Corporate Hedging and the Variance of Stock Returns[*,†,‡]

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Abstract

By means of a difference-in-differences approach on the volatility of stock returns (σ-DID), we investigate the effect that hedging has on corporate risk. Examining the relation between hedging and the idiosyncratic variance of stock returns, we show that when new commodity derivatives are introduced in the Chicago Mercantile Exchange (CME), firms with exposure to the commodities experience up to a 40% drop in the idiosyncratic variance of stock returns. The effect is persistent over time and it is associated with real effects: firms that hedge more also experience an increase in profit margins, investment, access to credit lines, and a drop in cash holdings. Our results establish a direct link between corporate risk management policies and stock return behavior.

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1 Introduction

Making cash flows less sensitive to external shocks is the central mechanism via which hedging affects corporate policies and firm value. The work of Froot et al. (1993), Graham and Rogers (2002) and Campello et al. (2011), among others, has shown that the existence of information frictions combined with asymmetries in the tax schedule provide reasons for firms to engage in hedging activities. There is also mounting evidence that links hedging policies to firm value. Pérez-González and Yun (2013) report that following the introduction of weather derivatives firms that are sensitive to weather conditions obtain higher valuations, invest more and increase leverage. Similarly, Gilje and Taillard (2017) find that a variation in hedging effectiveness induces firms to reduce investment, sell assets and obtain lower valuations.

One aspect of hedging that remains little understood is how it affects stock return behavior. A major difficulty in analyzing the relation between hedging and stock returns lies in that hedging is likely to be co-determined together with other corporate policies (Bolton et al. (2011)), which may affect both the mean and the variance of stock returns.[1] Moreover, the possible effects that the use of derivatives may have on stock returns will depend on the extent to which derivatives are used to hedge rather than to speculate.

In this paper, we take up the challenge of investigating the relation between hedging and the behaviour of stock returns, specifically focussing on how hedging is related to the variance of stock returns. To address some of the challenges indicated above, we use a panel of shocks to the cost of hedging. The shocks consist in the introduction of new commodity derivatives in the CME (Chicago Mercantile Exchange). More precisely, we construct a variant of the standard difference-in-differences (DID) to derive the average treatment effect (ATE) of hedging on the idiosyncratic variance of stock returns. We identify the sensitivity of firms to the shock by looking at the exposure that each firm has to the commodity for which the new derivative has been introduced.

Our main result is that the idiosyncratic variance of the stocks that are exposed to the new derivative drops by up to 40%, a result that is consistent with lower sensitivity of stock returns to commodity prices after the introduction of the derivative (Tufano (1998)). We show that the mechanism that underlies this result relates to a lower volatility of cash flows, and that it also depends on liquidity and hedging effectiveness. Most importantly, we show that hedging is the

[1] On this topic, see Campbell et al. (2001), Goyal and Santa-Clara (2003), Comin and Philippon (2006), Brandt et al. (2009), or Diebold and Yilmaz (2014).

channel through which firm fundamentals and stock returns are related.

The treatment group contains firms facing ex-ante exposure to the commodities and are thus likely to benefit from the introduction of the derivative. We develop a text-search algorithm that allows us to retrieve this information from *"Item 7A - Quantitative and Qualitative Disclosures about Market Risks"* in the 10-K filings in the Securities and Exchange Commission (SEC) for each of the five commodities (butter, pork belly, whey, benzene and ethanol) for which futures and option derivatives began trading in the CME in 1996, 1997, 1998, 2001 and 2005, respectively. In order to build the control group, we acknowledge that hedging is industry-specific (Bakke et al. (2016), Rampini et al. (2014), Jin and Jorion (2006), Tufano (1996)) and thus, we select firms within the same industry but without exposure to the commodity, or firms that employ a substitute of the commodity of interest.

In order to disentangle the systematic and idiosyncratic components of risk, our σ-DID follows a two-step regression procedure. In the first step we estimate the effect that the introduction of new derivatives has on stock returns, controlling for observable firm characteristics and time- and firm-fixed effects, as well as factors that are known to affect returns. The set of squared residuals of the first step are then used as a proxy of the idiosyncratic variance of the firm's stock returns. In the second step we run a standard DID-type regression on the squared residuals of the first stage. The second stage regression includes the interaction between the dummy identifying the post-treatment period and the dummy identifying firms in the treatment group, as well as controls for observable firm characteristics (including the usage of alternative derivatives for hedging purposes) and time- and firm-fixed effects. The second stage allows to carry out inference on the average impact of the intervention on the idiosyncratic variance. We test for parallel trends and choose similar treatment and control firms conditional on our set of covariates.

We find that the introduction of derivatives leads to a 56% higher probability of hedging initiations for firms in the treatment group as compared to the control group (extensive margin). Depending on the specific case, the reduction in idiosyncratic variance is between 3.17% and almost 40% of the average variance of the stock returns of the firms in the sample over the period that surrounds the event. We find that delistings of the derivatives from the CME reverse most of these effects, leading to an increase in idiosyncratic variance. The main finding that emerges from our results is that the effects of the listings/delistings of commodity derivatives on the variance of stock returns are economically significant and persistent over time.

We shed light on the economic mechanism responsible for our results and analyze how firms adjust their behavior after the listing of derivatives. The picture that emerges is one whereby the main action comes from existing users of OTC derivatives or alternative exchange-traded derivatives switching to CME derivatives when these become available due to liquidity considerations (intensive margin). While overall exposure to systematic risk may not change, the drop in idiosyncratic volatility of stock returns is associated with lower cash flow volatility. Moreover, this drop in uncertainty leads to effects in terms of firm fundamentals.

We quantify the effects of hedging on corporate risk by linking the observed response in risk to variation in corporate policy decisions. Following the introduction of the new derivatives, treated firms experience relatively lower costs of goods sold (3.24%), and higher gross profitability (5.26%). Additionally, they reduce their cash holdings (1.15%), increase their access to credit lines (1.86%), increase leverage (1.71%) and increase investment (0.54%).

These "real" effects indicate that treated firms increase their gross margins due to improved access to hedging via the new commodity derivatives traded in the CME. The reduction in cash holdings suggests that firms can hold a smaller amount of "precautionary" cash as a result of better hedging of commodity price risk. As profitability increases, firms also obtain more credit and can increase investment. Taken together, these changes in the balance sheet and income statement suggest that the mechanism that links the new derivatives to a reduction in the idiosyncratic volatility is related to a change in corporate policies. In other words, easier access to hedging instruments changes the risk-return profile of firms. As the drop in variance is mostly due to a reduction in its idiosyncratic component, higher profitability appears to be associated with better management of the internal resources of the firm, rather than by changes in exposure to market risk (systematic component).

We also look at the role that hedge effectiveness plays in our results. From Gilje and Taillard (2017) and Tufano (1998), we know that when hedging is effective, it reduces the sensitivity of firms' cashflows and stock returns to changes in commodity prices. Our results suggest that particularly for those firms for which effective hedging is available, the adoption of the new CME derivatives leads to a lower ex-post exposure to commodity price risk, and to a drop in the idiosyncratic variance of stock returns. Overall, our main results suggest that higher market completeness through the listing of derivatives allows exposed firms to implement risk management strategies that are both, sufficiently liquid and effective.

We run a series of additional tests to check the robustness of our results. We perform a placebo test by artificially moving the date of the introduction to one and two months earlier. This test can also be considered an empirical test for the parallel trends assumption (Angrist and Krueger (1999)). When we run the σ-DID approach we show that in almost all specifications there is no evidence of the market anticipating the effect of the introduction of the derivatives on stock return variance. Second, we re-run our empirical tests using an alternative definition for the control group. The main take-homes are still the same. Additionally, we run a set of regressions where all introduction events are pooled together and we can control for commodity-type-fixed effects, and we find that the effect of a relatively higher drop in variance for the treatment group is also observed in this specification. Finally, we investigate whether the listings are associated with particular patterns in the variance of the market as a whole (proxied by the VIX index), and with patterns in the variance of the prices of the underlying commodities. We find that there is no evident relation between the variance of the VIX and of the commodity prices, with the timing of the introductions and delistings of the derivatives in the CME. Summing up, all our robustness checks support the main findings.

The novelty of our paper lies in establishing a connection between the behavior of stock returns and corporate policies, via a shock to hedging. We analyze how the completion of markets impacts firms by affecting their (idiosyncratic) risk exposures. To the best of our knowledge, this is the first paper that quantifies such relation by linking the observed response in risk to variation in corporate policy decisions. Prior papers lack either the effect of exposure on risk, or the effect of variations of risk on corporate policy decisions in the context of hedging (Bartram (2019), Pérez-González and Yun (2013), Bartram et al. (2011), Jin and Jorion (2006), Hentschel and Kothari (2001), Guay (1999)). We shed new light on whether the use of derivatives leads to an increase or decrease in firm risk. Since derivatives can be used to hedge or to speculate, both are possible in principle. Our results validate the view that hedging reduces costly lower-tail outcomes (Servaes et al. (2009), Adam and Fernando (2006), Stulz (1996)), but also that hedging allows for variance minimization (Bartram (2019)). Our paper also has the advantage of spanning across a fairly large sample of treated firms, obtained via textual analysis, and to bring some methodological innovations, in the form of the σ-DID which supports that on net derivatives are used to reduce risk and the result appears not to be driven by self-selection. Finally, our findings on the real effects of hedging are consistent with the results of Gilje and Taillard (2017), Pérez-González and Yun (2013) and Campello et al. (2011), which show that hedging reduces the cost of borrowing and investment restrictions; with Cornaggia (2013) which shows that hedging leads to improvements in productivity; and with Disatnik et al. (2013), which show that hedging leads to lower cash holdings and greater reliance on credit lines.

The rest of the paper is structured as follows. In Section 2 we develop the σ-DID approach for the estimation of the effect of hedging on variance of stock returns in a DID setting. In Section 3 we describe the data, the institutional background at the CME, the text search algorithm and the definitions of the treatment and control groups. In Section 4 we carry out the main empirical analysis including the effects on idiosyncratic volatility and the underlying economic mechanism behind. In Section 5 we carry out a series of robustness checks. Section 6 concludes.

2 σ-DID

We introduce a regression methodology to assess whether a corporate event affects the average level of risk of a firm as it is measured by its equity variance. More precisely, in this section we introduce a variant of the DID methodology designed to estimate the ATE of an intervention on the equity variance of firms (Bertrand et al. (2004)).

We consider a panel of N firms observed over a window spanning T time periods. The firms in the panel are divided into a treatment group (labelled 1) and a control group (labelled 0), which is denoted as g. On period t^* we assume that an intervention affects the firms in the treatment group. The unexpected return of a risky asset can be expressed as a function of common factors and an idiosyncratic component (Ross, 1976). We assume that the return of the i-th firm in group g on period t, denoted by r_{igt}, is generated as

$$r_{igt} = \alpha_{igt} + \sum_{k=1}^{K} \beta_{k\,igt} f_{kt} + \sqrt{\sigma^2_{igt}}\, z_{igt} \ ,$$

where f_{kt} denotes the return of the k-th factor on period t, z_{igt} is an exogenous error term with unit variance, and α_{igt}, $\beta_{k\,igt}$, and σ^2_{igt} are model parameters. The σ^2_{igt} parameter measures the variability of firm i in group g on period t conditional on the factors and plays a key role in our framework. We assume that

$$\sigma^2_{igt} = A_{\sigma\, i} + B_{\sigma\, t} + \delta_\sigma I_{gt} + C'_\sigma X_{ig} I_t \ , \qquad (1)$$

where $A_{\sigma\, i}$ is a firm-fixed effect, $B_{\sigma\, t}$ is a time-fixed effect, δ_σ is the average impact of the intervention on the variance of the treatment group, I_{gt} is the intervention dummy ($I_{gt} = 1$ if $g = 1$ and $t > t^*$ and zero otherwise), C_σ is a p-dimensional vector of parameters, X_{ig} is a p-dimensional vector of firm characteristic controls and I_t is the post-treatment dummy ($I_t = 1$ if $t > t^*$ and zero otherwise). Notice that (1) is the analog of the standard DID specification. The parameter δ_σ measures the differential contribution of the intervention on the variance of the treated group in the post-treatment period as compared to the control group. The model accounts both for time-fixed effects ($B_{\sigma\, t}$) that are common to the entire market as well as firm-specific time-varying exposure to the market factors through $\beta_{k\, igt}$.

The δ_σ parameter is the main quantity of interest for which inference is sought. In order to carry out inference on this parameter consider first the unfeasible case in which the α_{igt} and β_{igt} parameters are known. If we define the squared residual as

$$y_{igt} = \left(r_{igt} - \alpha_{igt} - \sum_{k=1}^{K} \beta_{k\, igt} f_{kt} \right)^2 \;, \tag{2}$$

then it is straightforward to verify that

$$y_{igt} \;\; = \;\; A_{\sigma\, i} + B_{\sigma\, t} + \delta_\sigma I_{gt} + C_\sigma' X_{ig} I_t + u_{igt} \;, \tag{3}$$

where $u_{igt} = (A_{\sigma\, i} + B_{\sigma\, t} + \delta_\sigma I_{gt} + C_\sigma' X_{ig} I_t)(z_{igt}^2 - 1)$. We make the following identification assumptions. Let $D_{I\, i}$ be a dummy which is one for firm i and zero otherwise and $D_{T\, t}$ is a dummy which is one in period t and zero otherwise. Let W_{igt} be defined as $(D_{I\, 1}, ...D_{I\, N}, D_{T\, 1}, ..., D_{T\, T}, X_{ig}' I_t, I_{gt})'$. Then, we assume that z_{igt} is independent of W_{igt} which implies that $\mathrm{E}(z_{igt}|W_{igt}) = 0$ and $\mathrm{Var}(z_{igt}|W_{igt}) = 1$. This is sufficient for the error term u_{igt} in equation (3) to be mean zero and uncorrelated with the remaining variables of the equation. Under these assumptions, equation (3) can be estimated by standard least squares methods, and inference can be carried out using robust standard errors that take into account the heteroskedasticity of the error term.

Direct estimation of equation (3) is unfeasible since the α_{igt} and β_{igt} coefficients are unknown. To overcome this hurdle, we replace y_{igt} in (2) with the squared residuals obtained by a first stage regression estimated by least squares (Engle (1982)). In particular, we assume that

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha I_{gt} + \sum_{k=1}^{K} A_{\beta\, k\, i} f_{kt} + \sum_{k=1}^{K} \delta_{\beta\, k} f_{kt} I_{gt} + C_\alpha' X_{ig} I_t + \epsilon_{igt} \;. \tag{4}$$

For the purpose of this paper we consider three variants of the model described in (4). The first specification is based on including no factors in the mean equation of returns, that is

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha I_{gt} + C'_\alpha X_{ig} I_t + \epsilon_{igt} \ . \tag{5}$$

The second specification is a CAPM-type specification that is based on using the market return as the sole factor driving returns, that is

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha I_{gt} + A_{\beta\, i} r_{mt} + \delta_\beta r_{mt} I_{gt} + C'_\alpha X_{ig} I_t + \epsilon_{igt} \ , \tag{6}$$

where r_{mt} denotes the return on the market. Lastly, we consider a factor specification in the spirit of Tufano (1998). In this specification, in addition to the market factor we control for commodity returns, that is

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha I_{gt} + A_{\beta_i} r_{mt} + \delta_\beta r_{mt} I_{gt} + D_{\beta^c_i} r_{ct} + \delta_{\beta^c} r_{ct} I_{gt} + C'_\alpha X_{ig} I_t + \epsilon_{igt} \ , \tag{7}$$

where r_{mt} denotes the return on the market and r_{ct} denotes the return of the same underlying commodity of the commodity derivative, which we call commodity factor for short. Equation 7 allows us to investigate whether changes in the stock return volatility are due to a change in the exposure to the underlying commodity or is due to some other effect.

Finally, we remark that Appendix A1 discusses the finite sample properties of the σ-DID estimator, while Table A1 in the Appendix reports the results of a Monte Carlo experiment where we study the properties of the proposed estimation procedure. It suffices to say here that the two step testing procedure performs satisfactorily in terms of size and power for reasonable sample sizes.

