean of 0.1, following the reasoning from Benford's law. The Significance variable plots different signs depending on the confidence levels related to the Z-score presented. We remove the firm-quarter observations where there are missing third decimals, which removes all cases where either net income data or shares outstanding data is missing.

	0	1	2	3	4	5	6	7	8	9
Frequency	0.1140	0.0999	0.0951	0.0968	0.0999	0.0970	0.0943	0.0986	0.0937	0.1106
Standard Error	0.0024	0.0023	0.0022	0.0022	0.0023	0.0022	0.0022	0.0022	0.0022	0.0024
Z-Score	6.20	-0.03	-2.18	-1.40	-0.03	-1.35	-2.53	-0.60	-2.80	4.73
Significance	***		**				**		***	***

Figure A4: Distribution of Third Decimal Digit in Diluted Negative EPS

Figure A4 shows the total occurrences of each digit in the third decimal place in negative diluted EPS.

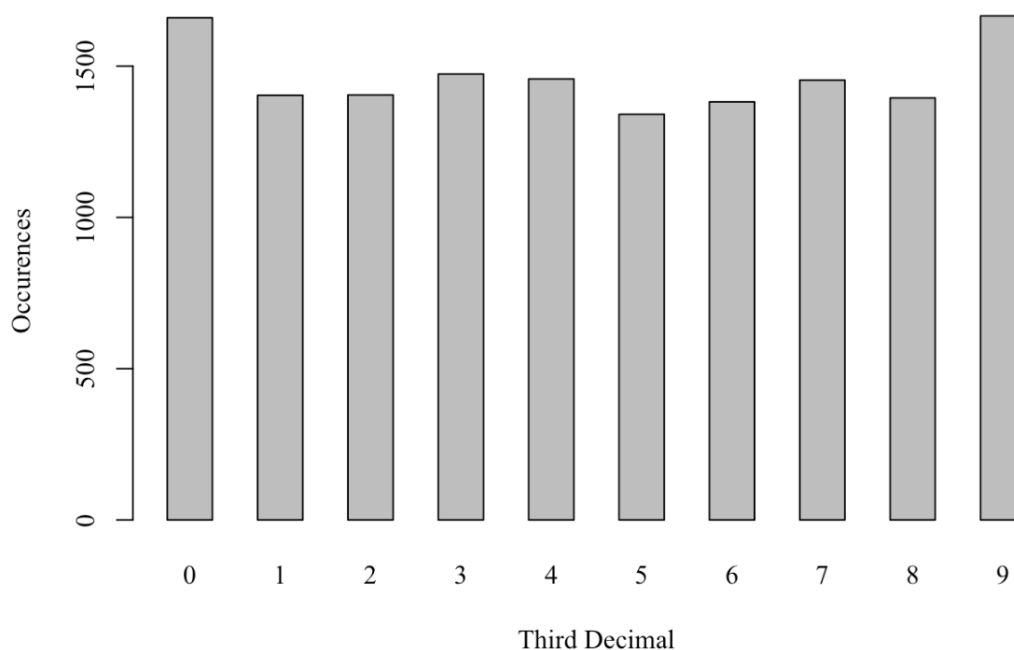


Figure A5: Probit Regression on the Occurrence of the Digit 4, including Q-score when N=4

Figure A5 displays the outcome after running a probit regression on the binary variable DUMMY4, which takes on the value of 0 if the third decimal digit in diluted EPS is not a 4 and the value of 1 if the same digit is a 4. The independent variables are the logarithm of total assets, our manually calculated diluted EPS, price-to-book ratio, and the binary variable used for the firm-specific rounding tests when N = 4. It takes on the value of 0 if the third decimal digit for the last 4 quarters has been at least one 4, and the value of 1 if no 4 has appeared.

	Estimate	Std. Error	z value	Pr(> z)
Intercept	-1.2456402	0.1124815	-11.0741791	0.0000000
Log Assets	-0.0018165	0.0052024	-0.3491692	0.7269623
EPS Magnitude	-0.0000536	0.0001125	-0.4760511	0.6340380
Price-to-Book	0.0000264	0.0000847	0.3120068	0.7550353
Q-score	0.0093792	0.0296582	0.3162431	0.7518180

Figure A6: Third Decimal Place – Time Specific

Figure A6 shows the robustness tests on our Finnish, Norwegian, and Danish data regarding the frequency of digit 4 in the third decimal place over time. The quarterly observations have been combined by year to increase robustness for each year. The data has been filtered by only containing observations with diluted EPS above 0.001. The black dots represent the observed frequency, the red line the expected frequency of 10%, and the blue lines represent the confidence intervals for a significance of 95%. The test the confidence intervals are based on is a double-sided Z-test.

