The valuation effects of index investment in commodity futures

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Abstract

This paper studies the valuation effect of the SP-GSCI roll on commodity contracts. We identify a surge of investment tracking commodity futures indices in December 2003. Before 2004, the roll period generated average cumulative abnormal price changes amounting to 115 bps for the nearby contract and 146 bps for the first deferred contract. From 2004 to 2010, the average cumulative abnormal price changes of the nearby (first deferred) is equal to -60 bps (-40 bps). However, a strategy that front-runs the roll does not generate abnormal profits at the contract level after (reasonable) transaction costs. A difference-in-differences regression confirms that the financialization has an alleviating effect, with the nearby (first deferred) average cumulative abnormal price changes showing a 158 (166) bps drop, statistically significant at the 1% level. The introduction of electronic trading alone has no effect on abnormal price changes during the roll. Finally, the contemporaneous change in hedging pressure is negatively related (statistically significant at the 1% level) to cumulative abnormal price changes, while the contemporaneous change in the commodity index pressure, average hedging pressure, and cross (average) hedging pressure does not affect cumulative abnormal price changes.

JEL classification: G13, G14, K23.

Keywords: commodity index investment, price pressure, risk premium, liquidity premium, hedging pressure, cross hedging pressure, sunshine trading, predatory trading.

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1. Introduction

This paper examines whether the increase in market participation of commodity index traders (CITs), known in the literature as the "financialization" of commodity markets, has a material effect on commodity futures prices when commodity indices roll positions from the nearby to the first deferred contracts. To address this question, we focus on the Standard and Poor's Goldman Sachs Commodity Index (SP-GSCI) components.[1] This index is arithmetically weighted based on the relative importance of the commodities in the economy, and the liquidity of the futures contracts. If the financialization has a permanent effect on commodity futures prices, it should be observable when "first generation" products, that replicate the SP-GSCI index, roll their positions from the fifth to the ninth business day of the month preceding maturity (hereafter, the roll). Every day of the roll, the index transfers 20% of its positions in nearby contracts maturing in less than a month to the first deferred contracts. This particular window overlaps with the rebalancing of the BCOM index, and many other U.S. funds invested in commodities.

The emergence of CITs induces a change in the supply/demand of nearby and first deferred contracts, which can be analyzed theoretically through the lens of several models. Brunnermeier and Pedersen (2005) study how predatory traders that know the traders' need to liquidate quickly their position take advantage of them (front trading). Admati and Pfleiderer (1991) propose an alternative view when the trades are known in advance (sunshine trading). In that setting, the impact of the extra demand is mitigated, and trades do not affect prices, everything else being equal. Within the Grossman and Miller (1988) framework, the roll creates a temporary order imbalance. The demand (supply) for the immediacy of the first deferred (nearby) contract increases (decreases) its price, which generates positive (negative) price changes. The classic "normal backwardation" theory states that hedgers pay a hedging premium if the demand of hedging is net short (hedging pressure); see Keynes (1930), and Hicks (1946). Roon *de*, Nijman, and Veld (2000) show that price changes of a commodity are theoretically and empirically related to the hedging pressure of commodities that are close substitutes (cross-hedging pressure). Kang, Rouwenhorst, and Tang (2020) demonstrate that speculators provide insurance to hedgers at long-term horizons (over four weeks), whereas hedgers provide liquidity to speculators at weekly horizons. This generates two distinct premiums, *i.e.*, the liquidity premium, and the insurance premium. We conjec-

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[1] The three major cross-sector indices in terms of tracking OI are respectively, the SP-GSCI (formerly GSCI), the Bloomberg Commodity Index (BCOM, formerly Dow Jones UBS Commodity Index or DJ-UBSCI), and the Deutsche Bank Commodity Index (DBCI). Other diversified indices exist, such as the Reuters-Jefferies CRB Index (RJ-CRB), the Rogers International Commodity Index (RICI), the Chase Physical Commodity Index, Pimco, Oppenheimer, or Bear Sterns. Other non-diversified funds directly track subsectors (energy or agricultural futures) or single futures (crude oil, natural gas, gold).

ture that these premiums are also related to cross-hedging pressure since arbitrage capital can easily switch from one commodity to another.[2] Since CITs are structural long investors, it is an empirical issue to see whether changes in CITs pressure, changes in (cross-) hedging pressure, and (cross-) hedging pressure help explain risk-adjusted price changes during the roll. Our empirical analysis proceeds in three steps. First, we examine whether a structural break affects simultaneously the CITs' market participation in the 27 SP-GSCI components during the 1999—2010 period. Using the Bai, Lumsdaine, and Stock (1998) algorithm, we find a common break in the proportions of open interest (OI) resulting from index investment in the nearby contracts. This break occurs in December 2003 and is statistically significant at the 1% level. It is identical to that retained in Boons, Roon *de*, and Szymanowska (2014). However, it occurs five years before the one identified by Hamilton and Wu (2015) on WTI crude oil futures, and three years after the one used by Mou (2011). When we restrict the analysis to the 19 SP-GSCI contracts that are under the CFTC supervision, this date is not affected. As an alternative investment index proxy, we use the market share of the long commercial positions (SCL) that include swap dealers and CITs. The break occurs a month before, in November 2003. We also examine six CFTC contracts that are not components of a commodity index. Reassuringly, we find no break in the 2003–2004 period. Finally, we show that the break does not overlap with the staggered introduction of electronically traded contracts that took place from August 2006 to October 2008. Indeed, a Bonferroni test rejects the null hypothesis that the initiation of electronic trading, which is contract-specific, is within the confidence interval of the break at the 1% level. This makes us confident that a significant change in market participation is observed by the end of 2003.

Next, we present the results of an event study on the nearby and the first deferred contracts to analyze the valuation effect of the roll. The windows of interest are the pre-roll and the roll periods. We find that the average cumulative abnormal price change (ACAPC) during the roll is equal to 115 bps for the nearby, and 146 bps for the first deferred contracts before 2004, and statistically different from zero at the 1% level. Once we correct for event-induced variance and cross-correlation, the ACAPCs of the nearby and the first deferred remain statistically significant at the 1% level. After 2003, ACAPCs decrease to -60 bps (nearby) and -40 bps (first deferred) respectively, and are no longer statistically significant at the 10% level when t-statistics are corrected for event-induced variance and cross-correlation. The results are not affected when the ACAPCs are value-weighted (SP-GSCI weights) instead of equally-weighted, or when we use raw cumulative price changes instead of cumulative abnormal price changes. We also uncover that cumulative abnormal price changes (CAPCs)

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[2] Typically, the CME lists intermarket spread with legs on different, but related, commodities. Both legs have the same maturity.

do not resist reasonable transaction costs. When we implement a calendar spread strategy based on individual contracts that front runs the index roll by ten days, we find that the residual profits left to arbitragers are lower than the transaction costs, would they enter the trade; see Mou (2011). With a difference-in-differences regression, we analyze the drop in the CAPCs of the rolling contracts. The financialization drop is 158 bps for the nearby and 166 bps for the first deferred over the roll window, both statistically significant at the 1% level, while the introduction of electronic trading does not affect CAPCs. In contradiction with Masters (2008), we find that the financialization is beneficial to the market functioning as the CAPCs during the roll are reduced. We also document a similar pattern in the pre-roll period.

Finally, we demonstrate that the main determinant of CAPCs is the change of net long commercial positions during the roll. Before the financialization, the economic magnitude of this variable is substantial for the nearby (first deferred). A one standard deviation increase is associated with a 1.42% (0.95%) decrease in CAPC. After the financialization, this variable is also statistically significant at the 1% level. Nearby (First Deferred) CAPCs are even more sensitive to changes of the net long commercial positions. A one standard deviation increase translates into a 3.22% (2.15%) decrease in the corresponding CAPC. The net long commercial position aggregates the position of long and short "commercials" over all maturities. To disentangle which maturities generate the CAPCs, we relate them to the turn-over of individual contracts. It appears, that CAPCs are positively related to longer-term (second deferred and further) maturities. The change in CITs pressure, average hedging pressure, cross liquidity and cross-hedging pressure do not explain CAPCs.

This paper contributes to the literature in several ways. First, we date the financialization using a statistical method instead of relying on anecdotal evidence. Then, we show that the valuation effect of the SP-GSCI "pure" roll is statistically significant at the 1% level before the financialization, even when t-statistics are adjusted appropriately for heteroscedasticity and cross correlation. The post-financialization does not show statistically significant ACAPCs at the usual levels (after correcting for heteroscedasticity and cross correlation). This result differs from the valuation effect of the annual index rebalancing ("January roll"). Yan, Irwin, and Sanders (2019) find that price pressure resulting from the weight adjustments is the main driver of the January roll CAPCs, while we conclude that rolls are driven by liquidity needs. Brunetti and Reiffen (2014) study the impact of the roll on the term structure (nearby minus first deferred). We depart from their approach since the roll may have specific effects depending on the contract maturity (selling pressure *vs.* buying pressure from CITs). Our analysis is also related to Kang et al. (2020) who show that the change in net "commercials" position is positively related to futures returns. We demonstrate that the corresponding price of liquidity more than doubles in the aftermath of the financialization. More importantly, our results show that the proportion of CITs investment in OI does not induce a significant price reaction during the roll. This suggests that non informative trades do not affect significantly commodity prices, which gives support to the sunshine hypothesis.

The remainder of the paper is organized as follows. Section 2 presents the hypothesis development in the context of the existing literature. Section 3 provides details on the data and the methodology. Section 4 reports the empirical results, and their robustness is discussed. Section 5 concludes.

2. Prior literature and hypotheses development

Following Master's hearing before the U.S. Senate, several articles examine the economic consequences of the financialization, and when they materialize. However, previous research diverges on its starting date.

