

Adverse Commodity Futures Term Structure and Corporate Asset Impairment

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Abstract

This study examines whether an adverse commodity futures term structure predicts asset impairment. Using 191 Chinese listed firms in the ferrous-metals supply chain from 2014Q1 to 2024Q4, the analysis interacts a one-sided contango measure with predetermined inventory exposure. Firms with greater inventory exposure are more likely to recognize impairment losses as contango intensifies; this association persists one quarter ahead and extends to the intensity of positive impairment losses. By contrast, basis volatility yields no comparable interaction. Lower gross margins and operating cash flows are consistent with an inventory-pressure channel, indicating that futures-curve information identifies reporting risk beyond price volatility.

Keywords: Commodity futures, Term structure, Asset impairment, Inventory exposure, Contango

JEL classification: G13; G32; M41; Q02

1. Introduction

Commodity futures prices incorporate expected demand, inventories, carrying costs, and risk premia (Fama and French, 2016; Tang, 2012). Their term structure therefore conveys information about storage conditions and the relative valuation of nearby and deferred delivery beyond spot-price levels or volatility (Chaves et al., 2011; Boons and Prado, 2019; Kang et al., 2020).

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Little evidence, however, connects this forward-looking signal to a corporate reporting outcome. This paper asks whether an adverse term structure predicts asset impairment for firms exposed to physical inventories.

The distinction is directional. Contango—a premium on deferred delivery relative to nearby delivery—can signal weak nearby demand, high inventory carrying costs, and pressure on near-term sales, whereas backwardation more often reflects tight spot demand. This study therefore isolates the adverse contango side of the curve and interacts it with predetermined inventory exposure. The design tests whether firms facing the same market-wide curve state respond differently according to a persistent, pre-sample exposure. Asset impairment is an appropriate reporting endpoint because inventory pressure can compress margins and operating cash flow before it affects impairment testing and recognition; accounting judgment and constrained reversals also make a symmetric prediction inappropriate (Chen et al., 2004; Riedl, 2004).

Using 191 Chinese listed firms in the ferrous-metals supply chain, the analysis combines quarterly accounting data with daily January–May settlement prices for rebar, iron ore, coking coal, and coke over 2014Q1–2024Q4. Adverse contango is positively associated with impairment occurrence among firms with greater predetermined inventory exposure; the association persists one quarter ahead and extends to positive impairment-loss intensity. It is not reproduced by basis volatility. Table 2 shows that lower gross margins and operating cash flow are consistent with an inventory-pressure channel, while Appendix Tables A1–A2 locate stronger effects among financially constrained firms and in rebar and iron ore. The results link a directional futures signal to firm-level reporting risk (Lin et al., 2021; Han et al., 2023).

2. Data

The sample covers listed firms in ferrous-metal mining, processing, and manufacturing. The study excludes ST-designated firms, firms listed after 2019, and observations with material missing data. The accounting panel contains 191 firms and 7,984 firm-quarter observations over 2014Q1–2024Q4 before lagged-variable restrictions. Quarterly accounting data are taken from listed-company financial databases, and daily settlement prices are obtained for January and May contracts on rebar, iron ore, coking coal, and coke. Continuous firm variables are winsorized at the 1st and 99th percentiles. The same January–May contract pair is used throughout to avoid a mechanically changing maturity comparison. The mean impairment-

occurrence indicator is 0.6177, mean positive impairment-loss intensity is 0.0026, and mean predetermined inventory exposure is 0.1560.

3. Methodology

3.1. Directional term-structure measure

For commodity k on trading day d , define the log spread

$$TS_{k,d} = \ln(P_{k,d}^{Jan}) - \ln(P_{k,d}^{May}). \quad (1)$$

The spread is lower when deferred prices are relatively high, that is, when contango is stronger. Let $\overline{TS}_{k,q}$ be the average daily spread in quarter q , and let $Z(\overline{TS}_{k,q})$ denote its commodity-specific standardized value. The study aggregates the four markets as

$$CompLevel_q = \frac{1}{4} \sum_{k=1}^4 Z(\overline{TS}_{k,q}). \quad (2)$$

Because a lower composite level represents a more adverse state, the study defines the one-sided pressure measure

$$ContangoPress_q = -CompLevel_q, \quad AdverseTS_q = \max(ContangoPress_q, 0). \quad (3)$$

Thus, $AdverseTS_q$ is zero outside the adverse contango region and increases only with the severity of that region. This construction is substantive rather than mechanical: backwardation signals tight spot demand and does not impose inventory pressure. It also matches the asymmetry of impairment accounting, in which unfavorable evidence can trigger recognition whereas favorable conditions need not generate an equally immediate reversal. The measure captures a directional market state, not generic basis volatility.

3.2. Impairment outcomes and exposure

The underlying impairment series is harmonized so that positive values denote losses and negative values denote reversals. A missing impairment entry is coded as zero when it represents no reported impairment or reversal. This study uses two outcomes:

$$ImpairDummy_{i,q} = \mathbf{1}(AIL_{i,q}^{adj} > 0), \quad (4)$$

$$ImpairIntensity_{i,q} = \frac{\max(AIL_{i,q}^{adj}, 0)}{Assets_{i,q}}, \quad (5)$$

where AIL^{adj} is the adjusted impairment measure. Equation (4) captures whether a positive loss is recognized; equation (5) captures the size of a positive loss relative to total assets and is zero for reversals or no loss.

