Finance Research Letters 59 (2024) 104808

Contents lists available at ScienceDirect

Finance Research Letters

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

Futures, provisional sales, and earnings management in the global gold mining industry

Alessandro Paolo Rigamonti [a], Giulio Greco [a,*], Alessandro Capocchi [b]

[a] Department of Economics and Management, University of Pisa, Via C. Ridolfi, 10, 56124, Pisa, Italy
[b] Department of Business and Law, University of Milano, Bicocca, Piazza dell'AteneoNuovo, 1, 20126, Milano, Italy

ARTICLE INFO

JEL classifications:
G3
E32
Q02

Keywords:
Earnings management
Future
Gold
Interim reporting

ABSTRACT

This study investigates the impact of futures on earnings management in the gold mining industry. Using quarterly data from a global sample of gold firms between 2003 and 2019, we find evidence of income-increasing accruals and real earnings management during contango periods (when futures price exceed the current spot price). Conversely, gold firms use income-decreasing accruals and real earnings management during backwardation periods (when the current spot price exceeds the futures price). This study contributes to the literature with evidence on futures as determinants of earnings management, as well as on the process through which managers smooth earnings.

1. Introduction

Prior research investigates the determinants of earnings management in financial markets (El Diri, 2018). Some studies reveal that managers engage in income-increasing earnings management when they believe that the firm's stock price is undervalued, before initial public offerings (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 research extends the literature by investigating futures as a determinant of earnings management in the global gold mining industry.

The futures market impacts operating activities when a company uses future prices in its sale contracts. Mining companies commonly use provisional sale (price) contracts in which the ore selling price is the futures price at delivery time, usually in subsequent quarters (KPMG, 2018; PWC, 2012). Revenue is recognized at the time of delivery (hence the term "provisional sales") .[1] In contango (backwardation) periods, future profits are projected to exceed (to be lower than) current period profits, thus incentivizing managers to smooth earnings. "When a firm's future performance is anticipated to be poor, managers have incentives to underreport current period earnings by transferring current earnings for possible use in the future" (Chauhan and Jaiswall, 2023, p. 94). When projected earnings exceed current earnings, prior literature suggests that managers shift profits from future to current periods to level profits across periods (Baik et al., 2020; DeFond and Park, 1997). Smoothing reduces earnings volatility and procures benefits, such as

* Corresponding author.
E-mail address: giulio.greco@unipi.it (G. Greco).

[1] 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 applies to 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.

https://doi.org/10.1016/j.frl.2023.104808
Received 30 May 2023; Received in revised form 26 October 2023; Accepted 25 November 2023
Available online 27 November 2023

increased managerial job security (DeFond and Park, 1997), lower cost of debt (Dichev et al., 2013), and coping with investors' pressure to ensure a steady stream of earnings (Dichev et al., 2013; Graham et al., 2005). Provisional sales help managers of gold firms because smoothing requires reliable forecasts of revenues and profits to reduce the risk of misreporting (Baik et al., 2020).

There are several reasons of interest for this research. First, prior research reveals that mining companies' earnings and value depend on commodity prices (Damodaran, 2009). Hence, futures prices are a primary concern for mining firms' managers and a cogent motivation for earnings management, which remains unexplored by prior literature. Second, El Diri's (2018) literature review underscores the need for further research on specific industry characteristics influencing earnings management. Finally, recent call for research encourages studies on earnings management in extractive industries, due to their huge economic, environmental, and social impact (Gray et al., 2019). Uncovering the industry-specific determinants of earnings management is thus of interest to both academics and practitioners.

We analyze the quarterly data of all gold-producing firms in the Compustat Global and Compustat North America Databases (SIC Code 1040) for the period 2003-–2019. We select gold-producing firms because many studies suggest that gold miners are price-takers (O'Connor et al., 2015). Gold prices are determined by a wide range of economic and political factors beyond the control of gold firms (Chirwa and Odhiambo, 2020; Malliaris and Malliaris, 2015).

Using accrual and real earnings management models, we find that gold firms use income-increasing (income-decreasing) accruals and real earnings management during contango (backwardation) periods. Earnings management is economically significant; for example, a 1 % positive (negative) difference between future and current prices implies a decrease (increase) of 124 million dollars in accruals.