2.1. Dating the financialization

A first strand of literature uses ad-hoc, visual, or indirect evidence to date the financialization. Sanders and Irwin (2011), Basak and Pavlova (2016), Boons et al. (2014), and Buyuksahin, Haigh, Harris, Overdahl, and Robe (2009) date the financialization around 2003—2004. Hamilton and Wu (2014) in 2005. Mou (2011) shows that front-running the "SP-GSCI roll" generates abnormal returns as early as 1999. The second strand of literature uncovers a progressive rise in different variables that cause (amount of index investment) or through which the financialization materializes (correlation between commodities and stock returns or excess correlation in indexed commodities). Buyuksahin and Robe (2014) report that the correlation between the SP-GSCI daily price changes and SP-500 daily returns rises during the 2004-–2010 period, Adams and Gluck (2015) determine statistically the break date (September 2008). Tang and Xiong (2012) demonstrate that prices of non-energy commodity futures have become increasingly correlated with oil prices after 2004. Similarly, Stoll and Whaley (2010) notice that agricultural futures do not converge to their spot prices during the 2006—2009 period.

Masters (2008) shows that CITs investment in the total OI changed dramatically from 1998 to 2008. This ratio is a natural candidate to look for a break caused by index investors. As a result, we should observe a permanent change simultaneously affecting CITs market shares of the SP-GSCI components. Conversely, no break should be observed for the remaining futures contracts.

Hypothesis 1. *The shares of index investment in the total OI of SP-GSCI components (SCIT) show a common break during the 1999-–2010 period.*

As an alternative proxy, we use the proportion of the "long commercials" over total OI since swap dealers and CITs are classified as "commercials" in the legacy CFTC reports. If CITs are becoming important players after the financialization, the share of "long commercials" in total OI (SCL) should increase sharply. This aggregate is interesting because it is also observable for contracts that are not in any index. Therefore, we should not find any common break for non-SP-GSCI contracts. Put differently, we use the group of CFTC contracts that are not components of indices as counterfactuals.

2.2. Non-informative trading and commodity prices

2.2.1. Predatory trading

Brunnermeier and Pedersen (2005) study a distressed trader who reveals some information to a predatory trader (*e.g.*, its broker-dealer). Hence, this predatory trader knows the trader's needs to liquidate quickly her position. The model foresees a higher price impact as the predator trades on this information along or before the distressed trader. Thus, the liquidation value of the distressed portfolio decreases. The model also predicts that the more predatory traders compete, the lower the price impact. With an infinity of predatory traders, the effect is similar to price pressure. Mou (2011) explores the performance of strategies that front-run the SP-GSCI roll from 2000 to 2010. The highest performance is obtained with a calendar spread that takes a long position in the first deferred and a short position in the nearby ten days before the roll. The flows invested in the calendar spread mimics the roll. This strategy delivers an average of 31 bps per roll before transaction costs. Then, he considers the most liquid futures (the WTI crude oil contract) for which he estimates the trading cost at one bp per contract.[3] After adjusting for transaction costs, he finds profitable front trading opportunities. He attributes these findings to the limits of arbitrage capital. As of 2009, he estimates the annual cost at USD 8.4 billion, for a total index investment of USD 211 billion.

2.2.2. Sunshine trading

Some liquidity traders pre-announce the size and timing of their orders to reduce their price impact. The pre-announcement lowers informational asymmetry because trades initiated for liquidity purposes are not related to information that could move prices. Admati

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[3] These transaction costs are extremely low. Hou and Norden (2018) estimate the transaction costs of a calendar spread on the VIX at 15 bps.

and Pfleiderer (1991) show theoretically that transaction costs are reduced when trades are pre-announced ("sunshine trading"). The effect on other traders is ambiguous as far as trading costs and welfare are concerned. Using intraday data from 2008–2009, Bessembinder, Carrion, Tuttle, and Venkataram (2016) fail to identify a systematic use of predatory strategies during the United States Oil Fund rolls, a large fund invested solely in WTI crude oil futures contracts. Consistent with the sunshine trading theory, the authors find more liquidity providers.

Sunshine trading shares many commonalities with the CITs' roll. Typically, public CITs disclose their roll policy, which closely follows that of the tracked index. Since the amount of assets under management is also public information, the daily trades of CITs are known by market participants. However, three differences are noteworthy. First, index fund managers neither explicitly announce their trades, nor the intraday timing within the window. Second, CITs also trade to match the incoming flows into their funds. Third, some CITs are private, and their impact is difficult to evaluate. To conclude, the change in CITs position is a noisy proxy of the trades realized during the roll.

2.2.3. Implications

To analyze abnormal price pressure effects, and check whether they are symmetrical on each leg, we compute the ACAPC of the nearby and first deferred contracts. We then state our hypotheses as follows,

Hypothesis 2.

a. *Predatory trading: The ACAPC of the nearby (first deferred) is negative (positive) during the pre-roll.*

b. *Sunshine trading: The ACAPC of the nearby (first deferred) is nil during the roll.*

Raman, Robe, and Yadav (2017) state that the "financialization" of commodities comprises three main players: a) commodity index traders ("CITs"), known as "massive passives", b) managed money traders (hedge funds) that are active in multiple asset classes, and c) institutional financial intraday traders after the inception of electronic trading. They show that electronic trading decreases the variance of the pricing error, narrows the bid-ask spread, and improves market depth for the WTI contract. To make sure that CAPCs are not driven by electronic trading instead of financialization (confounding effect), our hypothesis is as follows,

Hypothesis 3. *CAPCs are affected by the financialization but remain unaffected by the inception of electronic trading.*

Consider a price-taker investor willing to arbitrage the roll. Her investment strategy consists of opening and closing positions on the two legs, which entails paying the bid-ask spread on the nearby and the first deferred contract. The calendar spread can be also negotiated directly.[4] In that case, the bid-ask spread reduces to that of the spread position alone. Since the calendar spread is less risky than a one-leg position, one-leg transaction costs overestimate the real cost. Therefore, we consider that a realistic bid-ask spread lies somewhere between a higher bound (bid-ask spread on a single leg) and a lower bound that we set arbitrarily to a quarter of the higher bound. This is by far higher than one bp, in particular for less liquid contracts. Stoll and Whaley (2010) relate the magnitude of the cumulative term-structure changes to the bid-ask spread, with no formal test, however. Hence, our hypothesis is as follows,

Hypothesis 4. *After adjusting CAPCs for transaction costs, the pre-roll and the roll periods do not show trivial arbitrage opportunities, neither before, nor after the financialization.*

2.3. CITs pressure, hedging pressure, and CAPCs

2.3.1. Price pressure

Grossman and Miller (1988) present a three-period model, where two types of agents, market makers, and outside customers, trade a risky asset. Assuming that prices are normally distributed and that investors maximize their expected (exponential) utility, they derive the demand function and analyze the consequences of a liquidity shock that creates a temporary order imbalance. In that setting, they show how market makers are compensated for bearing the risk during the holding period. Specifically, the absolute expected returns increase with the order imbalance and decrease with the number of market makers. In our case, assuming that the market does not absorb instantaneously the CITs positive demand (supply) on the first deferred (nearby) contract, the current price should increase (decrease).[5] Brunetti and Reiffen (2014) derive a two-period model, close to the previous one, where the CITs' demand is exogenous.[6] The empirical part of their study is based on three agricultural contracts with disaggregated data (CFTC Large Traders Reporting System), from 2003 to 2012. Consistent

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[4] There is an order book for calendar spreads at the CME. However, this dedicated order book is only for convenience, the CME then breaks the order into the two legs of the calendar spread and puts them into the order book of the respective maturities. It seems on the surface that there is a separate order book dedicated to calendar spreads, but it actually feeds through to the order book of the simple long/short orders for any given maturity targeted, and so the bid-ask spread is on each leg of the trade. We thank Jérôme Taillard for providing us with the following explanation.

[5] Hereafter, this positive demand is called "CITs pressure" since we are analyzing the supply/demand of specific groups of traders (CITs, hedgers, and speculators).

[6] Additional assumptions are similar to those of Grossman and Miller (1988).

with their model, the slope of the term structure between the two nearest contracts increases as index traders roll their positions. Based on 12 agricultural contracts and a shorter data set (2004—2009), Aulerich, Irwin, and Garcia (2013) report an increase in the slope of the term structure (statistically significant at the 5% level) for five contracts only. Henderson, Pearson, and Wang (2015) examine the impact of financial investors' flow on commodity futures prices through commodity-linked notes (CLNs). This flow, generated by CLN issuers hedging their liabilities on the commodity futures markets, does not contain new information on futures prices. Nevertheless, commodity futures prices increase under buying pressure and decrease under selling pressure. These results are consistent with Bessembinder et al. (2016) who show that accumulated trading costs resulting from this price pressure amount to 3% per year.

2.3.2. Hedging pressure and speculative demand

The Theory of "Normal Backwardation" assumes that producers hedge their output against future price fluctuations by selling futures contracts. By doing so, they push futures prices below expected spot prices, thereby providing a positive premium, the insurance premium, to long futures investors; see Keynes (1930) and Hicks (1946).[7] Empirical studies show that hedging pressure (short minus long hedgers position scaled by the total OI) is a determinant of the commodity futures premium; see, *e.g.*, Bessembinder (1992).

The role played by hedging pressure can be extended to groups of commodities that are partly substitutable (cross hedging); see Anderson and Danthine (1981). Roon *de* et al. (2000) derive a model within the CAPM framework, where global hedging pressure is split in own-hedging pressure and cross-hedging pressure. Over ten commodity contracts, nine show positive own-hedging and four cross hedging pressure. Similarly, Kang et al. (2020) extend the hedging pressure framework. On aggregate, speculators are rewarded the insurance premium to act as the hedgers' counterparty (normal backwardation). However, individual speculators have a shorter horizon than hedgers and, at some points, they are in need for liquidity, which generates a second premium. This could explain why some empirical tests on hedging pressure fail to identify an insurance premium when liquidity is not controlled appropriately.[8] More importantly, Kang et al. (2020, p. 388, Table II) report a negative (positive) relation between contemporaneous "commercials" ("non-commercials") position changes and commodity price changes. They conclude that "commercials" trade

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[7] A producer (*e.g.* a farmer) receives an income which depends entirely on its production. Thus, she will be more likely to short futures at a discount than a processor (*e.g.* an airline company), who can pass-through commodity price fluctuations on consumers.

