

Universities of Pisa, Florence, and Siena

Ph.D. Program in Business Administration and Management

XXXVI Cycle

"Earnings management in commodity firms"

Ph.D. Thesis

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“The more you dream, the more you achieve.”

Michael Phelps

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First of all

I would first like to express my deepest gratitude to my supervisor, Prof. Giulio Greco, for his precious support. He provided constant availability, wise guidance, and motivation throughout the entire PhD program. I sincerely thank him for his commitment to the research activities and for the insightful discussions and precious advises dispensed during these three years.

I would also like to thank Prof. Alessandro Capocchi; your decision to select me as a mentee was a turning point in my academic life. I am truly grateful for the opportunities you provided for collaboration and all your investments in me.

I am also indebted to the Accounting Department at LSE – London School of Economics. I am extremely grateful for the marvellous experience, the precious comments, the seminars, and all the amazing opportunities provided to improve my research. Particularly, I wish to thank Prof. Maria Correia who made my visiting possible, despite the adverse healthcare conditions related to the Covid-19 pandemic.

Finally, I am also indebted the Department of Economics, Finance, and Accounting at ESADE Business School. I am grateful for all the comments from the PhD students, the faculty, and the wonderful environment I discovered. Particularly, I wish to thank Prof. Luca del Viva who made my visiting possible.

Despite the cliché, research is not an individual job closed in laboratories. It is essential to let ideas to circulate and receive comments from peers and seniors. That's why I wish to thank all the participants I have met during the several international and national conferenconferenceshe privilege to attend.

Last but not least, I want to individually thank Prof. Mariarita Pierotti (University of Pisa), Prof. Stefano Cascino (London School of Economics), Prof. Massimiliano Bonacchi (Free University of Bolzano), Prof. Amedeo Pugliese (University of Padua), Prof. Andrea Lionzo (Catholic University of Milan), Prof. Antonio Parbonetti (University of Padua), Prof. Pier Luigi Marchini (University of Parma), Prof. Marco Maria Mattei (Università di Bologna), Prof. Paola Orlandini (Università di Milano-Bicocca), Prof. Luca Anselmi (Università di Pisa), Prof. Francesco Mazzi (University of Florence), Prof. Lorenzo Dal Maso (University of Bologna), Antonio De Vito (University of Bologna), Camilla Ciappei (University of Padua), Francesco Ambrosini (University of Padua), Luca Menicacci (Free University of Bolzano), for their support and comments during these three years.

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CHAPTER I

"INTRODUCTION"

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1.1 Background and Research Objectives

Let me begin with a personal episode to move quickly to a technical perspective.

When I began my academic journey, I heard professors from every course telling me that business economics is a complex issue. I considered the quote a cliché that each professor repeats, trying to engage the class in the mental effort of focusing but also as an incentive for students to take their exams seriously. Until one day, a good friend taught me the difference between two words that seem synonyms but entail different meanings: complicated and complex.

Complicated derives from the Greek "*cum plico",* which means "with folds". Complicated things can be explained, which means "to unfold" in Greek. Thus, to understand a complicated issue, there is the need to eliminate the folds that make the issue complicated. It is simple to find a cause-and-effect relation when events are complicated.

Complex derives from the Greek "cum plecto", which means "braided". Complicated things cannot be explained because there are no folds to eliminate. To understand complex issues, it is necessary to investigate them systematically. It is difficult to establish a cause-and-effect relation when events are complex.

In recent years, we have seen a shift towards research that addresses endogeneity to establish a clearer and more precise link between the cause and the effect. Policymakers need a proof of causation link because reliable scientific facts do not support their decisions. The shift is because firms are complex, and it takes work to establish a causal effect link. For example, Zhang et al. (2022) highlight that only 40% of published papers investigating family businesses address endogeneity.

By examining three distinct yet highly intertwined topics regarding earnings management in commodity firms, this research shows exactly the complexity, i.e., the existing connections for a commodity firm to make earnings management decisions.

There is no single definition for the earnings management phenomenon. Ronen and Yaari (2008, p. 27) provide one of the more adequate definitions because it reveals the use of legal discretion by managers in both accounting and real decisions to influence the reported performance of a firm. Furthermore, it emphasises that the manipulation can be beneficial and detrimental.

"Earnings management is a collection of managerial decisions that result in not reporting the true short-term, value-maximizing earnings as known to management. Earnings management can be beneficial: it signals long-term value; pernicious: it conceals short- or long-term value; neutral: it

reveals the short-term true performance. The managed earnings result from taking production/investment actions before earnings are realized or making accounting choices that affect the earnings numbers and their interpretation after the true earnings are realized."

Thus, earnings management should not be considered the same as fraud (Dechow and Skinner 2000) and earnings quality (Dechow et al. 2010). Fraud occurs when managers violate an accounting principle, while earnings management occurs within the discretion provided by the accounting principles. Despite being highly intertwined, the concepts of earnings quality and earnings management differ. Earnings management focuses entirely on the discretion in the financial statement, while earnings quality refers to the usefulness of the information contained in the financial statement. For example, investors might find useful (or be misled by) information manipulated by managers.

The topic has been largely investigated in previous literature, providing mixed evidence.[1] This research shows that earnings management is a pervasive phenomenon requiring industry-specific investigations to reconcile the mixed results.

Furthermore, the research on commodity firms holds significance not only for contributing to the earnings management literature but also for exploiting the distinctive business features existing in the industry. The economic relevance of commodities to the global economy also makes the study of commodity firms relevant to practitioners and policymakers. The operations of such firms impact the global economic environment, and their influence extends beyond the traditional "real economy" because commodities are actively traded in financial markets by banks and investors, serving as instruments for both hedging and speculation.

The peculiar characteristics of commodity firms, such as the lack of control over volatile prices, substantial fixed costs, political pressures, environmental considerations, and tax implications, make them particularly intriguing subjects for research. The timing of this research is also relevant, considering the unprecedented economic disruptions caused by the COVID-19 pandemic. The pandemic highlighted the importance of commodity firms in shaping the economy and our world. This thesis is an attempt to uncover how commodity firms operate.

Chapter 2 investigates how commodity firms react to uncertainty. By focusing on oil, iron, and gold companies, we show that uncertainty triggers an earnings smoothing strategy.

Chapter 3 investigates how the gold companies use the information contained in the futures to implement a smoothing strategy,

[1] For example see El Diri (2018) literature review.

Chapter 4 investigates how American oil firms reacted to the discussion of increasing the excise tax related to fuel and gasoline that occurred in 2005.

The three papers are an early version of works published (or under review) in international journals. All the papers have been presented multiple times to national and international conferences during the three years of the Ph.D., where they received relevant feedback that helped me improve the quality of the manuscript, for which I am grateful. I was also lucky enough to be accepted at the London School of Economics and ESADE Business School for a visiting period where I could test my ideas, learn from the top scholars, and improve the quality of this thesis. None of this work would have been possible without the precious guidance of my supervisor, Prof. Giulio Greco. All the errors contained in the manuscript should be attributed only to myself.

1.2 Outline of the dissertation

This section describes the organisation of the thesis. All three chapters are quantitative empirical archival-based research. Chapters 2 and 3 investigate a sample of U.S. public firms, while Chapter 4 uses a global sample of firms.

Chapter 2 investigates the relationship between macroeconomic uncertainty (we use different proxies) and earnings smoothing. Chapter 3 explores the impact of futures on earnings management in the gold mining industry. Chapter 4 examines the role of fuel excise tax in inducing earnings management by exploiting the discussion in the U.S. in 2005 of whether to increase the federal excise tax. Chapter 5 briefly summarizes and concludes.

The remaining part of this Section contains a brief description of the research chapters in the thesis and an outline of the dissertation.

Chapter 2:

Paper Title: "Uncertainty, commodity firms, and earnings smoothing"

The research is motivated by several reasons. First, previous research investigated the role of macroeconomy in influencing earnings management (Filip and Raffournier, 2014; Trombetta and Imperatore, 2014). Such studies focus on specific economic events like economic downturns or crises. However, macroeconomic trends and volatility significantly impact firms' earnings, investments, and stock prices (Damodaran, 2009; Luther, 1996) on a daily basis. Thus, managers might use earnings management as a reaction to macroeconomic uncertainty. Understanding whether macroeconomic conditions shape earnings management is

of interest to scholars, as it could uncover a major phenomenon making earnings management more pervasive and systematic than previously thought (Bartomeu et al., 2021). Second, prior literature investigates how managers reduce the volatility of a company's earnings through smoothing activities (Beidleman, 1973; Fudenberg and Tirole, 1995; Barth et al., 1999; Graham et al., 2005; Myers et al., 2007). A common feature of these studies is that earnings volatility is often assumed (and smoothing is inferred by the properties of earnings and cash flows), and there is no investigation of exogenous sources of variation in the firm's reported earnings. This paper aims to extend the knowledge of the factors that drive earnings volatility and motivate earnings smoothing, investigating the role of uncertainty. Third, prior studies show that economic uncertainty dramatically increased in the past decades due to political factors, scientific and technological development, fast changes in consumer behavior and society, repeated crisis, and shocks (Altig et al. 2020; Baker, Bloom, and Davis, 2016; Ahir, Bloom and Furceri, 2022)[2]. Economic uncertainty is an exogenous random source of earnings variation and represents a primary motivation for smoothing earnings. The COVID pandemic and the subsequent events like the commodities price surge and the Ukraine war are producing worldwide economic uncertainty affecting the economy, exacerbating the incentive to smooth earnings for firms.

The study sample consists of 92,125 firm-year observations. 56,458 firm-year observations represent SIC code 13 (Oil and gas extraction) and SIC code 29 (Petroleum Refining), 6,820 firm-year observations represent SIC 29 (Petroleum Refining and Related Industries), 26,211 firm-year observations represent SIC 1040 (gold and silver ores) and 2,636 firm-year observations represent NAICS 212210 (Iron ores). The number of individual firms in each category is 1,720 oil producers, 646 gold producers and 38 iron producers.

We exploit the commodity firms setting. Commodity prices are, *per se*, a relevant macroeconomic factor that produces uncertainty for the overall economy (Inkpen and Moffett, 2011; Henzel and Rengel, 2017). Commodity-based firms' earnings and market value depend on the price fluctuations of the commodity they produce, and "as a consequence, even mature firms have volatility cash flow and earnings" (Damodaran, 2009, p.3). Hence, there is a direct link between uncertainty and the firms' profitability in the research setting. Instead of

[2] Economic uncertainty received huge attention after the seminal Bloom's (2009) seminal work. Prior literature provides multiple definitions of economic uncertainty, converging on the idea that uncertainty is the difficulty to forecast the future due to high environmental volatility. Multiple measurements have also been proposed, such as market-based measures such as stock market volatility (Baker et al. 2020), index of uncertainty built on newspaper coverage (Baker et al. 2016) or forecast disagreements (Altig et al. 2020). Using different measurements, prior research shows more frequent changes and higher upward and downward spikes across the decades. Research using aggregated indexes show an increasing trend in average global uncertainty (Ahir, Bloom and Furceri, 2022).

identifying a moderating effect, we can investigate the direct effect of how companies react to an increase in uncertainty. The fluctuations in commodity prices are related to market factors that are outside the control of the management and represent a major source of uncertainty for commodity companies (Dayanandan and Donker, 2011; Carter et al., 2017; Poitras, 2013). Commodity firms represent a suitable setting to analyse the effect of economic uncertainty on earnings smoothing, as these firms usually operate in a volatile environment, which may motivate earnings smoothing. In addition, commodity firms have standard business models with high fixed costs, i.e., depreciation, personnel, and maintenance (Damodaran, 2009). Their revenues are linked to commodity prices, so economic uncertainty directly maps into their profits (Damodaran, 2009).

This paper gets the financial data from the quarterly data from the Compustat North America database. The IMF Primary Commodity Price System (PCPS) contains quarterly data regarding the prices of 68 commodities starting from the first quarter of 1990. We use Datastream's daily time series to compute the quarterly standard deviation as a proxy for commodity price volatility.

Earnings management research typically involves a two-step research design. Initially, discretionary accruals are computed in the first regression to calculate the residuals, followed by regressing the residuals on explanatory variables in a second regression. However, potential bias may arise due to misspecification in the first equation, especially when the explanatory variable influences the regressors (Chen et al., 2018). Our setting mitigates these issues in two ways. We include the relevant variable in the first equation and do not use residuals in the second equation to make inferences. The attention is on the relation between commodity price and the level of accruals or operations expected by the models. By using well-established methods, we also reduce the subjectivity in the variable selection (McNichols and Stubben, 2018). Finally, to understand if the smoothing is informative, we use a set of well-established models (Tucker and Zarowin, 2006; Baik et al., 2020)

Oil firms smooth their earnings in response to the commodity price. By engaging in income-decreasing accruals management, oil firms shift profits of a quarter of high oil prices in quarters with low oil prices. The effect of earnings smoothing is statistically significant and has an economic relevance. Gold does not display coefficients suggesting earnings management. Gold has had a stable growing demand through the decades. When the economy is booming, it is required to produce mainly jewellery and electronics components. When the economic trend is decreasing, it is required by banks, hedge funds and investors as a hedge investment. Thus, the lower volatile demand and more stable trend make earnings smoothing unnecessary to gold

firms. This finding does not exclude that gold firms engage in earnings management with other motivations (e.g., Monem, 2003); it suggests that the macroeconomic environment does not produce earnings volatility triggering earnings smoothing. Also, results on real earnings management support the earnings smoothing hypothesis. Finally, our evidence suggests that oil companies smooth earnings to communicate private information externally, and investors find smoothing informative. Evidence does not support the garbling hypothesis. The main limitation is related to the generalizability of the results.

The paper makes several contributions to the existing literature. First, it adds to the emerging stream of research related to macroeconomy-wide factors and firm-specific decisions (Anolick et al., 2021; Bonaime et al., 2018; Duong et al., 2020; Gulen and Ion, 2016). The paper complements this literature with evidence that uncertainty affects both accounting choices and real operations quarterly. Furthermore, the paper shows that the effect of uncertainty is more pervasive than previously thought and not limited to specific crisis years. Second, it contributes to the existing literature on earnings smoothing. The effect of uncertainty on earnings management is not forgone because it can motivate manipulations (Graham et al., 2005), but it also increases scrutiny on financial reports (El Ghoul et al., 2021). The study shows the willingness of managers to reduce volatility caused by uncertainty. Investors' attention, however, might play a role because evidence shows that managers manipulate earnings to make them more informative. Finally, the research contributes to the literature investigating the role of firms' economic environment in determining earnings management. The paper also has multiple practical implications.

Chapter 3:

Paper Title: "Do futures influence earnings management in the global gold mining industry?"

Prior research investigates the role of financial markets in determining earnings management (El Diri, 2018). The role of futures markets received scant attention. Using future prices in sales contracts can promptly and directly influence operating activities through the futures market. The research exploits the gold industry because, in the mining industry, the use of provisional sales is largely implemented. Provisional sales refer to contracts where the selling price, typically for the next quarter, is based on future prices. This arrangement occurs when the delivery of the goods is not immediate, and both parties involved in the transaction consider the commodity's future value. On the one hand, such a mechanism can support managers in creating reliable forecasts of future revenues and support smoothing strategy. On

the other hand, futures provide useful information available to stakeholders to assess the reliability of information disclosed.

One option is using real earnings management, which is less detectable. Moreover, companies are motivated to proactively mitigate risk and minimize uncertainty in their financial performance to reduce the costs associated with a volatile performance (characterized by fluctuations in earnings and cash flow), such as a higher cost of equity, higher cost of capital, or suboptimal use of financing and investment decisions (Trueman & Titman, 1988; Froot et al., 1993; Minton & Schrand, 1999; Graham et al., 2005). Thus, managers might smooth performance in a volatile environment where relying on futures to forecast performance is difficult. Therefore, it is interesting to understand if managers use the information in the future to implement a smoothing strategy and if both accruals and real earnings management are used.

The paper uses a global sample by combining quarterly financial data available in Compustat North America and Compustat Global databases. It identifies gold firms using the SIC code 1040. The investigation is during the years 2003 – 2019. Quarterly data are suitable for our study because the influence of futures on sales occurs every quarter. The sample is made by 987 individual firms for 41,510 firm-quarter observations. Data regarding gold prices are from Datastream-Refinitiv. It selects the COMEX Gold Composite Commodity Future Price as a reference for future prices because it has the longest availability, starting from Q1 2003, which is the reason for the research period (2003 – 2019).

This paper uses discretionary accruals. Although their validity has been disputed in the recent literature, multiple papers use the methodology nowadays, which should be included in a thesis on earnings management. Thus, the dependent variables are abnormal accruals calculated with various models and abnormal operations (cash flow from operations, production costs, and discretionary expenses) using Roychowdhury models (2006). There are analyses using the single-stage regression in untabulated results, and the results hold.

The variable of interest is the difference between the future price (at quarter t) for quarter t+1 and the spot price in quarter t, divided by the spot price at quarter t. The economic significance is that the variable has positive values when the prices are expected to increase and negative values when prices are expected to decrease. As controls, we include controls for size, level of debt, profitability, market value, management compensation, and hedging. There are also time and country-fixed effects to control for unobservables.

The results support the hypothesis that managers use the information contained in the future to project future sales and engage in earnings smoothing. Results show a positive and statistically significant coefficient for accruals, suggesting that, when the current price is above

the future price, firms reduce current profits to increase future profits and vice versa. Evidence suggest that firms smooth earnings using also real earnings management. Gold firms reduce discretionary accruals and increase production costs when the current price is lower than the future price. It suggests that gold firms increase earnings in quarter t when expecting earnings in quarter t+1 to be higher. Endogeneity tests using the GMM and IV estimation confirm the consistency of results. Moreover, results are consistent with multiple robustness tests. The first related to the population by excluding Canadian firms from the sample (which represents 43.45% of the total), the second related to a time analysis to exclude the crisis year, which documents that during uncertain periods, futures managers do not rely on futures probably because less reliable, third to economic conditions by including in the equations the current price of gold. Finally, we perform a further investigation, splitting the sample into US GAAP users and IFRS users. US GAAP allows for more flexibility, and evidence suggests IFRS mitigate the smoothing. The limitation of the paper is the need for more controls for governance or ownership due to data unavailability.

The paper has several contributions. First, it contributes to the literature regarding the determinants of earnings management (Dechow et al., 2010; Teixeira and Rodrigues, 2022) because it shows that the future market influences accounting and operative decisions. The role of futures has received scant attention in previous literature. Second, it adds evidence on how the process by which managers smooth earnings (Baik et al., 2020; Graham et al., 2005). Finally, it complements the literature by showing that earnings management has pervasive and industry-specific features (Bertomeu et al., 2021; El Diri, 2018).

Chapter 4:

Paper Title: "Pain at the pump: Excise tax and earnings management"

There are at least two reasons of interest for this research. Firstly, existing studies on income tax-induced earnings management may not directly apply to the excise tax context. Excise taxes, applied to specific goods like fuel, alcohol, tobacco, gambling, and firearms, are fixed per unit or quantity sold. Changes in excise taxes lead to permanent alterations in consumption, making temporary income shifting less effective for excise tax collector firms. Research on tax pass-through rates indicates that firms do not entirely pass on the burden of excise tax increases to consumers, potentially resulting in profit loss (Ardalan & Kessing, 2021; Bonnet & Réquillart, 2013; Carbonnier, 2013). Secondly, the study is motivated by the reactions of excise tax collector firms to changes or the threat of changes in excise taxes. These responses directly impact the environment and social welfare. The actions taken by these firms, whether evading

or mitigating the impact of excise tax increases, have adverse effects on societal well-being and significant environmental implications. For instance, such actions may impede progress towards greener and more sustainable transportation systems, delay infrastructure modernization, and perpetuate unhealthy consumption habits. The income taxes paid by US oil firms between 1981 and 2008 totalled about 338 billion $, while the excise tax collected totalled about 1.1 trillion $ (CSR Report, 2021). The excise tax revenues are essential for many trusts providing relevant public services, like the US Highway Trust Fund, the Airport and Airway Trust Fund, and the Black Lung Disability Trust Fund. Analyzing the behavior of excise tax collectors is thus extremely relevant to policymakers and stakeholders.

This paper uses quarterly data from the Compustat North America database. The main analysis uses data from companies included in the SIC Code 13 (Oil & Gas Extraction) and the SIC Code 29 (Petroleum Refining). These industries represent the fuel production chain and are likely to be affected by increases in the fuel excise tax. The main analysis used the period spanning from Q1 1993 to Q4 2019. The final sample is composed of 22,309 firm-year observations from 737 individual firms. 19,654 firm-quarter observations are in the SIC Code 13, with 647 unique firms. 2,655 firm-quarter observations are included in the SIC Code 29 from 90 unique firms.

The research design exploits the political discussion that occurred in 2005 around the possibility of increasing the federal fuel excise tax to provide financial resources to the Highway Trust Fund. Because all the resources collected through the federal fuel excise tax are used to finance the Highway Trust Fund, the HTF introduces variability in the threat for the U.S. oil industry, particularly in relation to potential fuel excise tax increases. This variability stems from various factors, such as negotiations on investment projects and maintenance operations, road consumption, obsolescence of mass transit infrastructures, federal government choices on investments and funding, and pressure from labour unions. Oil firms have limited influence over the HTF's financial needs due to the involvement of multiple stakeholders. The political process related to the Trust Fund is unpredictable in its outcome and does not immediately impact oil prices or the performance of oil companies. While oil firms may engage in lobbying to prevent fuel excise tax increases, lobbying affects the treatment outcome rather than the probability of the treatment so it does not alter the fundamental source of variation in the perceived political costs associated with the Highway Trust Fund.

Thus, the insolvency that occurred in 2005 represents a suitable exogenous shock to test the hypothesis using a quasi-experimental multiple periods difference-in-differences methodology. By doing so, the paper examines whether US oil firms engage in accrual and real earnings

management during the political process leading up to the issuance of the Act (Q1, Q2, and Q3 2005) and after its issuance from Q4 2005 on (Barrage et al., 2020), as a response to the threat of excise tax increase. The research design uses a single equation approach, following the recommendations by Chen et al. (2018) to include the explanatory variable in single equation earnings management models and avoid using residuals (i.e., discretionary/abnormal accruals/real) as dependent variables. We include controls for the US GDP, fuel price, and fuel consumption.

The empirical analysis indicates that US oil firms adjust their sales and production operations to support consumption and enhance the excise tax collected. The results demonstrate a permanent adaptation of sales and production policies by oil firms to ensure a steady financial flow to the Highway Trust Fund and to counteract the potential threat of excise tax increases over time. These adjustments are economically significant and remain robust when alternative control groups are employed in the diff-in-diff analysis. A placebo test involving a different set of excise tax collectors (tobacco and alcohol) reveals no engagement in earnings management during and after the SAFETEA-LU Act. Additionally, a placebo test with an alternative treatment on oil firms (the 1997 Tax Relief Act, raising the passenger excise tax in the aviation industry) supports our findings. The empirical investigations also offer evidence of production "smoothing" concerning the level of excise tax collected.

The investigation provides multiple contributions to the literature. First, it extends the literature on tax-induced earnings management (Gaertner et al., 2020; Lin et al., 2012; Scholes et al., 1992) by showing that not only income tax induces earnings management by firms. Excise tax collectors permanently adjust their operations to protect the firm's value and profitability against changes in excise tax. Secondly, it contributes to the literature on the real effects of corporate taxation (Jacob, 2022). The study complements such literature, highlighting that excise tax has relevant real effects on social welfare and the environment. Results show that US excise tax collector firms contribute to keeping low excise taxes on fuel, which is environmentally destructive and inconsistent with social welfare goals. Finally, the paper expands the literature on public finance, showing that excise tax collectors' behaviours influence the resources available to the government. This is a perspective to which literature dedicated scant attention (Hillman, 2019) and should be addressed.

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CHAPTER II

Uncertainty, commodity firms, and earnings smoothing

Abstract

This paper studies the relationship between macroeconomic uncertainty and earnings smoothing. It investigates US commodity firms' quarterly data from the period 1990-2019. The findings show that oil and iron firms use both accruals and real operations to smooth earnings in quarters with high commodity price volatility and high basis risk. Earnings smoothing is economically significant and aims to convey useful information about firms' true economic performance to investors. The findings are shown to be robust to placebo tests using gold firms, to endogeneity tests with the general method of moments (GMM) and instrumental variables (IV), and analyses using the Economic Policy Uncertainty (EPU) index. This study contributes to previous research on macro economy-wide factors and firm-specific decisions and the existing body of earnings smoothing literature. It also informs market participants about commodity firms' financial reporting quality and has direct policy implications for financial reporting regulation in extracting industries.

Keywords: earnings management, earnings smoothing, macroeconomic uncertainty, commodity

JEL codes: M41, Q02, E32

1. Introduction

Recent studies highlight that Chief Financial Officers (CFOs) estimate that business model, industry-wide, and economy-wide factors account for most of the earnings quality in external reporting, with quality earnings defined as being "sustainable and repeatable" (Dichev et al., 2013, p. 3). Despite the emphasis placed by researchers on income-increasing earnings management, CFOs suggest that earnings management is split almost equally between income-increasing and income-decreasing for cookie jar reserving, i.e., earnings smoothing[3] (Dichev et al., 2013; Graham et al., 2005). This paper investigates the relationship between macroeconomic uncertainty[4] and earnings smoothing. The research is motivated by three factors.

First, prior studies have examined the influence of the macroeconomy on earnings management by investigating economic downturns, emphasising aggregate macroeconomic expectations (Filip and Raffournier, 2014; Trombetta and Imperatore, 2014). Yet, macroeconomic uncertainty has a much larger effect on managers' decisions than considerations over whether the economy will expand or contract (Baker and Bloom, 2013; Binz, 2022). Macroeconomic uncertainty continuously impacts firms' earnings, investments, and stock prices (Damodaran, 2009). Hence, earnings management could be part of a firm's reaction to macroeconomic uncertainty. Despite this phenomenon being well documented, the current literature base lacks empirical evidence on how firms react to macroeconomic uncertainty using earnings management.

Second, prior studies have investigated how managers reduce the volatility of a company's earnings and create cookie jar reserves through smoothing activities (Baik et al., 2020; Graham et al., 2005; Myers et al., 2007). A common feature of these studies is that earnings volatility is often assumed (and smoothing is inferred by the properties of earnings and cash flows), and there is no investigation of exogenous sources of variation in the firm's reported earnings. Macroeconomic uncertainty appears to be a primary exogenous source of variation in earnings to which income smoothing can be related (Dichev et al., 2013).

Third, previous studies have shown that macroeconomic uncertainty dramatically increased over recent decades due to a combination of political factors, scientific and technological

[3] Earnings smoothing "reflects the ongoing and overtime use of income-increasing and income-decreasing accrual and real activities earnings management to reduce the volatility of reported earnings and generate future reporting slack" (Demerjian et al., 2020, p. 409). Smoothing creates "cookie jar" reserves, savings from previous quarters, which are used to bolster earnings in subsequent quarters (Fogel-Yaari and Ronen, 2020).

[4] Macroeconomic uncertainty received huge attention after the Bloom's (2009) seminal work. Prior literature provides multiple definitions of macroeconomic uncertainty, converging on the idea that uncertainty is the difficulty to forecast the future due to high environmental volatility (Ahir et al., 2022; Altig et al., 2020).

development, rapid changes in consumer behavior and in society as a whole, repeated crises, and shocks (Ahir et al., 2022; Altig et al., 2020; Baker et al., 2016). A study on macroeconomic uncertainty and earnings smoothing could be informative for external users regarding the quality of financial reporting in the volatile new normal scenario, which the COVID-19 pandemic, the Ukraine War, and the energy crisis have impacted.

Ex ante, the relationship between macroeconomic uncertainty and earnings smoothing is ambiguous. On the one hand, prior research has found that managers dampen earnings to reduce their volatility and generate future reporting slack for signalling purposes or for managerial opportunism (Baik et al., 2020; Graham et al., 2005)[5]. The implicit assumption of these studies is that the external macroeconomic environment induces earnings volatility. On the other hand, recent research suggests that macroeconomic uncertainty may reduce earnings smoothing through its effect on investors' attention to the firms' earnings and external financial reporting (El Ghoul et al., 2021; Garel and Petit-Romec, 2021). In the latter view, uncertainty increases the value of information, with uninformed investors bearing an unacceptable level of risk, which tightens the investors' scrutiny on the firm's reported performance (Andrei et al., 2021). Hence, whether macroeconomic uncertainty incentivises firms to smooth earnings or not is ultimately an empirical question.

To investigate this topic, the paper exploits the commodity firms setting. Previous studies have used several measures of uncertainty, including market-based measures such as stock market volatility (Baker et al., 2020), an index of policy uncertainty built on newspaper coverage (Baker et al., 2016) or analysts' forecast disagreements (Altig et al., 2020). Previous macroeconomic literature has used commodity price volatility as an indicator of macroeconomic uncertainty (Bakas and Triantafyllou, 2018; Han and Wang, 1998; Joëts et al., 2017). Commodities prices are a relevant macroeconomic factor producing uncertainty for the overall economy (Henzel and Rengel, 2017; Inkpen and Moffett, 2011). The volatility of commodity prices is related to a wide range of economic, political, social, and environmental factors that are outside the control of a commodity firm's management (Carter et al., 2017; Dayanandan and Donker, 2011; Poitras, 2013)[6]. Commodity firms represent a suitable setting

[5] Managers use earnings smoothing for signaling purposes, when they want to communicate to outside parties the firm's true economic performance to help investors predict future earnings (Baik et al., 2020). Managers can also use smoothing for job security and compensation reasons, to obtain a lower cost of capital or better trade terms with customers and suppliers (Dou et al., 2013; Graham et al., 2005).

[6] The volatility of daily prices can neither be influenced nor fully anticipated by the average US commodity firm. Taken together, US commodity firms account for a fraction of oil, iron, and gold production worldwide, having accounted for on average about the 10% of the global oil production through the decades and a one-digit percentage of global gold and iron productions (US Geological Survey, 2022). The production is spread over many Countries including Russia, China, Canada, Venezuela, Saudi Arabia and other OPEC Countries. In several

to analyse the effect of macroeconomic uncertainty on earnings smoothing, as these firms usually operate in an uncertain macroeconomic environment. These firms operate under a similar business model, with high fixed costs (i.e. depreciation, employees, maintenance), so macroeconomic uncertainty directly maps into revenues and profits (Damodaran, 2009)[7].

The main research analyses for this study utilize financial quarterly data from U.S. oil, iron, and gold commodity producer firms over the period spanning from 1990 Q1 to 2019 Q4. The research uses the gold commodity firms as a placebo test. This research investigates accrual and real earnings management using a single equation approach (Chen et al., 2018). More specifically, it augments the Jones model (Jones, 1991), the modified Jones model (Dechow et al., 1995), the Jones model augmented with return on assets (ROA), and the modified Jones model augmented with ROA (Kothari et al., 2005), with commodity quarterly price volatility. Similarly, the empirical analysis of real earnings management uses Roychowdhury's (2006) models, augmented with commodity price volatility.

The results show that oil and iron firms engage in income-decreasing (increasing) earnings management in quarters where commodity price volatility is high (low) to smooth income and create cookie jar reserves. The results are robust across a series of different accrual earnings management models. Further results show that oil and iron firms charge more production overheads and discretionary expenses to decrease (increase) the reported earnings in quarters with high (low) commodity price volatility. The effect of commodity price volatility on earnings management is economically significant. As expected, our findings do not provide evidence of gold-producing firms' accrual or real earnings management. To ensure robust findings, the paper also uses the spread between the current commodity price and future price as an alternative measure of uncertainty and obtain consistent results. Findings are also robust to endogeneity checks, with GMM and IV using US oil exports to China as instrumental variables.