This study contributes to the literature on the determinants of earnings management in financial markets (Dechow et al., 2010; Teixeira and Rodrigues, 2022; Wu et al., 2022) by demonstrating the effect of futures on earnings management in the global gold industry. It provides evidence that, in "bad news" periods (i.e., futures lower than current price), managers under-report current earnings to report higher future earnings (Kirschenheiter and Melumad, 2002), while in "good news" periods (i.e., futures higher than current price), they shift profits from the future to the current period. This manipulation aims at ensuring a stable stream of profits across different market conditions (Cohen and Zarowin, 2007; Ditchev et al., 2013; Bertomeu et al., 2017). Indeed, "the managers' incentives to manage performance depend on external economic and market conditions" (Wu et al., 2022, p. 3), as the latter influences investors' reaction to earnings surprises/disappointments and managerial bonus remuneration, among others (Kirschenheiter and Melumad, 2002; Cohen and Zarowin, 2007). This study reveals that the influence of commodity price cycles extends beyond strategic and business decisions (Damodaran, 2009) to accounting choices. Combined with other managers' private information about the firm, the expected commodity price (i.e., future price) affects the outcome of accounting choices, triggering earnings smoothing (Kirschenheiter and Melumad, 2002). This research can enrich the ongoing discussion about how changing economic conditions shape earnings management practices (Cohen and Zarowin, 2007; Ditchev et al., 2013; Wu et al., 2022).

This study also provides evidence regarding the process by which managers smooth earnings (Baik et al., 2020; Graham et al., 2005), showing how gold firms exploit private projections of future revenues and profits based on forward prices in their provisional sales contracts. Finally, it complements recent research suggesting that earnings management is pervasive and has industry-specific traits (Bertomeu et al., 2021; El Diri, 2018). Accrual earnings management (AEM) and real earnings management (REM) are used on a quarterly basis and strongly intertwined with the types of company operations (i.e., provisional sales).

2. Hypothesis development

Future gold price is driven by the demand of physical gold and by financial investments in gold (O'Connor et al., 2015). Damodaran (2009) observes that the effect of commodity price on revenues is magnified at the operating income level because commodity companies usually have high fixed costs (operating leverage). Gold firms may have to keep mines operational even at low points in price cycles, to avoid excessive costs of shutting down and restarting operations, as well as to maintain the option of activating deeper mines or mines with lower quality ores, which become profitable only above certain price levels (Moel and Tufano, 2002; Damodaran, 2009). Price exposure may induce managers to use earnings management to level profits across periods and secure benefits such as increased managerial job security and lower cost of debt (DeFond and Park, 1997; Graham et al., 2005; Dichev et al., 2013).

Gold firms may use accruals and real activities to smooth earnings (Dechow et al., 2010). REM techniques studied in the literature include sales manipulation, overproduction, and use of discretionary expenses (Roychowdbury, 2006). Accelerating sales with price discounts, more lenient credit terms, and channel stuffing is unsuitable for gold firms, given the nature of gold. 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., 2015). The gold production process can also be accelerated. "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 the value of inventory, reducing the cost of goods sold. Finally, gold firms can use discretionary expenses (e.g. selling, general, and administrative expenses)[2] to manage earnings with limited risks (Cohen et al., 2008). 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

[2] Exploration and valuation of mineral resources are not considered R&D; they are capitalized under PPE or intangibles, depending on the selected measurement criteria (KPMG, 2018).

earnings management.

The above considerations lead us to formulate the following hypothesis:

HP1: Futures trigger earnings management in the gold mining industry.