Figure A6-a: Frequency of Third Decimal Digit 4 Over Time in Finland

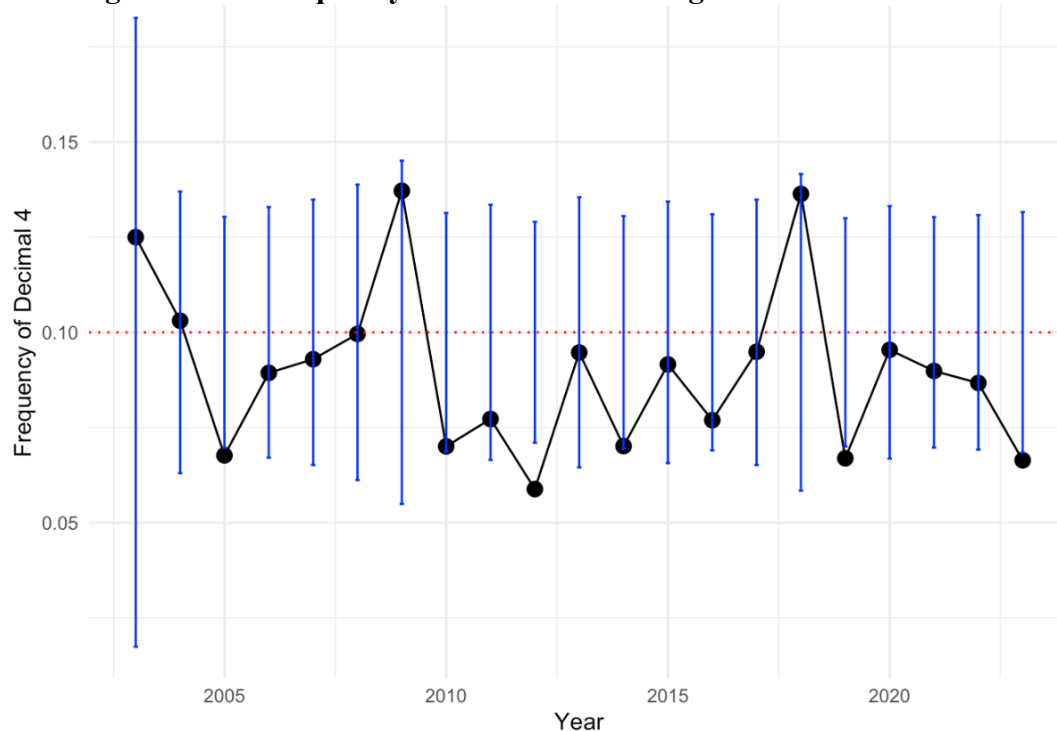


Figure A6-b: Frequency of Third Decimal Digit 4 Over Time in Norway

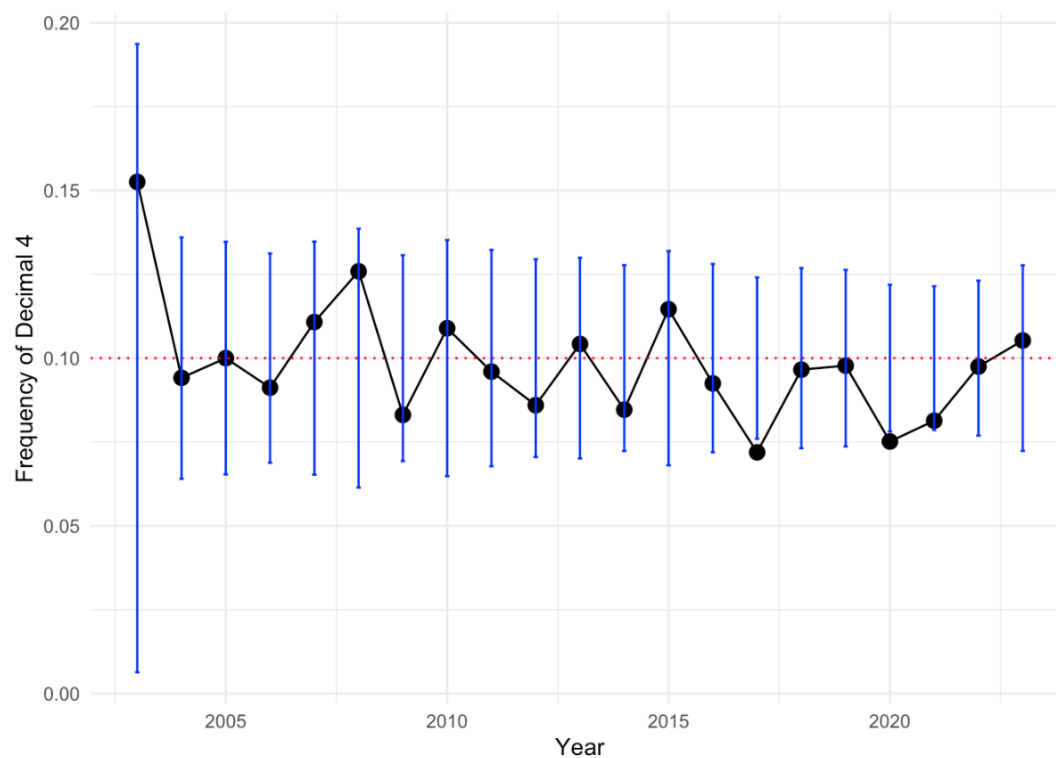


Figure A6-c: Frequency of Third Decimal Digit 4 Over Time in Denmark

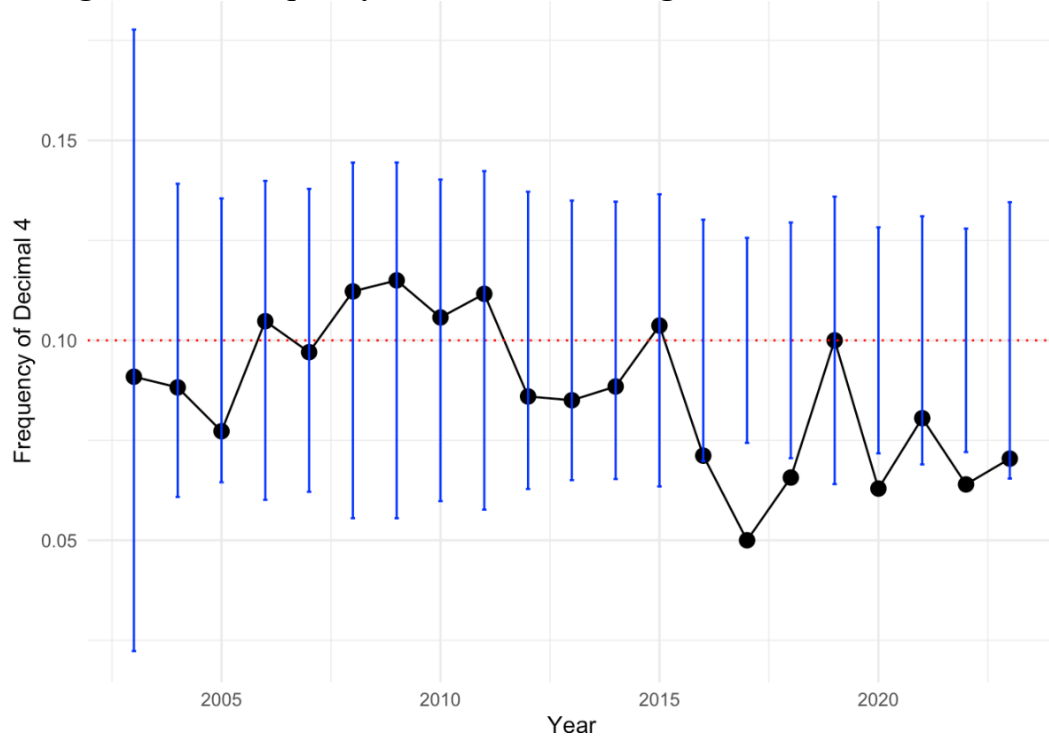


Figure A7: Third Decimal Place – Firm Specific

Figure A7 shows the robustness tests on our Finnish, Norwegian, and Danish data regarding the frequency of digit 4 in the third decimal place for firms with historic avoidance of reporting a 4 compared to those that have reported a 4 in any of the past N quarters. The data is sorted into two groups based on the Q-score variable, and the frequency is calculated by dividing the total occurrences of digit 4 by the total firm observations in the group in question. The difference in frequency is compared using a Z-statistic. The sample is filtered solely by containing diluted EPS values above 0.001.

Figure A7-a: Firm-specific Rounding Analysis using the Q-score in Finland

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	4802	4217	3284	1594	535
Q=0	0.084	0.09	0.1	0.1	0.097
Q=1	0.093	0.093	0.091	0.084	0.067
Z-test	-0.71	-0.288	1.062	1.883	2.559
Significance				*	**

