

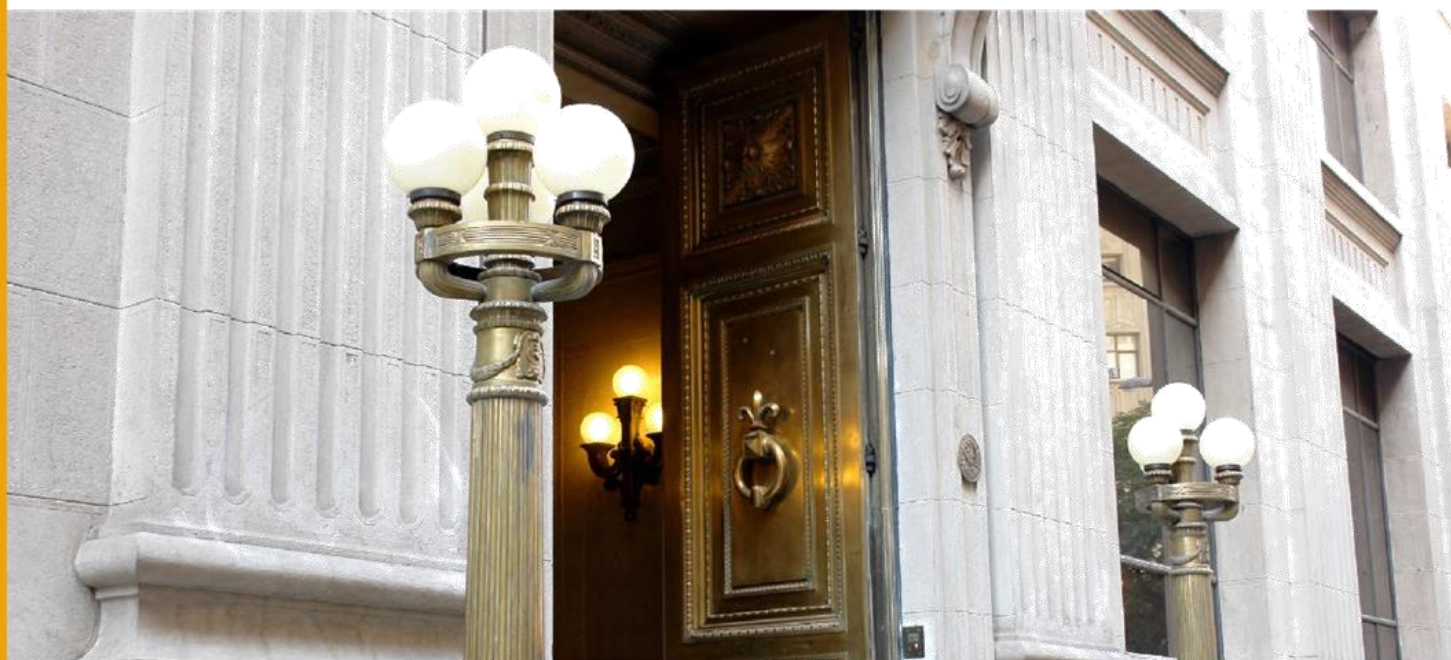
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Calm News Regimes and Price Discovery: Evidence from the Chilean Peso and Copper Futures

Rodrigo Barría
Francisco Pinto

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Calm News Regimes and Price Discovery: Evidence from the Chilean Peso and Copper Futures*

Rodrigo Barría
Central Bank of Chile

Francisco Pinto
Central Bank of Chile

Resumen

Examinamos cómo el flujo público de noticias relacionadas con materias primas influye en la interconexión entre el mercado spot USD/CLP local y los futuros internacionales del cobre. Dado el rol de Chile como principal exportador mundial de cobre, el USD/CLP es ampliamente considerado una moneda vinculada a materias primas. Utilizando datos propietarios a nivel transaccional del mercado USD/CLP del Banco Central de Chile, datos de alta frecuencia de futuros de cobre de COMEX y factores diarios contruidos a partir de noticias de Bloomberg, mostramos que períodos de menor intensidad noticiosa en el ámbito de las materias primas se asocian con un vínculo más estrecho entre el tipo de cambio y el precio del cobre. En particular, la información contenida en el flujo de órdenes de los denominados usuarios finales emerge como un determinante clave de esta relación. Específicamente, encontramos que un aumento de una unidad en nuestra medida de tranquilidad noticiosa se asocia con incrementos del 5 % y del 3 % de desviaciones estándar en nuestra medida de conectividad TVP-VAR y en una medida alternativa basada en correlaciones, respectivamente. Además, los indicadores de transacción informada aumentan entre 17 y 18 puntos porcentuales por unidad de desequilibrio en el flujo de órdenes de futuros internacionales de cobre cuando los usuarios finales mantienen posiciones vendedoras netas de dólares en el mercado spot local.

Abstract

We examine how the public commodity-news environment shapes connectedness between the Chilean USD/CLP spot market and international copper futures. Given Chile's position as the world's leading copper exporter, USD/CLP is widely regarded as a commodity currency. Using proprietary transaction-level USD/CLP data from the Central Bank of Chile, high-frequency COMEX copper futures data, and Bloomberg news coverage summarized into daily factors, we show that calmer commodity-news regimes are associated with a stronger FX-copper link, with the informative order Flow of end-users serving as a key driver of this relationship. Specifically, we find that a oneunit increase in our news-tranquility measure is associated with 5% and 3% standarddeviation increases in our TVP-VAR connectedness measure and correlation-based connectedness measure, respectively. Furthermore, local informed-trading measures rise by 17 to 18 percentage points per unit of imbalance in international copper futures order flow when end-users are selling USD in the local market.

* The authors are grateful to Hugo Peralta and Bruno Montenegro for their assistance with the dataset. The views expressed are those of the authors and do not necessarily reflect the views of the Central Bank of Chile or its board members. This study was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the authors and did not involve nor compromise other institutions.

E-mail addresses: rbarria@bcentral.cl, fpinto@bcentral.cl.

1 Introduction

Given Chile’s position as the world’s leading copper exporter, the USD/CLP exchange rate is widely regarded as a commodity currency, and prior work documents a close association between USD/CLP and global copper market conditions (Cashin *et al.*, 2004; Chen & Rogoff, 2003). Using connectedness measures constructed from high-frequency intraday data, we show that this association is far from stable over time. Building on this finding, we investigate whether public news regimes play a role in driving this time variation. Specifically, we examine when copper market information is more strongly reflected in the USD/CLP exchange rate, and whether such information is incorporated primarily through public news announcements or through the order flow of informed investors. Our main findings are twofold: calmer commodity news regimes are associated with a stronger link between the local USD/CLP spot market and foreign-traded copper futures, and this link is consistent with a mechanism in which the informative order flow of end-users plays a central role.

In particular, this paper studies how the public commodity news environment shapes the connectedness between the Chilean USD/CLP spot market and the international copper futures market. We focus on daily news regimes defined by the intensity and composition of commodity related news. Our guiding intuition is that when public commodity news is abundant and covers multiple topics, price dynamics may reflect heterogeneous narratives that mask the copper-specific fundamental signals relevant for USD/CLP. Conversely, when public commodity news is relatively quiet, copper price movements may more cleanly reflect copper fundamentals, thereby strengthening the FX–copper linkage. We empirically evaluate this conjecture and then examine whether the stronger connectedness observed during calm regimes is associated with the informed trading of specific investor groups.

Our analysis combines three data sources. First, we use a unique dataset of transaction-level USD/CLP spot trades from the Central Bank of Chile’s FX registry, which covers the vast majority of spot transactions and includes trade prices, volumes, timestamps, and participant-type classifications. Second, we use high-frequency copper futures data from COMEX to measure global copper price dynamics and copper futures trading activity. Third, we construct daily measures of copper- and oil-related news intensity from Bloomberg News using keyword-based counts across multiple sources and horizons. To summarize the public commodity-news environment, we apply robust principal component analysis to standardized news intensity series and extract two factors: *Calm*, capturing overall news intensity (oriented so that higher values correspond to lower news flow), and *Composition*, capturing systematic rotation in coverage between oil and copper (and related shifts across sources and horizons).

We measure USD/CLP–copper connectedness using two complementary metrics. Our primary measure is a TVP-VAR-based Pairwise Connectedness Index (PCI), which captures time variation in spillovers between USD/CLP and copper returns; as a benchmark, we also compute a correlation-based connectedness measure using intraday (5-minute) returns. We then relate these connectedness measures to the public news factors and to trading activity in both markets. To quantify trading based transmission and informativeness, we use order-flow measures in USD/CLP and copper futures, and we complement them with standard microstructure proxies for information-based trading in USD/CLP. Finally, to assess market quality implications, we examine how the public news environment relates to daily USD/CLP liquidity using the Amihud measure, a regression based price-impact measure, and an estimate of the realized volatility.

We document four empirical findings.

First, the USD/CLP–copper linkage is stronger when public commodity-news intensity is low: calmer news regimes are associated with higher connectedness under both the PCI and the correlation-based measure. A one-unit increase in our news-tranquility measure is associated with a 5% standard deviation increase in the PCI connectedness measure and a 3% increase in the correlation-based connectedness measure.