3. Research design

This study merges quarterly data from Compustat North America and Compustat Global databases. We analyze quarterly data available from Q1 2003 to Q4 2019 for firms included in the Standard Industrial Classification (SIC) Code 1040 (gold and silver ores), because futures impact sales operations on a quarterly basis. We obtain 41,510 firm-quarter observations from 987 individual firms. Table 1 shows the breakdown of firms by country (item *loc* in Compustat, Country Code Headquarters). We use data from Datastream-Refinitiv on the Commodity Exchange Inc. (COMEX) Gold Composite Commodity Future Price, whose timespan began in Q1 2003 (Batten and Lucey, 2010) .[3]

We calculate discretionary accruals, abnormal cash flows from operations, discretionary expenses, and production costs[4] (Roychowdhury, 2006), using the following models:

1. Jones model (1991):

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

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

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \varepsilon_{it} \quad (2)$$

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

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{\Delta Revenue_{it}}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \beta_4 ROA_{it-1} + \varepsilon_{it} \quad (3)$$

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

$$\frac{Total\ Accruals_{it}}{Assets_{it-1}} = \beta_1\left(\frac{1}{Assets_{it-1}}\right) + \beta_2\frac{(\Delta Revenue_{it} - \Delta Receivables_{it})}{Assets_{it-1}} + \beta_3\frac{PPE_{it}}{Assets_{it-1}} + \beta_4 ROA_{it-1} + \varepsilon_{it} \quad (4)$$

5. Cash flow from operations:

$$\frac{CFO_{it}}{ASSETS_{it-1}} = \beta_0 + \beta_1\left(\frac{1}{ASSETS_{it-1}}\right) + \beta_2\frac{SALES_{it}}{ASSETS_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{ASSETS_{it-1}} + \varepsilon_{it} \quad (5)$$

6. Production costs:

$$\frac{PROD_{it}}{Assets_{it-1}} = \beta_0 + \beta_1\frac{1}{Assets_{it-1}} + \beta_2\frac{SALES_{it}}{Assets_{it-1}} + \beta_3\frac{\Delta SALES_{it}}{Assets_{it-1}} + \beta_4\frac{\Delta SALES_{it-1}}{Assets_{it-1}} + \varepsilon_{it} \quad (6)$$

7. Discretionary expenses:

$$\frac{DISEXP_{it}}{Assets_{it-1}} = \beta_0 + \beta_1\frac{1}{Assets_{it-1}} + \beta_2\frac{SALES_{it-1}}{Assets_{it-1}} + \varepsilon_{it} \quad (7)$$

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

[4] Production costs are the sum of the cost of goods sold and the change in inventory; discretionary expenses are the sum of R&D and SG&A expenses (Roychowdhury, 2006). Advertising expenses are not included in Compustat quarterly (item *xad* in the annual version).

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	United Kingdom	2475	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	Kyrgyzstan	58	0.17	India	195	0.46	Philippines	272	0.66	Peru	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	United States	4743	11.43			
Total	41,510	100.00												

This table illustrates the frequency distributions of firm-quarter observations across countries.

For Eqs. (1) and 2, we also use Collins et al. (2017) adjustments to the Jones and the modified Jones models, which add further controls for quarter effects, performance, and growth.

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

1. Main model discretionary AEM:

$$\mathbf{AEM}_{it} = \mathbf{b_1Future}_t + \mathbf{b_2Controls}_{it} + \mathbf{b_3YearFixedEffects}_{it} + \mathbf{b_4CountryFixedEffects}_{it} + \varepsilon_{it} \quad (8)$$

2. Main model abnormal REM:

$$\mathbf{REM}_{it} = \mathbf{b_1Future}_t + \mathbf{b_2Controls}_{it} + \mathbf{b_3YearFixedEffects}_{it} + \mathbf{b_4CountryFixedEffects}_{it} + \varepsilon_{it} \quad (9)$$

In Eq. (8), AEM_{it} is our discretionary accruals measure (calculated using the four abovementioned models); in Eq. (9), REM_{it} is the abnormal cash flow from operations, abnormal production costs, and abnormal discretionary expenses. $Future_t$ is our 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.[5] Positive and negative values indicate contango and backwardation periods, respectively. As controls, we included size, measured by the natural logarithm of the total assets; leverage, measured by the total liabilities on total assets; profitability, measured by a return-on-assets index; book-to-market ratio; a measure of stock compensation expense using the item *stkcoq* in Compustat (Sun and Xiaolan, 2019); and a derivative use measure by Barton (2001), which measures the intensity of 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. We added time and country-fixed effects and used robust standard errors clustered by firm. Appendix A summarizes the variables used in the empirical analysis and provides their sources. All variables were winsorized at the 1 % level.