3 Data and Empirical Strategy

We use the introduction of different commodity derivatives by the CME as a panel of shocks to the cost and liquidity of risk management instruments of the different commodities. This empirical strategy allows us to estimate the relation between risk and hedging decisions of firms. The exercise we implement is related to recent work by Almeida et al. (2017) and Hoberg and Moon (2017), which look at analogous derivative introductions by the CME in steel futures products and foreign exchange derivative contracts, respectively. In particular, we examine five cases of introductions of commodity derivatives in the CME: butter, pork belly, whey, benzene and ethanol which take place in 1996, 1997, 1998, 2001 and 2005, respectively.[2] For each commodity the CME offers both, futures and options contracts.

We focus on commodity derivatives because firms' exposures to specific inputs or outputs can be perfectly identified in section *"Item 7A - Quantitative and Qualitative Disclosures about Market Risks"* of firms' annual reports filed in the SEC.[3] Firms are obliged to disclose the different commodities for which they are facing material risk exposures. To the extent that we are able to identify which firms are ex-ante exposed to specific commodities, irrespective of their investment opportunities, we can then evaluate the effects of introducing specific derivatives written on the commodities.[4]

We are not interested on analyzing substitution patterns between different risk management instruments after the introduction of the commodity derivatives. We instead want to focus on the *overall* effect of the usage of these derivatives on the risk of firms that i) initiate hedging a specific commodity derivative introduced by the CME or ii) substitute from other risk management instruments toward exchange-traded derivatives (as in Almeida et al. (2017) and Hoberg and Moon (2017)).[5] Moreover, building on recent evidence in Bartram (2019), we focus on the usage of derivative instruments for hedging purposes only. That is, we allow for selective hedging and full-cover hedging in the spirit of Culp and Miller (1995) and Stulz (1996), but we rule out the trade of derivatives for speculative purposes.

Institutional Background at the CME

In order to understand our results better, it is convenient to get some insight on the reasons why the derivatives were introduced, and on the institutional background at the CME. The CME generally publishes information regarding a new derivative introduction through a Special Executive Release (SER). Additionally, they publish a press release in the Media Room at the date of the

[2]We focus on these five independent events to avoid contamination from recession periods or the 2007 financial crisis and other confounding market or regulatory events.

[3]Item 7A requires to furnish the information required by Item 305 of Regulation S-K.

[4]Focusing on commodity derivatives also has the advantage that non-financial corporations tend to do a more balanced use of exchange-traded derivatives, over-the-counter derivatives and other risk management instruments to deal with commodity exposures. Figure 12 in Servaes et al. (2009) shows that 32% of non-financial corporations use commodity derivatives, while Table XXVI in Bodnar et al. (2018) shows that 33%, 33% and 38% use forward contracts, futures contracts and fixed pricing contracts to deal with their commodity exposures, respectively.

[5]We acknowledge that some firms will not react to the introduction of commodity derivatives by the CME. Survey evidence in Table XIII in Bodnar et al. (2018) and Bodnar et al. (1998) or discussion in Carter et al. (2006) highlight insufficient exposure and the costs of setting up and maintaining a derivatives program as the main reasons why firms do not use derivatives. However, our empirical strategy allows us quantifying the effects on those firms that *do react* to the introduction. Therefore, if we observe an effect that is statistically significant, then, that must come from the reaction of i) initiators and/or ii) substituters.

introduction. Table A2 in the Appendix contains a list of the introduction and delisting cases used in the analysis, with the relevant dates and contract characteristics. Contracts were offered in all 12 calendar months, with six consecutive months listed for trading at all times. It also reports information on the source of innovation of the contract (i.e., new underlying, new contract terms or new derivatives), cross-hedge alternatives at the CME, the effectiveness and liquidity of the existing cross-hedge products and the existence of OTC alternatives. The table also sheds light on the reason why the derivatives were introduced, the date of the first available Factiva news on the introduction and the source of the news. Finally, we explain the background for the delisting of some of these derivatives with information from the CME. Private conversations with the CME convey that listing decisions generally imply an active underlying in the OTC market (no need to generate liquidity), the existence of cross-hedge products (e.g., benzene vs. unleaded gasoline) and that the product exists in alternative/competing markets (e.g., CME vs. CBOT). Moreover, changes in consumer tastes, extensions to existing product lines and expected liquidity in the medium-term are additional reasons why these commodity derivatives are introduced. For instance, the introduction of fresh pork bellies in our empirical set up responds to changes in consumer behavior and a preference for fresh over frozen pork bellies. The introduction of butter and ethanol derivatives were mainly driven by expected liquidity considerations. The former was due to a drop in the governmental butter stock and the latter, because of the promotion of the Federal government of ethanol as a clean-burning fuel.

Upon the introduction of commodity derivatives, industrial corporations are typically the first to react, while financial institutions may also be within the early adopters to deal with client risk. Among non-financial corporations, there is a non-negligible share of ex-ante non-hedgers and the rest of companies has prior experience with derivatives.[6] The CME also delists some commodity derivatives when the trading volume does not allow to cover operating costs or due to regulatory changes in the market.

Commodity Prices and Sample Construction

Mayhew and Mihov (2004) suggest higher expected commodity price volatility as one reason why exchanges introduce new options and derivatives. We collect daily or weekly commodity prices of each of the underlying commodities of interest for our analysis. These prices pretend to represent the market-closing prices for spot commodities used by the settlement committees of the CME

[6] The CME suggests that around 25% of the customers involved in introductions had no prior experience with derivatives.

in marking-to-market futures contracts on the commodities. Specifically, we collect weekly butter prices from the United States Department of Agriculture; daily pork belly from EIKON; daily dry whey (Class III Milk) from EIKON; daily benzene data (unleaded gasoline) from the Federal Reserve Economic Data (FRED) and daily ethanol data from FRED.

Figure A1 in the Appendix reports the introductions and delistings of the various commodity derivatives, alongside the price of the commodity itself. In each panel of the figure, we report the price for each commodity (butter, pork belly, whey, benzene and ethanol). The figures do not reveal a clear pattern that links the timing of the introductions and delistings to the time series of the commodity prices.

To construct the sample for our σ-DID, we start with U.S. firms traded on the AMEX, NASDAQ, and NYSE, and covered by Compustat annual database, and CRSP. We construct the arithmetic returns of the stock using the end-of-day closing price. We define the pre-treatment period as 2 months (44 trading days) before the date of the event at the CME. As for the post-treatment periods, we consider 1-6 months, both monthly and cumulative. Observations that lie outside the above ranges are dropped. We require at least one observation in the pre- and post-treatment period to avoid attrition. Note that in our empirical implementation we focus on a monthly scale rather than a narrower one in order to avoid capturing short lived variance reactions that are less interesting from an economic standpoint.[7] We further merge all the commodity price data. We also drop any firm-observation which does not belong to either the treatment or control groups later defined.

Finally, we construct the following firm characteristics using Compustat annual data: size is computed an the log of total assets (Compustat item 6); total debt is computed as debt in current liabilities (item 34) plus long-term debt (item 9); market value of equity is computed as stock price (item 199) times common shares used to calculate earnings per share (item 54); market-to-book is computed as market value of equity plus total debt plus preferred stock liquidating value (item 10) minus deferred taxes and investment tax credit (item 35), all divided by total assets (item 6); profitability is computed as operating income before depreciation (item 13) divided by total assets (item 6); book leverage is computed as total debt divided by total assets (item 6); cash holdings are computed as cash (item 1) over total assets (item 6), and investment is computed as capital expenditures (item 128) over total assets (item 6). Finally, we construct a credit line variable by

[7] We have also looked at alternative definitions for the post-treatment period including: weekly and monthly intervals up to a year. However, the choice of the pre- and post-treatment periods does not substantially alter the main conclusions from the analysis.

means of Capital IQ annual data. After merging the Capital IQ database with the Compustat database, we define undrawn credit lines as undrawn credit divided by total assets (item 6) in Compustat.[8]

Text Search Algorithm

All publicly listed firms in the U.S. are required by law to file material information electronically with the SEC. The SEC handles the electronic filing through the Electronic Data Gathering, Analysis, and Retrieval system (EDGAR). The primary purpose of EDGAR is to allow investors timely access to price relevant corporate information.

We develop a text-search algorithm in order to identify which firms have exposure to variability in the prices of specific commodities (*Exposure*) and a dummy variable capturing firm-year observations using derivatives for hedging purposes (*Dummy Hedge*). Then, we search for specific keywords in all available 10-K, 10-KT, 10-K405, 10KSB, and 10KSB40 filed in the SEC's EDGAR system. When a match is found, we manually read the surrounding text and discard false positives. A firm or firm-year observation that does not contain any of the keywords of interest, or for which the match cannot be validated with any neighboring word, is treated as a non user (commodity or hedging instruments). More precisely, we use the text-search algorithm to generate the following variables:

- *Exposure:* we generate dummy variables identifying firm observations with ex-ante exposure to commodity price risk (butter, pork belly, whey, benzene and ethanol). By ex-ante we mean firms that are exposed to the commodity prior to the introduction by the CME.[9]

- *Dummy Hedge:* we generate a dummy variable identifying firm-year observations using derivatives for hedging purposes as in FAS 133 (and consistent with prior literature: Bartram (2019), Allayannis and Weston (2001), Graham and Rogers (2002)).

The specific text search procedure is described in Table A3 in the Appendix, while we also report additional examples as the ones that follow in Appendix A2. For example, for the case of exposure to benzene we find:

> *"The primary raw materials for polyurethane chemicals are benzene and po. Benzene is a widely-available commodity that is the primary feedstock for the production of*

[8] Although the SEC mandated electronic submission of SEC filings in 1996, the coverage by Capital IQ is comprehensive only from 2002 onward.

[9] We generate similar variables for delisting cases.

MDI. Approximately one-third of the raw material costs of MDI is attributable to the cost of benzene".

An example for the case of butter is:

"Ben&Jerry's ice cream has a high level of butter fat and low level of air incorporation. The fat content of the ice cream is derived primarily from butter fat in the cream and secondarily from egg yolks".

Treatment and Control Groups

Once we have the commodity exposure dummies and the dummy for hedging matched to the CRSP sample of daily returns, we construct the treatment and control groups. The treatment group is based on the dummy variable for the exposure to a specific commodity described in the previous subsection ($Treated = Exposure$). For the construction of the control group, we integrate two strategies. We build on existing evidence in the literature suggesting that hedging is industry-specific and thus, the optimal comparison of the decisions of hedging firms is possible when looking at similar firms operating within the same industry (Rampini et al. (2014), Bakke et al. (2016), Tufano (1996)). As a result, first, we investigate if there is a natural substitute for the commodity of interest, such as margarine for butter ($Control = Substitutes$). If yes, we construct a text search algorithm as the one described above and search for the substitute (margarine, ghee). Second, we identify the sectors that are related to the industries of interest, but are not directly exposed to the introduction of the derivative with SIC/NAICS industry codes ($Control = Related\ Industries$).[10] To summarize, given $I_{gt} = Treat_{ig} * I_t$, then,

$$Treat_{ig} = \begin{cases} Exposure_{ig} & \{g = 1 \text{ and } \forall t\} \\ Substitutes_{ig} \bigcup Related\ Industries_{ig} & \{g = 0 \text{ and } \forall t\} \end{cases}.$$

Table A4 in the Appendix provides a detailed treatment and control group creation strategy, while Table A5 in the Appendix contains the final outcome in terms of SIC/NAICS industry codes for the baseline analysis and for the robustness checks.

[10] We also search the CMEGroup's Education Services for dependents. We denote as dependents supply and demand factors related to the commodity of interest and other commodities intrinsically related (e.g., porkbelly-pork or whey-milk serum). When a dependent commodity is found, we construct a text search algorithm as the one described above and search for the dependent in the 10-K reports. We assign those firm-observations to the treatment group ($Treat = Dependents$).

Table 1 reports key firm characteristics for each of the treatment and control groups for the case of introductions, across the five commodity derivatives used in the analysis. For each variable, we include the difference between the means of the treatment and control groups and the associated p-values. For example, in the case of butter there are 45 firms in the treatment group and 26 in the control group. The two sets are not statistically different along four of the five dimensions reported in the table (market to book, size, book leverage, hedging dummy) and differ at the 10% level in terms of profitability. Given these results, we assume throughout the paper that our treatment and control groups are comparable conditional on our set of covariates.

<u>Table 1 About Here</u>

We further test for the parallel trends assumption to ensure the internal validity of our σ-DID model. In theory, it requires that in the absence of treatment, the difference between the treatment and control groups is constant over time. Visual inspection is generally useful with an annual panel of data. However, in our empirical strategy we use high-frequency data and thus, visual inspection does not allow to conclude anything about the pre-trends. Therefore, our setup requires analyzing the pre-treatment properties of idiosyncratic volatility further. We use a moving average smoothing technique to construct two new series (one for the treatment and one for the control) in which each observation is an average of the 10 nearby observations of the original idiosyncratic volatility of stock returns daily series.

Figures 1 and 2 show our parallel trends test results for the introduction and delisting cases for 3 months of pre-treatment and 4 weeks of post-treatment. As we can observe, the trends for treatment and control in all introduction and delisting cases are parallel. Moreover, in the robustness checks we will perform some anticipation or placebo tests by artificially moving the date of the introduction to one and two months earlier to test for whether we observe any effects. This allows us to shed more light on the parallel trends assumption with an empirical test (Angrist and Krueger (1999)).

<u>Figure 1 About Here</u>

Figure 2 About Here

4 Empirical Analysis

We start our empirical analysis by following the approach outlined in Section 2. We first run the regression in equation (6) and then the regression in equation (3) after replacing y_{igt} with the squared residual of the first step. With this specification, we control for the time-varying firm-specific exposure to the market factor in addition to controlling for the average market conditions by including day fixed effects. We carry out the exercise for all five commodities across different time horizons. The set of controls includes the following firm characteristics: book leverage, size, profitability, market to book and a dummy for hedging. Additionally, we include firm fixed effects, to capture potentially unobservable heterogeneity across firms. Errors are clustered at the firm level.

Table 2 contains the main results of our analysis. It shows that following the introduction of the derivatives at the CME the idiosyncratic variance of stock returns for the treatment group declines relatively more than for the control group. The first row of the table reports the ATE on the variance of butter users, respectively for the first month (column 1), the second month (column 2), up to six months after the introduction (column 6). In each of the months after the event the variance of the butter users (treatment group) declines relatively more than the corresponding control group. Rows 3, 5, 7 and 9 report a similar picture for pork belly, whey, benzene and ethanol. Across the various commodities and horizons, the effect is almost always negative and significant.

Table 2 About Here

The even rows of the table (rows 2, 4, 6, 8, 10) report the cumulative ATE over different time horizons, respectively one month (column 1), two months (column 2), up to six months after the event (column 6). The cumulative effect is generally negative and significant, and in almost all cases it peaks between three and four months and then declines. The only exception is whey, in which case the cumulative effect is highest in months five and six. We provide the intuition behind the difference between monthly and cumulative results in Appendix A3.

The main message that emerges from Table 2 is that the introduction of the commodity derivatives at the CME has led to a relatively larger drop in the variance of the treatment group than for the control group and that such effect is persistent over time. Moreover, to the extent that we are controlling for the market factor, the results suggest that the decrease in risk for firms exposed is concentrated on the idiosyncratic component of the volatility of stock returns. For robustness, we also report the estimation results for equations (5) and (3) in Table A6 in the Appendix.[11] The ATE is also negative and significant for most commodities and horizons. Comparing the findings with those in Table 2, we see they are very similar in magnitude.

Economic Significance

Next, we assess the economic significance of this result. Table 3 reports the estimates for the cumulative monthly impact of the introduction of commodity derivatives on the treatment group in terms of mean variance. We compute the estimate for the variance by dividing the estimate for the ATE (δ_σ) in equation (6) by the average variance of the sample of the period including both, pre- and post-treatment periods in equation (3). This ratio can then be interpreted as the variance increase or reduction caused by the intervention relative to the average variance of the firms in the panel. This can be considered as a measure of the economic significance of the ATE.