Second, calm regimes coincide with a compositional shift in FX trading: end-users, whose spot FX demand is tied to cross-border activity and currency exposure management, increase their trading activity when public news intensity declines, whereas other investor groups show little systematic response. A one-unit increase in our news tranquility measure is associated with a 1% standard deviation increase in end-user trading volume in the local USD/CLP market.

Third, the strengthening of the USD/CLP–copper link in calm regimes is consistent with an informed trading mechanism: a key driver of connectedness between the local USD/CLP spot market and the international copper futures market is the order flow of end-users in calm news regimes. A one-unit increase in our news tranquility measure is associated with an 8% standard deviation increase in the PCI connectedness measure and an 11% standard deviations increase in the correlation-based connectedness measure per unit of end-user order flow imbalance in local the USD/CLP market. Furthermore, international copper futures order flow has an economically important effect on local USD/CLP informed trading measures through local USD/CLP end-user order flow: there is a 17 to 18 percentage point increase in local USD/CLP informed trading measures for each additional unit of order flow imbalance in the international copper futures market when end-users are sellers of USD in the local spot market.

Fourth, calm regimes are associated with higher price-impact measures of illiquidity in the local USD/CLP market: a one-unit increase in our news tranquility measure is associated with a 5% to 6% standard deviation increase in these measures. Taken together with the evidence on trading volume and informed trading, this pattern is consistent with a larger information component in local USD/CLP trading activity rather than with a genuine deterioration in market liquidity.

This paper contributes to the broad literature on behavioral frictions in financial markets, which studies how deviations from fully rational investor behavior can help explain empirical puzzles that are difficult to reconcile within standard rational frameworks. Important contributions in this area include Barberis *et al.* (2015), Adam *et al.* (2017), Maxted (2024). This paper is also related to the literature examining the asset-pricing implications of time-varying investor attention. Seminal contributions include Hirshleifer and Teoh (2003), Andrei and Hasler (2015), Kacperczyk *et al.* (2016), Benamar *et al.* (2021), among others. Finally, the paper connects to the literature that exploits high-frequency financial market data to deepen our understanding of macroeconomic and financial dynamics. Relevant contributions in this area include Gürkaynak and Wright (2013) and Nakamura and Steinsson (2018).

Our contribution is to provide evidence on state dependent, trading-based price discovery linking a small open economy’s FX market to global commodity markets, using proprietary participant-level FX trading data combined with high-frequency connectedness measures and text-based news regimes. The analysis highlights how the public information environment can shape not only cross-market linkages, but also the composition of trading and the

perceived liquidity conditions under which information is incorporated into exchange rates. Whereas much of the existing literature examining commodity currencies relies on aggregated data at relatively low frequencies (Rossi, 2013), we exploit proprietary, disaggregated transaction-level data at intraday frequency. In a related study, Fernandez *et al.* (2023) examine copper mining strikes and USD/CLP at the daily frequency based on aggregated observations. Our intraday transaction-level data allow us to study information transmission and price discovery at a finer level of detail.

The remainder of the paper is organized as follows. Section 2 describes the data sources and sample construction. Section 3 presents the methodology, elaborating more on the connectedness measures, the construction of the news factors, and the order-flow, informativeness, and liquidity measures. Section 4 reports the empirical results and discusses the evidence on trading-based transmission. Finally, Section 5 concludes.

2 Data

Our empirical analysis draws on datasets from multiple sources. The first dataset, corresponding to proprietary information provided by the Central Bank of Chile, contains transaction-level USD/CLP spot FX trades, including trade prices and volumes. A second dataset covers copper futures traded on COMEX (CME Group, United States) and reports futures prices and traded volumes. An additional source of information is Bloomberg News, from which we collect news items related to the Chilean peso and copper markets in both domestic and international contexts.

The primary FX dataset used in this study is the centralized registry of foreign exchange transactions (POSCAM dataset) maintained by the Central Bank of Chile. While the registry covers multiple FX instruments (including spot, forwards, swaps, and NDFs) we restrict the analysis to spot transactions only. The dataset provides transaction-level records and reports anonymized counterparty identifiers, transaction type, timestamps, transaction amounts, the applied exchange rate (USD/CLP quoted as CLP per USD), and settlement details. Transactions are classified by participant type (e.g., Real sector, Non-resident, Insurance companies, Pension funds, Mutual funds, and Broker dealers), with the classification provided by the Central Bank. The sample covers January 2016 through December 2024. We exclude canceled records and observations with missing or zero prices or volumes. A complementary FX dataset, also obtained via the Central Bank of Chile, comes from the *Bolsa Electrónica de Chile* (BEC) and contains tick-by-tick USD/CLP spot trades executed on the main local FX electronic trading platform used by banks. The available data span from January 2016 through December 2024. The data cover trades executed each business day between 09:00 and 15:00 (Chile local time). For each trade, the dataset reports trade direction (buy/sell), timestamp, traded volume, and transaction price. As in the primary dataset, we exclude cancelled records and observations with missing or zero prices or volumes. For both datasets described above, reporting is mandatory, and the resulting information covers approximately 98% of the universe of USD/CLP spot transactions, which mitigates concerns about selection bias and supports the representativeness of our measures.

Copper futures data are obtained from FirstRate Data and originate from COMEX (CME Group). The dataset consists of 1-minute time-stamped intraday bars for the COMEX copper futures contract (HG), quoted in USD per pound and based on a contract size of

25,000 lbs. Each 1-minute bar reports open, high, low, and close prices, as well as trading volume aggregated as the sum of contracts traded within the minute. The sample spans from January 2016 through December 2024, with timestamps reported in U.S. Central Time and covering the electronic trading session from Sunday 5:00 p.m. to Friday 4:00 p.m. To conduct the analysis, we use a continuous futures price series constructed by chaining the most liquid front-month contracts. The series is adjusted to mitigate mechanical price discontinuities on roll dates. We apply standard filters to the intraday bars by retaining only observations with positive trading volume and excluding zero-volume bars.

To proxy market attention, we construct daily news-intensity measures for copper and oil using Bloomberg News. Specifically, we count the number of Bloomberg-reported news items published each day that contain commodity-specific keywords. For copper, we use the terms “copper” and “*cobre*”; for oil, we use “oil” and “*petróleo*”.¹ Bloomberg News, accessible through Bloomberg terminals, aggregates content from multiple sources, including newspapers, Twitter, and its own reporting, among others.

Table 1 presents descriptive statistics for the 5-minute USD/CLP spot rate, copper futures, and oil futures used in the analysis. Across all three assets, returns are centered very close to zero at the intraday frequency, with median returns equal to zero in each case. The USD/CLP series has a mean close price of 764 CLP per dollar and a median 5-minute trading volume of USD 13 million, while copper futures have a mean price of 3.6 USD per pound and a median volume of 305 contracts. Oil futures are both the most volatile and the most actively traded series in the sample, with return percentiles ranging from -0.31 to 0.30, a mean volatility measure of 0.19, and a median 5-minute volume of 2,065 contracts. More generally, the table reveals substantial right-tail dispersion in trading activity across all three markets, particularly for copper and oil, consistent with episodic surges in information arrival and market participation. These features motivate our use of time-varying connectedness measures based on high-frequency data.

Table 1: Price, Returns and Trading Volume Dataset (5-minute)
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Table 2 reports descriptive statistics for daily USD/CLP spot trading activity by participant type, decomposed into total volume, purchases, and sales. All values are expressed in millions of U.S. dollars and correspond to trading against the banking sector. Banks are the dominant counterpart, with average daily volume of USD 2,079 million. Among non-bank participants, Real Sector Companies and Broker Dealers are the largest groups on average, followed by Non-residents and Pension Funds, while Mutual Funds and Insurance Companies account for comparatively small volumes.

The table also reveals substantial dispersion in trading activity across days. This is especially marked for Pension Funds and Non-residents, whose 95th percentile volumes are several times larger than their 5th percentile values, indicating episodic surges in participation. In addition, buy and sell volumes are broadly balanced across most categories, suggesting that the table mainly reflects variation in gross trading intensity rather than persistent net directional positions. Finally, the distributions are generally right-skewed, with means above medians and relatively large upper tails, implying that high-volume trading days are infrequent but quantitatively important. These features underscore the relevance

¹“*Cobre*” and “*petróleo*” are the Spanish terms for “copper” and “oil”, respectively.

of distinguishing across participant groups when studying order flow and price discovery in the USD/CLP market.

Table 2: Trading Activity by Participant Type (Daily)

Table 3 reports descriptive statistics for the daily news-count variables constructed from Bloomberg terminal searches for the keywords “oil” and “copper” across general news outlets, Bloomberg, and Twitter. The table shows that oil-related coverage is far more abundant than copper-related coverage throughout the sample. For instance, daily oil news averages 7,133 items, compared with 1,030 for copper news, and the same dominance of oil holds for Bloomberg and Twitter counts as well.

The table also reveals substantial time variation in news intensity. Oil-related series display particularly wide distributions, with high upper tails for both Bloomberg and Twitter coverage, while copper-related series fluctuate around a lower baseline. More generally, the fact that means exceed medians in most cases indicates right-skewed distributions and episodic surges in attention. These patterns support the paper’s use of a factor-based approach to summarize the common variation in commodity-news intensity and composition.