Predetermined inventory exposure is

$$InvExp_i = \frac{1}{N_i^{2014}} \sum_{q \in Q_{2014}} \frac{Inventory_{i,q}}{Assets_{i,q}}, \quad (6)$$

where Q_{2014} is the set of available quarters for firm i in 2014 and N_i^{2014} is its number of observations. Using this pre-sample average reduces the concern that current inventory changes or impairment recognition mechanically determine exposure. Controls are lagged leverage, size, tangibility, operating cash flow, and operating-cost ratio.

3.3. Specification

The baseline model is

$$Y_{i,q} = \beta(AdverseTS_{q-\ell} \times InvExp_i) + \Gamma X_{i,q-1} + \mu_i + \tau_q + \varepsilon_{i,q}, \quad (7)$$

where Y is either outcome (4) or (5), $\ell \in \{0, 1\}$, μ_i and τ_q are firm and quarter fixed effects, and standard errors are clustered by firm. Quarter effects absorb common market conditions and firm effects absorb time-invariant exposure and reporting differences. Since $InvExp_i$ is time invariant, identification comes from the differential response of high- and low-exposure firms to the same quarterly market state. The coefficient is therefore interpreted as a differential association, not as clean causal identification: persistent business-model or risk-management differences may still covary with exposure.

The interaction is informative even though the market variable is common to all firms in a quarter. A positive β means that the same adverse curve state is more strongly associated with impairment for firms whose pre-sample balance sheets contain more inventory. This comparison separates directional market information from a firm's average reporting propensity and from aggregate quarter shocks; it does not require that all firms hold the same commodities or use identical hedging policies.

4. Results

Table 1 reports the main estimates. The contemporaneous interaction is 0.4764 (standard error 0.1249; $p < 0.01$) for impairment occurrence. With the term structure lagged one quarter, the coefficient is 0.3453 (0.1299; $p < 0.01$). The lagged interaction is also positive for impairment intensity, 0.0035 (0.0016; $p < 0.05$). The timing is consistent with a sequence in which futures expectations affect procurement, sales, cash collection, and impairment testing before recognition; it does not establish a causal mediation effect.

Table 1: Adverse futures term structure and asset impairment

Variable	(1) Impairment occurrence	(2) Impairment occurrence	(3) Intensity of positive impairment losses
$AdverseTS \times InvExp$	0.4764*** (0.1249)		
$L.AdverseTS \times InvExp$		0.3453*** (0.1299)	0.0035** (0.0016)
Lagged controls	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes
Standard errors clustered by firm	Yes	Yes	Yes
Observations	7,774	7,774	7,774

Notes: L . denotes a one-quarter lag. Controls are lagged leverage, size, tangibility, operating cash flow, and operating-cost ratio. Standard errors are in parentheses. ***, ** denote significance at the 1% and 5% levels, respectively.

The result is specific to direction. Replacing $AdverseTS$ with within-quarter basis volatility yields insignificant interactions for both impairment occurrence and intensity. The signal is therefore not simply a more uncertain curve; it is the relative price of deferred delivery in a state consistent with weak nearby demand and high inventory carrying costs. This contrast also supports the interpretation that the interaction isolates an economically adverse state rather than a general market-risk proxy.

Table 2 reports the operating-channel estimates. The lagged interaction is negative and significant for gross margin (-5.5909 ; standard error 2.0030) and operating cash flow (-0.0353 ; 0.0118), but not for return on assets (-0.8657 ;

0.7615). Thus, the pressure appears first in operating margins and liquidity rather than immediately in a broad profitability measure. Appendix Table A1 shows that the impairment response is concentrated among high-leverage, low-cash-flow, and large firms, which have less financial capacity to absorb an adverse inventory state or greater physical exposure to it. Commodity-specific interactions in Appendix Table A2 are significant for rebar (0.3047; $p < 0.05$) and iron ore (0.2637; $p < 0.01$), marginally significant for coke, and insignificant for coking coal. The strongest signal therefore appears in the finished-product and key-input segments of the chain.

Table 2: Operating channels of adverse futures term structure

Variable	Gross margin	Operating cash flow	Return on assets
$L.AdverseTS \times InvExp$	-5.5909*** (2.0030)	-0.0353*** (0.0118)	-0.8657 (0.7615)
Lagged controls	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes
Standard errors clustered by firm	Yes	Yes	Yes
Observations	7,775	7,775	7,768

Notes: L . denotes a one-quarter lag. Controls are lagged leverage, size, tangibility, operating cash flow, and operating-cost ratio. Standard errors are in parentheses. *** denotes significance at the 1% level.

5. Conclusion

This study examines whether a directional commodity futures signal reaches corporate financial reporting through inventory exposure. For Chinese listed firms in the ferrous-metals supply chain, the one-sided adverse-contango measure is positively associated with impairment recognition among firms with greater predetermined inventory exposure; the association persists one quarter ahead and extends to the intensity of positive impairment losses. It is not reproduced by basis volatility, which indicates that curve direction—not generic uncertainty—is the relevant information. The accompanying declines in gross margins and operating cash flow are consistent with a channel from weak nearby demand and high carrying costs to inventory pressure

and impairment testing. The findings complement work on term-structure information in commodity pricing (Boons and Prado, 2019; Kang et al., 2020) and on the asymmetric recognition of long-lived asset impairments (Riedl, 2004). More broadly, they show how a forward-looking futures curve can penetrate firm balance sheets when persistent physical exposure makes market conditions economically consequential. The evidence is drawn from the ferrous-metals supply chain and identifies differential associations with a common market state rather than exogenous changes in inventory or hedging policy, but it provides a compact framework for reading futures-curve information as an indicator of corporate reporting risk.

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