To address concerns that the macroeconomic uncertainty measure is related to the firms' fundamentals or concerns that commodity firms may affect the macroeconomic uncertainty (reverse causality), the research also uses the Economic Policy Uncertainty (EPU) Index as an alternative measure of uncertainty (Baker et al., 2016). This test confirms that uncertainty

Countries, the production is organized by state-owned companies. In any case, to ease endogeneity concerns, we run additional tests in Sections 6 and 7.

[7] Dichev et al. (2013) survey of CFOs indicates that the four primary factors affecting earnings management are: the firm's business model, the industry, the macro-economic conditions, and the accounting standards. Therefore, the first three factors should be even more important for the commodity industry.

affects earnings smoothing. Taken together, these tests support a causal interpretation of the effect of macroeconomic uncertainty on earnings smoothing in commodity firms.

Further investigations analyse whether earnings smoothing by commodity firms improves stock informativeness (Baik et al., 2020; Tucker and Zarowin, 2006). The results show that, as uncertainty increases, oil and iron firms with smoother earnings have stocks containing more information on future earnings than the stocks of oil and iron firms with less smooth earnings.

This paper makes several important contributions to the existing research base. First, it adds to the emerging stream of literature on macro economy-wide factors and firm-specific decisions (Anolick et al., 2021; Bonaime et al., 2018; Duong et al., 2020; Gulen and Ion, 2016) by investigating financial reporting decisions in commodity firms. Prior research investigated the effect of uncertainty on abnormal share repurchase (Anolick et al., 2021), sustainability performance (Jia and Li, 2020), lobbying activities (Shang et al., 2021), trade credit (D'Mello and Toscano, 2020), dividends policy (Attig et al., 2021) and cash holding (Duong et al., 2020). It complements this literature with evidence that uncertainty affects both accounting choices and real operations at a quarterly level.

Previous studies have also investigated the effect of macro-economic uncertainty on earnings management, focusing on financial crises (e.g., the 1997 Asian crisis or the 2009 Great Financial Crisis), with mixed results (Ahmad-Zaluki et al., 2011; Arthur et al., 2015; Trombetta and Imperatore, 2014). The paper uses a continuous measure of macroeconomic uncertainty, capturing different dimensions - economic, political, social, and environmental – and shows that uncertainty can have a systematic and pervasive relationship with earnings smoothing, not limited to yearly reports in specific periods of crises. Indeed, findings show that macroeconomic uncertainty affects earnings smoothing through accruals and real operations management even at a quarterly interim reporting level, complementing the findings of Bertomeu et al. (2021).

Second, the paper contributes to the existing earnings smoothing literature. On the one hand, prior research suggested that macroeconomic uncertainty motivates earnings management (Graham et al., 2005). On the other hand, it suggests that uncertainty constrains earnings manipulation through increased investors' scrutiny over financial reports (El Ghoul et al., 2021). This study provides evidence that, for managers operating under macroeconomic uncertainty, the willingness to dampen earnings volatility prevails over fears of increased investor scrutiny. However, the investors' attention may play a role in the decision on how smoothing is implemented. Evidence suggests that commodity firms use smoothing to make earnings more informative for analysts and investors rather than to garble the firm's

performance. Investors award signalling with a lower cost of equity and price premiums (Francis et al., 2004), which are both highly desirable for managers operating under uncertainty. Our findings suggest that earnings smoothing in mandatory financial reports are used to mitigate the adverse consequences of macroeconomic uncertainty on corporate valuation by investors. In this sense, this paper: a) contributes to existing studies on managers' assessment of the costs and benefits of smoothing, with evidence of such assessment taking place under macroeconomic uncertainty (Baik et al., 2020), and b) complements prior research on the use of voluntary disclosure to mitigate the adverse consequences of uncertainty on corporate valuation by investors with evidence on mandatory reporting (Boone et al., 2020; Nagar et al., 2019).

Finally, the study contributes to corporate finance and accounting literature by investigating the determinants of earnings management related to firms' economic environment features. Recent contributions in this area have highlighted the importance of investors' distraction (Garel and Petit-Romec, 2021), stakeholders' orientation (Ni, 2020), and media news (Chahine et al., 2015). This study adds further evidence concerning the wider role of macroeconomic uncertainty.

This study has practical implications for policymakers, auditors, investors, and other market participants. It informs market participants about the commodity firms' financial reporting quality while informing practitioners on the potential wider real effects on the economy and social well-being (e.g. consumer goods availability and prices) of real earnings management by commodity firms. Finally, it supports the idea that extractive industries need more specific accounting and disclosure regulations. This motion has recently been under discussion by the International Accounting Standard Board (IASB project on Extractive Activities, 2022).

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 develops the hypothesis. Section 4 describes the sample and the research design. Section 5 displays the main findings. Section 6 addresses endogeneity concerns. Section 7 includes robustness tests, also using the EPU Index. Section 8 investigates the informativeness of earnings. Section 9 discusses the study's findings, while Section 10 concludes.

2. Literature review

Previous research in this field has examined the effect of uncertainty on several firm-specific decisions such as mergers and acquisitions (Bonaime et al., 2018); corporate investment (Gulen and Ion, 2016); internal managerial cost-cutting and efficiency-seeking decisions (Binz, 2022). These studies use an economic policy uncertainty (EPU) index by Baker et al. (2016), broadly referring to uncertainty about government policies affecting the economy.

Other studies have investigated the influence of the macroeconomic environment on accounting decisions, especially on earnings management. Kousenidis et al. (2013) documented a decrease in earnings management during the European Sovereign Debt Crisis. Filip and Raffournier (2014) and Arthur et al. (2015) found that the quality of accruals improved in a European company sample during the Great Financial Crisis. Other studies on the Asian financial crisis have provided competing results, including evidence of income-increasing accrual earnings management during the 1997-1998 Asian crisis (Ahmad-Zaluki et al., 2011; Chia et al., 2007). Lin and Wu (2022) focused on Chinese companies and investigated their reactions to oil price shocks and oil-implied volatility (OVX). This research produced mixed with the authors finding that "oil aggregate demand shocks decrease the degree of accrual earnings management, thus improving the quality of accounting. Surprisingly, OVX weakens that" (Lin and Wu, 2022, p. 9). Trombetta and Imperatore (2014) found that earnings management decreases when the crisis intensity is low and increases when the crisis is severe, suggesting a non-monotonic relationship. The abovementioned studies share a focus on specific periods of crisis. However, the macroeconomic environment produces fluctuations more frequently and displays significant volatility beyond specific periods of expansion and recession (Bekaert et al., 2013; Cesa-Bianchi et al., 2020).

A related stream of research examines how macroeconomic uncertainty mediates the effect of accrual quality on investors' reactions to earnings news or the cost of capital. D'Augusta and Prencipe (2022) find that macroeconomic shocks cause a stronger reaction to bad news for firms with low-quality accruals but not those with high-quality accruals. D'Augusta and Prencipe used an endogenous source of macro uncertainty, given the change in the Chicago Board Options Exchange S&P 500 options volatility index. Another previous study showed that macroeconomic conditions (business cycles and shocks) mediate the relationship between accrual quality and cost of equity capital (Kim and Qi, 2010). There is a risk premium for low accrual quality only during periods of economic expansion but not in recession periods.

A recent study by El Ghoul et al. (2021) explored the relationship between economic policy uncertainty (EPU) and earnings quality, with the authors finding that firms display lower discretionary accruals and earnings smoothing in periods of high EPU. They explain that investors' scrutiny of firm-specific information (i.e. performance), which is heightened during periods of high uncertainty, limits earnings management. The findings of El Ghoul et al. (2021) partially contrast with the results of prior earnings smoothing literature, which suggests that uncertainty is a primary reason to smooth earnings since managers want to dampen volatile earnings, meaning cookie jar reserving is likely to be used in periods of high volatility (Dichev et al., 2013; Graham et al., 2005).

This paper delves deeper into the relationship between macroeconomic uncertainty and earnings smoothing, with special reference to the commodity firms' setting. In a departure from previous studies, instead of using times proxies for periods of crises (or expansion or recessions), we use a continuous measure of exogenous macroeconomic uncertainty provided by commodity price volatility (Diaz et al., 2016; Poitras, 2013; Regnier, 2007). International supply and demand and political, social and environmental factors beyond firms' control affect commodity prices (Carter et al., 2017). Commodity firms have volatile revenues and earnings, largely dependent on and influenced by commodity prices (Damodaran, 2009). Therefore, commodity firms' managers may be interested in dampening earnings volatility and generating future reporting slack under uncertainty as a financial reporting strategy.

3. Hypothesis development

Prior research has suggested two possible effects of macroeconomic uncertainty on earnings smoothing in commodity firms. On the one hand, previous studies have suggested that macroeconomic uncertainty motivates commodity firms to smooth earnings. Commodity firms are price-takers, and the volatility of revenues can be traced back to where the price level is (Damodaran, 2009). These firms present large, fixed costs (e.g. depreciation, employees, manutention). Hence, changes in commodity prices directly map onto revenues, cash flows and earnings. Macroeconomic uncertainty may exacerbate managerial concerns for job security or remuneration, factors prior literature identifies as key motivations for earnings smoothing (DeFond and Park, 1997; Demerjian et al., 2020; Graham et al., 2005). Concerned managers could smooth earnings during uncertain periods by making cookie jar reserves, which could be released during less uncertain periods. Macroeconomic uncertainty can also push managers to use smoothing for signalling purposes. Commodity firms' managers may use smoothing to

make earnings more useful for investors and analysts, communicating the firm's "sustainable and repeatable" performance (Ditchev et al., 2013, p. 1), especially when volatile markets produce excess profits[8] (Demerjian et al., 2020; Tucker and Zarowin, 2006). Regardless of the managerial motivation, macroeconomic uncertainty can trigger smoothing.

On the other hand, the existing literature also suggests that macroeconomic uncertainty may not encourage earnings smoothing. An uncertain and volatile macroeconomic environment may lead market participants to monitor firms' performance more closely (Andrei et al., 2021). This external scrutiny increases the risks of detection for managers and the litigation risks associated with misstatements or restatements (Myers et al., 2007; Ronen and Yaari, 2008; Watts, 2003). Some studies have shown that investors' attention to firm-specific information constrains earnings management. For instance, Garel and Petit-Romec (2021) found that firms exploit the loosening in monitoring resulting from investors' distraction and subsequently engage in more aggressive earnings management. El Ghoul et al. (2021) found evidence of lesser earnings management during periods of high policy uncertainty, in which investors scrutinize firm-specific information more closely.

Figure 1 outlines the workings of the hypothesis. The above considerations suggest that macroeconomic uncertainty plays a role in the earnings smoothing decisions of commodity firms. Whether macroeconomic uncertainty positively or negatively affects earnings smoothing in commodity firms is an empirical question; we formulate and test the following non-directional hypothesis.

HP: Macroeconomic uncertainty affects earnings smoothing by commodity firms.

4. Research methodology

4.1. Sample selection

This study investigates oil, iron, and gold commodity firms[9]. Gold commodity firms are also useful as a placebo test, since macroeconomic uncertainty does not threaten gold firms to the degree that it threatens oil and iron firms[10]. Over recent decades, data from the World Gold

[8] Binz (2022) finds that firms overall reduce expenses more than revenues during periods of macroeconomic uncertainty with a net positive effect on profitability.

[9] These resources are fundamental for the economic activity overall and provide key contributions to the GDP of 63 Countries worldwide. Available at: https://www.worldbank.org/en/topic/extractiveindustries/overview#1

[10] This happens because gold is either used in manufacturing (jewelry and technology mainly) and for investment and monetary purposes, by banks and investors (Baur, 2013; O'Connor et al., 2015; Starr and Tran, 2008). There is demand either in periods of expansion or recession. For example, in periods of recession, the banks and

Council and Bloomberg has shown gold as being the least volatile commodity (and more stable than major stocks and stock indices).

This paper uses quarterly data from the Compustat North America database. We downloaded the quarterly data available from the first quarter of 1990 to the last quarter of 2019 of firms included in the SIC codes 13 (exploration and production), SIC Code1040 (gold and silver ores) [11] and NAICS 212210 (Iron ores). Quarterly data are suitable for our study on earnings smoothing in commodity firms (Han and Wang, 1998; Hsiao et al., 2016). Diebold and Yilmaz (2008) find that macroeconomic uncertainty maps onto asset returns on a quarterly basis. Hence, managers are likely to smooth earnings on a quarterly basis, without focusing only on the fourth and final quarter (Han and Wang, 1998; Hsiao et al., 2016). Earnings management concentrated at end of the year in the annual reports could also be deemed riskier for these firms and be more easily detected by financial reports users. Finally, the US ASC 270, applies the integral method to interim reporting. Unlike the discrete method required by the IAS34, the ASC 270 "allows smoothing, as it permits certain costs to be allocated to interim periods based on estimates of time expired, benefits received or other activity associated with the interim period" (Bogle, 2020)[12].

The study sample consists of 92,125 firm-year observations. 56,458 firm-year observations represent SIC code 13 (Oil and gas extraction) and SIC code 29 (Petroleum Refining), 6,820 firm-year observations represent SIC 29 (Petroleum Refining and Related Industries), 26,211 firm-year observations represent SIC 1040 (gold and silver ores) and 2,636 firm-year observations represent NAICS 212210 (Iron ores). The number of individual firms in each category is 1,720 oil producers, 646 gold producers and 38 iron producers.

4.2 Measures of macroeconomic uncertainty

We measure macroeconomic uncertainty for each commodity using: the quarterly price volatility, and the spread between the commodity quarterly spot price and the future price (basis risk).

Commodity price volatility is widely used in macroeconomic literature as a measure of uncertainty (Alquist et al., 2013; Blanchard and Riggi, 2013; Feng et al., 2017; Ratti and Vespignani, 2016; Ratti and Vespignani, 2016). Joëts et al. (2017) demonstrated that the

investors' demand for gold may increase, as gold is used as a safe haven (Baur and McDermott, 2010; Sargan, 1958).

[11] Compustat does not provide firms with the code 1041, which uniquely identifies gold mining but provides companies with the code 1044, which uniquely identifies silver mining.

[12] Available at: https://advisory.kpmg.us/articles/2020/interim-financial-reporting.html

volatility of commodity prices reflects macroeconomic uncertainty. Bakas and Triantafyllou (2018) showed that macroeconomic uncertainty is strictly related the volatility of commodity prices, while Barrero et al. (2017) found that oil price is particularly important for uncertainty in the short term. The commodity price volatility is calculated as the standard deviation of the commodity (oil/iron/gold) daily price in quarter *t.* In robustness checks, the paper also uses commodity price volatility calculated as the standard deviation of the commodity (oil/iron/gold) daily price in quarter *t* and *t-1* (that is in the past six months).

The sources for the time series on commodity prices are the International Monetary Fund (IMF) commodity prices database and Refinitiv-Datastream. The research uses the logarithmic transformation of the commodity prices to avoid possible exponential trend effect.

The spread between the commodity spot price and the future price is also called basis risk and is used in commodity studies and in finance studies on hedging (Alquist and Kilian, 2010; Broll et al., 2015; Figlewski, 1984; Newell and Prest, 2017). The spread between the current spot price and the future and can be either narrow or wide. The spread is narrow when the spot price converges toward the future price. When the spread is wide, there is uncertainty in the market. For example, if the spot price is much higher than the future price, there can be a risk of falling demand or shocks in the demand for the commodity. If the future price is much higher than the current price, there is a significant risk premium embedded in the future value, which can be related to several factors including dwindling supply or shocks, such as those generated by wars, or civil unrest (Baumeister and Kilian, 2016). In this paper, we use the absolute value of spread between the quarterly spot price and the quarterly future price to measure the expected uncertainty. If a commodity firm observes a wide spread, it can expect earnings volatility to occur and could use earnings smoothing to "save" profits for eventual use in future periods.

We use the NYMEX future contracts for the oil industry available on the EIA website. There are four types of contracts. Contract Type 1 is the price for deliveries in the next month. Types 2, 3 and 4 represent the price for the following months. The paper presents the results on Type 3 because it provides expectations about the next quarter's price. The paper uses the other contracts to perform robustness check analysis. The price of NYMEX future contracts is used by central banks and the IMF to measure market's expectations on future prices and has been proven to predict better than econometric models (Alquist et al., 2013). The research uses the NYMEX future contracts for iron ore 62% swap for the iron industry available on Datastream. The selection is motivated because it has the largest timespan, data start from Q4 2010. Finally, it uses the future for the gold industry available on Datastream. Again, the motivation fo the

selection of the "CMX-GOLD 100 OZ TOTAL OI FUT" is the largest timespan available on the database. Data starts from 1995 Q2 and were collected by the U.S. Commodity Futures Trading Commission. The unit of measure is different from the average spot price thus, results are not biased but the coefficients change.

4.3. Research design

This study augment with the commodity price volatility and the commodity basis risk multiple accrual and real earnings management models to use a single equation research design and avoid potential bias caused by the incorrect specification of the first-step equation used to calculate the residuals (Chen et al., 2018). Using a single equation approach, we include the relevant explanatory variable (i.e. macroeconomic uncertainty) in the first equation, and we do not use residuals in a second equation to make inferences[13]. By using well-established methods, we also reduce the subjectivity in the variables selection (McNichols and Stubben, 2018).

Our macroeconomic uncertainty measure is firm-invariant in every quarter-year, incorporating quarter-by-year fixed effects. We add to our models firm fixed effects, which can capture the firm quarter-invariant features affecting earnings management, e.g. internal control system, corporate culture or reputation, managerial financial skills (Gormley and Matsa, 2014).

To test our hypothesis, we estimate the following models:

1. Jones model (Jones, 1991)

$$\frac{Total\ Accruals_{it}}{AST_{it-1}} = \beta_1\left(\frac{1}{AST_{it-1}}\right) + \beta_2\frac{\Delta Revenue_{it}}{AST_{it-1}} + \beta_3\frac{PPE_{it}}{AST_{it-1}} + \beta_4 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

2. Modified Jones model (Dechow et al., 1995)

$$\frac{Total\ Accruals_{it}}{AST_{it-1}} = \beta_1\left(\frac{1}{AST_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{AST_{it-1}} + \beta_3\frac{PPE_{it}}{AST_{it-1}} + \beta_4 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

3. Jones model augmented with ROA (Kothari et al., 2005)

$$\frac{Total\ Accruals_{it}}{AST_{it-1}} = \beta_1\left(\frac{1}{AST_{it-1}}\right) + \beta_2\frac{\Delta Revenues_{it}}{AST_{it-1}} + \beta_3\frac{PPE_{it}}{AST_{it-1}} + \beta_4 ROA_{it-1} + \beta_5 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

4. Modified Jones model augmented with ROA (Kothari et al., 2005)

$$\frac{Total\ Accruals_{it}}{AST_{it-1}} = \beta_1\left(\frac{1}{AST_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{AST_{it-1}} + \beta_3\frac{PPE_{it}}{AST_{it-1}} + \beta_4 ROA_{it-1} + \beta_5 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

Table 1 summarizes all the variables used in the empirical analysis and provides the sources. To ensure results are not driven by outliers, all the variables are winsorized at 1%.

[13] Chen et al. (2018) strongly advice to avoid the use of first and second equation to use only a single equation including all the relevant regressors.

The attention is focused on the coefficient of $Uncertainty_t$. A negative significant coefficient would signal that uncertainty triggers earnings smoothing, aimed at generating cookie jar reserving in more uncertain quarters, due to either managerial concerns or signalling purposes. A positive significant coefficient would signal that uncertainty does not trigger smoothing, as commodity firms reap the rewards of volatility (Binz, 2022; Dayanandan and Donker, 2011; Salerno, 2017)[14]. A non-significant coefficient would signal that uncertainty does not affect earnings management.

This research also augments real earnings management models from (Roychowdhury, 2006) with uncertainty measures. These models aim at capturing operations deviating from normal practices, related to production costs and discretionary expenses. If uncertainty triggers smoothing, commodity firms may use underproduction and discretionary expenses to smooth earnings in quarters with higher volatility (Roychowdhury, 2006)[15]. We estimate the following models[16].

5. Production costs:

$$\frac{PROD_{it}}{AST_{it-1}} = \beta_0 + \beta_1 \frac{1}{AST_{it-1}} + \beta_2 \frac{SALES_{it}}{AST_{it-1}} + \beta_3 \frac{\Delta SALES_{it}}{AST_{it-1}} + \beta_4 \frac{\Delta SALES_{it-1}}{AST_{it-1}} + \beta_5 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

6. Discretionary expenses:

$$\frac{DISEXP_{it}}{AST_{it-1}} = \beta_0 + \beta_1 \frac{1}{AST_{it-1}} + \beta_2 \frac{SALES_{it-1}}{AST_{it-1}} + \beta_3 Uncertainty_t + \beta_5 Firm\ Fixed\ Effects_t + \varepsilon_{it}$$

The sample is an unbalanced panel data. Thus, there could be a violation in the assumptions of the ordinary least square (OLS) estimation because of the error terms (Baltagi and Wu, 1999; Collins and Dent, 1984). The model could have heteroscedasticity and serial correlation in the error term. To control for heteroscedasticity and serial correlated error, our empirical analysis uses the feasible general least squared (FGLS) estimation (Hansen, 2007b; Romano and Wolf,

[14] This is also suggested by ample practitioners' evidence, see, e.g. Wall Street Journal (2023); New York Times (2022); Reuters (2022); Financial Times (2021).

[15] Underproduction keeps higher portions of indirect costs in the value of goods sold, thus lowering earnings. This behavior would be consistent with anecdotal and practitioners' evidence that some undersupply exists in periods of high volatility - see the row between the US government and the US oil firms over supplies in the aftermath of the pandemic and during the Ukraine War (CNN, 2021).

[16] Srivastava (2019) discusses the concern that models of REM do not control for differences in the individual firm's competitive strategy. This concern is minor in our setting as commodity firms share similar business models and can hardly deviate from the industry trend set by the commodity price (Damodaran, 2009). This is also related to the oligopolistic nature of commodity industries (Radchenko, 2005; Rahman, 2016)

2017) which is an unbiased estimation procedure (Hansen, 2007). The FGLS estimator is the most efficient but does not have the best performance record in estimating the confidence interval (Reed and Ye, 2011). The use of FGLS is also justified because the covariance matrix is unknown, and so the use of weighted least square is not feasible.

4.4 Descriptive statistics and univariate analysis

Table 2 displays the descriptive statistics of the commodity prices. Over the period 1990 Q1 to 2019 Q4, the oil quarterly average price was, on average, $74.68 per barrel, with the median being $73.06. The price is negatively skewed with a high level of kurtosis (1.41), suggesting a deviation from normality. Similar values can be observed for its future. The gold quarterly average price was on average $1367.13 per troy ounce, with the median being $1293.95. The price is positively skewed and displays a high kurtosis (2.194), suggesting a deviation from normality. Regarding the commodity price volatility, is noteworthy that the quarterly average standard deviation is about 4% of the average oil price, about 7% of the average iron price and about 1.6% of the average gold price.

Gold futures display larger values because calculated on the value of 100 ounces. Iron quarterly average price was on average $100.94 per tonne, with the median being $91.64. The price is positively skewed and displays a high degree of kurtosis (1.974), suggesting a deviation from normality.

Table 3 provides the descriptive statistics of the other variables used in the research. Table 4 displays the univariate analysis performed by computing the correlation matrix. It shows that all the quarterly average prices (West Texas Intermediate [WTI], Gold, Iron) have a significant negative correlation with total accruals, with a p-value <0.05. Although, at this stage, there is no categorization based on SIC codes, these results suggest potential accrual earnings management manipulations as companies should display higher accruals as the commodity price increases. Commodity firms use accruals to reduce reported profits when prices are high in order to increase earnings in periods when the price decreases. Overall, oil, gold and iron are highly positively correlated, suggesting that their prices show a similar pattern and are a suitable proxy for macroeconomic trends in commodity producers. This ensures that any differences in the results are not driven by a different behaviour of the commodity price.

5. Results

5.1. Earnings smoothing through accruals

Table 5 records the results obtained by regressing the accrual earnings management models augmented with the quarterly price volatility. The oil and iron price volatility (Table 5, columns 1-4) are significantly and negatively correlated with total accruals, with a p-value <0.01. The control variables related to sales and adjusted sales show a significant (p-value <0.01) positive coefficient in the expected direction. The results suggest that oil and iron firms smooth their earnings to affect cookie jar reserving in volatile periods in which profits soar. This evidence provides support for our hypothesis that macroeconomic uncertainty affects earnings smoothing. Untabulated results show that the Jones model augmented with the ROA and the modified Jones model augmented with the ROA provide consistent findings.

The effect of earnings smoothing is not only statistically significant but is economically material. For example, the coefficient estimated with the Jones model (Table 5, column 1) indicates that for every 1% increase/decrease in the oil price volatility, the net effect on total accruals is a decrease/increase of 0.0165%[17] (Wooldridge, 2010), which equates to about $6.31 million (the average total accruals in the oil companies in our sample are about $371 million). The effect is doubly economically significant, considering that the average quarterly earnings in the oil industry are $71.32 million. For iron firms, the results show that for every 1% increase in the iron price volatility, the total accruals decrease by 0.0056%. A 1% increase/decrease in the quarterly iron price volatility implies a decrease/increase in the quarterly total accruals equivalent to about $1.43 million (the average quarterly total accruals in the iron companies are about $252 million). The effect is economically significant, considering the average quarterly earnings in the iron industry are $60.70 million.

Columns 5 and 6 of Table 5 show that for gold firms (our placebo sample), the gold price volatility has a positive significant association with total accruals (p-value <0.01 in column 5 and p-value <0.05 in column 6). The control variables related to sales and adjusted sales show a significant and positive coefficient in the expected direction. The results suggest that there is no smoothing associated with price volatility in the gold industry, with gold firms appearing to reap the rewards in quarters featuring higher price volatility. Gold has evidenced a stable growing demand through the decades. When the wider economy is booming, gold is required to produce mainly jewellery and electronics components. When the economy is trending toward recession, gold is required by banks, hedge funds and investors as a hedge investment.

[17] Coefficients multiplied by *e*.

Thus, the lower volatile demand and greater overall stability likely make earnings smoothing unnecessary for gold firms.

Table 6 displays the results obtained running the accrual earnings management models augmented with the commodity basis risk, measured by the absolute value of the spread between the current price and the future price. The results show that the basis risk has a negative significant association for both the oil and iron firms (Table 6, columns 1-4), with a p-value >0.01 across the models. Given the size of these firms, the accruals management is economically significant. These findings suggest that oil and iron companies smooth earnings by decreasing accruals as uncertainty increases and vice versa. By contrast, the coefficient of uncertainty has a positive significant association with gold firms (p-value <0.01). Even if the coefficient for gold firms is very low, its significance shows that uncertainty has an opposite effect on accruals management.

5.2. Earnings smoothing through real operations

Table 7 shows the empirical results related to real earnings management models. Columns 1 and 3 of Table 7 demonstrate that the commodity price volatility negatively affects production costs in oil and iron firms, which is significant at the 1% level. Given that a 1% increase/decrease in the commodity price volatility corresponds to a decrease/increase of about $1.4 million in the production costs for oil firms and about $1 million for iron firms, the effect can be economically significant. These findings suggest that oil and iron firms slow production in quarters with high commodity price volatility to retain more indirect costs in the costs of goods sold and lower the reported earnings. Conversely, in quarters with low oil price volatility, they use overproduction to send more indirect costs to the inventory and increase earnings (Roychowdhury, 2006). Columns 2 and 4 of Table 7 show real operations used to smooth earnings. By looking at the positive significant correlation between discretionary expenses and commodity price volatility in oil and iron firms (p-value<0.05 for oil firms and p-value<0.10 for iron firms), the smoothing appears more pronounced for oil firms, providing further support for our hypothesis that macroeconomic uncertainty affects earnings smoothing.

Results of the placebo test show that quarterly average gold price has no significant associations with production costs and discretionary expenses (Table 7, columns 5 and 6). These results suggest no evidence of real operations being used to smooth earnings in gold firms.

Table 8 displays the results of regressing the real earnings management models augmented with the commodity basis risk. The commodity basis risk has a negative significant association

with production costs in oil and iron firms (Table 3, columns 1 and 3). These findings suggest that oil and iron firms decrease production in quarters with high commodity price volatility to keep higher portions of indirect costs in the costs of goods sold, thus lowering the reported earnings. Conversely, they use overproduction in quarters with low commodity price volatility to spread the overhead to more units and reduce the cost of goods sold. Columns 2 and 4 of Table 8 show that discretionary expenses positively correlate with commodity price volatility in oil firms (p-value <0.10) and that this association is close to being significant for iron firms. These results suggest that oil and iron firms use real operations focused on R&D, selling, general and administrative expenses (SGA), and other discretionary expenses in quarters with high/low commodity price volatility to smooth earnings. By comparison, columns 5 and 6 of Table 8 show that gold firms do not engage in earnings smoothing using real operations.

6. Endogeneity tests

6.1 Instrumental Variable

To address endogeneity concerns, we perform a two stage least squares (2SLS) estimation, using the US quarterly oil exports to China from 1990 Q1 to 2019 Q4, as an instrumental variable.

On the 11th December 2001, after intense political negotiations, China officially became a member of the WTO and benefitted from the subsequent reduction of tariffs on trade. There is no standard procedure for a state to become a member of the WTO because the decision depends on the features of each applying state (Matsushita et al., 2015). The process can last years and is largely dependent on political and trade negotiations. For example, Russia applied for WTO membership in 1993, but was only accepted in 2012.[18] Despite knowing that China had submitted the application, the results of the procedure could hardly have been anticipated by commodity firms. Furthermore, no one could possibly have predicted the economic magnitude and consequences of China's accession, meaning it thus qualifies as an exogenous shock for commodity markets. China's entrance into the WTO represented a shock to the global economy, as prior literature has highlighted, it resulted in an increase in commodities price volatility, creating a spillover bi-directional effect for the rest of the world economy and especially the US (Fung et al., 2003; Zhang and Wang, 2014).

This study uses the US quarterly oil exports to China as an instrumental variable. The US oil quarterly export may affect the price volatility but has no ex-ante relation with the decision

[18] All the applications and their history are visible at the World Trade Organization website. Russia's application process is available at: https://www.wto.org/english/thewto_e/acc_e/a1_russie_e.htm

to smooth earnings. This ensures that the results are not biased, since the instrumental variable is correlated with the independent variable, but not with the dependent variable[19]. We use the US oil quarterly exports for the analysis on both oil and iron firms. We were unable to retrieve historical quarterly data on US iron exports to China. However, since commodities prices are correlated with the oil price (e.g. Balli et al., 2019) this instrumental variable exogenously affects the iron price volatility.

In the 2SLS first step, we regress oil price volatility using the total of US exports to China measured as the natural logarithmic of barrels sold to China in each quarter. Data are available from the US Energy Information Administration (EIA) website.

Equation 7 – 2SLS First stage

$$Price\ Volatility_t = \alpha + \beta_1 Export\ to\ China_t + \varepsilon_t$$

In the second step, we regress our main analyses equation with the fitted price volatility, as follows.