TABLE 3 ABOUT HERE

For the case of butter, the variance of the returns of the treatment group, as a percentage of the average variance, dropped by 3.17% in the first month, by 18.59% cumulatively over the first two months, and by 27.22% over the first three months. The cumulative effect begins to decrease over the fourth, fifth and sixth month, but it is still above 20% after six months, thus showing remarkable persistence over time. In the case of pork belly, the effect is even stronger, reaching a cumulative value of 39.67% at the third month, and remaining as strong as 36.39% at the sixth month. For the case of whey, the effect is even more persistent than for the other commodities, as it reaches

[11]The first-stage results are reported in Table A7 in the Appendix, which contains the ATE captured by δ_α in equation (5). As the specification controls for firm and time fixed effects, as well as a set of firm characteristics (market-to-book, size, profitability, book leverage and dummy hedge), δ_α captures the effect that the introduction of the commodity derivatives has on the stock returns of the treatment group vis-a-vis the control group.

its highest value in the sixth month at 28.51%. For benzene, the effect is strongest in the second month with a value of 22.38%. The effect is relatively weaker for ethanol, which reaches a peak of 7.77% in the second month and then declines in the following months. The main conclusion from Table 3 is that the effect of the introduction of the commodity derivatives is economically very significant. In most cases, the ATE on the idiosyncratic variance of the treatment group represents a large share of the average variance of the period of observation.[12]

Heterogeneity in Results

The results in Tables 2 and 3 suggest that the effects are strongest for butter, pork belly and whey, and weaker for benzene and ethanol. We offer several possible explanations for the heterogeneity in results. The first possibility is the frequency of the grids defined for the estimation windows. In Table A9 in the Appendix, we examine finer grids and find that results are significant for benzene and ethanol using weekly grids. Benzene shows a highly negative and statistically significant coefficient in ATE w3 (column 3), while ethanol shows it in ATE w1 (column 1) (significant at 1%). That is, non-financial corporations with ex-ante exposure to benzene and ethanol reacted very early after the introduction. What the weekly grid analysis suggests is that a non-statistically significant ATE in a specific month may hide highly statistically significant coefficients in the weekly grid that washes out with aggregation.

Second, the heterogeneity of results reported in Table 2 might be related to the liquidity of the derivative. In Table A2 in the Appendix, we provide information on the institutional background of each listing by the CME. Panel b) provides information on cross-hedge alternatives for each listing. Listing decisions by the CME are generally associated with an active underlying in the OTC market to ensure liquidity. In some cases, however, although the ex-ante expectation of liquidity is high, the contracts show very low trading volume ex-post. The low liquidity may be due to the existence of more effective hedging instruments that were available to firms at that time (OTC or exchange-traded).[13]

Third, hedging effectiveness, which is measured by the correlation between the movements in the price of the commodity and the movements in the corresponding derivative, may also be the cause behind part of the heterogeneity in the results. By construction when a hedge is effective, it reduces

[12] The economic significance of the results of Table A6 in the Appendix is reported in Table A8 in the Appendix.

[13] According to private conversations with the CME, in the case of benzene, the presence of unleaded gasoline contracts (cross-hedge at the CME) was the likely reason why benzene contracts were never very liquid (despite their higher effectiveness for some firms). For the case of ethanol, the existence of a similar product at the CBOT (where grains and seeds have been traditionally traded) was possibly a reason why ethanol never took off.

the volatility of cashflows. However, when the hedge has an ineffective component, additional volatility in the cashflows of the firm may be created by engaging in derivative transactions (Gilje and Taillard (2017)). We provide analysis on liquidity and effectiveness considerations later in the section. Last, for the case of ethanol the phenomenon of "financialization of commodities" may have played a role (Brogaard et al. (2019), Basak and Pavlova (2016)). Starting in 2004, investors entered the commodity futures markets and this led to distortions in the price of the underlying commodities.

A final remark is in order regarding the results in Tables 2 and 3. The results are consistent with the idea of derivatives being used for the elimination of costly lower-tail outcomes or catastrophic events which is generally associated with selective hedging (Servaes et al. (2009), Adam and Fernando (2006)). As long as managers' view on the evolution of specific commodities and the positions taken as a result do not interfere with hedge accounting, selective hedging can lead to a reduction in the idiosyncratic volatility of stock returns. Similarly, our results are consistent with the traditional view of derivatives being used for variance minimization purposes, which is consistent with pure hedging (Bartram (2019), Stulz (1996)).

Delisting of Commodity Derivatives

Next, we investigate the effect that the delisting of derivatives has on the variance of stock returns. In our sample, we identify four relevant delisting events: butter, pork belly, benzene and ethanol.

The definitions of treatment and control discussed above in Section 3 for the case of introductions also apply to the case of delistings, the only difference being that for delistings we restrict our analysis of the treatment group to firms that ex-ante hedge. More precisely, for the treatment we impose the additional requirement that at the time of the delisting the firm included in the analysis are using derivatives to hedge risk ($Dummy\,Hedge = 1$). This choice is motivated by the fact that firms affected by the delisting of a specific commodity are already hedgers at the pre-treatment period.

Our main set of results for delistings are reported in Table 4. Across time horizons and commodities, a delisting is associated with a positive effect on variance. The effect is relatively stronger in terms of significance for the cases of butter, benzene and ethanol. It is positive but generally not significant for the case of pork belly.[14]

TABLE 4 ABOUT HERE

Two comments are in order before switching to the discussion of the mechanism behind the observed results. These comments are related to the comparison of the results in Tables 2 and 4 and the overall heterogeneity of the results. First, note that the results on delistings cannot be directly compared against those on introductions. While the ATE of introductions captures both the intensive and extensive margin, the ATE of delistings only captures the extensive margin associated with ending the use of the derivative. Second, the heterogeneity we observe in the results is also driven by the availability of cross-hedges upon delistings and the timing of the substitutions to OTC or other exchange-traded alternatives. For instance, in the case of pork belly, substitution to frozen pork belly CME derivatives constitutes an almost perfect substitute. This may be the reason why we do not observe a persistent effect in the increase in idiosyncratic volatility. However, for the rest of our delisting cases the substitution may be more difficult. The extent to which firms can accommodate the transition will act as a modulator of the effect on idiosyncratic volatility. In the extreme case of firms not being able to find cross-hedge products, the effect will be larger and more persistent.

Volatility of Quarterly Cashflows

Our σ-DID methodology relies on assumptions that link our idiosyncratic risk variable with the volatility of cashflows. Unfortunately, a simple DID procedure on an annual panel of the volatility of quarterly cashflows (and returns) is less desirable from an econometric point of view in the context of our empirical setup.[15] Nevertheless, estimating the results for cashflow volatility is important as the fact that hedging leads to cashflow smoothing does not necessarily imply smoothing stock returns.

We evaluate the possible mechanisms behind our observed results with the analysis in Table

[14] In unreported analysis, we also examine the effect of delistings on variance without controlling for exposure to the market factor. Similarly to what happens for introductions, the size and significance of the coefficients of the ATE are similar to the ones reported in Table 4.

[15] Note that when analyzing each event, we drop all Compustat firm-year observations which are neither part of the treated and control firms nor part of the pre- and post-treatment period. As a result, a low number of firm-year observations in the event may lead to low power in any analysis undertaken with an annual panel.

5, where we estimate the ATE of the introduction and delisting of commodity derivatives in the CME with an annual panel of Compustat data, using the previous 4 and 8 quarters to compute the rolling standard deviation of cashflows and stock returns. The pre-treatment period considers two fiscal years, while the post-treatment period includes one fiscal year after the introduction/delisting date. We pool the data from the different events assuming independence to avoid degrees of freedom issues, but we report the individual commodity listing/delisting results in Table A10 in the Appendix. We further include commodity, firm and year fixed effects to control for unobserved heterogeneity across events, firms and time. Panel a) shows the results for introductions of commodity derivatives by the CME, while panel b) shows the effect of derivative delistings.

TABLE 5 ABOUT HERE

The results are negative (positive) and statistically significant for the 4 quarters and 8 quarters estimations of the rolling standard deviation of stock returns and cashflows for derivative introductions (delistings) in the CME. This result is the first suggestive evidence we provide to support the idea that engaging in hedging for firms with ex-ante exposure has an impact on firm fundamentals. These results imply that even if firms facing no material exposure to commodity price risk can potentially benefit from the introduction of the commodity derivative by the CME (as the industry can be considered overall less risky), we still observe a decrease in the volatility of cashflows, which can only be achieved when firms engage in hedging.

Real Effects of Hedging

Next, we deepen the analysis on the relation between the introduction of the derivatives and a set of corporate accounting variables. More precisely, we consider the time series of accounting data for two years before the introduction and one year after the introduction, for all the firms in the treated and control group.[16] We run a regression in which different accounting variables (specifically, cost of goods sold, ebitda over sales, cash holdings over total assets, book leverage, undrawn credit lines, and investments over total assets) are regressed on a set of controls (cash flows over total assets, market to book, book leverage, size and hedging dummy) and on a dummy

[16] For the case of the hedging variable (*Dummy Hedging*), we focus on a pre-treatment and post-treatment period of one year to avoid confounding factors unrelated to the introduction of the commodity derivative in terms of hedging.

for being in the treatment group after the introduction. The regressions include commodity type, time and firm fixed effects. Errors are clustered at a firm level.

The results are reported in Table 6. Starting from the first column of the table, we observe the marginal effect of the introduction of the derivatives on the probability of hedging (extensive margin) from a probit model. The marginal effect coefficient is 0.123, which means that the introduction of the derivatives corresponds to a 56% higher probability of initiation of hedging for firms in the treatment group as compared to the control group.

In the other columns of the table, we see that the introduction of the derivatives is associated with relatively lower costs of goods sold over sales, and higher ebitda over sales for the firms in the treatment group. Both these variables suggest that firms in the treatment group can increase their gross margins due to improved access to commodity derivatives. In particular, as the gross margin improves thanks to a lower cost of good sold or higher sales, these results suggest that access to commodity derivatives allows firms to improve their cost structure.[17] At the same time, treated firms reduce their cash holdings and increase undrawn credit, leverage and investment. The reduction in cash holdings and the increase in undrawn credit lines is particularly telling because it suggests that the need for precautionary cash drops and credit lines free up as a result of better hedging of costs, consistent with the results in Disatnik et al. (2013) that firms that hedge have a lower need to hold precautionary cash. Investment is the flip side of this effect, as more resources can be freed from precautionary cash, treated firms can invest more.

Table 6 About Here

Table A11 in the Appendix examines the economic significance of the ATE of introductions for the accounting variables reported in Table 6. We observe that the introduction of the derivatives reduces the cost of goods sold over sales by 3.24% and increases Ebitda over sales by 5,26%. Firms in the treatment group decrease cash holdings by 1,15%. In terms of credit lines, we observe a 1,86% increase in undrawn credit lines. In terms of financing and investment decisions of firms, hedging increases the reliance on external debt financing by 1,71%, and increases investment by 0,54%.

[17]Both the lower cost of goods sold and the higher sales are consistent with input and output hedging in the spirit of Mackay and Moeller (2007).

Liquidity Vs. Effectiveness

Results in Table 2 show that after the introduction of the commodity derivatives in the CME, the idiosyncratic variance of stock returns decreases. Nevertheless, these results are silent about whether firms change their behavior after the listing of derivatives contracts. In order to further clarify how firms adjust their risk management decisions after the introduction of the derivatives in the CME, next, we evaluate the role of liquidity and effectiveness.

First, we investigate the role of liquidity by analyzing whether the reduction in the idiosyncratic risk component observed in Table 2 is driven by the extensive and/or intensive margin of hedging.[18] That is, we analyze whether most of the variation that we observe in the idiosyncratic variance comes from firms initiating hedging (extensive margin) as reported on Table 6, or from firms that substitute from OTC derivatives or other exchange-traded derivatives to the new CME derivatives once they are introduced (intensive margin), as evidence in Almeida et al. (2017) suggests. That is, firms switching to CME alternatives due to liquidity considerations. Appendix A4 provides the details of the empirical specification we are using.

Our parameter of interest is δ_σ, which captures the effect in terms of the extensive margin (hedging initiations). The results of our analysis are reported in Table 7. To understand these results, we need to compare them with the results of Table 2, which does not distinguish between the two margins. The table reports negative and statistically significant results for butter, pork belly and ethanol within the first 22 days of trading. We also observe the effects of hedging initiation activity within the second month for pork belly, benzene and ethanol (ATE m2). The comparison of the results with those from Table 2 suggests that most of the variation in idiosyncratic volatility comes from the intensive margin. That is, from firms that were already hedging through either OTC contracts or other exchange-traded derivatives written on the same underlying asset. This is the case because there is little effect associated with the extensive margin.

TABLE 7 ABOUT HERE

Second, an important assumption throughout the analysis we have performed so far is that there is no distinction between effective and ineffective hedges. Effectiveness is measured by the correlation

[18] Liquidity is extremely important in futures and options trading. Market participants tend to prefer less effective contracts offering high liquidity as opposed to highly effective new contracts that are less liquid.

between movements in the price of the commodity and those of the derivative. Ineffectiveness may contribute to additional volatility in firms' cashflows (above and beyond the volatility in cashflows driven by commodity price risk). Theoretically, our cashflow smoothing result in Table 5 is compatible with effective hedging and some degree of ineffective hedging. However, the differential impact of the listings on idiosyncratic volatility may also depend on the degree of hedge effectiveness. That is, hedge effectiveness is the mechanism through which the hedging decision affects ex-post exposure for firms facing material exposure to commodity price risk ex-ante.[19]

In order to examine whether hedge effectiveness may affect the results, we exploit the adoption of FAS 133 (which became effective in 2001) to evaluate whether the reduction in idiosyncratic volatility observed in Table 2, is driven mostly by the firms in the treatment group that hold more effective hedging contracts (versus ineffective hedges or speculative trades).[20] Because FAS 133 reporting was introduced fairly late in our sample, we can only carry out the test for the benzene and ethanol contracts, as they were introduced after the adoption of FAS 133.

We provide additional evidence on the empirical specification in Appendix A5. In Table 8, we run a specification similar to the one reported in Table 2, explicitly accounting for effective and ineffective hedges. For the case of benzene and ethanol, we find that the drop in the variance is driven by effective hedgers.

TABLE 8 ABOUT HERE

Controlling for the Commodity Factor (Tufano (1998))

Our results in the previous section suggest that the main action in driven firms already involved in hedging that choose effective hedges when the CME contracts become available. However, in order to connect ex-ante exposure, with hedging decisions and changes in corporate policy decisions, we still need to show that firms experience a reduction in ex-post exposure. In order to do so, we consider a version of our σ-DID in which we additionally control for exposure to commodity prices

[19]Figure 7 in Servaes et al. (2009) precisely shows the implications of hedge effectiveness in reducing ex-post exposure across different commodities. Additionally, Gilje and Taillard (2017) analyze whether and how hedge effectiveness has real effects on investment.

[20]Under FAS 133, *"Accounting for Derivative Instruments and Hedging Activities"* (issued 6/98), an entity that elects to apply hedge accounting is required to establish at the inception of the hedge the method it will use for assessing the effectiveness of the hedging derivative and the measurement approach for determining the ineffective aspect of the hedge. The effectiveness of hedge depends on the correlation between changes in the fair value of the derivative and the item being hedge. Any ineffective portion of the hedging relation or a derivative not designated as a hedging instrument (speculation), the gain or loss is recognized in earnings in the period of change.

in the spirit of Tufano (1998).

The motivation behind this additional piece of analysis is testing whether the observed reduction in the idiosyncratic risk component in Table 2 is coming from a change in the relevant exposure to the commodity or there are other channels operating. Specifically, we consider the specification comprising of (7) in the first stage, and then run equation (3) in the second stage, where y_{igt} is replaced with the squared residual of the first stage regression. Our results are reported in Table 9, in which we display the ATE associated with the introduction of the derivatives on the various commodities, over different time horizons controlling for the market and commodity factors. We report the estimated coefficients for both, the first and second stages.

Table 9 About Here

The first stage reports the δ_{β_c} coefficient, which measures the change in the sensitivity (exposure with respect to changes in the price of the commodity) after the introduction of the commodity derivative by the CME for firms in the treatment group as compared to the control. We observe that the introduction reduces the exposure to changes in commodity prices for the firms in the treatment group for at least one period. In particular, the effect is stronger for pork belly and whey and weaker for benzene and ethanol.

When we look at the results from the second stage, we see that the ATE is negative and significant for most commodities and horizons and results are in line with the ones reported in Table 2. These results suggests that the reduction in idiosyncratic risk following a derivatives introduction is not solely explained by a reduction in the exposure to commodity prices, but, possibly, by a change in other corporate policies, such as investment.[21] The main takeaway from this table is that after controlling for the exposure to the commodity price, the impact on the idiosyncratic variance is still significant.