[8] For instance, Gorton, Hayashi, and Rouwenhorst (2012) do not detect a link between the risk premium and hedgers' positions.

as contrarians while “non-commercials” are momentum traders. In this paper, our focus is on the reverse relation, *i.e.*, how abnormal price changes are affected by position changes of “commercials”, which includes CITs. Assuming that CITs and pure “commercials” positions are fully and simultaneously transferred from the nearby to the first deferred, the impact on commodity prices should be nil. However, market frictions and changes in supply or demand could temporarily affect commodity prices through the liquidity premium. Typically, an increase in the liquidity premium affects negatively the price of both contracts.

Cheng, Kirilenko, and Xiong (2015) examine the response of various groups of traders to external shocks. More specifically, they study the reaction of financial traders to changes in the VIX during the 2008 financial crisis. They show that financial traders reduce their net long position in response to market distress and that hedgers reduce their short positions as prices fall. This “convective” risk flow is the direct consequence of this external shock. Since hedging pressure explains changes in the price of futures commodity contracts, a natural question arises concerning the determinants of hedging demand. Acharya, Lochstoer, and Ramadorai (2013) study a risk-averse producer that faces speculative capital constraints (default risk). The inclusion of speculative limits to arbitrage, and the subsequently higher premium, depress the producer’s hedging demand. Instead of hedging, the producer reduces inventories, which in turn decreases the spot price. Their model predicts that the futures risk premium increases with hedging demand proxy by aggregate producers’ default risk. The empirical part of their study confirms this result for oil producers. Rampini, Sufi, and Viswanathan (2014) propose an alternative approach based on the trade-off between debt financing and risk management. Because debt and hedging positions need to be collateralized, financially constrained firms hedge less. The empirical part uses airline companies, and shows that the more financially constrained they are, the less they hedge against fuel price changes. These models predict lower hedging for levered firms but the aggregated impact on demand (net “commercials”) is unclear.

2.3.3. Implications

Kang et al. (2020) emphasize the role of different groups of investors in determining commodity price changes and the related premiums. Specifically, “non-commercials” speculators create a liquidity premium, while “commercials” hedgers create an insurance premium. Following the same rationale, we make a step further by analyzing the specific impact of CITs. This group of investors is not individualized in Kang et al. (2020) since CITs switching positions from the nearby to the first deferred are not observable in the CFTC legacy reports over the sample period.[9] If CITs play a role similar to “net commercials”, their position

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[9] Short/long position in the CFTC legacy report refers to the sum of short/long position on all the open

change should affect negatively (positively) the nearby (first deferred); see Grossman and Miller (1988).

We test whether the CITs pressure, liquidity, and insurance help explain CAPCs, which are risk-adjusted price changes with a benchmark that does not take these factors into consideration. More broadly, "cross-hedging liquidity" as well as "cross-hedging insurance" could also affect individual CAPCs since commodity markets are intertwined. Hence, we state the following hypothesis and check whether the financialization of futures markets alters these premiums.

Hypothesis 5. *Changes in CITs pressure, (cross-) liquidity, and (cross-) insurance demands are determinants of the nearby and first deferred CAPCs.*

3. Data and Methodology

3.1. Dating the financialization

Since 1986, the CFTC provides the weekly "Commitment of Traders" (COT) report that summarizes "commercials" long and short positions, and long, short, and spreading positions of "non-commercials" categories for U.S. futures contracts.[10] In 2006, the CFTC revised these categories. The "supplemental" (SCOT) report was added for contracts having at least 20 active trader positions above a pre-defined threshold. It was followed by the "disaggregated" (DCOT) report because most swap dealers were classified as "commercials" when, in fact, they were CITs. Despite their non-speculative role, they dedicate a large part of their activity to hedge indices-related positions.[11] The disaggregated report splits the original categories of "commercials" and "non-commercials" into hedgers, swap dealers, managed money, and other "reportables". The supplemental report refers to 13 agricultural futures contracts. The positions reported in the aforementioned categories, managed for commodity investment vehicles (*e.g.* ETFs, ETNs, and mutual funds), are aggregated in a specific category (CIT). From August 2006, the index investment is directly observable from the CFTC reports.

To estimate the share of index investment in the total open interest, we start with the total index investment in the Crude oil WTI contract, which is available in the CFTC

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maturities for a given contract. Therefore, CITs position rolling from the nearby to the first deferred are not observable at the aggregate level. Starting in 2006, the DCOT reports CIT positions.

[10] See http://www.cftc.gov/MarketReports/CommitmentsofTraders/index.htm

[11] For the same reasons, swap dealers could claim position limits exemptions, as if they were producers or processors in needs of hedging.

special report from 2000 to 2010. The index weights are provided by S&P Global.[12] With this information, we are able to reconstruct the volume invested in each contract, and the total volume invested by CITs in the SP-GSCI. The total OI from the whole term structure is directly available from the CFTC report. We apply Masters and White (2008, p. 49-51) algorithm over the sample period (2000—2010).[13] The algorithm delivers the OI per contract attributable to CITs (VCIT). The share of total index investment (SCIT) is defined as VCIT divided by total OI; see the definition in the Appendix, Table A1.

Sanders and Irwin (2013) argue that the algorithm produces index investment figures that are sensitive to low-weighted contracts. In particular, they find a low, sometimes negative, correlation between $VCIT_{CFTC}$ directly available from the CFTC (after 2006), and $VCIT_{Masters}$ computed with the algorithm. We repeat the exercise with the 13 futures contracts of the CFTC supplemental report. We find that the lowest correlation is 62% (Kansas wheat), and the remaining ones are above 77%. We also run a pooled regression of $VCIT_{Masters}$ on $VCIT_{CFTC}$ to check whether the former is an unbiased estimate of the latter. The global R^2 is equal to 76%, the constant (-0.05) is not statistically different from 0 at the 1% level, and the slope is equal to 0.76 (statistically different from 1 at the 1% level). The bias in the slope may well result from the fact that $VCIT_{Masters}$ accounts for CITs positions in the SP-GSCI and BCOM index, while $VCIT_{CFTC}$ accounts for all index investors. Assuming that market shares of funds related to indices are constant over time or that non-GSCI/BCOM market share is more important in the 2006-2010 period, the break date should not be affected by this measurement issue.

We start the empirical analysis with the 27 SP-GSCI contracts. Following Bai et al. (1998), the dynamics of $\mathbf{SCIT_t}$ is a Vector Auto Regression with q lags, $q = 1, 2, \ldots, 10$, and the number of lags is chosen based on the Bayesian Information Criterion (BIC), computed over the full sample with no breaking covariates. We test for a break on the intercept since we are primarily interested in a structural shift in the level (mean) of the index investment (and not in the trend). We estimate the following equation:

$$\mathbf{SCIT_t} = \left({}^{\mathbf{T}}\mathbf{G_t} \otimes \mathbf{G_t}\right)\theta + d_t\left(k\right)\left({}^{\mathbf{T}}\mathbf{G_t} \otimes \mathbf{I_n}\right){}^{\mathbf{T}}\mathbf{S}\mathbf{S}\delta + \epsilon_{\mathbf{t}}, \tag{1}$$

where ${}^{\mathbf{T}}\mathbf{SCIT_t} = \left[SCIT_{c,t}\right], c = 1, 2, \ldots, 27$, ${}^{\mathbf{T}}\mathbf{G_t}$ is a row vector containing $\mathbf{SCIT_{t-1}}$, $\mathbf{SCIT_{t-2}}, \ldots, \mathbf{SCIT_{t-q}}$, n the number of equations, and $\mathbf{S}$ a selection matrix such that only the intercept is allowed to break with $\mathbf{S} = s \otimes \mathbf{I_n}$ and $s = [1, 0, \ldots, 0]$. Eq. 1 is estimated for every date k, such that $d_t\left(k\right) = 0$ if $t < k$ and 1 otherwise. The potential break date is the

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[12] We thank S&P Global for providing us with the historical SP-GSCI weights.

[13] For 1999, we start with the January figures in Masters and White (2008) and the first figures available in 2000. Then, we make a linear interpolation and allocate the corresponding amounts to each month.

value of k that generates the maximum F-statistic, which is statistically significant as soon as this statistic is higher than the limiting χ^2 distribution. Finally, the confidence intervals are constructed for three levels of statistical significance, *i.e.* 90%, 95%, and 99%; see Bai et al. (1998, p. 401).

3.2. The valuation effect of the roll

Daily closing prices of nearby and first deferred SP-GSCI/CFTC contracts are collected from Barchart.[14] We also consider six alternative contracts (ALT) covered by the CFTC, actively traded in the U.S., that are neither components of the SP-GSCI, nor of other popular indices such as BCOM. The sample starts on January 2, 1999, and ends on December 31, 2010. The daily change in commodity price is computed as:

$$r_{c,t}^{m} = \ln F_{c,t}^{m} - \ln F_{c,t-1}^{m},$$

where $F_{c,t}^{m}$ is the futures price, c the commodity, t the day and m the maturity of the contract. The weekly "commitment of traders" report is downloaded from the CFTC; see Appendix, Table A2.

We estimate the valuation effect of the roll with an event study. As already mentioned, this classic methodology is used in a non-standard context, and several differences are worth mentioning. First, the unit of analysis is a futures contract instead of a firm. Second, each unit is subject to the event (roll) at known intervals, up to 12 times per year for seven contracts. Third, the number of events is high with a minimum of 60 rolls (agricultural) to a maximum of 144 rolls (energy) over the sample period, while the number of contracts is small (19). Fourth, despite the growing literature on commodity asset prices, there is no well-accepted benchmark concerning commodity futures contracts; see, *e.g.*, Bakshi, Gao, and Rossi (2019), and Boons and Porras Prado (2019).

Following Henderson et al. (2015), the benchmark is a multi-factor model that describes price changes of individual futures contracts. The corresponding variables are downloaded from Thomson Reuters. These are the MSCI emerging market index, SP-500 index, USD index, VIX, T-Bond, Baltic Dry Index, and inflation indices. The period over which CAPCs could materialize is not well identified either (pre-roll or roll). Therefore, we examine the prospectus of various ETFs and check how closely they follow the roll.[15] We observe that

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[14] The SP-GSCI contracts not under CFTC supervision have specificities that make them hard to compare with others. Moreover, CITs and indices providers are vague regarding the methodology they use to roll non-CFTC contracts (ICE-UK and LME).