Equation 8 – 2 SLS Second stage

$$Total\ Accruals_{it} = \alpha + \beta_1 Fitted\ Price\ Volatility_t + \beta_2 Controls_{it} + \varepsilon_{it}$$

Equation 9– 2 SLS Second stage

$$Production\ Costs_{it} = \alpha + \beta_1 Fitted\ Price\ Volatility_t + \beta_2 Controls_{it} + \varepsilon_{it}$$

Equation 10 - 2 SLS Second stage

$$Discretionary\ Expenses_{it} = \alpha + \beta_1 Fitted\ Price\ Volatility_t + \beta_2 Controls_{it} + \varepsilon_{it}$$

Table 9 shows the results regarding oil firms. Columns 1 to 4 addresses accrual earnings management using, the Jones model, Modified Jones model, the Jones model augmented with ROA, and the Modified Jones model augmented with ROA, respectively. The variable of interest, represented by the fitted oil quarterly price volatility, shows a negative and significant coefficient (at the 0.01 level) in all the four models. Column 5 shows the coefficient regarding production costs which is negative and statistically significant (p-value<0.01). Column 6 shows the coefficient regarding the discretionary expenses, which is positive and statistically significant. Control variables demonstrate all the expected signs and are all statistically

[19] Several studies use Chinese imports or exports as an instrumental variable. For example, Acemouglu et al. (2016) use Chinese imports to study US employment. Bloom et al. (2016) uses Chinese import-export data to study technological change.

significant (p-value<0.01). Overall, the results strongly support the hypothesis that macroeconomic uncertainty affects earnings smoothing in oil firms.

Table 10 shows the results obtained regarding iron firms. Again, the variable of interest has a negative and statistically significant coefficient (p-value < 0.01) regarding total accruals, and has coefficients that are consistent and statistically significant (p-value < 0.01) with the real earnings management measures. Overall, the results strongly support the conclusion that macroeconomic uncertainty affects earnings smoothing in iron firms.

6.2 General Method of Moments (GMM)

When earnings management is driven by time-invariant, correlated omitted variables, an endogeneity problem arises (Bartov et al., 2000; McNichols, 2002). Biases arise if we ignore the dynamic relations of phenomena (Wintoki et al., 2012). In this case, current values of accrual can be a function of past firm performances. The smoothing strategy implies that past decisions are influential for the decision in the present. For example, if a firm "borrows" from the future to increase earnings, it must decrease earnings at a future period. To address this issue and potential endogeneity concerns, we use the generalized method of moments (GMM) to implement a firm fixed effects specification (Cascino, 2017; Eugster, 2020; Hann et al., 2020). Holtz-Eakin et al. (1988) proposed the GMM estimation, which was further developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). It provides three main advantages compared to the OLS estimation (Wintoki et al., 2012). First, it ameliorates unobservable heterogeneity by including firm fixed effects. Second, the estimation allows the dependent variable to be influenced by past values of the independent variables. Third, the process is dynamic, so we can use past values as instrument and solve for simultaneity. In our estimation, we use lagged values as instrumental variables for both the dependent and independent variables, uncorrelated with the error terms. With the use of the GMM dynamic panel model that accounts for firm fixed effects, we can precisely determine the impact of the commodities price on earnings management (Mellado-Cid et al., 2019). The model follows the Blundell and Bond approach (2000). We drop the unobserved firm-specific heterogeneity, by using a first differencing transformation, and it contains unobservable level effects correlated with the lags of the dependent variable (Blundell and Bond, 2000). Moreover, we treat as endogenous variables the total accruals and the commodities price. The instruments have ten lags. To assess the reliability of the GMM estimates, we applied Sargan's (1958) test to evaluate the validity of the instrumental variables.

Untabulated results show that the GMM estimation of Equations 1-4 broadly confirms that the quarterly commodity price volatility has a negative significant association with total accruals in oil and iron firms, and a positive significant association in gold firms. Table 11 shows the GMM estimation of the real earnings management models (production costs and discretionary expenses) augmented with the quarterly commodity price volatility. The coefficients show consistency with the results previously reported and the validity tests suggest the instrumental variable is adequate. The results show that oil and iron price volatility has a negative association with the production costs (Table 11, columns 1 and 3) while there is a positive and significant association with discretionary expenses (Table 11, columns 2 and 4). Focusing on gold firms, gold quarterly price volatility has a positive and significant association with production costs and a non-significant association with discretionary expenses.

Overall, the GMM estimation provides further evidence that our results are robust to endogeneity. The first-order serial correlation – AR (1) displays a consistent and significant p-value (<0.01) in all the columns, suggesting that the residuals in the first differences are correlated.

7. Robustness tests

This research has undertaken several robustness checks. First, the paper replicates the main analysis using the commodity price volatility in the previous two quarters, obtaining fully consistent results for both accrual and real earnings management (untabulated).

Second, the paper ensures that earnings smoothing is triggered by volatility *per se* and not by upward spikes in the commodity price produced by volatility and, furthermore, that the effect of volatility is not limited to quarters with high commodity prices. The research runs a cross-sectional analysis splitting for each commodity in the sample, in observation of the quarterly commodity spot price above and below the whole sample median (i.e., the period 1990-2019). The untabulated findings confirm evidence of earnings smoothing for oil and iron firms through accrual and real earnings management, either in the sub-sample of quarters with below-the-median prices or in the sub-sample of quarters with above-the-median prices. Conversely, there is no evidence of earnings smoothing by gold firms. The results are confirmed even when using prices corrected for inflation using the US Consumer Price Index.

To further ease concerns that our macroeconomic uncertainty measure is related to the firms' fundamentals or concerns that commodity firms may affect macroeconomic uncertainty (reverse causality), we ran additional robustness checks using the Economic Policy Uncertainty (EPU) Index by Baker et al. (2016). This index uses newspaper coverage to measure

uncertainty and captures events involving government policy, which affect the economic environment. The EPU index has been widely used in recent research on uncertainty, as it is unlikely that this index is systematically influenced by the average firm (e.g. Binz, 2022; El Ghoul et al., 2021; Nagar et al., 2019).

The paper replicates the main analyses using the EPU index as a macroeconomic uncertainty measure. In the empirical tests, EPU is defined as the average of the monthly policy uncertainty index for each quarter, downloaded from the Economic Policy Uncertainty website[20]. Univariate analysis shows that the EPU has a positive significant correlation with the oil price volatility (0.41 significant at the 1% level), gold price volatility (0.58 significant at the 1% level) and iron price volatility (0.20 significant at the 1% level). The significant correlation confirms that commodity price volatility can capture economic policy uncertainty and that gold provides a robust placebo test.

Table 12 regresses the accrual earnings management models augmented with the EPU. The results show that the EPU has a negative and significant correlation with total accruals, with a p-value <0.01 (Table 13, columns 1-4). By contrast, for gold firms, the correlation coefficient is positive and significant, with a p-value of 0.01 (Table 12, columns 5 and 6). These findings confirm that uncertainty triggers earnings smoothing in oil and iron firms and not in our placebo sample. Table 14 regresses the real earnings management models augmented with the EPU. The results show that, as uncertainty increases, oil and iron firms use underproduction and more discretionary expenses to smooth quarterly earnings (Table 13, columns 1-4). Uncertainty does not trigger real earnings management in gold firms (Table 13, columns 5 and 6).

The paper also runs an additional analysis (untabulated) using a well-established measure of smoothing in stock informativeness studies (Dou et al., 2013; Leuz et al., 2003), which is the correlation between the change in total accruals (TACC) and the change in cash flows from operations (CFO), both scaled by lagged total assets over three consecutive quarters. This measure implies that managers use discretion to smooth earnings. Thus, a negative correlation signals more smoothing. The correlation is multiplied by -1 to ensure that larger values of the correlation mean more smoothing (ES). The paper regresses this measure on the measures of macroeconomic uncertainty (commodity price volatility and basis risk) and on EPU, adding a set of controls, including the firms' size, leverage, profitability, and book-to-market ratio. The findings confirm that macroeconomic uncertainty is associated with higher earnings smoothing for oil and iron firms.

[20] See http://www.policyuncertainty.com/index.html

8. Earnings smoothing and stock informativeness

Managers use smoothing to either communicate their true expectations regarding future profitability (Tucker and Zarowin, 2006), or to garble the firm's performance for opportunistic reasons (e.g. DeFond and Park, 1997; Leuz et al., 2003). In this section, the paper investigates whether macroeconomic uncertainty affects the use of earnings smoothing by commodity firms, i.e. whether smoothing is used by oil and iron firms to conceal the firm's performance or to increase the stock and the earnings informativeness.

To do so, the paper uses the merged CRSP-Compustat quarterly database, which provides data on accounting and stock information. It uses a well-established measure of smoothing in stock informativeness studies, provided by the correlation between the change in total accruals (TACC) and the change in cash flows from operations (CFO), both scaled by lagged total assets over three consecutive quarters (see above section 7).

To investigate whether macroeconomic uncertainty affects the stock price informativeness about the firm's future performance, the paper modifies Tucker and Zarowin (2006), adding interactions for macroeconomic uncertainty[21] and estimates the following model:

$$\begin{aligned} Return_t = \ & \alpha_0 + \beta_1 EPS_{3t} + \beta_2 ES_t + \beta_3 ES_t * EPS_{3t} + \beta_4 Uncertainty_t + \beta_5 ES_t \\ & * Uncertainty_t + \beta_6 EPS_{3t} * Uncertainty_t + \beta_7 ES_t * EPS_{3t} \\ & * Uncertainty_t + \varepsilon_t \end{aligned}$$

Where: $Return_t$ is the stock return in quarter *t*; EPS_{3t} is the sum of earnings per share in quarter t+1 to t+3; ES_t is the earnings smoothing measure described above; $Uncertainty_t$ is measured by the commodity price volatility ($Uncertainty_t$), and alternatively with a dummy indicating quarters with high volatility, i.e. quarters with commodity price volatility above the median of the sample ($HighUncertainty_t$). The interaction term $ES_t * EPS_{3t}$ is used by prior studies to ascertain whether earnings smoothing affects the ability of current stock returns to reflect the information about future earnings (commonly called future earnings response coefficient FERC). If positive and significant, it implies that stock returns of firms with smoother earnings contain more information about future earnings than stock returns of firms with less smooth earnings (Dou et al., 2013). If negative and significant, it implies the opposite, with firms with smoother earnings having stock containing less information on future earnings. In this analysis, the coefficient of interest is that of the interaction $ES_t * EPS_{3t} * Uncertainty_t$ ($or\ High\ Uncertainty$), i.e. the interaction between the FERC and uncertainty.

[21] This approach is used in prior literature to investigate factors affecting the use of smoothing. For example, Baik et al. (2020) add interactions with the managerial ability.

If positive and significant, it means that, as uncertainty increases, firms with smoother earnings have stock returns containing more information on future earnings than the stock returns of firms with less smooth earnings. If this is the case, commodity firms use earnings smoothing to convey information useful to investors and analysts as a reaction to macroeconomic uncertainty. Conversely, commodity firms use earnings smoothing to conceal information about the firm's true performance.

Table 14 displays the results of the analysis. Table 14, column 1, shows that for oil firms EPS_{3t} has a positive significant correlation with stock return (p-value >0.01), as expected. Uncertainty has a negative significant correlation with stock returns (p-value <0.01). The FERC ($ES_t * EPS_{3t}$) is not significant, but the FERC interacted with uncertainty is positive and significant at the 1% level. These findings provide evidence of the role of uncertainty in shaping the commodity firm's smoothing decision. They also suggest that as uncertainty increases, oil firms with smoother earnings have stock returns containing more information on future earnings than the stock returns of firms with less smooth earnings. These findings are confirmed in Table 14, column 2, when the paper uses a dummy for the quarters in which uncertainty is high. Oil firms use earnings smoothing to communicate the firm's true performance within an uncertain macroeconomic environment and help for investors and analysts to predict future earnings, amid volatile commodity prices.

Columns 3 and 4 of Table 14 display the analysis on iron firms, for which there are only 830 firm-year observations after merging Compustat and CRSP. Although with a weaker significance, the findings show that the FERC interacted with uncertainty has a positive significant association with stock return with p-value <0.05 when using the price volatility as measure of uncertainty, and with p-value <0.10 when using a dummy for quarters with high uncertainty.

Further investigations examine if smoothing improves earnings informativeness. If the smoothing strategy has the goal of improving the informativeness of earnings, smoothing should make the relation between current and future income stronger (Tucker and Zarowin, 2006). We modify Tucker and Zarowin's (2006) model for earnings informativeness as follows

$$EPS_{3t} = \alpha_0 + \beta_1 EPS_t + \beta_2 ES_t + \beta_3 ES_t * EPS_t + \beta_4 Uncertainty_t + \beta_5 ES_t * Uncertainty_t + \beta_6 EPS_t * Uncertainty_t + \beta_7 ES_t * EPS_t * Uncertainty_t + \varepsilon_t$$ case, $ES_t *$

Where: EPS_t is the earnings per share in quarter t and the rest of the variables are as defined above. Again, the coefficient of interest is that of the interaction $ES_t * EPS_t * Uncertainty_t$ $(or\ High\ Uncertainty)$. A positive and significant coefficient indicates that, as

uncertainty increases, smoothing strengthens the relation between current and future earnings, increasing the current earnings informativeness of the firm's future earnings. Conversely, as uncertainty increases, smoothing would weaken this relation. Untabulated results show that the interaction is positive and significant at the 1% level for oil firms, using either $Uncertainty_t$ ($or\ High\ Uncertainty$), while the coefficient is not significant for iron firms. The earnings smoothing performed by oil firms is indeed informative

As a robustness check, we re-run all our analyses using alternative measures of earning smoothing such as the correlation between the change in total accruals (TACC) and the change in cash flows from operations (CFO), over four, five and six consecutive quarters. We also use another well-established measure of smoothing that implies the use of discretionary accruals (Baik et al., 2020; Tucker and Zarowin, 2006), which is the Spearman correlation between the annual change in discretionary accruals (DAC) and pre-managed income (PMI): Corr(ΔDAC, ΔPMI). Results not tabulated are consistent with those displayed in Table 14.

As an alternative to earnings management, hedging could be used to cope with uncertainty (Pincus and Rajgopal, 2002). Prior literature produced mixed results on the effectiveness of hedging in creating value by reducing earnings volatility. Guay and Kothari (2003) find that in non-financial corporations (including mining and oil), the economic significance of hedging is low. Regarding the oil industry, Pincus and Rajgopal (2002) find that that commodity-price hedging positions are independent of decisions on earnings management. Another finding of the authors is that accrual management only takes the effect of hedging into account in the fourth quarter. Due to the nature of contracts, hedging may be less effective in managing the uncertainty at a quarterly level. For this reason, Jin and Jorion (2006) claim that hedging does not affect market value in the oil industry. In any case, we run robustness analyses adding a derivative use measure by Barton (2001) as control. The measure is calculated as the fair value of derivatives (items deracq and deraltq from the financial statements in Compustat) scaled by total assets[22]. Untabulated findings confirms the main analysis even when controlling for the derivative use.

[22] A more refined measure would be the ratio between the derivative position and the amount of risk exposure. This would require an extensive analysis of the footnotes searching for the portion of production hedged, which is hardly feasible on large longitudinal samples (Jin and Jorion, 2006). The derivative use measure is viable as it is based on the fair value of the hedge, which represents the amount exposed to changes in the value of the underlying (Barton, 2001).

9. Discussion of the findings

This study finds that commodity firms smooth earnings in response to macroeconomic uncertainty. Prior literature has investigated accrual earnings management during high macroeconomic uncertainty, focusing mainly on financial crises, such as the 1997 Asian crisis and the 2009 Great Financial Crisis (e.g. Ahmad-Zaluki et al., 2011; Arthur et al., 2015; Trombetta and Imperatore, 2014). However, macroeconomic uncertainty produces fluctuations on a more frequent basis, and displays significant volatility beyond specific periods of expansion and recession (Bekaert et al., 2013; Cesa-Bianchi et al., 2020). The research confirms that macroeconomic uncertainty has a systematic and pervasive relationship with earnings management, and is not limited to yearly reports or specific periods of crises (Bertomeu et al., 2021). Pervasiveness extends beyond its impact on quarterly financial reporting, encompassing the utilization of real operations by firms facing macroeconomic uncertainty.

Findings use a measure of macroeconomic uncertainty, which is sensitive to economic, political, social, and environmental events, showing that macroeconomic uncertainty continuously affects earnings smoothing and has multiple sources, which are not limited to financial crises or policy uncertainty (El Ghoul et al., 2021).

Prior literature suggests that macroeconomic uncertainty motivates managers to smooth earnings (DeFond and Park, 1997; Demerjian et al., 2020; Graham et al., 2005). At the same time, it suggests that macroeconomic uncertainty may also constrain earnings smoothing, due to increased investors' scrutiny (El Ghoul et al., 2021; Garel and Petit-Romec, 2021). To ascertain which effect prevails, the paper focused on a setting featuring high structural macroeconomic uncertainty. The findings show that oil and iron firms smooth earnings in more uncertain quarters, generating cookie jar reserves, which can be released in less uncertain periods. By contrast, the placebo sample represented by gold firms shows that firms for which macroeconomic uncertainty does not represent a threat do not engage in earnings smoothing.

The results suggest that, for firms operating under uncertainty, the willingness to dampen earnings volatility prevails over the threat of increased investors' scrutiny in an uncertain macroeconomic environment. However, the investors' attention for firms operating under uncertainty may be more relevant when considering the purposes of smoothing. The results show that smoothing is informative for investors and analysts, as it strengthens stock informativeness. Managers operating under uncertainty use smoothing for signalling rather than for garbling purposes. Indeed, signalling is rewarded by investors with lower cost of equity and price premiums (Baik et al., 2020; Francis et al., 2004), which are both highly desirable for managers operating under uncertainty. In this sense, the findings provide evidence on the

managerial assessment of the costs and benefits of smoothing under macroeconomic uncertainty (Baik et al., 2020).

The signalling by managers suggests that smoothing in mandatory financial reports is used to mitigate the adverse consequences of macroeconomic uncertainty on corporate valuation by investors and analysts. By dampening earnings, commodity firms communicate the firm's true performance beyond the current volatility and convey useful information for investors and analysts. Prior research has found that firms use voluntary disclosure to mitigate the adverse consequences of policy uncertainty on corporate valuation by investors (Boone et al., 2020; Nagar et al., 2019). The paper complement these findings with evidence on the use of mandatory financial reports.

This paper has direct policy implications. Policymakers, auditors, investors, and other market participants are informed that macroeconomic uncertainty affects the financial reporting quality of commodity firms. The findings support the usefulness of developing specific accounting and disclosure regulation for extractive industries converging globally, such as the IASB project on Extractive Activities (2022). This project serves to provide answers to companies that signaled difficulties in applying some International Financial Reporting Standards (IFRS) accounting standards to extractive activities outside the scope of IFRS 6. It also offers a response to stakeholders signaling a lack of disclosure on operations and reserves. The research suggests that a lack of accounting and disclosure regulation leaves more room for accrual and real earnings management.

This study also informs practitioners on the behavior of commodity firms, which play a central role in the current global economy, in the financial markets and in the international political landscape, currently plagued by the Ukraine War and the energy crisis. Real operations used to smooth earnings, such as deliberate underproduction, have wider real effects on the economy and social wellbeing. Underproduction of oil and iron in periods of high volatility can cause significant economic and human costs, as this can trigger inflation and increases in consumer goods prices. It can also reduce the availability of consumer products, such as food (Braun and Tadesse, 2012).

Future research might focus on countries where commodity firms are primarily state-owned enterprises, and the national governments have a strong influence on financial reporting and real choices. This would serve to expand the literature on how different ownership models influence earnings management practices. Research on agricultural commodities could to further advance knowledge in this area could also prove highly valuable.

10. Conclusions

This paper provides evidence that macroeconomic uncertainty is an important driver of earnings smoothing. It finds that oil and iron commodity firms smooth earnings, using either accrual or real operations, as a response to increased commodity price volatility. The findings remain robust as evidenced by placebo tests with gold firms, endogeneity tests (IV analysis and General Method of Moments) and a robustness check using as an alternative measure of uncertainty the EPU Index.

This paper contributes to the emerging stream of literature on macro economy-wide factors and corporate decisions (Anolick et al., 2021; Bonaime et al., 2018; Duong et al., 2020; Gulen and Ion, 2016), by providing a thorough investigation of financial reporting in major commodities industries. This research provides evidence that macroeconomic uncertainty has a systematic and pervasive relationship with income smoothing, achieved through financial reporting and real operations decisions, and that this behavior is not limited to specific periods of crises (Bertomeu et al., 2021). The paper also contributes to prior earnings smoothing literature, by showing that macroeconomic uncertainty motivates earnings smoothing aimed at signalling purposes, to mitigate the adverse consequences of macroeconomic uncertainty on corporate valuation by investors and analysts. Finally, the paper contributes to the existing literature in the field of corporate finance and accounting, by investigating the determinants of earnings management related to the features of firms' business environment, with evidence on the wider impact of macroeconomic uncertainty.

The paper has practical implications for policymakers, auditors, investors, and other market participants, and supports the notion that accounting and disclosure regulation for extractive industries needs improvement (IASB project on Extractive Activities, 2022). This study serves to inform market participants and stakeholders about commodity firms' earnings quality, as well as the potential real effects on the economy and social wellbeing (e.g. consumer goods availability and prices) of real earnings management by commodity firms.

Declaration of interest

None.

Funding sources

This research did not receive any specific grant from funding agencies in public, commercial or not-for-profit sectors.

Data availability statement

Commodity price data are available at IMF Primary Commodity System Primary Commodity Price System - At a Glance - ANNUAL - IMF Data. Data are available without restrictions and freely accessible.

Data regarding global production of oil and oil export to China are available at the US Energy Information Administration Petroleum & Other Liquids Data - U.S. Energy Information Administration (EIA). Data are available without restrictions and freely accessible.

Data regarding global production of oil, gold and iron are available at the US Geological Survey Mineral Commodity Summaries | U.S. Geological Survey (usgs.gov). Data are available without restrictions and freely accessible.

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Table 1: Summary of the variables used and their sources

Summary of the variables used to calculate macroeconomic uncertainty measures and their sources			
Measures of commodities prices			
Name	**Label**	**Description**	**Source**
WTI average quarterly price	WTI	US Crude Oil WTI Cushing OK Spot, 39o API,	IMF
Gold average quarterly price	Gold	LME, grade A cathodes, spot price, CIF European	IMF
Iron average quarterly price	Iron	Iron Ore (FE63.5%) in CIF China	IMF
Oil future quarterly price	OilFut	Cushing, OK Crude Oil Future Contract 3 ($ per per Barrel)	NYMEX
Gold future quarterly price	GoldFut	CMX-GOLD 100 OZ TOTAL OI FUT - OPEN INTEREST	Datastream
Iron future quarterly price	IronFut	NYMEX-Iron ore 62% swap TRC1	Datastream
WTI quarterly price volatility	OilVol	Standard deviation of the WTI daily price in quarter *t*	Own elab.
Gold quarterly price volatility	GoldVol	Standard deviation of the Gold daily price in quarter *t*	Own elab.
Iron quarterly price volatility	IronVol	Standard deviation of the Iron daily price in quarter *t*	Own elab.
WTI quarterly basis risk	OilBasis	Absolute value of the difference between WTI spot price and future price in quarter t	Own elab.
Gold quarterly basis risk	GoldBasis	Absolute value of the difference between Gold spot price and future price in quarter t	Own elab.
Iron quarterly basis risk	IronBasis	Absolute value of the difference between Iron spot price and future price in quarter t	Own elab.

Table 1: Summary of the variables used and their sources (Continued)

Measures of financial data			
Name	**Label**	**Description**	**Source**
Total accruals	TACC	Change in non-cash current assets minus the change in current liabilities excluding the current portion of long-term debt, minus depreciation and amortisation from quarter t to quarter t-1, scaled by lagged total assets in quarter t-1 in firm i	Compustat
Total Assets	AST	The total assets reported in quarter t in firm i	Compustat
Property Plant and Equipment	PPE	Gross property, plant, and equipment in quarter t in firm i	Compustat
Sales	Sales	Net sales in quarter t in firm i	Compustat
Change in Sales	$\Delta SALES_t$	Change in net sales from quarter t to quarter t-1 in firm i	Compustat
Adjusted Sales	ΔS_t-ΔR_t	Change in net sales minus change in receivables from quarter t to quarter t-1 in firm i	Compustat
ROA	ROA	Return on assets in quarter *t*-1 in firm *i*	Compustat
Production Costs	PROD	The sum of cost of good sold (cogs) and inventory in quarter t, all scaled by lagged total assets in quarter t-1 for firm i	Compustat
Discretionary expenditure	DISEXP	Sum of R&D, advertising, selling and general and administrative expenses in quarter t in firm i	Compustat

Table 2: Descriptive statistics of commodity prices

This table reports summary statistics for quarterly average price, quarterly future price, and quarterly price volatility.

	Mean	Median	Skewness	Kurtosis	SD	N
Quarterly average price						
WTI ($/barrel)	74.684	73.067	-0.165	1.411	23.016	120
Gold ($/troy ounce)	1367.137	1293.951	0.764	2.194	184.269	120
Iron ($/Mt)	100.938	91.642	0.426	1.974	39.283	120
Quarterly future price						
OilFut ($/barrel)	74.086	70.070	-0.046	1.386	23.453	120
GoldFut ($/100 OZ)	461790.491	440581.000	0.758	2.809	62233.796	106
IronFut ($/Mt)	102.305	96.230	0.296	1.739	41.957	44
Quarterly price volatility						
OilVol	3.216	2.467	2.315	9.743	2.741	120
GoldVol	23.352	15.825	1.577	6.263	20.619	120
IronVol	7.077	5.950	1.320	5.916	4.014	60

Table 3: Descriptive statistics of other variables

This table shows the distribution of the other variables used in this research. All variables are scaled by total assets of the quarter *t*-1.

	Mean	Median	p25	p75	SD	N
TACC	-0.036	-0.032	-0.093	0.007	0.266	78398
1/AST	0.811	0.010	0.001	0.070	4.717	84389
PPE	1.185	1.012	0.730	1.372	0.966	61883
ΔS_t-ΔR_t	0.003	0.000	-0.011	0.014	0.060	72130
$SALES_t$	0.107	0.065	0.001	0.137	0.145	82171
$\Delta SALES_t$	0.003	0.000	-0.004	0.011	0.042	80338
DISEXP	0.212	0.033	0.017	0.074	0.931	4068
PROD	0.147	0.000	0.000	0.001	0.875	74610
ROA	-0.111	-0.004	-0.039	0.013	0.524	83859

Table 4: Correlation matrix

This table reports the Pearson's correlation coefficients for both dependent and explanatory variables included in the analyses.

Variables	Oil Basis Risk	Gold Basis Risk	Iron Basis Risk	Oil Volatility	Gold Volatility	Iron Volatility	TACC	1/AST	$\Delta Sales_t$	PPE	ΔS_t-ΔR_t	$SALES_t$	PROD	DISEXP	ROA
Oil Basis Risk	1.000														
Gold Basis Risk	0.220***	1.000													
Iron Basis Risk	-0.095**	-0.296***	1.000												
Oil Volatility	0.694***	0.149***	-0.274***	1.000											
Gold Volatility	-0.216***	0.149***	-0.220***	-0.039	1.000										
Iron Volatility	-0.324	0.155***	-0.518***	-0.030	0.403***	1.000									
TACC	-0.056	-0.081*	0.003	-0.061	0.084*	0.024	1.000								
1/AST	-0.037	-0.027	-0.030	-0.008	0.066	0.044	-0.125***	1.000							
$\Delta Sales_t$	-0.048	-0.008	-0.024	-0.041	-0.021	0.003	-0.027	0.000	1.000						
PPE	0.030	-0.053	0.103**	0.008	-0.096**	-0.018	0.091**	-0.080*	-0.011	1.000					
ΔS_t-ΔR_t	-0.049	0.013	0.033	-0.056	-0.012	-0.040	0.057	-0.039	0.824***	0.008	1.000				
$SALES_t$	0.066	0.081*	-0.017	0.086*	-0.068*	-0.016	-0.092**	-0.121***	0.287***	-0.042	0.176***	1.000			
PROD	-0.017	0.078*	0.000	-0.041	0.000	0.004	-0.202***	0.047	0.228***	0.026	0.283***	0.195***	1.000		
DISEXP	-0.062	-0.016	0.004	-0.024	0.006	0.052	-0.311***	0.791***	0.046	-0.067*	0.010	0.003	0.220***	1.000	
ROA	0.035	-0.070*	0.000	0.039	-0.040	-0.027	0.528***	-0.454***	-0.047	0.144***	-0.080*	0.120***	-0.452***	-0.507***	1.000

Table 5: Accruals earnings management models with commodity price volatility

This table reports the estimated coefficients obtained by running an FGLS estimation using the Jones model (Columns 1, 3 and 5) and the Modified Jones model (columns 2, 4 and 6). The dependent variable is total accruals (TACC). Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
Models	Jones	Modified Jones	Jones	Modified Jones	Jones	Modified Jones
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
VARIABLES	TACC	TACC	TACC	TACC	TACC	TACC
Quarterly price volatility	-0.00615***	-0.00624***	-0.00205***	-0.00161***	0.00068***	0.00015**
	(0.00038)	(0.00038)	(0.00058)	(0.00057)	(0.00010)	(0.00014)
1/AST	0.00399***	0.00401***	0.55833***	0.58703***	-0.00053	-0.00202**
	(0.00033)	(0.00034)	(0.07929)	(0.08016)	(0.00053)	(0.00087)
$SALES_t$	0.16580***		0.35003***		0.37939***	
	(0.02435)		(0.04847)		(0.07956)	
PPE	-0.02554***	-0.02516***	-0.02067***	-0.02349***	-0.01489***	0.02922***
	(0.00106)	(0.00107)	(0.00609)	(0.00613)	(0.00360)	(0.00537)
ΔS_t-ΔR_t		0.11611***		0.24645***		0.04562
		(0.01746)		(0.03775)		(0.04463)
Observations	63278	63278	1720	1720	26211	26211
Number of gvkey	1,720	1,720	39	38	646	646
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	10287	9773	156.4	191.4	3353	2991

Table 6: Accrual earnings management models augmented with the commodity basis risk

This table reports the estimated coefficients obtained by running an FGLS estimation using the Jones model (Columns 1, 3 and 5) and the Modified Jones model (columns 2, 4 and 6). The dependent variable is the Basis Risk, measured as the absolute value of the difference between spot price and futures price. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
	Jones	Modified Jones	Jones	Modified Jones	Jones	Modified Jones
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	TACC	TACC	TACC	TACC	TACC	TACC
Basis Risk (WTI, Gold, Iron)	-0.00445***	-0.00450***	-0.00123***	-0.00113***	0.00001***	0.00001***
	(0.00034)	(0.00034)	(0.00041)	(0.00039)	(0.00000)	(0.00000)
1/AST	0.00388***	0.00391***	-0.22639	-0.17989	-0.00089	-0.00159***
	(0.00033)	(0.00035)	(0.45809)	(0.44721)	(0.00057)	(0.00062)
$SALES_t$	0.16703***		0.09145**		0.38695***	
	(0.02435)		(0.04505)		(0.08290)	
PPE_t	-0.02878***	-0.02849***	-0.02342***	-0.02358***	-0.01910***	-0.00955*
	(0.00101)	(0.00102)	(0.00466)	(0.00458)	(0.00442)	(0.00491)
ΔS_t-ΔR_t		0.11948***		0.07687**		0.02090
		(0.01744)		(0.03406)		(0.05068)
Observations	63278	63278	1720	1720	26211	26211
Number of gvkey	1,720	1,720	39	38	646	646
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	10287	9773	156.4	191.4	63.04	26.25

Table 7: Real earnings management models augmented with commodity price volatility

