New Evidence on the Financialization of Commodity Markets*

Brian J. Henderson†
The George Washington University

Neil D. Pearson††
University of Illinois at Urbana-Champaign

Li Wang‡
University of Illinois at Urbana-Champaign

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Abstract

Following the recent, dramatic increase in commodity investments by financial institutions, academics, practitioners, and regulators have engaged in a heated debate over whether financial institutions' trades and holdings have affected commodity prices and their return dynamics. Distinct from the prior literature, this paper examines the price impact of commodity investments on the commodities futures markets using a novel dataset of Commodity-Linked Notes (CLNs). CLN issuers hedge their liabilities by taking long positions in the underlying commodity futures on the pricing dates. These hedging trades are plausibly exogenous to the contemporaneous and subsequent price movements, allowing us to identify the price impact of the hedging trades. We find that these hedging trades cause significant price changes in the underlying futures markets, and therefore provide direct evidence of the impact of "financial" trades on commodity futures prices.

Keywords: Financialization, commodity-linked notes, commodity structured products, commodity index investors, commodity futures

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† *E-mail*: bjhndrsn@gwu.edu. The George Washington University, Department of Finance, Funger Hall Suite 502, 2201 G ST NW, Washington DC, 20052. Phone (202) 994-3669.

†† *E-mail*: pearson2@illinois.edu. The University of Illinois at Urbana-Champaign, Department of Finance, 419 Wohlers Hall, 1206 South Sixth Street, Champaign IL 61820. Phone (217) 244-0490.

‡ *E-mail*: liwang2@illinois.edu. The University of Illinois at Urbana-Champaign, Department of Finance, 340 Wohlers Hall, 1206 South Sixth Street, Champaign IL 61820.

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Following the recent, dramatic increase in commodity investments by financial institutions, academics, practitioners, and regulators have engaged in a heated debate over whether financial institutions' trades and holdings have affected commodity prices and their return dynamics. Distinct from the prior literature, this paper examines the price impact of commodity investments on the commodities futures markets using a novel dataset of Commodity-Linked Notes (CLNs). CLN issuers hedge their liabilities by taking long positions in the underlying commodity futures on the pricing dates. These hedging trades are plausibly exogenous to the contemporaneous and subsequent price movements, allowing us to identify the price impact of the hedging trades. We find that these hedging trades cause significant price changes in the underlying futures markets, and therefore provide direct evidence of the impact of "financial" trades on commodity futures prices.

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1. Introduction

Following several highly publicized reports espousing the historical diversification benefits of exposure to commodity futures,[1] in recent years financial institutions have increased dramatically their investments in commodity futures. For example, according to an oft-cited report, the value of index-related commodities futures investments grew from $15 billion during 2003 to over $200 billion during 2008.[2] The period of most rapid growth in investments coincided with the 2007–2008 boom in commodity prices, leading to heated debate among academics, practitioners, and regulators regarding whether or not these "financial" flows influence commodity futures prices and return dynamics. The question of whether financial investors have affected prices through their increased participation in this market remains unresolved.[3] We contribute to this debate by analyzing a unique dataset of Commodity Linked Note (CLN) issuances marketed to retail investors. Each of the sample CLNs is issued by and is an obligation of a financial institution but has a payoff linked to the price of a single commodity, commodity futures contract, commodities index, or basket of commodities futures. To hedge its liability, the issuer trades in the commodities futures markets, typically establishing a long position in near-term contracts. Importantly, CLN issuances are not based on information and the hedging trades are plausibly exogenous to the contemporaneous and subsequent price movements, providing clean identification of the price impacts of the hedging trades.

We find that CLN issuers' hedging trades associated with products referencing individual commodities have significant price impact on the referenced commodities' futures prices, providing evidence that investment flows that do not convey information nonetheless affect prices. The issuers' initial hedging trades for issues with proceeds greater than or equal to $2 million, $5 million, and $10 million raise the underlying commodity futures prices by an average of 37, 40, and 51 basis points, respectively, around the pricing dates of the CLNs. We find similar results for each of five different underlying commodity sectors, these being agricultural commodities, energy commodities, industrial metals, platinum and palladium, and gold and silver. We also find similar results around the pricing dates of products linked to commodity baskets consisting of small numbers of commodities. However, we find no evidence of price

[1] See for example Erb and Harvey (2006), Gorton and Rouwenhorst (2006), and Ibbotson and Associates (2006).
[2] CFTC Staff Report (2008).
[3] Irwin and Sanders (2011) refer to this question as a "Bubble" issue and provide a thorough literature survey. Irwin and Sanders (2011) use "commodity index fund" or "index fund" to refer to all commodity investment instruments.

impacts around the pricing dates of CLNs based on diversified commodity indexes. Additionally, we find that very small CLN issues, defined as those with proceeds less than $2 million, do not impact commodity futures prices.

With the development of commodity investment instruments and considerable investment funds flowing into commodity index funds,[4] some researchers have argued that the financial sector gained influence relative to the real sector in determining the price level and return dynamics of commodity prices, a phenomenon that is referred to as the "financialization" of commodities. Theoretical arguments indicate that futures prices reflect both systematic risk premiums (Black 1976, and Jagannathan 1985) and hedging pressures from the net hedging demand of commodities producers and suppliers (Keynes 1930, Hicks 1939, Stoll 1979, Hirshleifer 1988, and Bessembinder 1992). According to the financialization hypothesis, the increased demand for long positions by financial investors, which are neither hedgers nor traditional speculators in this market, is of large enough magnitude to affect the market prices and return dynamics. Whether or not these flows from financial investors have impacted the prices and return dynamics of commodities futures is the subject of considerable debate in the recent literature.

One branch of the recent literature focuses on the relation between net positions of non-commercial traders and futures price changes. This research employs the Commodity Index Trader (CIT) supplement to the Commitments of Traders (COT) weekly report[5] to construct investment flows by index traders and studies their relation with futures prices. For the oil market, Singleton (2011) finds a link between investor flows and futures prices, consistent with the financialization hypothesis. A criticism of the CIT report data stems from the aggregation of positions by category as opposed to separating the index traders' positions for different trading purposes.[6] Another subset of this literature analyzes the return correlations between commodity futures prices and other financial assets (e.g., stocks or bonds) or the co-movement among commodities futures prices to determine the extent to which commodity markets have been influenced by financialization. This part of the literature is motivated by the view of "financial"

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[4] Tang and Xiong (2010) and Irwin and Sanders (2011) provide detailed data summarizing the evolution of commodity index funds.
[5] The CIT was initiated in 2007 and reports the aggregate positions of Commodity Index Traders in selected agricultural markets.
[6] See, for example, Gilbert (2010), Tang and Xiong (2010), and Buyuksahin and Robe (2011).

investors as index investors who focus on the strategic portfolio allocation between commodities and other asset classes and thus tend to trade in and out of many commodities at the same time, especially the commodities in one or more of the leading commodity indexes (Tang and Xiong 2010). This argument predicts that financialization causes price co-movements between commodities futures and other major asset classes to increase, and that co-movement among index commodities should rise relative to those not in the indices. Although researchers generally agree that correlations increased during the recent financial crisis (Silvennoinen and Thorp 2010 and Tang and Xiong 2010), some have pointed out that that even though the correlations between equity and commodity returns increased dramatically in the fall of 2008, the correlations remained lower than their peaks in the previous decade when commodity index investment was not yet popular (Buyuksahin, Haigh and Robe 2010).

Many of the studies that fail to find evidence that financial investors' positions impact commodity futures prices rely on vector autoregressions and so-called Granger causality tests. This approach involves regressing percentage or log changes in futures prices on lagged futures price changes and lagged changes in some measure or measures of investors' positions. Researchers then interpret insignificant estimates of the coefficients on the variables measuring lagged changes in financial investors' positions as a lack of evidence that financial investors' demands impact futures prices, while significant coefficient estimates would be interpreted as evidence that changes in financial investors' positions impact prices. A limitation of this approach is that commodity futures prices rapidly incorporate information, including the information in order flows, implying that the most likely causal channel comes through *contemporaneous* changes in investors' positions to changes in futures prices, *not* from lagged changes in investors' positions. The vector autoregressions using lagged position changes are incapable of producing evidence that contemporaneous changes in investors' positions impact futures prices, because contemporaneous changes in investors' positions are not included in the regressions. Possible alternative regressions of changes in futures prices on contemporaneous changes in investors' positions are unidentified because over any interval contemporaneous returns can cause changes in investors' positions[7] and also because both the commodity price

[7] Specifically, any such analysis must use a time period of finite length. Changes in investors' positions over some later part of the time period, say the second half of the period, can be caused by futures price changes over the first half of the period. This creates correlation between changes in futures prices and investors' positions measured over the same time period.

changes and the changes in investor positions can be caused by an omitted common factor, e.g. information that became available to some market participants.

Our approach overcomes the identification problem because the trades that hedge CLNs sold to retail investors are plausibly exogenous. Specifically, the issuer ordinarily will execute the hedge trades regardless of changes in futures prices, eliminating the "reverse causality" from commodity futures price changes to trades and changes in positions. In addition, it seems unlikely that retail investors base their purchases of CLNs on information about future changes in futures prices because the issuers' costs of structuring, marketing, and hedging the CLNs render the CLNs high cost financial products.[8] CLN issuers must embed these costs in the CLNs' issue prices, negatively impacting CLN returns and making them poor vehicles for speculating on changes in commodity futures prices. Further, the CLNs provide no or very limited leverage. It seems unlikely that investors sophisticated enough to possess valuable information about future commodity prices choose to trade on that information using high-cost, unlevered CLNs rather than low-cost, liquid futures contracts that provide levered returns.[9] CLN issues are unlikely to be based on the issuers' private information because the issuers typically hedge their exposure to the underlying commodity prices and their main objective is to profit from the embedded fees rather than to trade on information about the future commodity futures prices.[10]

The CLN issuances provide a convenient laboratory to study the impact of hedging trades because the offering documents specify the CLNs' pricing dates and indicate that the CLNs price at the close of regular trading in the underlying commodity futures or commodity index. Since the issuers hedge their liabilities associated with CLNs close to when the notes are priced, we are able to determine the approximate dates and times when the issuers execute the hedge trades. Thus, we are able to determine the approximate times when large "financial" trades in the futures market are executed. Therefore, the pricing date price impact of the CLN issuances provides direct evidence on whether such "financial" trades impact commodity futures prices.

[8] Henderson and Pearson (2011), among other studies, document the large issue premiums in structured notes linked to individual stocks and issued by financial institutions to predominantly retail investors.
[9] A field survey by staff at United Nations (2011) showed that the financial investors rely primarily upon official statistics about the commodity markets and pay more attention to the financial market than to the fundamentals of the commodities.
[10] To the extent that the CLN issuer chooses not to hedge an issue, the issuer's exposure to the commodity price will be negative, i.e. an issuer who does not hedge or hedges only partially will benefit from decreases in commodity price. Thus, the positive price impacts we find cannot be explained by a hypothesis that the CLN issues cause other market participants to infer that the issuer has private information about future commodity prices.

Our approach has several additional advantages. First, by using the CLN data we are able to avoid relying upon the criticized CIT data. Second, we analyze the impact of new flows into long-only commodity index investment on the commodity futures markets. This differs from studies focusing on the roll activity of a commodity index, such as Mou (2010) and Stoll and Whaley (2010), which analyze trades for existing long-only commodity index investment and for which the trades in the front-month and front-next contract net to zero. Third, our analysis includes all commodity sectors, rather than simply the agricultural sector or crude oil.[11]

As indicated above, we find average price impacts of 37, 40, and 51 basis points around the pricing dates of the commodity structured product issues with proceeds greater than or equal to $2 million, $5 million, and $10 million, respectively. We find similar results for each of five different underlying commodity sectors, and also for issues of products linked to commodity baskets consisting of small numbers of commodities. These main results exclude issues that are priced and sold during the "roll" of the popular S&P GSCI commodity index that occurs from the 5th to 9th business day of each month, the so-called "Goldman roll," because Mou (2010) presents evidence that the heavy selling of the front-month contract by investors who track the index causes the price of the front-month contract to be temporarily depressed. We repeat the main analysis including issues sold during the Goldman roll and obtain results similar to our main results, indicating that our main results are robust to the inclusion or exclusion of issues sold during the Goldman roll. We also find that our results are robust to the choice of benchmark used to compute the abnormal returns on the commodity futures contracts.