[15] See, *e.g.*, iShares S&P GSCI Commodity-Indexed Trusts (BlackRock), iPath® S&P GSCI® Total Return Index ETN (Barclays), VelocityShares, or Lyxor S&P GSCI (Société Générale).

most of them stick to the SP-GSCI definition. In addition, we observe that the trading volume of the futures contract directly written on the SP-GSCI performance concentrates during the five days of the roll; see Appendix, Figure A1. To test Hypothesis 2, we estimate the valuation effects of the pre-roll (H2a) and roll (H2b) on the daily log price changes of individual nearby $\left(r^{N}_{c,t}\right)$ and first deferred $\left(r^{FD}_{c,t}\right)$ SP-GSCI/CFTC contracts. The following regression is estimated in a single pass,

$$r^{m}_{c,t} = \alpha_{0,c} + \alpha_{1,c} JAN_{c} \gamma_{c,t} + \sum_{r=1}^{R} PRECAPC^{m}_{c,r} \delta^{r}_{c,t} + \sum_{r=1}^{R} CAPC^{m}_{c,r} \Delta^{r}_{c,t} + {}^{\mathbf{T}}\mathbf{a_{c}} \mathbf{HPW_{t}} + \epsilon_{t}, \quad (2)$$

where $m = \{Nearby = N, Firstdeferred = FD\}$, c is the commodity contract, t is the time (day), $\gamma_{c,t}$ is a dummy variable equal to 1 if $\textit{January roll} - 5 \leq t \leq \textit{January roll} + 4$, r is the current roll, $\textit{date}\,(r)$ the date of roll r, $\delta^{r}_{c,t} = 0.20$ if $\textit{date}\,(r) - 5 \leq t \leq \textit{date}\,(r) - 1$, and 0 otherwise, $\Delta^{r}_{c,t} = 0.20$ if $\textit{date}\,(r) \leq t \leq \textit{date}\,(r) + 4$, and 0 otherwise, $PRECAPC^{m}_{c,r}$ and $CAPC^{m}_{c,r}$ capture the cumulative abnormal price change of contract c on pre-roll and roll r respectively, and $\mathbf{HPW_{t}}$ are the explanatory variables that capture the dynamics of commodities price changes.[16]

Yan et al. (2019) perform an event study on the annual index rebalancing ("January" roll) when the SP-GSCI weights experience their annual revision. Twenty-four SP-GSCI components are changing their respective index weights but seven of them are also rolling from the nearby to the first deferred. To avoid any confounding effect, we discard January CAPCs. We also estimate pre-roll CAPCs simultaneously as we expect them to be "abnormal".

Every month, 16 to 24 futures commodity contracts roll simultaneously. Therefore, the CAPCs are potentially cross-correlated because the error terms are not independent (missing variables in the benchmark for example). Ignoring this cross-correlation shrinks the standard errors of the CAPCs, which in turn leads to an over-rejection of the null hypothesis. To overcome this cross-correlation effect, we estimate the CAPCs every month for all the contracts, and keep the CAPCs of the contracts that are not rolling as counterfactuals; see Section 4.3.2. Eq. 2 is estimated as a Seemingly Unrelated Regression. This approach is also appropriate given the small number of observations in cross-section and the long time series; see Karafiath (1994).

The vector $\mathbf{CAPC_{c,r}} = {}^{\mathrm{T}}[CAPC_{1,r}, \ldots, CAPC_{C,r}]$ gives the abnormal returns during the (pre) roll. We construct an equally (value) weighted portfolio $P = \{$equally-weighted,

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[16] The benchmark is: $r_{c,t} = \beta_{0} + \beta_{c,EM} r_{EM,t} + \beta_{c,EM(1)} r_{EM,t+1} + \beta_{c,S\&P} r_{S\&P,t} + \beta_{c,USD} r_{USD,t} + \beta_{c,TB} r_{TB,t} + \beta_{c,VIX} r_{VIX,t} + \beta_{c,BDI} BDI_{t} + \beta_{c,INF} INF_{t} + \beta_{c,lag} r_{c,t-1} + \epsilon_{c,t}$, where the variables are described in Henderson et al. (2015, p. 1293).

SP-GSCI-weighted} to obtain $CAPC_{P,r} = [w_{1,r}, \ldots, w_{C,r}] \times {}^{\mathrm{T}}[CAPC_{1,r}, \ldots, CAPC_{C,r}]$ and the average abnormal cumulative price change $ACAPC_P = \frac{1}{R} \sum_{r=1}^{R} CAPC_{P,r}$. Finally, we adjust the standard errors for event-induced variance and cross-correlation; see Boehmer, Musumecci, and Poulsen (1991), and Kolari and Pynnonen (2010). The variance of the (pre) roll is equal to $var\left(CAPC_{P,t}\right) = S^2_{P,t} = {}^{\mathrm{T}}[w_{1,t}, \ldots, w_{C,t}] \times \mathbf{\Omega} \times [w_{1,t}, \ldots, w_{C,t}]$ at time t where $\mathbf{\Omega} = [cov\left(\mathbf{CAPC_i}, \mathbf{CAPC_j}\right)]$ with $(i, j) \in [1 : C] \times [1 : C]$, and $CAPC_i = [CAPC_{i,1}, \ldots, CAPC_{i,R}]$. Under the null hypothesis, $CAPC_{P,r} \sim \mathcal{N}\left(0, \sigma^2_{P,r}\right)$ and $\frac{CAPC_{P,t}}{\sqrt{S^2_{P,t}/C}} \sim t_{C,t}$, where C is the number of contracts at time t. The central limit theorem gives the critical statistics $\frac{mean\left(t_{C,t}\right)}{\sqrt{var\left(t_{C,t}\right)/R}} \sim \mathcal{N}\left(0, 1\right)$ to test the null hypothesis ($ACAPC_P = 0$), where R is the number of rolls.

3.3. The impact of the financialization on CAPCs

To check the impact of the financialization on CAPCs, we use a difference-in-differences regression. The treated CAPCs are those estimated for SP-GSCI contracts at the time of the roll. The controls are the CAPCs of SP-GSCI contracts that do not roll, *i.e.*, the nearby contracts with an expiry date beyond that of the next roll. We add six alternative contracts (ALT) that are not components of any major commodity index; see Appendix, Table A2. We are aware that the choice of non-treated contracts (ALT) may lead to a selection bias. In particular, the choice of the contracts included in the SP-GSCI depends on the liquidity and the importance of the commodity in the economy. These characteristics may differ from those of ALT contracts. However, because we limit our analysis to a short period (roll window), we hope that this bias is negligible with respect to the effect we target. As a robustness check, we use only the SP-GSCI contracts that do not roll on a given month as non-treated. The financialization was not only characterized by an increasing number of commodity index traders but also by a major change in the trading of commodities, *i.e.* the progressive introduction from 2006 to 2008 of electronic trading; see Raman et al. (2017). Non-treated contracts are the ones that are not yet traded electronically. To disentangle the respective effects of "electronification" and "financialization", we write the following baseline model:

$$\begin{aligned} CAPC^m_{c,r} = {} & \mu_c + \beta_1 DROLL_{c,r} + \beta_2 DFIN_{c,r} + \beta_3 DELEC_{c,r} \\ & + \beta_4 DROLL_{c,r} \times DFIN_{c,r} + \beta_5 DROLL_{c,r} \times DELEC_{c,r} + \epsilon_{c,r}, \end{aligned} \tag{3}$$

where $CAPC^m_{c,r}$ is a panel of nearby (first deferred) CAPCs at time r, μ_c is a contract fixed effect; $DROLL_{c,t}$ is a dummy equal to "1" for the contract rolling at r and to "0" otherwise; $DFIN_r$ is a dummy equal to "1" if $date(r) \geq Break\ Date$ and to "0" otherwise, with the Break Date estimated as described in Section 3.1.; $DELEC_{c,r}$ is a dummy equal to "1" when contract c is traded electronically, and to "0" otherwise. We estimate Eq. 3 as a Panel with contract fixed effects since the demand/supply of contracts depends on the underlying commodity. Given the small number of observations in cross-section, we do not introduce time fixed effect. The standard errors are clustered at the contract level to account for the contract characteristics (high dispersion of the variance across contracts). If the financialization affects CAPCs, the coefficient β_4 should be significantly different from zero. The coefficient β_4 captures the marginal effect of electronic trading on the rolling contracts. According to Hypothesis 3, β_5 is expected to be nil.

3.4. Front trading the roll

Following Mou (2011), we mimic the roll ten days before it starts. As he put it: [*Calendar spread positions are created on each day . . . , which runs from 10 to 6 business days before the SP-GSCI's first rolling date*]. The spread position is short of the maturing contracts in the SP-GSCI and long the deferred contracts that it will roll into. We assume that both predators and arbitragers are price takers because the timing of the roll is an essential feature for such agents. Transaction costs are decomposed into a fixed component (exchange commission and operational costs) and a variable component, the bid-ask spread. As a proxy for the bid-ask spread, we use the low-frequency estimator proposed by Abdi and Ranaldo (2017), and consider that the fixed component is negligible.

$$TC_{c,t} = \max\left[\sqrt{\frac{4}{N}\sum_{t=1}^{N}\left(C_{c,t} - M_{c,t}\right)\left(C_{c,t} - M_{c,t+1}\right); 0}\right],$$

where N is the number of days, $C_{c,t}$ the closing price of contract c, on day t, and $M_{c,t}$ the difference between the "high" and "low" price of contract c, on day t. We compute this estimator for the nearby contracts. To test Hypothesis 4, we subtract transaction costs to the calendar spread for each commodity.

3.5. CAPCs, CIT, liquidity, and insurance demands

We rely on the weekly (from Tuesday to Tuesday) CFTC statistics that are released every Friday and aggregated over the term structure at the commodity level. Note that the beginning of the roll can be any day of the week. To estimate the change in price pressure resulting from the roll, we assume that CITs' positions are concentrated on the nearby contract before the roll, and fully transferred onto the first deferred contract at the end of the roll. Consequently, the change in CITs pressure is equal to minus the CIT position the last Tuesday before the roll.