This table reports the estimated coefficients obtained by running an FGLS estimation on real earnings management models augmented with the quarterly commodity price volatility. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
	Column 1 Production costs	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Discretionary expenses	Column 5 Production costs	Column 6 Discretionary expenses
Quarterly Price Volatility	-0.00048***	0.00825**	-0.00023**	0.00024*	-0.00001	-0.00329
	(0.00011)	(0.00337)	(0.00011)	(0.00012)	(0.00002)	(0.00211)
1/AST	0.00292***	0.09941***	1.06656***	2.10540	0.00058***	0.14329***
	(0.00011)	(0.00312)	(0.02485)	(1.80619)	(0.00013)	(0.00873)
$SALES_t$	0.20906***		-0.00069		0.27156***	
	(0.00394)		(0.00440)		(0.00875)	
$\Delta SALES_t$	-0.06950***		0.01891*		-0.12562***	
	(0.00621)		(0.01067)		(0.01434)	
$\Delta SALES_{t-1}$	-0.03476***		0.01379		-0.08649***	
	(0.00567)		(0.01104)		(0.01309)	
$SALES_{t-1}$		-0.10088		0.08779***		1.40263**
		(0.09345)		(0.00779)		(0.63089)
Observations	63278	63278	26211	26211	1720	1720
Number of gvkey	1,720	1,720	646	646	39	38
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	4524	809.8	1105	351.7	14527	518.8

Table 8: Real earnings management models augmented with the commodity basis risk

This table reports the estimated coefficients obtained by running an FGLS estimation on real earnings management models augmented with the Basis Risk calculated as the absolute value of the difference between spot price and futures price. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
	Column 1 Production costs	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Discretionary expenses	Column 5 Production costs	Column 6 Discretionary expenses
Basis Risk (WTI, Gold, Iron)	-0.00023***	0.00496*	-0.00057*	0.00011	-0.00000	0.00000
	(0.00009)	(0.00271)	(0.00003)	(0.00011)	(0.00000)	(0.00000)
1/AST	0.00294***	0.10169***	0.62684***	2.13513	0.00076***	0.14080***
	(0.00011)	(0.00290)	(0.020753)	(1.83501)	(0.00013)	(0.00911)
$SALES_t$	0.20605***		0.00177		0.27072***	
	(0.00389)		(0.00121)		(0.00932)	
$\Delta SALE_t$	-0.06738***		0.01380***		-0.13095***	
	(0.00620)		(0.00413)		(0.01573)	
$\Delta SALE_{t-1}$	-0.03456***		0.01218***		-0.09857***	
	(0.00567)		(0.00439)		(0.01437)	
$SALES_{t-1}$		-0.00505		0.09546***		1.05186
		(0.08258)		(0.00788)		(0.70183)
Observations	63278	63278	1720	1720	26211	26211
Number of gvkey	1,720	1,720	39	38	646	646
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	4525	815.2	1634	314	1058	272.6

Table 9: Addressing endogeneity: Instrumental Variable Analysis on Oil firms

This table reports the regression on the Jones Model (column 1), Modified Jones Model (column 2), Jones model augmented with ROA (column 3), Modified Jones model augmented with ROA (column 4), Production Costs (column 5), Discretionary expenses (column 6), augmented with the fitted quarterly price volatility. The first stage regressed the US quarterly oil exports to China as an instrumental variable for oil price volatility. Robust standard errors clustered by firm are contained in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

VARIABLES	Column 1 TACC	Column 2 TACC	Column 3 TACC	Column 4 TACC	Column 5 Production costs	Column 6 Discretionary expenses
Fitted Price Volatility	-0.01118***	-0.01140***	-0.00507***	-0.00537***	-0.00084***	0.02569***
	(0.00084)	(0.00085)	(0.00078)	(0.00079)	(0.00019)	(0.00446)
1/AST	0.00378***	0.00328**	0.01899***	0.01885***	0.00689***	0.11422***
	(0.00144)	(0.00154)	(0.00149)	(0.00160)	(0.00036)	(0.00977)
$SALES_t$	0.14089***		0.06026		0.10602***	
	(0.04665)		(0.04149)		(0.00589)	
PPE	-0.01954***	-0.01886***	-0.02641***	-0.02581***		
	(0.00208)	(0.00212)	(0.00194)	(0.00198)		
ΔS_t-ΔR_t		0.08395*		0.06675*		
		(0.04424)		(0.03949)		
ROA			0.23067***	0.23050***		
			(0.01134)	(0.01165)		
$\Delta SALE_t$					0.00264	
					(0.02041)	
$\Delta SALE_{t-1}$					-0.03234	
					(0.01974)	
$SALES_{t-1}$						-0.06340
						(0.07144)
Observations	63278	63278	63278	63278	63278	63278
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: Addressing endogeneity: Instrumental Variable Analysis on Iron firms

This table reports the regression on the Jones Model (column 1), Modified Jones Model (column 2), Jones model augmented with ROA (column 3), Modified Jones model augmented with ROA (column 4), Production Costs (column 5), Discretionary expenses (column 6), augmented with the fitted quarterly price volatility. The first stage regressed the US quarterly oil exports to China as instrumental variable for iron price volatility. Robust standard errors clustered by firm are contained in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

VARIABLES	Column 1 TACC	Column 2 TACC	Column 3 TACC	Column 4 TACC	Column 5 Production costs	Column 6 Discretionary expenses
Fitted Price Volatility	-0.00569***	-0.00562***	-0.00620***	-0.00623***	-0.00049***	0.00216***
	(0.00131)	(0.00135)	(0.00132)	(0.00135)	(0.00012)	(0.00057)
1/AST	0.58653*	0.61571*	0.62744*	0.65967*	0.72220***	1.88544***
	(0.33284)	(0.35155)	(0.32789)	(0.34350)	(0.24853)	(0.54851)
$SALES_t$	0.32931***		0.26713		0.00219	
	(0.06827)		(0.07147)		(0.00230)	
PPE	-0.02108***	-0.02030***	-0.02185***	-0.02142***		
	(0.00492)	(0.00498)	(0.00492)	(0.00498)		
ΔS_t-ΔR_t		0.17006***		0.13472**		
		(0.06391)		(0.06056)		
ROA			0.43078***	0.51397***		
			(0.09928)	(0.08878)		
$\Delta SALE_t$					0.00480	
					(0.00416)	
$\Delta SALE_{t-1}$					0.00289	
					(0.00880)	
$SALES_{t-1}$						0.07857***
						(0.01286)
Observations	1720	1720	1720	1720	1720	1720
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 11: Addressing endogeneity: GMM and real earnings management

This table reports the estimated coefficients obtained by running dynamic panel system GMM using 10 lags. Results report the coefficients obtained using real earnings management models augmented with the commodities quarterly price volatility. Tests for autocorrelation in levels (AR1) indicate the quality of the instrumental variables. The Sargan's test is used to indicate whether the restrictions are overidentified. Robust standard errors clustered by firms are contained in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	Oil firms		Iron firms		Gold firms (placebo)	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
VARIABLES	Production Costs	Discretionary Expenses	Production Costs	Discretionary Expenses	Production Costs	Discretionary Expenses
Quarterly Price Volatility	-0.00075***	0.00772***	-0.00018**	0.00046**	0.00003***	0.00039
	(0.00005)	(0.00214)	(0.00007)	(0.00009)	(0.00000)	(0.00111)
1/AST	0.00731***	0.11632***	0.74010***	-0.53878	0.00173***	0.17041***
	(0.00004)	(0.00143)	(0.01286)	(0.60002)	(0.00000)	(0.00410)
$SALES_t$	0.10761***		-0.00178		0.19689***	
	(0.00117)		(0.00219)		(0.00355)	
$\Delta SALE_t$	0.01405***		0.01580**		-0.10091***	
	(0.00457)		(0.00785)		(0.01119)	
$\Delta SALE_{t-1}$	-0.02554***		0.00904		-0.12342***	
	(0.00470)		(0.00803)		(0.01129)	
$SALES_{t-1}$		0.15021***		0.09677***		0.56633**
		(0.04124)		(0.00374)		(0.26541)
Observations	63278	63278	1720	1720	26211	26211
Number of gvkey	1,720	1,720	39	39	646	646
AR(1)	0	0	0	0	0	0
SARGAN	25395	25616	2413	2385	9638	9016
N. Instruments	2192	2144	1213	1199	2030	1981

Table 12: Accruals earnings management models with Economic Policy Uncertainty (EPU) Index

This table reports the estimated coefficients obtained by running an FGLS estimation using the Jones model (Columns 1, 3 and 5) and the Modified Jones model (columns 2, 4 and 6). The dependent variable is total accruals (TACC). Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
Models	Jones	Modified Jones	Jones	Modified Jones	Jones	Modified Jones
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
VARIABLES	TACC	TACC	TACC	TACC	TACC	TACC
EPU Index	-0.00035***	-0.00035***	-0.00008***	-0.00010**	0.00020***	0.00017***
	(0.00002)	(0.00002)	(0.00004)	(0.00004)	(0.00004)	(0.00005)
1/AST	0.00412***	0.00419***	0.59440***	0.62220***	-0.00053	-0.00113**
	(0.00033)	(0.00035)	(0.07754)	(0.07771)	(0.00055)	(0.00059)
$SALES_t$	0.16167***		0.26397***		0.38553***	
	(0.02439)		(0.03319)		(0.07889)	
PPE	-0.01892***	-0.01853***	-0.03099***	-0.02855***	-0.01294***	-0.00604
	(0.00129)	(0.00133)	(0.00519)	(0.00515)	(0.00409)	(0.00449)
ΔS_t-ΔR_t		0.11430***		0.17330***		0.02870
		(0.01735)		(0.02628)		(0.04884)
Observations	63278	63278	1720	1720	26211	26211
Number of gvkey	1,720	1,720	39	38	646	646
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	10287	9773	156.4	191.4	3353	2991

Table 13: Real earnings management models augmented with Economic Policy Uncertainty (EPU) Index

This table reports the estimated coefficients obtained by running an FGLS estimation on real earnings management models augmented with the EPU index. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms		Gold firms (placebo)	
	Column 1 Production costs	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Discretionary expenses	Column 5 Production costs	Column 6 Discretionary expenses
EPU index	-0.00009***	0.00063**	-0.00004***	0.00005***	-0.00000	-0.00000
	(0.00000)	(0.00028)	(0.00000)	(0.00001)	(0.00000)	(0.00096)
1/AST	0.00264***	0.09610***	1.64210***	3.48140***	0.000578***	0.14018***
	(0.00011)	(0.00328)	(0.01501)	(0.69131)	(0.000126)	(0.00818)
$SALES_t$	0.23459***		-0.00019		0.261***	
	(0.00437)		(0.00336)		(0.00898)	
$\Delta SALES_t$	-0.08983***		0.00401		-0.121***	
	(0.00627)		(0.00432)		(0.0143)	
$\Delta SALES_{t-1}$	-0.04340***		0.00350		-0.0814***	
	(0.00554)		(0.00382)		(0.0130)	
$SALES_{t-1}$		-0.23510**		0.05820***		1.24705**
		(0.10904)		(0.00751)		(0.61127)
Observations	63278	63278	26211	26211	1720	1720
Number of gvkey	1,720	1,720	646	646	39	38
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald-test	4524	809.8	1105	351.7	14527	518.8

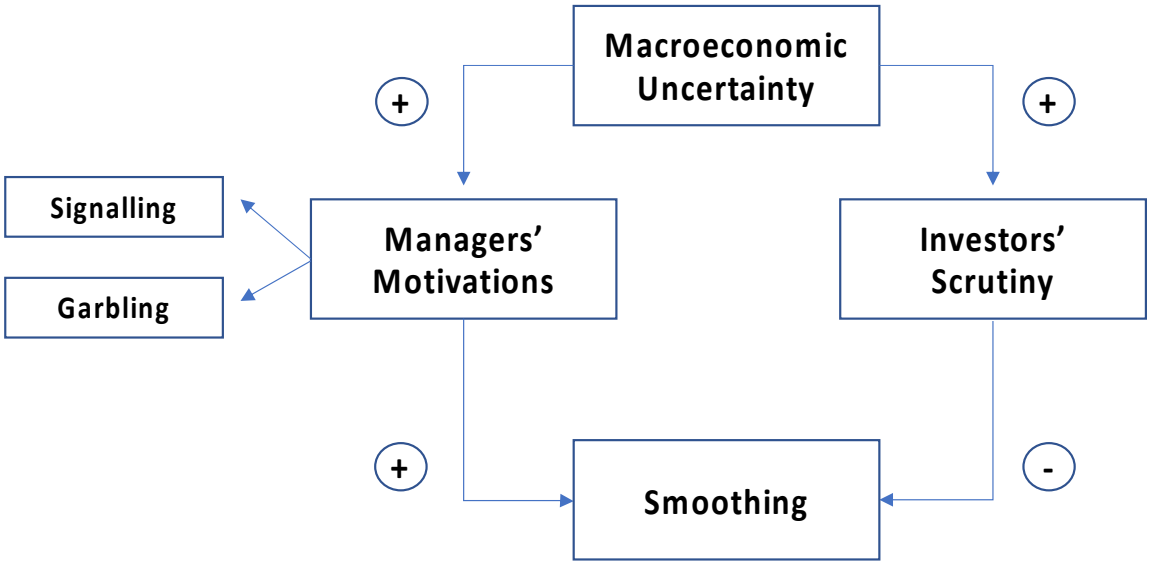
Table 14: Results for stock informativeness of smoothing

This table reports the estimated coefficients obtained by running an FGLS estimation. The dependent variable is the stock return in quarter t. The variable of interest is $ES_t * EPS_{3t} * Uncertainty_t$ ($or\ High\ Uncertainty$). Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Oil firms		Iron firms	
	Column 1	Column 2	Column 3	Column 4
	$Return_t$	$Return_t$	$Return_t$	$Return_t$
EPS_{3t}	0.00883***	0.01024***	0.01373**	0.01426**
	(0.00092)	(0.00101)	(0.00592)	(0.00592)
ES_t	0.02201***	0.01050**	0.05684	-0.00101
	(0.00437)	(0.00435)	(0.04230)	(0.02603)
$ES_t \times EPS_{3t}$	-0.00044	0.00063	-0.00701	-0.00331
	(0.00110)	(0.00095)	(0.00816)	(0.00822)
$Uncertainty_t$	-0.01130***		-0.00256	
	(0.00091)		(0.00510)	
$ES_t \times Uncertainty_t$	-0.00436***		-0.00471	
	(0.00102)		(0.00549)	
$EPS_{3t}\ x\ Uncertainty_t$	-0.00072***		-0.00092	
	(0.00018)		(0.00079)	
$ES_t \times EPS_{3t} x\ Uncertainty_t$	0.00138***		0.00170**	
	(0.00024)		(0.00075)	
$High\ Uncertainty_t$		-0.00788		-0.03745
		(0.00535)		(0.0354)
$ES_t\ x\ High\ Uncertaintyty_t$		0.00081		0.04825
		(0.00595)		(0.0386)
$EPS_{3t}\ x\ High\ Uncertainty_t$		-0.00502***		-0.01610
		(0.00109)		(0.0101)
$ES_t \times EPS_{3t} x\ High\ Uncertainty_t$		0.00113***		0.00134*
		(0.00019)		(0.00075)
Constant	0.03420***	0.00301	-0.01332	-0.01532
	(0.00395)	(0.00395)	(0.03897)	(0.02367)
Observations	24,681	24,681	830	830
Number of gvkey	690	690	21	21
Wald-test	1256	561.6	62.24	48.19

Figure 1: The hypothesis

This figure describes the workings of the hypothesis. Macroeconomic uncertainty increases both the managers' motivation and the investors' scrutiny, which have an opposite effect on smoothing. Further analyses investigate whether earnings smoothing is signalling or garbling.



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CHAPTER III

"DO FUTURES INFLUENCE EARNINGS MANAGEMENT IN THE GLOBAL GOLD MINING INDUSTRY?"

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Abstract

This study uses global quarterly data to examine the influence of futures on earnings management in the gold mining industry. The analysis reveals that gold firms strategically employ both income-increasing and decreasing accruals and real earnings management to smooth earnings during contango and backwardation periods. The economic significance of this earnings smoothing is significant. Endogeneity tests and various robustness checks confirm the findings. Further investigations indicate that the impact is more pronounced in countries with accounting regulations allowing greater discretion. These results contribute to the literature on earnings management determinants related to financial markets, with practical implications for financial report users and accounting standard setting in the extractive industries. The practical implications extend to financial report users and accounting standard settings in the extractive industries.

Keywords: earnings management, future, gold, interim reporting.

JEL codes: M41, Q02, E32

1. Introduction

Prior research investigates the determinants of earnings management related to financial markets (see El Diri, 2018, for a literature review). For example, studies find that managers use income-increasing earnings management when they believe that the firm's stock price is undervalued, before IPOs, when they list overseas, or to meet analysts' expectations (Dechow et al., 2010; Graham et al., 2005; Teixeira and Rodrigues, 2022; Wang et al., 2023). This study extends the literature by investigating futures as a determinant of earnings management in the global gold mining industry.

Provisional sales refer to contracts where the selling price, typically for the next quarter, is based on future prices. This arrangement occurs when the delivery of the goods is not immediate, and both parties involved in the transaction consider the commodity's future value. Revenue is recognized at the time of delivery (therefore, they are called provisional sales)[23]. In contango periods (wherein the current spot price is lower than the futures price), the expectation is to have an increase in future profits compared to current earnings. In backwardation periods, the expectation is to have current profits larger than future profits. The projection provides managers with an opportunity to smooth earnings. Previous literature highlights that when current performance is expected to be better than future performance, managers are incentivised to smooth earnings by increasing current profits to increase future profits (Chauhan and Jaiswall, 2023, p. 94). Previous literature highlights that when there is the expectation of larger future profits, managers have an incentive to smooth earnings by increasing current profits and reducing future profits (Baik et al., 2020; DeFond and Park, 1997). Moreover, literature shows that the smoothing strategy has multiple benefits such as lowering the cost of debt (Dichev et al., 2013), increasing managerial job security (DeFond and Park, 1997), and addressing investors' pressure for a steady stream of earnings because it reduces earnings volatility (Dichev et al., 2013; Graham et al., 2005). Smoothing requires reliable forecasts of revenues and profits to reduce the risk of misreporting (Baik et al., 2020), and the use of provisional sales might help managers in doing so.

There are at least two points of interest for this research. First, previous studies address the motivations for earnings management related to stock prices (Dechow et al., 2010; El Diri, 2018). Damodaran (2009) highlights that mining companies' earnings and value depend on the commodity prices they produce and sell. Hence, futures prices are a primary concern for mining firms' managers and a cogent motivation for earnings management. Second, a recent call for research encourages

[23] The recognition and measurement of provisional sales (or sales with provisional pricing) is the same under the US Generally Accepted Accounting Principles and the International Financial Reporting Standard IFRS 15 (KPMG, 2018; PWC, 2012). It is applied by companies producing iron, copper, gold and other metal concentrates. Contracts may include refunds or further remuneration for the difference between the future price used at the time of the contract and current price at the time of the delivery.

studies on earnings management in extractive industries (Gray et al., 2019). Among the reasons for interest in extractive industries are mining companies' huge worldwide stock values, the political, environmental, and social implications of mining industry activities, challenges in measuring operations, and defining industry-specific accounting standards (Gray et al., 2019; IASB, 2022). Thus, uncovering the industry-specific determinants of earnings management is of interest to both academics and practitioners.

The investigation uses a global sample by merging quarterly financial data from the Compustat Global and Compustat North America Databases regarding all gold firms (identified using the SIC Code 1040) from 2003 to 2019. We exploit gold firms' specific features considering that multiple types of research suggest that such companies cannot control the selling price (i.e., are price takers. See O'Connor et al., 2015 for a literature review). Gold firms cannot influence the price by cutting (or increasing) the supply[24] because most of the gold mined throughout history is available in multiple forms. Gold prices are determined by a wide range of economic and political factors that are outside the control of gold firms (Chirwa and Odhiambo, 2020; Malliaris & Malliaris, 2015). To address any remaining concerns regarding possible endogeneity, the paper implements GMM and IV estimations.

Using accrual and real earnings management models, we find that, during the backwardation period, gold firms use income-decreasing accruals and real earnings management. Conversely, gold firms use income-increasing earnings management and abnormal real activities during the contango period. The effect is economically significant. For example, a 1% negative (positive) difference between the future and current prices implies an increase (decrease) of 124 million dollars in accruals.

These findings are robust to the endogeneity tests using IV and GMM. Moreover, we test for robustness by excluding Canadian firms from the sample (because Canadian firms represent 43% of the sample), excluding the crisis period (2007-2008), and controlling for the current state of the economy by including the quarter gold price. All of the robustness tests confirm and support the validity of our main analysis. Further investigations show that gold firms applying the US Generally Accepted Accounting Principles (US GAAP) smooth earnings more than firms applying the International Financial Reporting Standards (IFRS), as the former allows greater accounting discretion in interim reporting.

Besides being used by managers in sale contracts, outsiders observe futures and influence their pay-out expectations (Acharya & Lambrecht, 2015). Our findings can be interpreted in the light of the recent Acharya & Lambrecht (2015) economic theory of income smoothing, suggesting that insider managers smooth earnings to optimize the reported earnings given the outsiders' beliefs.

[24] For example like oil producers that influence the market price especially by exploiting the creation of cartels. Oil is not indestructible and cannot be utilized multiple times as opposed to gold.

When the future price exceeds the current price, a portion of the future profits may be anticipated to meet and consolidate the time pattern of positive pay-out expected by outsiders. On the other hand, when the current price exceeds the future price, income-decreasing earnings management is used to set a time pattern of decreasing pay-out for the outsiders, adjusting their expectations to the future price trend. Our findings are also consistent with Acharya and Lambrecht's (2015) prediction that accrual and real earnings management occur simultaneously. When production is subject to scrutiny by outside subjects (e.g. investors, authorities), over(or underproduction) is used to manage the outsiders' expectations.

This study contributes to the literature on the determinants of earnings management in financial markets (Dechow et al., 2010; Teixeira and Rodrigues, 2022) by showing that futures affect earnings management in the global gold industry. Additionally, this study provides evidence regarding how managers smooth earnings (Baik et al., 2020; Graham et al., 2005). It presents evidence of gold firms utilizing forward prices in provisional sales contracts to manage earnings systematically. The study contributes to recent research highlighting earnings management's pervasive and industry-specific nature (Bertomeu et al., 2021; El Diri, 2018). Notably, findings highlight that both accrual and real earnings management are consistently employed every quarter, particularly in connection with specific business operations such as provisional sales.

The results of this study have several practical implications. It informs investors, lenders, and other market participants of the earnings management practices that affect the financial reporting of gold firms. This evidence suggests that extractive industries require additional accounting and disclosure regulations to reduce managerial discretion. For example, additional mandatory disclosure of reserves and orders might limit the managerial ability to manage earnings by informing investors about a firm's prospects. This would not harm firms because gold production is usually entirely sold. This study also supports recently discussed projects such as the International Accounting Standard Board Project on Extractive Activities (IASB 2022).

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 develops the hypothesis. Section 4 describes the sample and the research design. Section 5 displays the main findings and the endogeneity tests. Section 6 includes robustness tests. Section 7 provides further investigations. Section 8 concludes.

2. Literature Review

The literature largely investigated the motives for earnings management and an earnings smoothing strategy related to capital markets. The intuition behind all the papers is that capital markets have frictions that do not allow perfect information. Thus, earnings management occurs.

For example, there are incentives related to the stock market and opportunities to raise more capital (Lev 1989; Ramakrishnan and Thomas 1998; Kothari 2001; Gelb and Zarowin 2002). For example, Subramanyam (1996) finds that the stock market price discretionary accruals and managers use discretion to reflect fundamental value using a "pervasive income smoothing that improves the persistence and the predictability of earnings" (Subramanyam, 1996, p. 278). The literature uses the earnings response coefficient to measure the stock market's reaction to reported profit and finds lower reaction in noisy reported earnings (Felthman and Jinhan 2000). The market cannot always detect opportunistic earnings management and overvalue firms that engage in income-increasing manipulations (Chambers 1999). The ability of investors to recognize earnings management is higher for sophisticated investors and lower during optimistic periods (Daneshfar et al. 2009; Roychowdhury 2006). However, when the market detects anomalies, it reacts negatively (El Diri, 2018), representing a risk for firms.

Initial public offerings (IPO) represent another determinant for earnings management. Before the firm goes public, the management has most of the information, and there is a large information asymmetry with investors. Thus, multiple incentives exist to manipulate earnings to report superior performance and avoid being undervalued by the market (Fan 2007). Moreover, the manipulations are driven by the specific industry in which a firm operates (Singer 2007). However, considering the lack of data availability or firm comparable, some papers highlight the importance of cash flow analysis during IPOs, which reduces the need to use discretionary accruals to manipulate earnings (Bartov 2002).

Furthermore, the need to meet or beat a benchmark creates another determinant for earnings management. The market considers meeting or beating benchmarks in the valuation of firms; consequently, managers try to avoid reporting losses or a reduction in profits (Burgstahler and Dichev, 1997). Moreover, there is a preference to show an increase in the performance, which also creates an incentive for profitable firms (De Angelo et al., 1996). The incentive exists because firms that meet or beat a benchmark have a positive effect on their valuation from the stock market.

This literature review briefly summarizes the main determinants related to the capital market that motivate earnings management. There are other related to management compensation (e.g., Laux and Laux 2009), managerial ability (e.g., Demerjian et al., 2013), corporate governance, debt covenants (e.g, Franz et al., 2014; Dyreng et al., 2022), accounting standards (e.g., Walker 2013), and other.

However, the role of future markets is largely unexplored and it provides an important factor that influences accounting decision especially for the producer of the goods traded in the future market. Moreover, gold has been largely investigated as a commodity by economists but has not received large attention by accounting scholars. This paper tries to fill such gaps in the literature.

3. Hypothesis development

The demand for goods made with gold and by the financial sectors that invest in gold for speculation purposes or hedging drives the gold future market price (O'Connor et al., 2015). Gold miners are price-takers and exposed to the fluctuations in the gold market because of the large amount of gold accumulated throughout history (O'Connor et al., 2016). Damodaran (2009) observes that commodity companies usually have high fixed costs (high operating leverage) which amplify the effect of gold price fluctuations in the total revenues and profits. During economic cycles characterized by low gold price, gold firms cannot close mines, to avoid excessive costs of shutting down and restarting operations. The same is true for deeper mines or mines with lower quality ores. Even if they become profitable only above certain price levels gold firms do not close such mines (Moel & Tufano, 2002; Damodaran, 2009). Considering the exposure to the price fluctuation, managers might be tempted to level profits across periods using earnings management to secure benefits of a smooth stream such as reducing cost of debt and increased managerial job security (DeFond and Park, 1997; Graham et al., 2005; Dichev et al., 2013).

Managers use real activities and accruals to manipulate earnings (Dechow et al., 2010). Real earnings management techniques studied in the literature are sales manipulation, overproduction, and the use of discretionary expenses (Roychowdbury, 2006). Accelerating sales with price discounts, more lenient credit terms, and channel stuffing is likely unsuitable for gold firms, given the nature of the product sold. Over(under)production to report lower(higher) cost of goods sold may be a viable strategy. It could be implemented by exploiting deeper mines or mines yielding a lower quality of ore, that is, by opportunistically using mining capacity to produce more ore than necessary to meet demand (O'Connor et al., 2016). Also, to some extent, the gold production process may be accelerated. Extracted ore is included in the stockpile inventory, which can be sold or further processed on leach pads. Ore on leach pads represents ore that has been mined and placed on leach pads, where a solution is applied to separate the gold. When moving ore from the stockpile to leach pads, "costs are added to ore on leach pads based on current mining costs, including applicable depreciation and amortization relating to mining operations" (Newmont, 2020, p. 84). Hence, opportunistically accelerated processing increases inventory value, reducing the cost of goods sold. Finally, manipulated discretionary expenses can be advertising expenses, R&D expenses and selling, general and administrative expenses (SGA). Gold firms are likely to focus on the latter due to the reduced relevance of advertising and R&D[4].

Prior studies suggest that managers trade-off between accrual and real earnings management according to their relative costs (El Diri, 2018). We expect that gold firms use accrual and real

earnings management as complementary, given the relative costs of real activities manipulation. In consumer product and services firms, sales manipulation, overproduction and reduction of advertising or R&D expenses can harm the brand positioning and the development of new products (Cohen et al., 2008). Gold firms have no such risks using real earnings management. Also, gold is not perishable, and there is no risk of obsolescence for gold in the inventory. Also, the economic theory of income smoothing predicts that accrual and real earnings management occur simultaneously when insiders use over(underproduction) to affect the outsiders' expectations (Acharya & Lambrecht, 2015). Like oil, the production of gold is subject to scrutiny by investors, authorities, and other subjects (O'Connor et al., 2015). Gold firms could use overproduction(under) jointly with income-increasing(decreasing) accruals earnings management to meet the expectations of outsiders about a future(negative) positive trend in earnings.

HP: earnings management is associated with futures

4. Research Design

This study merges quarterly data from Compustat North America and Compustat Global databases. It uses the quarterly data available from Q1 2003 to Q4 2019 for firms included in SIC Code1040 (gold and silver ores). Quarterly data are suitable for our study because futures impact sales operations on a quarterly basis. The sample is made by a total of 987 individual firms providing 41,510 firm-quarter observations. The breakdown of firms by country (item *loc* in Compustat, Country Code Headquarters) is in Table 1. Data regarding futures comes from Datastream-Refinitiv. The reference used is the COMEX Gold Composite Commodity Future Price which is traded in multiple stock exchange such as NYMEX and is considered a global benchmark. The timeseries begins in Q1 2003 (Batten & Lucey, 2010)[25].

The paper calculates discretionary accrual earnings management (AEM) and real earnings management using well-established models in the literature. The following equations were estimated:

1. Jones model (Jones 1991):

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1 \left(\frac{1}{Assets_{it-1}}\right) + \beta_2 \frac{\Delta Revenue_{it}}{Assets_{it-1}} + \beta_3 \frac{PPE_{it}}{Assets_{it-1}} + \varepsilon_{it}$$

2. Modified Jones model (Dechow et al. 1995):

[25] This is the primary reference for future gold price and is traded on the NYMEX and other stock exchanges including Chicago, London. Tokyo, Seul, São Paulo.