Table 3: News Activity for Copper and Oil

3 Methodology

In this section, we describe the connectedness measures used in the study, namely returns correlation and the partial connectedness index. These measures are employed to capture the degree of interdependence between USD/CLP and copper returns. We then introduce the market liquidity indicators applied to assess liquidity conditions in the USD/CLP market. Furthermore, we outline the procedure used to quantify informed trading. Additionally, we present the explanatory variables incorporated into the analysis, which include text-based news and order flow in both copper futures and USD/CLP markets. Finally, we detail the estimation procedure implemented to apply the proposed methodology.

3.1 Interrelation between Chilean peso and copper markets

To assess the interdependence between the Chilean peso–U.S. dollar (USD/CLP) spot market and the international copper futures market, we employ two complementary measures. The first is a pairwise connectedness index which captures directional spillovers between the local FX spot market and global copper futures prices. This approach is widely used in the literature studying financial market linkages (Diebold & Yilmaz, 2023). The second measure, used as a robustness check, is the Pearson correlation between the 5-minute USD/CLP spot price traded in Chile and the 5-minute closest-maturity copper futures contract traded on the CME exchange. While the connectedness measure provides insights into dynamic interactions, the correlation measure offers a simple benchmark for co-movement.

The analysis uses high-frequency data sampled at 5-minute intervals over the period 2016-2024. To ensure accurate synchronization, we account for differences in trading hours across time zones by converting all timestamps to Chilean local time (UTC-3 during summer

and UTC-4 during winter). Other variables in our dataset follow CME Exchange conventions, using Eastern Standard Time (UTC-5) and U.S. Central Time (UTC-6 during winter and UTC-5 during summer). Non-overlapping periods are excluded to avoid bias in the estimation.

As we formally hypothesize in the following section, a local FX market linked to the international copper market is expected to exhibit sensitivity to copper-related news events, reflecting the economic significance of copper exports for Chile.

As our first measure of connectedness, we employ the Pairwise Connectedness Index (PCI) proposed by Antonakakis *et al.* (2020) and Gabauer (2021). This index is computed using 5-minute USD/CLP returns and 5-minute closest-maturity copper futures returns traded on the CME exchange, while controlling for oil returns. The formal definition of PCI is presented in Equation 1.

$$\text{PCI}_{ij,t} = 2 \left(\frac{\tilde{\psi}_{ij,t} + \tilde{\psi}_{ji,t}}{\tilde{\psi}_{ii,t} + \tilde{\psi}_{jj,t} + \tilde{\psi}_{ij,t} + \tilde{\psi}_{ji,t}} \right), \quad 0 \leq \text{PCI}_{ij,t} \leq 1 \quad (1)$$

In this expression, $i = r_{\text{USD/CLP},t}$ and $j = r_{\text{Copper},t}$ denote the returns of the USD/CLP local exchange rate and the CME copper futures, respectively. The element $\tilde{\psi}_{ij,t}$ represents the variance share that variable j contributes to the forecast error variance of variable i , based on generalized impulse response function (GIRF) shocks derived from a dynamic TVP-VAR process of USD/CLP returns, copper futures returns, and oil futures returns, following the methodology of Antonakakis *et al.* (2020) and Gabauer (2021). During the estimation of GIRF, we control for the volatility contribution of oil returns to USD/CLP returns. For oil returns, we use the closest-maturity oil futures contract traded on the CME exchange. Figure 1 shows the PCI values we estimate over the sample period.

Figure 1: PCI Connection Measure

The second measure to capture the relation between the local FX spot market and the copper futures market is computed as the Pearson correlation (Corr) depicted in equation 2.

$$\text{Corr}(r_{\text{copper},t}, r_{\text{USD/CLP},t}) = \frac{\text{COV}(r_{\text{copper},t}, r_{\text{USD/CLP},t})}{\sigma_{\text{copper}} \cdot \sigma_{\text{USD/CLP}}} \quad (2)$$

Where cov and σ stands for the covariance and standard deviation, respectively. Figure 2 presents the calculated correlation over the sample period.

Figure 2: CORR Connection Measure

Figures 1 and 2 provide two complementary views of time variation in the USD/CLP–copper relationship. Both figures display a daily measure of the FX–copper link and its 20-day rolling mean, illustrating that the strength of co-movement changes over time rather than remaining stable. The main difference is methodological and interpretive. Figure 1 reports the Pairwise Connectedness Index (PCI) estimated from a TVP-VAR framework, which is a model-based measure of dynamic spillovers and is bounded between 0 and 1. By construction, the PCI reflects connectedness implied by the underlying multivariate dynamics of the variables we include in the VAR. In contrast, Figure 2 reports a rolling Pearson correlation computed from high-frequency returns, which provides a simpler benchmark measure of co-movement.

In practice, the two measures are expected to move together but need not coincide one-for-one. The correlation captures linear comovement at the chosen sampling frequency, whereas the PCI summarizes connectedness through the TVP-VAR variance-decomposition channel. As a result, episodes of heightened linkage may appear in both figures, while differences in amplitude and smoothness can arise because one measure is model-based and multivariate (PCI) whereas the other is a direct bivariate co-movement statistic computed from returns (correlation).

3.2 News on commodity markets

To capture the informational effect of commodity markets on the USD/CLP exchange rate, we construct a news-based measure that aggregates copper- and oil-related news events at a global level. This measure aims to reflect the influence of commodity-specific information on local FX dynamics, given Chile’s strong economic dependence on copper exports.

We collect daily news coverage from three sources: traditional news outlets, Twitter, and Bloomberg, as reported by the Bloomberg Terminal “NT” screen . To identify relevant stories, we search for the keywords “copper”, “cobre”, “oil”, and “petróleo” in the NT tool. We then aggregate these results into two categories, namely copper and oil, obtaining daily counts of news items across all sources.

To account for heterogeneity in the pace at which investors assimilate and incorporate information into their trading decisions, we compute short-term (5-day), medium-term (20-day), and long-term (40-day) moving averages for each category. This results in a structured dataset covering $2 \text{ assets} \times 3 \text{ sources} \times 3 \text{ horizons}$. Before aggregation, we standardize each variable by its previous year’s mean to control for seasonality and scale differences.

This multi-horizon approach captures different behavioral patterns: short-term horizons reflect immediate market responses to news shocks, often associated with high-frequency trading and short-lived sentiment effects; medium-term horizons represent adjustments by institutional investors and portfolio managers who rebalance positions over weeks; and long-term horizons capture persistent informational trends and structural shifts in market expectations, which may influence macroeconomic positioning and hedging strategies. By including these horizons, our measure reflects both transient and persistent informational effects across different market participants. This approach is consistent with the literature on investor attention and the assimilation of news and information components in trading behavior (Da *et al.*, 2011).

The resulting dataset has daily frequency and dimensionality $2 \times 3 \times 3$ for each day. To reduce complexity and uncover the underlying structure of news coverage, we apply robust principal component analysis (RPCA) as proposed by Candès *et al.* (2011). RPCA projects the original news vector onto two principal components. Each component captures a latent factor summarizing copper and oil related news dynamics. RPCA is particularly well suited to news data because it separates systematic patterns from outliers and extreme observations. Standard PCA does not provide this separation and can be overly influenced by anomalous observations. In contrast, RPCA delivers a more robust decomposition that better preserves the dataset’s underlying structure. Operationally, we stack each date’s text vectors into a matrix M as shown in the Matrix M below. RPCA decomposes M via convex optimization into a low-rank matrix L and a sparse matrix S . The matrix L captures the dominant structures and dynamics in the data, equation 3. The matrix S captures outliers, unusual

events, and noise. Finally, we compute the principal components of L using singular value decomposition (SVD), as shown in equation 4.

Matrix M

$$M = \begin{matrix} & \begin{matrix} t=1 & t=2 & t=3 & t=4 & \dots & t=T \end{matrix} \\ \begin{matrix} Copper_{5D}^{News} \\ Copper_{5D}^{Bloomberg} \\ Copper_{5D}^{Twitter} \\ Oil_{5D}^{News} \\ Oil_{5D}^{Bloomberg} \\ Oil_{5D}^{Twitter} \\ .. \\ Oil_{40D}^{News} \\ Oil_{40D}^{Bloomberg} \\ Oil_{40D}^{Twitter} \end{matrix} & \begin{bmatrix} .. & & Copper_{5D}^{News} \\ .. & & Copper_{5D}^{Bloomberg} \\ .. & & Copper_{5D}^{Twitter} \\ .. & & Oil_{5D}^{News} \\ .. & & Oil_{5D}^{Bloomberg} \\ .. & & Oil_{5D}^{Twitter} \\ .. & & .. \\ .. & & Oil_{40D}^{News} \\ .. & & Oil_{40D}^{Bloomberg} \\ .. & & Oil_{40D}^{Twitter} \end{bmatrix} \end{matrix}$$

Matrix M containing the input vector of news for each timestamp t .

$$M = L_{\text{low-rank}} + S \quad (3)$$

$$L = U_{\text{PC}} \Sigma V^{\top} \quad (4)$$

Table 4: PCAs Vectors

The principal component in Table 4 show that higher values of PC1 correspond to an overall decline in the volume of news across copper and oil, and across news source. PC1 loads more heavily on oil news than on copper news. Within oil, the loadings place greater weight on news from general outlets than on Twitter or the specialized Bloomberg source. Across horizons, the oil-related PC1 weights are relatively stable, suggesting that changes in oil news at the 5-day horizon are correlated with changes at the 20- and 40-day horizons. This pattern is consistent with persistence in oil news intensity, periods of elevated (low) oil news coverage tend to cluster, so short-horizon spikes may signal sustained high news volume in subsequent days, and vice versa. For copper, PC1 places relatively greater weight on Bloomberg, a specialized news source, than on general news outlets or Twitter. In terms of horizon, the copper loadings peak at 20 days, suggesting that copper news dynamics may cluster at intermediate horizons and be less persistent over time than oil.