The liquidity is the change in the "commercial net long position" over the roll, scaled by the total open interest of the last Tuesday before the roll. This variable is not directly affected by the roll if CITs fully report their positions from the nearby to the first deferred. We assume that changes in "commercial net long position" (liquidity demand) are uniformly spread over short periods, and not related to the roll. The average hedging pressure (insurance) is the 52-week moving average of the "commercial net long" position. The cross-hedging pressures are computed within a group of commodities. We define four groups, *i.e.*, Agricultural, Energy, Metals, and Softs. On this ground, we use the following baseline panel regression specification:

$$CAPC^{m}_{c,r} = \gamma_1 CIT_{c,r} + \gamma_2 Q_{c,r} + \gamma_3 AHP_{c,r} + \gamma_4 QG_{c,r} + \gamma_5 AHPG_{c,r} + \mu_c + \epsilon_{c,r}, \qquad (4)$$

where the subscripts c and r represent the contract, and the roll date, respectively. The dependent variable $CAPC^{m}_{c,r}$ is the abnormal cumulative price change of contract c, maturity m, and roll r; $CIT_{c,r}$ is the demand of CITs for the first deferred (nearby) contract;[17] $Q_{c,r}$ is the change in hedging pressure during the roll; $AHP_{c,r}$ is the 52-week moving average of the hedging pressure; $QG_{c,r}$ is the change in cross-hedging pressure computed as the change in hedging pressure within the group and without the current contract; $AHPG_{c,r}$ is the 52-week moving average hedging pressure within the group and without the current contract. These variables are defined in the Appendix, Table A1. Eq. 4 is estimated with contract fixed effect, and variance clustering at the contract level.

Under Hypothesis 5, the coefficients γ_1 and γ_3 of Eq. 4 should be positive, γ_2 is expected to be negative, while γ_4 and γ_5 can be either positive or negative. Finally, we check whether our results are sensitive to the financialization. For that purpose, we split the sample into two sub-samples based on the financialization date. We estimate Eq. 4 on both sub-samples.

4. Empirical results

4.1. Break test

Table 1 reports the results concerning the existence of a common break affecting CITs' monthly market share of the SP-GSCI components. With the BIC computed over the full

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[17] With this definition, $CIT_{c,r}$ is negative (supply) for the nearby contract. According to Hypothesis 5, $CAPC^{N}_{c,r}$ should be negative. Therefore, γ_1 is also positive.

sample (and no break), we select a Vector Autoregression with five lags. The Bai et al. (1998) algorithm described in Section 3.1 identifies a break in December 2003.[18] The financialization materializes at a date close or equal to that retained by Sanders and Irwin (2011), Buyuksahin et al. (2009), and Boons et al. (2014) among others. When we restrict the sample to the CFTC contracts, the break date does not change. For robustness purposes, we repeat the test with the share of "commercial" long positions (SCL). A break is detected in November 2003, which is close to the one previously documented. When we turn our attention to six non-indexed CFTC (ALT) contracts, we observe a significant break in April 2008, long after the previous ones. Altogether, these results are in favor of a break that occurs at the end of 2003.

[Insert Table 1 here]

The introduction of electronically traded futures contracts took place from August 2006 to October 2008. We test the null hypothesis (Hypothesis 1) that the inception of electronic trading dates lie inside the confidence interval of the break date. The corresponding Bonferroni test (19 simultaneous hypotheses) rejects the null hypothesis at the 1% level. We conclude that the financialization does not overlap with the electronification of individual commodity contracts. We are not aware of another alternative hypothesis that could explain the break documented here. Altogether, these results make us confident that the date identified as the financialization is not related to any other innovation at the exchange level.

4.2. Descriptive statistics

The composition of the index is remarkably stable over the 1999–2010 period. Two contracts, Orange Juice and Platinum show a decreasing weight in the index, and from the 2004 January roll their weight is equal to zero. Table 2, Panel A provides the descriptive statistics by contract for the 1999–2003 period. Column 1 reports the average of the nearby CAPCs. We observe a wide range of CAPCs from -96.17 bps (Coffee) to 496.61 bps (Natural Gas) with a median of 14.75 bps. In column 2, the first deferred CAPCs exhibit a very similar pattern, the CAPCs ranging from –67.42 bps (Feeder cattle) to 498.81 bps (Natural Gas), and 84.91 bps for the median.

[Insert Table 2 here]

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[18] At the 1% level, this translates into a six-day confidence interval around the break date. The critical values are available in Bekaert, Harvey, and Lumsdaine (2002, p. 244).

In column 3, the average change in the market share of CITs during the roll (CIT) varies widely from -33.83% (Lean Hogs) to -1.23% (Silver), and the median (-12.77%). It is interesting to note that, even before the financialization, the change in CITs' position represents an important part of the open interest. Not surprisingly, in column 4, we see that the change in hedging pressure during the roll (Q) has a lower magnitude with a minimum of -3.13% (Platinum), and a maximum of 2.45% (Coffee). An important part of the (uninformative) trading originates from CITs, probably over the two nearest maturities, while only a small part is generated by "commercials", with a non-identified maturity. Column 5 shows that the vast majority of the contracts exhibit positive hedging pressures (minimum = 9.58%, median = 6.58%, maximum = 44.16%). In column 6, the change of cross-hedging pressure (QC) presents similar characteristics (minimum = -1.97%, median = -0.30%, maximum = 0.65%) to that of hedging pressure with a lower dispersion, however. Column 7 shows the average hedging pressure. It ranges from 2.30% (Heating Oil) to 0.83% (Orange Juice) with a median equal to 20.08%, and the dispersion is half that of the own average hedging pressure.

Table 2, Panel B provides the descriptive statistics over the 2004–2010 period. To summarize, the financialization has two major consequences. First, the distribution of nearby and first deferred average CAPCs is shifted to the left, even when raw sugar (SB), an extreme value, is excluded. Second, as expected, the change in CITs pressure is (one and a half to two times) higher after the financialization. The remaining variables (change in hedging pressure, average hedging pressure at the contract level or the group level) are smaller and less dispersed than before.

The last point worth mentioning is the extremely high correlation of nearby and first deferred CAPCs. This correlation is equal to 97% for the 1999–2010 period, and it is stable over sub-periods. A similar result is obtained with the raw price changes.

4.3. Valuation effect

4.3.1. Univariate analysis

Table 3 reports the results of the event study for the nearby and first deferred contracts. The 1999–2003 pre-roll ACAPC is equal to 102.87 bps (nearby), and 135.42 bps (first deferred). The corresponding t-stats are statistically significant at the 1% level when the t-stat is adjusted for heteroscedasticity and cross-correlation. In 2004–2010, the pre-roll ACAPC is equal to –65.47 (nearby), and -39.94 (first deferred) respectively. ACAPCs are not statistically significant at the 10% levels after adjusting for heteroscedasticity and cross-correlation. This entails a rejection of Hypothesis 2a in both the pre- and post-financialization periods.

[Insert Table 3 here]

The ACAPC of the roll is 115.25 (146.36) bps for the nearby (first deferred), and the adjusted t stat is statistically significant at the 1% level. During the 2004–2010 period, the ACAPC is equal to -59.73 bps (nearby) and -40.70 bps (first deferred), and not statistically significant at the 10% level with the adjusted t-stat. To summarize, ACAPCs are statistically significant at the 1% level over the 1999–2003 period while there are not significant anymore over the 2004–2010 period (rejection of Hypothesis 2b).

We recompute the ACAPCs by weighting individual CAPCs with their respective index weights. Again, we observe similar qualitative results. We reiterate our analysis with raw (log) price changes, and the results are similar to those previously documented. Finally, we compute the ACAPCs with a non-parametric benchmark (peer contract written on a similar commodity but not a component of an index). We also used Bakshi et al. (2019) model as a benchmark. The results, available upon request, are virtually the same as those presented in Table 3. Considered altogether, they support the sunshine trading hypothesis (Hypothesis 2b), at least in the post-financialization period. To summarize, the absolute value of the CAPC roll drops substantially after the financialization, which is positive for the market functioning.

4.3.2. Multivariate analysis

Table 4 reports the results of the difference-in-differences regression. These results provide sharper support for the financialization effects associated with the commodities included in the SP-GSCI index. In columns 1 and 2, we estimate the baseline model with non-SP-GSCI and non-rolling contracts as controls. The difference-in-differences coefficient (β_4) is negative for both the nearby (-1.58) and the first deferred (1.66) contracts, and statistically significant at the 1% level. As in Bessembinder et al. (2016), the alleviating effect of the financialization also supports the sunshine trading hypothesis. The difference-in-differences coefficient related to electronic trading (β_5) is not statistically significant at the usual levels so that there is no evidence that the staggered introduction of electronically traded contracts affects the CAPCs; see Raman et al. (2017), and Martinez, Gupta, Tse, and Kittiakarasakun (2011). Consistent with Hypothesis 3, the financialization is responsible for the CAPCs drop.

[Insert Table 4 here]

In columns 3 and 4, the controls are restricted to non-rolling contracts. We report similar results to the ones previously documented. We also estimate the model for the pre-roll week.

The drop is lower in magnitude, but still statistically significant at the 5% level, with non-SP-GSCI and non-rolling contracts as controls. When only non-rolling contracts are considered the magnitude drops again as well as the statistical significance.

4.4. Arbitrage opportunities around the roll

Mou (2011) shows that the calendar spread starting ten days before the roll is the most rewarding strategy before transaction costs. We check whether significant profits remain when we consider reasonable (bid-ask spread on the long leg) or reduced transaction costs (a quarter of the bid-ask spread).

[**Insert Table 5 here**]

We report the results in Table 5. In column 1, the raw change in price is statistically significant (at the 5% level or less), for seven over 19 commodities. More specifically, the equally-weighted portfolio with the 19 contracts is rewarded 23 bps per roll, and statistically significant at the 1% level. However, this performance does not resist even mild transaction costs. In the pre-financialization period, only two (five) contracts have a positive performance after full (reduced) transaction costs that are statistically significant at the 10% (5%) level. In columns 8 and 9, the post-financialization period shows no contract with a positive performance after full transaction costs statistically significant at the usual level. Only two contracts have a positive performance with reduced transaction costs statistically significant at the 5% level (and one at the 10% level).