4. Results and discussion

4.1. Descriptive statistics and univariate analysis

Table 2 presents the descriptive statistics for the variables. The average $Future_t$ is 0.041 (median 0.024), with a standard deviation of 0.115. Derivative use is zero for most firms, with approximately 1 % having non-zero values of long-term and current derivatives assets, reflecting the fact that a derivative component is often included in sales contracts (see footnote 2).

4.2. Main analyses

Table 3 presents the results of the main analyses, which show that *Future* has a significantly positive association with abnormal accruals in all AEM models (Table 3, columns 1–6). This 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 and shift current profits to 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. These findings support HP1. 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 engage in earnings management when they believe that the firm's stock price is undervalued or to increase their compensation (Teixeira and Rodrigues, 2022).

Column 2 of Table 4 indicates that gold firms use real production operations to smooth their earnings. We find evidence of abnormally high production costs used to increase earnings in quarters with a positive spread between future and current gold prices. Abnormal production indicates that higher proportions of fixed overheads are assigned to products in the inventory, thus lowering the cost of goods sold and increasing profits (Roychowdhury, 2006). 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. Overproduction appears to be an effective REM technique for gold firms. Column 3 of Table 4 provides evidence of abnormally low discretionary expenses in quarters with high spreads, indicating income-increasing earnings management. These findings support HP1. We find no evidence of abnormal cash flows (Table 4, column 1), suggesting that gold firms do not use sales manipulation likely because they are not suitable.

We also run cross-sectional analyses using a dummy for contango and backwardation periods. Columns 1–4 in Table 5 display the analysis using discretionary accruals calculated with Jones and modified Jones models, adjusted by Collins et al. (2017). Contango and backwardation periods are strongly associated with income-increasing accruals (columns 1–2) and income-decreasing accruals (columns 3–4), respectively. Columns 5–8 in Table 5 confirm the findings for REM (not including abnormal cash flow from operations, as it is not significant in the main model).

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

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 modified 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 appendix.

Table 3
Main analyses: accrual earnings management (AEM).

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 AEM Jones model (Collins et al., 2017)	Column 6 AEM modified Jones model (Collins et al., 2017)
Future	0.152***	0.195***	0.150***	0.233***	0.121**	0.132**
	(0.050)	(0.056)	(0.048)	(0.066)	(0.055)	(0.059)
Size	-0.045***	-0.049***	-0.043***	-0.058***	-0.014***	-0.016***
	(0.005)	(0.005)	(0.004)	(0.006)	(0.004)	(0.005)
Leverage	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	0.005**	0.005**	0.005**	0.006**	-1.390**	-1.318*
	(0.002)	(0.002)	(0.002)	(0.003)	(0.703)	(0.706)
Derivative use	0.156	0.338	0.159	0.319	0.006**	0.006**
	(0.291)	(0.375)	(0.291)	(0.373)	(0.002)	(0.003)
Book-to-market ratio	0.000*	0.000*	0.000*	0.000	-0.009***	-0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)
Stock-based compensation	0.017***	0.020***	0.016***	0.026***	0.008***	0.009***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)
Observations	41,510	41,510	41,510	41,510	41,510	41,510
R-squared	0.117	0.150	0.116	0.152	0.091	0.101
F-Stat	25.49	32.37	26.57	27.75	11.42	11.54
F-Prob	0.000	0.000	0.000	0.000	0.000	0.000
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Std. error clustered by	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM

This table provides the ordinary least squares (OLS) estimate of Eqs. (1)–4 (main model) using accruals earnings management (AEM) measures as the dependent variable. 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.

We perform several robustness checks. First, we use the current price to control for normal economic revenue generation. Untabulated findings are consistent with the results in Table 3.[6] Second, we employ a single equation approach (Chen et al., 2018) ,[7] adding futures directly in the earnings management models. Untabulated results show that the variable futures is positively and significantly associated with accruals and productions costs, confirming our main findings. Third, we estimate Eqs. (1)–7 for each country and quarter, using countries with enough observations (United Kingdom, Australia, United States, and Canada). Cross-country institutional setting differences may influence accounting practices and the application of accounting rules. Table 6 displays findings consistent

[6] All the untabulated findings are available upon request.