Additional regression analyses show that the pricing date price impacts are increasing in the size of the CLN issues, which is a proxy for the magnitude of the hedging trade. We also present evidence that our results are not due to a selection bias in which issuers tend to complete CLN issues on days of positive returns.

The next section of the paper reviews the related literature. Section 3 briefly describes the sample of CLN issues and the retail market for CLNs, and also indicates the sources of the other data used in the analysis. Section 4 contains the main results regarding the price impact of the hedging trades, while Section 5 shows that the results are robust to the inclusion or exclusion of issues during the Goldman roll and to the choice of benchmark used to compute the abnormal returns on the commodity futures contracts. Section 6 briefly concludes.

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[11] Buyuksahin and Robe (2009) and Singleton (2011) are examples of recent papers focusing on specific sectors of commodities futures markets.

2. Related Literature

With the development of commodity investment instruments and considerable investment funds flowing into commodity index funds,[12] some researchers argue that the financial sector gained influence relative to the real sector in determining the price level and return dynamics of the commodity market, a phenomenon that is referred to as the "financialization" of commodities. One branch of this literature focuses on the relation between the changes in futures prices and the net positions of non-commercial traders. Masters (2008) attributed the boom in commodity prices from 2007–2008 to institutional investors' embrace of commodities as an investable asset class. Gilbert (2010) examined the price impact of index-based investment on commodity futures over the period 2006–2008 by constructing a quantity index based on the positions of index traders in 12 agricultural commodities from the Commodity Index Trader supplement to the CFTC's weekly Commitments of Traders (COT) report. He estimated that the maximum impact of index funds in the crude oil, aluminum, and copper markets is a price increase of 15%. These results are based on the assumption that the quantity index is an adequate proxy for total index-related investment, not just positions in agricultural commodities.

Another strand of this literature analyzes the return correlations between commodity futures contracts and other financial assets (e.g., stocks or bonds) or the co-movements among commodity futures prices to determine the extent to which commodity markets have been influenced by financialization. Silvennoinen and Thorp (2010) predict that the return correlation between commodities and other financial assets will rise due to the increase in commodity index investment. They test this hypothesis during the financial crisis and find increasing integration between commodities and financial markets. Tang and Xiong (2010) argue that as most index investors focus on the strategic portfolio allocation between commodities and other asset classes, they tend to trade in and out of all commodities in a chosen index at the same time. This argument predicts that the price co-movement among indexed commodities should rise relative to those not in the indices when commodity index investment increases. Tang and Xiong (2010) find that since the early 2000s futures prices of non-energy commodities in the US have become increasingly correlated with oil futures prices and that this trend is significantly more pronounced for commodities in the two popular S&P GSCI commodity index and Dow Jones-

[12] Tang and Xiong (2010) and Irwin and Sanders (2011) provide detailed data and figures depicting the evolution of the commodity index fund.

UBS Commodity Index ("DJ-UBS") than for commodities not in the indices. They also find that this increasing co-movement cannot be explained by the increasing demand from emerging markets such as China or by an inflation factor, consistent with their argument that the prices of commodities are now driven by the commodity index investors' behavior, reflecting a process of financialization of commodities. Cheng, Kirilenko, and Xiong (2012) find evidence of increased systematic risk in commodities futures markets resulting from the financialization of commodities markets.

In contrast to the above referenced studies, a number of researchers argue from both theoretical and empirical perspectives that commodity prices and return dynamics are not affected by financialization, i.e. they are still determined by "real" fundamental factors.[13] Buyuksahin, Haigh and Robe (2010) document that even though the correlations between equity and commodity returns increased dramatically in the fall of 2008, they remained lower than their peaks in the previous decade when commodity index investment was not yet popular. In contrast to Tang and Xiong (2010), they found little evidence of a secular increase in spillovers from equity to commodity markets during some extreme events. Irwin and Sanders (2011) challenge the results in Tang and Xiong (2010) due to their reliance on the CIT supplement to the COT weekly report to construct investment flows by index traders because the report does not separate the index traders' positions for different trading purposes, but instead uses their aggregate positions by classified category.[14] In addition, Irwin and Sanders (2011) argue that the differences-in-differences approach used in Tang and Xiong (2010) may not control for some fundamental factors that are common to all commodities in a given sector. For example, they argue that inventory levels and shipping costs contain important information about fundamentals. Failing adequately to consider market fundamentals may also lead to incorrect inferences in tests of co-movement (Ai, Chatrath, and Song (2006)).

Buyuksahin and Robe (2011) employ daily, non-public data on individual trader positions in seventeen U.S. commodity futures markets. This dataset is contract-specific for most trader categories (including, importantly, for hedge funds), permitting Buyuksahin and Robe (2011) to

[13] For example, Krugman (2008), Pirrong (2008), Sanders and Irwin (2008), Smith (2009), Irwin, Sanders and Merrin, (2009), Buyuksahin and Harris (2009), Buyuksahin and Robe (2009), Till (2009), Korniotis (2009), Hong and Yogo (2010), Stoll and Whaley (2010), and Power and Turvey (2011). Irwin and Sanders (2011) and Singleton (2011) survey the relevant literature.

[14] See Gilbert (2010), Tang and Xiong (2010), and Buyuksahin and Robe (2011).

distinguish traders' positions at different contract maturities. In contrast to Tang and Xiong (2010), Buyuksahin and Robe (2011) find that only hedge fund activity rather than index fund activity is a significant factor explaining the recent increase in correlations between stock and commodity returns after controlling for the business cycle and other economic factors. However, the hedge fund data are ambiguous regarding the trading purpose because some funds may trade based on information about fundamentals and others may follow "technical" trading rules (Gilbert, 2010). Also, this daily index investment data does not overcome the previously limitations of the CIT data for the energy and metal markets.

A recent paper by Mou (2010) provides support for the financialization hypothesis by focusing on the practice whereby commodity index investors "roll" their positions in the front-month futures contract into longer-dated contracts. They document that the price impact of this rolling activity is both statistically and economically significant. Due to limits to arbitrage, this publicly-known trading is able to impact futures prices. Singleton (2011) presents new evidence from the crude oil futures market that there is an economically and statistically significant effect of investor flows on futures prices, after controlling for returns in U.S. and emerging economy stock markets, a measure of the balance-sheet flexibility of large financial institutions, open interest, the futures/spot basis, and lagged returns on oil futures. He finds that the intermediate-term (three month) growth rates of index positions and managed-money spread positions had the largest impacts on futures prices and argues that such impact may be due to different opinions about public information and learning processes. These results are subject to the previously mentioned limitations of the CIT data.

In less directly related work, Cheng, Kirilenko and Xiong (2012) present evidence that trades by financially stressed commodity index traders and hedge funds had important impacts on commodity futures prices during the financial crisis. Hong and Yogo (2010, 2012) present evidence that growth in open interest in commodity futures market predicts changes in the prices of commodity futures contracts, inflation, and nominal interest rates.

3. The U.S. Retail Market for Commodity-Linked Notes

CLNs are issued by and are obligations of financial institutions and have payoffs linked to the price or change in price of a commodity or commodity futures contract, commodity index, or basket of commodities or commodity futures. Most CLN issuers have "shelf registrations" through which they issue CLNs periodically, with features of specific issues described in pricing supplements. Each pricing supplement includes the terms of the CLN, such as the maturity date, participation (or leverage) rate, cap value (or maximum return), coupon rate, buffer level, investor fee and other provisions that determine the final payoff to the investor. Importantly for our analysis, the pricing supplements also include the pricing date (and time, e.g. the close of trading) when issuers price the notes. The issues in our sample were priced as of the close of trading in the underlying commodity on the pricing date. In anticipation of, or shortly after, the sale of the CLNs, the issuers enter into hedging transactions. The typical CLN hedging trade involves the purchase of related futures or swap contracts, or other instruments the value of which derives from the underlying asset. When the issuer's hedge transaction involves a commodity swap or swaps, the swap counterparties typically rehedge in the futures markets. The issuers file the pricing supplements describing the CLNs with the U.S. Securities and Exchange Commission (SEC), which makes them available through its EDGAR database.

The sample consists of nearly the entire universe of publicly issued CLNs in the United States with payoffs depending on the price or change in price of an individual commodity, a basket of commodities, or a commodity index. We construct the sample by first identifying all issuers of publicly registered CLNs in the United States.[15] The sample consists of the publicly registered CLNs issued by the 20 banks and other financial intermediaries identified as issuers.[16] After identifying the issuers, we collect the 424(b) fillings for each issuer from the SEC's EDGAR website. We then process those filings to identify all CLN issues and extract the details required for the analysis including the pricing date, product name, proceeds amount, reference commodity, commodities, or commodity index, maturity date, and coupon rate.

The first sample CLN issue dates to January 17, 2003, when Swedish Export Credit Corporation offered "90% Principal Protected Zero-Coupon GSCI Excess Return Indexed Notes." These notes promised to return to investors 90% of the principal amount plus a possible additional return linked to the performance of the Goldman Sachs Commodity Index,[17] and did not pay any other interest. The first sample CLN referencing a single commodity consists of the

[15] We identify issuers by searching Mergent's FISD database for issues matching both keywords "commodity" and "link." Additionally, we search www.quantumonline.com and the AMEX website for listed CLNs, and identity the issuers of the CLNs that we find.
[16] The sample consists of CLNs issued by the following 20 issuers: ABN AMRO, AIG, Bank of America, Barclays, Bear Stearns, Citigroup, Credit Suisse, Deutsche Bank, Eksportfinans, Goldman Sachs, HSBC, JP Morgan, Lehman Brothers, Merrill Lynch, Morgan Stanley, RBC, Swedish Export Credit, UBS, Wachovia, and Wells Fargo.
[17] This is the former name of the index now known as the S&P GSCI.

"Principal Protected Notes linked to Gold Bullion" issued by UBS during May 2003. These notes guaranteed full principal payment at maturity plus a possible additional return capped at 21.4%.

As of August 2011, the total proceeds of publicly registered CLN issues exceed $60 billion, which amount is comparable to the market value of equity-linked notes based on individual equities issued from 1994 to 2009 as reported in Henderson and Pearson (2010). By August of 2011, the total outstanding amount of notes not yet called or matured is about $42 billion, which amounts to approximately 11% of the total commodity index investment.[18] The sample CLNs have payoff profiles linked to a large number of different assets, including those comprising the most popular commodity indices, e.g., the S&P GSCI and the DJ-UBS, and also commodities that are not in the leading indices, e.g. platinum and palladium.

Owning a CLN is not equivalent to owning the underlying commodity or commodity futures contract. Importantly, payments to CLN holders are obligations of the issuing financial institution and these payments are backed only by the creditworthiness of the issuing financial institution. At maturity, the investor receives a cash payment as defined in the pricing supplement rather than the underlying physical commodity or commodity futures contract.

The specific terms and features of the CLNs vary across products. The Accelerated Return Notes (ARNs) linked to the Silver Spot Price priced and sold by Bank of America on February 25, 2010 are an example of a popular product type. These ARNs had a face value and issue price of $10 per unit, had a zero coupon rate, and matured on May 3, 2011. The starting value of the reference commodity, the silver spot price as determined by London Silver Market Fixing Ltd., was $15.92 on the pricing date. The notes' payoff at maturity is based on the ending value, which is the silver spot price as of the calculation date, April 26, 2011. If the change in the spot price from the pricing date to the calculation date is positive the investors receive the face value plus an additional payment equal to the product of the face value and three times the percentage increase, capped at 34.26%. If the percentage change in the spot price is negative then the principal amount returns to investors is reduced by the product of the percentage change and the face value.

[18] A report by the Institute of International Finance (2011) shows the total investment in commodity index-linked funds to be approximately $400 billion. Stoll and Whaley (2010) estimated that the total commodity index investment in the U.S. market in 2009 is about $174 billion. Of the total commodity index investors, 42% are institutional traders, 24% are index funds, and 25% are retail investors holding exchange-traded commodity products.