We find that the index investment industry bears an annual (average) economic cost of the roll that went from USD 0.8 billion before financialization to USD 2.66 billion after. However, this surge is largely attributable to the higher contract prices. These results depart from Mou (2011) who uses the crude oil contract minimum tick to estimate transaction costs. Nevertheless, our results are consistent with the "efficient market" hypothesis with frictions, as transaction costs are larger than CAPCs on average. They align with Stoll and Whaley (2010) hypothesis relating the reaction of the term structure to the bid-ask spread. Our results are also consistent with Bessembinder et al. (2016) who document narrower bid-ask spreads and increased liquidity during the roll of the U.S. Oil Fund. Finally, because we omit other components of the transaction cost and execution risks, our conclusion in support of Hypothesis 3 is further reinforced. However, we cannot discard the possibility of intraday predatory trading achieved by speculators ahead of indexed fund managers, penalizing the performance of CITs.

4.5. Explaining the CAPCs: A panel approach

Table 6 displays the results from OLS estimations of Equation (4) with variance clustered at the contract level.

[Insert Table 6 here]

The first (second) column reports the results corresponding to the baseline specification for the nearby (first deferred) in the pre-financialization period. On one hand, the change in the net long position of "commercials" (Q) appears to be the main determinant of cumulative abnormal price changes for the nearby (first deferred) contract. The coefficient is equal to -34.35 (-33.72), and statistically significant at the 1% level. The economic magnitude of this variable is substantial. A one standard deviation increase is associated with a 1.42% (0.95%) decrease in the nearby (first deferred) CAPC. On the other hand, CIT is not significant at the 10% level for both the nearby and the first deferred. This result is not surprising by itself since CITs are not supposed to play a major role before the financialization. Nevertheless, the proportion of open interest that switches from the nearby to the first deferred is above 10%. This result can be interpreted as evidence that CITs' non-informative trades do not move prices while unexpected position changes do. The average hedging pressure, cross liquidity, and cross-hedging pressure are not statistically significant at usual levels either. The post-financialization period shows contrasted results. As before, Q remains statistically significant at the 1% level. Its economic magnitude is more than double in the post-financialization. A one standard deviation increase is associated with a 3.22% (2.15%) decrease in the nearby (first deferred) CAPC. As before, CIT is not statistically significant at the 10% level. This reinforce the view that known trades do not generate abnormal price changes. The remaining variables (average hedging pressure, cross-liquidity, and cross-hedging pressure) are not statistically significant at the usual levels.

The change in net commercial position does not provide information on the group of investors generating CAPCs. The DCOT report is more informative since the variable Q is decomposed in four groups "hedgers" (producer/merchant/processor), "swap dealer", "money managers", and "other reportables". CITs are included in the "swap dealer" group, which allows us to analyze who is providing liquidity to the market. We estimate a simplified version of the previous model,

$$CAPC^{m}_{c,r} = \gamma_1 Q^{MM}_{c,r} + \gamma_2 Q^{SWAP}_{c,r} + \gamma_3 Q^{HEDGE}_{c,r} + \mu_c + \epsilon_{c,r}, \tag{5}$$

Table 7 displays results from OLS estimations of Equation (4) with variance clustered at the contract level.

[Insert Table 7 here]

The coefficient of Q^{HEDGE} is equal to -54.02, and statistically significant at the 5% level. It captures most of the estimated coefficient of Q in the previous table. A one standard deviation decrease is associated with a 1.80% (1.90%) increase in the nearby (first deferred) CAPC. To summarize, producers reduce their hedging demand to provide liquidity to swap dealers, and possibly money managers. While the net change of "swap dealers" and "money managers" is of the opposite sign, it is not statistically significant at the usual levels. We interpret this result as evidence that the "swap dealers" and "money managers" categories are not homogeneous.

5. Conclusion

In this paper, we examine the consequences of the financialization of commodity futures markets. We identify a common structural break in the SP-GSCI components that occurs in December 2003. We study the abnormal price reaction of commodity contracts during the roll and the week before (pre-roll). We do find supportive results for the sunshine trading hypotheses in the post-financialization period, as the magnitude and the statistical significance of the cumulative abnormal price changes decrease. Hence, the financialization eases the activity of index investors, in the context of predictable trade awareness. We also question the size of the cumulative abnormal price changes, and relate them to the transaction costs bore by a price taker arbitrager. We show that these potential profits disappear as soon as reasonable transaction costs are accounted for. We regress cumulative abnormal price changes on changes in CITs pressure, changes of hedging pressure, average hedging pressure, changes in cross-hedging pressure, and cross-hedging pressure. We show that change in hedging pressure is an important determinant of abnormal price changes. This study reconciles two contrasting findings of the literature on commodity index investment. On the one hand, we document a significant shift in the risk sharing structure of commodity markets, with the entry of CITs. On the other hand, we show that it is unlikely that CITs have modified the term structure of the contracts that are involved in the roll. A related question, that we leave for future research, is whether the change in hedging pressure materializes at any time as in Kang et al. (2020) or only during the roll periods.

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Table 1: **Break detection in CITs' market share**

This table reports the break dates in the monthly CITs' market share series (SCIT). The break is determined with the Bai et al. (1998) algorithm. The sample covers the 1999—2010 period. Row 1 presents the results obtained with the 27 SP-GSCI contracts. In row 2, we reiterate the procedure with 21 SP-GSCI contracts only. We exclude contracts listed on the LME (Metals) for three main reasons: a) the roll is not well-defined, b) there is an unusual number of maturities for individual contracts, and c) the open interest of the contracts is not reliable. In row 3, only the 19 contracts covered by the CFTC are considered. Row 3 presents the break date for the "commercials" long positions (SCL) of the legacy report as an alternative proxy for CITs' market share series. Row 4 reports the results for six non-SP GSCI/CFTC contracts. The estimation involves vector auto-regression with the number of lags determined with the Bayesian Information Criterion. We test for a break in the intercept. We report the mean breakpoints as well as the 90%, 95%, and 99% confidence intervals for the break. We report the intercept increase (mean change) after the w.r.t. before the breakpoint in % and the Sup-Wald statistics as well as its significance level based on the asymptotic critical values obtained by simulation in Bekaert et al. (2002). *** indicates a significance level of 1%.

Variables	1999–2010							
	# Contracts	BIC	Break date	CI (10%)	CI (5%)	CI (1%)	Intercept (× 100)	Sup-Wald statistics
SCIT/SP-GSCI	27	5	Dec-03	0.00	0.08	0.25	6.17	204.78
SCIT/SP-GSCI	21	5	Dec-03	0.07	0.10	0.20	6.53	225.60
SCIT/SP-GSCI/CFTC	19	5	Dec-03	0.08	0.11	0.21	3.81	196.88
CL/SP-GSCI/CFTC	19	4	Mar-03	0.53	0.76	1.07	3.40	55.92
CL/non SP-GSCI/CFTC	6	1	Oct-06	1.71	2.45	4.40	0.40	34.54

Table 2: **Descriptive statistics: CAPCs and pressure**

This table reports the cumulative abnormal prices change of the nearby and the first deferred during the roll, the CITs position of the Tuesday before the roll (CIT), net trading (Q), cross- net trading (QG, trading of commodities in the same group without the current contract), the 52-week average hedging pressure (AHP), and the 52-week average hedging pressure (AHPG, hedging pressure of commodities in the same group without the current contract) of 19 SP-GSCI futures contracts under the CFTC supervision. The groups are Agricultural, Energy, Softs, and Metals. The periods of interest are 1999—2003 (before financialization) and 2004—2010 (after financialization). The variables are defined in the Appendix, Table A1.

	1999–2003								
Tickers	PRECAPC (N)	PRECAPC (FD)	CAPC (N)	CAPC (FD)	CIT	Q	AHP	QG	AHPG
C	87.15	95.37	82.32	87.50	-10.21	-0.68	-3.12	0.65	11.81
CC	10.16	25.78	24.87	40.00	-2.93	-0.27	-2.98	-0.69	5.11
CL	224.20	232.75	246.28	246.82	-21.89	-0.82	1.44	-1.84	6.01
CT	69.21	101.29	77.10	108.33	-11.99	-0.26	0.83	-0.31	6.14
FC	-63.93	-66.62	-62.70	-67.42	-25.38	0.45	-9.58	-0.13	8.56
GC	-17.83	-19.58	-19.00	-21.05	-4.59	-0.82	3.17	0.39	11.24
HO	206.09	277.61	216.42	287.41	-19.03	-1.31	11.20	-1.68	2.17
KC	-85.06	-56.14	-96.17	-62.60	-5.82	2.45	7.89	-0.28	4.81
KW	27.51	64.67	32.59	67.65	-16.41	-0.09	8.13	-0.07	7.48
LC	70.73	329.42	70.79	332.63	-19.65	-0.35	2.66	-0.26	7.71
LH	87.22	188.97	120.34	212.12	-33.83	-1.08	2.48	-0.25	7.73
NG	481.74	489.22	496.61	498.81	-7.38	-0.37	5.26	-0.97	4.17
OJ	40.66	37.69	33.89	28.74	-19.54	-0.26	14.48	0.25	6.57
PL	121.79	134.54	121.76	131.49	-10.55	-3.13	35.32	-1.67	-1.44
RB	-	-	-	-	-	-	-	-	
S	86.38	83.28	88.46	82.31	-5.31	-0.37	10.81	0.45	7.43
SB	100.36	82.85	97.37	62.40	-13.55	-0.33	10.16	-1.22	3.29
SI	-32.53	-35.25	-6.05	-7.81	-1.23	0.69	44.16	-1.97	5.22
W	72.17	85.43	77.96	93.73	-26.43	0.04	9.82	-0.33	4.04
Min	-85.06	-66.62	-96.17	-67.42	-33.83	-3.13	-9.58	-1.97	-1.44
Median	71.45	84.36	77.53	84.91	-12.77	-0.34	6.58	-0.30	6.07
Max	481.74	489.22	496.61	498.81	-1.23	2.45	44.16	0.65	11.81
	2004–2010								
C	84.40	78.36	30.11	24.38	-19.43	-0.06	4.59	0.35	13.23
CC	-0.96	-1.76	-56.59	-60.28	-10.49	0.29	18.17	0.09	1.98
CL	-125.49	-64.45	-162.55	-99.28	-48.66	0.02	2.40	-0.24	34.02
CT	-43.36	-38.70	-63.20	-57.43	-22.08	0.11	6.54	0.06	2.08
FC	-47.43	-50.33	-45.15	-51.63	-41.45	-0.26	-8.83	0.00	9.10
GC	-23.59	-25.38	-17.84	-19.81	-8.75	-0.22	39.37	0.01	18.03
HO	-90.69	-61.64	-128.31	-97.96	-40.35	0.35	7.95	0.01	2.40
KC	-82.70	-62.66	-132.49	-112.22	-13.83	0.52	14.29	-0.01	0.84
KW	50.54	42.94	15.16	7.13	-33.58	0.25	13.23	0.12	7.45
LC	-124.80	-92.74	-132.42	-102.98	-35.57	-0.33	-0.50	-0.08	7.72
LH	-104.40	-20.60	-103.72	-33.80	-39.20	-0.12	-2.89	0.03	7.54
NG	-30.11	-2.98	-59.82	-31.17	-16.76	0.08	-5.13	0.09	3.95
OJ	-	-	-	-	-	-	-	-	
PL	-	-	-	-	-	-	-	-	
RB	-68.64	-20.50	-89.33	-43.71	-25.96	-0.11	8.65	0.03	1.25
S	201.29	176.40	184.50	161.34	-13.40	-1.05	5.06	-0.10	7.14
SB	-556.03	-554.32	-641.55	-630.14	-19.47	0.28	17.45	-0.45	12.44
SI	-53.61	-53.67	-121.95	-122.64	-4.20	0.09	41.43	-0.56	40.47
W	8.05	9.47	-35.03	-32.84	-39.17	0.18	-6.43	-0.10	2.38
Min	-556.03	-554.32	-641.55	-630.14	-48.66	-1.05	-8.83	-0.56	0.84
Median	-47.43	-25.38	-63.20	-51.63	-22.08	0.08	6.54	0.01	7.45
Max	201.29	176.40	184.50	161.34	-4.20	0.52	41.43	0.35	40.47