[7] Earnings management studies usually calculate discretionary accruals in a first regression, and then regress the discretionary accruals on the explanatory variables in a second. This two-step design may suffer from potential bias caused by the misspecification of the first equation used to calculate the residuals. In particular, the regressors of the first equation in most studies are likely to be affected by the explanatory variable (Chen et al. 2018).

Table 4
Main analyses: real earnings management (REM).

Variables	Column 1 REM abnormal cash flow from operations	Column 2 REM abnormal production costs	Column 3 REM abnormal discretionary expenses
Future	-0.042	0.041***	-0.096**
	(0.056)	(0.014)	(0.043)
Size	0.069***	-0.004***	-0.008**
	(0.006)	(0.001)	(0.004)
Leverage	0.000	-0.000*	0.000
	(0.000)	(0.000)	(0.000)
Profitability	-0.000	-0.001*	-0.002
	(0.001)	(0.000)	(0.001)
Derivative use	0.903	-0.124	-0.153
	(0.763)	(0.182)	(0.103)
Book-to-market ratio	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Stock-based compensation	-0.020***	-0.001	0.006*
	(0.006)	(0.001)	(0.003)
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	0.000	0.000	0.000
Year FE	YES	YES	YES
Country FE	YES	YES	YES
Std. error clustered by	FIRM	FIRM	FIRM

This table provides the OLS estimate of Eqs. (5)–7 (main model) using real earnings management (REM) as the dependent variable. The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in parentheses. ***, **, and * represent statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

with the main analyses.[8] Finally, to address concerns about potential time-variant unobservable heterogeneity across firms, we re-run our main analysis using a generalized method of moments (GMM) approach (Ullah et al., 2018; Wooldridge, 2002). Untabulated results show findings consistent with the main analyses.

4.3. Further investigations

We examine the interaction between futures and a dummy for non-zero values of derivatives use. The results provide mild evidence that the interaction has a positive significant association with earnings management, suggesting that firms with non-zero values of derivatives use, likely more risk averse, employ more earnings management. Finally, because the sample includes 43.45 % of Canadian firms, we run an analysis excluding such firms. Untabulated findings confirm that the results are not solely driven by the most represented country in the sample.

We also conduct further analyses using aggregate measures of earnings smoothing, including the standard deviation of earnings scaled by the standard deviation of cash flows from operating activities and the correlation between changes in accruals and changes in operating cash flow (Leuz et al., 2003). We then regress these measures on several proxies for the variation in the future, such as the standard deviation of future over four and eight quarters, the standard deviation of the spread between future and current price, and the average absolute value of the spread between future and current price. Untabulated findings show that larger variation in the future is associated with more earnings smoothing.[9]

Finally, we ascertain whether the relationship between futures and earnings management differs for firms reporting losses for several consecutive quarters. We identify such "loss firms" with a dummy for observations reporting negative pre-managed income for three or four consecutive quarters. The pre-managed income is calculated as net income less discretionary accruals (Tucker & Zarowin, 2006). We then examine the interaction of the dummy with the futures. Untabulated findings reveal that *Future* exhibits a positive significant association as in the main analyses. The dummy for loss firms exhibits a positive significant association with discretionary accruals. The interaction term is not significant, indicating that the impact of futures on earnings management in loss firms is not different from that in other firms. Even when experiencing negative performance, firms still use futures to mitigate the reported performance volatility.

5. Conclusions

This study investigated whether gold futures trigger earnings management in the global gold industry. Gold firms use income-increasing (income-decreasing) AEM and REM during contango (backwardation) periods to smooth their earnings and ensure a

[8] We thank an anonymous reviewer for this suggestion.
[9] This finding does not indicate that earnings are more stable/less volatile during period of larger future variation. It suggests that firms reduce earnings volatility relative to cash flows volatility more during periods of larger future variation, thereby making more smoothing.

Table 5
Cross-sectional analysis: contango versus backwardation periods.