Figure A7-b: Firm-specific Rounding Analysis using the Q-score in Norway

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	7204	6441	5176	2758	1058
Q=0	0.094	0.099	0.103	0.101	0.1
Q=1	0.097	0.097	0.094	0.089	0.078
Z-test	-0.225	0.23	1.187	1.714	2.412
Significance				*	**

Figure A7-c: Firm-specific Rounding Analysis using the Q-score in Denmark

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	4421	3931	3126	1623	548
Q=0	0.076	0.084	0.089	0.09	0.085
Q=1	0.09	0.09	0.091	0.084	0.1
Z-test	-1.061	-0.517	-0.213	0.778	-1.055
Significance					

Figure A8: Third Decimal Place – Factor Specific

Figure A8 shows the robustness tests on our Finnish, Norwegian, and Danish data regarding the frequency of digit 4 in the third decimal place while focusing on different factors, such as total assets, EPS magnitude, and price-to-book ratio. The data is sorted on the factor in focus and divided into 10 groups, where we focus on group 1 which contains the smallest values of the factor, and group 10 with the largest. From these groups, the frequency of the digit 4 in the third decimal place is calculated for each group, where it is compared between groups 1 and 10. The difference is tested with a Z-statistic. The sample is filtered on containing diluted EPS values above 0.001.