5 Robustness Tests

We carry out a set of robustness tests related to the findings of the previous sections. First, we investigate whether the introductions and delistings have been anticipated by the market. Second, we define an alternative control group and re-do the analysis in Table 2. Third, we run a set of

[21] These results are also consistent with evidence reported in Table 6.

pooled idiosyncratic volatility of stock returns regressions for introductions. Fourth, we examine the correlation between the variance of the individual commodities and the VIX.

Placebo Tests and Anticipation Effects

The first robustness check is related to possible anticipation effects and the parallel trends assumption discussed in Figure 1. If market participants are aware of the listing dates, it is possible that the effects of the derivative on variance could be factored in before the event date. Different mechanisms may drive the presence or lack of anticipation effects. If the variance reduction is determined by the availability of the hedging instrument, then no effect should be observed until the hedging instrument is available. If the variance reduction is determined by the fact that markets perceive firms as less risky in the future, then, there could be an anticipation in the reduction in the idiosyncratic variance. Arguably, the effect of an anticipation should be reflected mainly in a bias of the coefficients of the ATE towards zero, and thus generate less significant results than otherwise.

We examine the potential presence of anticipation effects by running the σ-DID approach on the variance of stock returns over different horizons preceding the introduction of the derivative in the CME. This test can also be considered an empirical test for whether the parallel trends assumptions holds or there are effects prior to derivative listings (Angrist and Krueger (1999)). More precisely, in Table A12 in the Appendix panel a) reports the effect when the listing date is moved to 2 months before the actual listing date, while panel b) shows the effect for a month before the actual introduction, and across all five commodities. Our results show that with the exception of two cases, the coefficient of the ATE is not statistically significant. Overall, the conclusions that we draw from the evidence reported in Table A12 in the Appendix are that the events were not anticipated by the market.

Alternative Control Group

We now allow for a different definition of the control group and test whether our results are significantly affected. In our alternative definition, the control group is defined as the smallest set of firms forming an industry group (SIC codes only) which is a direct substitute for our commodity (Steps 2.1 and 2.2. in Table A4 in the Appendix). We obtain this by looking at the most frequent hits in the search for *keyword uses* (Step 3.1 in Table A4 in the Appendix). More details on the exact definition for the alternative control group are reported in Table A5 in the Appendix under column *Alternative CG?*.

We run the same specification as the one reported in Table 2, using the alternative definition of the control group. Our results are reported in Table A13 in the Appendix. The results are qualitatively similar to those obtained with the original definition of the control group.

Pooled Regressions

Next, we investigate the ATE associated with introductions in a pooled regression, in which all the events are included in the same specification. Our results are reported in Table A14 in the Appendix. The pooled regressions reinforce the findings of Table 2 by showing that there is a significant and large ATE associated with the introduction of the derivatives. The variance of the treatment group drops significantly more than the control across all horizons. The coefficient is fairly stable over time, ranging between 3.57 and 5.49, which is in line with results from Table 2.

VIX Index and the Variance of Commodity Prices

Our identification approach is designed to eliminate the effect of common factors such as the overall variance of the stock market index or the commodity factor. Nevertheless, it is interesting to examine how the different events relate to a measure of market variance such as the Chicago Board Options Exchange (CBOE) variance index (VIX).

In Figure 3 we report the time series of the VIX index, along with the introductions and delistings events. The introductions of the various derivatives are spread across the sixteen years that span from 1996 to 2011. During this time the VIX experiences significant variations, starting below 20 in the early years, then averaging above 20 for the central years, with peaks up to 40, and then reverting back to below 20 in the later years of the decade. The introductions of the derivatives occur both at times of low and high VIX. Overall, no clear pattern emerges from the figure. We investigate this further in Table A15 in the Appendix, which reports the correlations between the variance of prices of the individual commodities and the VIX, as well as the respective correlations between the commodities. While some of the correlations are high between certain commodities, like benzene and ethanol, the correlations between the commodities and the VIX are generally relatively low, thus confirming the conclusions obtained from the visual inspection of Figure 3.

Figure 3 About Here

In Figure A2 in the Appendix, we also report the time series of the variance of the five commodities and the dates of the introduction and delisting (when available). In the case of butter and pork belly it emerges that the introduction of the derivatives followed a period of increased variance in the price of the commodity. In the case of butter, the times series of the variance shows significant variation over the period that follows the introduction. In the case of pork belly, there is a sharp drop in variance some time after the introduction, and then variance remains low at the time of the delisting and for a long time after. In the case of benzene, the introduction happens after a long period of low variance and is followed by a similar period of low variance. For the case of ethanol, variance is low before the introduction and increases to some extent in the years after the introduction. Overall, the figure seems to show a different picture for each commodity, which seems hard to reconcile with a specific relation between the timing of the introduction and a pattern in the variance of the commodity.

One final remark is in order. Although we have performed several robustness checks to show the validity of our results, we also acknowledge that there may be some limitations in the analysis. More precisely, lobbying efforts by firms, alternative channels other than cashflow volatility affecting stock return behavior or selection in treatment and control groups may impact our results.

Lobbying, for instance, is an important channel by which corporations influence policy or decision-taking by stakeholders to earn value effects.[22] Firms in our events could lobby to exert pressure over the CME to list these instruments.[23] As a result, they could alter corporate policy decisions before the derivatives are introduced. This in turn, could have an impact on stock returns which is independent from the effect that arises through hedging. Moreover, there are significant differences between the characteristics of lobbying and non-lobbying firms. Specifically, firm size is an important factor driving both hedging decisions and the extent to which a firm engages in lobbying.

Ex-ante differences in lobbying expenditures, other omitted or confounding firm characteristics, or economic events surrounding the listing/delisting process not being absorbed by our fixed effects (e.g., same effect on treatment and control firms) could also affect our results, by introducing a selection/omitted variable bias in our observed response of hedging. That is, an under or overestimation of the effect of treatment. Nevertheless, we are confident on the internal and external validity of our results given the assignment of treatment conditional on observed covariates, the

[22]E.g., See Faccio (2006), Faccio and Parsley (2009), Acemoglu et al. (2016) or Fisman (2001) among others.

[23]There is vast evidence on the role of lobbying coalitions in the energy sector on trying to influence policy decisions (Kang (2016)).

saturation of our empirical specifications with various fixed effects, the different tests performed to rule our alternative explanations and the battery of robustness checks included.

6 Conclusions

In this paper, we examine whether corporate risk management affects the variance of stock returns. We use the introduction of new derivative contracts (futures and options) in the CME as a shock to the cost of hedging for corporations. We consider five different commodities (butter, pork belly, whey, benzene and ethanol) whose derivatives began trading between 1996 and 2005, and examine the change in stock return variance of firms that are exposed to the commodity following the introduction of the derivative. We also look at the effect of derivative delistings to learn whether there is a reversal of treatment of the results.

We use our σ-DID to examine the change in variance of stock returns in a DID setting. In order to construct the treatment and control groups, we use textual analysis to identify a set of firms that are exposed to the price risk of a specific commodity or are are substitutes of the commodity of interest. By accounting for firm- and time-fixed effects and for the time-varying exposure of firms to the aggregate changes in variance, we can focus our analysis on the idiosyncratic variance of stock returns.

We find that the introduction of the commodity derivatives leads to a 56% higher probability of initiation of hedging for firms in the treatment group as compared to the control group. After the introduction of the derivatives in the CME, the idiosyncratic variance of stock returns for the treatment group declines relatively more than for the control group. In most cases, the ATE on the idiosyncratic variance of the treatment group represents a large share of the average variance of the period of observation. The effect on the variance is economically significant and in most cases it ranges between 20% and 30% of the average variance of stock returns over the period of observation. The effect is persistent over time: six months after the introduction, we still observe a cumulative ATE between 5.73% and 36.39% of average variance, depending on the commodity. The drop in variance is accompanied by a drop in the volatility of cashflows and a change in real variables, such as cost of goods, profitability, cash holdings and investment. In particular, we observe a drop in costs and in cash holdings, and an increase in profitability and investment. Our findings suggests that firms can increase their profitability and lower their precautionary cash holdings when they have cheaper access to risk management instruments. We also provide evidence on how a higher degree of market completeness alters the liquidity-effectiveness trade-off. The main action in terms of hedging comes from the intensive margin (liquidity) and effective hedging contracts. However, we also observe ineffective hedges associated with lower idiosyncratic volatility. Overall, our results provide novel evidence on firms using derivatives for variance minimization purposes (pure hedging), but also consistent with elimination of costly lower-tail outcomes (selective hedging).

This paper opens new questions and opportunities for research in the field of corporate risk management. We establish a connection between risk management and stock return behavior that is novel, and that bears potentially interesting implications for corporate policies, such as liquidity management and leverage. Additionally, the σ-DID methodology that we develop offers a new approach to study the effects of a relevant event on the second moment of a variable of interest. In this paper, we offer a specific application of this method to the variance of stock returns, but it is potentially applicable also in other settings.

References

Acemoglu, Daron, Simon Johnson, Amir Kermani, James Kwak, and Todd Mitton (2016) 'The value of connections in turbulent times: Evidence from the united states.' *Journal of Financial Economics, 121(2):368-391*

Adam, Tim, and Chitru S. Fernando (2006) 'Hedging, speculation and shareholder value.' *Journal of Financial Economics, 81(2): 283-309*

Allayannis, George, and James P. Weston (2001) 'The use of foreign currency derivatives and firm market value.' *Review of Financial Studies, 14(1): 243-276*

Almeida, Heitor, Kristine Watson Hankins, and Ryan Williams (2017) 'Risk management with supply contracts.' *Review of Financial Studies, 30(12): 4179-4215*

Angrist, Joshua D., and Alan B. Krueger (1999) 'Empirical strategies in labor economics.' *Handbook of Labor Economics, 3 (A): 1277-1366*

Bakke, Tor Erik, Hamed Mahmudia, Chitru S Fernando, and Jesus M Salas (2016) 'The causal effect of option pay on corporate risk management.' *Journal of Financial Economics, 120(3): 623-643*

Bartram, Söhnke M. (2019) 'Corporate hedging and speculation with derivatives.' *Journal of Corporate Finance, 57: 9-34*

Bartram, Söhnke M., Gregory W. Brown, and Jennifer Conrad (2011) 'The effects of derivatives on firm risk and value.' *Journal of Financial and Quantitative Analysis, 46(4): 967-999*

Basak, Suleyman, and Anna Pavlova (2016) 'A model of financialization of commodities.' *Journal of Finance, 71(4): 1511-1556*

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan (2004) 'How much should we trust differences-in-differences estimates?' *Quarterly Journal of Economics, 119(1): 249-275*

Bodnar, Gordon M., Erasmo Giambona, John R. Graham, and Campbell R. Harvey (2018) 'The theory and practice of corporate risk management: Evidence from the field.' *Financial Management, 47(4): 783-832*

Bodnar, Gordon M., Gregory S. Hayt, and Richard C. Marston (1998) 'Wharton survey of financial risk management by U.S. non-financial firms.' *Financial Management, 27(4): 104-114*

Bolton, Patrick, Hui Chen, and Neng Wang (2011) 'A unified theory of Tobin's q, corporate investment, financing, and risk management.' *Journal of Finance, 66(5): 1545-78*

Brandt, Michael W., Alon Brav, John R. Graham, and Alok Kumar (2009) 'The idiosyncratic volatility puzzle: Time trend or speculative episodes?' *Review of Financial Studies, 23(2): 863-899*

Brogaard, Jonathan, Matthew C Ringgenberg, and David Sovich (2019) 'The economic impact of index investing.' *Review of Financial Studies, 32(9): 3461-3499*

Campbell, John, Martin Lettau, Burton Malkiel, and Yexiao Xu (2001) 'Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk.' *Journal of Finance, 56(1): 1-43*

Campello, Murillo, Chen Lin, Yue Ma, and Hong Zou (2011) 'The real and financial implications of corporate hedging.' *Journal of Finance, 66(5): 1615-1647*

Carter, D.A., D.A. Rogers, and B.J. Simkins (2006) 'Hedging and value in the U.S. airline industry.' *Journal of Applied Corporate Finance, 18(4): 21-33*

Comin, Diego, and Thomas Philippon (2006) 'The rise in firm-level volatility: Causes and consequences.' *Vol. 20 of NBER Macroeconomics Annual 2005: 167-228*

Cornaggia, Jess (2013) 'Does risk management matter? Evidence from the U.S. agricultural industry.' *Journal of Financial Economics, 109(2): 419-440*

Culp, Christopher L., and Merton H. Miller (1995) 'Metallgesellschaft and the economics of synthetic storage.' *Journal of Applied Corporate Finance, 9(3): 8-25*

Diebold, Francis X., and Kamil Yilmaz (2014) 'On the network topology of variance decompositions: Measuring the connectedness of financial firms.' *Journal of Econometrics, 182(1): 119-134*

Disatnik, David, Ran Duchin, and Breno Schmidt (2013) 'Cash flow hedging and liquidity choices.' *Review of Finance, 18(2): 715-748*

Engle, Robert F. (1982) 'Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation.' *Econometrica, Journal of the Econometric Society, 50(4): 987-1007*

Faccio, Mara (2006) 'Politically connected firm.' *American Economic Review, 96(1): 369-386*

Faccio, Mara, and David C. Parsley (2009) 'Sudden deaths: Taking stock of geographic ties.' *Journal of Financial and Quantitative Analysis, 44 (3): 683-718*

Fisman, Raymond (2001) 'Estimating the value of political connections.' *American Economic Review, 91(4): 1095-1102*

Froot, Kenneth A., David S. Scharfstein, and Jeremy C. Stein (1993) 'Risk management: Coordinating corporate investment and financing policies.' *Journal of Finance, 48(5): 1629-1658*

Gilje, Erik P, and Jérôme P. Taillard (2017) 'Does hedging affect firm value? Evidence from a natural experiment.' *Review of Financial Studies, 30(12): 4083-4132*

Goyal, Amit, and Pedro Santa-Clara (2003) 'Idiosyncratic risk matters!' *Journal of Finance, 58(3): 975-1007*

Graham, John R., and Daniel A. Rogers (2002) 'Do firms hedge in response to tax incentives?' *Journal of Finance, 57(2): 815-839*

Guay, Wayne R (1999) 'The impact of derivatives on firm risk: An empirical examination of new derivative users.' *Journal of Accounting and Economics, 26(1): 319-351*

Hentschel, Ludger, and Sri Prakash Kothari (2001) 'Are corporations reducing or taking risks with derivatives?' *Journal of Financial and Quantitative Analysis, 36(1): 93-118*

Hoberg, Gerard, and Katie Moon (2017) 'Offshore activities and financial vs. operational hedging.' *Journal of Financial Economics, 125(2): 217-244*

Jin, Yanbo, and Philippe Jorion (2006) 'Firm value and hedging: Evidence from U.S. oil and gas producers.' *Journal of Finance 61(2): 893-919*

Kang, Karam (2016) 'Policy influence and private returns from lobbying in the energy sector.' *Review of Economic Studies, 83(1): 269-305*

Mackay, Peter, and Sara B. Moeller (2007) 'The value of corporate risk management.' *Journal of Finance, 62(3): 1379-1419*

Mayhew, Steward, and Vassil Mihov (2004) 'How do exchanges select stocks for option listing?' *Journal of Finance, 59(1): 447-471*

Pérez-González, Francisco, and Hayong Yun (2013) 'Risk management and firm value: Evidence from weather derivatives.' *Journal of Finance, 68(5): 2143-2176*

Rampini, Adriano A., Amir Sufi, and S. Viswanathan (2014) 'Dynamic risk management.' *Journal of Financial Economics, 111(2): 271-296*

Ross, Stephen (1976) 'The arbitrage theory of capital asset pricing.' *Journal of Economic Theory, 13(3): 341-360*

Servaes, Henri, Ane Tamayo, and Peter Tufano (2009) 'The theory and practice of corporate risk management.' *Journal of Applied Corporate Finance, 21(4): 60-78*

Stulz, René M. (1996) 'Rethinking risk management.' *Journal of Applied Corporate Finance, 9(3): 8-25*

Tufano, Peter (1996) 'Who manages risk? an empirical examination of risk management practices in the gold mining industry.' *Journal of Finance, 51(4): 1097-1137*

_ (1998) 'The determinants of stock price exposure: Financial engineering and the gold mining industry.' *Journal of Finance, 53(3): 1015-1052*