Variables	Column 1 AEM Jones model (Collins et al., 2017)	Column 2 AEM modified Jones model (Collins et al., 2017)	Column 3 AEM Jones model (Collins et al., 2017)	Column 4 AEM modified Jones model (Collins et al., 2017)	Column 5 REM abnormal production costs	Column 6 REM abnormal discretionary expenses	Column 7 REM abnormal production costs	Column 8 REM abnormal discretionary expenses
Contango	0.033***	0.037***			0.008***	-0.010**		
	(0.009)	(0.009)			(0.002)	(0.004)		
Backwardation			-0.012***	-0.014***			-0.005**	0.010**
			(0.005)	(0.005)			(0.002)	(0.004)
Size	-0.013***	-0.015***	0.000	0.000	-0.001	-0.007*	-0.001	-0.001*
	(0.004)	(0.005)	(0.000)	(0.000)	(0.001)	(0.004)	(0.001)	(0.004)
Leverage	0.000	0.000	-1.473**	-1.416*	-0.000***	0.000	-0.000***	0.000
	(0.000)	(0.000)	(0.745)	(0.743)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-1.492*	-1.439*	0.00447*	0.00505*	-0.002***	-0.002*	-0.002***	-0.002*
	(0.765)	(0.764)	(0.002)	(0.003)	(0.000)	(0.001)	(0.001)	(0.001)
Derivative use	0.005**	0.005**	-0.011***	-0.011***	0.007	-0.151	0.00676	-0.153
	(0.002)	(0.003)	(0.003)	(0.004)	(0.135)	(0.103)	(0.134)	(0.102)
Book-to-market ratio	-0.011***	-0.011***	0.009***	0.009***	-0.0007	-0.001	-0.001	-0.001
	(0.003)	(0.004)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Stock-based compensation	0.009***	0.009***	-0.018**	-0.022***	0.001	0.005	0.001	0.005
	(0.002)	(0.002)	(0.007)	(0.008)	(0.001)	(0.004)	(0.001)	(0.003)
Observations	41,510	41,510	41,510	41,510	41,510	41,510	41,510	41,510
R-squared	0.091	0.101	0.091	0.101	0.157	0.130	0.157	0.132
F-Stat	11.42	11.54	11.42	11.54	15.58	13.72	15.56	23.74
F-Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Std. error clustered by	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM	FIRM

This table provides the OLS estimate of a cross-section comparing contango and backwardation periods. Robust standard errors are indicated in parentheses. ***, **, and * represent statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

Table 6
Main analyses with earnings management estimated on a country-quarter basis.

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	0.164***	0.162***	0.208***	0.201***	-0.0417	0.0411***	-0.0963**
	(0.050)	(0.048)	(0.057)	(0.055)	(0.056)	(0.014)	(0.043)
Size	-0.043***	-0.041***	-0.047***	-0.046***	0.069***	-0.004***	-0.008**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.001)	(0.004)
Leverage	-0.000	-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)
Profitability	0.240	0.242	0.423	0.421	-0.000	-0.001*	-0.001
	(0.314)	(0.314)	(0.395)	(0.395)	(0.001)	(0.000)	(0.001)
Derivative use	0.016***	0.015***	0.019***	0.018***	0.903	-0.124	-0.154
	(0.004)	(0.004)	(0.004)	(0.004)	(0.763)	(0.182)	(0.103)
Book-to-market ratio	-0.014***	-0.014***	-0.015***	-0.014***	0.000	-0.004	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.000)	(0.000)	(0.000)
Stock-based compensation	0.006**	0.006**	0.006**	0.006**	-0.020***	-0.001	0.006*
	(0.003)	(0.002)	(0.003)	(0.003)	(0.006)	(0.001)	(0.003)
Observations	37,135	37,135	37,135	37,135	37,135	37,135	37,135
R-squared	0.121	0.120	0.153	0.152	0.133	0.047	0.136
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 provides the OLS estimate of Eqs. (1)–7 on a country-quarter basis. The variable of interest is *Future*, which represents the spread between the current and future gold prices. Robust standard errors are indicated in parentheses. ***, **, and * represent statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

steady stream of profits. This study contributes to the literature by providing evidence on futures as determinants of earnings management and on the process through which managers smooth earnings. Regarding practical implications, this research informs investors, lenders, and other market participants of the earnings management practices that affect the financial reporting of gold firms, thereby contributing to the debate about standard setting in the extractive industry (IASB, 2022).