Table 4 shows that higher values of PC2 are associated with a broad decline in copper news and an increase in oil news. For copper, the largest loading occurs at the 20-day horizon. Unlike PC1, PC2 places relatively greater weight on copper news from Twitter and general news outlets, rather than from Bloomberg. Across horizons, the copper-related weights peak at 20 days, suggesting that variation in accumulated news at intermediate horizons is more pronounced than variation at shorter horizons. For oil, PC2 similarly assigns greater weight to news from Twitter and general outlets than from Bloomberg. In terms of horizon, the oil loadings are relatively stable across the 5-, 20-, and 40-day windows, similar as in PC1.

3.3 Order flow measures

To capture the trading patterns of market participants reacting to copper- and oil-related news, we construct an order flow measure per market that serves as a proxy for directional

trading intensity. This measure is widely used in the related literature and provides insights into how order imbalances influence price dynamics in FX and commodity markets (Evans & Lyons, 2002; Ready & Ready, 2022). In particular, we employ the Order Flow Imbalance (OFI) metric proposed by Chordia *et al.* (2002) as our measure of order flow in both the local USD/CLP market and the CME copper futures market. For the USD/CLP market, we use the visible side of each transaction to compute buy and sell dollar volumes, from which we calculate the OFI at the daily frequency. For the CME copper futures market, we estimate buy and sell volumes using 5-minute gross volumes, which we subsequently sign using the Bulk Volume Classification (BVC) procedure described by Easley *et al.* (2016). This classification assigns trade direction based on price movements within the bid-ask spread, ensuring accurate identification of buyer- and seller-initiated trades.

The OFI measure is defined in Equation 5 as:

$$\text{OFI}_t = \frac{\text{Buy}_t - \text{Sell}_t}{\text{Buy}_t + \text{Sell}_t} \quad (5)$$

Where Buy_t represents the total buy-side volume during period t , Sell_t represents the total sell-side volume during period t . A positive (negative) OFI_t indicates net buying (selling) pressure, indicating demand (supply) dominance for USD/CLP spot or copper futures.

3.4 Market liquidity measures

To examine the effect of the news environment on the observed liquidity conditions of the local USD/CLP spot market, we employ three widely used measures: the standard deviation of USD/CLP returns, the Amihud illiquidity measure, and a regression-based price impact coefficient. Although these measures utilize different methodologies, they all fundamentally quantify price impact.

The first measure corresponds to the daily standard deviation of 5-minute USD/CLP returns, calculated between 9:00 a.m. and 3:00 p.m. Chilean local time. Equation 6 presents the formula we employ to estimate the daily standard deviation:

$$\sigma_{\text{USD/CLP}} = \sqrt{\frac{1}{N-1} \sum_{t=1}^N (r_{\text{USD/CLP},t} - \bar{r}_{\text{USD/CLP}})^2} \quad (6)$$

Where $\sigma_{\text{USD/CLP}}$ represents the daily standard deviation of 5-minute USD/CLP returns, $r_{\text{USD/CLP},t}$ denotes the 5-minute USD/CLP returns, $\bar{r}_{\text{USD/CLP}}$ stands for the daily average of USD/CLP returns, and N represents the number of observations within a day. Following this measure, higher volatility signals lower liquidity, as prices fluctuate more in response to trades.

The second measure is the Amihud illiquidity metric (Amihud, 2002), defined as in equation 7:

$$\text{ILLIQ}_d = 10^6 \cdot \frac{1}{P_d} \sum_{p=1}^{P_d} \frac{|R_{pd}|}{\text{VOL}_{pd}} \quad (7)$$

Where R_{pd} is the USD/CLP return for 5-minute period p within day d , and VOL_{pd} is the USD/CLP trading volume (in USD) for the same period p of day d . This ratio is aggregated

at the daily level. In a more liquid market, the Amihud measure tends to be lower, reflecting the ability to absorb larger volumes without significant price changes.

The third liquidity measure is the price-impact coefficient proposed by Brennan and Subrahmanyam (1996). We estimate this coefficient using OLS by fitting the following regression model:

$$r_{\text{USD/CLP},t} = \alpha + \beta \text{OFI}_{\text{USD/CLP},t} + \varepsilon_t \quad (8)$$

Where $r_{\text{USD/CLP},t}$ denotes the 5-minute USD/CLP return and $\text{OFI}_{\text{USD/CLP},t}$ is the corresponding Order Flow Imbalance (OFI) measure defined in Equation 5. The parameter β captures the sensitivity of USD/CLP returns to FX order flow, serving as an indicator of market liquidity. A lower β implies that order flow exerts a smaller effect on price changes, signaling higher liquidity. Conversely, a higher β indicates that trades have a stronger price impact, consistent with illiquid market conditions.

3.5 Informed vs. non-informed trading

To measure informed trading in the local USD/CLP market, we construct three measures of informed trading: the Probability of Informed Trading (PIN) proposed by Easley *et al.* (1996), the Volume-Synchronized Probability of Informed Trading (VPIN) introduced by Easley *et al.* (2012), and the Multilayer PIN (MPIN) developed by Ersan and Alıcı (2016). We then relate informed trading to participant behavior by exploiting trader-type labels in our proprietary dataset, which allow us to distinguish informed from non-informed order flow. Building on the premise that these segments differ in information acquisition and processing, we hypothesize that identical commodity-news shocks may translate into segment-specific order-flow responses and, in turn, different patterns in the timing and magnitude of price adjustment.

The informed-trading measures we employ are grounded in the microstructure view that private information is revealed through trading activity. Accordingly, periods of informed trading are associated with order-flow imbalances that are unusually large relative to normal market conditions. Accordingly, PIN-, VPIN-, and MPIN-type metrics use the statistical properties of order flow, particularly persistent or extreme imbalances, to proxy the extent to which trading reflects information-based activity as opposed to liquidity, hedging, or other non-informational motives.

In what follows, we describe the construction of PIN, VPIN, and MPIN and discuss how each measure maps order-flow dynamics into an estimate of informed trading.

The model of Easley *et al.* (1996) (PIN) quantifies the likelihood of informed trading by modeling the arrival of informed and uninformed orders as independent Poisson processes. In each trading period, an information event occurs with probability α . Uninformed traders submit both buy and sell orders regardless of news, with Poisson arrival intensities ε_b and ε_s , respectively. By contrast, conditional on an information event, informed orders arrive with Poisson intensity μ and are one-sided: they are buyer-initiated following favorable information and seller-initiated following unfavorable information. The model is estimated using transaction-level data in which trades are classified as buyer- or seller-initiated; the resulting likelihood yields the PIN expression reported in Equation 9. In that equation, α denotes the probability of an information event, μ is the intensity of informed order arrivals conditional on such an event, and ε_b and ε_s are the uninformed buy and sell arrival intensities.

$$\text{PIN} = \frac{\alpha\mu}{\alpha\mu + \varepsilon_b + \varepsilon_s} \quad (9)$$

The Volume-Synchronized Probability of Informed Trading (VPIN) of Easley *et al.* (2012) extends the PIN intuition to settings in which trades cannot be directly classified as buyer- or seller-initiated at the transaction-level. Rather than relying on individually identified trades, VPIN infers informed trading from high-frequency aggregates of volume and price changes. The procedure partitions trading activity into N volume-time “buckets” and proxies buyer-versus seller-initiated volume within each bucket by signing volume using a bulk-classification rule based on contemporaneous price changes (returns). VPIN then summarizes directional trading pressure through the absolute order-flow imbalance $|V_\tau^{\text{Sell}} - V_\tau^{\text{Buy}}|$. Consistent with the microstructure rationale underlying PIN, unusually large signed imbalances are interpreted as episodes in which informed trading is more likely. The VPIN estimator used in this paper is reported in Equation 10.

$$\text{VPIN} = \frac{\sum_{\tau=1}^N |V_\tau^{\text{Sell}} - V_\tau^{\text{Buy}}|}{N \times E[V_\tau^{\text{Sell}} + V_\tau^{\text{Buy}}]} \quad (10)$$

In Equation 10, V_τ^{Buy} and V_τ^{Sell} denote the estimated buyer- and seller-initiated volume in bucket τ , so that $V_\tau^{\text{Buy}} + V_\tau^{\text{Sell}}$ is total volume in that bucket. The absolute difference $|V_\tau^{\text{Sell}} - V_\tau^{\text{Buy}}|$ captures the order-flow imbalance in bucket τ . We aggregate imbalances across the N buckets in the estimation window and normalize by $N \times E[V_\tau^{\text{Sell}} + V_\tau^{\text{Buy}}]$, yielding a dimensionless measure of imbalance intensity.