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \varepsilon_{it}$$

3. Jones model augmented with ROA (Kothari et al., 2005):

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{\Delta Revenue_{it}}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \beta_4 ROA_{it-1} + \varepsilon_{it}$$

4. Modified Jones model augmented with ROA (Kothari et al., 2005):

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \beta_4 ROA_{it-1} + \varepsilon_{it}$$

5. Cash Flow from operations (Roychowdhury, 2006):

$$\frac{CFO_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{SALES_{it}}{ASSETS_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{ASSETS_{it-1}} + \varepsilon_{it}$$

6. Production costs (Roychowdhury, 2006):

$$\frac{PROD_{it}}{Assets_{it-1}} = \beta_0 + \beta_1\frac{1}{Assets_{it-1}} + \beta_2\frac{SALES_{it}}{Assets_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{Assets_{it-1}} + \beta_4\frac{\Delta SALES_{it-1}}{Assets_{it-1}} + \varepsilon_{it}$$

7. Discretionary expenses (Roychowdhury, 2006):

$$\frac{DISEXP_{it}}{Assets_{it-1}} = \beta_0 + \beta_1\frac{1}{Assets_{it-1}} + \beta_2\frac{SALES_{it-1}}{Assets_{it-1}} + \varepsilon_{it}$$

To study the impact of futures on earnings management, we run the following model:

8. Main model accruals earnings management:
   $AEM_{it} = \beta_1 Future_t + \beta_2 Controls_{it} + \beta_3 Year\ Fixed\ Effects_{it} + \beta_4 Country\ Fixed\ Effects_{it} + \varepsilon_{it}$

9. Main model real earnings management:
   $REM_{it} = \beta_1 Future_t + \beta_2 Controls_{it} + \beta_3 Year\ Fixed\ Effects_{it} + \beta_4 Country\ Fixed\ Effects_{it} + \varepsilon_{it}$

In Equation 8, AEM_{it} is the discretionary accruals measure (calculated using the four models explained above), whereas in Equation 9, REM_{it} is abnormal cash flow from operations, abnormal production costs, and abnormal discretionary expenses. $Future_t$ is the explanatory variable, measured as the difference between the futures price (close price at quarter $t+1$) and the current price (at quarter t) divided by the current price[26]. A positive value indicates a contango period; a negative value indicates a backwardation period. The paper controls for hedging using Bartons's (2001) measure of derivative use, management compensation using the Compustat item stkcoq measuring stock compensation, the firm's size with the natural logarithm of total assets, the market value with BTM ratio, and ROA to control for profitability. The derivative use variable measures the intensity of

[26] As a robustness check, we re-run the same analyses using the future close price at t+2 obtaining consistent results.

hedging activity and is calculated as the fair value of derivatives (items *deracq* and *deraltq* from the financial statements in Compustat) scaled by total assets. There are also time and country-fixed effects and robust standard errors clustered by firm. Appendix A summarizes the variables used in the empirical analysis and provides their sources. All variables are winsorized at the 1% level.

5. Results and discussion

5.1. Descriptive statistics and univariate analysis

Table 2 presents the descriptive statistics for the variables in the analyses. The average $Future_t$ is 0.041 (median 0.024), with a standard deviation of 0.115, indicating that the futures price is, on average, 4.1% higher than the current price (median 2,4%). Derivative use is zero for most firms, with approximately 1% having nonzero values of long-term and current derivatives assets. This is consistent with the fact that a derivative component is already often included in sales contracts (see above note 1).

5.2 Main analyses

Table 3 presents the results of the main analyses. The results show that *Future* has a significantly positive association with abnormal accruals in all accrual-earnings management models (Table 3, columns 1-4). This finding suggests that a higher spread between future and current gold prices is associated with positive abnormal accruals and vice versa. Gold firms borrow profits from future periods when the current price is below the futures price. Instead, they shift current profits in future periods, when the future price falls below the current price. The effect is economically significant because a 1% increase in the spread implies a 0.15% increase in total accruals (using the lowest coefficient), worth about $124 million, considering the sample average. The control variables showed the expected signs. Consistent with prior research, book-to-market ratio and stock-based compensation are significantly associated with income-increasing discretionary accruals, supporting the notion that managers use earnings management when they believe that the firm's stock price is undervalued or to increase their compensation (Teixeira and Rodrigues, 2022).

Table 4 indicates that gold firms use real earnings management to smooth their earnings. Evidence is consistent with abnormally high production costs, used to increase earnings in quarters with a positive spread between future and current gold prices (Table 4, Column 2). Abnormal production indicates that higher portions of fixed overheads are assigned to products in the inventory, thus lowering the cost of goods sold and increasing profits (Roychowdhury, 2006). Again, earnings management is economically significant because a 1% increase in the spread between future and current gold prices increases production costs by approximately $46 million. Column 3 of Table 4 provides evidence of abnormally low discretionary expenses in quarters with high spreads, indicating

income-increasing earnings management. Results show no evidence of abnormal cash flows (Table 4, column 1). Overall, accrual-based earnings management appears to be more economically significant than real earnings management, due to easier implementation than real activities manipulation (El Diri, 2018).

5.3 Endogeneity tests

5.3.1 General Method of Moments (GMM)

To address concerns about potential unobservable heterogeneity across firms in panel data, we use a GMM approach (Ullah et al., 2018; Antonakis et al., 2014). The decision to smooth earnings might be driven by idiosyncratic unobserved time-variant factors, e.g., firm culture or organization capital (Gormley & Matsa, 2013). While standard fixed effects address the presence of time-invariant unobserved factors, GMM estimation addresses time-variant unobserved heterogeneity across firms (Ullah et al., 2018; Wintoki et al., 2012; Wooldrige, 2001). "First-differencing is used to eliminate the unobserved effect, and then lags two and beyond are used as instrumental variables for the differenced lagged dependent variable" (Wooldrige, 2001, p. 98). This study implements a firm-fixed effects specification using the generalized method of moments (GMM) to reduce endogeneity concerns (Eugster, 2020; Hann et al., 2020). Table 5 columns 1 – 4 show a positive and statistically significant coefficient (p – value < 0.01) with the variable of interest *future* consistent with the smoothing hypothesis. Also the analyses on real earnings management support the hypothesis also with weaker evidence because abnormal discretionary expenses (column 7) does not show statistical significance. The coefficient in column 6 (abnormal production costs) however still confirms the smoothing strategy. Consistent with the main analysis we find no evidence regarding column 5 (abnormal cash flow).

5.3.2 Instrumental Variable Analysis

This study also conducts an instrumental variable analysis. Recent literature suggests that oil prices influence gold prices, however changes in gold prices do not impact oil prices (Kumar, 2017; Zhang and Wei, 2010). The instrumental variable must influence our variable of interest but must not influence our dependent variable.

Reboredo (2013a) provides four possible mechanisms to explain the connection between oil and gold prices: a) the inflationary effect of oil price which increases the price of all goods and also the gold price; b) the variation of oil price impacts the economic forecasts and the growth of economy. Investors use gold as an alternative assets to preserve monetary value. In addition, there are multiple studies showing evidence consistent with the use of gold as a "safe heaven" in periods of turmoil (e.g., Reboredo 2013b) ; c) oil exporting countries have a portfolio strategy to ensure diversification and during an increase of oil price it is necessary to buy more gold to maintain the correct proportion

of diversification; d) the depreciation of the US dollar increases oil prices and at the same time pushes investors to buy gold to preserve the monetary value.

Thus, the oil price represents a suitable instrumental variable because it is strongly correlated with the gold price but does not affect the smoothing decision by managers in any way. In the first stage (untabulated), we regress the *Future* variable on quarterly oil prices.

Equation 10

$$Fitted\ gold\ future\ price_t = \alpha + \beta_1 Oil\ volatility_t + \varepsilon$$

The IV analysis second stage used the fitted values of *Future* in equations 8 and 9. Table 6 (columns 1–4) displays the results obtained using abnormal accruals as the dependent variable. These findings are consistent with those of the main analysis presented in Table 3 by showing a positive and statistically significant coefficient (p – value < 0.01 in columns 1 and 4 and p – value < 0.05 in columns 2 and 3). Table 6 (columns 5–7) displays the results obtained using abnormal real operations as dependent variables. Again, the findings about discretionary accruals and abnormal production costs are consistent with those of the main analysis in Table 4.

6. Robustness tests

This paper performs several robustness checks to ensure the consistency of the results.

First, it performs a test related to the population included in our sample. Table 1 shows that 43.45% of the sample is represented by Canadian firms, so such firms are excluded from the analysis. In this way the research ensures evidence does not derive from specific country features.

Table 7 Panel A shows the results using accrual earnings management models augmented with the variable of interest $Futures_t$. In columns 1 to 4 the coefficient is positive and statistically significant (p – value < 0.05 in columns 1 and 3, p – value < 0.1 in column 2 and 4). Table 7 Panel B displays the results regarding real earnings management. Abnormal production costs (column 2) still displays a positive and statistically significant coefficient (p – value < 0.05). Columns 1 and 3 show a different behaviour. Abnormal cash flow from operation (column 1) becomes statistically significant (p – value < 0.05) with a negative coefficient while discretionary expenses (column 3) is not statistically significant. Overall, results are consistent with previous findings.

Second, it performs a test related to the time period of our analysis. The sample covers the year 2003 – 2019, which includes the financial crisis period (2008-2009) so it tests whether the results still holds in such period.

Table 8 panel A displays the results of an analysis on the years 2008-2009 regarding accrual earnings management. In columns 1 to 4 the coefficient is not statistically significant for the variable of interest future. Table 8 panel B shows the results of an analysis on the years 2008-2009 regarding real earnings management. The variable of interest in abnormal cash flow from operation (column 1)

has a negative and statistically significant coefficient (p-value < 0.1), in abnormal production costs shows a positive and statistically significant coefficient (p–value < 0.05). Abnormal discretionary expenses (column 3) does not show statistical significance.

Table 9 – Panel A shows the results regarding accrual earnings management during the time period 2003 – 2019 by excluding the year 2008 – 2009. Thus, it removes the financial crisis period. In all columns 1 to 4, the variable of interest shows a positive and statistically significant coefficient (p – value < 0.01). Table 9 – Panel B shows the results regarding real earnings management during the time period 2003 – 2019 by excluding the year 2008 – 2009. The results are consistent and similar to the main analyses by showing a positive and significant (p–value < 0.01) coefficient for column 2 (abnormal production costs), negative and significant coefficient (p – value < 0.05) for column 3 (abnormal discretionary expenses), and no statistical significance in column 1 (abnormal cash flow from operations).

To sum up the robustness analyses regarding time period, the paper finds consistent results in non-crisis years, while in crisis years (2008 and 2009) futures have no significant relationship with earnings management. A possible explanation of the results is that during a highly uncertain crisis period involving financial markets, managers may avoid relying on futures to engage in earnings management.

Indeed, the literature disagrees on whether crisis periods (with the concept sometimes overlapping with that of uncertain, extremely volatile periods in the literature) bring higher or lower earnings management, and findings are different across contexts. For example, Filip and Raffournier (2014) and Arthur et al. (2015) find that accruals quality improved during the 2008-2009 crisis in European companies. Other studies on the 1997-1998 Asian financial crisis provide competing results with evidence of earnings management (Ahmad-Zaluki et al. 2011; Ming Chia et al. 2007). Other studies use uncertainty indexes peaking during crisis years (often the EPU). Yung and Root (2019) find evidence that firms increase earnings management in periods of heightened economic uncertainty (high EPU), consistent with even stronger incentives. El Ghoul et al. (2021) on TAR find evidence of reduced earnings management during periods of high economic policy uncertainty (high EPU), in which investors and lenders scrutinize firm-specific information more closely, thereby limiting managerial discretion.

Third, it controls for the state of the economy because, given the same delta between the spot and the future prices, the behaviour of gold companies might be different when we consider the current price trend. For example, when the current spot price is declining (holding the difference with futures constant), gold companies experience a reduction in revenues and react differently compared to an economic situation where the current spot price is increasing. The paper does not include a control

for the current spot price in the main analysis as such control is embedded in the current sales used in models for discretionary accruals and abnormal real operations. However, to reduce such concerns, it performs an analysis including also the current spot price to equations 8 and 9. In this analyses. Columns 3 and 4 show the results using the adjustment suggested by Collins et al. (2017) when using quarterly data.

Table 10 shows the results on accrual earnings management models. All columns 1 to 4 show a positive and statistically significant coefficient for the variable of interest consistently with the main analyses.

Finally, untabulated results check that coefficients are consistent when using the single equation approach suggested by Chen et al. (2018) described in the previous paper. The multiple robustness tests performed in this section provide strong evidence supporting the validity of our main analyses.

7. Further investigations

This study undertakes a further cross-sectional investigation by splitting the sample into firms that use US GAAP and IFRS. US GAAP adopts the integral method for interim reporting (i.e., interim reports are an integral part of the annual period), whereas IFRS uses the discrete approach (i.e., the interim period is a stand-alone period). The key difference is that IFRS requires costs to be recognized when incurred, whereas US GAAP permits costs to be allocated to interim periods based on estimates, allowing more room for smoothing (Bogle, 2020)[27]. A more stringent interval reporting requirement may be specified under IFRS Standards than under US GAAP. Nevertheless, such stringency often contributes to improved alignment with annual closing procedures. In contrast, US GAAP-based interim reporting may provide advantages in synchronizing with budgeting and management reporting (Bogle, 2020).

The sample has 19,656 US GAAP firm-quarter observations and 21,854 IFRS firm-quarter observations[28].

Table 11 reports an interaction analysis, using abnormal accruals as dependent variables, wherein *Future* is interacted with a dummy for the use of IFRS (*Future*IFRS*). The interaction term is negative and significant across columns 1–4, signalling that earnings smoothing is mitigated in IFRS firms. On reviewing Table 11, Column 1, we find the difference between the baseline (0.294) and interaction coefficients (-0.271), indicating that, compared to US GAAP firms, IFRS firms still display abnormally positive accruals in quarters with high positive *Future,* but to a much lesser extent than US GAAP firms. The findings suggest the importance of accounting rules in shaping the relation

[27] For example, portions of year-end bonuses to employees may be anticipated, or maintenance expenses can be deferred or anticipated across quarters basing on budgets. See: https://advisory.kpmg.us/articles/2020/interim-financial-reporting.html.

[28] US GAAP are used by US companies, and also by Canadian, UK, Australian or other countries' firms.

between *Future* and earnings smoothing. Un-tabulated findings show that there is no significant interaction between *Future* and the use of IFRS when using real earnings management models. This suggests that real activities manipulation does not vary across different sets of accounting standards.

8. Conclusions

Using a global sample of gold producers from the period 2003-2019, this study investigated whether gold futures influence earnings management decisions. The paper uses discretionary accruals and abnormal operations models to test the use of both accrual and real earnings management by gold firms. Evidence shows that gold firms smooth their earnings to ensure constant profits by using income-increasing (income-decreasing) accruals and real earnings management during contango (backwardation) periods. The findings are robust to endogeneity checks using the GMM estimation and the instrumental variable analysis using oil as an instrumental variable by exploiting the relation between oil and gold. Further investigation highlights the role of accounting rules in limiting earnings smoothing. Results are also consistent in multiple robustness checks to control for population, period and the state of the economy. Further investigations show that accounting principles have a role. US GAAP users smooth their earnings more than IFRS users by exploiting the higher discretionality the principles allow.

The study acknowledges weaker results for real earnings management. Overall, findings suggest that some real earnings management techniques are used complementarily with accrual earnings management, others are not. Overproduction is a viable strategy for gold firms thanks to the nature of the production process, which can be accelerated or exploit deeper mines (O'Connor et al., 2016). The research obtains the strongest results on this. The lack of evidence related to sales manipulation may be related to the fact the price discounts and channel stuffing are likely unsuitable for gold firms. Indeed, prior literature emphasizes that not all REM techniques are suitable in any industry. Price discounts and channel stuffing are more apt for consumer products and services or retail (Roychowdbury, 2006; Cohen et al., 2008). Finally, gold firms are unlikely to have significant R&D and advertising expenses. Other selling, general and administrative expenses might be related to other firm-specific factors, and this may be the reason why the results do not hold with GMM, which attempts to reduce endogeneity concerns from time-variant unobservable heterogeneity across firms.

This study contributes to the literature with evidence on the futures as determinants of earnings management and on the process through which managers smooth earnings. It shows that the information in the futures provides reliable forecasts managers use to project future revenues (using the provisional sales) and perform a smoothing strategy. Previous literature has largely investigated the determinants of earnings management but dedicated scant attention to the role of futures. The

paper has policy implications as it informs market participants about the financial reporting of a relevant commodity industry and advocates requests for additional specific accounting and disclosure regulations.

This study has some limitations. It does not control for ownership and governance variables because of the unavailability of data in the global sample. Data are available only for a limited number of countries and we do not have access to such data. However, surveys of CFOs suggest that factors related to business and industry, such as futures for the gold mining industry, are the primary reasons for earnings management and are more influential than firm-specific governance features (Dichev et al., 2013, p. 16).

Declaration of interest

None.

Funding sources

This research did not receive any specific grant from funding agencies in public, commercial, or not-for-profit sectors.

Data availability statement

The financial data that support the findings of this study are available from Wharton Research Data Services. Restrictions apply to the availability of the data, which were used under license for this study. Data can be downloaded at https://wrds-web.wharton.upenn.edu/wrds/index.cfm under the permission of the data provider.

Commodity price data are available at Datastream-Refinitiv and IMF Primary Commodity System Primary Commodity Price System – At a Glance – ANNUAL – IMF Data. Restrictions apply to the availability of the data from Datastream-Refinitiv, which were used under license for this study. Data from the IMF are available without restrictions and freely accessible.

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Table 1 – Breakdown of firm-quarter observations by Country

Country	N	%	Country	N	%	Country	N	%	Country	N	%	Country	N	%
Argentina	66	0.16	Jersey	60	0.14	Ghana	10	0.02	Switzerland	14	0.03	France	95	0.23
Australia	11,881	28.62	Japan	52	0.13	Hong Kong	478	1.15	UK	2,475	5.96	Germany	24	0.06
Bermuda	58	0.14	Kazakhstan	60	0.14	Indonesia	128	0.31	South Africa	600	1.45	New Zealand	99	0.24
Canada	18,036	43.45	KGZ	58	0.17	India	195	0.46	Philippines	272	0.66	Perù	239	0.58
China	390	0.94	Morocco	65	0.16	Ireland	190	0.46	Papua New Guinea	30	0.07	Sweden	421	1.01
Colombia	41	0.10	Malaysia	16	0.04	Israel	53	0.13	Turkey	50	0.12	Russia	297	0.72
Cyprus	32	0.08	Norway	9	0.02	Singapore	311	0.75	USA	4,743	11.43			
Total	41,150	100.00												

This table illustrates the frequencies of country distributions firm-quarter observations.

Table 2 – Descriptive statistics

	Mean	Median	p10	P90	SD	N
AEM Jones model	-0.051	-0.097	-0.242	0.143	0.360	41,510
AEM Modified Jones	-0.076	-0.131	-0.272	0.129	0.378	41,510
AEM Jones with ROA	-0.053	-0.098	-0.243	0.141	0.353	41,510
AEM Mod Jones with ROA	-0.065	-0.130	-0.270	0.136	0.412	41,510
REM Abnormal Cash flow from operations	0.068	-0.007	-0.256	0.509	0.504	41,510
REM Abnormal Production costs	-0.026	-0.001	-0.114	0.208	0.102	41,510
REM Abnormal Discretionary expenses	0.048	0.031	0.000	0.134	0.201	41,510
Future	0.041	0.024	-0.079	0.193	0.115	41,510
Size	3.32	3.100	0.432	6.839	2.661	41,510
Leverage	0.667	0.171	0.018	0.779	2.482	41,510
Profitability	-0.145	-0.023	-0.268	0.190	0.511	41,510
Derivative Use	0.0001	0.000	0.000	0.000	0.003	41,510
Book-to-market ratio	0.851	0.504	0.132	2.230	1.771	41,510
Stock-based compensation (million $)	0.637	0.077	0.000	1.393	2.190	41,510

This table reports the summary statistics for the variables used in the analysis. The variable definitions are provided in the appen

Table 3 – Main analyses: Accrual earnings management

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA
Future	0.152***	0.195***	0.150***	0.233***
	(0.0500)	(0.0562)	(0.0479)	(0.0664)
Size	-0.0447***	-0.0492***	-0.0429***	-0.0583***
	(0.00457)	(0.00499)	(0.00436)	(0.00589)
Leverage	-7.99e-05	-7.99e-05	-8.49e-05	-2.28e-05
	(8.02e-05)	(7.88e-05)	(8.02e-05)	(9.63e-05)
Profitability	0.00544**	0.00541**	0.00543**	0.00556**
	(0.00243)	(0.00248)	(0.00240)	(0.00268)
Derivative Use	0.156	0.338	0.159	0.319
	(0.291)	(0.375)	(0.291)	(0.373)
Book-to-market ratio	0.000229*	0.000217*	0.000235*	7.05e-05
	(0.000129)	(0.000126)	(0.000127)	(0.000223)
Stock-based Compensation	0.0168***	0.0196***	0.0155***	0.0255***
	(0.00362)	(0.00396)	(0.00350)	(0.00452)
Observations	41,510	41,510	41,510	41,510
R-squared	0.117	0.150	0.116	0.152
F-Stat	25.49	32.37	26.57	27.75
F-Prob	0.0000	0.0000	0.0000	0.0000
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimate of the Equation (8) - Main Model using accruals earnings management (AEM) measures as the dependent variable, calculated alternatively with the Jones model (column 1), Modified Jones model (column 2), Jones model with ROA (column 3), and Modified Jones model with ROA (column 4). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 4 – Main analyses: real earnings management

VARIABLES	Column 1 REM -Abnormal Cash flow from operations	Column 2 REM -Abnormal Production Costs	Column 3 REM- Abnormal Discretionary expenses
Future	-0.0416	0.0409***	-0.0963**
	(0.0564)	(0.0143)	(0.0428)
Size	0.0689***	-0.00442***	-0.00827**
	(0.00628)	(0.00130)	(0.00417)
Leverage	0.000195	-7.39e-05*	2.23e-05
	(0.000153)	(4.12e-05)	(9.18e-05)
Profitability	-0.000232	-0.000686*	-0.00149
	(0.00143)	(0.000372)	(0.000976)
Derivative Use	0.903	-0.124	-0.153
	(0.763)	(0.182)	(0.103)
Book-to-market ratio	5.44e-05	-2.57e-05	-0.000102
	(0.000190)	(5.24e-05)	(0.000104)
Stock-based Compensation	-0.0201***	-0.00144	0.00572*
	(0.00580)	(0.00109)	(0.00337)
Observations	41,510	41,510	41,510
R-squared	0.133	0.047	0.135
F-Stat	9.79	7.94	23.75
F-Prob	0.0000	0.0000	0.0000
Year FE	YES	YES	YES
Country FE	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM

This table provides the OLS estimate of Equation (9) - Main Model using real earnings management as the dependent variable: abnormal cash flow from operations (column 1), abnormal production costs (column 2), and abnormal discretionary expenses (column 3). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5 – Generalized Methods of Moments (GMM)

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA	Column 5 REM -Abnormal Cash flow from operations	Column 6 REM -Abnormal Production costs	Column 7 REM- Abnormal Discretionary expenses
Future	1.428***	1.317***	1.299***	1.979***	0.160	0.047***	0.003
	(0.083)	(0.090)	(0.082)	(0.096)	(0.345)	(0.017)	(0.010)
Size	-0.044***	-0.054***	-0.042***	-0.065***	0.028***	-0.003***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.000)	(0.000)
Leverage	-0.000***	-0.000***	-0.000***	-0.000**	0.001*	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	0.006***	0.005***	0.006***	0.006***	0.004	-0.001***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)
Derivative Use	0.388	0.546	0.375	0.606	-0.019	-0.069	-0.039
	(0.396)	(0.414)	(0.390)	(0.439)	(5.353)	(0.096)	(0.153)
Book-to-market ratio	0.001	0.001	0.001	-0.000	-0.001	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)
Stock-based Compensation	0.045***	0.063***	0.040***	0.085***	-0.018	-0.003***	-0.002***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.023)	(0.000)	(0.001)
Observations	41,510	41,510	41,510	41,510	41,510	41,510	41,510
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.000	0.000	0.000	0.000	0. 272	0.0015	0.000
Sargan	8899	8017	8824	8513	16986	7407	27513
Number of Instruments	1407	1403	1407	1403	1285	1406	1284

This table provides the dynamic panel system GMM using 10 lags estimate of our main models. Results report the coefficients obtained using discretionary accruals and real earnings management as dependent variables. The quality of the instrumental variables is expressed by the autocorrelation test (AR1). The Sargan's test is used to indicate whether the restrictions are overidentified. Robust standard errors clustered by firms are contained in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Table 6 – IV analysis using oil price

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA	Column 5 REM -Abnormal Cash flow from operations	Column 6 REM Abnormal Production Costs	Column 7 REM-Abnormal Discretionary expenses
Fitted Future	0.654***	0.501**	0.556**	0.897***	0.573*	0.358***	-0.0313
	(0.225)	(0.238)	(0.224)	(0.283)	(0.297)	(0.0721)	(0.110)
Size	-0.0445***	-0.0494***	-0.0427***	-0.0588***	0.0679***	-0.00417***	-0.00711*
	(0.00448)	(0.00508)	(0.00426)	(0.00600)	(0.00632)	(0.00138)	(0.00431)
Leverage	-9.46e-05	-0.000105	-0.000100	-5.08e-05	0.000213	-8.79e-05**	3.30e-05
	(8.56e-05)	(8.48e-05)	(8.58e-05)	(9.55e-05)	(0.000171)	(4.38e-05)	(8.62e-05)
Profitability	0.00586**	0.00560**	0.00583**	0.00579**	-0.000881	-0.000811**	-0.00184
	(0.00248)	(0.00258)	(0.00244)	(0.00278)	(0.00149)	(0.000386)	(0.00112)
Derivative Use	0.164	0.348	0.168	0.329	0.707	-0.125	-0.185***
	(0.304)	(0.393)	(0.304)	(0.398)	(0.711)	(0.180)	(0.0662)
Book-to-market ratio	0.000206	0.000193	0.000213	3.94e-05	3.58e-05	-2.73e-05	-0.000120
	(0.000136)	(0.000135)	(0.000134)	(0.000236)	(0.000187)	(5.41e-05)	(0.000112)
Stock-based Compensation	0.0164***	0.0194***	0.0152***	0.0257***	-0.0193***	-0.00173	0.00569
	(0.00356)	(0.00402)	(0.00345)	(0.00459)	(0.00565)	(0.00115)	(0.00350)
Observations	41,510	41,510	41,510	41,510	41,510	41,510	41,510
R-squared	0.117	0.147	0.117	0.149	0.118	0.038	0.022
Year FE	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM

This table reports the coefficients obtained using IV estimation (second stage). In the first stage, *Fitted Future* is obtained by regressing *Future* on the quarterly oil price. Analysis was conducted for the entire sample. Robust standard errors clustered by firms are presented in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Table 7 – Panel A – Accrual earnings management Removing Canadian firms

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA
Future	0.347**	0.345*	0.346**	0.325*
	(0.163)	(0.175)	(0.162)	(0.178)
Size	-0.0336***	-0.0368***	-0.0313***	-0.0446***
	(0.00999)	(0.0111)	(0.00958)	(0.0123)
Leverage	-0.000519	-0.000281	-0.000568	0.00131
	(0.00119)	(0.00120)	(0.00115)	(0.00117)
Profitability	0.00211	0.00231	0.00211	0.00411
	(0.00481)	(0.00504)	(0.00467)	(0.00593)
Derivative use	-0.931	-0.575	-0.976	-0.328
	(0.692)	(0.749)	(0.693)	(0.773)
Book-to-market ratio	0.000369***	0.000375***	0.000370***	0.000311***
	(0.000112)	(9.45e-05)	(0.000110)	(7.83e-05)
Stock-based Compensation	0.00831	0.0113	0.00681	0.0159*
	(0.00783)	(0.00839)	(0.00761)	(0.00891)
Observations	23,014	23,014	23,014	23,014
R-squared	0.067	0.089	0.066	0.115
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimation of the Equation (8) by removing Canadian firms from the sample- Main Model using accruals earnings management (AEM) measures as the dependent variable, calculated alternatively with the Jones model (column 1), Modified Jones model (column 2), Jones model with ROA (column 3), and Modified Jones model with ROA (column 4). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7 – Panel B – Real earnings management removing Canadian firms

VARIABLES	Column 1 REM -Abnormal Cash flow from operations	Column 2 REM -Abnormal Production Costs	Column 3 REM- Abnormal Discretionary expenses
Future	-0.228*	0.124**	0.570
	(0.123)	(0.0592)	(0.857)
Size	0.0266***	-0.00383	0.00744
	(0.00488)	(0.00296)	(0.0226)
Leverage	0.0196	0.0254***	-0.274
	(0.0212)	(0.00641)	(0.201)
Profitability	0.336***	-0.132***	-3.094*
	(0.0969)	(0.0163)	(1.705)
Derivative use	2.740***	0.467	1.851
	(0.625)	(0.441)	(5.061)
Book-to-market ratio	1.90e-05	-5.33e-05**	0.000278
	(4.69e-05)	(2.12e-05)	(0.000248)
Observations	849	838	716
R-squared	0.434	0.645	0.183
Year FE	YES	YES	YES
Country FE	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM

This table provides the OLS estimation of Equation (9) by removing Canadian firms from the sample - Main Model using real earnings management as the dependent variable: abnormal cash flow from operations (column 1), abnormal production costs (column 2), and abnormal discretionary expenses (column 3). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8 – Panel A – Accrual earnings management during the crisis year (2008-2009)

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA
Future	0.173	0.228	0.146	0.343
	(0.116)	(0.152)	(0.105)	(0.213)
Size	-0.0296***	-0.0365***	-0.0287***	-0.0399***
	(0.00471)	(0.00568)	(0.00436)	(0.00722)
Leverage	-0.000882	0.000776	-0.000967	0.00463***
	(0.00109)	(0.00113)	(0.00100)	(0.00136)
Profitability	0.0360***	0.0383***	0.0368***	0.0414***
	(0.0103)	(0.00837)	(0.0107)	(0.00698)
Derivative use	0.000160**	0.000173***	0.000157***	0.000162***
	(4.67e-05)	(3.88e-05)	(4.77e-05)	(3.60e-05)
Book-to-market ratio	0.0116**	0.0166***	0.0109**	0.0194***
	(0.00495)	(0.00557)	(0.00466)	(0.00688)
Stock-based Compensation	0.0116**	0.0166***	0.0109**	0.0194***
	(0.00495)	(0.00557)	(0.00466)	(0.00688)
Observations	1,398	1,186	1,398	1,186
R-squared	0.168	0.217	0.173	0.238
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimation of the Equation (8) by focusing only on the years 2008-2009 - Main Model using accruals earnings management (AEM) measures as the dependent variable, calculated alternatively with the Jones model (column 1), Modified Jones model (column 2), Jones model with ROA (column 3), and Modified Jones model with ROA (column 4). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8 – Panel B – Real earnings Management during the crisis period (removing 2008-2009)

VARIABLES	Column 1 REM -Abnormal Cash flow from operations	Column 2 REM -Abnormal Production Costs	Column 3 REM- Abnormal Discretionary expenses
Future	-0.00197	0.0277	-0.151
	(0.292)	(0.0541)	(0.141)
Size	0.0203**	-0.00267*	0.00917**
	(0.00785)	(0.00144)	(0.00413)
Leverage	0.00517***	-0.00126***	-0.00314***
	(0.000946)	(0.000259)	(0.000718)
Profitability	-0.0203	-0.00739	-0.0251***
	(0.0151)	(0.00702)	(0.00601)
Book-to-market ratio	0.000134*	-4.44e-05	1.18e-05
	(7.64e-05)	(2.81e-05)	(3.28e-05)
Stock-based Compensation	0.0115	-0.00434**	-0.00850**
	(0.0104)	(0.00200)	(0.00399)
Observations	1,398	1,337	1,342
R-squared	0.112	0.085	0.200
Year FE	YES	YES	YES
Country FE	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM

This table provides the OLS estimation of Equation (9) by focusing only on the years 2008-2009 - Main Model using real earnings management as the dependent variable: abnormal cash flow from operations (column 1), abnormal production costs (column 2), and abnormal discretionary expenses (column 3). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9 – Panel A – Accrual earnings management during non-crisis year (all years excluding 2008 – 2009)