This study has some limitations. It does not control for ownership and governance variables due to the unavailability of data in the global sample. However, surveys of chief financial officers suggest that factors related to business and industry, such as futures for the gold mining industry, are the primary reason for earnings management and are more influential than firm-specific governance features (Dichev et al., 2013, p. 16).

This research may open avenues for future research: First, researchers could expand the investigation to the SIC Code 1000 "Metal Mining" firms, analyzing other commodities with a futures market. Second, studies could investigate the relationship between future and earnings management in extremely volatile or crisis periods. Finally, future research could dig deeper to determine how futures affect the relationship between earnings smoothing and valuation ratios.

Declaration of generative AI in scientific writing

The Authors declare that they did not use any generative AI in wirting the paper.

Declaration of Competing Interest

The Authors declare that they do not have any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work.

Data availability

Data from Compustat and Datastream-Refinitiv

Appendix A. Summary of the variables used and their sources

Label	Description	Source
AEM Jones	Discretionary accruals calculated using the Jones (1991) model	Compustat
AEM modified Jones	Discretionary accruals calculated using the modified Jones (1991) 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's (2006) model	Compustat
REM abnormal production costs	Abnormal production costs calculated using Roychowdhury's (2006) model	Compustat
REM abnormal discretionary expenses	Abnormal discretionary expenses calculated using Roychowdhury's (2006) 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 and long-term derivative in quarter t for firm i, scaled by total assets (Barton, 2001)	Compustat
Book-to-market ratio	Ratio between book and market value in quarter t in firm i	Compustat
Stock-based compensation	Item stkcoq from Compustat (Sun and Xiaolan, 2019)	Compustat

References

Baik, B., Choi, S., Farber, D.B., 2020. Managerial ability and income smoothing. Acc. Rev. 95, 1–22.
Barton, J., 2001. Does the use of financial derivatives affect earnings management decisions? Acc. Rev. 76, 1–26.
Batten, J.A., Lucey, B.M., 2010. Volatility in the gold futures market. Appl. Econ. Lett. 17, 187–190.
Bertomeu, J., Cheynel, E., Li, E.X., Liang, Y., 2021. How pervasive is earnings management? Evidence from a structural model. Manag. Sci. 67, 5145–5162.
Bertomeu, J., Darrough, M., Xue, W., 2017. Optimal conservatism with earnings manipulation. Con. Acc. Res. 34 (1), 252–284.
Cohen, D.A., Zarowin, P., 2007. Earnings management over the business cycle. https://web-docs.stern.nyu.edu/old_web/emplibrary/EM_08_23_07FINAL.pdf (accessed September 2023).
Chauhan, Y., Jaiswall, M., 2023. Economic policy uncertainty and incentive to smooth earnings. Int. Rev. Econ. Fin. 85, 93–106.
Chen, W.E.I., Hribar, P., Melessa, S., 2018. Incorrect inferences when using residuals as dependent variables. J. Account. Res. 56 (3), 751–796.
Chirwa, T.G., Odhiambo, N.M., 2020. Determinants of gold price movements: an empirical investigation in the presence of multiple structural breaks. Resour. Policy. 69, 101818.
Cohen, D.A., Dey, A., Lys, T.Z., 2008. Real and accrual-based earnings management in the pre-and post-Sarbanes-Oxley periods. Account. Rev. 83, 757–787.
Collins, D.W., Pungaliya, R.S., Vijh, A.M., 2017. The effects of firm growth and model specification choices on tests of earnings management in quarterly settings. Account. Rev. 92 (2), 69–100.
Damodaran, A., 2009. Ups and downs: valuing cyclical and commodity companies. SSRN. https://doi.org/10.2139/ssrn.1466041.
Dechow, P., Ge, W., Schrand, C., 2010. Understanding earnings quality: a review of the proxies, their determinants and their consequences. J. Acc. Econ. 50, 344–401.