In our implementation, the expectation term is computed as the sample mean of bucket volume across the same N buckets in the window:

$$E[V_\tau^{\text{Sell}} + V_\tau^{\text{Buy}}] \approx \frac{1}{N} \sum_{\tau=1}^N (V_\tau^{\text{Sell}} + V_\tau^{\text{Buy}}).$$

The Multilayer Probability of Informed Trading (MPIN) of Ersan and Alıcı (2016) relaxes the baseline PIN framework by allowing for multiple latent types of information events, rather than a single information regime. Specifically, MPIN extends PIN by modeling informed trading as arising from a mixture of J information-event types (or “layers”), where each type j is characterized by its own probability of occurrence α_j and informed order-arrival intensity μ_j . As in the original PIN model, estimation relies on transaction-level data in which trades are classified as buyer- or seller-initiated. The resulting MPIN expression is reported in Equation 11. The parameters, including the number of layers J , are estimated numerically via maximum likelihood.

$$\text{MPIN} = \frac{\sum_{j=1}^J \alpha_j \mu_j}{\sum_{j=1}^J \alpha_j \mu_j + \varepsilon_b + \varepsilon_s}. \quad (11)$$

In Equation 11, α_j denotes the probability of an information event of type j , and μ_j is the (conditional) arrival intensity of informed orders associated with event type j . The parameters ε_b and ε_s are the arrival intensities of uninformed buy and sell orders, respectively.

4 Empirical Analysis

This section empirically investigates how the public commodity-news environment influences the observed market connectedness between the USD/CLP spot market and the international copper futures market, as well as the underlying USD/CLP price discovery mechanism.

The evidence presented here is consistent with informed traders allocating less attention to public news and focusing instead on high-value information embedded in trading activity in the international copper market, a pattern in line with a segmented-market rational inattention mechanism. Accordingly, end-users traders allocate their limited attention and resources away from low-signal public news and towards high-value information contained in international copper order-flow dynamics. We do not claim that this information is private per se; rather, it is more specialized and less widely accessible, as it is more costly to extract and requires greater expertise to interpret.

Accordingly, low-attention to public news periods should feature (i) stronger FX–copper linkage, (ii) a larger role for informed agents’ order flow in explaining that linkage, (iii) stronger evidence that copper-market information is transmitted through order flow into USD/CLP, and (iv) higher price-impact measures of illiquidity, consistent with a greater information share in order flow.

Hypotheses

Let $\mathcal{L}_t$ denote the FX–copper linkage measured by the Pairwise Connectedness Index (PCI) and the 5-minute return correlation (Corr) we introduce in Section 3.1. As discussed in Section 3.2, the first two principal components summarize distinct dimensions of the public commodity-news environment. *PC1* captures the level of public commodity news flow (i.e., a low-news versus high-news regime), whereas *PC2* captures the composition of that flow, reflecting systematic rotation in coverage between oil and copper (and, more broadly, shifts across sources and horizons). We label *PC1* as *Calm*, interpreting it as an index of overall commodity news intensity. Because *PC1* loads with the same sign on essentially all commodity-news inputs, it primarily reflects a common level factor. We orient *PC1* so that higher values correspond to lower news intensity, consistent with a calm (low-information-flow) regime. We label *PC2* as *Composition*, interpreting it as an oil–copper rotation/tilt factor. In contrast to *PC1*, *PC2* exhibits a systematic sign reversal between oil- and copper-related series and therefore captures relative emphasis rather than overall intensity. We orient *PC2* so that higher values correspond to relatively lower copper news and relatively higher oil news, consistent with an oil-dominant tilt in the public news environment. In our empirical specification, we include *PC2* (*Composition*) as a control when identifying the effects of low-news regimes (*PC1* (*Calm*)) on trading-based price discovery. This control absorbs shifts in whether the public commodity-news environment is relatively oil-dominant or copper-dominant. Such shifts may matter because oil and copper can plausibly transmit differently to USD/CLP. We outline below the testable hypotheses informing this research.

H1 Low-attention strengthens linkage. The FX-copper linkage $\mathcal{L}_t$ is stronger when public commodity-news intensity is low. The rationale for H1 is that calmer public-news environments may correspond to periods in which price variation is less contaminated by broad narrative noise or multi-topic information shocks. In contrast, when

commodity news intensity is high, the news flow may bundle heterogeneous stories (e.g., oil- versus copper-driven coverage, and shifts across sources or horizons) and additional noise, weakening the link between copper-specific fundamentals and USD/CLP. Consistent with this hypothesis, we expect that when news intensity is low, copper price movements provide a cleaner signal of the fundamentals relevant to USD/CLP, thereby strengthening the observed linkage.

H2 Participation shifts toward participants with operational and hedging FX demand in calm news regimes. When public commodity-news intensity is low (high $PC1\ Calm_{t-1}$), USD/CLP trading activity tends to be relatively stronger among participants whose FX transactions are more closely tied to operational and hedging needs, while other participant groups show little systematic response. Formally, the daily percentage change in the trading volume of end-users, who execute cross-border transactions and manage currency exposures from operational cash flows and balance-sheet positions, increases with $Calm_{t-1}$. Conversely, we expect the corresponding response for other participant groups to be weaker or statistically insignificant.

H3 Trading-based mechanism and cross-market transmission. If calm public-news regimes shift information acquisition toward a more specialized mechanism, end-users—*operational and hedging FX users*—should become a key channel through which copper-related signals are transmitted to USD/CLP. Two testable implications follow. First, the effect of these users’ order imbalance on the FX–copper linkage is expected to be stronger when public commodity-news intensity is low. Second, copper-market order flow informativeness is expected to transmit into USD/CLP informativeness primarily through its interaction with this group’s trading activity.

H4 Daily liquidity implications of calm news regimes. When public commodity-news intensity is low, that is, when $Calm_{t-1}$ is high, USD/CLP liquidity measures based on price impact worsen. Testably, higher $Calm_{t-1}$ is associated with greater Amihud illiquidity, a larger return–order-flow price-impact coefficient, and higher realized volatility in USD/CLP returns. This pattern is consistent with trades carrying a larger share of private information when public signals are relatively sparse, rather than with a genuine deterioration in liquidity.

4.1 Low-attention and the FX–copper linkage (H1)

We first test whether the FX–copper linkage is stronger precisely when public news intensity is low. Our dependent variable Y_t is either $PCI_t^{USD/CLP, Copper}$ or $Corr(r_t^{Copper}, r_t^{USD/CLP})$ (Section 3.1). We estimate:

$$\mathcal{L}_t = \alpha + \beta_1 Calm_{t-1} + \beta_2 Composition_{t-1} + \gamma' X_t + \varepsilon_t, \quad (12)$$

where $Calm_{t-1}$ ($PC1_{t-1}$) and $Composition_{t-1}$ ($PC2_{t-1}$) summarize the public-information environment (Section 3.2) and X_t includes controls such as the VIX, MOVE, and day and year fixed effects.

Table 5 shows that $Calm_{t-1}$ enters positively for both linkage measures: when public commodity-related news intensity is low, the USD/CLP market is more tightly linked

to copper. The coefficient on *Calm* ($PC1_{t-1}$) is positive and statistically significant. A one-unit increase in $PC1_{t-1}$, interpreted as a shift toward a calmer news environment, raises $PCI_t^{USD/CLP,Copper}$ by approximately 5% standard-deviations (column 1), and increases the estimated correlation between USD/CLP and copper futures returns by about 3% standard-deviations (column 2). The coefficient on *Composition* ($PC2_{t-1}$) is statistically insignificant. Overall, the positive and significant coefficient on *Calm* indicates that the USD/CLP–copper linkage is stronger when public commodity news intensity is low. This pattern aligns with a specialized trading-based price-discovery view: in periods when common public signals are sparse, market participants may rely more on information revealed through trading activity, potentially including cross-market signals from the copper market, rather than on public written news coverage. In the following sections, we test this mechanism directly by examining whether (i) Order flows of end-users with operational and hedging FX demand account for a larger share of FX-copper linkage when attention is low and (ii) copper-market order flow is transmitted into USD/CLP through order-flow-based measures of informativeness.

Table 5 about here

4.2 Trading participation shifts toward operational and hedging users when public news intensity is low (H2)

Hypothesis H2 concerns the composition of trading activity across participant types. If the public commodity-news environment is relatively quiet (high $Calm_{t-1}$), trading incentives may favor specialized end-users, whose FX activity is linked to operational and hedging needs and informed by more specialized knowledge. By contrast, other segments may reduce in relative terms their participation. This section evaluates that implication by examining whether calmer news regimes are associated with systematic changes in trading activity across groups. The evidence is descriptive and does not by itself identify a causal mechanism; rather, it documents whether participation patterns vary with the public-information environment in a way consistent with H2.

To test H2, we relate group-level changes in trading activity in the USD/CLP spot market to the public-news factors. For each group g , we estimate:

$$\Delta\%Vol_{g,t} = \alpha + \beta_1 Calm_{t-1} + \beta_2 Composition_{t-1} + \gamma' X_t + \varepsilon_t, \quad (13)$$

where $\Delta\%Vol_{g,t}$ denotes the daily percentage change in trading volume for group g , and X_t includes the same set of controls used in the previous section (VIX, MOVE, and day and year fixed effects). We group USD/CLP market participants into (i) End-Users (EU), and (ii) Delegated investors (DI). End-users comprise the Non-Residents, Real Sector firms, Insurance Companies, and the residual Other end-user category. These participants typically access spot FX as part of cross-border transactions, operational cash-flow needs, or hedging and balance-sheet management. Delegated investors comprise Pension Funds, Mutual Funds, and Broker Dealers.² Their FX trading is generally tied to portfolio allocation and risk management decisions undertaken on behalf of underlying investors or clients, rather than

²Broker dealers in our data are local non-bank brokers trading against banks. While their activity may be heterogeneous, it is more naturally linked to portfolio and client-flow considerations than to operational FX needs, motivating our classification within the delegated-investor group.

to operational FX needs. This classification is descriptive and intended to capture broad differences in the economic role of FX usage across participant types.