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA
Future	0.161***	0.205***	0.161***	0.241***
	(0.0535)	(0.0576)	(0.0520)	(0.0648)
Size	-0.0451***	-0.0492***	-0.0434***	-0.0573***
	(0.00455)	(0.00491)	(0.00438)	(0.00563)
Leverage	-7.94e-05	-8.51e-05	-8.43e-05	-4.27e-05
	(7.64e-05)	(7.68e-05)	(7.62e-05)	(8.69e-05)
Profitability	0.00534**	0.00528**	0.00533**	0.00537**
	(0.00240)	(0.00244)	(0.00237)	(0.00262)
Derivative use	0.171	0.350	0.175	0.333
	(0.293)	(0.377)	(0.293)	(0.374)
Book-to-market ratio	-0.00130	-0.00127	-0.00126	-0.00260
	(0.00186)	(0.00190)	(0.00185)	(0.00205)
Stock-based Compensation	0.0169***	0.0193***	0.0157***	0.0250***
	(0.00380)	(0.00418)	(0.00372)	(0.00465)
Observations	11,512	10,356	11,511	10,355
R-squared	0.115	0.145	0.115	0.148
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimation of the Equation (8) by removing the years 2008-2009 - Main Model using accruals earnings management (AEM) measures as the dependent variable, calculated alternatively with the Jones model (column 1), Modified Jones model (column 2), Jones model with ROA (column 3), and Modified Jones model with ROA (column 4). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9 – Panel B – Real earnings management during non-crisis year (all years excluding 2008 – 2009)

VARIABLES	Column 1 REM -Abnormal Cash flow from operations	Column 2 REM -Abnormal Production Costs	Column 3 REM- Abnormal Discretionary expenses
Future	-0.0658	0.0450***	-0.0899**
	(0.0468)	(0.0128)	(0.0371)
Size	0.0725***	-0.00448***	-0.0101***
	(0.00621)	(0.00126)	(0.00387)
Leverage	0.000181	-6.88e-05*	3.23e-05
	(0.000131)	(3.70e-05)	(8.30e-05)
Profitability	-0.000258	-0.000659*	-0.00133
	(0.00142)	(0.000372)	(0.000927)
Derivative Use	0.861	-0.126	-0.129
	(0.743)	(0.182)	(0.101)
Book-to-Market ratio	0.00217	0.000330	-0.00163
	(0.00204)	(0.000457)	(0.00108)
Stock Based Compensation	-0.0230***	-0.00123	0.00761**
	(0.00570)	(0.00104)	(0.00328)
Observations	11,515	11,201	11,141
R-squared	0.145	0.049	0.145
Year FE	YES	YES	YES
Country FE	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM

This table provides the OLS estimation of Equation (9) by removing the years 2008-2009 - Main Model using real earnings management as the dependent variable: abnormal cash flow from operations (column 1), abnormal production costs (column 2), and abnormal discretionary expenses (column 3). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10 – Accrual earnings management controlling for the current price

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model (Collins et al., 2017)	Column 4 AEM Modified Jones Model (Collins et al., 2017)
Future	0.197***	0.218***	0.197***	0.216***
	(0.0656)	(0.0649)	(0.0594)	(0.0627)
Current price	6.23e-05	3.97e-05	0.000116**	0.000123**
	(5.31e-05)	(4.38e-05)	(5.31e-05)	(5.59e-05)
Size	-0.0447***	-0.0495***	-0.0149***	-0.0167***
	(0.00457)	(0.00507)	(0.00466)	(0.00503)
Leverage	-8.01e-05	-8.00e-05	0.000122	0.000110
	(8.01e-05)	(7.90e-05)	(0.000123)	(0.000129)
Profitability	0.00544**	0.00542**	0.00854***	0.00888***
	(0.00243)	(0.00249)	(0.00160)	(0.00163)
Derivative Use	0.158	0.341	-1.495**	-1.423*
	(0.291)	(0.375)	(0.757)	(0.757)
Book-to-market ratio	0.000235*	0.000220*	-0.00925***	-0.00934***
	(0.000129)	(0.000125)	(0.00323)	(0.00342)
Stock-based Compensation	0.0168***	0.0197***	0.00578**	0.00643**
	(0.00362)	(0.00400)	(0.00239)	(0.00257)
Observations	41,510	41,510	41,510	41,510
R-squared	0.117	0.150	0.137	0.142
F-Stat	24.57	35.74	11.20	11.39
F-Prob	0.0000	0.0000	0.0000	0.0000
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Std. Error clustered by	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimation of the Equation (8) by including the current price as control variable - Main Model using accruals earnings management (AEM) measures as the dependent variable, calculated alternatively with the Jones model (column 1), Modified Jones model (column 2), Jones model with ROA (column 3), and Modified Jones model with ROA (column 4). The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in the parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 11 – Cross section US GAAP versus IFRS

VARIABLES	Column 1 AEM Jones Model	Column 2 AEM Modified Jones Model	Column 3 AEM Jones Model with ROA	Column 4 AEM Modified Jones Model with ROA
Future	0.294***	0.246***	0.271***	0.377***
	(0.0439)	(0.0488)	(0.0431)	(0.0520)
IFRS	0.0719***	0.0569***	0.0679***	0.0906***
	(0.00517)	(0.00563)	(0.00508)	(0.00616)
Future x IFRS	-0.271***	-0.174**	-0.245***	-0.312***
	(0.0643)	(0.0708)	(0.0632)	(0.0755)
Size	-0.0361***	-0.0423***	-0.0350***	-0.0456***
	(0.00115)	(0.00127)	(0.00113)	(0.00140)
Leverage	-7.78e-05**	-7.85e-05**	-8.31e-05**	-2.65e-05
	(3.41e-05)	(3.56e-05)	(3.35e-05)	(3.80e-05)
Profitability	0.00497***	0.00504***	0.00500***	0.00509***
	(0.000428)	(0.000447)	(0.000421)	(0.000477)
Derivative Use	0.175	0.348	0.177	0.456
	(0.480)	(0.503)	(0.472)	(0.536)
Book-to-market ratio	0.000242	0.000221	0.000245	-0.0152***
	(0.000210)	(0.000220)	(0.000207)	
Stock-based Compensation	0.0126***	0.0164***	0.0118***	0.0199***
	(0.00214)	(0.00237)	(0.00211)	(0.00253)
Observations	41,510	41,510	41,510	41,510
R-squared	0.104	0.140	0.105	0.141
F-Stat	189.61	150.59	187.20	150.02
F-Prob	0.0000	0.0000	0.0000	0.0000

This table reports the cross-sectional analysis showing the differences between firms using US GAAP and IFRS. The variable of interest is the interaction term between the *Future* and IFRS. Analysis was conducted for the entire sample. Robust standard errors clustered by firms are presented in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

Appendix A: Summary of the variables used and their sources

Label	Description	Source
AEM Jones	Discretionary Accruals calculated using the Jones (1991)'s model	Compustat
AEM Modified Jones	Discretionary Accruals calculated using the Modified Jones (1991)'s model (Dechow et al., 1995);	Compustat
AEM Jones with ROA	Discretionary Accruals calculated using the Jones model with ROA (Kothari et al., 2005)	Compustat
AEM Modified Jones with ROA	Discretionary Accruals calculated using the Modified Jones' model with ROA (Kothari et al., 2005)	Compustat
REM Abnormal Cash flow from operations	Abnormal cash flow from operations calculated using Roychowdhury (2006)'s model	Compustat
REM Abnormal Production costs	Abnormal production costs calculated using Roychowdhury (2006)'s model	Compustat
REM Abnormal discretionary expenses	Abnormal discretionary expenses calculated using Roychowdhury (2006)'s model	Compustat
Future	Difference between future price at quarter *t*+1 and current price in quarter *t*, divided by current price	Refinitiv
Leverage	Ratio between total liabilities and total assets in quarter t for firm i	Compustat
Profitability	Return on Assets in quarter t for firm i	Compustat
Size	Natural logarithm of total asset in quarter t for firm i	Compustat
Derivative Use	Sum of current derivative and long-term derivative in quarter t for firm i, scaled by total assets (Barton, 2001)	Compustat
Book-to-market ratio	Ratio between book value and market value in quarter t in firm i	Compustat
Stock-based compensation	Item stkcoq from Compustat (Sun and Xiaolan, 2019)	Compustat

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CHAPTER IV

"PAIN AT THE PUMP: EXCISE TAX-INDUCED REAL EARNINGS MANAGEMENT IN THE US OIL INDUSTRY"

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Abstract

This study investigates earnings management induced by excise taxes in firms responsible for collecting excise tax. Drawing on economic theory concerning tax pass-through rates and demand elasticity, the hypothesis is that firms employ earnings management strategies to mitigate the threat of excise tax increases. The research uses a quasi-experimental difference-in-differences research design, exploiting the exogenous shock resulting from the insolvency of the U.S. Highway Trust Fund in 2005. It analyzes quarterly data from U.S. oil firms spanning from 1993 to 2019. The findings provide strong evidence that the looming threat of an increase in the fuel excise tax prompts real activity management within oil firms. The findings show that oil firms engage in sales discounts, channel stuffing, and boosting production to increase the excise tax collected. Moreover, the findings indicate that adjustments to sales and production operations are permanent after 2005, reflecting an effort to preempt potential future excise tax increases. The paper does not find evidence of increased accruals earnings management after 2005. Placebo tests corroborate the findings. External validity is assessed using the threat of excise tax increases in the alcoholic beverages industry. This paper contributes to prior literature on tax-induced earnings management and to the literature on the real effects of corporate taxation and earnings management. The paper has relevant policy implications.

Keywords: earnings management, excise tax, oil industry.

JEL codes: M41, M48, L92

1. Introduction

Prior research studied tax-induced earnings management, focusing on income taxes (Gaertner et al., 2020; Guenther, 1994; Lin et al., 2012; Scholes et al., 1992). Some studies find evidence of income shifting, accelerated expense recognition (Gaertner et al., 2020; Scholes et al., 1992), or accelerated production and sales before scheduled changes in tax rates (Monem, 2003). Other studies examine earnings management to mitigate threats of income tax increases or to avoid scrutiny of the income taxes paid (Han & Wang, 1998; Hsiao et al., 2016; Wong, 1988). While prior research focuses entirely on corporate income taxation, this paper investigates earnings management induced by excise taxes.

There are at least two reasons of interest for this research. First, prior research findings on income tax-induced earnings management may not externalize to the excise tax setting. Excise is a tax on the consumption of specific goods (e.g., fuel, alcohol, tobacco, gambling, firearms), usually levied as a fixed amount per unit or quantity of product sold. Changes in excise taxes trigger long-lasting changes in consumption, for which temporary income shifting does not provide substantial relief to excise tax collector firms. Indeed, the economic literature on tax pass-through rates suggests that firms do not fully transfer the burden of excise tax increases to consumers through higher selling prices, thus losing profits (Ardalan & Kessing, 2021; Bonnet & Réquillart, 2013; Carbonnier, 2013). Also, even if the demand may be price inelastic or poorly elastic in the short term, excise tax increases harm the firm's profitability in the medium-long term. This occurs, for example, by discouraging consumption and incentivizing the purchase of substitute products (Hughes et al., 2008; Johansson & Schipper, 1997; Ulbrich, 2013). When governments use excise taxes as Pigovian taxes to mitigate consumer behaviors with negative externalities for society and the environment, these taxes can lead to industry declines (DeCicca et al., 2013)[29].

Another reason of interest is related to the excise tax collector firms' reactions to changes or threats of change in excise tax. Such responses have direct consequences on the environment and social welfare. The actions of excise collecting firms, whether to evade or mitigate the impact of excise tax increases, have adverse effects on social well-being and significant environmental implications. These actions, for instance, can hinder progress toward greener and more sustainable transportation systems, delay infrastructure modernization, and uphold unhealthy consumption habits. Prior healthcare research suggests, e.g., that tobacco producers

[29] See, e.g., the excise tax on cigarettes. Through the decades, governments have been using the tax to fund healthcare expenses, but also to reduce consumption and push for alternative healthier products (DeCicca et al., 2013).

engage in aggressive price discounts to mitigate excise tax increases, uphold consumption, especially among youth, and avoid consumers from abandoning the smoking habit (Jamison et al., 2009)[30]. Moreover, the actions of tax collector firms have public finance implications, again impacting social welfare. Governments often depend on the tax collected for essential public spending[31]. The US Congressional Research Service estimates that the US excise tax gathered between 2000 and 2019 is about 1.7 trillion $, with an average of 85 billion $ per year, providing about 3.5% of the total federal tax receipts every year (CRS Report, 2021). The income taxes paid by US oil firms between 1981 and 2008 totaled about 338 billion $, while the excise tax collected totaled about 1.1 trillion $ (CSR Report, 2021). The excise tax revenues are essential for many trusts providing relevant public services, like the US Highway Trust Fund, the Airport and Airway Trust Fund, and the Black Lung Disability Trust Fund. Analyzing the behavior of excise tax collectors is thus extremely relevant to policymakers and stakeholders.

To investigate excise tax-induced earnings management, this paper analyzes the fuel excise tax in the US and the US oil firms' quarterly data from 1993 to 2019. It uses a quasi-experimental multiple periods difference-in-differences design, exploiting the exogenous shock provided by the insolvency of the U.S. Highway Trust Fund in 2005, to which the resources of the federal fuel excise tax are dedicated. The federal fuel excise tax current rate was set in 1993 and never changed afterward[32]. In the first quarter of 2005, the U.S. Highway Trust Fund closed the accounts with a significant unbalance and was projected to default in the short term. The Congress discussed including a fuel excise tax increase in the Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU Act). Our research design examines whether US oil firms engage in accrual and real earnings management during the political process leading up to the issuance of the Act (Q1, Q2, and Q3 2005) and after its issuance from Q4 2005 on (Barrage et al., 2020), as a response to the threat of excise tax increase.

After controlling for the US GDP, the fuel price, and fuel consumption, the empirical analysis provides evidence that US oil firms adjust their sales and production operations to support consumption and increase the excise tax collected. The findings show that US oil firms permanently adjusted their sales and production policies to ensure a robust flow of financial resources to the Highway Trust Fund and mitigate the threat of an increase in the excise tax

[30] The 2009 Center for Disease Control (CDC) review of scientific evidence recommended the US government to further increase the cigarettes excise tax in 2009, as the prior increases in 1998 and 2002 were insufficient to significantly decrease the habit among consumers, due to the reaction of tobacco producers (Jamison et al., 2009).
[31] The fuel excise tax is e.g., often addressed to as "cash cow" for the governments (Hodge, 2010)
[32] We refer to fuel excise tax to both gasoline excise tax and diesel excise tax (18.4 cents per gallon gasoline; 24.4 per gallon diesel).

over the years. The adjustments are economically relevant. The results are robust to using alternative control groups in the diff-in-diff analysis. A placebo test with an alternative population shows that a different group of excise tax collectors (tobacco and alcohol) do not engage in earnings management during and after the issuance of the SAFETEA-LU Act. A placebo test with an alternative treatment on oil firms (the 1997 Tax Relief Act, which increased the passenger excise tax in the aviation industry) also corroborates our results. The empirical investigations also provide evidence of production "smoothing" around the level of excise tax collected.

Further analysis does not provide evidence of accruals management during the Congressional debate on the SAFETEA-LU Act (Q1, Q2, and Q3 2005) and after the issuance of the SAFETEA-LU Act in 2005. Further investigations provide evidence that the quarterly effective tax rates volatility decreases after the issuance of the SAFETEA-LU Act in 2005, compared to prior periods, signaling a reduction in the discretional use of quarterly income tax expenses.

This research also assesses the external validity of findings, investigating the pending threat of an increase in the beer excise tax started in 2013 in the alcoholic beverages industry. The results provide evidence of real earnings management, with alcoholic beverage firms engaging in sales manipulation and overproduction to inflate inventory. This real activities management supports consumption and hedging against a possible increase in the excise tax.

This paper contributes to prior literature in several ways. It contributes to the literature on tax-induced earnings management (Gaertner et al., 2020; Lin et al., 2012). Prior literature suggests that firms use earnings management around scheduled changes in tax rates (Gaertner et al., 2020; Scholes et al., 1992) or to mitigate threats of income tax increases (Han & Wang, 1998; Hsiao et al., 2016). This research provides evidence that excise tax collectors use real activities management to support consumption and increase the excise tax collected as a means to mitigate the threat of increases in the excise tax rate. The adjustments of sales and production policies represent a long-lasting strategy to safeguard the excise collector firm's profits and value.

This research also contributes to the literature on the real effects of corporate taxation (Jacob, 2022). Prior research finds evidence related to the impact of corporate income taxation on corporate investment, foreign direct investment (FDI), aggregate growth, and innovation. This study complements this literature with evidence that excise tax has relevant real effects on social welfare and the environment. Indeed, the behavior of tax collecting firms, preempting excise tax increases, negatively affects social well-being and has environmental implications, e.g.,

slowing the transition to environmentally friendly transportation, delaying the renewal of infrastructures, and keeping unhealthy consumption habits. We find evidence that US excise tax collector firms contribute to keeping low excise taxes on fuel, which is environmentally destructive and inconsistent with social welfare goals. Notably, the use of fuels for transportation accounts for over 30% of the greenhouse emissions in the US, more than any industry (US Environmental Protection Agency, 2023)[33]. A mere 1% increase in the fuel price can reduce the demand by 0.58% (Zimmer & Koch, 2017). Using the 2019 US data, we can estimate that a 25 cents per gallon excise tax increase (9,6% of the 2019 average fuel price) would have reduced the consumption by about 22 million gallons per day, saving about 10,13 kg CO^2 per gallon. In this context, the paper can also contribute to the emerging literature on externalities of corporate decisions prioritizing profitability over social well-being and environmental concerns (Caskey & Ozel, 2017; Liu et al., 2021).

Finally, this research can expand the public finance literature, investigating the role of tax-collecting firms. The findings suggest that fuel tax collector earnings management impacts on the excise tax collected, thus influencing government revenues. This, in turn, has implications for public finance choices. While much of the existing public finance literature focuses on the decisions and policies made by governments, the influence of tax collectors on public finance has remained largely unexplored (Hillman, 2019).

The paper has important policy implications. It can inform policymakers, tax authorities, trade authorities, and other stakeholders that excise tax-collecting firms can use real activities to influence the level of tax collected and the regulation concerning such taxes. This has relevant social and environmental implications.

The remainder of the paper is organized as follows. Section 2 provides the literature review. The hypothesis development is in section 3. Section 4 provides the background on the SAFETEA-LU Act issuance. Section 5 describes the sample and the methodology. Section 6 includes the results of the main analysis and the robustness tests. Section 7 reports further investigations, while Section 8 concludes.

2. Literature review

A stream of research on tax-induced earnings management focused on scheduled changes in corporate income tax rates. Scholes et al. (1992) investigate "whether and how firms shifted income over time in response to a known schedule of declining tax rates" (Scholes et al., 1992, p. 2). The Authors find that firms defer sales and accelerate SG&A expenses before the

[33] See: https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

enactment of the 1986 Tax Reform Act (TRA) to minimize tax expenses. Similarly, Guenther (1994) and Lopez et al. (1998) find that firms decrease their accruals for the year prior to the 1986 TRA tax rate reduction. Firms with net operating losses deferred operating income and recognized more non-recurring losses to increase the tax refunds from net operating losses carrybacks before the TRA enactment (Maydew, 1997).

Gaertner et al. (2020) investigate the income tax rate reduction enacted by the Tax Cuts & Jobs Act in 2017. The authors find that firms accelerate defined benefit pension contributions to take advantage of tax deductions at a higher rate before the tax rate reduction in 2017. They also find that firms increasing pension contributions in 2017 reduced them in 2018 "consistently with intertemporal income shifting rather than a permanent change in pension funding strategy" (Gaertner et al., 2020, p. 1990).

Monem (2003) studies the introduction of the Australian Gold Tax, an industry-specific income tax rate outside the US. This paper finds that gold firms accelerated gold production and sales in the years leading up to the introduction of the tax to anticipate profits. Lin et al. (2012) examine foreign investment enterprises (FIEs) in China and find that they report higher discretionary current accruals before regional tax rate increases.

The abovementioned literature examines earnings management as a response to known schedules of corporate income tax rate reductions or increases (i.e., anticipated changes). Another stream of literature, based on the political cost hypothesis[34], examines earnings management in response to threats of windfall income taxes, potential income tax increases, or to avoid scrutiny on the income taxes paid (Baloria & Klassen, 2018; Han & Wang, 1998; Hsiao et al., 2016; Wong, 1988). Han and Wang (1998) find that US oil firms manage accruals downward to avoid windfall profit taxes during the 1990 Persian Gulf crisis. Similarly, Hsiao et al. (2016) find evidence of income-decreasing accrual earnings management by US oil firms during the Arab Spring. Wong (1988) investigates New Zealand firms and find that they select the method of accounting for export tax credits to avoid scrutiny of the corporate income tax rate. Baloria and Klassen (2018) find that firms use accounting discretion to manage tax expenses upward before the 2012 US elections in an attempt to avoid increases in corporate income taxation and advocate future favorable tax legislation.

[34] Political costs are government-imposed transfers of wealth from the private sector (Watts & Zimmerman, 1978). Wealth transfer are from firms to governments or from firms to other firms or subjects (Watts & Zimmerman, 1978). "The political cost hypothesis predicts that firms will exploit discretion in accounting policies to orchestrate the appearance of lower profits in response to an increase in the threat of these political costs" (Boland & Godsell, 2020, p. 1). Changes in corporate tax rates can be seen as a political cost (Jacob et al., 2021; Mills et al., 2013; Zimmerman, 1983).

While not directly related to excise taxation, the abovementioned literature suggests that scheduled increases or threats of increases in the excise tax motivate earnings management by excise tax collectors. Indeed, increases in excise tax lower the excise tax collector's profit and value, transferring wealth from the collector to the government or to other firms, i.e., those selling substitute products. Prior economic literature suggests that increases in excise taxes affect the firm's quantities sold through the price elasticity of demand and the gross margin, through the tax pass-through rate (Acemoglu et al., 2017; Ulbrich, 2013). In the next section, based on these two economic mechanisms, we develop our hypotheses on the use of earnings management by US oil firms in response to the threat of fuel excise tax increase.

3. Hypothesis development

Excise taxes are selective taxes imposed on specific consumption or behavior, used for multiple purposes such as generating government revenues, discouraging consumption, and correcting negative externalities (Cnossen, 2005; McCarten & Stotsky, 1995; Ulbrich, 2013). Economic theory unambiguously predicts the outcome of an excise tax: it decreases the product demand, and increases the product market price (Acemoglu et al., 2017). There are two economic mechanisms to be considered: the tax pass-through rate and the price elasticity of demand (Acemoglu et al., 2017).

An increase in the excise tax increases the consumer price and may erode the producers' profitability. Tax pass-through studies provide evidence that increases in consumption taxes, like the VAT and the excise tax, are not always entirely paid by the consumers but, in several cases, are partially absorbed by the excise tax collector. This happens because an increase in the tax cannot always be fully passed to the selling price to avoid falls in demand (Ardalan & Kessing, 2021; Bonnet & Réquillart, 2013; Carbonnier, 2013).

The consumer final price paid by consumers can be expressed by the following equation:

$$P = (q(t, \tau)+t)(1+\tau),$$

Where *t* is the excise tax, τ indicates the value-added tax rate (usually 0 in the case of fuels), and q(t, τ) is the producer price, which itself is a function of both tax rates. If the tax pass-through rate is less than one, then the producer bears part of the excise tax burden, sacrificing margins to uphold the demand. If it is higher than one, it could increase the risk of long-term falling demand for the producer, as firms attempt to keep margins sacrificing the demand (Johansson & Schipper, 1997; Ulbrich, 2013; Xu et al., 2014).

The tax pass-through rate depends on the product and the market. For example, Shrestha and Markowitz (2016) find that a 10-cent increase in state beer taxes in the U.S. raises retail prices by about 17 cents, which means there is an over-shifting of excise tax to consumers. By contrast, the excise tax on cigarettes is not fully passed to smokers, and there are different tax pass-through rates across brands (Lillard & Sfekas, 2013; Xu et al., 2014). Chouinard and Perloff (2004) investigate the gasoline state tax changes between 1989 and 1997 and the 1993 increase in the federal gasoline tax. The authors find that "an increase in the federal tax by 1¢ raises the retail price by 0.47¢ and decreases the wholesale price by 0.56¢. Thus, consumers and wholesalers each pay roughly half of the federal specific tax." Using these data, we can estimate that US oil companies lost a gross margin of about 2,291 million $ following the 1993 fuel excise tax increase, with the tax rising from 14.1 to 18.4 cents per gallon and an annual consumption of about 2,728 billion barrels in 1993. The burden of state excise tax primarily falls on consumers with differences between larger and smaller states (e.g., a 1¢ increase in a state tax raises the retail price by 0.97¢ in Vermont but by only 0.75¢ in California). Doyle and Samphantharak (2008) find that the reinstatement of a state gasoline tax after a suspension led to a 0.5% decrease in wholesale prices in Indiana and a 1.4% in Illinois, as producers could not shift the reinstatement to consumers fully.

In addition to the pass-through rates (and even if the tax is fully passed or over-shifted), the price elasticity of demand needs consideration. In the case of fuel, several studies have found that the demand in the short run is price inelastic, but it becomes price elastic in the long run (Goodwin, 1992; Hughes et al., 2008; Johansson & Schipper, 1997; Ulbrich, 2013). Johansson and Schipper (1997) find that the long-run demand of cars has a negative association with the fuel price (after controlling for car ownership taxes). Recent research revisited past data and find evidence that gasoline demand has been more price elastic than previously believed, even in the short term (Coglianese et al., 2017; Levin et al., 2017). The higher the price elasticity of demand, the higher will be the reduction of demand following a consumer price increase caused by the excise tax (or by consumption taxes in general).

The above arguments suggest that any excise tax increases potentially result in losses for excise tax collector firms. To mitigate the threat of fuel excise tax increases, fuel excise tax collector firms may engage in real activities management. They may boost production and sales to increase the excise tax gathered and transferred to the government. Given the role of fuels in the economy, the government's primary objective is collecting revenues, rather than

discouraging consumption (Ulbrich, 2013)[35]. Therefore, boosting excise tax collection can ease the government's pressure for funds. We formulate the following hypothesis.

HP: Oil firms use real activities management to mitigate the threat of fuel excise tax increases.

4. The Highway Trust Fund and the fuel excise tax empirical setting

The U.S. fuel excise tax has two components: the federal excise tax and the state excise tax. The federal fuel excise tax, first introduced in 1932, saw several increases until it was set at the current rate of 18.4 cents per gallon for gasoline (24.4 cents per gallon for diesel) in 1993, remaining unchanged since. Over the period from 1993 to 2019, 42 states and the District of Columbia (D.C.) have increased their per gallon tax rate. Notably, several states raised rates of less than 10 cents per gallon in more than thirty years (Auxier, 2014). During the same period, the gasoline price grew from 1.065 dollars per gallon at the beginning of 1993 to 2.488 dollars per gallon in December 2019 (Energy Information Administration, 2023). The United States maintains one of the lowest fuel excise tax levels globally (U.S. Department of Energy, 2023).

The fuel federal excise tax revenues are entirely allocated to finance the Highway Trust Fund, which provides funding for highways and mass transit. This fund has a history of high spending, caused by factors like aging infrastructures, management issues, political state, and local lobbying for increased spending and job creation (Congressional Budget Office, 2015; Davis, 2018).

In January 2005, the Highway Trust Fund was at risk of insolvency. It closed the 2004 accounts with an unbalance and was projected to default within a few years (Congressional Budget Office, 2015; Davis, 2018). On February 9, 2005, the H.R.3 SAFETEA-LU was introduced in the House. The draft law included several provisions related to safe and efficient transportation (investments in roads, airports, highways, bridges, and others), and a proposal to increase the federal fuel excise tax to address the Highway Trust Fund's financial needs[36].

After a heated political debate in the House and in the Senate, the SAFETEA-LU Act (Safe, Accountable, Flexible, Efficient Transportation Equity Act) was approved and signed by President Bush in July 2005[37], without any increase in the federal fuel excise tax.

[35] Indeed, the excise tax is suspended in periods of extraordinarily high fuel prices. E.g., some US states suspended the state excise on fuels in early 2022. See e.g. https://www.cbsnews.com/news/connecticut-georgia-maryland-gas-tax-holiday/

[36] Available at: https://www.congress.gov/bill/109th-congress/house-bill/3

[37] Available at: https://www.govinfo.gov/content/pkg/PLAW-109publ59/pdf/PLAW-109publ59.pdfs

The Act allocated 375 billion $ for safe and efficient transportation, including additional resources for the Highway Trust Fund. It also authorized transferring funds from the General Fund to the Highway Trust Fund. In the following years, several administrations relied on the General Fund resources to address the Highway Trust Fund recurring financial needs, avoiding insolvency, despite an ongoing debate on the excessively low fuel excise tax in the U.S., which is going on even in recent years (Congressional Budget Office, 2015)[38].

The Highway Trust Fund and the fuel excise tax empirical is a suitable setting for a study on earnings management motivated by the threat of excise tax increase. The Highway Trust Fund is a source of the variation in the threat, including random factors related to (among others): the negotiations on investment projects and maintenance priorities among the Trust, the state and local authorities; the consumption of roads; the obsolescence of mass transit infrastructures; the federal government investments and funding decisions; the pressure from labor unions. Multiple subjects - including state and local authorities, the construction industry, labor unions, the US Chamber of Commerce, and the members of the Congress listening to the above businesses (either Republican or Democratic) – have had involvement with the Highway Trust Fund over the years (Davis, 2018). Due to its complexity and the number of subjects involved, oil firms can hardly influence the Highway Trust Fund management and investments' decisions, along with its financial needs.

The political process around the Trust has not been initiated by oil firms, and its outcome can hardly be anticipated. Also, the political process around the Highway Trust Fund does not affect the oil price and does not contemporaneously affect the oil firms' performance. The oil firms lobbied the Congress to avoid the fuel excise tax increase. Indeed, oil & gas industry expenses on lobbying activities surged in 2005, after a slight constant decrease in the period 2002-2004, with expenditure rising by 28.5%[39]. Lobbying is a routinely made activity, dealing with several issues, but does not affect the source of the variation in the threat of fuel excise tax increase provided by the Highway Trust Fund. In other words, lobbying can influence the

[38] Available at: https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50297-transportationtestimony-senate.pdf

[39] Data are available at https://www.opensecrets.org. At the same time, the American Petroleum Institute representing the US oil firms and the local fuel dealers also lobbied against fuel excise tax increases, which some states were discussing in the period. See e.g.: July 5, 2005, Taxes on the Rise in Connecticut, *Virginia. Convenience Store News*, available at: https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:4GJM-BM80-01V4-X4CJ-00000-00&context=1516831; or *Dave Anderton Deseret Morning News*. (May 18, 2005 Wednesday). Gasoline prices in Utah near record. Deseret Morning News (Salt Lake City), available at: https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:4G6C-K720-TWHW-6298-00000-00&context=1516831.

outcome of the treatment but not the probability of the treatment. Taken together, the abovementioned conditions provide a robust test for our hypotheses.

As abovementioned, the federal fuel excise tax rate was set in 1993 and has remained unchanged. The exogenous shock involves Q1, Q2, and Q3 2005. It is noteworthy the lack of relevant events affecting the fuel price and the consumer demand not only in 2005 but also for at least a couple of years before and after 2005. Indeed, the period 2002-2007 featured stable growth in the US GDP, increasing in each quarter with an annual mean of +2.77% (See Figure 1)[40]. The WTI oil price averaged 48.9 $ per barrel with steady growth without shocks (Energy Information Administration, 2023)[41]. Figure 2 shows that the gasoline price averaged 2.032 $ per gallon, steadily growing without shocks (Energy Information Administration, 2023)[42].