Dechow, P.M., Sloan, R.G., Sweeney, A.P., 1995. Detecting earnings management. Acc. Rev. 70, 193–225.
DeFond, M.L., Park, C.W., 1997. Smoothing income in anticipation of future earnings. J. Acc. Econ. 23, 115–139.
Dichev, I.D., Graham, J.R., Harvey, C.R., Rajgopal, S., 2013. Earnings quality: evidence from the field. J. Acc. Econ. 56, 1–33.
El Diri, M., 2018. Introduction to Earnings Management. Springer International Publishing.
Graham, J.R., Harvey, C.R., Rajgopal, S., 2005. The economic implications of corporate financial reporting. J. Acc. Econ. 40, 3–73.
Gray, S.J., Hellman, N., Ivanova, M.N., 2019. Extractive industries reporting: a review of accounting challenges and the research literature. Abacus 55, 42–91.
IASB, 2022. International Accounting Standard Board Extractive Activities Project Update. https://www.ifrs.org/content/dam/ifrs/project/extractive-activities/inbrief-extractiveactivities-jan2022.pdf. accessed May 2023.
Jones, J.J., 1991. Earnings management during import relief investigations. J. Acc. Res. 29 (2), 193–228.
Kirschenheiter, M., Melumad, N.D., 2002. Can "big bath" and earnings smoothing co-exist as equilibrium financial reporting strategies? J. Acc. Res. 40 (3), 761–796.
Kothari, S.P., Leone, A.J., Wasley, C.E., 2005. Performance matched discretionary accrual measures. J. Acc. Econ. 39, 163–197. https://doi.org/10.1016/j.jacceco.2004.11.002.
KPMG, 2018. Insights into Mining. Adoption of IFRS 15. https://assets.kpmg.com/content/dam/kpmg/ca/pdf/2018/10/ca-insights-into-mining-adoption-of-IFRS-15-survey.pdf (accessed May 2023).
Leuz, C., Nanda, D., Wysocki, P.D., 2003. Earnings management and investor protection: an international comparison. J. Financ. Econ. 69 (3), 505–527.
Malliaris, A.G., Malliaris, M., 2015. What drives gold returns? A decision tree analysis. Fin. Res. Let 13, 45–53.
Newmont, 2020. Form 10-K. https://www.newmont.com/investors/reports-and-filings/default.aspx (accessed July 2023).
Moel, A., Tufano, P., 2002. When are real options exercised? An empirical study of mine closings. Rev. Finan. Stud. 15, 35–64.
O'Connor, F.A., Lucey, B.M., Batten, J.A., Baur, D.G., 2015. The financial economics of gold—a survey. Int. Rev. Financ. Anal. 41, 186–205.
PWC, 2012. Financial reporting in the mining industry. International financial reporting standards. https://www.pwc.com/id/en/publications/assets/eumpublications/financial-reporting-in-the-mining-industry.pdf (accessed 10th May 2023).
Roychowdhury, S., 2006. Earnings management through real activities manipulation. J. Acc. Econ. 42, 335–370.
Sun, Q., Xiaolan, M.Z., 2019. Financing intangible capital. J. Financ. Econ. 133, 564–588.
Teixeira, J.F., Rodrigues, L.L., 2022. Earnings management: a bibliometric analysis. Int. J. Acc. Inf. Manag. 30, 664–683.
Tucker, J.W., Zarowin, P.A., 2006. Does income smoothing improve earnings informativeness? Account. Rev. 81 (1), 251–270.
Ullah, S., Akhtar, P., Zaefarian, G., 2018. Dealing with endogeneity bias: the generalized method of moments (GMM) for panel data. Ind. Mark. Manag. 71, 69–78.
Wang, P., Chi, M., Wang, X., 2023. Overseas listing and earnings management methods selection. Fin. Res. Let. 55 (Part B), 103998.
Wu, W.S., Fok, R.C., Chang, Y., Chen, C.J., 2022. Credit default swaps and corporate performance smoothing. J. Corp. Fin. 75, 102238.
Wooldridge, J.M., 2002. Introductory Econometrics A Modern Approach. South-Western College Publishing, New York.