Some other CLNs include either an early redemption or an "auto-callable" feature. An example comes from the iPath Dow Jones–AIG Agriculture Total Return Sub-Index ETN issued by Barclays on October 23, 2007. These notes mature on October 22, 2037, do not pay interest, and allow the holders to redeem their notes on any redemption date, defined as the third business day following each valuation date. The valuation date is any business day between October 24, 2007 and October 15, 2037, inclusive. Upon redemption, investors receive cash payment in an amount equal to (1) the principal amount times (2) the index factor on the applicable (or final) valuation date minus (3) the investor fee on the applicable (or final) valuation date. The investors must redeem at least 50,000 Securities at one time in order to exercise the redemption right prior to final maturity. The index factor on any given day is equal to the closing value of the Index on that day divided by the initial index level, which is the closing index level on the pricing date. Investors pay a fee of 0.75% per year times the product of the principal amount and the index factor.

Another popular CLN structure references a commodity index and pays monthly coupons to investors. The notes linked to the Dow Jones-AIG Commodity Index Total Return issued by the Swedish Export Credit Corporation in April 2006 are an example of such a structure. These notes matured on March 30, 2007, and were redeemable by the issuer prior to maturity. On the maturity or early redemption date, the notes promised investors an amount equal to the principal amount times the leveraged index performance, defined as one plus the product of the leverage factor, here 3, and the adjusted index performance factor. At maturity or upon redemption, the investors also receive the supplemental amount that has accrued on the outstanding principal amount of each note for the period from and including the issue date of the notes to the applicable settlement date. The supplemental amount accrues at a rate equal to three-month U.S. dollar LIBOR minus a spread of 0.24% per annum, as reset on the 30th day of June, September and December, beginning June 30, 2006, compounded quarterly on each reset date.

Table 1 summarizes the numbers of CLN issues and the aggregate proceeds for various groups of underlying commodities, by year. The sample used for this table includes almost all of the publicly registered CLNs issued by the 20 main banks and financial intermediaries listed in Table 2.[19] For each sample year, beginning with 2003 and ending in August 2011, the table

[19] The sample excludes several CLN issues by Swedish Credit Corporation because those issues were remarketing efforts of previously issued notes and the documents do not indicate the dates on which the additional notes were marketed and sold.

columns present the number of CLN issues and total proceeds (in thousands of dollars). The CLNs are subdivided by the type of underlying reference commodity. Individual commodities are grouped into the commodity sectors: Agriculture (corn, cotton, wheat, soybeans, coffee, sugar, live cattle, lean hogs, soybean oil, soybean meals, red wheat, and cocoa), Energy (WTI crude, Brent crude, natural gas, heating oil, and unleaded gasoline), Industrial Metals (Aluminum, copper, lead, nickel, and zinc), Platinum and Palladium, and Gold and Silver. The table also includes a category "Diversified Index and Commodity Baskets" CLNs based on diversified indexes include products based on the DJ-UBS, S&P GSCI, Deutsche Bank Liquid Commodity Index, and some other commodity indices, excluding products based on sub-indices. The commodity baskets of more than one individual commodity are specified by the issuers. CLNs based on a sub-index restricted to a single commodity sector are included with the CLNs based on individual commodities in that sector.[20]

The rightmost column of Table 1 presents the annual CLN proceeds across all issuers. Issuance across the full sample spanning 2003 through August 2011 totals nearly $59 billion. The total proceeds of CLN issues during the 2007–2008 boom exceed $30 billion and account for approximately 50% of the total amount issued during the full sample period. Similar to the estimates of index investors' position sizes by Stoll and Whaley (2009), CLN issuance proceeds decline dramatically in 2009 to $13.2 billion. The number of CLN issues, however, remains large at about 300 issues per year from 2008 through 2011. In the full sample of CLNs with proceeds of over $59 billion, approximately 12% of the proceeds come from notes linked to agricultural commodities, 36% from notes linked to energy commodities, 8% from notes linked to industrial metals, 1% from notes linked to platinum and palladium, 10% from notes based on gold and silver, and 33% from notes linked to a diversified commodities index or a basket of more than one individual commodity. The bottom row of Table 1 reports the average proceeds per issue for each of the reference categories. CLNs referencing energy commodities tend to be the largest with average proceeds over $102 million. CLNs referencing Platinum and Palladium, commodities which are not included in the major indexes, tend to be the smallest with average proceeds of just over $20 million across the 33 sample observations.

[20] For example, a CLN based on the S&P GSCI-Energy sub-index would be included with the CLNs based on individual energy commodities.

Table 2 presents the number of CLN issues and total proceeds for each issuer in the sample. Similar to Table 1, the columns of Table 2 present the number of issues and total proceeds (in thousands of U.S. dollars) for each issuer of CLNs. The first columns of the table disaggregate the products linked to individual commodities by sector, followed by the issues linked to an index or basket of more than one commodity, and finally the total number of CLNs and proceeds for the issuers. Referring to the rightmost column, which aggregates the data across all types of commodities at the issuer level, Barclays, Deutsche Bank, and Swedish Export Credit issued the largest numbers of CLNs with 261, 186, and 171 issues, respectively. Based on proceeds, Deutsche Bank and Barclays are the largest issuers, having raised over $23 billion and $16 billion of proceeds, respectively. Among the other frequent issuers of CLNs, Bank of America's 119 offerings total over $2.7 billion proceeds, Merrill Lynch's 51 offerings total more than $2.6 billion, and Eksportfinans's 64 issues total more than $2.5 billion. Scanning the columns, one can see that some issuers such as Barclays are particularly active in issues linked to particular underlying assets. For example, Barclays issued 51 out of a the total 132 CLNs linked to agricultural commodities and10 out of 33 linked to platinum and palladium, but only 99 out of 842 linked to diversified indexes and baskets. Overall, the table makes clear that the sample of 1,491 CLN issues spans many issuers and reference assets.

4. Price Impact of the Hedging Trades

To measure the impact of CLN issuers' hedging trades on commodity futures prices, we focus on the returns of front-month futures contracts around the pricing dates, when issuers execute trades to hedge the commodity exposures stemming from the CLNs. Unless the market supply of futures contracts is perfectly elastic, large buy (sell) trades will raise (lower) futures prices. This price impact should be increasing in the size of the issue (e.g., the price impact must be zero if the trade size is zero), and there is a theoretical argument that the price impact of a trade should be linear in the size of the trade (Huberman and Stanzl (2000)). For these reasons, we expect to see significant price impacts around the pricing dates of CLN issues with large proceeds. Also, because the hedging trades associated with an index linked product are spread across many different contracts, price impacts around the pricing dates of the index products are likely smaller and possibly undetectable.

As briefly indicated above, we examine CLN issuances because the hedging trades associated with the issues constitute new buying pressure from financial investors that is not based on contemporaneous returns or private information possessed by any market participant. The issuer ordinarily will execute the hedge trades regardless of changes in futures prices during the period when the hedge trades are being made, eliminating the possible "reverse causality" from price changes to trades and changes in positions.

In addition, it seems unlikely that the CLN issuances convey to the market valuable private information held by retail investors. The issuers' costs of structuring, marketing, and hedging the CLNs render them high cost financial products.[21] CLN issuers must embed these costs in the issue prices, negatively impacting CLN returns and making them poor vehicles for speculating on changes in commodity futures prices. Further, the CLNs provide no or very limited leverage. Finally, most CLNs suffer from illiquid secondary markets, rendering it costly for a CLN investor to exit a position. The majority of the products are not exchange traded and trade "over-the-counter" only infrequently, with the issuer typically being the only market participant willing to provide a secondary market bid price.[22]

In contrast, underlying each CLN are one or more low cost, liquid, exchange-traded futures contracts offering embedded leverage. Due to the ease of access, low cost, liquidity, and embedded leverage of futures contracts, it seems likely that an investor who did possess valuable private information about future commodity prices would prefer to trade on that information using futures contracts rather than CLN's.[23] In order for one to believe that retail investors buying CLNs possess valuable private information about future commodity prices, one must believe that investors purchasing CLNs are sophisticated enough to possess valuable private information, but so unsophisticated that that they are unaware that the futures contracts provide a better vehicle for speculation.

Finally, it seems very unlikely that the CLN issuances convey issuers' positive private information to other market participants, because the issuers typically hedge their exposure to the underlying commodity futures prices and thus have no or limited net exposure to the underlying

[21] Examination of the pricing supplements reveals that the underwriter compensation is approximately 2% per issue, which is a lower bound on the initial over-pricing of these products. Other embedded costs include legal fees, hedging costs, and any other costs associated with designing and distributing the notes. Henderson and Pearson (2011), among other studies, document the large issue premiums in structured notes linked to individual stocks and issued by financial institutions to predominantly retail investors.
[22] Some of the CLNs are listed and trade as exchange-traded notes.
[23] In a different context, Black (1975) argues that the embedded synthetic leverage is an important reason why investors with valuable private information might prefer to take advantage of that information using options rather than the options' underlying stocks. The same reasoning implies that an investor with information would prefer to trade futures contracts rather than purchase CLNs.

futures prices. To the extent that a CLN issuer chooses not to hedge a CLN issue or to hedge only partially, the issuer's exposure to the commodity price will be negative, i.e. an issuer who does not hedge or hedges only partially will benefit from decreases in the underlying futures price. Thus, the positive price impacts we document below cannot be explained by the hypothesis that the CLN issues cause other market participants to infer that the issuer has private information about future commodity prices.

4.1 Research design

To measure the price impact of CLN issuers' hedging trades, the analysis uses the returns on the front-month futures contract on the reference commodity, computed from futures price data obtained from Bloomberg.[24] The daily futures return is defined, as in Tang and Xiong (2010), as

$$R_{i,t} = \ln(F_{i,t,T}) - \ln(F_{i,t-1,T}), \tag{1}$$

where $F_{i,t,T}$ is the date-t price of the front-month futures contract of commodity i with maturity or delivery date T.

The financial institutions issuing CLNs price and issue the notes based on the closing market price of the reference commodity or commodity futures contract on the pricing date. We collect the pricing date for each sample issue of publicly registered CLNs from the pricing supplements available through the S.E.C.'s EDGAR database. Although the documents specify the date and time when the issues are priced, the exact timing of the issuers' hedge trades is not clear. For example, the issuer may execute the entire hedge trade on the pricing date, or it may delay a portion of the hedge trade until the next day in an effort to spread the price impact and minimize the average purchase price of the futures contracts. For this reason, the analysis focuses on the price impact over a two-day window encompassing the pricing date and the following trading date.

For some CLNs, the issuers may hedge their obligations using commodity swaps traded "over-the-counter." In this case, the commodity swaps dealers in turn face the need to hedge their swap positions, and typically do this by transacting in the futures market. Thus, the hedging demand is passed through to the commodity futures markets, even when the initial

[24] Gorton and Rouwenhorst (2006), Tang and Xiong (2010), and Stoll and Whaley (2010) argue that the closest to expiring futures contract may be illiquid close to its expiration and the traders may use the next-closest-month expiring contract, the "front-next" contract. We repeated the main analyses using the front-next contract and obtained similar results.

hedge trades involve swaps.[25] That said, over-the-counter swap dealers may have the ability to net some exposures internally and thus might not pass all exposures through to the futures market. To the extent that this happens, the hedge trades associated with CLNs might not impact the futures market as much as hedge trades directly executed in the futures market by the issuers, reducing the magnitude of our estimated impact. It has been estimated that swap dealer netting is relatively small in agricultural futures markets, but that it can be large in the energy and metals markets (CFTC 2008). Taking account of this, other things equal we expect a greater price impact in the agricultural sector than in the energy sector or metal sector. Also, if the CLN issuer hedges using swaps, it is possible that the swap counterparty will not immediately rehedge in the futures market. This is another reason why we focus on the two-day futures market return.