Table 3: **Event study around the roll of nearby SP-GSCI contracts**

This table reports the results of an event study based on the 19 SP-GSCI components covered by the CFTC around the pre-roll and the roll periods. The periods of interest are 1999—2003 (before financialization) and 2004—2010 (after financialization). Individual abnormal cumulative price changes (CAPCs) are computed with respect to the benchmark presented in Henderson et al. (2015, p. 1293). January rolls are excluded. Panel A reports the average cumulative abnormal price changes (ACAPC) of an equally- and a value-weighted portfolio (SP-GSCI weights), and the t-statistics with: a) no adjustments, b) corrected for event-induced variance (BMP), and c) corrected for event-induced variance and cross-correlation (KP). Panel B reports the results with raw (log) price changes. Statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and *** respectively.

	Equally-weighted				Value-weighted			
	1999–2003		2004–2010		1999–2003		2004–2010	
	Pre-roll	Roll	Pre-roll	Roll	Pre-roll	Roll	Pre-roll	Roll
	Panel A: HPW parametric benchmark							
Nearby								
	102.87	115.25	-65.47	-59.73	93.02	119.96	-52.99	-51.16
Unadj. t-stat	4.92	5.49	-3.66	-3.23	3.70	4.98	-2.62	-2.59
HAC	4.39	3.87	-2.58	-1.83	3.23	4.79	-2.20	-1.67
HAC and cross-correlation	3.63	3.84	-1.57	-1.26	3.40	3.81	-2.10	-1.52
First deferred								
	135.42	146.36	-39.94	-40.7	113.38	141.77	-27.27	-23.44
Unadj. t-stat	6.84	7.45	-2.34	-2.34	4.95	6.46	-1.41	-1.34
HAC	6.34	5.96	-1.33	-0.90	4.77	6.43	-0.97	-0.27
HAC and cross-correlation	5.08	5.05	-1.03	-0.92	4.42	4.90	-1.14	-1.03
	Panel B: Raw price changes							
Nearby								
	100.94	123.21	-64.42	-89.44	85.86	128.86	-57.34	-72.42
Unadj. t-stat	4.80	5.83	-3.25	-4.55	3.41	5.30	-2.38	-3.17
HAC	4.21	4.23	-1.92	-3.09	2.82	5.13	-1.69	-2.23
HAC and cross-correlation	3.55	4.06	-1.09	-1.50	3.26	4.00	-1.47	-2.37
First deferred								
	135.03	151.35	-38.43	-70.93	108.40	147.80	-31.04	-44.02
Unadj. t-stat	6.79	7.65	-2.03	-3.81	4.74	6.71	-1.33	-2.16
HAC	6.29	6.18	-0.70	-2.33	4.50	6.68	-0.61	-0.98
HAC and cross-correlation	5.07	5.14	-0.68	-1.26	4.40	4.98	-0.70	-1.95

Table 4: **The Financialization and CAPCs during the roll**

This table reports the results of the difference-in-differences panel regression analyzing whether the cumulative abnormal price changes observed during the roll are altered after the financialization of commodities markets. The dependent variable, $CAPC$ is estimated with the Henderson et al. (2015). $DROLL_{c,t}$ is a dummy variable set to "1" ("0") when the commodity is (not) part of the SP-GSCI and do (not) roll. , is a dummy variable set to "1" ("0") in the post- (pre-) financialization period. $DFIN_t$, is a dummy variable set to "1" ("0") in the post- (pre-)electronification period. The controls are all CFTC contracts that do not roll (columns 1 and 3) or the SP-GSCI/CFTC contracts that do not roll (columns 2 and 4). The estimations include contract and year fixed effects. The sample period is 1999–2010. The estimations correct for within-contract error clustering. The robust standard errors are in parenthesis, and statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and *** respectively.

Panel A: Roll period

	CFTC N	CFTC FD	GSCI N	GSCI FD
DFIN	-0.379	-0.386	-0.408	-0.367
	(0.406)	(0.297)	(0.507)	(0.422)
DROLL	0.969**	1.309***	1.004*	1.352***
	(0.440)	(0.390)	(0.506)	(0.434)
DELEC	0.421	0.415*	0.576*	0.508*
	(0.246)	(0.207)	(0.297)	(0.270)
DROLL × DFIN	-1.579**	-1.657***	-1.553*	-1.678**
	(0.700)	(0.587)	(0.797)	(0.672)
DROLL × DELEC	-0.157	-0.243	-0.313	-0.336
	(0.376)	(0.374)	(0.394)	(0.396)
Constant	0.122	0.0547	0.00316	-0.0266
	(0.258)	(0.209)	(0.337)	(0.283)
Observations	3,540	3,540	2,676	2,676
R-squared	0.013	0.018	0.017	0.023
Number of contracts	25	25	19	19

Panel B: Pre-roll period

	CFTC N	CFTC FD	GSCI N	GSCI FD
DFIN	-0.293	-0.363	-0.661	-0.438
	(0.325)	(0.261)	(0.431)	(0.424)
DROLL	0.927**	1.326***	0.731*	1.265***
	(0.350)	(0.346)	(0.417)	(0.399)
DELEC	-0.00297	0.0633	0.0978	0.0239
	(0.201)	(0.145)	(0.239)	(0.216)
DROLL × DFIN	-1.374**	-1.284**	-1.002	-1.207*
	(0.615)	(0.560)	(0.686)	(0.653)
DROLL × DELEC	0.0617	-0.225	-0.0425	-0.187
	(0.377)	(0.316)	(0.408)	(0.349)
Constant	0.247	0.0453	0.201	0.00423
	(0.262)	(0.222)	(0.369)	(0.346)
Observations	3,540	3,540	2,676	2,676
R-squared	0.011	0.017	0.016	0.022
Number of contracts	25	25	19	19

Table 5: **Front running the index roll**

This table reports the performance of a calendar spread that front runs the SP-GSCI roll by ten days; see Mou (2011). Column 1 reports the raw performance, Column 2 accounts for the bid-ask spread of the day estimated with Abdi and Ranaldo (2017). Column 5 is the total number of rolls per contract during the corresponding sub-period. The RBOB gasoline contract inception is in November 2006. The number of observations is 645 and 953, respectively and statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and *** respectively.

	1999–2003					2004–2010				
	Raw returns (%) (1)	TC (%) (2)	Profit (%) (1) - (2) (3)	Profit (%) (1) - (2) / 4 (4)	# rolls	Raw returns (%) (1)	TC (%) (2)	Profit (%) (1) - (2) (3)	Profit (%) (1) - (2) / 4 (4)	# rolls # rolls
C	0.08	0.37	-0.29	-0.01	25	0.40***	0.51	-0.11	0.27**	35
CC	0.20	0.75	-0.55	0.01	25	0.18***	0.62	-0.44	0.03	35
CL	0.32***	0.68	-0.36	0.15	60	0.54***	1.02	-0.48	0.28*	84
CT	0.40*	0.62	-0.22	0.24	25	0.69***	0.62	0.07	0.54**	35
FC	-0.11	0.18	-0.29	-0.16	40	-0.15	0.25	-0.41	-0.22	56
GC	-0.11	0.02	-0.13	-0.12	30	-0.11	0.21	-0.33	-0.17	42
HO	0.10	0.90	-0.80	-0.13	60	0.41***	0.97	-0.56	0.17	84
KC	0.45***	0.95	-0.49	0.22**	25	0.11**	0.68	-0.57	-0.06	35
KW	0.39***	0.19	0.20*	0.34***	25	0.18***	0.88	-0.7	-0.04	35
LC	0.37	0.31	0.05	0.29	30	0.01	0.4	-0.39	-0.09	42
LH	1.17**	0.50	0.67	1.04**	35	0.33	0.61	-0.28	0.18	49
NG	0.99***	1.33	-0.34	0.66**	60	0.56***	1.36	-0.8	0.22	84
OJ	0.10	0.47	-0.43	-0.03	30	0.08	0.85	-0.67	-0.11	42
PL	-0.68	0.19	-0.87	-0.72	60	3.59	0.54	3.05	3.46	84
RB	N A	NA	N A	N A	60	0.04	0.59	-0.56	-0.11	84
S	-0.01	0.49	-0.50	-0.13	35	-0.33	0.71	-1.05	-0.51	49
SB	0.74	0.82	-0.08	0.53	25	-0.05	0.74	-0.79	-0.24	35
SI	-0.02	0.04	-0.05	-0.02	30	-0.08	0.37	-0.45	-0.17	42
W	0.58***	0.40	0.18*	0.48***	25	0.35***	1.08	-0.73	0.08	35
Agriculture	0.34***	0.35	-0.01	0.26**	215	0.08	0.6	-0.52	-0.07	301
Energy	0.35***	0.73	-0.38	0.17*	240	0.39***	0.98	-0.6	0.14*	336
Metals	-0.37	0.11	-0.48	-0.40	120	1.75	0.42	1.33	1.65	168
Softs	0.38	0.71	-0.35	0.20	130	0.21**	0.71	-0.47	0.04	182
Equally-weighted	0.23***	0.50	-0.28	0.10	705	0.50**	0.72	-0.22	0.32	987