Table 6 about here

Table 6 shows a clear asymmetry across groups. The coefficient on $Calm_{t-1}$ is positive and statistically significant for EU activity, indicating that EU trading volume tends to increase in calmer (low-intensity) copper and oil news environments. In particular, a one unit increase in $Calm_{t-1}$ is statistically significant and associated with an average daily increase of approximately 1% in the combined EU volume. The results also show that this group also increase their volume in roughly 1% when $Composition_{t-1}$ increases, meaning a relatively calmer environment for copper news but not for oil news, although the statistical significance is marginal. In contrast, DI trading volume exhibits no statistically meaningful relationship with the public news factors. Taken together, these estimates suggest that calm news regimes are associated with a compositional shift in USD/CLP trading toward EU participants, consistent with H2.

In the next subsection, we build on this participation result by examining whether the increased role of EU activity in calm periods is also reflected in the way trading relates to cross-market signals and price discovery.

4.3 Daily mechanism: End-user order flow and cross-market transmission (H3)

Sections 4.1 and 4.2 document two daily patterns: (i) the FX–copper linkage is stronger when the public commodity-news environment is calmer, and (ii) USD/CLP trading activity shifts toward end-users in those calm regimes. Hypothesis H3 investigates whether these patterns are consistent with a specialized trading-based price discovery mechanism, by testing whether End User order flow and international copper-market order flow jointly explain variation in the USD/CLP–copper linkage and in USD/CLP informativeness. A rational interpretation is that low public-news environments favor specialized traders with the technical knowledge and expertise to extract high-value information from fundamentals such as the international copper market. In such environments, the informational content of international copper order flow becomes more relevant and more strongly reflected in the local USD/CLP market dynamics. The results in this section are observational and should be interpreted as documenting daily empirical regularities consistent with this mechanism, rather than establishing causality.

4.3.1 Daily linkage mechanism: EU order imbalance matters more in calm news regimes

To test whether the strengthening of the daily FX–copper linkage in calm regimes operates through EU trading, we estimate:

$$\mathcal{L}_t = \alpha + \beta_1 OFI_t^{EU} + \beta_2 (OFI_t^{EU} \times Calm_{t-1}) + \beta_3 Calm_{t-1} + \gamma' X_t + \varepsilon_t, \quad (14)$$

where $\mathcal{L}_t$ is measured daily using either $PCI_t^{USD/CLP, Copper}$ or $Corr(r_t^{Copper}, r_t^{USD/CLP})$. OFI_t^{EU} denotes daily end user order imbalance in USD/CLP (Section 3.3), and X_t includes VIX, MOVE, and day and year fixed effects controls.

Table 7 shows that the interaction term $OFI_t^{EU} \times Calm_{t-1}$ is positive and statistically significant, whereas the baseline coefficient on EU order imbalance is statistically insignificant. A one-unit increase in the order-flow news interaction component $OFI_t^{EU} \times Calm_{t-1}$ is associated with an 8% standard deviation point increase in $PCI_{USD/CLP, Copper}$ and an 11% standard deviation point increase in the $Corr_{USD/CLP, Copper}$ connectedness indices. For levels of $Calm_{t-1}$ close to zero, the effect of the order flow OFI_t^{EU} on the Chilean local market is not statistically significant. This pattern implies that the marginal effect of End User order imbalance on the FX-copper linkage increases in calm (low-intensity news) periods, consistent with order flow becoming more informative as the relative amount of public news decline.

Table 7 about here

4.3.2 Daily transmission mechanism: copper order flow conditions the informativeness of EU trading

We next test whether copper-market information is transmitted to USD/CLP through trading. Let $Info_t$ denote a USD/CLP information-based trading proxy (PIN, MPIN, or VPIN; Section 3.5). Let OFI_t^{Copper} denote copper-futures order imbalance (Section 3.3). If price discovery in the local USD/CLP market shifts toward a more specialized mechanism, with end-users acting on information from the international copper market, then copper-market order flow should condition the informativeness of End User USD/CLP order flow in the local FX market. We estimate:

$$Info_t = \alpha + \beta_1 OFI_t^{EU} + \beta_2 (OFI_t^{EU} \times OFI_{t-1}^{Copper}) + \beta_3 OFI_{t-1}^{Copper} + \gamma' X_t + \varepsilon_t, \quad (15)$$

$$Info_t = \alpha + \beta_1 OFI_t^{EU} + \beta_2 (OFI_t^{EU} \times OFI_t^{Copper}) + \beta_3 OFI_t^{Copper} + \gamma' X_t + \varepsilon_t. \quad (16)$$

Equation (15) captures predictive transmission (lagged copper order flow), whereas Equation (16) captures same-day transmission. In both cases, the interaction coefficient β_2 tests whether the informational content of End User USD/CLP order flow varies systematically with the international copper-market order imbalance.

Table 8 provides evidence that copper-market order flow conditions the relationship between End User USD/CLP order flow and USD/CLP informativeness. Focusing on the predictive specification in Equation (15), Table 8 Panel A shows that the interaction coefficient β_2 is negative and statistically significant for both PIN and MPIN, while it is not statistically different from zero for VPIN. This result indicates that lagged copper order imbalance significantly shapes how local End User order imbalance maps into order-flow-based measures of information in the USD/CLP market. In the same-day specification (Equation (16)), Table 8 Panel B shows that the interaction is statistically significant for VPIN but not for PIN or MPIN. This pattern is not contradictory: PIN/MPIN and VPIN capture related but distinct dimensions of information-based trading (trade-arrival based versus

volume-synchronized imbalance intensity), so it is plausible that some effects appear with a lag in PIN/MPIN while others register contemporaneously in VPIN.

Table 8 about here

The negative sign of β_2 in Panel A is informative about the direction of transmission. Because the interaction enters as $\beta_2 (OFI_t^{EU} \times OFI_{t-1}^{Copper})$, a negative β_2 implies that USD/CLP informativeness increases when the local End User imbalance and lagged copper-market imbalance have opposite signs. This pattern is consistent with PIN and MPIN being higher when the international copper market displays net buying pressure and end-users are net sellers of USD in the local market; economically, the corresponding increases are 17 and 18 percentage points, respectively, per unit of imbalance in the international copper market. This is an economically relevant effect, given that these measures range from 0 to 100%.

A natural microstructure interpretation is anticipatory trading based on copper-market information. When copper-market order flow indicates net buying pressure (positive OFI), informed agents infer upward pressure on copper prices. Given Chile's copper exposure, higher copper prices mechanically imply an expected appreciation of the peso. End User participants, particularly those agents with USD-linked cash flows (e.g., exporters and mining-related firms), respond by selling USD in the spot USD/CLP market (negative OFI_t^{EU}) to reduce exposure to a USD depreciation against the peso. Under this mechanism, copper-market order flow is incorporated into USD/CLP through trading: when copper buy pressure is followed by USD selling pressure in USD/CLP, the interaction term becomes negative, and with $\beta_2 < 0$ this translates into a positive contribution to the informed-trading proxies. Overall, the statistical significance of β_2 provides evidence of cross-market transmission operating through order flow, consistent with the view that information is incorporated into USD/CLP through trading. Table 8 Panel B, shows that according to the local market USD/CLP Volume Based VPIN measure, the mean EU order flow also contains same day information about the copper market order flow. According to this, the interaction between mean EU order flow imbalance in the local USD/CLP market and the international copper market order flow produce a positive effect on the Modified Volume PIN measure when both imbalances are positive. Suggesting that for same day information, an increase in the copper market buy imbalance accompanied by buy dollar imbalance in the local USD/CLP market translates into higher levels of information in the local USD/CLP market.

4.4 Liquidity implications: in calm news regimes higher information share manifests in higher price impact (H4)

In periods with fewer public news signals, the participation of specialized end-users (EU) with higher-value information tends to increase relative to delegated investors (see Section 4.3.2). This shift marginally tilts the price discovery process in the local USD/CLP market toward these fundamentally informed end user participants. As a result, a larger share of USD/CLP order flow becomes information-driven. Consequently, exchange rate movements exhibit stronger price responses, reflecting the incorporation of new fundamental information rather than a deterioration in market liquidity.

We estimate:

$$Y_t = \alpha + \beta_1 Calm_{t-1} + \beta_2 Composition_{t-1} + \gamma' X_t + \varepsilon_t, \quad (17)$$

where Y_t is one of the USD/CLP liquidity proxies (Amihud illiquidity, the price-impact coefficient, or the daily standard deviation of 5-minute returns; Section 3.4).

Table 9 shows that $Calm_{t-1}$ is positively and significantly associated with higher Amihud illiquidity, a higher price-impact coefficient, and higher realized volatility of USD/CLP returns. In particular, a one-unit increase in $Calm_{t-1}$ is associated with a statistically significant 5% to 6% standard-deviation increase in these measures. The $Composition_{t-1}$ component does not show any statistically significant effect on these measures.