The price impact should be increasing in the size of the hedge trade. For this reason, we do not include small CLN issues in the analysis but instead focus on subsamples of products with more sizeable proceeds so that we reasonably expect the issuers' hedge trades to be large enough to produce measurable price impact. Table 3, Panel A presents the number of issues and average proceeds (in thousands of dollars) for the principal subsamples we use. The table describes three subsamples: CLN issues with proceeds of at least \$2, \$5, and \$10 million dollars. Referring to Panel A, of the 1,491 issues in the full sample, 1,046 CLN issues have proceeds of at least \$2 million, including 538 issues linked to individual commodities or baskets. The average proceeds are sizeable, ranging from \$24.7 million for issues linked to platinum and palladium to \$152.5 million for issues linked to energy commodities. The subsample of CLNs with proceeds of at least \$10 million of proceeds consists of 590 issues, including 294 issues linked to individual commodities or baskets and 296 issues linked to commodity indexes. The average issue sizes are large for this subset, ranging from \$44 million to \$305 million depending on the underlying commodity type.

The S&P GSCI "rolls" from the front-month futures contracts to the longer dated contracts during a rolling period which spans the 5th to 9th business day of each contract maturity

[25] This argument is illustrated by the following statement that appeared in a feature article in the May 2006 issue of *Futures Industry* magazine:

> Keith Styrcula, chairman of the Structured Products Association, explains that one way a CLNs issuer can hedge its commodity exposure is through a total return swap with either its own swaps desk or a third party. The counterparty will then lay off the risk in the futures market. "At the end of the day, much of the hedging winds up creating open interest and volume in the underlying futures contracts. All roads lead to enhanced liquidity on the futures exchanges." (O'Hara, 2006)

month. During this period, 20% of the index rolls each day from the front-month futures contracts to longer dated contracts. Mou (2010) finds that the roll produces downward price pressure on the front-month futures contracts over this period for the commodities included in the index and corresponding upward price pressure for the next-month contracts, i.e. that it affects the futures price term structure. The hedging trades studied in this paper are different from the rolling activity considered in Mou (2010) since they represent net inflows to the futures market and impact the level of futures prices, as opposed to rebalancing along and impacting the term structure. To keep our results separate and distinct from the roll effect, in the main analysis we further restrict the sample to include only the issues having pricing dates that do not fall during the S&P GSCI roll periods. Panel B of Table 3 presents the sample of large issues with pricing dates that do not fall during index roll windows. The sample contains 837 CLN issues with proceeds of at least $2 million and 476 with proceeds of at least $10 million. The average proceeds are of similar magnitudes to those in Panel A.

We measure the price impact of the hedging trades using the daily abnormal return for the reference commodity's front-month futures contract. For each sample CLN issuance, *i*, with pricing date *t*, we define the abnormal return ($AR_{i,t}$) to the front-month futures contract on the CLN reference commodity as

$$AR_{i,t} = R_{i,t} - \hat{R}_{i,t}, \tag{2}$$

where $R_{i,t}$ is the day *t* return to the front-month commodity contract for the underlying commodity, defined as the difference in log daily closing futures prices: $R_{i,t} = \log(F_{i,t}) - \log(F_{i,t-1})$. The benchmarked return ($\hat{R}_{i,t}$) is estimated using a factor model capturing economic effects likely to influence commodity futures returns.

The return benchmark includes variables likely related to contemporaneous changes in commodities futures prices. As discussed by Tang and Xiong (2010) and Singleton (2011), demand stemming from the growth in emerging market Asian economies has been an important factor in commodity prices over the sample period. We include the returns to the MSCI Emerging Markets Asia Index, $R_{EM,t}$, to capture the impact of growth in emerging market Asian economies on commodities prices. Because the futures contracts trade in the U.S. and the U.K., we account for non-synchronicity in close-to-close returns from different time zones by including the next day return to this index, $R_{EM,t+1}$. Inclusion of the S&P 500 index return, $R_{S\&P,t}$, captures changes in demand due to U.S. economic growth. We include the returns to the

U.S. Dollar Index futures contracts, $R_{USD,t}$, consistent with Tang and Xiong (2010) who control for the strength of the U.S. Dollar as the dollar's strength influences demand for commodities and the dollar is the most common settlement currency for commodity transactions. Next, we include the return to the JP Morgan Treasury Bond Index, $R_{Tbond,t}$, to capture the link between commodity demand and fluctuations in interest rates, as in Tang and Xiong (2010). To control for the contemporaneous relation between commodities prices and innovations to the VIX index found in Cheng, Kirilenko, and Xiong (2012), we include the contemporaneous percentage change in the VIX index, $R_{VIX,t}$. We also include two additional control variables. The first is the Baltic Dry Index, BDI_t, which measures changes to the cost of transporting raw materials by sea and proxies for commodity demand. The second macroeconomic control is the 10-year breakeven inflation rate change, INF_t, as computed by Gürkaynak, Sack, and Wright (2010). Calculation of the breakeven inflation rate involves comparison of the nominal yield curve and the U.S. TIPS yield curve. Finally, we include the lagged commodity futures return to account for autocorrelation, or persistence, in the return series. With the exception of the change in the breakeven inflation rate, the data are obtained from Datastream and Bloomberg. The breakeven inflation rate data are from the Board of Governors of the Federal Reserve System.[26]

Computation of the benchmark returns begins with estimation of the following regression model for each observation:

$$R_{i,t} = \beta_{i,EM}R_{EM,t} + \beta_{i,EM+}R_{EM,t+1} + \beta_{i,S\&P}R_{S\&P,t} + \beta_{i,USD}R_{USD,t} + \beta_{i,Tbond}R_{Tbond,t} + \beta_{iVIX}R_{VIX,t} + \beta_{i,BDI}BDI_t + \beta_{i,INF}INF_t + \beta_{i,lag}R_{i,t-1} + \varepsilon_t. \quad (3)$$

For each sample observation, we estimate the benchmark model using data from the sixty trade days immediately preceding the pricing date. For each sample observation, the expected return, $\hat{R}_{i,t}$, comes from the sum product of the estimated coefficients from Model (3) and the values of the right hand side variables on the issuance date (X), i.e.

$$\hat{R}_{i,t} = \beta' X . \quad (4)$$

The commodity futures event-time abnormal return in equation (2) above is obtained by subtracting the benchmark return computed using equations (3) and (4) from the log return in equation (1). The next section presents the main results of the paper, which are the average

[26] Breakeven inflation data are available at: http://www.federalreserve.gov/econresdata/researchdata.htm

abnormal commodity futures returns, or price impacts, surrounding issuance of CLNs linked to individual commodities.

4.2. Individual commodities and commodity baskets

According to the financialization hypothesis, large inflows to commodity futures markets from financial investors for the purpose of gaining passive, strategic allocation to commodities affect prices in this market. The results in this section shed light on this topic by examining the returns to commodity futures around CLN issuances. The finding that hedging trades in commodities futures associated with the issuance of CLNs linked to individual commodities impact the prices of those contracts constitutes compelling evidence that these exogenous, non-fundamental trades impact prices by statistically and economically meaningful magnitudes.

The exact timing of the issuer's hedging trades is not certain, and hedging policy may vary across issuers. For example, an issuer may execute the entire hedging trade near the close of trading on the pricing date, to coincide with the determination of the offering price. Alternatively, the issuer may delay a portion of the hedging trade until the next day to minimize market impact. Should an issuer hedge their exposure with an instrument other than futures contracts, such as a commodity swap, although the swap dealer likely offsets its risk by buying futures, the exact timing when the order flow reaches the futures market is uncertain. For these reasons, the main analysis focuses on the price impact over the two-day event window spanning the pricing date and the next subsequent trading day. We denote this two-day window as Days [0,1]. Additionally, we present the abnormal returns on the pricing date, referred to as Day 0, and the next day, Day +1.

For the sample of CLNs referencing individual commodities or baskets of commodities, Table 4 presents the average abnormal returns for the front month underlying commodity futures contracts. The averages presented in Table 4 include three subsets of products based on the issue proceeds: issues totaling at least $2 million proceeds, at least $5 million proceeds, and at least $10 million proceeds. The price impact, as measured by the abnormal return to the front month futures contracts, should increase in the size of the hedge trade. The sample excludes issues during the S&P GSCI roll window.

The first row of Panel A presents the average abnormal returns to the front-month futures contracts. Across the three subsamples of large CLN issuances, the average abnormal returns on the pricing date, Day 0, are positive and significant. For the sample CLNs having proceeds greater than \$2, \$5, and \$10 million, respectively, the Day 0 average abnormal returns are 21, 22, and 30 basis points. The corresponding *t*-statistics (2.69, 2.39, and 2.93, respectively) indicate statistical significance of the price impacts at conventional levels. The abnormal returns on the trading day immediately following the pricing date, Day +1, are generally positive. This evidence is consistent with issuers delaying a portion of the hedge trade. Abnormal returns over the two day window, [0,1], are positive at 35, 37, and 48 basis points across the three subsamples. Additionally, the *t*-statistics range from 2.88 to 3.25, indicating significance at conventional levels. Consistent with the hypothesis that the abnormal returns stem from the issuers' hedging trades, the abnormal returns increase monotonically across the subsamples with increasingly larger proceeds sizes. For all products having proceeds greater than \$10 million, the Days [0,1] abnormal returns average 48 basis points compared to 21 basis points for all CLN issuances having at least \$2 million proceeds. Under the assumption CLNs having greater proceeds require larger hedge trades, the patterns in Table 4 are consistent with the interpretation that the abnormal returns result from the price impact of order flow resulting from CLN issuers' hedging trades.

The next two rows of Table 4 present the number of positive and negative abnormal returns in each subsample. The last row provides the probability that, under the null hypothesis that the probability of a positive return is 0.5, the number of positive abnormal returns equals or exceeds the number reported in the table. Specifically, the probability reported for date *t* is

$$\text{Prob}\left(k \geq x_t\right) = \sum_{k=x}^{n} \binom{n}{k} p^k (1-p)^{n-k}, \tag{5}$$

where x_t is the number of positive returns observed on date t in the sample, $\binom{n}{k} p^k (1-p)^{n-k}$ is the probability of k positive abnormal returns out of a total of n observations, and $p = 0.5$ is the probability of a positive abnormal return under the null hypothesis that positive and negative returns are equally likely. All *p*-values for the two-day abnormal returns, [0,1], are less than 1%, indicating that the numbers of positive two-day returns are significantly larger than the number of non-positive returns for each sub-sample. For example, the sample of issues with proceeds of at least \$10 million contains 151 issues with positive two-day returns around the pricing date and 101 with negative returns. Under the null hypothesis, the probability that 151 out of 252 returns are positive is less than 1%.

Panel B of Table 4 repeats the analysis from Panel A, but excludes CLN issues referencing baskets of commodities. The results are similar to those presented in Panel A, indicating that the results presented in Panel A are not driven by the inclusion of CLNs linked to more than one commodity. The price impacts over the two-day period including CLN pricing dates are positive and statistically significant. The magnitudes of the price impacts are nearly identical to those in Panel A.

The results presented in Table 4 are consistent with the "financialization" of commodity markets since commodities futures prices tend to increase on days when CLN issuers likely execute hedging trades. These hedging trades appear to have statistically and economically meaningful impact on the corresponding futures prices. The price impact, that is the average abnormal return for the CLN reference assets' front-month futures contract during the two-day window around the pricing date, increases in size and significance as the issue size increases. The magnitude of the price impacts is large, suggesting that the average CLN issue has an economically significant impact on the reference commodities' futures price.

The financialization hypothesis predicts that price impacts should be observed in every sector of the commodity markets. We check this predication by turning to the price impacts across various sectors of the commodities markets. We subdivide the individual commodities into the following sectors: agriculture, energy, industrial metals, platinum and palladium, gold and silver, and baskets of commodities. Table 5 presents the results for each of the five sectors in separate panels. The format for each panel is identical to the panels presented in Table 4.

The results presented in Table 5 for the commodity sectors provide additional supporting evidence that the abnormal returns to the reference commodities surrounding CLN issuances result from the issuers' hedging trades. First, the two-day abnormal returns are positive across all sectors. Second, the magnitudes of the two-day abnormal returns generally increase across the subsamples with increasingly larger proceeds cutoff sizes. The sample sizes for the commodity sector subsamples are small, causing some of the positive point estimates to be insignificant, but these results are consistent with the prediction that price impacts should be found in every commodity sector.