Figure A8-a: Prevalence of Rounding with Specific Factors in Finland

	Assets	EPS Magnitude	Price-To-Book Ratio
Group 1	0.087	0.096	0.074
Group 10	0.105	0.1	0.099
Z-test	-0.962	-0.206	-1.459
Significance			

Figure A8-b: Prevalence of Rounding with Specific Factors in Norway

	Assets	EPS Magnitude	Price-To-Book Ratio
Group 1	0.108	0.113	0.084
Group 10	0.089	0.083	0.102
Z-test	1.269	2.012	-1.273
Significance		••	

Figure A8-c: Prevalence of Rounding with Specific Factors in Denmark

	Assets	EPS Magnitude	Price-To-Book Ratio
Group 1	0.081	0.122	0.096
Group 10	0.093	0.074	0.072
Z-test	-0.685	2.477	1.311
Significance		••	

Figure A9: Second Decimal Place – Time Specific

Figure A9 analyzes the frequency of digits 9 and 0 for the second decimal in diluted positive EPS for Sweden, Finland, Norway, and Denmark over time on an annual basis. The black dots show the observed frequency, the blue lines the confidence intervals for 95% confidence, and the red line the null hypothesis at 10%.

Figure A9-a: Frequency of Second Decimal Digit 9 Over Time in Sweden

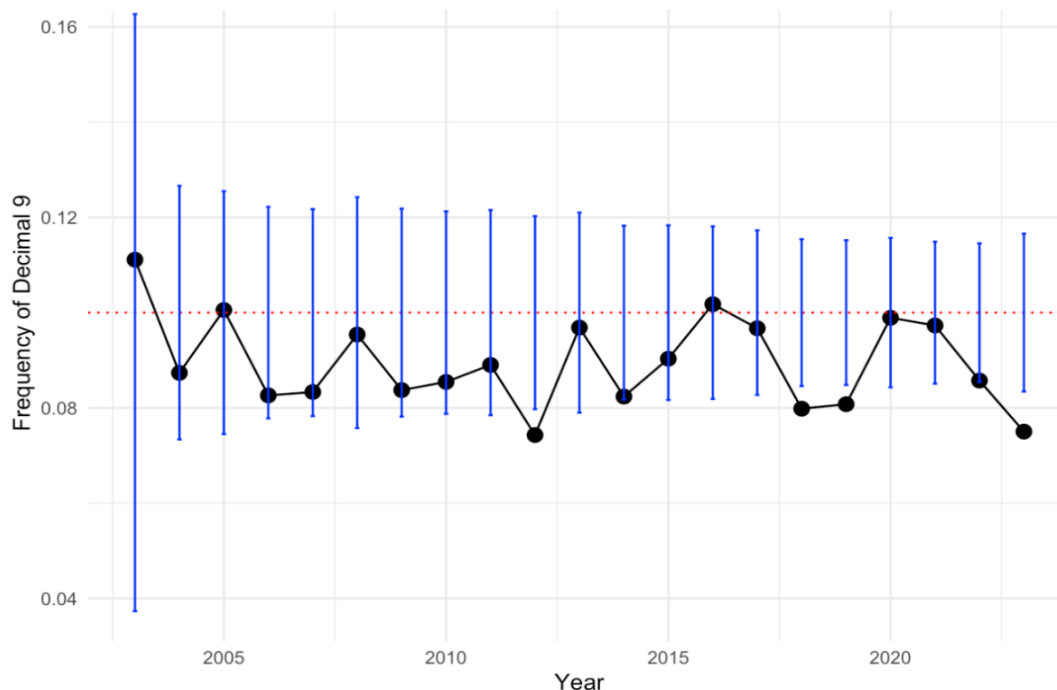


Figure A9-b: Frequency of Second Decimal Digit 0 Over Time in Sweden

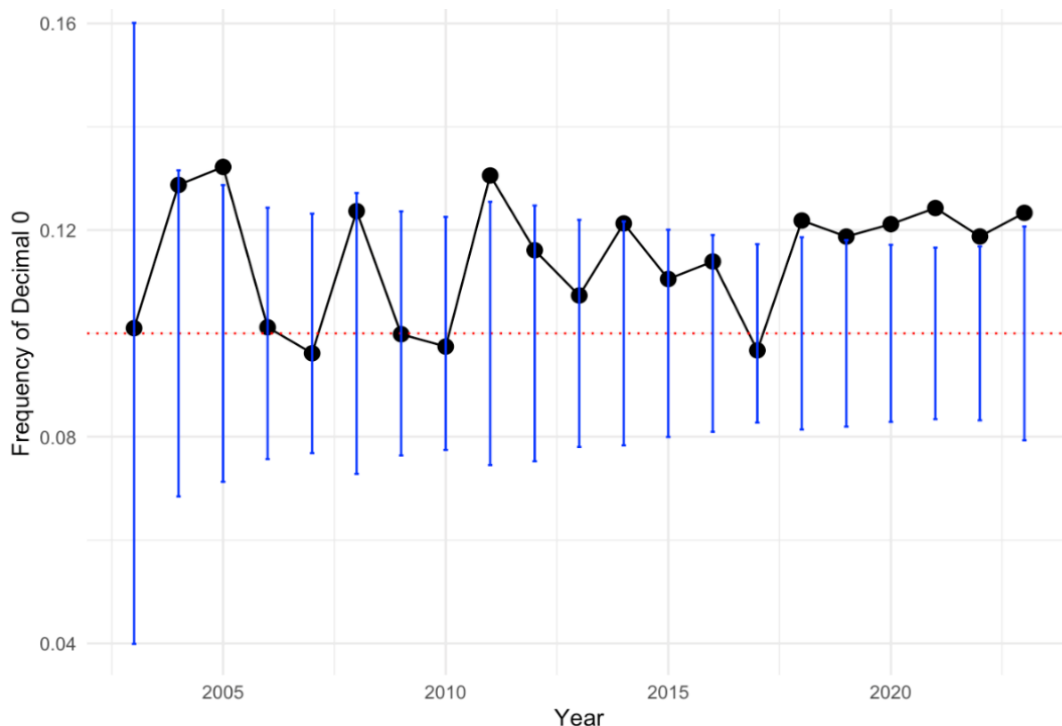


Figure A9-c: Frequency of Second Decimal Digit 9 Over Time in Finland

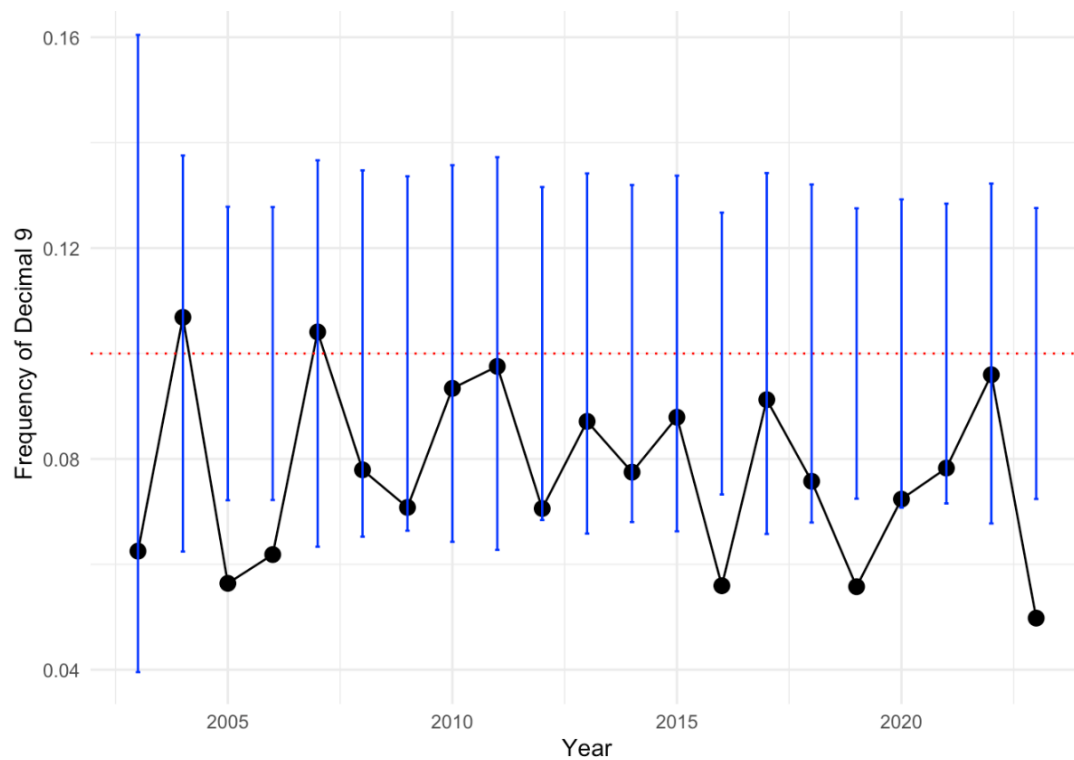


Figure A9-d: Frequency of Second Decimal Digit 0 Over Time in Finland

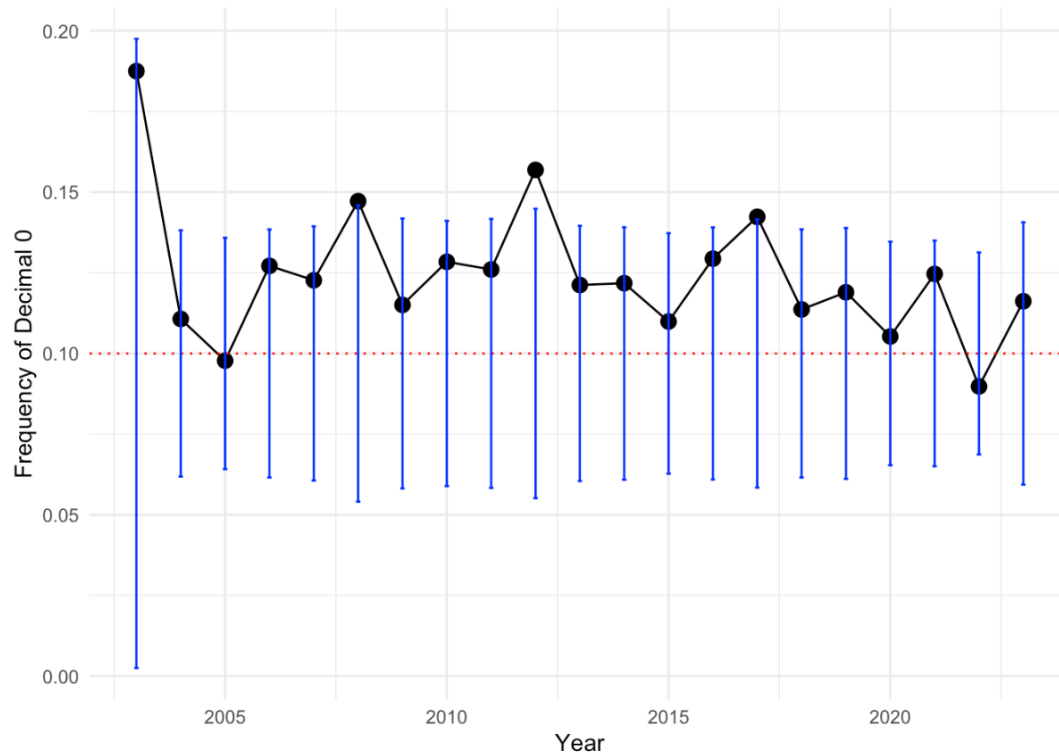


Figure A9-e: Frequency of Second Decimal Digit 9 Over Time in Norway

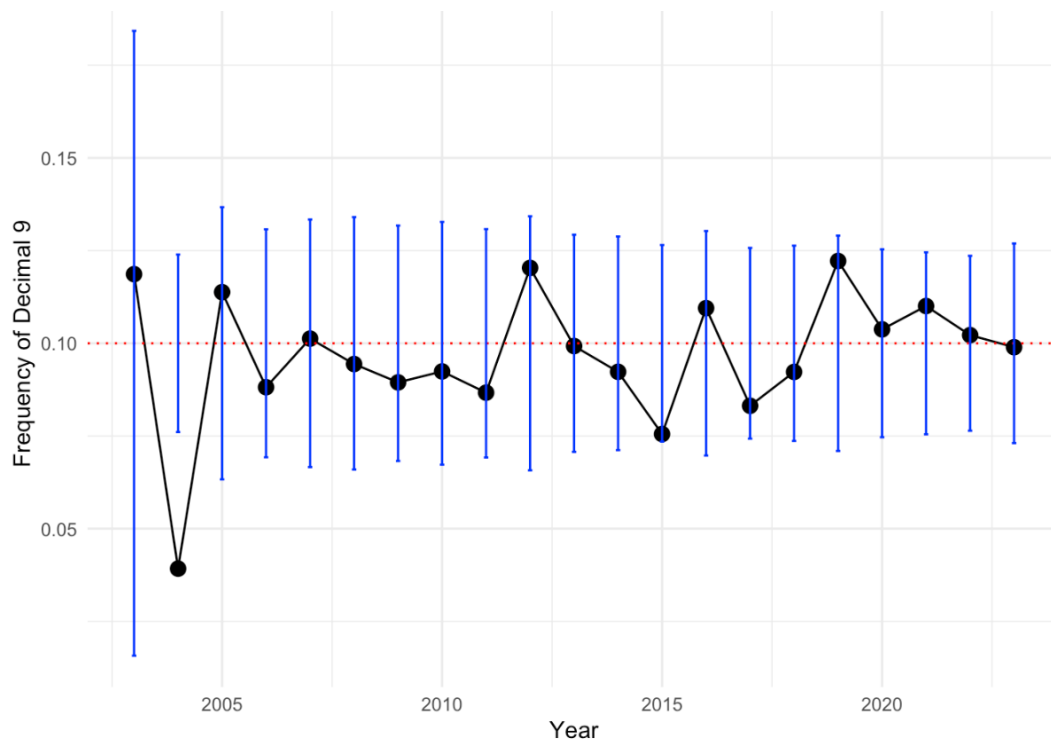


Figure A9-f: Frequency of Second Decimal Digit 0 Over Time in Norway

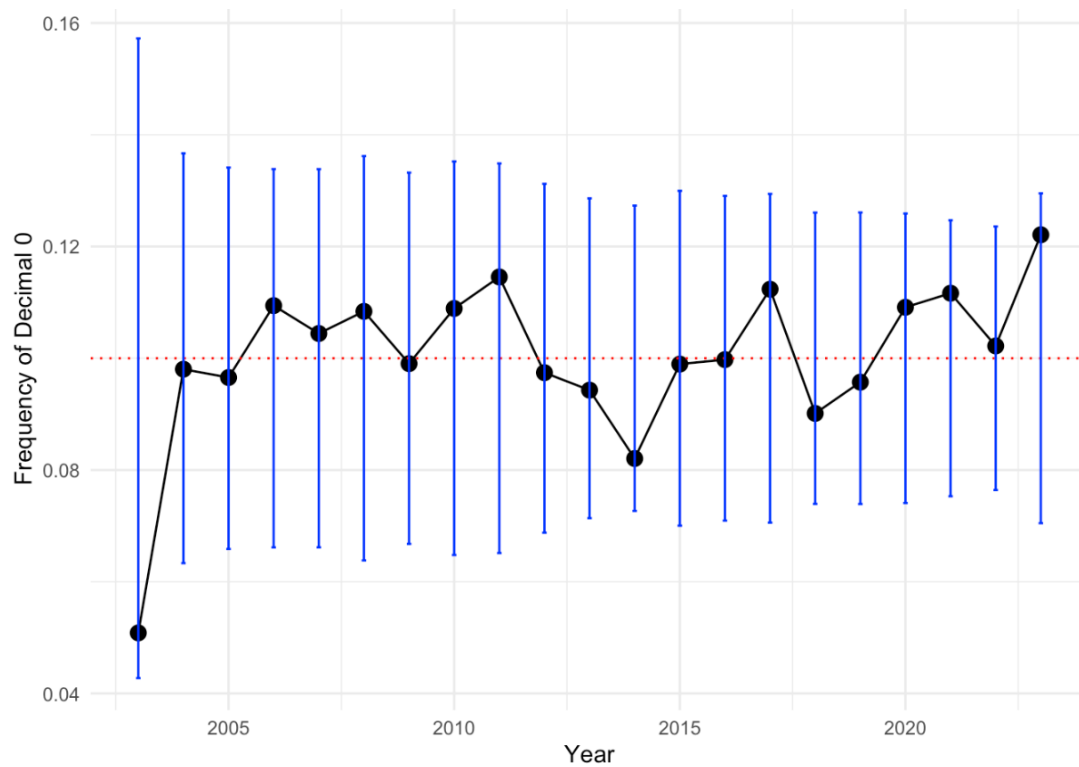


Figure A9-g: Frequency of Second Decimal Digit 9 Over Time in Denmark

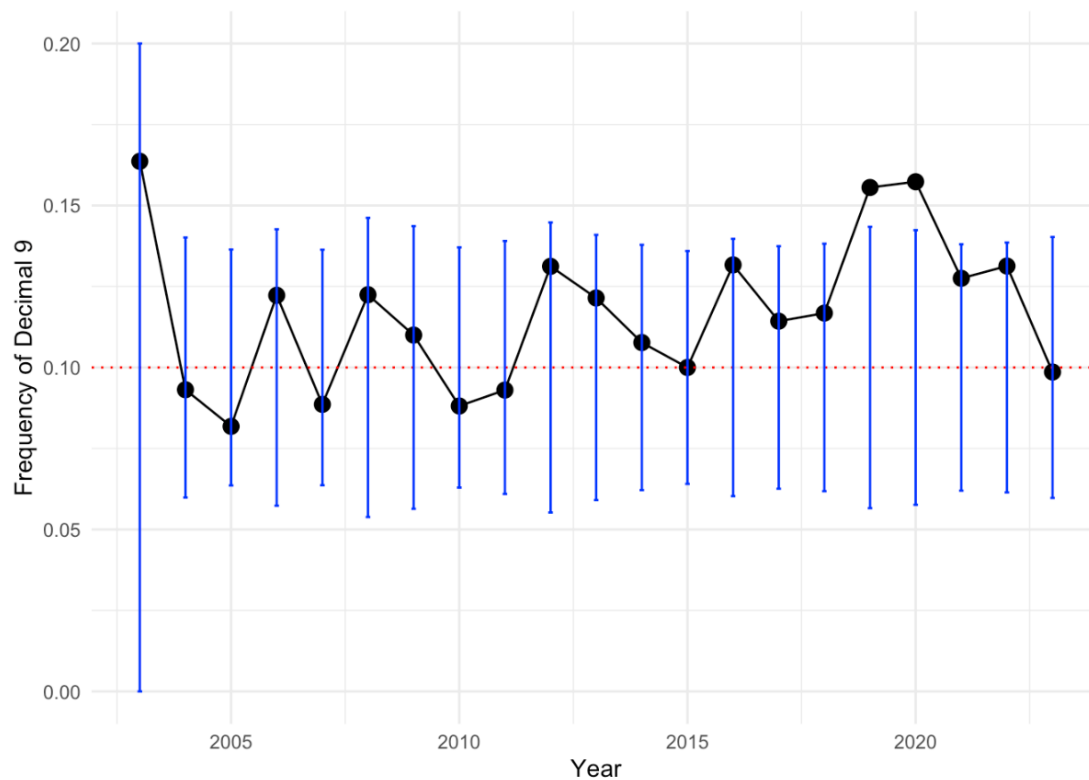


Figure A9-h: Frequency of Second Decimal Digit 0 Over Time in Denmark

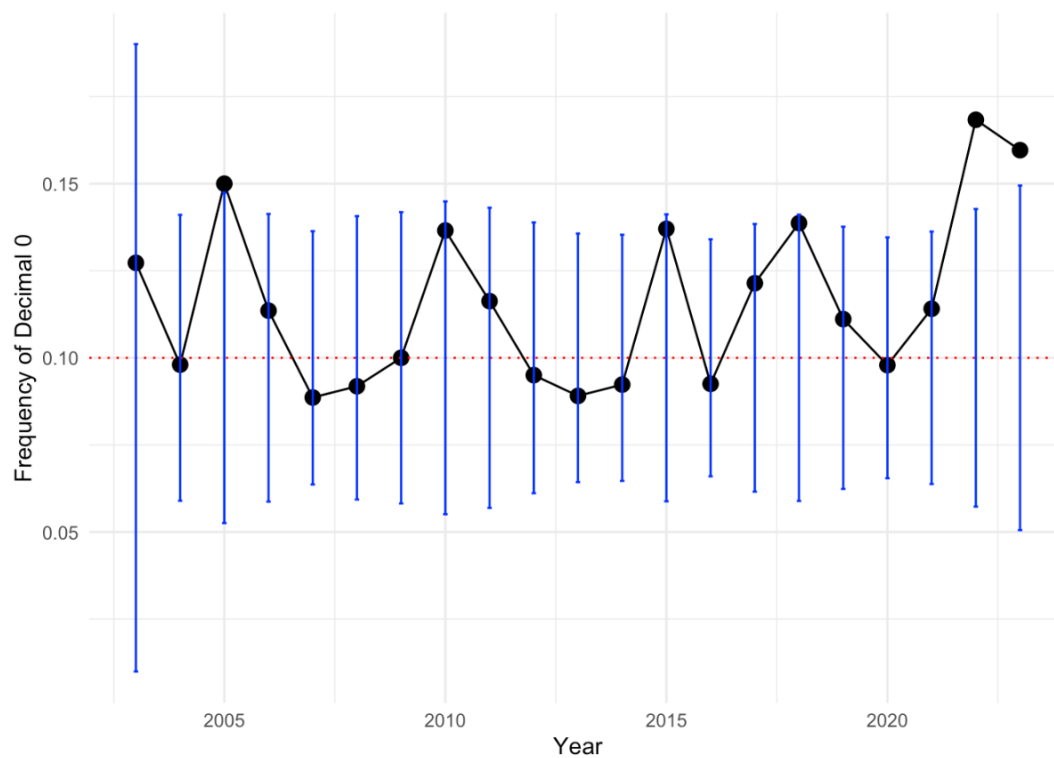


Figure A10: Second Decimal Place – Firm Specific