The period is suitable for an increase in the fuel excise tax from the government's perspective. Indeed, the government is more likely to consider increasing the excise tax in periods of stable growth rather than in periods of recession or high fuel prices related to external shocks, like wars or the COVID crisis. Figure 3 displays the gasoline excise tax collected in the US from 2000 to 2007 (Internal Revenue Service, 2021)[43]. After years of collection worth an average of 20 billion $ per year, the excise tax collected surged by almost 30% in 2005 and averaged 25 billion $ from 2006 to 2019. Similarly, the diesel excise tax collected averaged 8.3 billion $ between 2000 and 2004, increasing to 9.3 billion $ in 2005 and averaging 9.3 billion $ between 2006 and 2019.

5. Methodology

5.1 Sample selection

This research uses quarterly data from the Compustat North America database. For our main analysis, we use the quarterly data of US companies included in the SIC (Standard Industrial Classification) Code 13 (Oil & Gas Extraction) and the SIC Code 29 (Petroleum Refining). These industries represent the fuel production chain and are likely to be affected by increases in the fuel excise tax[44]. The main analysis uses the period spanning from Q1 1993 to Q4 2019. The final sample is composed of 22,309 firm-year observations from 737 individual firms. 19,654 firm-quarter observations are in the SIC Code 13, with 647 unique firms. 2,655 firm-quarter observations are included in the SIC Code 29 from 90 unique firms.

[40] See also: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2008&locations=US&start=2002
[41] The WTI oil time series available at: http://www.eia.gov/dnav/pet/pet_pri_spt_s1_m.htm.
[42] US fuel price time series available at: https://www.eia.gov/petroleum/gasdiesel/
[43] See: https://www.irs.gov/statistics/soi-tax-stats-excise-tax-statistics
[44] Some SIC 29 firms engaged in oil & gas extraction through subsidiaries and SIC 13 firms manufacturing oil related products.

5.2 Research design

The paper uses a multiple periods difference-in-the-differences (DID) research design to test the hypotheses. It considers the sample of US oil firms as the treated group. As non-treated group, it alternatively uses a) all the other US firms in Compustat North America, with entropy balancing correction (Hainmueller, 2012); b) other excise tax firms (alcohol and tobacco); c) the non-US oil firms in the Compustat Global database. Following prior economic research (Barrage et al., 2020), the DID model includes interactions between the treatment and two periods: the period during the political process leading to the issuance of the SAFETEA-LU Act (Q1, Q2, and Q3 2005) and the period after the issuance from Q4 2005 on. In this way, the paper can ascertain whether the firm's reaction to the threat of fuel excise tax increases is temporary or if it represents a permanent strategy.

The research design uses a single equation approach, following the recommendations by Chen et al. (2018) to use single equation earnings management models and avoid using residuals (i.e., discretionary/abnormal accruals/real) as dependent variables[45]. It uses the real earnings management models from Roychowdhury (2006), related to cash flows from operations, production costs, and discretionary expenses. To further analyze the production activity, it decomposes the production costs into cost of goods sold and inventory changes. This allows an understanding of whether the increased production is related to sales or to increasing the inventory (or both).

This research uses the following models:

$$\frac{TACC_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{\Delta Revenue_{it}}{ASSETS_{it-1}} + \beta_3\frac{PPE_{it}}{ASSETS_{it-1}}$$
$$+ \ +\beta_4 TREATMENT + \beta_5 Q2005 + \beta_6 AFTER2005 + \beta_7 SAFETEALU05$$
$$+ \beta_8 POSTSAFETEALU \ + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

1) Cash flow model

[45] As noted by Chen et al. (2018), two step procedures using residuals as dependent variable may result in a misspecification in the first step equation, since the explanatory variable usually affects the regressors of the first regression. For example, estimating discretionary accruals and then regressing them on the auditor tenure would neglect the fact that the tenure already affects the total accruals in the first regression, as well as other regressors. Hence, the best and most simple solution is to use single equations to study earnings management (Chen et al., 2018, p. 34).

$$\frac{CFO_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{SALES_{it}}{ASSETS_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{ASSETS_{it-1}} + \beta_4 TREATMENT + \beta_5 Q2005 + \beta_6 POST2005 + \beta_7 SAFETEALU05 + \beta_8 POSTSAFETEALU + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

2) Production costs model

$$\frac{PROD_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{SALES_{it}}{ASSETS_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{ASSETS_{it-1}} + \beta_4\frac{(\Delta SALES_{it-1})}{ASSETS_{it-1}} + \beta_5 TREATMENT + \beta_6 Q2005 + \beta_7 POST2005 + \beta_8 SAFETEALU05 + \beta_9 POSTSAFETEALU + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

3) Cost of goods sold model:

$$\frac{COGS_{it}}{AST_{it-1}} = \beta_0 + \beta_1\frac{1}{ASSETS_{it-1}} + \beta_2\frac{SALES_t}{ASSEST_{it-1}} + \beta_4 TREATMENT + \beta_5 Q2005 + \beta_6 POST2005 + \beta_7 SAFETEALU05 + \beta_8 POSTSAFETEALU + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

4) Discretionary expenses model

$$\frac{DISEXP_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{SALES_{it}}{ASSETS_{it-1}} + \beta_3 TREATMENT + \beta_4 Q2005 + \beta_5 POST2005 + \beta_6 SAFETEALU05 + \beta_7 POSTSAFETEALU + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

5) Change in inventory model:

$$\frac{\Delta INV_{it}}{AST_{it-1}} = \beta_0 + \beta_1\frac{\Delta SALES_{it}}{ASSETS_{it-1}} + \beta_2\frac{\Delta SALES_{it-1}}{ASSETS_{it-1}} + \beta_3 TREATMENT + \beta_4 Q2005 + \beta_5 POST2005 + \beta_6 SAFETEALU05 + \beta_7 POSTSAFETEALU + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

Where: *Treatment* is a dummy for being a US oil firm, as defined above; *Q2005* is a dummy for the Q1, Q2, and Q3 2005; *POST2005* is a dummy for the quarters from Q4 2005 to Q4 2019; *SAFETEALU05* is the interaction between the treatment and *Q2005*; *POSTSAFETEALU* is the interaction between the treatment and *POST2005*. The controls added are the quarterly US GDP per capita (available on the FRED database); the average quarterly gasoline gallon price, adjusted for inflation (Energy Information Administration, 2023); the average gasoline consumption in thousands of barrels per day (Energy Information Administration, 2023b). Table 1 summarizes the variables definition and sources. There are also fixed effect per year and per quarter (the latter account for further time fixed effect related to e.g., seasonality).

In further investigations on accrual earnings management, we use the modified Jones model (Dechow et al., 1995).

6) Total accrual model

$$\frac{TACC_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{\Delta Revenue_{it}}{ASSETS_{it-1}} + \beta_3\frac{PPE_{it}}{ASSETS_{it-1}}$$
$$+ \ +\beta_4 TREATMENT + \beta_5 Q2005 + \beta_6 AFTER2005 + \beta_7 SAFETEALU05$$
$$+ \beta_8 POSTSAFETEALU \ + \gamma_1 Controls_t + \gamma_2 Year_t + \gamma_3 Quarters_n + \varepsilon_{it}$$

In the main analyses, the paper estimates the models with an OLS. It replicates the analysis also using the generalized method of moments (GMM) to reduce potential endogeneity issues with unobservable heterogeneity across firms (Bartov et al., 2000; McNichols, 2002). It implements a firm fixed effects specification (Cascino, 2017; Eugster, 2020; Hann et al., 2020) which ameliorates unobservable heterogeneity by including firm fixed effects.

When using as non-treated firms all the other non-US firms, it uses entropy balancing (Gallemore, 2022; Hainmueller, 2012). Entropy balancing weights each observation such that the weighted means of each control variable are similar between treated and control group. To equalize treatment and control distribution moments, entropy balancing identifies continuous weights for all covariates while maintaining the closest weights to equal. Entropy balance needs the researcher to set only the tolerance level and reduce the discretion that exists in the propensity score matching (McMullin & Schonberger, 2020). We prefer such method because "seemingly innocuous design choices greatly influence sample composition and estimates" (Shipman et al., 2017). We winsorize all the variables at 1%.

6 Empirical analysis

6.1 Main findings

Table 3 reports the results of the main empirical analysis using the US oil firms are treated and all the US non-oil firms as control group. The variables of interest are SAFETEALU05 and POSTSAFETEALU measuring the fuel excise tax collectors' reaction during the Congressional debate on the fuel excise tax increase and after the issuance of the SAFETEA-LU Act.

Table 3, column 1, displays the results obtained using cash flow from operations (CFO) on total assets as dependent variable. Oil companies have a cash flow from operations on average greater than about 8.3% compared to control group (see the coefficient of the Treatment significant at the 1%). SAFETEALU05 has a non-significant coefficient, while POSTSAFETEALU has a negative and significant coefficient (p-value<0.01). The results show that, after 2005, oil firms display cash flows from operations about 7% higher compared to control group. This suggests that companies boosted sales through discounts, channel stuffing or favorable payment conditions to increase the total sales. The adjustment to sales policy appears to be permanent after the issuance of the SAFETEALU Act. A 1% adjustment is economically significant. Given the size of these companies, a 1% decrease is worth on average hundreds of millions $ per quarter for the oil industry. The control variables are all significant (p-value<0.01) and show significant coefficients in the expected direction. Fuel consumption has a significant positive association with the cash flows, while the GDP per capita has a negative one (see Table 3, column 1).

Table 3, column 2, shows that there is no evidence of permanent changes in the oil firms' discretionary expenses. Table 3, columns 3, 4 and 5 analyzes the productions costs, the cost of goods sold and the change in inventory. In Table 3, column 3, the dummy POSTSAFETEAULU has a positive and statistically significant coefficients (p-value<0.01), while the dummy SAFETEALU05 has no statistical significance. The results show that oil companies have on average 0.68% higher production costs than other firms (see the coefficient of the Treatment). After the issuance of the SAFETEA-LU Act the difference is doubled and reaches about 1.86% (given by 0.68% plus 1.18%). To ascertain whether the higher production costs are related to goods sold or to an increase in the inventory, we separately analyze these two components. Table 3 column 4 and 5, show in either case a positive coefficient significant at the 1% for POSTSAFETEAULU, while SAFETEALU05 has no statistical significance. The average cost of goods sold in oil firms is 0.57% higher than the other firms (see the coefficient of Treatment in Table 4, column 4). The difference more than doubles to about 1.6% after the issuance of the SAFETEA-LU Act. Again, considering the size of these companies the increase is worth

hundreds of millions $ for the industry. The change in inventory is on average lower than non-treated firms (see the coefficient of Treatment in Table 4, column 5), reversing to higher after the issuance of the SAFETEA-LU Act, from about -0.1% to slightly positive. This finding suggests that the increase in production costs is mainly related to the cost of goods sold and to a lesser extent to the change in inventory. Switching inventory policy is in any case useful in the event of a sudden increase in the excise tax, as such tax is levied on production.

After controlling for the fuel consumption, the GDP per capita and the fuel price, this analysis provides evidence that oil firms permanently adjust sales and production operations to support consumption with higher cost of goods sold (matched with increased sales) and a higher inventory turnover. These findings align with the structural increase in the excise tax collected reported by the Internal Revenue Service (IRS) after the 2005 (see above section 4). Overall, the findings provide support for HP1 with evidence of the use of real earnings management to mitigate the threat of an excise tax increase.

The adjustments to operations appear to be aimed at the excise tax collection and not at influencing the net income. Indeed, we can see that production costs increase after the issuance of the SAFETEA-LU Act, primarily due to the rise in the cost of goods sold. This indicates that the increased production is not an overproduction strategy to allocate a higher portion of indirect costs to inventory (with the goal of increasing reported earnings), but rather an increase in goods sold.

To ensure that the analysis is not driven by the control group selection, we use two alternative control groups. First, we use Compustat Global to select oil companies from the rest of the world. Since the issuance of new regulation occurs in the US, we expect that non-US oil companies are not influenced. Table 4 displays the results of the analysis, including country and year-fixed effects. The dummy variable Treatment does not show statistically significant coefficients apart from the production costs (which are, on average 2.27% higher in US oil firms than in the rest of the world). This finding is interesting, because the control and treated groups includes companies from the same industry that share the same business model and operates similarly, implying minimal ex ante differences. Hence, if the SAFETEA-LU Act had no impact on US oil firms, we should not find any difference after this regulation's issuance.

The multiple period diff-in-diff analysis provides evidence of differential behavior between treated and non-treated during Q1, Q2, and Q3 2005 (Congressional debate on the SAFETEA-LU Act) and after the issuance of the SAFETEA-LU Act. Table 4, column 1, shows that US oil firms quarterly cash flow from operations is on average about 3.8% lower than non-US oil firms during Q1, Q2, and Q3 2005 (Congressional debate on the SAFETEA-LU Act) and about 5.2%

lower after the issuance of the SAFETEA-LU Act. Both SAFETEALU05 and POSTSAFETEALU are significant at the 1% level. The results provide evidence that, compared to non-US oil firms, US oil firms inflated sales because of the issuance of the SAFETEA-LU Act.

Table 4, column 2, shows that discretionary expenses are about 2.5% higher during Q1, Q2, and Q3 2005 and 2% higher after the issuance of the SAFETEA-LU Act (coefficient of SAFETEALU05 and POSTSAFETEAULU significant at the 1% level). This result is likely driven by selling, general & administrative expenses, which are influenced by inflated sales.

Production costs are 2.27% higher for US oil firms (see the coefficient of Treatment in Table 4, column 3). The difference with the non-US oil firms increases to about 3.8% during Q1, Q2, and Q3 2005 and to about 4% after the issuance of the SAFETEA-LU Act.

In this analysis, we control for country and year fixed effects. The average growth of the GDP per capita in the US has been 1.6% between 1993 and 2019, while the world average has been 1.8% in the same period. Hence, it is unlikely that production costs grew because the US economy outperformed the rest of the world (WorldBank, 2023).

Table 4, columns 4 and 5, decompose productions costs into cost of goods sold and change in inventory. The results show that the increase in production costs is related to the cost of goods sold and unrelated to the increase in the inventory. The cost of goods sold is 1.15% higher for US oil firms during Q1, Q2, and Q3 2005 (see the coefficient of SAFETEALU05 in table 4, column 4) and about 2.1% after the issuance of the SAFETEA-LU Act (see the coefficient of POSTSAFETEALU in table 4, column 4). The change in inventory does not display significant coefficients. The findings provide evidence of boosted production aimed at sales rather than overproduction, increasing the inventory.

Table 5 uses other US excise collector as non-treated control group. We use tobacco firms belonging to the SIC codes 2100–2199 and alcoholic beverages firms corresponding to the SIC codes 2080–2085 (Wang et al., 2022), over the period 1993-2019, for a total 1,601 firm-quarter observations. The analysis confirms evidence of sales and production operations adjustments after the issuance of the SAFETEA-LU Act. Cash flow from operations of US oil firms is 3.41% higher than that of other excise tax collectors (table 5, column 1). The difference becomes -0.64% after the issuance of the SAFETEA-LU Act, signaling a change in the US oil firms' behavior. Both the production costs and the costs of goods sold are higher in US oil firms than in other excise tax collectors, with the difference roughly doubling after the enactment of the new regulation (table 5, columns 3 and 4). Interestingly, US oil firms average change in inventory is slightly lower than that of alcohol and tobacco firms (two consumer products),

about -0.3% (table 5, column 5). After issuance of the SAFETEA-LU Act the difference reduces to -0.08%. This signals a shift in production policies compared to other excise tax collectors.

6.2 Placebo tests

Our first placebo is an alternative treatment test. The aviation passenger excise tax is due as a percentage of the fare plus a fixed rate and is dedicated to fund the Airport & Airway Trust Fund. It is the most financially relevant among the several aviation-related excise, like the cargo waybill and the aviation fuel excise (Congressional Research Service, 2017). The aviation-related excise taxes are allocated to maintenance and development of airports and airways, and to fund the Federal Aviation Administration (whose purposes are similar to those of the Highway Trust Fund). In 1997, the Tax Relief Act set a schedule of increases to be enacted between the 1998 and the 2002 aimed at "providing a more stable source of revenue for the Airport and Airway Trust Fund" (Henry, 2003, p. 44). We test whether US oil firms engage in real earnings management after the approval of the 1997 Tax Relief Act. There could be two reasons motivating firms to react: a) it is an increase made to meet the financial needs of a dedicated Trust Fund; b) it could drag along increases in aviation fuel excise tax and potentially on the fuel excise tax.

The analysis re-run equation 1-5 on the period 1993-2004, using the period from Q3 1997 to Q4 2004 for the diff-in-diff analysis. In this way, we capture the effect of the approval of the TRA97 in Q2 1997 and we exclude the effect of the 2005 SAFETEA-LU Act. Oil companies represent the treated group and US excise tax collector the control group. The analysis uses entropy balancing.

Table 6 display the results of the analysis. The *Treatment* variable is significant and has coefficient with signs similar to those of Table 3, which uses the same control group. The variable of interest *Treatment*TRA97* does not provide evidence of sales manipulation (Table 6, column 1, coefficient insignificant). The coefficient for production costs is not significant (Table 6, column 3). The difference in the cost of goods sold reduces (from 0.9% to 0.3%), indicating no inflated sales. Thus, There is no evidence of real earnings management, aimed at supporting consumption and increasing the excise tax collected.

The second test is a placebo population test on whether the issuance of the SAFETEA-LU Act impacts the behavior of alcohol and tobacco producers. On one hand, an increase in the most significant excise tax might set a precedent for increases in other excise taxes. Thus, the threat of a fuel excise tax increase could potentially spill over into other excise taxes. On the other hand, unlike the fuel tax, excise taxes on alcohol and tobacco were not earmarked for specific federal programs as of 2005 (CSR Report, 2021). Hence, we expect that alcohol and

tobacco producers remain unaffected by the political process around the issuance of the SAFETEA-LU Act. This could provide some counterfactual evidence on how excise tax firms behave absent the threat of excise tax increases in the period. We run the regression of Equation (1) to (6) using as treated firms a sample of firms including alcoholic beverages firms belonging to the SIC codes 2100–2199 and tobacco firms corresponding to the SIC codes 2080–2085 (Wang et al., 2022) in the period 1993-2019. We obtain a total population of 1,478 firm-observations from 64 unique firms which is the treated group in the analysis. All US non-excise tax collector US firms give the control group. The analysis uses entropy balancing (Gallemore, 2022; Hainmueller, 2012).

Table 7 reports the results of the placebo population test. Table 7, columns 1 to 6, show that the interaction terms for SAFETEALU05 have no significant association with all the dependent variables. There is thus no earnings management in the quarters in which the SAFETEA-LU Act was discussed in the Congress. Table 8, columns 1 to 6 show the interactions for POSTSAFETEALU. Cash flow from operations and change in inventory do not show significant coefficients (columns 1 and 6). POSTSAFETEALU has significant negative associations with the production costs and the cost of goods sold (p-value < 0.01). The results do not suggest additional production aimed at supporting consumption and increasing the excise tax collected. Rather, the signs are consistent with a decline in the consumption of unhealthy products, which started in mid 2000s (DeCicca et al., 2013). The findings suggest that the threat of increase in the fuel excise tax did not trigger sales manipulation or overproduction in the tobacco and alcohol industry.

6.3 Excise tax and real earnings management after the enactment of the SAFETEA-LU Act in 2005

In this section, we analyze whether, after the issuance of the 2005 act, oil firms run their operations considering the excise tax levels collected. To perform the investigation, we augment the real earnings management models with the amount of excise tax collected in the quarters t-1 and t-2 ($Excise_{t-1}$and $Excise_{t-2}$). The Compustat North America database reports the quarterly excise tax data for some oil firms (the item is *txwq* from the footnotes). Data for this item starts from 2005 and are available for 2,459 firm-quarter observations in Compustat for 201 unique firms. We add year and quarter fixed effects to control the level of demand and for the seasonality.

Results are tabulated in Table 8. The results provide evidence of a negative association between the production costs (column 1) and the amount of excise tax collected in the previous quarter t-1, while there is no association with the excise tax collected at t-2. The coefficient is

statistically significant with p-value<0.05. Table 8, column 2, show that there is also a significant negative association (p-value < 0.05) between the cost of goods sold and the excise tax collected in the previous quarter ($Excise_{t-1}$), while there is no association with the excise tax collected at t-2. The results concerning the change in inventory do not yield significant results (Table 8, column 3). Taken together, the findings suggest that oil firms tend to increase production and sales following quarters with low excise tax collection, and vice versa. This may indicate a "smoothing" of production levels and could help explain the consistent level of quarterly excise tax collection, despite the seasonal fluctuations in consumption (Internal Revenue Service, 2021).

7 Further investigations

7.1 Accrual earnings management

In further investigations, we also explore whether oil firms engage in accrual earnings management. Prior studies suggest that oil firms use income-decreasing accrual earnings management to mitigate the threat of windfall profit tax in politically sensitive quarters (Han & Wang, 1998). In our case, oil firms might employ income-decreasing accrual earnings management, particularly during Q1, Q2 and Q3 2005, to orchestrate the appearance of low earnings and lobby against the potential fuel excise tax increase. Furthermore, prior literature suggests that managers trade-off real activities management and accrual earnings management, assessing their costs and benefits, and use them as substitutes (Zang, 2012). It is interesting to see if this finding extends to our specific setting.

Table 9 display the results of the diff-in-diff analysis, using alternatives control groups. The results do not provide convincing evidence of accrual earnings management. The coefficient of SAFETEALU is poorly significant (p<0.10) in column 1 and not significant in columns 2 and 3 of Table 9. The coefficient POSTSAFETEALU has different signs in columns 1 and 2 and is not significant in column 3 of Table 9. The findings suggest that the focus of oil firms is on supporting consumption and gathering excise tax. The government's decision to increase the excise tax is based on long term public budget projections and other political aims (e.g., discouraging consumption), rather than on current economic conditions (Ulbrich, 2013). Hence, accrual earnings management in sensitive quarters may be poorly useful, whilst long-term real activities management become more relevant. This evidence supports the idea that prior findings about accruals earnings management in response to income taxes threat do not extend to the excise tax setting. It is also consistent with prior literature suggesting that managers trade-

off real activities management and accrual earnings management, assessing their costs and benefits, and use them as substitutes (Zang, 2012).

7.2 Quarterly effective tax rates

This section explores quarterly income effective tax rates (ETR) during the Congressional debate on the issuance of the SAFETEA-LU Act and after its issuance. Quarterly effective tax rates are quarterly estimates of the annual (i.e., year-to-date) effective tax rate (Baloria & Klassen, 2018). Given the degree of discretion, quarterly effective tax rates are also used for earnings management purposes (Baloria & Klassen, 2018; Comprix et al., 2012; Cook et al., 2008).

We implement a multiple period dif-in-dif analysis, considering Q1, Q2 and Q3 2005 (Congressional debate on the SAFETEA-LU Act) and the period from Q4 2005 on. The control sample is given by all the other US firms. The analysis uses as dependent variables: a) GAAP ETR, calculated as income tax expense (*txt*) on pre-tax accounting income (*pi*); b) Hanlon's (2005) GAAP ETR, calculated as total income tax expense on total pre-tax income less minority interest; c) GAAP ETR volatility, calculated as the standard deviation of GAAP from quarter t to t-3; d) Hanlon's (2005) GAAP ETR volatility calculated as the standard deviation of Hanlon's (2005) GAAP ETR from quarter t to t-3. The control variables are selected from prior literature on the determinants of ETR: size, leverage, ROA, growth opportunities, income smoothness (Edwards et al., 2016; Hanlon & Heitzman, 2010; Wang et al., 2022).

Table 10 reports the results of the analysis. Table 10, column 1 and 2, shows that US oil firms have on average lower GAAP ETR than other US firms. The interaction with SAFETEALU05 is positive and significant with a p-value <0.01 for both GAAP ETR and Hanlon's (2005) GAAP ETR. The results show that oil firms display ETR higher than other US firms in Q1, Q2 and Q3 2005. Table 10, column 1, provides evidence that oil firms switched from a negative to a positive difference with other US firms (+2.52%). The interaction with POSTSAFETEALU is positive and significant, with p-value <0.01 for both GAAP ETR and Hanlon's (2005) GAAP ETR. After the issuance of the SAFETEA-LU Act, the difference between oil firms and other firms is reduced. Table 10, column 1, show that oil firms switch from about -4.8% prior to the Act to about +0.07% after the Act (given by -4.78%+4,85). Similarly, the difference changes from about -5% to about -2.9% with Hanlon's (2005) GAAP (Table 10, column 2).

The analysis provides evidence of increase in the tax burden for oil firms during and after the issuance of the SAFETEA-LU Act, in comparison to other non-oil US firms. This would be consistent with prior studies suggesting that real activities management increases the tax burden for firms, as sales manipulation or overproduction increase the taxable income (Zang, 2012).

However, the noticeable spike (+2,52%) in GAAP ETR during Q1, Q2 and Q3 2005 might suggest a discretional use of quarterly ETR to convey the message of a heavily taxed industry during the Congressional debate (Baloria & Klassen, 2018).

Table 10, columns 3 and 4, display the regressions of GAAP ETR volatility and Hanlon's (2005) GAAP ETR volatility. The results provide evidence of a change in GAAP ETR volatility during and after the issuance of the SAFETEA-LU Act. Table 10, column 3, shows that the oil firms ETR volatility is about 3% higher than in other firms, the difference becomes -1.39% during the issuance of the SAFETEA-LU Act and -2.87% after it. Table 10, column 4 display similar results, also in terms of magnitude. These findings overall indicate a decrease in accounting discretion applied to quarterly GAAP ETR estimates.

7.3 External validity test using excise tax on alcoholic beverages

To ensure that our findings are not related only to the fuel excise tax setting, we analyze the excise tax on alcoholic beverages[46]. After increasing the excise tax on cigarettes in 2009, the US Congress discussed in 2013 the possible increase in the beer excise tax from 18$ per *barrel* to 16$ per *gallon*, a considerable increase for the most consumed alcoholic beverage. The tax was projected to increase government revenues by 64 billion $ between the 2014-2023 but was not approved (US Congressional Budget Office, 2013).

Using a diff-in-diff approach, we analyze whether alcoholic beverage producers engage in real activities management after the 2013 as a response to the threat of increase in the excise tax. We consider the period 2010-2017, from the end of the great recession to the TCJA Act, which introduced a discount of 2 $ in the excise rate for the first 6 million barrels produced reversing the Obama era policies and easing the pressure on producers (U.S. Alcohol and Tobacco Tax and Trade Bureau, 2023). The treated sample is composed by alcoholic beverages firms corresponding to the SIC codes 2080–2085, while the control sample is given by other excise tax collector firms.

Table 11 displays the results of the analysis. Table 11, column 1, shows that alcoholic beverage firms engage in sales manipulation after the threat of increase in the excise tax. The coefficient *Alcohol*Budget2013* is significant at the 1% level and indicate that between the 2013 and 2017 the cash flow on assets is 8,4% lower than in the control firms. The result suggest that sales are inflated with discounts and channel stuffing to support consumption. Table 11, column 4, shows that the inventory policy significantly changes from -0.2% compared to the

[46] The excise tax on alcohol beverages (distilled spirits, wine, beer) is economically relevant averaging almost 10 billion $ a year in the 2010s (Internal Revenue Service, 2021).

control group to +1.1% (an increase of about 1.3%). We do not find evidence related to cost of goods sold and discretionary expenses. Overall, the findings suggest that the threat of increase in the excise tax push alcoholic beverages producers to support consumption, thereby increasing excise collection and preserving consumers' habits. Supporting consumption hedges against potential price increases, which affect consumer habits. Additionally, inflated inventory hedges against an impending increase in the excise tax, given that the beer excise tax is levied at the time of the production or import (U.S. Alcohol and Tobacco Tax and Trade Bureau, 2023).

8 Conclusions

Using a sample of US oil firms in the period 1993-2019, we investigated excise tax-induced earnings management. Using a multiple period difference-in-differences (DID) design, we provide compelling evidence that suggests US oil firms engaged in real activities management to support consumption and increase the excise tax collected, following the enactment of the SAFETEA-LU Act in 2005. Specifically, these firms adjusted their sales and production operations in anticipation of potential excise tax increases, and these adjustments became permanent, independent of broader economic trends or fluctuations in fuel prices. This strategy proved successful, as the fuel excise tax rate, set in 1993, remained unchanged as of 2019 (and also as of 2023). The findings are robust to placebo tests, using an alternative treatment and an alternative population. Further investigations provide evidence of production "smoothing" around the level of excise tax collected.

This paper contributes to the literature on tax-induced earnings management (Gaertner et al., 2020; Lin et al., 2012), with new evidence on excise taxes. It also contributes to the literature on the real effects of corporate taxation (Jacob, 2022). Finally, this research can expand the public finance literature with evidence of the unexplored role of tax collectors in public finance choices (Hillman, 2019).

This research can provide valuable insights for policymakers, tax authorities, trade regulators, and other stakeholders, highlighting the excise tax-collecting firms real activities aimed at influencing the amount of tax revenue generated and the associated regulatory frameworks. These insights hold relevance in the current context, given the ongoing discussions surrounding soaring energy prices due to factors like the pandemic and the Ukraine War[19]. Our findings also carry significant social and environmental implications worth consideration.

Declaration of interest

None.

Funding sources

This research did not receive any specific grant from funding agencies in public, commercial or not-for-profit sectors.

Data availability statement

The financial data that support the findings of this study are available from Wharton Research Data Services. Restrictions apply to the availability of the data, which were used under license for this study. Data can be downloaded at https://wrds-web.wharton.upenn.edu/wrds/index.cfm under the permission of the data provider.

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Table 1: Summary of the variables and their sources

Name	Label	Description	Source
Total Assets	$ASSETS_t$	The total assets reported in quarter t in firm i	Compustat
Sales	$SALES_t$	Sales in quarter t in firm i on total assets at quarter t-1	Compustat
Changes in Sales	$\Delta SALE_t$	Change in sales from quarter t to quarter t-1 in firm i, divided by total assets at quarter t-1	Compustat
Cost of goods sold	$COGS_t$	Cost of goods sold in quarter t in firm i, on total assets at quarter t-1	Compustat
Cash flow from operations	CFO_t	Cash flow from operations in quarter t in firm i on total assets at quarter t-1	
Production costs	$PROD_t$	Sum of the cost of goods sold and change in the inventory in quarter t in firm i, divided by total assets at quarter t-1	Compustat
Discretionary expenditure	$DISEXP_t$	Selling and general and administrative expenses in quarter t in firm i, divided by total assets at quarter t-1	Compustat
Change in inventory	ΔINV_t	Change in inventory from quarter t to quarter t-1 in firm i, divided by total assets at quarter t-1	Compustat
Total accruals	$TACC_t$	Change in non-cash current assets minus the change in current liabilities excluding the current portion of long-term debt, minus depreciation, and amortization from quarter t to quarter t-1, scaled by lagged total assets in quarter t-1 in firm i	Compustat
Property Plant and Equipment	PPE_t	Gross property, plant, and equipment in quarter t in firm i, divided by total assets at quarter t-1	Compustat

Changes in Sales Adjusted	ΔS_t-ΔR_t	Change in Sales adjusted for the change in account receivables from quarter t to quarter t-1 in firm i, divided by total assets at quarter t-1	Compustat
GDP per capita	GDP per capita	US gross domestic production per capita in real terms in quarter t	FRED
Fuel Consumption	Fuel Consumption	Average daily consumption of fuel in the US in quarter t in thousands barrel	EIA
Fuel price	Fuel price	Average fuel price per gallon in US cities, adjusted for inflation.	FRED

Table 2: Descriptive statistics

This table shows the descriptive statistics for the US oil firms sample. It shows the mean (Mean), the median (Median), skewness (Skewness), kurtosis (Kurtosis), standard deviation (SD) and the number of quarters available (N). The sample period ranges from Q1 1993 Q1 to Q4 2019.