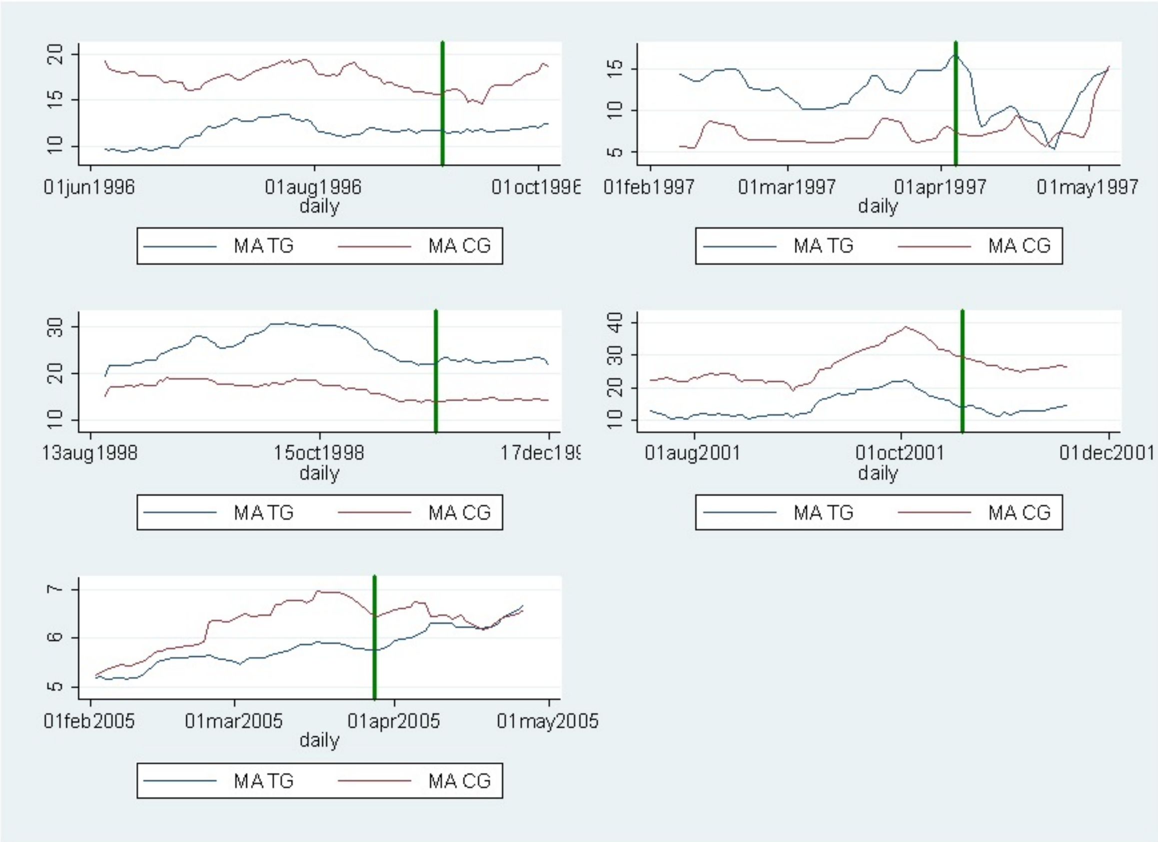

Figure 1: **Parallel Trends Assumption, Derivative Introductions in the CME.** In each panel of the figure, we report the parallel trends for each commodity derivative introduction case by the CME (butter, pork belly, dry whey, benzene and ethanol). The graphs report the outcome of moving average smoothing the idiosyncratic volatility series. That is, each observation is an average of nearby observations in the original series (10 days before and after). In green, we superimpose the date of the introduction of the derivatives in the CME. Table A3 in the Appendix provides information on variables built by means of textual analysis.

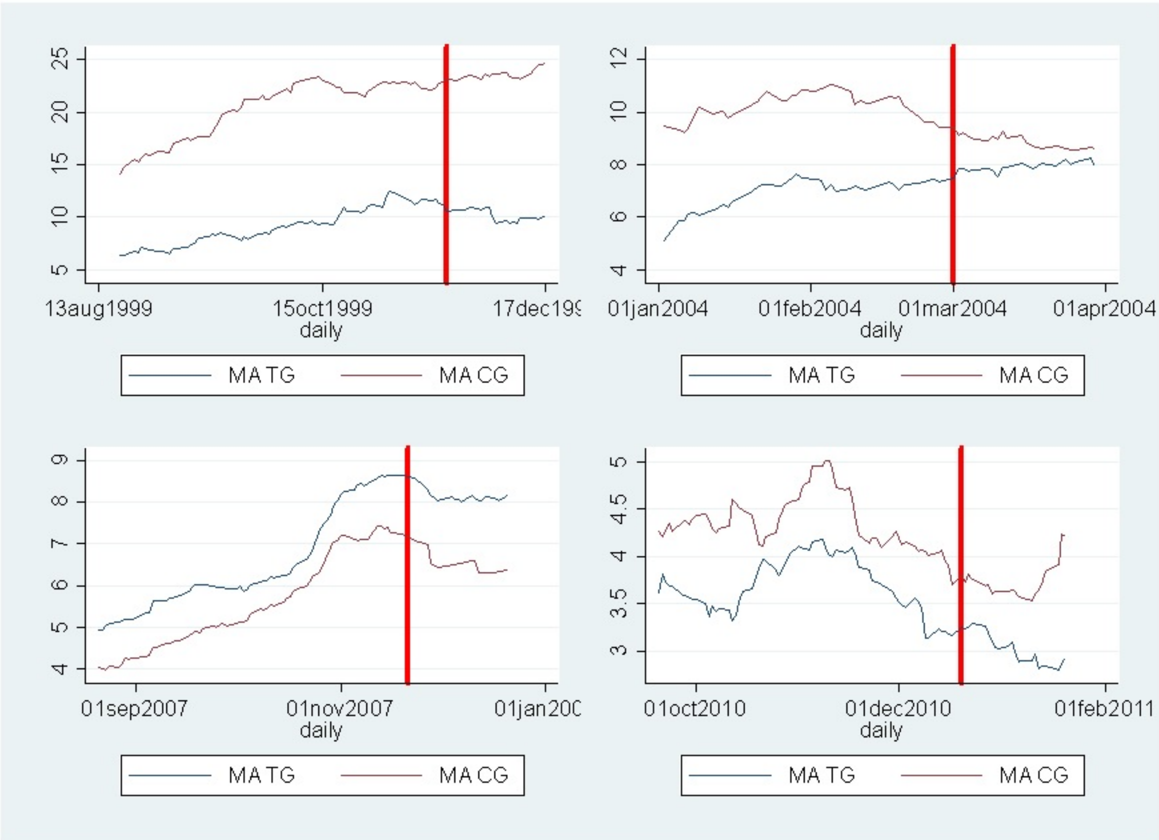

Figure 2: **Parallel Trends Assumption, Derivative Delisting in the CME.** In each panel of the figure, we report the parallel trends for each commodity derivative delisting case by the CME (butter, pork belly, benzene and ethanol). The graphs report the outcome of moving average smoothing the idiosyncratic volatility series. That is, each observation is an average of nearby observations in the original series (10 days before and after). In red, we superimpose the date of the delisting of the derivatives in the CME. Table A3 in the Appendix provides information on variables built by means of textual analysis.

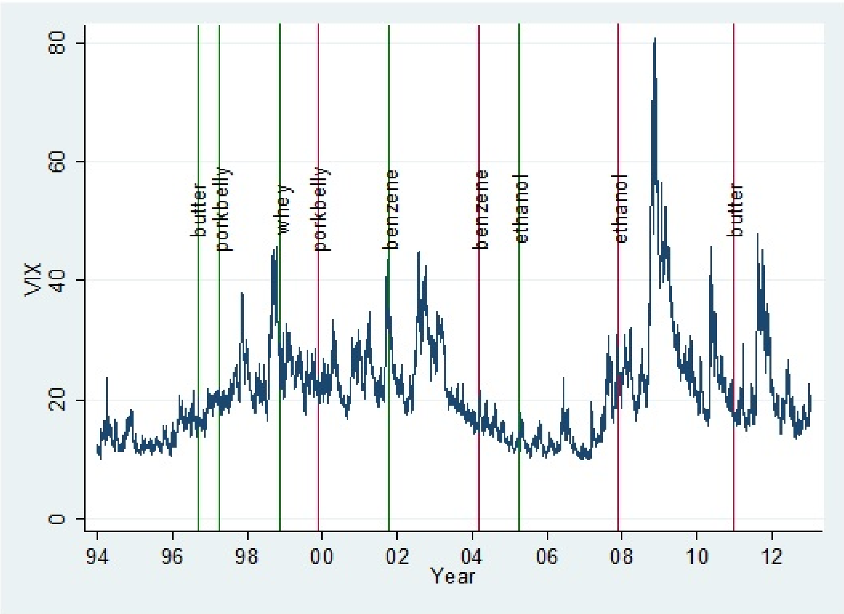

Figure 3: **Introductions and Delistings and the VIX Index.** The figure reports the time series of the VIX index. In green we superimpose the date of the introduction of the derivatives in the CME, while in red we have the date of the delisting (if available).

Table 1: **Summary Statistics for Treatment and Control Groups.** The table reports key firm characteristics for each of the treatment and control groups across the five commodity derivatives used in the analysis. For each variable, we include the difference between the means of the treatment and control groups and the associated p-values. Table A3 in the Appendix provides information on variables built by means of textual analysis.

Panel A: Butter

	Treatment group (TG)			Control group (CG)				
	Mean	Std Dev	Median	Mean	Std Dev	Median	≠(TG-CG)	p-value
Market-to-book	1,399	0,630	1,191	1.247	0.654	1.138	0.152	0.252
Size	5.784	2.381	5.510	4.854	2.482	4.721	0.930	0.121
Profitability	0.134	0.070	0.126	0.015	0.311	0.109	0.119	0.063
Book Leverage	0.305	0.191	0.285	0.304	0.223	0.319	0.001	0.399
Dummy Hedge	0.089	0.288	-	0.115	0.326	-	-0.026	0.376
# Firms	45			26				

Panel B: Pork belly

	Treatment group (TG)			Control group (CG)				
	Mean	Std Dev	Median	Mean	Std Dev	Median	≠(TG-CG)	p-value
Market-to-book	1.664	1.189	1.374	2.920	5.791	1.596	-1.256	0.110
Size	5.945	2.562	5.535	4.719	1.928	4.450	1.225	0.037
Profitability	0.140	0.085	0.141	0.015	0.275	0.109	0.126	0.002
Book Leverage	0.256	0.204	0.257	0.266	0.229	0.227	-0.011	0.390
Dummy Hedge	0.192	0.402	-	0.167	0.376	-	0.026	0.384
# Firms	26			60				

Panel C: Whey

	Treatment group (TG)			Control group (CG)				
	Mean	Std Dev	Median	Mean	Std Dev	Median	≠(TG-CG)	p-value
Market-to-book	1.774	1.158	1.575	1.471	1.004	1.129	0.303	0.083
Size	5.115	2.532	4.555	5.982	2.172	5.915	-0.867	0.027
Profitability	0.061	0.187	0.101	0.106	0.236	0.138	-0.045	0.150
Book Leverage	0.279	0.319	0.225	0.313	0.206	0.294	-0.035	0.291
Dummy Hedge	0.275	0.450	-	0.307	0.464	-	-0.032	0.362
# Firms	69			101				

Panel D: Benzene

	Treatment group (TG)			Control group (CG)				
	Mean	Std Dev	Median	Mean	Std Dev	Median	≠(TG-CG)	p-value
Market-to-book	1.128	1.160	0.848	1.453	1.580	1.016	-0.324	0.179
Size	7.607	2.241	8.081	5.592	1.951	5.326	2.014	0.000
Profitability	0.102	0.177	0.115	0.065	0.391	0.125	0.037	0.309
Book Leverage	0.286	0.145	0.283	0.373	0.285	0.353	-0.087	0.034
Dummy Hedge	0.378	0.492	-	0.282	0.453	-	0.096	0.238
# Firms	37			85				

Panel E: Ethanol

	Treatment group (TG)			Control group (CG)				
	Mean	Std Dev	Median	Mean	Std Dev	Median	≠(TG-CG)	p-value
Market-to-book	2.117	2.174	1.445	1.813	1.677	1.453	0.305	0.073
Size	5.925	2.209	5.700	6.926	2.398	6.962	-1.001	0.000
Profitability	0.018	0.315	0.107	0.161	0.188	0.186	-0.143	0.000
Book Leverage	0.194	0.216	0.139	0.217	0.169	0.209	-0.023	0.149
Dummy Hedge	0.557	0.497	1.000	0.126	0.333	-	0.430	0.000
# Firms	396			182				

Table 2: **Average Treatment Effect of Introductions on Variance controlling for the Market Factor.** The table reports the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (6) and then (3) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns						
		ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	-0.492	-5.081**	-6.843***	-2.136	-3.397	-3.570*	4,585
		(1.944)	(2.578)	(2.487)	(3.256)	(2.669)	(2.159)	
	Cumulative	-0.492	-2.739	-4.019**	-3.618**	-3.227*	-3.067*	
		(1.944)	(1.942)	(1.803)	(1.807)	(1.857)	(1.779)	
Pork belly	Monthly	-3.787*	-5.454**	-6.368**	-2.408	-5.440**	-5.313*	5,292
		(1.960)	(2.171)	(2.878)	(2.748)	(2.616)	(2.898)	
	Cumulative	-3.787*	-4.833**	-5.314***	-4.543**	-4.661**	-4.781**	
		(1.960)	(2.087)	(2.023)	(2.064)	(2.115)	(2.165)	
Whey	Monthly	-4.000**	-5.510**	-3.318	-7.749***	-8.202***	-5.471**	11,050
		(2.037)	(2.147)	(2.359)	(2.308)	(3.099)	(2.781)	
	Cumulative	-4.000**	-4.609***	-3.836**	-4.510***	-5.036***	-5.075***	
		(2.037)	(1.779)	(1.688)	(1.635)	(1.716)	(1.723)	
Benzene	Monthly	-4.535	-5.292**	-0.883	-0.813	-1.846	-1.581	7,433
		(4.149)	(2.362)	(5.768)	(3.327)	(2.942)	(3.146)	
	Cumulative	-4.535	-5.347*	-4.014**	-3.732*	-3.408*	-3.268*	
		(4.149)	(2.863)	(1.876)	(1.992)	(1.869)	(1.898)	
Ethanol	Monthly	-0.397*	-0.118	0.124	0.154	-0.145	-0.530**	35,109
		(0.237)	(0.241)	(0.241)	(0.218)	(0.203)	(0.247)	
	Cumulative	-0.397*	-0.321	-0.260	-0.161	-0.168	-0.254	
		(0.237)	(0.219)	(0.200)	(0.186)	(0.172)	(0.170)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.								