In Panel A, agricultural commodities exhibit positive price impacts on the pricing dates and the return magnitude increases in the issue size. The average abnormal return to agricultural commodities around CLN issuances of at least $10 million proceeds are 33 basis points while returns around issuances of at least $2 million were smaller in magnitude at 18 basis points but still significant. The agricultural commodity futures tend to exhibit small reversals on the next day, although even given the small reversals the two-day price impact is positive.

Panel B of Table 5 presents the price impacts for the energy commodities. The abnormal return estimates are positive and increase in the magnitude of the proceeds from the subsample with issues having proceeds of at least $2 million (96 basis points over days [0,1]) to the sample with at least $10 million proceeds (143 basis points over days [0,1]). In each subsample, the magnitudes of the price impacts in Panel B are larger than those for the other commodity sectors. This is unsurprising. Even though energy futures tend to be among the commodity futures with the greatest open interest and trading volumes,[27] the average size of the energy-related CLN issues is much larger than the average sizes of the issues in the other commodity sectors. The estimates are statistically significant, reflecting positive impacts over both days in the two-day window [0,1]. The energy price impacts are consistent with the main results in that they are positive and increase in the issue size.

Panels C through F present the price impacts for industrial metals, platinum and palladium, gold and silver, and commodity baskets, respectively. These results are all consistent with the main results since all event-window price impacts over the two day window beginning on the pricing dates, are on average positive and the magnitudes generally increase in the issue size. The significance levels for the price impacts in the individual commodities samples are low due to the small sample sizes. Additionally, in the case of gold it makes sense to consider the high open interest in gold futures. Approximately 86% of the issues in the "gold and silver" sector are linked to gold. Given that open interest in gold futures is so large, the lower price impacts in Panel E compared to other commodities is not surprising. Most importantly, the point estimates of average returns in this panel still demonstrate a generally increasing pattern with the size of issue, providing comfort that the price impact exists in all commodity sectors.

4.3 CLNs based on commodity indexes and CLNs with small proceeds

The analysis next turns to the CLNs referencing diversified commodity indexes. Although the sample size is large, we do not expect to observe significant price impacts around the pricing dates of these CLNs. The indexes are comprised of futures contracts on many

[27] Approximately 80% of the issues are based on crude oil, which has the most liquid futures market among all commodities.

different commodities, implying that the hedge trades will be spread across many commodities, resulting in small trades in each commodity. Second, Table 3 reveals that the average issue size in the sample of CLNs referencing a diversified commodities index and having proceeds of at least $2 million is just under $34 million. Compared to CLNs referencing agricultural or energy commodities which have average proceeds of $54 million or $152 million, respectively, the sample CLNs linked to indexes tend to be smaller. For these two reasons, we do not expect to find significant price impacts in the commodity indexes.

Table 6 presents the average abnormal futures returns for the various samples of CLNs based on commodity indexes. The table format is identical to the immediately preceding tables, reporting the average returns to the reference commodity index, the *t*-statistic, and the non-parametric test. Here, the return on the commodity index is constructed as in equation (1), using the futures contracts based on either the S&P GSCI or the DJ-UBS index. We match CLN issues based on indexes other than the two main indexes to the one of the two main indexes whose index composition most closely matches the other index.[28] For the sample of 391 CLNs linked to diversified commodity indexes having proceeds of at least $2 million, the average returns to the underlying commodity futures contracts in the two day window beginning on the pricing date are −3 basis points and are statistically indistinguishable from zero. Similar −2 and −3 basis point two-day average returns are obtained for the subsamples consisting of issues with proceeds of at least $5 and $10 million. On the pricing date alone, the average commodity index returns are −4, −7, and −3 basis points across the three subsamples by proceeds. Additionally, in the non-parametric tests, the *p*-values are large, and in some cases the pricing date index returns are negative more often than they are positive. In summary, as expected, we find no evidence that the hedging trades associated with index linked CLNs issuances result in price impacts to the underlying reference indexes.

[28] Specifically, CLN issues based on the S&P GSCI Enhanced Commodity Index Excess Return, S&P GSCI Light Energy Total Return Index, S&P GSCI Ultra-Light Energy Enhanced Strategy Excess Return, JPMorgan Commodity Curve Index — Aggregate Excess Return, JPMorgan Commodity Investable Global Asset Rotator 9 Long-Only Index, Lehman Brothers Commodity Index Pure Beta Total Return, Merrill Lynch Commodity Index, and Rogers International Commodity Index are mapped to the S&P GSCI index. CLN issues based on the UBS Bloomberg Constant Maturity Commodity Index, S&P Commodity Trends Indicator—Total Return, Barclays Capital Pure Beta Plus II Total Return, Barclays Capital Multi-Strategy DJ-UBSCI with Seasonal Energy Excess Return Index, Barclays Capital Voyager II DJ-UBSCI Total Return, Deutsche Bank Commodity Booster-Dow Jones-UBS 14 TV Index Excess Return, and Pure Beta DJ-UBS CI Total Return are mapped to the DJ-UBS index.

These results in Table 6 address a potential concern about a possible selection bias that might arise because the issuers may have a tendency to cancel issues when the underlying commodity suffers negative intra-day returns on the pricing date. As a result, to the extent that this selection bias exists, positive pricing date returns to the commodities futures contracts may be overrepresented in the sample of completed CLN issues.

The results in Table 6 address this possible selection bias because commodity index-linked products are just as subject to the potential selection bias as CLNs based on individual commodities. Thus, if the selection bias affects the results for individual and basket-linked CLNs, it should also affect the index- linked products, implying that the price impact for the index-linked products should be an upper bound on the selection bias. Since the results presented in Table 6 show that this upper bound is close to zero, we conclude the positive pricing date returns we observe in the sample of CLNs linked to individual commodities and commodity baskets are not due to the selection bias.

In addition, any potential selection bias should also apply to the smallest CLN issues, whereas the hedge trades associated with small issues are expected to have very limited price impacts. Thus, the price impacts for the smallest issues provide additional evidence about the extent to which the potential selection bias might be driving the results. Table 7 reports the average abnormal futures returns around the pricing dates for two subsamples of the smallest CLN issues, those issues having proceeds of less than $2 million and those with proceeds of less than $5 million. The initial hedge trades for this sample are small and thus are unlikely to cause large price impacts. These average abnormal returns around the pricing date are slightly negative and not statistically different from zero. From Panel A, the sample of CLNs referencing individual commodities and baskets of commodities contains 116 issues. The average returns around the pricing date are −17 basis points, and not statistically different from zero. Average returns are slightly positive (12 basis points) and insignificant for the same sample of 215 issues with proceeds less than $5 million. Panel B presents the results when we exclude basket-linked products from the subsample of small issues. The results are consistent with those in Panel A.

Taken together, the results in Tables 6 and 7 are evidence that the positive returns observed in the two day window around the pricing date are not due to the selection bias discussed above.

4.4 Are the price impacts permanent or temporary?

Table 8 presents the reference commodity's abnormal front-month futures returns for each of post-issuance days 2 through 5, along with the average abnormal returns for the two-day window, [0, 1], for which results were shown in Table 4. Panel A presents the results for the sample of CLNs referencing individual commodities and baskets of commodities. Panel B presents the results for the subsample of CLNs based on individual commodities, i.e. excluding CLNs referencing baskets. Each panel presents the average abnormal futures return, corresponding *t*-statistic, and non-parametric test for the issues of products having proceeds of at least 2, 5, and 10 million U.S. dollars.

The results in Table 8 provide no evidence that the positive two-day returns during the window [0,1] are reversed during days 2 through 5. With the exception of the average returns of −1 or −2 basis points on day 3 for the issues with proceeds of at least $10 million reported in Panels A and B, respectively, all of the average returns in Table 8 are positive. The day +2 returns for the subsamples of products having proceeds of at least 2 million dollars in Panels A and B are significantly positive at the 10% and 5% levels, respectively, using two-sided tests. These day +2 returns thus actually provide some evidence of return continuations rather than reversals. Regardless, the important finding in Table 8 is that there is no evidence that the initial price impacts are reversed in any of the subsamples. This suggests that the new flows into the commodity markets, which come to the futures markets in the form of the CLN issuers' hedging trades, have a persistent, and possibly permanent, price impact.

The existing literature provides two possible explanations for permanent price impacts. The first potential explanation is that the CLN issuances convey positive private information held by either the issuer or the CLN investors. As explained above, it seems very unlikely that the CLN issuances convey issuers' positive private information to other market participants, because the issuers typically hedge their exposure to the underlying commodity futures prices and thus have no or limited net exposure to the underlying futures prices. To the extent that a CLN issuer chooses not to hedge a CLN issue or to hedge only partially, the issuer's exposure to the commodity price will be negative, i.e. an issuer who does not hedge or hedges only partially will benefit from decreases in the underlying futures price. Thus, the positive price impacts we find cannot be explained by the hypothesis that the CLN issues cause other market participants to infer that the issuer has private information about future commodity prices.

Also as discussed above, it is unlikely that the CLN issuances convey to the market valuable private information held by retail investors. Due to their embedded costs, no or limited leverage, and for most of the products, limited secondary market liquidity, CLNs are poor vehicles for speculating on changes in commodity futures prices. In contrast, the underlying futures contracts are well suited to such speculation. In order for one to believe that CLN issuances convey value-relevant information, one must believe that investors purchasing CLNs are sophisticated enough to possess valuable private information about future commodity prices, but naïve enough to purchase CLNs in the primary market.

The second possible explanation for the permanent price impacts is that they are evidence of downward sloping demand curves for the underlying commodity futures. In a paper studying the effects of changes in the composition of the S&P 500 index, Schleifer (1986) finds that stocks experience large, positive abnormal returns when added to the S&P 500, and interprets this as evidence that demand curves for individual stocks slope downward. Schleifer (1986) finds no evidence of post-issuance reversals during the period after index investing became prominent, implying the price impacts are permanent. Kaul, Mehrotra, and Morck (2000) find permanent price impacts to stocks in the Toronto Stock Exchange 300 Index when the exchange re-weighted the index constituents. Our finding of permanent price impacts to commodity futures prices is consistent with these findings in the literature on index inclusions, and the explanation for the positive abnormal returns is likely to be the same. Had the price impacts been due to limited liquidity, the abnormal returns in Table 8 should contain evidence of reversals when the liquidity demands subsided. On the other hand, price impacts due to shifts in the demand curves for long commodity futures positions will not reverse. Thus, the lack of reversals evident across all subsamples analyzed in Table 8 constitute evidence consistent with the interpretation that the price impacts likely result from a shift in the demand curve for long positions in the commodity futures contracts as opposed to the liquidity demands of the hedging trades. In fact, the permanence of the price impacts implies that the large inflows to this market from long-only financial investors affect futures prices in even very liquid commodity futures contracts, i.e. evidence of the financialization of commodity futures markets.

4.5 Price Impact and Anticipated Hedge Trade Size

The financialization hypothesis predicts that the abnormal returns to commodity futures around CLN issuances are increasing in the sizes of the hedge trades. The analysis presented in this section examines whether the price impacts for the sample of CLNs referencing individual commodities and commodity basked are related to reasonable proxies for the sizes of the hedge trades.

Direct estimation of the sizes of the hedge trades for the sample CLNs would require many pricing models, one for each variety of CLN. Since CLN structures differ and can require complex pricing models, implementing pricing models for all or most of our sample of CLNs is not feasible at reasonable cost. A possible alternative approach might involve identifying a subset of products having similar structures and restricting the analysis to that subsample. However, that approach fails to produce a sample of sufficient size for meaningful analysis. In light of these restrictions, we employ several reasonable proxies for the magnitude of the hedge trade size.