	Mean	Median	Skewness	Kurtosis	SD	Nobs
Cash flow from operations	-0.007	0.044	-6.847	55.665	0.379	22,309
Production costs	0.112	0.038	3.264	15.962	0.182	22,309
Cost of Goods Sold	0.108	0.037	3.263	15.907	0.175	22,309
Discretionary expenses	0.073	0.013	7.164	63.185	0.318	22,309
Change in inventory	0.001	0.000	2.135	49.514	0.012	22,309
$Sales_t$	0.143	0.087	2.897	13.530	0.176	22,309
$\Delta Sales_t$	0.005	0.001	1.037	19.282	0.052	22,309
Total accruals	-0,063	-0.051	1.001	25.313	0.230	22,309
PPE	0.586	0.463	1.604	6.885	0.503	22,309
ΔS_t-ΔR_t	0.005	0.001	0.762	20.451	0.560	22,309
Fuel Price ($)	4.469	4.515	0.308	1.658	2.429	22,309
Fuel Consumption (th bar)	8,564	8,843	-0.705	2.181	695.88	22,309
GDP per capita ($)	48,159	49,886	-0.455	2.079	5,187.575	22,309

Table 3: Main analysis with US oil firms and all US non-oil firms

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models (columns 1 to 5). The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is discretionary expenses (DISEXP), in column 3 is production costs (PROD), in column 4 is cost of goods sold (COGS), and in column 5 is inventory level (INV). The variables of interest are SAFETEALU05 and POSTSAFETEALU05. Oil companies represents the treated group and all the other US firms available in Compustat as control group. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

VARIABLES	Column 1 Cash flow from operations	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Cost of Goods Sold	Column 5 Change in Inventory
Treatment	0.0835***	-0.0316**	0.0068***	0.0057***	-0.0010***
	(0.0026)	(0.0148)	(0.0010)	(0.0010)	(0.0002)
Q2005	0.0090**	-0.0212***	0.0073***	0.0060***	0.0016***
	(0.0042)	(0.0056)	(0.0017)	(0.0015)	(0.0003)
POST2005	0.0091**	-0.0225***	0.0045***	0.0079***	-0.0014***
	(0.0042)	(0.0056)	(0.0016)	(0.0015)	(0.0002)
SAFETEALU05	-0.0224	0.1358	0.0042	0.0002	0.0003
	(0.0163)	(0.0869)	(0.0070)	(0.0061)	(0.0007)
POSTSAFETEALU	-0.0132***	-0.0102	0.0118***	0.0104***	0.0008***
	(0.0035)	(0.0218)	(0.0014)	(0.0013)	(0.0002)
Fuel consumption$_t$	0.0001***	-0.0000	-0.0000**	-0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP per capita$_t$	-0.0000***	0.0000***	0.0000***	0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fuel Gallon Price$_t$	0.0016*	0.0001	-0.0021***	-0.0030***	0.0005***
	(0.0009)	(0.0012)	(0.0004)	(0.0003)	(0.0000)
1/Assets$_{t-1}$	-0.0749***	0.0760***	0.0045***	0.0040***	-0.0000
	(0.0012)	(0.0020)	(0.0003)	(0.0003)	(0.0000)
Sales$_t$	0.1714***		0.8047***	0.7782***	0.0072***
	(0.0053)		(0.0025)	(0.0025)	(0.0005)
ΔSales$_t$	-0.1701***		-0.1293***		
	(0.0197)		(0.0096)		
Sales$_{t-1}$		0.0140**			
		(0.0063)			
ΔSales$_{t-1}$			-0.0549***		-0.0058***
			(0.0089)		(0.0013)
Constant	-0.0420**	-0.0048	-0.0363***	-0.0248***	0.0024**
	(0.0212)	(0.0290)	(0.0071)	(0.0067)	(0.0012)
Observations	368,708	368,708	368,708	368,708	368,708
R-squared	0.4557	0.4238	0.7197	0.7271	0.0076
Year fixed effect	YES	YES	YES	YES	YES
Quarter fixed effect	YES	YES	YES	YES	YES

Table 4: Main analysis with US Oil and non-US global Oil firms

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models (columns 1 to 5). The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is discretionary expenses (DISEXP), in column 3 is production costs (PROD), in column 4 is cost of goods sold (COGS), and in column 5 is inventory level (INV). The variables of interest are SAFETEALU05 and POSTSAFETEALU05. Oil companies represents the treated group and non-US global oil companies the control group. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

VARIABLES	Column Cash flow from operations	Column 2 Discretionary expenses	Column 3 Productions costs	Column 4 Cost of goods Sold	Column 5 Change in Inventory
Treatment	0.0091	0.0021	0.0227***	0.0093	-0.0009
	(0.0157)	(0.0062)	(0.0082)	(0.0065)	(0.0020)
Q2005	0.0346	-0.0210*	0.0024	-0.0072	0.0009
	(0.0281)	(0.0111)	(0.0153)	(0.0121)	(0.0038)
POST2005	0.0466*	-0.0160	-0.0086	-0.0118	-0.0052
	(0.0258)	(0.0101)	(0.0141)	(0.0112)	(0.0035)
SAFETEALU05	-0.0382***	0.0248***	0.0152**	0.0115**	-0.0013
	(0.0122)	(0.0050)	(0.0065)	(0.0051)	(0.0016)
POSTSAFETEALU	-0.0518***	0.0198***	0.0172***	0.0207***	0.0009
	(0.0065)	(0.0027)	(0.0037)	(0.0027)	(0.0009)
$1/Assets_{t-1}$	-0.0792***	0.0259***	0.0041***	0.0040***	-0.0000
	(0.0004)	(0.0002)	(0.0002)	(0.0002)	(0.0000)
$Sales_t$	0.0999***		0.9082***	0.8603***	0.0105***
	(0.0053)		(0.0024)	(0.0021)	(0.0006)
$\Delta Sales_t$	-0.0405**		-0.1370***		
	(0.0168)		(0.0078)		
$Sales_{t-1}$		0.0728***			
		(0.0067)			
$\Delta Sales_{t-1}$			-0.0428***		-0.0035*
			(0.0077)		(0.0019)
Constant	0.0429**	0.0213***	-0.0573***	-0.0371***	-0.0001
	(0.0169)	(0.0067)	(0.0087)	(0.0070)	(0.0021)
Observations	65,009	65,009	65,009	65,009	65,009
R-squared	0.4955	0.4001	0.8399	0.8186	0.0169
Year fixed effect	YES	YES	YES	YES	YES
Quarter fixed effect	YES	YES	YES	YES	YES
Country fixed effect	YES	YES	YES	YES	YES

Table 5: Main analysis US Oil firms and US other excise collectors

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models (columns 1 to 5). The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is discretionary expenses (DISEXP), in column 3 is production costs (PROD), in column 4 is cost of goods sold (COGS), in column 5 is inventory level (INV). The variables of interest are SAFETEALU05 and POSTSAFETEALU05. Oil companies represent the treated group and US excise tax collector the control group. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

VARIABLES	Column 1 Cash flow from operations	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Cost of Goods Sold	Column 5 Change in Inventory
Treatment	0.0341***	-0.0341***	0.0257***	0.0258***	-0.0032***
	(0.0094)	(0.0075)	(0.0037)	(0.0035)	(0.0005)
Q2005	0.0643	-0.1381	0.1753***	0.1254***	0.0032
	(0.1271)	(0.1039)	(0.0502)	(0.0470)	(0.0073)
POST2005	0.1208	-0.1388	0.1307***	0.0755*	0.0049
	(0.1177)	(0.0969)	(0.0467)	(0.0435)	(0.0068)
SAFETEALU05	0.0255	0.0017	0.0034	-0.0057	0.0041
	(0.0490)	(0.0384)	(0.0188)	(0.0181)	(0.0027)
POSTSAFETEALU	-0.0405**	0.0199	0.0353***	0.0338***	0.0024***
	(0.0162)	(0.0128)	(0.0063)	(0.0060)	(0.0009)
Fuel consumption$_t$	-0.0005**	0.0003**	-0.0000	0.0001	-0.0000
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0000)
GDP per capita$_t$	-0.0044	0.0040	-0.0121***	-0.0137***	0.0006**
	(0.0043)	(0.0035)	(0.0017)	(0.0016)	(0.0002)
Fuel Gallon Price$_t$	0.0000	-0.0000	-0.0000*	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
1/Assets$_{t-1}$	-0.0756***	0.0682***	0.0037***	0.0036***	-0.0000
	(0.0005)	(0.0004)	(0.0002)	(0.0002)	(0.0000)
Sales$_t$	0.1413***		0.8863***	0.8562***	0.0086***
	(0.0104)		(0.0042)	(0.0036)	(0.0006)
ΔSales$_t$	-0.0997***		-0.1619***		
	(0.0350)		(0.0141)		
Sales$_{t-1}$		0.0235***			
		(0.0083)			
ΔSales$_{t-1}$			-0.0369***		-0.0084***
			(0.0142)		(0.0020)
Constant	0.6957*	-0.5493*	0.1521	-0.0320	0.0315
	(0.3792)	(0.3140)	(0.1511)	(0.1402)	(0.0219)
Observations	23,787	23,787	23,787	23,787	23,787
R-squared	0.5709	0.6261	0.7414	0.7369	0.0243
Year fixed effect	YES	YES	YES	YES	YES
Quarter fixed effect	YES	YES	YES	YES	YES

Table 6: Placebo Treatment Test – The 1997 Tax Relief Act

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models (columns 1 to 5). The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is discretionary expenses (DISEXP), in column 3 is production costs (PROD), in column 4 is cost of goods sold (COGS), in column 5 is inventory level (INV). Time is a dummy variable is zero for the period prior to the enactment of the 1997 Tax Relief Act (from Q1 1993 to Q2 1997) and 1 for the after the enactment (from Q3 1997 to Q4 2004) . US oil companies represents the treated group and all the non-oil US firms the control group. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Column 1	Column 2	Column 3	Column 4	Column 5
VARIABLES	Cash flow from operations	Discretionary expenses	Productions costs	Cost of goods Sold	Change in Inventory
Treatment	0.0747***	-0.0582***	0.00946***	0.00913***	-1.412***
	(0.00234)	(0.00583)	(0.00125)	(0.00122)	(0.390)
TRA97	0.00690	-0.00877	-0.00121	0.00198	0.270
	(0.00537)	(0.00616)	(0.00218)	(0.00218)	(0.828)
Treatment*TRA97	0.00514	0.0535***	-0.000920	-0.00328**	0.952*
	(0.00384)	(0.0182)	(0.00155)	(0.00152)	(0.510)
$1/Assets_{t-1}$	-0.0609***	0.0652***	0.00670***	0.00699***	-0.0524***
	(0.00279)	(0.00420)	(0.00105)	(0.000940)	(0.0114)
$Sales_t$	0.134***		0.815***	0.784***	
	(0.00769)		(0.00376)	(0.00383)	
$\Delta Sales_t$	-0.121***		-0.145***		
	(0.0300)		(0.0120)		
$Sales_{t-1}$		0.0648***			
		(0.00672)			
$\Delta Sales_{t-1}$			-0.0725***		-1.611
			(0.0113)		(1.765)
Const	-0.0368***	0.104***	-0.0305***	-0.0279***	2.541***
	(0.00360)	(0.00496)	(0.00181)	(0.00177)	(0.418)
Observations	239,655	239,655	239,655	239,655	239,655
R-squared	0.458	0.424	0.719	0.727	0.004
Year fixed effect	YES	YES	YES	YES	YES
Quarter fixed effect	YES	YES	YES	YES	YES

Table 7: Placebo population test – Excise Tax collectors

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models. The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is discretionary expenses (DISEXP), in column 3 is production costs (PROD), in column 4 is cost of goods sold (COGS), in column 5 is inventory level (INV). The variables of interest are SAFETEALU05 and POSTSAFETEALU05. The analysis uses the entropy balancing. US excise tax collectors represent the treated group and all non-oil US firms the control group. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

VARIABLES	Column 1 Cash flow from operations	Column 2 Discretionary expenses	Column 3 Production costs	Column 4 Cost of Goods Sold	Column 5 Change in Inventory
Placebo Treatment	0.0124**	-0.0117**	-0.0068*	-0.0083**	0.9559
	(0.0063)	(0.0048)	(0.0038)	(0.0036)	(1.7930)
Q2005	-0.0252*	0.0209*	0.0093**	0.0070*	6.8634*
	(0.0132)	(0.0122)	(0.0040)	(0.0037)	(3.9061)
POST2005	-0.0351**	0.0201*	0.0061	0.0076	5.5383
	(0.0143)	(0.0121)	(0.0050)	(0.0048)	(5.6772)
SAFETEALU05	-0.0410	0.0061	0.0015	0.0065	2.0621
	(0.0358)	(0.0261)	(0.0113)	(0.0090)	(11.5674)
POSTSAFETEALU	0.0059	-0.0086*	-0.0148***	-0.0171***	-4.4372
	(0.0111)	(0.0051)	(0.0044)	(0.0039)	(4.3559)
Fuel consumption$_t$	0.0002***	-0.0001*	-0.0001*	-0.0000	-0.0006
	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0311)
GDP per capita$_t$	-0.0000***	0.0000***	0.0000**	0.0000	0.0002
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0011)
Fuel Gallon Price$_t$	0.0172***	-0.0079***	-0.0027**	-0.0015	-0.7647
	(0.0044)	(0.0030)	(0.0013)	(0.0012)	(1.4785)
1/Assets$_{t-1}$	-0.0721***	0.0649***	0.0063***	0.0067***	-0.2163***
	(0.0052)	(0.0056)	(0.0019)	(0.0019)	(0.0621)
Sales$_t$	0.0805***		0.7967***	0.7685***	0.5071
	(0.0167)		(0.0067)	(0.0062)	(2.1895)
DSales$_t$	-0.1313***		-0.1181***		
	(0.0508)		(0.0258)		
Sales$_{t-1}$		0.1561***			
		(0.0089)			
DSales$_{t-1}$			-0.0607**		-27.3621**
			(0.0262)		(10.8480)
Constant	-0.1097	0.0543	-0.0115	-0.0005	-4.1933
	(0.0759)	(0.0694)	(0.0277)	(0.0260)	(25.5654)
Observations	346,399	346,399	346,399	346,399	346,399
R-squared	0.5495	0.6369	0.7115	0.7200	0.0022

Table 8 - Further investigation: Excise tax and real earnings management after the SAFETEA-LU Act

This table reports the estimated coefficients obtained using the Roychowdhury's models. The dependent variable in column 1 is production costs (PROD), in column 2 is cost of goods sold (COGS), and in column 3 is inventory level (INV). The models are augmented with the variables of interest $EXCISE_{t-1}$ and $EXCISE_{t-2}$,which represent the amount of excise collected in the quarter t-1 and t-2, respectively. The analysis is on US oil firms. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Column 1	Column 2	Column 3
VARIABLES	Production costs	Cost of Goods Sold	Change in inventory
$EXCISE_{t-1}$	-0.0886**	-0.0814**	-0.00481
	(0.0448)	(0.0384)	(0.0269)
$EXCISE_{t-2}$	-0.00630	-0.0137	0.00239
	(0.0378)	(0.0298)	(0.0246)
1/ASSETS	-27.14***	-21.31*	1.133
	(10.37)	(11.01)	(4.404)
$SALES_t$	1.001***	0.983***	0.00551
	(0.00845)	(0.00794)	(0.00354)
$\Delta SALES_t$	0.00281		
	(0.0185)		
$\Delta SALES_{t-1}$	-0.0159		-0.00908
	(0.0190)		(0.0122)
Observations	2,459	2,459	2,459
Year FE	YES	YES	YES
Quarter FE	YES	YES	YES
Wald-test	104169	86248	96.48

Table 9 - Further investigations: accrual earnings management

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Modified Jones model. The dependent variable is total accruals (TACC). The variables of interest are SAFETEALU05 and POSTSAFETEALU05. US oil firms represent the treated group, and the Columns display the analysis using different control groups. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

	Column 1	Column 2	Column 3
Dependent variable	Total Accruals	Total Accruals	Total Accruals
Control Group	Non-Oil US firms	Non-US Oil firms	Other US excise collectors
Treatment	-0.0282***	-0.0322***	-0.0304***
	(0.0026)	(0.0119)	(0.0082)
Q2005	-0.0006	-0.0283	0.0459
	(0.0032)	(0.0213)	(0.1093)
POST2005	-0.0090**	-0.0531***	0.0838
	(0.0035)	(0.0195)	(0.1013)
SAFETEALU05	-0.0188	0.0180*	0.0242
	(0.0122)	(0.0093)	(0.0421)
POSTSAFETEALU	-0.0028	0.0250***	-0.0055
	(0.0031)	(0.0049)	(0.0140)
1/Assets	0.0032***	0.0029***	0.0044***
	(0.0011)	(0.0003)	(0.0004)
Fuel consumption$_t$	-0.0000**		0.0002
	(0.0000)		(0.0002)
GDP per capita$_t$	0.0000		-0.0000**
	(0.0000)		(0.0000)
Fuel Gallon Price$_t$	0.0017**		0.0122***
	(0.0009)		(0.0037)
ΔS_t-ΔR_t	0.140***	0.0717***	0.151***
	(0.0172)	(0.0126)	(0.0224)
PPE	-0.0287***	-0.0457***	-0.0384***
	(0.00192)	(0.00231)	(0.00189)
Constant	0.0529***	-0.0700***	0.177
	(0.0139)	(0.0157)	(0.256)
Observations	368,708	65,009	23,787
R-squared	0.024	0.019	0.047
Country fixed effects	NO	YES	NO
Year fixed effects	NO	YES	NO

Table 10 - Further investigation: quarterly effective tax rates

This table reports the estimated coefficients running a dif-in-dif estimation. The dependent variables are: in column 1 GAAP ETR, in column 2 Hanlon's (2005) GAAP ETR, in column 3 the volatility of GAAP ETR, and in column 4 the volatility of Hanlon's GAAP ETR. The variables of interest are SAFETEALU05 and POSTSAFETEALU05. US oil firms represent the treated group, and the control group is represented by all other US companies. Robust standard errors are contained in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

VARIABLES	Column 1 GAAP ETR	Column 2 GAAP ETR Hanlon	Column 3 GAAP ETR Volatility	Column 4 GAAP ETR Hanlon Volatility
Treatment	-0.0478***	-0.0507***	0.0297***	0.0176***
	(0.0037)	(0.0042)	(0.0029)	(0.0031)
Q2005	-0.0304***	-0.0310***	0.0465***	0.0387***
	(0.0045)	(0.0049)	(0.0035)	(0.0037)
Post2005	-0.0706***	-0.0672***	0.0782***	0.0740***
	(0.0015)	(0.0016)	(0.0011)	(0.0012)
SAFETEALLU05	0.0730***	0.0473***	-0.0436***	-0.0429***
	(0.0169)	(0.0183)	(0.0133)	(0.0141)
POSTSAFETEALU	0.0485***	0.0211***	-0.0584***	-0.0494***
	(0.0056)	(0.0062)	(0.0043)	(0.0046)
Size	0.0115***	0.0213***	-0.0058***	-0.0030***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Leverage	0.0006	-0.0120***	-0.0035***	-0.0046***
	(0.0006)	(0.0006)	(0.0007)	(0.0007)
ROA	-2.9140***	-0.6816***	-0.0258***	-0.0282***
	(0.0305)	(0.0153)	(0.0065)	(0.0064)
$\Delta Sales_t$	0.1517***	0.0342***	-0.0151**	-0.0168**
	(0.0093)	(0.0100)	(0.0071)	(0.0075)
Foreign Income	0.5631	-1.7344*	-2.1976***	-3.1125***
	(0.9051)	(1.0059)	(0.6879)	(0.7388)
Smoothness	0.0003*	0.0001	0.0001	0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Constant	0.2968***	0.2180***	0.1266***	0.1264***
	(0.0021)	(0.0021)	(0.0014)	(0.0015)
Observations	368,708	368,708	368,708	368,708
R-squared	0.0706	0.0402	0.0210	0.0174

Table 11: External validity using alcohol beverages firms

This table reports the estimated coefficients obtained by running a dif-in-dif estimation using the Roychowdhury's models. The analysis considers the period 2010-2017. The treated sample is composed by alcoholic beverages firms corresponding to the SIC codes 2080–2085, while the control sample is given by other excise tax collector firms.The dependent variable in column 1 is cash flow from operations (CFO), in column 2 is production costs (PROD), in column 3 is cost of goods sold (COGS), in column 4 is inventory level (INV), and in column 2 is discretionary expenses (DISEXP).

VARIABLES	Column 1 Cash flow from operations	Column 2 Production costs	Column 3 Cost of Goods Sold	Column 4 Change in Inventory	Column 5 Discretionary expenses
Alcohol	0.00611	-0.0472***	-0.0380***	-0.00240**	-0.0214
	(0.0244)	(0.00935)	(0.00883)	(0.00101)	(0.0429)
Budget2013	-0.134**	0.0381*	0.0368*	-0.00288	0.137
	(0.0542)	(0.0209)	(0.0196)	(0.00227)	(0.231)
Alcohol*Budget2013	-0.0839**	-0.00180	-0.0180	0.0118***	0.00661
	(0.0329)	(0.0125)	(0.0119)	(0.00136)	(0.0853)
GDP per capita$_t$	0.00023**	-0.0000	-0.0000	0.0000	-0.00003
	(0.0000)	(0.0000)	(0.000)	(0.000)	(0.0004)
1/Assets	-0.0762***	0.00298***	0.00277***	-0.00003	0.0685***
	(0.0006)	(0.000)	(0.00021)	(0.00002)	(0.00245)
Sales$_t$	0.224***	0.861***	0.827***		
	(0.0156)	(0.00606)	(0.00534)		
ΔSales$_t$	-0.386***	-0.182***		0.0134***	
	(0.0493)	(0.0197)		(0.00201)	
Sales$_{t-1}$					0.243***
					(0.0555)
ΔSales$_{t-1}$		-0.059***			
		(0.1983)			
Constant	-1.162**	0.255	0.264	-0.0294	1.466
	(0.557)	(0.215)	(0.202)	(0.0234)	(2.369)
Observations	7,060	7,060	7,060	7,060	7,060
R-squared	0.551	0.653	0.649	0.018	0.593
Year FE	YES	YES	YES	YES	YES

Figure 1: US real GDP

Figure 3 shows the quarterly percent change in the US real GDP. Data are obtained from the Federal Reserve Bank of St. Louis. In the figure, the variations of the US quarterly real GDP are between -0.4% and +1.82% suggesting any variation in the economy does not explain a shift in oil firms' operations. We obtain the data from the Federal Reserve Bank of Saint Louis.

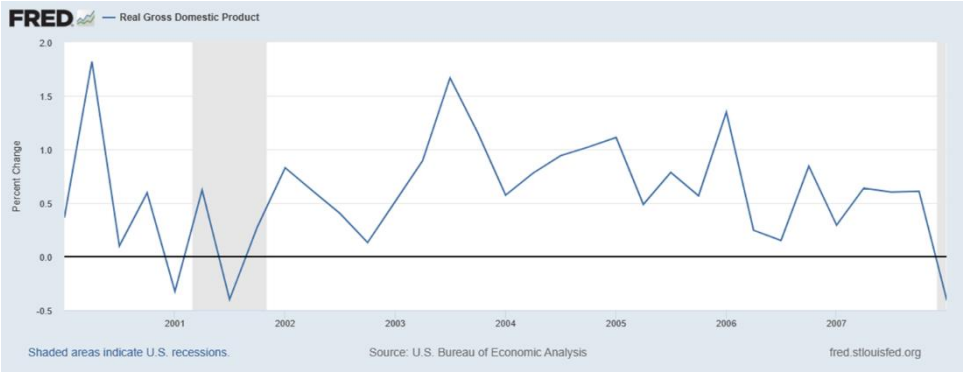


Figure 2: The dynamic of gasoline average price

This figure provides a graphical description of the change in average quarterly gasoline price (expressed in US dollars) in US cities during the selected period. It highlights we are investigating a stable period without large variations. Thus, it is a suitable setting for our investigation because we reduce (eliminate) incentives for commodity firms driven by oil price. We obtain the data from the Federal Reserve Bank of Saint Louis.

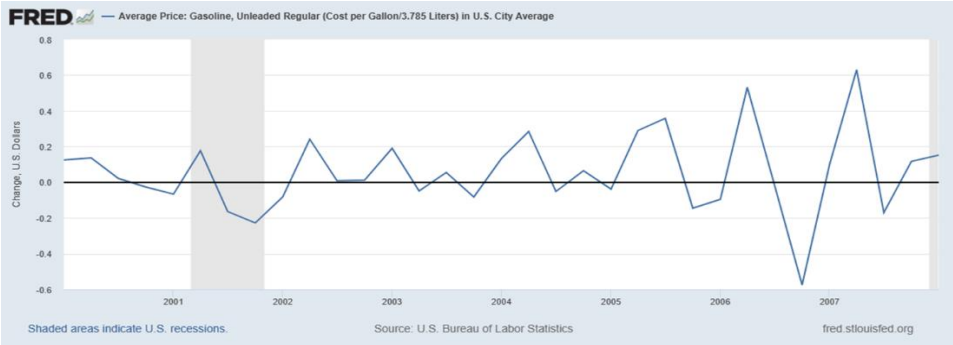
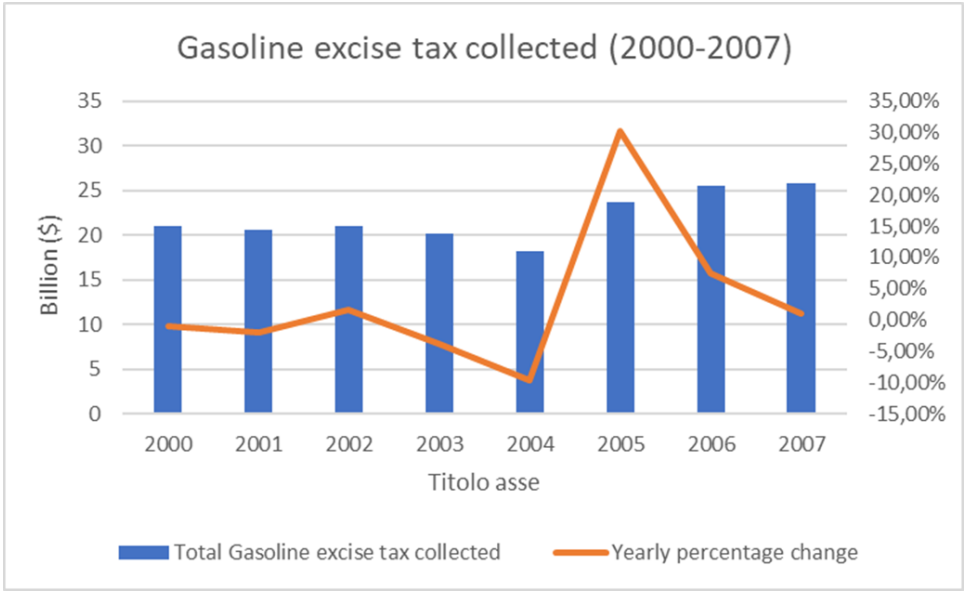


Figure 3: Total fuel excise tax collected

This figure shows the total resources collected with the fuel excise tax (blue histograms) and the yearly percentage change of total resources collected with the fuel excise tax (orange line) during the years 2000-2006. During the years 200-2004 there is a negative trend in the resources collected, with a drop of 5% in 2004. A large increase occurs in 2005 (+21.5%) when the Congress discusses whether to increase the fuel excise tax.



CHAPTER V

“CONCLUSIONS”

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1. Summary of the results, contributions, and potential future research

This thesis contains three empirical papers that investigate earnings management in commodity firms. The first study investigates the role of uncertainty in triggering earnings smoothing strategy by commodity firms. Evidence is consistent with managers dampening profits during uncertain periods. The second study investigates the role of futures in influencing earnings smoothing decisions. Investigating gold firms, which can project future revenues using provisional sales, provides evidence consistent with managers reducing current profits when expecting lower results in the future and vice versa. The third paper exploits the political discussion that occurred in 2005 on whether to increase the fuel excise tax to investigate excise tax-induced earnings management. Evidence is consistent with oil firms adjusting their operations and considering the level of resources collected in the previous quarter to avoid the excise tax increase.

Chapter 2 makes several contributions to the existing literature. First, it adds to a growing body of research related to macroeconomy-wide factors and firm-specific decisions. Second, it contributes to the existing literature on earnings smoothing. Lastly, it adds to the literature exploring how earnings management is affected by companies' economic environments.

Future research from Chapter 2 might focus on countries where commodity firms are primarily state-owned enterprises and the national governments strongly influence financial reporting and real choices. Such investigations would expand the literature on how different ownership models influence earnings management practices. Research on agricultural commodities could further advance knowledge in this area and could also prove highly valuable. Such a sample would be useful in investigating the negative externalities of market pressure. For example, if firms under market pressure (i.e., negative earnings surprise or not meeting earnings analysts' forecast) engage in real earnings management to influence the quantity produced (or the selling price), this would have a large and direct impact on social welfare. The largest hurdles in addressing this research idea are: a) the sic code 0100 identifies all of the agricultural commodities, and it is difficult to isolate the effect on a single commodity; b) the structure of the industry in which there are multiple large companies that produce more than one agricultural commodity.

By showing how the future market influences accounting and operational decisions, Chapter 3 adds to the literature regarding the determinants of earnings management. Second, it adds evidence on the process by which managers smooth earnings, and finally, it complements the literature by showing that earnings management has pervasive and industry-specific features.

Chapter 3 suggests at least three future avenues of research. First, researchers might investigate other commodities with a future market. For example, the SIC Code 1000 “Metal Mining” has more commodities (i.e., iron and many others) with a future market available worldwide and accounting features the paper describes in detail for gold firms. Second, the robustness tests highlight interesting differences between periods of crisis and more stable economic periods. The paper implies that the results can be explained in light of the future becoming less reliable in a period of crisis. However, the paper does not directly test the idea. Future research could delve into the relationship between future and earnings management during highly uncertain periods or extremely volatile economic conditions. Finally, future research can use valuation ratios or stock prices to investigate if relying on futures to do an earnings smoothing strategy is appreciated by investors.

Chapter 4 contributes to several streams of research. First, it extends the literature on tax-induced earnings management by showing that not only income tax induces earnings management by firms. Secondly, it contributes to the literature on the real effects of corporate taxation. Finally, the paper expands the literature on public finance, showing that excise tax collectors’ behaviours influence the resources available to the government.

Chapter 4 opens at least two future streams of research. First, it shows that not only tax on profits induce earnings management by firms. Researchers largely focused on income tax and dedicated scant attention to other relevant taxes like the excise tax. The excise tax provides a strong and permanent relationship with the government because firms collect resources for the government. Several other taxes relevant for firms and consumers might change supply and demand dynamics, like the VAT, tariffs, and others that remained largely unexplored. Second, future research might focus on other excise collector samples to generalize the results. The paper provides the results of alcoholic beverages as the external validity of the results. However, there are several excise tax collectors that still need to be explored, like cigarettes, aviation, automotive, guns, and others.