Table 3: **Magnitude of the Effect for Variance controlling for the Market Factor.** This table contains the estimates for the cumulative monthly impact of the introduction of commodity derivatives on the treatment group (exposure to a specific commodity price risk) in terms of idiosyncratic variance. We compute the estimate for idiosyncratic variance by dividing the estimate for ATE (δ_σ) in equation (6) by the average variance of the period (σ^2) including both, pre- and post-treatment periods in equation (3).

		m1	m2	m3	m4	m5	m6
Butter	δ_σ	-0.492	-2.739	-4.019	-3.618	-3.227	-3.067
	Mean σ^2	14.600	14.500	14.600	15.200	15.000	14.600
	% of σ^2	-3.369 %	-18.888 %	-27.527 %	-23.802 %	-21.513%	-21.006 %
Pork belly	δ_σ	-3.787	-4.833	-5.314	-4.543	-4.661	-4.781
	Mean σ^2	13.100	14.000	13.300	13.100	13.100	13.000
	% of σ^2	-28.908 %	-34.521 %	-39.954 %	-34.679 %	-35.580 %	-36.776 %
Whey	δ_σ	-4.000	-4.609	-3.836	-4.510	-5.036	-5.075
	Mean σ^2	20.000	19.600	18.600	17.500	17.800	17.600
	% of σ^2	-20.000 %	-23.515 %	-20.623 %	-25.771 %	-28.292 %	-28.835 %
Benzene	δ_σ	-4.535	-5.347	-4.014	-3.732	-3.408	-3.268
	Mean σ^2	25.600	23.300	22.900	21.700	20.100	19.100
	% of σ^2	-17.714 %	-22.948 %	-17.528 %	-17.198 %	-16.955 %	-17.109 %
Ethanol	δ_σ	-0.397	-0.321	-0.260	-0.161	-0.168	-0.254
	Mean σ^2	4.560	4.620	4.490	4.420	4.310	4.330
	% of σ^2	-8.706 %	-6.948 %	-5.790 %	-3.642 %	-3.897 %	-5.866 %

Table 4: **Average Treatment Effect of Delistings on Variance.** The table reports the average treatment effect for idiosyncratic variance, associated with the delistings of existing commodity derivatives in the CME. The specification employed is as in equation (6) and then (3) for all four commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability and market to book). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns						
		ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	0.935***	1.083***	0.877***	1.113***	0.540*	0.443	5,480
		(0.264)	(0.355)	(0.275)	(0.324)	(0.311)	(0.331)	
	Cumulative	0.935***	0.998***	0.951***	0.966***	0.848***	0.781***	
		(0.264)	(0.266)	(0.227)	(0.222)	(0.201)	(0.200)	
Pork belly	Monthly	7.435**	3.506	1.099	2.156	2.329	1.040	7,619
		(3.749)	(4.826)	(5.973)	(5.049)	(3.316)	(4.161)	
	Cumulative	7.435**	5.736	2.688	3.283	3.548	3.213	
		(3.749)	(4.115)	(4.209)	(3.882)	(3.106)	(3.019)	
Benzene	Monthly	2.069*	4.277***	4.904***	3.423***	3.178**	4.405***	6,026
		(1.146)	(1.285)	(1.501)	(1.110)	(1.368)	(1.377)	
	Cumulative	2.069*	2.912***	3.515***	3.362***	3.296***	3.465***	
		(1.146)	(1.020)	(1.050)	(0.983)	(1.020)	(1.028)	
Ethanol	Monthly	0.788	2.179***	1.746**	0.923	2.057***	0.812	41,326
		(0.737)	(0.829)	(0.807)	(0.853)	(0.782)	(0.869)	
	Cumulative	0.788	1.634**	1.577***	1.328**	1.407**	1.209**	
		(0.737)	(0.639)	(0.593)	(0.577)	(0.560)	(0.564)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.								

Table 5: **Response of Quarterly Cashflows and Stock Return Rolling Standard Deviations.** The table reports the average treatment effect for the volatility of quarterly cashflows and stock returns, associated with the introduction (Panel a)) and delistings (Panel b)) of new derivatives in the CME. The volatility of quarterly cashflows and stock returns is computed using the rolling standard deviation for the last 4 and 8 quarters. The pre-treatment period considers 2 fiscal years, while the post-treatment period includes 1 fiscal year. All five events are pooled in a single regression. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include commodity type, firm and year effects, to capture potentially unobservable heterogeneity across commodities, firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

Panel a) Commodity derivative Introductions

	Dependent Variable: Rolling Standard Deviation			
	Stock Returns		Cashflows	
	4q	8q	4q	8q
Treat*Post	-0.014***	-0.012**	-0.004***	-0.003***
	(0.005)	(0.005)	(0.001)	(0.001)
Clustered SE	Firm	Firm	Firm	Firm
Commodity FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs	2,568	2,568	2,568	2,568

Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.

Panel b) Commodity derivative Delistings

	Dependent Variable: Rolling Standard Deviation			
	Stock Returns		Cashflows	
	4q	8q	4q	8q
Treat*Post	0.009***	0.008***	0.005***	0.005***
	(0.003)	(0.002)	(0.002)	(0.002)
Clustered SE	Firm	Firm	Firm	Firm
Commodity FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
# Obs	2,745	2,745	2,745	2,745

Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.

Table 6: **Response of Accounting Variables.** This table shows the average treatment effect of the introduction of commodity derivatives on hedging (extensive margin) and other relevant firm characteristics including, cash holdings, ebitda over sales, cost of goods sold over sales, leverage, investment in capital expenditures and undrawn credit lines using Compustat and Capital IQ annual data. The estimation for Hedging in the first column corresponds to a probit model, while the remaining columns to OLS estimation. The pre-treatment period considers 2 fiscal years, while the post-treatment period includes 1 fiscal year. All five events are pooled in a single regression. We include commodity type, firm and day fixed effects, to capture potentially unobservable heterogeneity across commodity types, firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

	Dependent Variable:						
	Hedging	Cash	Ebitda	Cogs	Leverage	Capex	Undrawn (+)
	Probit	OLS	OLS	OLS	OLS	OLS	OLS
ATE	0.314**	-1.495*	6.831***	-4.206**	2.216**	0.703*	2.165*
	(0.158)	(0.876)	(2.575)	(1.947)	(0.907)	(0.367)	(1.297)
ATE (dx/dy)	0.123**						
	(0.062)						
Market-to-book	-0.052	0.200	0.501	1.086	-1.047**	0.317***	0.001
	(0.049)	(0.443)	(3.501)	(4.545)	(0.435)	(0.119)	(0.299)
Size	0.200***	-2.246	-10.142	12.824	4.818***	0.190	-2.205**
	(0.0381)	(1.455)	(11.411)	(7.872)	(1.512)	(0.272)	(0.908)
Profitability	1.671***	5.862*	192.1***	-113.0**	-26.618***	-0.649	0.925
	(0.557)	(3.320)	(55.712)	(52.022)	(6.749)	(1.868)	(2.312)
Leverage	0.486	-14.348***	0.621	-0.426		-0.012	-0.0498*
	(0.360)	(3.740)	(0.494)	(0.264)		(0.009)	(0.029)
Cash Holdings	-0.499				-18.187***		-6.660**
	(0.409)				(4.213)		(2.666)
Dummy Hedging		0.289	3.285	-1.008	0.431	-0.324	0.354
		(0.853)	(4.713)	(2.849)	(1.061)	(0.294)	(0.717)
Clustered SE	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Commodity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Obs	1,602	2,568	2,479	2,479	2,492	2,485	1,752

Notes:

(dx/dy): marginal effects from Probit model.

(+): considers two commodity introductions only, benzene and ethanol, due to CIQ data availability.

Table 7: **Extensive Margin, Average Treatment Effect of Introductions on Variance controlling for the Market Factor.** The table reports the extensive margin for the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (8) and then (9) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability and market to book). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis, while Appendix A4 reports the empirical specification used in the analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns										
		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	-4.017**	5.241	4.071	2.434	2.973	3.837	-1.403	-2.485	-2.447	-2.446	4,585
		(2.025)	(5.983)	(2.786)	(3.519)	(1.855)	(2.463)	(3.526)	(2.402)	(1.749)	(2.222)	
	Cumulative	-4.017**	0.837	3.073	2.973	2.973	3.861	2.287	0.434	0.403	0.606	
		(2.025)	(3.395)	(1.908)	(1.855)	(1.855)	(2.289)	(1.421)	(1.064)	(1.167)	(1.250)	
Pork belly	Monthly	-5.790*	-8.058*	-5.904	-7.916	-6.818	-7.597*	-6.233	2.152	-4.127	0.721	5,292
		(3.077)	(4.376)	(3.903)	(5.496)	(4.164)	(4.570)	(3.974)	(6.030)	(3.089)	(2.964)	
	Cumulative	-5.790*	-7.476*	-6.861*	-6.818	-6.818	-7.500*	-7.091*	-4.656	-4.491	-3.584	
		(3.077)	(4.012)	(3.738)	(4.164)	(4.164)	(4.506)	(4.264)	(3.982)	(3.765)	(3.525)	
Whey	Monthly	0.826	-4.233	-5.189	-5.723	-3.349	5.591	4.062	-1.922	-2.420	-5.107	11,050
		(5.138)	(3.305)	(3.887)	(3.512)	(2.459)	(4.126)	(4.449)	(3.970)	(4.152)	(3.660)	
	Cumulative	0.826	-2.031	-3.344	-3.349	-3.349	0.941	1.596	0.788	0.280	-0.403	
		(5.138)	(2.574)	(2.322)	(2.459)	(2.459)	(2.635)	(2.689)	(2.456)	(2.380)	(2.265)	
Benzene	Monthly	-10.343	-11.106	-3.449	9.854*	-2.865	-3.861**	3.145	0.205	0.563	0.246	7,433
		(8.137)	(9.979)	(3.462)	(5.778)	(4.931)	(1.800)	(4.145)	(3.347)	(1.785)	(2.298)	
	Cumulative	-10.343	-9.053	-7.235	-2.865	-2.865	-3.306	-1.040	0.186	0.494	0.434	
		(8.137)	(7.679)	(5.807)	(4.931)	(4.931)	(2.645)	(1.769)	(1.921)	(1.539)	(1.382)	
Ethanol	Monthly	1.284**	-0.730	0.179	-1.607**	-0.0187	-0.998*	-0.213	-0.258	-0.00424	0.0479	35,109
		(0.654)	(0.521)	(0.550)	(0.814)	(0.487)	(0.552)	(0.545)	(0.402)	(0.426)	(0.499)	
	Cumulative	1.284**	0.594	0.611	-0.0187	-0.0187	-0.513	-0.366	-0.327	-0.241	-0.184	
		(0.654)	(0.524)	(0.452)	(0.487)	(0.487)	(0.500)	(0.488)	(0.437)	(0.394)	(0.395)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability and Market-to-book.												

Table 8: **Effective and Ineffective Hedging under FAS 133.** The table reports the ineffective (Panel a)) and effective (Panel b)) hedging components under FAS 133 for the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (10) and then (11) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability and market to book). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis, while Appendix A5 reports the empirical specification used in the analysis.

Panel a) Hedge Ineffectiveness

		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Benzene	Monthly	0.0375	-1.000	-0.955	-0.325	-0.532	-2.922*	-1.375	1.236	0.678	6.024***	7,433
		(2.342)	(2.702)	(1.334)	(3.209)	(1.755)	(1.520)	(1.618)	(0.807)	(0.788)	(0.672)	
	Cumulative	0.0375	-0.843	-0.815	-0.532	-0.532	-1.791	-1.604	-1.440	-1.115	-0.512	
		(2.342)	(2.102)	(1.496)	(1.755)	(1.755)	(1.456)	(1.268)	(1.443)	(1.313)	(1.385)	
Ethanol	Monthly	1.122	-0.593	1.154	-1.841*	0.010	-1.203	-0.891	-0.502	-0.464	-0.158	35,109
		(0.700)	(0.655)	(0.703)	(0.954)	(0.694)	(0.932)	(0.848)	(0.589)	(0.769)	(0.723)	
	Cumulative	1.122	0.512	0.833	0.010	0.010	-0.615	-0.714	-0.665	-0.592	-0.498	
		(0.700)	(0.625)	(0.557)	(0.694)	(0.694)	(0.754)	(0.768)	(0.670)	(0.629)	(0.637)	

Panel b) Hedge Effectiveness

		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Benzene	Monthly	-4.382**	-6.263***	-4.119***	7.905*	-0.218	-5.160***	2.690	-3.746	-0.824	-1.696	7,433
		(2.158)	(1.408)	(1.587)	(4.293)	(0.939)	(1.205)	(3.422)	(2.334)	(1.411)	(2.039)	
	Cumulative	-4.382**	-4.787***	-3.393*	-0.218	-0.218	-2.507**	-0.405	-0.783	-0.639	-0.382	
		(2.158)	(1.512)	(1.743)	(0.939)	(0.939)	(1.043)	(1.771)	(1.351)	(1.128)	(1.040)	
Ethanol	Monthly	0.673	-1.009	-0.249	-3.422**	-1.236	-1.110**	-1.252**	-1.962**	-2.018	-1.816**	35,109
		(0.536)	(1.230)	(0.906)	(1.458)	(1.000)	(0.489)	(0.611)	(0.805)	(1.361)	(0.787)	
	Cumulative	0.673	-0.327	-0.330	-1.236	-1.236	-1.203*	-1.259**	-1.471**	-1.567**	-1.622**	
		(0.536)	(1.103)	(0.931)	(1.000)	(1.000)	(0.712)	(0.585)	(0.602)	(0.745)	(0.743)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Controls: Leverage, Size, Profitability and Market-to-book.

Table 9: **Average Treatment Effect of Introductions for Tufano (1998) regressions and on Variance.** The table reports the average treatment effect for the analog of equation (8) in Tufano (1998) for our difference-in-differences setup and for the idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (7) and then (3) for all five commodities across different time horizons. δ_{β_c} represents the change in the sensitivity (exposure with respect to changes in the price of the commodity) after the introduction of the commodity derivative by the CME for firms in the treatment group. δ_σ is the change in the idiosyncratic volatility after the introduction of the commodity derivative by the CME. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	δ_{β_c}	-0.001	-0.002	0.006	-0.001	0.004	-0.006	-0.012	-0.012	-0.004*	-0.046	4,585
		(0.004)	(0.013)	(0.007)	(0.004)	(0.007)	(0.035)	(0.021)	(0.065)	(0.002)	(0.073)	
	δ_σ	0.251	-0.311	0.979	-1.599	0.212	-4.217*	-4.443**	-0.934	-3.101	-2.681	
		(2.303)	(2.689)	(2.135)	(2.289)	(1.629)	(2.231)	(2.230)	(2.730)	(2.291)	(2.023)	
Pork belly	δ_{β_c}	0.188	-0.477	-0.085	0.186	0.188	0.096	0.022	-0.282**	-0.101	0.007	5,292
		(0.534)	(1.023)	(0.468)	(0.248)	(0.142)	(0.171)	(0.099)	(0.129)	(0.109)	(0.089)	
	δ_σ	-1.645	-5.831*	-7.285***	-3.711	-3.791*	-5.460**	-6.368**	-2.452	-5.455**	-5.317*	
		(2.379)	(3.023)	(2.702)	(3.285)	(1.958)	(2.168)	(2.878)	(2.733)	(2.613)	(2.896)	
Whey	δ_{β_c}	2.759	0.657	-1.005	-0.425	-0.425	-0.168	0.028	0.120	-0.228	0.001	11,050
		(8.974)	(3.523)	(0.982)	(0.852)	(0.852)	(0.232)	(0.048)	(0.113)	(0.625)	(0.435)	
	δ_σ	-3.167	-3.846	-1.805	-8.615***	-3.997**	-5.515**	-3.322	-7.746***	-8.211***	-5.471**	
		(3.646)	(2.927)	(3.520)	(2.575)	(2.038)	(2.148)	(2.359)	(2.309)	(3.099)	(2.781)	
Benzene	δ_{β_c}	-0.406*	0.014	-0.042	0.043	0.067	0.004	-0.035	0.094	0.036	0.026	7,433
		(0.237)	(0.346)	(0.085)	(0.057)	(0.048)	(0.027)	(0.065)	(0.067)	(0.054)	(0.061)	
	δ_σ	-6.136	-9.050	-8.272***	3.474	-4.512	-5.292**	-0.892	-0.828	-1.836	-1.586	
		(5.828)	(6.032)	(3.168)	(5.822)	(4.162)	(2.362)	(5.759)	(3.328)	(2.941)	(3.141)	
Ethanol	δ_{β_c}	0.174***	-0.033***	-0.047	0.054	-0.056***	-0.037***	-0.072***	-0.043***	-0.070***	-0.042***	35,109
		(0.039)	(0.011)	(0.064)	(0.035)	(0.014)	(0.011)	(0.013)	(0.014)	(0.009)	(0.008)	
	δ_σ	-1.388***	0.452	-0.064	0.797**	-0.369	-0.123	0.122	0.203	-0.004	-0.556**	
		(0.328)	(0.304)	(0.318)	(0.366)	(0.237)	(0.242)	(0.241)	(0.218)	(0.202)	(0.246)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.

Appendix

A1. Finite Sample Properties of the σ-DID Estimator

The dependent variable used in the second stage regression is affected by measurement error. Consider for simplicity the specification of the model with no factors. Then, we have that the dependent variable used in the second stage is

$$\begin{aligned}
\tilde{y}_{igt} &= (r_{igt} - \hat{\alpha}_{igt})^2 \\
&= (r_{igt} - \alpha_{igt} + \alpha_{igt} - \hat{\alpha}_{igt})^2 \\
&= (r_{igt} - \alpha_{igt})^2 + (\alpha_{igt} - \hat{\alpha}_{igt})^2 + 2(r_{igt} - \alpha_{igt})(\alpha_{igt} - \hat{\alpha}_{igt}) \\
&= y_{igt} + e_{igt},
\end{aligned}$$

where $\hat{\alpha}_{igt}$ denotes the least square estimator of α_{igt} and e_{igt} denotes the measurement error induced by the first stage regression. Note that this measurement error is not mean zero nor independent of y_{igt}. However, when N and T are large, e_{igt} converges in probability to zero and the effect of the measurement error on the least squares estimator becomes negligible.