Figure A10 displays the firm-specific robustness test on the second decimal place for Sweden, Finland, Norway, and Denmark. The method is the same as in our main analysis, where we divide our sample into two groups depending on the binary variable Q-score for different periods of N. The frequency of digit 9 in the second decimal place is compared between the two groups and the difference is reported by using a Z-statistic. All datasets are filtered for containing positive diluted EPS.

Figure A10-a: Second Decimal Place Q-score in Sweden

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	15814	14002	11019	5463	1971
Q=0	0.098	0.096	0.092	0.09	0.085
Q=1	0.089	0.089	0.09	0.084	0.1
Z-test	1.099	1.136	0.417	0.778	-1.055
Significance					

Figure A10-b: Second Decimal Place Q-score in Finland

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	5016	4597	3885	2444	1373
Q=0	0.094	0.1	0.094	0.09	0.085
Q=1	0.078	0.076	0.073	0.084	0.1
Z-test	1.124	2.149	2.382	0.778	-1.055
Significance		**	**		

Figure A10-c: Second Decimal Place Q-score in Norway

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	7269	6530	5272	2781	1118
Q=0	0.104	0.106	0.1	0.09	0.085
Q=1	0.098	0.097	0.098	0.084	0.1
Z-test	0.537	1.08	0.276	0.778	-1.055
Significance					

Figure A10-d: Second Decimal Place Q-score in Denmark

	N=1	N=2	N=4	N=10	N=20
No of firms for Q=1	4312	3774	2929	1461	520
Q=0	0.148	0.142	0.138	0.09	0.085
Q=1	0.113	0.111	0.105	0.084	0.1
Z-test	2.204	2.636	3.339	0.778	-1.055
Significance	**	***	***		

Figure A11: Second Decimal Place – Factor Specific

Figure A11 displays the factor-specific robustness test on the second decimal place, where the factors used are total assets and price-to-book ratio. The sample is sorted on the factor in focus and divided into ten groups where group 1 contains the lowest values and group 10 the highest. The frequency of the digit 9 in the second decimal place is calculated for groups 1 and 10 and compared by using Z-statistics. The sample only contains firm observations with positive diluted EPS values. Note that for this test, sorting on EPS magnitude is not an efficient measure to use, as several of the samples' first 10% of observations have values below 0.09, making the frequency of number 9 in the second decimal place 0. Therefore, we do not display EPS magnitude for this test.

Figure A11-a: Second Decimal Place Factor Specific in Sweden

	Assets	Price-To-Book Ratio
Group 1	0.092	0.091
Group 10	0.093	0.103
Z-test	-0.121	-1.136
Significance		

Figure A11-b: Second Decimal Place Factor Specific in Finland

	Assets	Price-To-Book Ratio
Group 1	0.041	0.076
Group 10	0.113	0.091
Z-test	-4.455	-0.902
Significance	***	

Figure A11-c: Second Decimal Place Factor Specific in Norway

	Assets	Price-To-Book Ratio
Group 1	0.082	0.112
Group 10	0.119	0.087
Z-test	-2.501	1.66
Significance	**	*

Figure A11-d: Second Decimal Place Factor Specific in Denmark

	Assets	Price-To-Book Ratio
Group 1	0.117	0.112
Group 10	0.128	0.108
Z-test	-0.501	0.211
Significance		