The first proxy is the number of futures contracts the CLN issuer would need to trade in order to hedge completely their CLN liability, assuming the option elasticity $(\partial V/\partial F)\times(F/V)$ for each CLN equals one, where V is the CLN proceeds and F is the futures price of the front-month futures contract. We normalize the number of futures contracts needed to hedge by the open interest in the two nearest futures contracts since these are the most liquid futures contracts (Mou 2010), and call the result of this normalization *RelativeIssueSize*. Under the assumption that each CLN has a similar elasticity, *RelativeIssueSize* captures the cross-sectional variation in the hedge trade size relative to the open interest in the reference commodity futures contracts. We expect the abnormal return, or price impact, in the individual commodity futures around CLN issuances to correlate positively to *RelativeIssueSize* since larger values indicate the issuer's trade is greater relative to the open interest.

Column (1) of Table 9 presents regression results for the following model,

$$AR_i = \gamma_0 + \gamma_1 \times RelativeIssueSize_i + \epsilon_i, \tag{6}$$

where the dependent variable, AR_i, is the two-day abnormal return to the reference commodity's front-month futures price for the i^{th} CLN defined in Section 4.1. The magnitude of the commodity futures abnormal return, our proxy for the price impact of hedging trades, is related positively to *RelativeIssueSize* as indicated by the estimated coefficient of 0.217 and *t*-statistic of 3.03. The mean value of *RelativeIssueSize* is 0.61%, indicating that the average hedging trade constitutes approximately 0.61% of the total open interest in the reference commodity futures. With *RelativeIssueSize* at its mean, the estimates indicate a 23 basis point price impact. A one standard deviation increase in *RelativeIssueSize* above its mean corresponds to a 48 basis point larger price impact, demonstrating that the price impacts is economically meaningful.

RelativeIssueSize is an imperfect proxy for the hedge trade size. An alternative, though noisy, proxy for hedge trading is the abnormal futures trading volume around CLN issuance. We define *AbnormalVolume* as the number of contracts traded (futures volume) in the reference commodity's front month futures contract during the two-day window around the CLN issuance, Days [0,1], minus the trailing 60-day average daily futures contract volume. For comparison across commodities, we normalize the abnormal volume by open interest in the two front contracts. Column (2) of Table 9 presents the results for the regression model

$$AR_i = \gamma_0 + \gamma_2 \times \ AbnormalVolume_i + \ \epsilon_i. \qquad (7)$$

The size of the abnormal returns relates positively to the average two-day *AbnormalVolume*. The coefficient estimate is positive and significant at the 10% level. The significance level is not surprising given that *AbnormalVolume* is a noisy measure for the size of the issuer's hedging trade. The mean value of *AbnormalVolume* is 0.56, corresponding to a 44 basis point average price impact for the average issue. The economic magnitude of the trading is significant. A one standard deviation increase in *AbnormalVolume* corresponds to an approximately 21 basis point larger price impact. Since the trade size proxies are noisy, the results likely under-estimate the price impacts by the standard errors-in-variables argument.

We also estimate an alternative specification, including as covariates the volume during the two-day event window (*2-DayVolume*) and twice the 60-day average volume (2×*AverageVolume*). The price impact is likely smaller in commodities having higher trading volumes. Column (3) of Table 9 presents the estimates for the following regression model:

$$AR_i = \gamma_0 + \gamma_3 \times \ (2 - DayVolume_i) + \ \gamma_4 \times (2 \times AverageVolume_i) + \ \epsilon_i, \qquad (8)$$

where *2-DayVolume* is the volume in the front-month futures contract over the two-day window [0,1] normalized by the open interest in the two front-month contracts. *AverageVolume* is the trailing sixty-day average volume in the front-month contract normalized by open interest in the two front-month contracts; it is multiplied by 2 in order to be consistent with the variable *2-DayVolume*. Consistent with the previous results and the interpretation that CLN issuers' hedge trades impact prices, the coefficient estimate for *2-DayVolume* is positive and significant at the 10% level. As expected, although the coefficient estimate for *AverageVolume* is not statistically significant, the negative point estimate is consistent with the interpretation that the price impact is lower for commodity futures normally having higher trading volume. While each of the regression models employs imperfect proxies for hedge trade size, the regression results presented in Table 9 are consistent with the hypothesis that CLN issuer's hedging trades impact prices in the commodity futures market and that the magnitude of the impact is economically and statistically significant.

5. Robustness tests

In this section we first present results showing that the main results about abnormal futures price returns around the pricing dates of individual and basket-linked CLNs are robust to the exclusion from the sample of CLN issues priced during the five day period during each month in which the S&P GSCI "rolls" to the next-month futures contracts, the "Goldman roll." Then, we show that the main results above are also found if one computes the abnormal futures price return using an alternative return benchmark.

5.1 The "Goldman roll"

Motivated by the findings in Mou (2010) that the rolling activity of commodity index traders has significant impact on the term structure of commodity futures prices, the results presented in Tables 4 through 9 exclude from the sample all CLNs having pricing dates that fall during the period when the S&P GSCI "rolls" from the front-month futures contracts to the next-month contracts. During the rolling period which spans the 5^{th} to 9^{th} business day of each contract maturity month, 20% of the index rolls each day from the near-term futures contract to a longer dated contract. Mou (2010) finds that the roll produces downward price pressure on the front-month futures contracts over this period for the commodities included in the index and corresponding upward price pressure for the next-month contracts. For the CLNs priced during roll periods, roll-related selling of the front-month contract may offset the demand pressure from the hedging trades associated with CLNs. For this reason, we expect to find a smaller price impact, or possibly even no price impact, for CLN issues that are priced during the roll period. For robustness, we expand the analysis in Section 4.2 to include the CLNs linked to individual commodities or baskets of commodities with pricing dates that fall during the GSCI roll period. Table 10 presents the results.

In the sample of CLNs having proceeds of at least $2 million, there are 197 issues priced during S&P GSCI roll periods, of which 69 reference an individual commodity and 11 reference a basket of commodities. The remaining 117 CLNs reference a commodity index. The average abnormal return to the reference commodities' front-month futures contracts during two-day windows around the pricing dates are of similar magnitude to main results in Table 4 and are statistically significant at conventional levels. As expected, the average abnormal returns over the two-day window [0,1] are slightly smaller than those in Table 4 when we include the issues priced during the Goldman roll period. For the CLNs with proceeds of at least $2 million, the average two-day abnormal return is 29 basis points with a *t*-statistic of 2.45. The non-parametric test indicates that the number of CLNs associated with positive abnormal returns (290) exceeds the number with negative returns (248) by a significant margin under the null hypothesis that positive and negative returns are equally likely. The price impacts for issues having proceeds of at least $5 million are similar, although slightly lower at 26 basis points. The larger issues, those with proceeds of at least $10 million, exhibit the largest price impact at 39 basis points with a *t*-statistic of 2.44. Across the three subsamples, the average abnormal returns are positive on both Days 0 and +1. Panel B repeats the results in Panel A but excludes CLNs linked to baskets. The results are nearly identical in the two panels. Overall, Table 10 indicates that the economic magnitude and statistical significance of the results remain when we include issues that occur during the Goldman roll. Thus, the results are not driven by the exclusion of issues priced during the S&P GSCI roll windows.[29]

5.2. Alternative Benchmark

The benchmark model in equation (3) has intuitive appeal because it controls for variables related to contemporaneous changes in commodity prices. Despite this appeal, it is possible that the benchmark model is poorly specified. To address this potential concern, for robustness we consider an alternative benchmark model in which the benchmark return is the simple arithmetic average daily futures return over the sixty trade days immediately prior to the pricing date. The simple average return is a noisy estimate of the expected futures return, but is a reasonable one under the assumption that the expected return is either constant or changes slowly over time.

The analysis presented in Table 11 repeats the event study of abnormal commodity futures returns around CLN pricing dates for the sample CLNs referencing individual commodities and baskets of commodities but using the alternative return benchmark. Referring

[29] In untabulated results, we repeat all analyses presented in the paper (not just the main results) including the CLNs priced during the S&P GSCI roll period, and obtained results qualitatively and quantitatively similar to the results presented in the paper that exclude issues priced during the roll period.

to Panel A of Table 11, the two-day abnormal returns are positive, statistically significant, and increase across the subsamples with progressively larger proceeds. Across the samples of CLNs having proceeds of at least 2, 5, and 10 million dollars, the two-day average abnormal returns are 33, 38, and 50 basis points, respectively, with *t*-statistics ranging from 2.50 to 2.95. The non-parametric tests indicate that there are significantly more observations with positive than negative abnormal returns over the two-day window. The average abnormal returns on each of Day 0 and Day +1 are positive and generally statistically significant. Panel B repeats the analysis excluding the basket-linked products, and contains results nearly identical to those in Panel A. These results in Table 11 provide comfort that the main results discussed above are not an artifact created by the choice of the benchmark return model.[30]

6. Conclusion

Financial institutions issuing CLNs either execute hedge trades in the commodity futures markets or hedge using swaps which are then rehedged in the futures markets. These hedge trades have significantly positive and economically meaningful impacts on the reference commodity futures prices around the pricing dates of the CLNs. For the sample of CLNs linked to individual commodities or baskets of commodities, we find abnormal returns to the front-month futures contract of between 37 and 51 basis points during a two-day window around the pricing date. These findings indicate that CLN issues, which are new inflows to the commodities market, had important impacts on the underlying commodity futures prices during the sample period from 2003 to August 2011. Our findings are not restricted to one commodity type, but apply generally across commodity sectors.

Regression analyses show that the abnormal futures returns are positively correlated with reasonable proxies for the size of the issuers' hedge trades. A one standard deviation increase in the hedge trade proxy corresponds to an increase in the abnormal futures return of 21 to 44 basis points, depending on the proxy. Thus, both the abnormal futures returns and the regression analyses lead to the conclusion that the hedge trades correspond to statistically and economically meaningful positive returns to the reference commodity futures.

We find no evidence of reversals, indicating the hedging trades result in either slowly decaying or permanent increases in commodity futures prices. Since the CLN issuers' hedge

[30] In untabulated results, we repeated all of the analyses presented in the paper (not just the main results) using the alternative benchmark model, and obtained results similar to those presented in the paper.

trades are unlikely to be based on valuable private information about future commodity prices, the price impacts are likely due to downward sloped demand curves for commodity futures contracts.

The results support the view that the trades of financial institutions play an important role in price formation in the commodities futures markets. In this sense, the commodities prices are no longer determined only by the supply and demand in the real sector. Instead, they are also affected by the financial institutions' behavior, which reflects a fundamental process of financialization of commodities.

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Table 1: Numbers of Issues and Total Proceeds of the Commodity-Linked Notes, by Year

Number of issues and aggregate proceeds of U.S. commodity-linked notes issued in each year during 2003-2011. The sample consists of all commodity-linked notes with pricing supplements in the S.E.C.'s EDGAR database through Aug. 31, 2011, issued by the banks and other financial intermediaries identified as the main issuers. The sample is divided into six groups according to the type of underlying commodity: agriculture, energy, industrial metals, platinum and palladium, gold and silver, and diversified indexes and commodity baskets. The category diversified index includes products based on the Dow Jones-UBS Commodity Index, S&P GSCI, Deutsche Bank Liquid Commodity Index, and some other commodity indices, excluding products based on sub-indices. Baskets of more than one individual commodity are specified by the issuers. CLN's based on a sub-index that includes commodities in only one commodity sector are included with the issues based on individual commodities in that sector. The proceeds are in thousands of dollars.