In order to give insights on the finite sample properties of the testing procedure we carry out a Monte Carlo simulation study in which we compare the performance of the σ-DID procedure proposed here versus the infeasible procedure based on directly observing y_{igt}. Specifically, we simulate a panel of returns where the mean equation is set equal to (5), the variance equation is set equal to (1) and z_{igt} is normally distributed. In both the mean and variance equations we assume that the time- and firm-fixed effects are drawn at random from an exponential distribution with unit mean and there is one covariate X_{ig} only that is also exponentially distributed with unit mean. The coefficients C_α and C_σ are set both equal to 1. We assume that the treatment affects half of the firms in the panel starting from the second half of the sample period.

We carry out the simulation study for different values of the δ_σ parameter equal to 0, 0.05 and 0.1 and panel dimensions (N, T) equal to (10,22), (20,44) and (30, 66). For each replication of the simulation exercise we carry out inference on the significance of the δ_σ parameter by carrying out a t-test using Newey-West corrected standard errors. Finally, we compute the empirical rejection probability at the 5% significance level for the infeasible test (based on y_{igt}) and σ-DID procedure (based on $\tilde{y}_{igt}$). Summary results are reported in Table A1 in the Appendix.

As far as size properties are concerned, the table shows that for small panels both the infeasible test and σ-DID procedure are oversized, with the distortion of the σ-DID being more severe. However, both procedures perform more satisfactorily as the panel dimensions increase. As far as power is concerned we see that the σ-DID has lower power than the infeasible alternative. However, the power loss appears to be modest across the different panel dimensions considered. Overall, the simulations convey that for reasonably large panels the performance of the σ-DID is satisfactory.

A2: Examples of Excerpts from the Text Search Algorithm

Butter

"Substantially all of the raw materials used in Lincoln Snacks' production process are commodity items, including corn syrup, butter, brown and granulated sugar, popcorn, various nuts and oils. The company manufactures and markets three nationally-recognized branded products. Poppycock is a premium priced mixture of nuts and popcorn in a deluxe buttery glaze."

"Sara Lee Bakery produces a wide variety of fresh and frozen baked and specialty items. The key ingredients for these products – butter, milk, sugar, fruits, eggs and flour - are purchased from suppliers at prices that are subject to such influences as supply and demand, weather, and government price controls.

"Our dairy group utilizes a significant amount of butter fat to produce Class II products. The Class II butter fat price can generally be tied to the pricing of butter traded on the CME. We purchase butter futures and butter inventory in an effort to better manage our butter fat cost in Class II.

Pork Belly

"IDP's pork facilities produce fresh boxed pork for shipment to retailers and also produce pork bellies, hams and boneless picnic meat for shipment to customers who further process the pork into bacon, cooked hams, luncheon meats and sausage items.

"The Thorn Apple Valley division of the company is engaged in the slaughtering and cutting of hogs and the sale of primal cuts of fresh pork products, including hams, shoulders, ribs and pork bellies.

"Our meat processing and hog production operations use various raw material, mainly corn, lean hogs, pork bellies and wheat, which are actively traded on commodity exchanges. We hedge these commodities when we determine conditions are appropriate to mitigate the inherent price risks. While this hedging may limit our ability to participate in gains from favorable commodity fluctuations, it also tends to reduce the risk of loss from adverse changes in raw material prices.

Whey

"Raw milk, imported milk powder and whey protein are the principal raw materials in the company's business, accounting for over 70% of the company's cost of sales. The company is exposed to the fluctuations in the price of raw milk, milk powder and whey protein. During the past two years, the rise and fall in the prices of these commodities have significantly affected the company's business operations and profitability.

"Commodity prices impact our business directly through the cost of raw materials used to make our products (such as skim milk powder, lactose and whey protein concentrate), the cost of inputs used to manufacture and ship our products and the amount we pay to produce or purchase packaging for our products. Commodities such as these are susceptible to price variance caused by conditions outside of our control. Dairy costs are the largest component of our cost of goods sold.

Benzene

"We manufacture styrene by converting ethylene and benzene into ethyl-benzene, which we then process into styrene. Ethylene and benzene are both commodity petrochemicals. Prices for each can fluctuate widely due to significant changes in the availability of these products. During fiscal year 2000, prices for benzene, one of the primary raw materials for styrene, were approximately 56% higher than the prices paid for benzene in fiscal year 1999.

"The development of financial instruments to hedge against changes in the prices of benzene has occurred in the past year. The company may seek periodically in the future, to the extent available, to enter into financial hedging contracts for the purchase of benzene in an effort to manage its raw material purchase costs.

Ethanol

"We are exposed to the risk of price fluctuations on natural gas liquids and petroleum feedstock used as raw material, and purchases of ethanol.

"We produce ethanol and its co-product, distiller's grains, from corn. We enter into derivative instruments to hedge our exposure to price risk related to forecasted corn and natural gas purchases, forward corn purchase contracts and forecasted ethanol sales.

"Exposure to commodity price risk results from our dependence on corn and natural gas in the ethanol production process, and the sale of ethanol. We enter into derivative contracts to manage the company's exposure to price risk related to forecasted corn and natural gas purchases, forward corn purchase contracts and forecasted ethanol sales. To manage our ethanol price risk, our hedging strategy designed to establish a price floor for our ethanol sales.

A3: Intuition Monthly vs. Cumulative Results

In order to understand the intuition behind our monthly and cumulative results, we build a simplified example based on the introduction of butter derivatives by the CME in 05/09/1996. Assume we build a daily grid to present the results instead. Then, what we observe in terms of the ATE on daily/cumulative idiosyncratic volatility can be mapped into daily actual volume or open interest data, which describe the liquidity and activity of options and futures contracts at each point in time for treated firms (in our setup).

Assume now there are only two non-financial firms in the market with material exposure to butter that react to the introduction.[24] When firm A buys a call option on butter in 05/10/1996 (month 2 after the introduction), then, the actual volume in the market is one and the open interest is one (if not settled). To the extent that firm A engages in hedging, we observe a drop in the idiosyncratic volatility of stock returns in our Table 2 under ATE m2. Assume now that firm B buys two call options on butter in 05/11/1996. Then, the actual volume will be two, while the open interest will be three (if not settled). As firm B engages in hedging, we again observe a drop in the idiosyncratic volatility of stock returns in our Table 2 under ATE m3. Now, if we focus on the effect in ATE m3, the monthly results reflect the activity of firm B only, while the cumulative results reflect the activity of firms A and B. Therefore, the monthly ATE on the idiosyncratic volatility of stock returns can be considered a (linear) function of the contracts traded in that given period, while the cumulative shows the aggregate effect of all firm contracts that are still active.

A4: Extensive versus Intensive Margin

In this section, we provide details of the empirical strategy we implement in order to understand whether the variation that we observe in the idiosyncratic variance comes from firms initiating hedging (extensive margin), or from firms that substitute from OTC derivatives or other exchange-traded derivatives to the new CME derivatives once they are introduced (intensive margin).

The following specification allows us to capture these effects:

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha Hedge_{igt} I_{gt} + A_{\beta\, i} r_{mt} + \delta_\beta r_{mt} Hedge_{igt} I_{gt} + C'_\alpha X_{ig} I_t + \epsilon_{igt} \ , \tag{8}$$

where $Hedge_{igt}$ allows capturing the effect on returns of those firms that initiate hedging after the

[24] For simplicity we assume that there are no other type of investors operating in the market when the CME introduces the derivatives.

introduction of the commodity derivative by the CME.

The specification for the idiosyncratic risk component:

$$\sigma^2_{igt} = A_{\sigma\, i} + B_{\sigma\, t} + \delta_\sigma Hedge_{igt} I_{gt} + C'_\sigma X_{ig} I_t \ + \epsilon_{igt}. \tag{9}$$

The parameter of interest is δ_σ, which captures the effect in terms of the extensive margin (hedging initiations). That is, the effect on the idiosyncratic variance of stock returns for firms in the treatment group (exposed to commodity price risk) that switch from the non-hedge to the hedge status after the introduction of the derivative by the CME. The results are reported in Table 7.

A5: Hedge Effectiveness

In order to examine whether hedging effectiveness may affect the results reported in Table 2, we look at the degree of hedge effectiveness of firms that engage in hedging when each of the commodity derivatives gets listed in the CME. To this purpose, we exploit the adoption of FAS 133 (which became effective in 2001) to evaluate whether the reduction in idiosyncratic volatility is driven mostly by the firms in the treatment group that hold more effective hedging contracts (versus ineffective hedges or speculative trades). Due to the fact that FAS 133 reporting was introduced fairly late in our sample, we can only carry out the test for the benzene and ethanol contracts.

We set up the following regression:

$$r_{igt} = A_{\alpha\, i} + B_{\alpha\, t} + \delta_\alpha FAS133_{igt} I_{gt} + A_{\beta\, i} r_{mt} + \delta_\beta r_{mt} FAS133_{igt} I_{gt} + C'_\alpha X_{ig} I_t + \epsilon_{igt} \ , \tag{10}$$

where $FAS133_{igt} = \{Effective_{igt}, Ineffective_{igt}\}$.

The specification for the idiosyncratic risk component:

$$\sigma^2_{igt} = A_{\sigma\, i} + B_{\sigma\, t} + \delta_\sigma FAS133_{igt} I_{gt} + C'_\sigma X_{ig} I_t \ + \epsilon_{igt}. \tag{11}$$

Our parameter of interest is δ_σ, which captures the effect in terms of effective and ineffective hedges under FAS 133. For effective hedging, the parameter captures the effect of either a switch from the non-hedge to the effective hedge status after the introduction of the derivative by the CME; or a switch from the ineffective hedge to the effective hedge status after the introduction of the derivative by the CME. Similarly, for ineffective hedging, the parameter captures the effect of either a switch from the non-hedge to the ineffective hedge status after the introduction of the derivative by the

CME; or a switch from the effective hedge to the ineffective hedge status after the introduction of the derivative by the CME.

The results of the analysis are reported in Table 8. Panel a) reports the analysis for ineffective hedging, and it shows that there is no effect associated with the introduction of the derivatives. Panel b) reports the case for effective hedging.

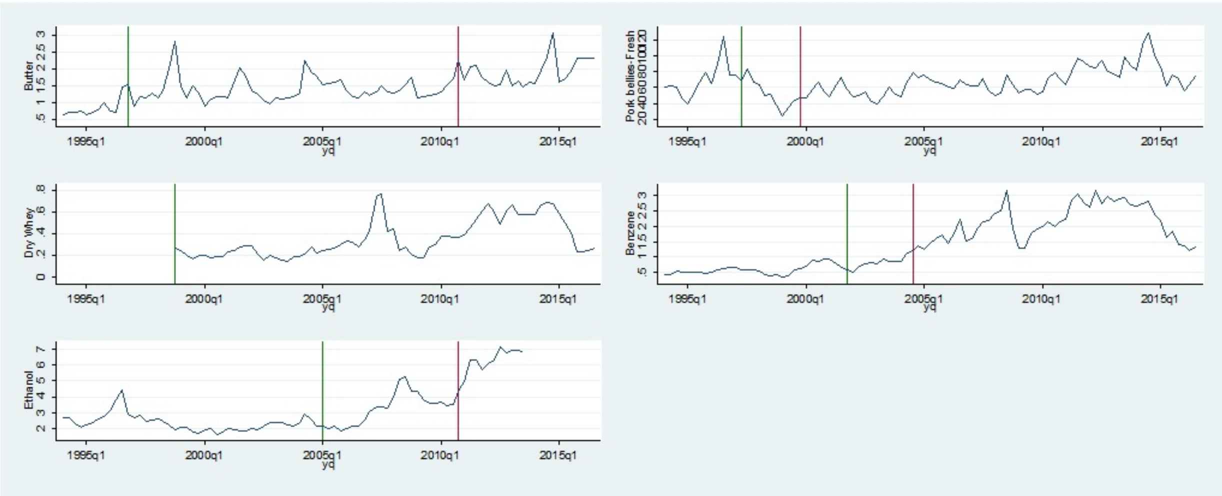

Figure A1: **Introductions and Delistings and Commodity Prices.** In each panel of the figure, we report the price for each commodity (butter, pork belly, dry whey, benzene and ethanol). In green, we superimpose the date of the introduction of the derivatives in the CME, while in red we have the date of the delisting (if available).

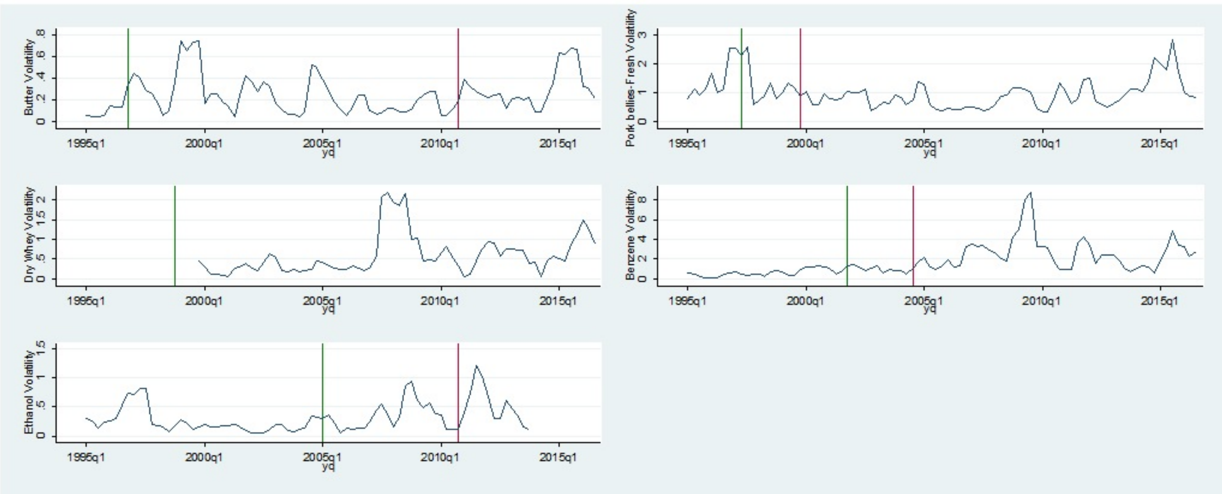

Figure A2: **Introductions and Delistings and Variance of Commodity Prices.** In each panel of the figure, we report the variance of the price for each commodity (butter, pork belly, dry whey, benzene and ethanol). In green we superimpose the date of the introduction of the derivatives in the CME, while in red we have the date of the delisting (if available).

Table A1: **Size and Power of the σ-DID test.** The table reports the Monte Carlo rejection frequencies of the test $H_0 : \delta_\sigma = 0$ versus $H_1 : \delta_\sigma \neq 0$ at the 5% significance level. The left panel reports the rejection frequencies of the infeasible test based on observing y_{igt} in equation (3) directly whereas the right panel reports the rejection frequencies of the σ-DID test (based on the proxy $\tilde{y}_{igt}$). The Monte Carlo experiment is carried out for different panel dimensions (N/T) and different values of the treatment parameter (δ_σ).

	Infeasible Test			σ-DID		
N/T	$\delta_\sigma = 0$	$\delta_\sigma = 0.05$	$\delta_\sigma = 0.1$	$\delta_\sigma = 0$	$\delta_\sigma = 0.05$	$\delta_\sigma = 0.1$
10/22	0.094	0.176	0.359	0.108	0.160	0.321
20/44	0.072	0.290	0.694	0.077	0.282	0.651
30/66	0.058	0.449	0.917	0.063	0.418	0.896

Table A2: **Cases of Introductions and Delistings of Derivatives.** Panel a) provides the list of the cases of introduction and delistings of derivatives in the CME, and the corresponding contract characteristics. Settlement occurs in USD. Panel b) provides information on the extent to which the introduction represented an innovation to the market (e.g., new derivatives, underlying or contract terms), the CME cross-hedging and OTC alternatives and their liquidity. Panel c) provides information on the reason why the derivatives were introduced, the date of the first available Factiva news on the introduction and the source. Finally, Panel d) provides information on the delisting background for the derivatives.