Combined with the evidence that calm regimes coincide with higher end user trading activity (Table 6) and stronger informativeness proxies linked to EU and copper order flow (Table 8), the results in Table 9 suggest that the higher price impact observed in calm periods is reflecting a larger information component in trading (i.e., more informed trading) rather than with a deterioration in liquidity.

Table 9 about here

5 Conclusion

This paper examines how copper- and oil-related news shapes connectedness between the Chilean USD/CLP market and the international copper futures market. We measure connectedness using TVP-VAR-based pairwise connectedness index (PCI) and a correlation-based metric. Our main findings are twofold: calmer commodity-news regimes are associated with a stronger link between the local USD/CLP spot market and foreign-traded copper futures, with the evidence pointing to an important role for the informative order flow of end-users.

The stronger FX-copper linkage appears to be more pronounced when trading by end-users in the domestic USD/CLP market is relatively more important, particularly among Non-Residents, Real Sector firms, Insurance Companies, and other end-user participants whose spot FX activity is more closely linked to cross-border transactions and currency-exposure management.

Consistent with this pattern, declines in copper and oil news intensity coincide with higher End-User trading activity, while Delegated Investors display little systematic response.

In parallel, our proxies for informed trading in USD/CLP increase with End User' order flow, particularly in periods when international copper futures order flow becomes unbalanced (i.e., tilted toward net buying or net selling).

Furthermore, calm commodity-news periods are associated with higher price impact in the USD/CLP spot market. Combined with the evidence that End-User trading volume increases in these regimes and that informativeness proxies vary systematically with End-User order flow, the results point toward a larger information component in End-User FX trading as the driver of higher price impact, rather than a deterioration in liquidity.

In economic terms, a one-unit increase in our news-tranquility measure is associated with a statistically significant 1% rise in End User trading volume, a 5% standard-deviation increase in the USD/CLP-copper TVP-VAR connectedness measure, and a 3% standard-deviation increase in the correlation-based connectedness measure. Furthermore, on days

when end-users are net sellers of USD in the local market, PIN and Modified PIN increase by 17 and 18 percentage points, respectively, per unit of imbalance in international copper-futures order flow.

Taken together, these findings are consistent with End-User order flow serving as an important channel through which fundamental information is incorporated into the local USD/CLP spot market, especially during calm news regimes.

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Tables

Table 1: Price, Returns and Trading Volume Dataset (5-minute)

	Mean	P5	P25	P50	P75	P95
Panel A: USD/CLP						
Close price	764	625	670	755	839	953
Return	0.00	-0.14	-0.04	0.00	0.04	0.14
Standard deviation	0.09	0.04	0.06	0.08	0.10	0.15
Trading Volume	16	0	5	13	24	44
Panel B: Copper						
Close price	3.6	2.5	3.0	3.5	4.2	4.8
Return	0.00	-0.16	-0.05	0.00	0.05	0.16
Standard deviation	0.10	0.06	0.07	0.09	0.11	0.16
Trading Volume	423	39	153	305	539	1,202
Panel C: Oil						
Close price	57	30	49	56	68	80
Return	0.00	-0.31	-0.09	0.00	0.09	0.30
Standard deviation	0.19	0.09	0.13	0.16	0.21	0.35
Trading Volume	2,969	434	1,135	2,065	3,718	8,390

The table displays the 5-minute price, returns and trading volume distribution across local Chilean USDCLP market, international copper (CME) and oil (CME) markets. P5, P25, P50, P75 and P95 represent the 5th, 25th, 50th, 75th, and 95 percentiles, respectively. USDCLP trading volume in millions USD, copper and oil volume in number of contracts. Source: Authors' calculations.

Table 2: Trading Activity by Participant Type (Daily)

Name	Mean	P5	P25	P50	P75	P95
Panel A: Insurance Companies						
Trading volume	38	4	13	27	52	109
Buys	20	1	5	13	29	64
Sales	18	1	4	11	25	58
Panel B: Broker Dealers						
Trading volume	561	324	456	554	666	815
Buys	293	165	236	288	347	440
Sales	268	148	213	262	316	407
Panel C: Real Sector Companies						
Trading volume	656	356	501	623	778	1,053
Buys	320	159	237	305	383	527
Sales	337	153	235	308	406	595
Panel D: Pension Funds						
Trading volume	293	27	102	194	352	924
Buys	144	3	40	91	176	474
Sales	149	0	35	87	187	524
Panel E: Mutual Funds						
Trading volume	44	11	24	38	58	98
Buys	23	3	10	18	30	57
Sales	22	4	9	17	29	57
Panel F: Non-residents						
Trading volume	299	70	138	223	362	784
Buys	148	30	62	103	187	406
Sales	151	32	64	105	181	413
Panel G: Others						
Trading volume	188	34	74	161	262	436
Buys	76	13	30	63	101	178
Sales	111	16	36	83	160	292
Panel H: Banks						
Trading volume	2,079	1,098	1,602	2,012	2,462	3,279
Buys	1,054	528	780	1,009	1,269	1,712
Sales	1,025	521	782	986	1,221	1,655

The table contains information on the daily trading activity expressed in millions USD. All sectors trading activity against the Banking Sector. Sectors covered: Insurance Companies, Broker Dealers, Real Sector Companies, Pension Funds, Mutual Funds, Non-residents, Others End Users, and Banks. Selected statistics in columns: Mean and quantiles (P5, P25, P50, P75, P95). Source: Authors' calculations.

Table 3: News Activity for Copper and Oil

Name	Sum	Mean	P5	P25	P50	P75	P95
Panel A: Oil News							
Oil News	16,498,704	7,133	4,667	5,751	6,619	8,153	11,066
Oil Bloomberg	2,252,419	974	262	346	441	766	3,813
Oil Twitter	7,463,267	3,227	1,108	1,609	2,168	3,358	8,818
Panel B: Copper News							
Copper News	2,315,212	1,030	730	894	1,007	1,144	1,410
Copper Bloomberg	279,075	124	44	59	75	108	439
Copper Twitter	290,741	129	68	93	118	152	230

The table shows the daily count of news for keywords “oil” and “copper” from three different data sources: public news outlets, Twitter and Bloomberg. Statistics shown: sum, mean, and selected quantiles (P5, P25, P50, P75, P95). Source: Authors’ calculations.

Table 4: Explained variance and loadings for the first two principal components

Item	PC1	PC2
Explained variance (%)	54.28	45.72
Cumulative (%)	54.28	100.00
Copper news (5d)	-0.12	-0.10
Copper Bloomberg (5d)	-0.19	-0.08
Copper Twitter (5d)	-0.05	-0.20
Oil news (5d)	-0.32	0.23
Oil Bloomberg (5d)	-0.20	0.12
Oil Twitter (5d)	-0.23	0.17
Copper News (20d)	-0.28	-0.41
Copper Bloomberg (20d)	-0.24	-0.32
Copper Twitter (20d)	-0.24	-0.40
Oil News (20d)	-0.35	0.24
Oil Bloomberg (20d)	-0.20	0.11
Oil Twitter (20d)	-0.28	0.20
Copper News (40d)	-0.18	-0.27
Copper Bloomberg (40d)	-0.17	-0.25
Copper Twitter (40d)	-0.17	-0.26
Oil news (40d)	-0.34	0.24
Oil Bloomberg (40d)	-0.19	0.11
Oil Twitter (40d)	-0.30	0.19

The table reports principal component loadings; details on the news types are provided in Section 3.2. 2-decimal rounding. The parentheses in the first column refers to the window length used to compute the average. Source: Authors' calculations.

Table 5: News Effect on Connectedness

	(1)	(2)
	PCI	Corr
Constant	-0.70*** (0.15)	-0.07 (0.12)
$Calm_{t-1}$ ($PC1_{t-1}$)	0.05*** (0.02)	0.03** (0.01)
$Composition_{t-1}$ ($PC2_{t-1}$)	-0.03 (0.02)	-0.02 (0.01)
N obs	2,159	2,159
R^2	0.33	0.01

The dependent variables, PCI and Corr, represent two alternative measures of connectedness between USD/CLP and copper returns; these measures are introduced in Section 3.1. PC1 and PC2, introduced in Section 3.2, are the first two principal components summarizing the public commodity-news environment. For purposes of this regression, both measures are standardized. Coefficients are in decimal format, for example 0.05 is equivalent to 5%. We label PC1 as Calm, representing overall commodity-news intensity, and PC2 as Composition, representing oil–copper rotation/tilt in news flow. Estimates are obtained via OLS with robust Newey–West statistics and include additional control variables: the VIX, MOVE, and day and year fixed effects. Stars denote statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors’ calculations.

Table 6: Sector Volume Change to News PCA

	(1)	(2)
	$\Delta\% \text{ Volume}_{EU}$	$\Delta\% \text{ Volume}_{DI}$
Constant	-0.08** (0.03)	-1.72 (6.83)
$\text{Calm}_{t-1} \text{ (PC1}_{t-1})$	0.01*** (0.00)	1.00 (0.83)
$\text{Composition}_{t-1} \text{ (PC2}_{t-1})$	0.01** (0.00)	1.72 (2.14)
N obs	2,158	2,158
R^2	0.09	0.01

$\Delta\% \text{ Volume}$ denotes the daily percentage change in trading volume in the USD/CLP spot market. Column (1) reports results for the End User (EU) group, defined as the aggregation of trading volume from the Real Sector, Non-residents, Insurance Companies, and Other End User participants. Column (2) reports results for the Delegated Investor (DI) group, defined as the aggregation of trading volume from Pension Funds, Mutual Funds, and Broker Dealers. Coefficients are in decimal format, for example 0.01 is equivalent to 1%. PC1 and PC2, introduced in Section 3.2, are the first two principal components summarizing the public commodity-news environment. We label PC1 as *Calm*, representing overall commodity-news intensity, and PC2 as *Composition*, representing oil-copper rotation/tilt in news flow. Estimates are obtained via OLS with robust Newey-West statistics and include additional control variables: the VIX, MOVE, and day and year fixed effects. Stars denote statistical significance: *p<0.1, **p<0.05, ***p<0.01. Source: Authors' calculations.