Underlying Commodity	**Agriculture**		**Energy**		**Industrial Metals**		**Platinum and Palladium**		**Gold and Silver**		**Diversified Index and Commodity Baskets**		**Full Sample**	
Year	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds
2003	0	-	0	-	0	-	0	-	1	26,000	4	283,840	5	309,840
2004	0	-	1	73,020	0	-	0	-	2	20,651	14	508,016	17	601,687
2005	10	397,699	0	-	0	-	0	-	2	7,200	31	627,406	43	1,032,305
2006	12	44,490	15	603,043	1	15,000	0	-	10	152,800	53	3,220,735	91	4,036,067
2007	17	1,111,729	37	864,977	12	1,113,000	0	-	7	130,655	112	3,606,139	185	6,826,500
2008	25	3,182,529	34	8,999,389	13	2,462,750	3	225,000	20	2,428,132	186	5,743,194	281	23,040,994
2009	28	956,595	37	9,270,339	16	54,027	1	50,000	51	1,213,710	153	1,701,632	286	13,246,303
2010	9	309,954	39	479,971	16	285,669	7	191,665	66	1,669,858	161	1,812,544	298	4,749,661
2011 (Aug.)	31	922,833	45	1,013,874	25	579,888	22	230,699	33	492,561	129	1,853,337	285	5,093,193
Total	132	6,925,828	208	21,304,612	83	4,510,334	33	697,364	192	6,141,567	843	19,356,843	1491	58,936,549
Average Proceeds		52,468		102,426		54,341		21,132		31,987		22,962		39,528

Table 2: Numbers of Issues and Total Proceeds of the Commodity-Linked Notes, by Issuer

Numbers of issues and aggregate proceeds of U.S. commodity-linked notes issued by each issuer during 2003-2011. The sample consists of all commodity-linked notes with pricing supplements in the S.E.C.'s EDGAR database through Aug. 31, 2011, issued by the banks and other financial intermediaries identified as the main issuers. The sample is divided into six groups according to the type of underlying commodity: agriculture, energy, industrial metals, platinum and palladium, gold and silver, and diversified indexes and commodity baskets. The category diversified index includes products based on the Dow Jones-UBS Commodity Index, S&P GSCI, Deutsche Bank Liquid Commodity Index, and other commodity indices, excluding products based on sub-indices. Baskets of more than one individual commodity are specified by the issuers. CLN's based on a sub-index that includes commodities in only one commodity sector are included with the issues based on individual commodities in that sector. The proceeds are in thousands of dollars.

Underlying Commodity	**Agriculture**		**Energy**		**Industrial Metals**		**Platinum and Palladium**		**Gold and Silver**		**Diversified Index and Commodity Baskets**		**Full Sample**	
Issuers	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds	No.	Proceeds
ABN	12	14,588	1	1,000	0	-	0	-	0	-	5	43,076	18	58,664
AIG	0	-	1	2,500	0	-	0	-	0	-	0	-	1	2,500
Bank of America	6	72,909	20	318,147	3	39,100	1	63,556	28	1,119,088	61	1,147,661	119	2,760,460
Barclays	51	2,814,935	41	6,643,574	21	1,476,929	10	219,174	39	403,770	99	4,599,251	261	16,157,633
Bear Stearns	0	-	0	-	0	-	0	-	0	-	4	27,406	4	27,406
Citigroup	2	13,183	4	22,846	7	96,000	0	-	15	173,996	18	227,201	46	533,227
Credit Suisse	0	-	2	10,193	1	4,245	0	-	1	16,055	4	10,028	8	40,521
Deutsche Bank	6	2,003,683	16	12,626,492	10	2,022,544	2	44,033	14	3,079,561	138	3,391,002	186	23,167,315
Eksportfinans	7	434,643	1	1,000	1	155,544	3	73,461	9	287,819	43	1,579,149	64	2,531,617
Goldman Sachs	3	37,060	6	56,961	1	11,001	0	-	5	92,480	40	621,537	55	819,039
HSBC	0	-	0	-	0	-	1	9,807	7	54,221	45	359,365	53	423,393
JP Morgan	8	54,696	35	298,025	15	59,433	9	43,302	22	121,812	56	407,892	145	985,160
Lehman Brothers	2	250,500	27	42,610	1	10,000	0	-	4	18,933	8	405,155	42	727,198
Merrill Lynch	6	219,698	7	241,658	0	-	0	-	8	232,795	30	1,964,673	51	2,658,824
Morgan Stanley	9	102,565	22	170,265	3	20,187	1	19,225	20	122,822	55	353,484	110	788,548
RBC	2	28,000	5	3,810	4	3,830	0	-	1	2,410	8	14,149	20	52,199
Swed. Ex. Cred.	10	649,526	8	571,797	15	561,520	2	48,776	8	202,557	128	3,069,577	171	5,103,754
UBS	8	229,843	12	293,735	1	50,000	3	175,000	9	199,906	89	1,044,866	122	1,993,349
Wachovia	0	-	0	-	0	-	0	-	2	13,342	0	-	2	13,342
Wells Fargo	0	-	0	-	0	-	1	1,030	0	-	12	91,372	13	92,402
Total	132	6,925,828	208	21,304,612	83	4,510,334	33	697,364	192	6,141,567	843	19,356,843	1491	58,936,549

Table 3: Average Size of the CLN Issues, by Commodity Sector

Numbers of issues and average proceeds of CLN issues for sub-samples with proceeds greater than or equal to \$2 million, greater than or equal to \$5 million, and greater than or equal to \$10 million. The sample is divided into seven groups according to the type of underlying commodity: agriculture, energy, industrial metals, platinum and palladium, gold and silver, diversified indexes, and commodity baskets. The category diversified index includes products based on the Dow Jones-UBS Commodity Index, S&P GSCI, Deutsche Bank Liquid Commodity Index, and other commodity indices, excluding products based on sub-indices. Baskets of more than one individual commodity are specified by the issuers. CLN's based on a sub-index that includes commodities in only one commodity sector are included with the issues based on individual commodities in that sector. Panel A shows the average proceeds for subsamples of issues satisfying the size criteria, including issues priced during the 5^{th} through 9^{th} business day of each month when the GSCI "rolls" from the front-month futures contracts into longer term futures contracts. Panel B excludes issues priced during the S&P GSCI roll period. The proceeds are in thousands of dollars.

Panel A: Total sample, including issues priced during the S&P GSCI roll periods

	Agriculture		**Energy**		**Industrial Metals**		**Platinum and Palladium**		**Gold and Silver**		**Diversified Index**		**Commodity Baskets**	
CLN Issue Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds
≥ \$2 million	109	54,188	132	152,538	68	51,420	28	24,687	143	32,290	508	33,884	58	17,786
≥ \$5 million	90	64,937	91	219,770	52	66,240	22	30,712	108	41,669	402	41,961	40	24,341
≥ \$10 million	73	78,377	65	305,075	36	92,756	14	44,073	77	55,721	296	54,521	29	31,008

Panel B: Sample excluding issues priced during the S&P GSCI roll periods

	Agriculture		**Energy**		**Industrial Metals**		**Platinum and Palladium**		**Gold and Silver**		**Diversified Index**		**Commodity Baskets**	
CLN Issue Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds	No.	Avg. Proceeds
≥ \$2 million	93	59,097	107	133,876	57	59,513	28	24,687	126	30,920	391	33,056	47	17,733
≥ \$5 million	78	69,803	72	197,342	43	77,866	22	30,712	94	40,288	311	40,727	32	24,520
≥ \$10 million	63	84,727	52	270,597	32	102,413	14	44,073	70	51,880	231	52,416	21	33,820

Table 4: Average Abnormal Returns of Underlying Commodity Futures Around the CLN Pricing Dates, Excluding Issues Priced During S&P GSCI Roll Periods

Abnormal returns of underlying commodity futures contracts around the pricing dates of the CLNs based on individual commodities and commodity baskets. CLN's based on a commodity sub-index that includes commodities in only one commodity sector are included with the issues based on individual commodities in that sector. Issues priced during the S&P GSCI roll periods are excluded. Abnormal returns are computed relative to a benchmark given by the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. The first row in each panel reports the average abnormal returns on the CLN's underlying futures contracts around the pricing date for three different size groups. Below the returns are *t*-statistics for the tests of the hypothesis that the average returns are equal to zero. The next two rows present the number of positive and negative returns. The last row provides the probability that the number of positive returns equals or exceeds the number of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

Panel A: Individual commodities and commodity baskets

	Proceeds ≥ $2 million			Proceeds ≥ $5 million			Proceeds ≥ $10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.22%	0.14%	0.37%	0.21%	0.19%	0.40%	0.31%	0.20%	0.51%
t-statistic	2.78	1.74	2.97	2.28	2.04	2.88	2.81	1.91	3.09
Number of returns > 0	234	239	254	169	179	193	128	130	149
Number of returns ≤ 0	224	219	204	172	162	148	124	122	103
Probability under H_0	0.3371	0.1873	0.0110	0.5857	0.1931	0.0085	0.4251	0.3297	0.0022

Panel B: Individual commodities (excluding commodity baskets)

	Proceeds ≥ $2 million			Proceeds ≥ $5 million			Proceeds ≥ $10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.23%	0.13%	0.37%	0.22%	0.18%	0.40%	0.33%	0.19%	0.52%
t-statistic	2.66	1.47	2.71	2.15	1.81	2.63	2.72	1.74	2.90
Number of returns > 0	208	213	224	152	160	172	117	117	136
Number of returns ≤ 0	203	198	187	157	149	137	114	114	95
Probability under H_0	0.4218	0.2449	0.0378	0.6335	0.2848	0.0265	0.4477	0.4477	0.0042

Table 5: Average Abnormal Returns of Underlying Commodities Around the CLN Pricing Dates by Commodity Sector, Excluding Issues Priced During GSCI Roll Periods

Abnormal returns of underlying commodity futures contracts on and around the pricing dates of the CLNs for six sub-samples of CLNs defined by commodity sector: Agriculture, Energy, Industrial Metals, Platinum and Palladium, Gold and Silver, and Commodity Baskets. CLN issues priced during the S&P GSCI roll periods are excluded. Abnormal returns are computed relative to a benchmark given by the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. The first row in each panel reports the average abnormal returns on the CLN's underlying futures contracts around the CLN pricing dates. Below the returns are *t*-statistics for tests of the hypothesis that the average returns are equal to zero. The next two rows present the number of positive and negative returns. The last row provides the probability that the number of positive returns equals or exceeds the number of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

Panel A: Agriculture

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.18%	-0.14%	0.04%	0.24%	-0.12%	0.12%	0.33%	-0.28%	0.05%
t-statistic	1.05	-1.02	0.20	1.25	-0.83	0.53	1.54	-1.82	0.18
Number of returns >0	51	45	44	44	37	39	37	27	33
Number of returns ≤0	42	48	49	34	41	39	26	36	30
Probability under H_0	0.2035	0.6607	0.7330	0.1541	0.7142	0.5450	0.1037	0.8963	0.4007

Panel B: Energy

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.31%	0.65%	0.96%	0.41%	0.72%	1.14%	0.75%	0.68%	1.43%
t-statistic	1.44	2.66	2.63	1.45	2.52	2.56	2.09	1.95	2.52
Number of returns >0	51	60	62	35	40	44	28	27	31
Number of returns ≤0	56	47	45	37	32	28	24	25	21
Probability under H_0	0.7190	0.1229	0.0608	0.6380	0.2048	0.0382	0.3389	0.4449	0.1058

Panel C: Industrial Metals

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.50%	-0.15%	0.36%	0.45%	0.19%	0.64%	0.42%	0.17%	0.59%
t-statistic	1.96	-0.55	0.93	1.44	0.66	1.39	1.24	0.56	1.18
Number of returns >0	29	28	34	21	23	27	15	16	20
Number of returns ≤0	28	29	23	22	20	16	17	16	12
Probability under H_0	0.5000	0.6043	0.0924	0.6196	0.3804	0.0631	0.7017	0.5700	0.1077

Table 5 (continued): Average Abnormal Returns of Underlying Commodities Around the CLN Pricing Dates by Commodity Sector, Excluding Issues Priced During GSCI Roll Periods

Panel D: Platinum and Palladium

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.31%	-0.22%	0.09%	0.34%	-0.48%	-0.13%	0.42%	-0.11%	0.30%
t-statistic	1.18	-0.79	0.21	1.14	-1.61	-0.28	0.96	-0.33	0.46
Number of returns >0	13	13	16	9	9	12	5	7	9
Number of returns ≤0	15	15	12	13	13	10	9	7	5
Probability under H_0	0.7142	0.7142	0.2858	0.8569	0.8569	0.4159	0.9102	0.6047	0.2120

Panel E: Gold and Silver

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
							-		
Average abnormal return	0.07%	0.09%	0.16%	-0.07%	0.15%	0.08%	0.04%	0.33%	0.29%
t-statistic	0.54	0.82	0.95	-0.57	1.16	0.43	-0.31	2.23	1.40
Number of returns >0	64	67	68	43	51	50	32	40	43
Number of returns ≤0	62	59	58	51	43	44	38	30	27
Probability under H_0	0.4645	0.2665	0.2114	0.8233	0.2352	0.3031	0.7985	0.1410	0.0361