Table 6: **CAPC, CITs pressure, liquidity and insurance during the roll**

This table reports the results of a panel regression examining whether cumulative abnormal price changes observed during the roll depend on CITs, and short-term changes in price pressure, and the long-term in own (cross-) price pressure. The dependent variable, $CAPC$ is an estimate of the change in prices in excess of the Henderson et al. (2015) model. The model is estimated for three sub-periods, *i.e.*, 1999–2003, the pre-financialization period, and 2005–2010, the post-financialization period; 2004 is excluded because two variables (AHP and AHPG) are computed with pre-financialization information. CIT is the position of CITs the Tuesday before the roll divided by the open interest estimated with the Masters and White algorithm (1999–2003, 2005–2010). Q is the change in net long positions of "commercials" divided by the open interest of the contract. AHP is the 52-week average of the (minus) "commercials" net long position divided by the open interest of the contract. QG and AHPG are computed as above over a group of contracts (Agricultural, Metal, Energy, and Softs) to which the current contract belongs without the current contract itself. The variables are defined in the Appendix A1. The specifications contain a contract fixed effect, and estimated within-contract error clustering. Robust standard errors are in parenthesis and statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and *** respectively.

	Nearby		First Deferred	
	1993–2003 (1)	2005–2010 (2)	1993–2003 (3)	2005–2010 (4)
CIT	-0.866	-1.600	-2.177	-1.765
	(2.678)	(1.879)	(2.556)	(1.811)
Q	-30.04***	-67.99***	-28.59***	-64.84***
	(9.723)	(11.60)	(8.983)	(10.88)
AHP	0.619	3.736	1.388	3.116
	(0.999)	(2.156)	(0.822)	(2.199)
QG	-2.018	-5.538	-1.440	-7.345
	(5.031)	(4.619)	(4.839)	(4.395)
AHPG	0.541	-3.382	0.617	-1.634
	(1.324)	(3.684)	(1.392)	(3.154)
Constant	0.428	-0.345	0.429	-0.398
	(0.357)	(0.725)	(0.328)	(0.703)
Observations	575	676	575	676
R-squared	0.165	0.181	0.185	0.186
Number of contracts	18	17	18	17

Table 7: **Cumulative abnormal price change during the roll and position changes**

This table reports the results of a panel regression examining whether the cumulative abnormal price changes observed during the roll depends on the change of net long positions of money managers, swap dealers, and hedgers. The model is estimated for the 2006–2010, when the DCOT reports are available. The variables are defined in the Appendix Table A1. The specifications contain a contract fixed effect, and are estimated using within-contract error clustering. Robust standard errors are in parenthesis. Statistical significance at the 10%, 5%, and 1% levels are indicated by *, **, and *** respectively.

	2006–2010	
	Nearby	First Deferred
QMM	13.86	7.05
	(22.77)	(18.99)
QSWAP	50.03	35.56
	(35.10)	(32.29)
QHEDGE	-54.02**	-58.00***
	(21.28)	(17.58)
Constant ($\times 10^2$)	-4.18***	8.34***
	(1.35)	(1.27)
R-square		
Within	0.235	0.237
Between	0.230	0.332
Overall	0.238	0.240
Observations	523	523
Number of contracts	17	17

Appendix

Table A1: **Variable definition**

We define the variables, their units, frequency, period of availability and additional descriptions if needed. The variables are computed over the 1999–2010 period.

Variable	Computation	Description	Source
Futures price	$F^m_{c,t}$	Price of a futures contract c, at time t, maturing at m.	Barchart
Futures price change	$r^m_{c,t} = \ln(F^m_{c,t}) - \ln(F^m_{c,t-1})$		
Cumulative abnormal price change	$CAPC^m_{c,w}$	CAPC of contract c, maturing at m, over the roll period r.	
Open interest per contract	$OI_{c,t}$	Open interest in USD of contract c at time t	CFTC Legacy report.
Total open interest	$TOI_t = \sum_c OI_{c,t}$		
Total SP-GSCI investment	See below		
Amount tracking SP-GSCI contracts	$VCIT_{c,t}$	See Masters and White (2008, p. 45-51)	
Market share of SP-GSCI contracts	$SCIT_{c,t} = {}^{VCIT_{c,t}}/_{OI_{c,t}}$	Market share of CITs on contract c, at time t.	
Market share of "commercials" long	$SCL_{c,t} = {}^{CL_{c,t}}/_{OI_{c,t}}$	Market share of "commercials" long on contract c, at time t.	
"Commercials" long	$CL_{c,t}$	"Commercials" long on contract c, at time t.	CFTC legacy report.
"Commercials" short	$CS_{c,t}$	"Commercials" short on contract c, at time t.	CFTC legacy report.
"Commercials" net long	$CNL_{c,t} = CL_{c,t} - CS_{c,t}$	"Commercials" net long on contract c, at time t.	
Hedging pressure	$HP_{c,t} = {}^{-CNL_{c,t}}/_{OI_{c,t}}$	Hedging pressure on contract c, at time t.	
Cross-hedging pressure	$HPG_{c,t} = -\frac{\sum_{g=\{G\}-c} CNL_{g,t}}{\sum_{g=\{G\}-c} OI_{g,t}}$	Hedging pressure on contract c, at time t, of group g.	
Short term change in hedging pressure	$Q_{c,t} = {}^{(CNL_{c,t}-CNL_{c,t-1})}/_{OI_{c,t-1}}$	Change in hedging pressure on contract c, from $t-1$ to t.	
Average hedging pressure	$AHP_{c,t} = \frac{1}{52}\sum_{\tau=t-51}^{t} HP_{c,\tau}$	52-week average hedging pressure.	
Cross short-term	$QG_{c,t} = \frac{\sum_{g=\{G\}-c} (CNL_{g,t}-CNL_{g,t-1})}{\sum_{g=\{G\}-c} OI_{g,t}}$		
Average cross-hedging pressure	$AHPG_{c,t} = \frac{1}{52}\sum_{\tau=t-51}^{t} HPG_{c,t}$	52-week average cross-hedging pressure.	

Table A2: **Contract characteristics**

The Table reports the specifications of 26 contracts covered by the CFTC; 19 contracts are included in the SP-GSCI, and 7 are not. The reported characteristics are the trading venues, tickers, underlying commodities, units, maturity months with the appropriate code letter, and the inception date of the corresponding electronically traded contract.

Commodity	Trading venue	Ticker	Unit	Maturity	Electronification
			Panel A: SP-GSCI contracts		
Corn	CBT	C	bu (5,000)	HKNUZ	01/08/2006
Cocoa	ICE-US	CC	MT (10)	HKNUZ	02/02/2007
WTI crude oil	NYMEX/ICE	CL	bbl (1,000)	FGHJKMNQUVXZ	05/09/2006
Cotton	ICE-US	CT	lbs (50,000)	HKNVZ	02/02/2007
Feeder cattle	CME	FC	lbs (50,000)	FHJKQUVX	24/11/2008
Gold	CMX	GC	ozt (100)	GJMQVZ	04/12/2006
Heating oil	NYMEX	HO	gal (42,000)	FGHJKMNQUVXZ	05/09/2006
Coffee	ICE-US	KC	lbs (37,500)	HKNUZ	02/02/2007
Kansas wheat	KBT	KW	bu (5,000)	HKNUZ	13/01/2008
Live cattle	CME	LC	lbs (40,000)	GJMQVZ	04/12/2006
Brent crude oil	ICE-UK	LCO	bbl (1,000)	FGHJKMNQUVXZ	12/06/2006
Gasoil	ICE-UK	LGO	MT (100)	FGHJKMNQUVXZ	12/06/2006
Lean hogs	CME	LH	lbs (40,000)	GJMNQVZ	04/12/2006
Natural gas	NYMEX/ICE	NG	MMBtu (10,000)	FGHJKMNQUVXZ	05/09/2006
Orange juice	ICE	OJ	lbs (15,000)	FHKNUX	02/02/2007
Platinum	NYMEX	PL	ozt (50)	FGHJKMNQUVXZ	04/12/2006
RBOB gasoline	NYMEX	RB	gal (42,000)	FGHJKMNQUVXZ	05/09/2006
Soybeans	CBT	S	bu (5,000)	FHKNQUX	01/08/2006
Raw sugar	ICE-US	SB	lbs (112,000)	HKNVZ	02/02/2007
Silver	CMX	SI	ozt (5,000)	FHKNUZ	04/12/2006
Wheat	CBT	W	bu (5,000)	HKNUZ	01/08/2006
			Panel B: Non-indexed contracts		
Minneapolis Wheat	CME	MWE	bu (50,000)	HKNUZ	15/12/2004
Lumber	CME	LB	m^3 (110,000)	FHKNUX	20/10/2008
Class III Milik	CME	DC	lbs (200,000)	FGHJKMNQUVXZ	17/09/2007
Oats	CBOT	O	bu (5,000)	HKNUZ	01/08/2006
Palladium	NYMEX	PA	ozt (100)	HMUZ	04/12/2006
Rough rice	CBOT	RR	CWT (2,000)	FHKNUX	01/08/2006

Maturity month code: F = January, G = February, H = Mars, J = April, K = May, M = June, N = July, Q = August, U = September, V = October, X = November, Z = December.

Figure A1: **Volume concentration during the roll**

We plot the total daily trading volume and OI of the futures contract directly written on the SP-GSCI performance. The shaded areas correspond to the 12 roll periods of the -randomly selected- year 2005. The frequency is daily.