Table 7: Mechanism

	(1)	(2)
	PCI	Corr
Constant	-0.70*** (0.16)	-0.07 (0.12)
OFI_t^{EU}	0.15 (0.11)	0.09 (0.12)
$OFI_t^{EU} \times Calm_{t-1} (PC1_{t-1})$	0.08** (0.04)	0.11** (0.05)
$Calm_{t-1} (PC1_{t-1})$	0.05** (0.02)	0.03** (0.01)
N obs	2,158	2,158
R^2	0.33	0.01

The dependent variables, PCI and Corr, represent two alternative measures of connectedness between USD/CLP and copper returns; these measures are introduced in Section 3.1. For purposes of this regression, both measures are standardized. Coefficients are in decimal format, for example 0.05 is equivalent to 5%. PC1, introduced in Section 3.2, is the first principal components summarizing the public commodity-news environment. We label PC1 as Calm, representing overall commodity-news intensity. The End User OFI (OFI_t^{EU}) is defined as the aggregation of order flows from the Real Sector, Non-Residents, Insurance Companies, and other end user participants. Estimates are obtained via OLS with robust Newey-West statistics and include additional control variables: the VIX, MOVE, and day and year fixed effects. Stars denote statistical significance: *p<0.1, **p<0.05, ***p<0.01. Source: Authors' calculations.

Table 8: PIN and Sectoral Order flows

	(1) PIN	(2) MPIN	(3) VPIN
Panel A: PIN and Copper Orderflow(t-1)			
Constant	0.26*** (0.01)	0.28*** (0.01)	0.26*** (0.01)
OFI_t^{EU}	0.02** (0.01)	0.02* (0.01)	-0.01 (0.01)
$OFI_t^{EU} \times OFI_{t-1}^{Copper}$	-0.17** (0.07)	-0.18** (0.08)	0.00 (0.07)
OFI_{t-1}^{Copper}	0.02 (0.01)	0.01 (0.01)	0.00 (0.01)
N obs	2,154	2,154	2,154
R^2	0.09	0.09	0.65
Panel B: PIN and Copper Orderflow(t)			
Constant	0.26*** (0.01)	0.29*** (0.01)	0.25*** (0.01)
OFI_t^{EU}	0.02** (0.01)	0.02* (0.01)	-0.01 (0.01)
$OFI_t^{EU} \times OFI_t^{Copper}$	-0.08 (0.07)	-0.06 (0.07)	0.12** (0.05)
OFI_t^{Copper}	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
N obs	2,158	2,158	2,158
R^2	0.09	0.09	0.65

The table displays the reaction of information measures to sectoral Order Flows and Copper Order Flow interaction. PIN, MPIN, and VPIN corresponds to alternative measures of informed trading we describe in section 3.5. Coefficients are in decimal format, for example 0.17 is equivalent to 17%. The End User OFI is defined as the aggregation of order flows from the Real Sector, Non-Residents, Insurance Companies, and other End User participants. Copper OFI refers to order flow in the international copper futures market. Estimates are obtained via OLS with robust Newey-West statistics and include additional control variables: the VIX, MOVE, and day and year fixed effects. Stars denote statistical significance: *p<0.1, **p<0.05, ***p<0.01. Source: Authors' calculations.

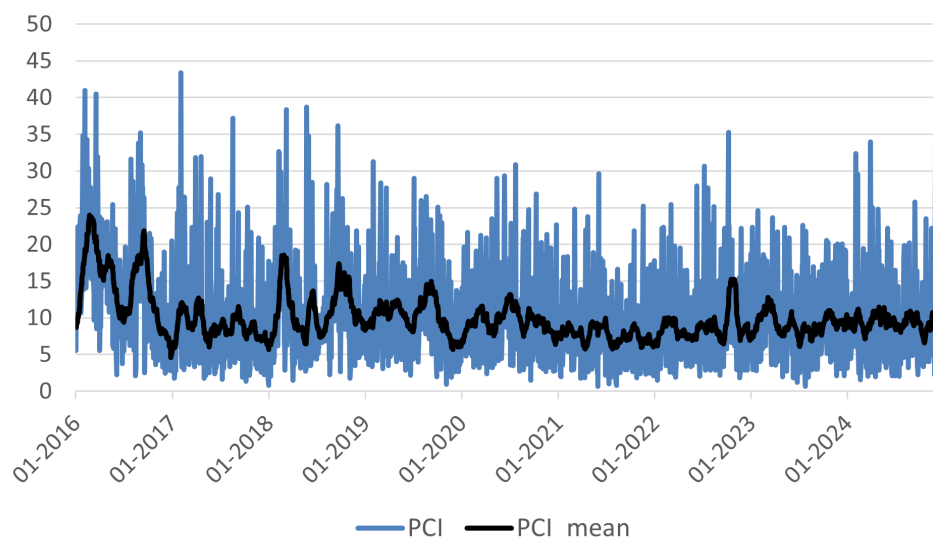
Table 9: News intensity effect on Liquidity

	(1)	(2)	(3)
	Amihud	Impact	USD/CLP StdDev
Constant	-0.16 (0.16)	-0.66*** (0.19)	-0.94*** (0.14)
$Calm_{t-1}$ ($PC1_{t-1}$)	0.05*** (0.02)	0.05*** (0.01)	0.06*** (0.01)
$Composition_{t-1}$ ($PC2_{t-1}$)	-0.01 (0.02)	0.00 (0.02)	-0.02 (0.01)
N obs	2,159	2,159	2,159
R^2	0.19	0.39	0.58

The table reports the impact of news intensity on USD/CLP liquidity proxies: Amihud illiquidity, the price-impact coefficient, and the daily standard deviation (StdDev) of 5-minute returns, introduced in Section 3.4. For purposes of this regression, these measures are standardized. Coefficients are in decimal format, for example 0.05 is equivalent to 5%. PC1 and PC2, introduced in Section 3.2, are the first two principal components summarizing the public commodity-news environment. We label PC1 as Calm, representing overall commodity-news intensity, and PC2 as Composition, representing oil-copper rotation/tilt in news flow. Estimates are obtained via OLS with robust Newey-West statistics and include additional control variables: the VIX, MOVE, and day and year fixed effects. Stars denote statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations.

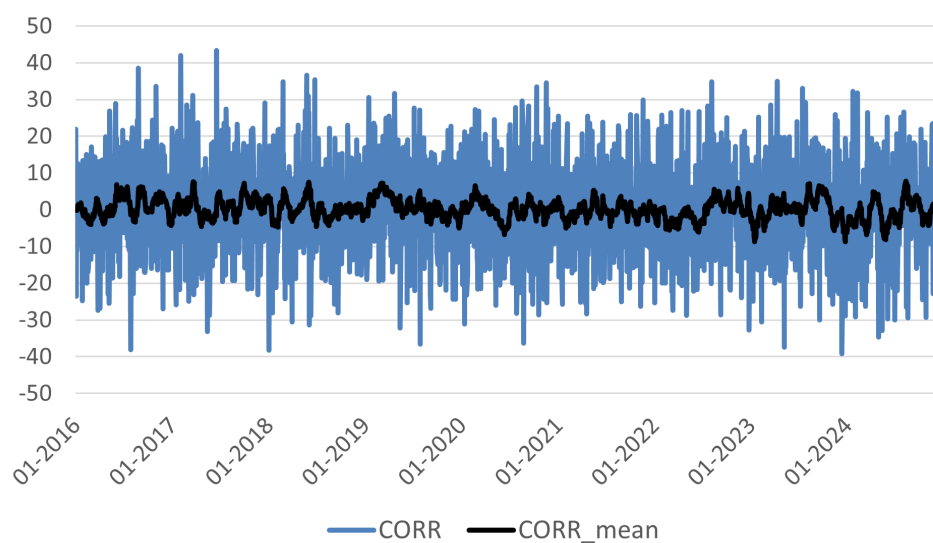
Figures

Figure 1: PCI Connection Measure



PCI connection measure between international copper returns and Chilean local USDCLP market and its 20 days rolling mean. Source: Authors' calculations.

Figure 2: CORR Connection Measure



CORR connection measure between international copper returns and Chilean local USDCLP market and its 20 days rolling mean. Source: Authors' calculations.

Appendix

A Volatility of Assets

Table A.1: Returns Standard Deviation by Hour (Chile Local Time)

Time	USD	Copper	Oil
9:00	0.09	0.09	0.16
10:00	0.08	0.11	0.18
11:00	0.08	0.10	0.19
12:00	0.09	0.08	0.17
13:00	0.07	0.07	0.15
14:00	0.04	0.06	0.14

Standard deviation of returns by hour for USD, Copper, and Oil. Source: Authors' calculations.

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