Panel F: Commodity Baskets

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.13%	0.24%	0.37%	0.15%	0.27%	0.42%	0.15%	0.28%	0.43%
t-statistic	0.85	1.40	1.70	0.98	1.20	1.64	0.94	1.01	1.58
Number of returns >0	26	26	30	17	19	21	11	13	13
Number of returns ≤0	21	21	17	15	13	11	10	8	8
Probability under H_0	0.2800	0.2800	0.0395	0.4300	0.1885	0.0551	0.5000	0.1917	0.1917

Table 6: Average Abnormal Returns of Underlying Diversified Commodity Index Futures Around the CLN Pricing Dates, Excluding Issues Priced During S&P GSCI Roll Periods

Average returns of underlying commodity index futures contracts around the pricing dates of the CLNs based on diversified commodity indexes. CLN issues priced during the S&P GSCI roll periods are excluded. Abnormal returns are computed relative to a benchmark given by the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. The first row in each panel reports the average abnormal returns on the underlying futures contracts of the CLNs around the pricing date for three different size groups. Below the returns are *t*-statistics for the tests of the hypothesis that the average returns are equal to zero. The next two rows present the number of positive and negative returns. The last row provides the probability that the number of positive returns equals or exceeds the number of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

Diversified commodity index

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	-0.04%	0.01%	-0.03%	-0.07%	0.04%	-0.02%	-0.03%	0.00%	-0.03%
t-statistic	-0.55	0.16	-0.28	-0.73	0.42	-0.19	-0.28	0.02	-0.18
Number of returns > 0	193	206	210	155	163	165	118	118	121
Number of returns ≤ 0	198	185	181	156	148	146	113	113	110
Probability under H_0	0.6192	0.1559	0.0783	0.5451	0.2137	0.1537	0.3962	0.3962	0.2553

Table 7: Average Abnormal Returns of Underlying Commodity Futures Around the Pricing Dates for Subsamples of CLN Issues with Small Proceeds, Excluding CLN Issues Priced During S&P GSCI Roll Periods

Abnormal returns of underlying commodity futures contracts around the pricing dates of the CLNs based on individual commodities and baskets. CLN issues priced during S&P GSCI roll periods are excluded. Abnormal returns are computed relative to a benchmark given by the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. The first row in each panel reports the average returns on the CLNs' underlying futures contracts around the pricing date for three different size groups. Below the returns are *t*-statistics for the tests of the hypothesis that the average returns are equal to zero. The next two rows present the number of positive and negative returns. The last row provides the probability that the number of positive returns equals or exceeds the number of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

	Proceeds < $2 million			Proceeds < $5 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	-0.14%	-0.21%	-0.35%	0.07%	-0.09%	-0.02%
t-statistic	-0.60	-0.99	-1.02	0.51	-0.62	-0.09
Number of returns > 0	54	45	50	119	105	111
Number of returns ≤ 0	46	55	50	98	112	106
Probability under H_0	0.2421	0.8644	0.5398	0.0872	0.7064	0.3930

Table 8: Average Abnormal Returns of Underlying Commodity Futures Following the CLN Pricing Dates, Excluding CLN Issues Priced During S&P GSCI Roll Periods

Average abnormal returns of the CLNs' underlying commodity futures contracts on and around the pricing dates of the CLNs based on individual commodities and baskets. CLN issues during the S&P GSCI roll period are excluded from the sample. Dates are relative to the pricing dates, e.g. date 0 is the pricing date and day 1 is the date one day after the pricing date. Abnormal returns are computed relative to a benchmark given by the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date.

Panel A: Individual commodities and baskets

Day relative to pricing date	**0**-1	2	3	4	5
Total Proceeds ≥ $2 million					
Average abnormal return	0.37%	0.17%	0.13%	0.12%	0.05%
t-statistic	2.97	1.93	1.37	1.40	0.55
Number of returns > 0	254	244	242	250	234
Number of returns ≤ 0	204	214	216	208	224
Probability under H_0	0.0110	0.0877	0.1214	0.0276	0.3371
Total Proceeds ≥ $5 million					
Average abnormal return	0.40%	0.17%	0.10%	0.11%	0.06%
t-statistic	2.88	1.61	0.92	1.05	0.58
Number of returns > 0	193	183	177	186	175
Number of returns ≤ 0	148	158	164	155	166
Probability under H_0	0.0085	0.0968	0.2579	0.0521	0.3325
Total Proceeds ≥ $10 million					
Average abnormal return	0.51%	0.10%	-0.01%	0.05%	0.07%
t-statistic	3.09	0.81	-0.05	0.39	0.56
Number of returns > 0	149	134	125	132	127
Number of returns ≤ 0	103	118	127	120	125
Probability under H_0	0.0022	0.1724	0.5749	0.2442	0.4749

Panel B: Individual commodities (excluding baskets)

Day relative to pricing date	**0**-1	2	3	4	5
Total Proceeds ≥ $2 million					
Average abnormal return	0.37%	0.20%	0.13%	0.14%	0.06%
t-statistic	2.71	2.01	1.28	1.41	0.59
Number of returns > 0	224	217	218	226	210
Number of returns ≤ 0	187	194	193	185	201
Probability under H_0	0.0378	0.1389	0.1182	0.0242	0.3466
Total Proceeds ≥ $5 million					
Average abnormal return	0.40%	0.21%	0.10%	0.13%	0.06%
t-statistic	2.63	1.83	0.88	1.17	0.50
Number of returns > 0	172	165	162	171	157
Number of returns ≤ 0	137	144	147	138	152
Probability under H_0	0.0265	0.1276	0.2129	0.0343	0.4100
Total Proceeds ≥ $10 million					
Average abnormal return	0.52%	0.14%	-0.02%	0.07%	0.06%
t-statistic	2.90	1.07	-0.18	0.55	0.45
Number of returns > 0	136	123	113	122	117
Number of returns ≤ 0	95	108	118	109	114
Probability under H_0	0.0042	0.1785	0.6534	0.2149	0.4477

Table 9: Regression of Abnormal Returns on Proxies for the Size of the Hedge Trade, Excluding CLN Issues Priced During the GSCI Roll Period

Coefficient estimates and *t*-statistics from regressions of the pricing date abnormal returns of the CLNs' underlying commodity front-month futures contract on proxies for the size of the hedge trade. The sample consists of CLNs linked to individual commodities and commodity baskets, excluding the issues priced during the GSCI roll period. For each commodity-pricing date pair, the dependent variable is the two-day (i.e. days [0,1]) abnormal return for the front-month futures contract for the CLN's underlying commodity. Abnormal returns are computed relative to a benchmark equal to the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. Model (1) uses the *Relative Issue Size*, defined as total proceeds divided by dollar open interest of the two-nearest expiring futures contracts, as a proxy for the hedge size trade. Model (2) uses *Abnormal Volume* as a proxy for the size of the hedge trade. *AbnormalVolume* is computed as the average volume in the reference commodity's front month futures contract during the two-day window around the CLN issuance, Days [0,1], minus the trailing 60-day average daily futures volume in those contracts. Alternatively, Model (3) regresses the abnormal returns on the volume during the two-day event window (*2-DayVolume*) and twice the 60-day average volume (2× *AverageVolume*). The independent variables, *AbnormalVolume*, *2-DayVolume*, and *AverageVolume* are normalized by the open interest in the two-nearest expiring futures contracts.

Right-hand Side Variable	Coefficient Estimates and *t*-statistics (in parenthesis)		
	(1)	(2)	(3)
Constant	0.001	0.0013	-0.0003
	(0.89)	(0.86)	(-0.08)
RelativeIssueSize	0.217		
	(3.03)		
AbnormalVolume		0.0056	
		(1.78)	
2-DayVolume			0.0057
			(1.81)
2×AverageVolume			-0.0043
			(-1.06)
Number of Observations	374	347	347
R-squared	0.02	0.01	0.01

Table 10: Average Abnormal Returns of Underlying Commodity Futures Around the CLN Pricing Dates, Including Issues Priced During the GSCI Roll Period

Average abnormal returns of the CLNs' underlying commodity futures contracts around the pricing dates of the CLNs based on individual commodities and baskets. CLN issues priced during S&P GSCI roll periods are included in the sample. Abnormal returns are computed relative to a benchmark equal to the return predicted by a factor model, estimated using ordinary least squares and data from the 60 days immediately preceding the pricing date. The first row in each panel reports the average abnormal returns on the CLNs' underlying futures contracts around the pricing date for CLN issues in three different size groups. Below the returns are *t*-statistics for the tests of the hypothesis that the average abnormal returns are equal to zero. The next two rows present the numbers of positive and negative returns. The last row provides the probability that the number of positive returns equals or exceeds the number of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

Panel A: Individual Commodities and Baskets

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.08%	0.21%	0.29%	0.06%	0.21%	0.26%	0.16%	0.22%	0.39%
t-statistic	1.02	2.52	2.45	0.60	2.37	1.92	1.58	2.20	2.44
Number of returns > 0	265	281	290	189	210	218	141	149	166
Number of returns ≤ 0	273	257	248	214	193	185	153	145	128
Probability under H_0	0.6510	0.1607	0.0385	0.9024	0.2127	0.0554	0.7758	0.4306	0.0154

Panel B: Individual Commodities (Excluding Baskets)

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.07%	0.20%	0.27%	0.05%	0.20%	0.25%	0.17%	0.22%	0.39%
t-statistic	0.83	2.17	2.07	0.50	2.11	1.67	1.51	1.98	2.24
Number of returns > 0	233	248	252	169	187	192	127	132	148
Number of returns ≤ 0	247	232	228	194	176	171	138	133	117
Probability under H_0	0.7532	0.2468	0.1469	0.9139	0.2999	0.1469	0.7695	0.5489	0.0326

Table 11: Average Abnormal Returns of Underlying Commodity Futures Contracts Around the Pricing Dates Based on an Alternative Benchmark, Excluding Issues Priced During the GSCI Roll Periods

Average abnormal returns of the CLNs' underlying commodity futures contracts around the pricing dates of the CLNs based on individual commodities and commodity baskets. CLN issues priced during S&P GSCI roll periods are excluded from the sample. Abnormal returns are computed relative to a benchmark equal to the average underlying commodity futures return over the 60 days immediately preceding the pricing date. The first row in each panel reports the average abnormal returns on the CLNs' underlying futures contracts for CLN issues in three different size groups. Below the returns are *t*-statistics for tests of the hypothesis that the average abnormal returns are equal to zero. The next two rows present the numbers of positive and negative abnormal returns. The last row provides the probability that the number of positive returns equals or exceeds the numbers of positive returns reported in the table under the null hypothesis that the probability of a positive return is 0.5.

Panel A: Individual commodities and commodity baskets

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.19%	0.13%	0.33%	0.21%	0.18%	0.38%	0.26%	0.24%	0.50%
t-statistic	2.24	1.49	2.50	2.24	1.85	2.72	2.38	2.08	2.95
Number of returns > 0	252	244	257	188	184	195	142	135	150
Number of returns ≤ 0	206	214	201	153	157	146	110	117	102
Probability under H_0	0.0177	0.0877	0.0050	0.0327	0.0795	0.0046	0.0253	0.1421	0.0015

Panel B: Individual commodities (excluding commodity baskets)

	Proceeds ≥ \$2 million			Proceeds ≥ \$5 million			Proceeds ≥ \$10 million		
	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]	Day 0	Day 1	Days [0,1]
Average abnormal return	0.21%	0.11%	0.33%	0.22%	0.16%	0.37%	0.28%	0.23%	0.51%
t-statistic	2.26	1.16	2.28	2.16	1.50	2.42	2.38	1.89	2.81
Number of returns > 0	229	216	227	172	164	173	133	123	136
Number of returns ≤ 0	182	195	184	137	145	136	98	108	95
Probability under H_0	0.0116	0.1619	0.0191	0.0265	0.1529	0.0202	0.0125	0.1785	0.0042