Panel a) Information on Derivative Listings and Delistings by the CME

CME listing	Product Group, Subgroup	Type	Contract Size	Units	Start	End
Butter	Agriculture, Dairy	Futures&Options	40 lbs	cents/lb	05.09.1996	20.12.2010
Pork belly (Fresh)	Agriculture, Livestock	Futures	40 lbs	cents/lb	04.04.1997	19.11.1999
Dry Whey	Agriculture, Dairy	Futures	44 lb	USD0.01/CWT	16.11.1998	n/a
Benzene	Energy, Chemicals	Futures	42,000xDeWitt	USD/gallon	19.10.2001	01.03.2004
Ethanol	Energy, Crude&Refined	Futures	30 Gallons	USD/gallon	29.03.2005	21.11.2007

Panel b) Degree of Market Completion, Hedging Alternatives and Effectiveness/Liquidity

CME listing	Previously Traded	Innovation	Cross-hedge CME (CH)	Effective CH?	Liquidity CH?	Other Alternatives
Butter	1976 (futures)	ND, CT	Class IV Milk	Low	High	OTC
Pork belly (Fresh)	1982 (frozen)	ND, NU	Pork belly (Frozen)	Intermediate	High	OTC
Dry Whey	n/a	ND, NU	Class III Milk, Cheese	Intermediate	High	OTC
Benzene	n/a	ND, NU	Gasoline	Low	High	OTC
Ethanol	1984 (futures)	CT	RBOB	Low	High	ET, OTC

Panel c) Listing Background, Factiva Analysis & CME

CME listing	Background	Factiva Date	Source
Butter	Depletion of government stocks of butter	04.09.1996	Reuters News
Pork belly (Fresh)	Higher demand for fresh over frozen in the market	06.03.1997	Reuters News
Dry Whey	Federal government phases out its dairy price support programmes	11.11.1998	Futures World News
Benzene	Previously unavailable risk management instrument	18.10.2001	Futures World News
Ethanol	Clean Air Act (42 U.S.C. Â§ 7401) and U.S. Federal legislation	03.03.2005	PR Newswire

Panel d) Delisting Background CME

CME delisting	Background	Re-listing
Butter	CME Cash-settled version more attractive vs. physical delivery	2007
Pork belly (Fresh)	More liquid CME hedging alternatives (frozen pork belly)	
Benzene	More liquid CME hedging alternatives (unleaded gasoline)	
Ethanol	CBOT future more attractive (CBOT already traded grains and seeds)	2006-9

Legend: ND=New Derivative, CT=Contract Terms, NU=New Underlying, OTC=Over-the-counter, ET=Exchange-traded. RBOB=reformulated blendstock for oxygenate blending.

Table A3: **Text-search Procedure: Exposure Variables.** The table below summarizes the main data extraction process to identify material exposure to commodity price risk from *"Item 7A - Quantitative and Qualitative Disclosures about Market Risks"* in the 10-K filings in the SEC. We first run Step 1 and find candidate sentences. Then, we look in the neighborhood of the keyword in Step 1 to locate pre-specified neighboring words to guarantee the exposure is real (Step 2). Finally, in Step 3 we get rid of the negations and false positives.

Step 1: Pre-selection of Candidate Sentences *Keywords*	**Step 2: Locate neighboring words** *Keywords*
butter	sale
pork bell	inventor
whey	commodit
benzene	raw material
ethanol	cost of good
	input
	output
	risk
Step 3: Rule out negations or false positives	

Table A3: **Text-search Procedure: Hedging Dummy.** The table below summarizes the data extraction process to identify derivative users for hedging purposes in the 10-K filings in the SEC. We first run Step 1 and find candidate sentences. Then, we look in the neighborhood of the keyword in Step 1 to rule out the use of derivative instruments for speculative or trading purposes (Step 2). Finally, in Step 3 we get rid of the negations and false positives.

Step 1: Pre-selection of Candidate Sentences *Keywords*	**Step 2: Rule out speculation** *Keywords*
derivative	hedg(ing)
hedg	not + speculati
financial instrument	not + trad
swap	
futur	
forward (contract)	
option (contract)	
risk management	
notional	
Step 3: Rule out negations or false positives	

Table A4: **Treatment and Control Group Strategy.** This table reports the strategy used to build the treatment (TG) and control groups (CG). In step 1 we build the TG, which contains all firm-year observations that result in a hit for the commodity in the 10-K filings in EDGAR (*dummy exposure*). In steps 2 and 3 we search for candidates to build the CG. First, we search Wikipedia to learn about the uses for the commodity listed. We identify whether or not it has a clear substitute, search for the substitute over the 10-K filings (*dummy substitute*) and assign those firm-year observations to the CG. In step 3, we further search for potential candidates for the CG in industries related to the TG but not affected by the listing of the commodity derivative. We do this by searching SIC and NAICS industry classification tables for keywords related to the TG (*keywords uses*). The output of this search is *SIC codes* and *NAICS codes*. We use the NAICS-to-SIC Crosswalk tables to convert all NAICS candidates into SIC codes (*SIC blocks*) and assign to the CG. Finally, in Step 4, we search the CMEGroup's Education Services. We focus on each subgroup of commodities (dairy, livestock, crude and refined) and determine i) supply and demand factors and ii) commodities on which the underlying commodity depends (*dependents*). We search for all *dependents* and assign these to the TG (*dummy dependent*). We undertake the same strategy for all listing and delistings cases. (*) denotes uses validated also at PubChem.

	Step 1: Create TG	**Step 2: Identify Potential CG Candidates - Wikipedia Search**	
		2.1 Identify Substitutes	**2.2 Uses of Commodity**
Butter		Margarine, Ghee	Butter types
Pork belly		Beef, Chicken	Pork belly, Pork and Pig farming
Dry Whey		Cheese, Casein	Dry Whey Uses
Benzene		Toluene (*), Heptane (*)	Benzene Uses (*)
Ethanol		RBOB	Ethanol Uses (*)
Action/Input:	Search 10-K filings for commodity	Search 10-K filings for substitutes	Inputs for Step 3
Output:	*dummy_exposure*	*dummy_substitutes*	*keywords_uses*

	Step 3: Search NAICS and SIC Tables		**Step 4: Search CME Education**
	3.1 Search for keyword_uses	**3.2 Assign SICs to CG**	**4.1 Assign Dependents to TG**
Butter	Dairy, bakery, fats and oils	2020-29, 2050-59, 2070-79	
Pork belly	Meat	2010-19	Pork
Dry Whey	Dairy, proteins, dietary supplements	2020-29, 2050-59	Milk (serum)
Benzene	Other chemicals, nylon fibers, plastics, rubbers, lubricants, dyes, detergents, drugs, explosives, pesticides	2086, 2820-29, 2844, 3020-21, 3031, 3041, 3050-53, 3060-69, 3070-79, 3080-89, 3090-99, 325130, 325910	Cyclohexane
Ethanol	Recreational drug, antiseptic and disinfectant, solvent, alternative fuel	2080-85, 1310-19, 2900-12, 2990-99, 1380, 1389	Corn
Action/Input:		Input convert NAICS to SIC: CrossWalk	Search 10-K filings for dependents
Output:	*SIC_codes, NAICS_codes*	*SIC_blocks*	*dummy_dependents*

Table A5: **Treatment and control group and Alternatives for Robustness Checks.** This table reports the final treatment (TG) and control group (CG) choices for the baseline regressions. The TG and CG choice follow the procedure in Table A4 in the Appendix. It also contains the alternative control group definition for the robustness checks in Table A13 in the Appendix in the last column under *Alternative CG?*.

Panel a) Butter	Introduction: 09/05/1996, Delisting: 12/20/2010			
	10-K search	SIC codes	NAICS Codes	Alternative CG?
Treatment group (TG):				
Text-search hits for keyword	butter			
Control group (CG):				
Text-search hits for keyword (*)	margarine			Yes
	ghee			Yes
Dairy sector (*)		2020-2029		Yes
Bakery sector (*)		2050-2059		No
Fats and oils sector (*)		2070-2079		No

Panel b) Pork Belly	Introduction: 04/04/1997, Delisting: 19/11/1999			
	10-K search	SIC codes	NAICS Codes	Alternative CG?
Treatment group (TG):				
Text-search hits for keyword	pork bell			
Control group (CG):				
	beef			Yes
	chicken			Yes
Meat Products (*)		2010-2019		No
Dependents (TG):				
Text-search hits for keyword	pork			

Panel c) Whey	Introduction: 16/11/1998			
	10-K search	SIC codes	NAICS Codes	Alternative CG?
Treatment group (TG):				
Text-search hits for keyword	whey			
Control group (CG):				
Text-search hits for keyword (*)	cheese			No
	casein			No
Dairy sector (*)		2020-2029		Yes
Bakery Sector (*)		2050-2059		Yes
Dependents (TG):				
Text-search hits for keyword	milk			

Note: (*) excluding those already in TG

cont'ed

Panel d) Benzene	Introduction: 19/10/2001, Delisting: 01/03/2004			
	10-K search	SIC codes	NAICS Codes	Alternative CG?
Treatment group (TG):				
Text-search hits for keyword	benzene			
Control group (CG):				
Text-search hits for keyword (*)	toluene			Yes
	heptane			Yes
Bottled-canned soft drinks (*)		2086		No
Plastic material & synthetic resin (*)		2820-2829		Yes
Perfumes cosmetics (*)		2844		No
Rubber and plastics footwear (*)		3020-3021		Yes
Reclaimed rubber (*)		3031		Yes
Rubber & plastic hose and belting (*)		3041		Yes
Gaskets, hoses, etc (*)		3050-3053		Yes
Fabricated rubber products (*)		3060-3069		Yes
Miscellaneous rubber products (*)		3070-3079		Yes
Miscellaneous plastic products (*)		3080-3089		No
Miscellaneous rubber and plastic (*)		3090-3099		No
Synthetic Dye and Pigment Manuf (*)			325130	No
Printing Ink Manufacturing (*)			325910	No
Dependents (TG):				
Text-search hits for keyword	cyclohexane			

Panel e) Ethanol	Introduction: 29/03/2005, Delisting: 21/11/2007			
	10-K search	SIC codes	NAICS Codes	Alternative CG?
Treatment group (TG):				
Text-search hits for keyword	ethanol			
Control group (CG):				
Text-search hits for keyword	rbob			
Alcoholic Beverages sector (*)		2080-2085		Yes
Crude petroleum & natural gas (*)		1310-1319		Yes
Petroleum refining (*)		2900-2912		No
Miscellaneous petroleum products (*)		2990-2999		No
Dependents (TG):				
Text-search hits for keyword	corn			

Note: (*) excluding those already in TG

Table A6: **Average Treatment Effect of Introductions on Variance.** The table reports the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (5) and then (3) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns						
		ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	-0.469	-5.091**	-6.802***	-2.126	-3.398	-3.578*	4,585
		(1.949)	(2.583)	(2.495)	(3.256)	(2.667)	(2.170)	
	Cumulative	-0.469	-2.732	-4.002**	-3.615**	-3.225*	-3.068*	
		(1.949)	(1.940)	(1.801)	(1.806)	(1.855)	(1.779)	
Pork belly	Monthly	-3.797*	-5.415**	-6.372**	-2.338	-5.444**	-5.222*	5,292
		(1.971)	(2.203)	(2.896)	(2.779)	(2.619)	(2.899)	
	Cumulative	-3.797*	-4.837**	-5.316***	-4.535**	-4.657**	-4.767**	
		(1.971)	(2.102)	(2.036)	(2.077)	(2.125)	(2.173)	
Whey	Monthly	-4.001**	-5.498**	-3.321	-7.754***	-8.209***	-5.490**	11,050
		(2.036)	(2.151)	(2.356)	(2.311)	(3.099)	(2.778)	
	Cumulative	-4.001**	-4.607***	-3.835**	-4.509***	-5.035***	-5.075***	
		(2.036)	(1.780)	(1.689)	(1.636)	(1.716)	(1.723)	
Benzene	Monthly	-4.525	-5.301**	-0.795	-0.516	-1.800	-1.523	7,440
		(4.161)	(2.393)	(5.749)	(3.410)	(2.962)	(3.144)	
	Cumulative	-4.525	-5.350*	-4.008**	-3.684*	-3.372*	-3.239*	
		(4.161)	(2.880)	(1.906)	(2.032)	(1.904)	(1.929)	
Ethanol	Monthly	-0.344	-0.353	0.183	0.0370	-0.173	-0.379	35,109
		(0.255)	(0.241)	(0.235)	(0.221)	(0.201)	(0.244)	
	Cumulative	-0.344	-0.387*	-0.278	-0.206	-0.208	-0.263	
		(0.255)	(0.227)	(0.201)	(0.188)	(0.174)	(0.171)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.								

Table A7: **Average Treatment Effects of Introductions on Stock Returns (No Market Factor).** The table reports the average treatment effects for stock returns, associated with the introduction of new commodity derivatives in the CME. The specification employed is as in equation (5) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Stock Returns (No Market Factor)						
		ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	-0.112	-13.501	8.556	7.317	-9.792	-52.181***	4,585
		(12.860)	(15.643)	(16.964)	(17.306)	(13.021)	(15.403)	
	Cumulative	-0.112	-7.052	-2.271	-0.565	-3.090	-12.831	
		(12.860)	(11.613)	(11.601)	(11.562)	(10.117)	(9.626)	
Pork belly	Monthly	-20.546*	-8.320	-20.205	-17.893	-4.687	-34.392**	5,292
		(11.962)	(17.803)	(13.331)	(13.566)	(12.308)	(13.571)	
	Cumulative	-20.546*	-15.155	-16.199	-16.072	-14.111	-17.078*	
		(11.962)	(12.664)	(12.051)	(11.223)	(10.672)	(9.745)	
Whey	Monthly	-12.003	12.806	-2.743	-8.871	-22.347*	18.461	11,050
		(14.955)	(11.574)	(12.022)	(12.445)	(11.612)	(15.237)	
	Cumulative	-12.003	-1.409	-2.410	-5.184	-9.589	-4.945	
		(14.955)	(9.733)	(8.925)	(8.368)	(8.060)	(8.131)	
Benzene	Monthly	-38.971**	-50.646**	-41.376*	-26.561	-56.012**	-70.296***	7,440
		(19.044)	(23.321)	(22.876)	(18.573)	(24.181)	(20.183)	
	Cumulative	-38.971**	-41.171**	-41.931**	-38.174**	-40.442**	-43.031**	
		(19.044)	(17.897)	(17.489)	(16.636)	(17.163)	(16.723)	
Ethanol	Monthly	26.709***	41.199***	0.5072	25.218***	16.757***	3.6214	35,109
		(5.319)	(4.614)	(4.305)	(5.083)	(5.233)	(5.020)	
	Cumulative	26.709***	36.815***	23.145***	23.884***	21.303***	17.729***	
		(5.319)	(4.008)	(3.322)	(3.122)	(3.089)	(3.070)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.								

Table A8: **Magnitude of the Effect for Variance.** This table contains the estimates for the cumulative monthly impact of the introduction of commodity derivatives on the treatment group (exposure to a specific commodity price risk) in terms of idiosyncratic variance. We compute the estimate for idiosyncratic variance by dividing the estimate for ATE (δ_σ) in equation (5) by the average variance of the period (σ^2) including both, pre- and post-treatment periods in equation (3).

		m1	m2	m3	m4	m5	m6
Butter	δ_σ	-0.469	-2.732	-4.002	-3.615	-3.225	-3.068
	Mean σ^2	14.800	14.700	14.700	15.400	15.100	14.700
	% of σ^2	-3.168 %	-18.585 %	-27.224 %	-23.474 %	-21.357 %	-20.870 %
Pork belly	δ_σ	-3.797	-4.837	-5.316	-4.535	-4.657	-4.767
	Mean σ^2	13.300	14.100	13.400	13.200	13.200	13.100
	% of σ^2	-28.548 %	-34.304 %	-39.671 %	-34.356 %	-35.280 %	-36.389 %
Whey	δ_σ	-4.001	-4.607	-3.835	-4.509	-5.035	-5.075
	Mean σ^2	20.500	20.100	19.000	17.800	18.100	17.800
	% of σ^2	-19.517 %	-22.920 %	-20.184 %	-25.331 %	-27.817 %	-28.511 %
Benzene	δ_σ	-4.525	-5.350	-4.008	-3.684	-3.372	-3.239
	Mean σ^2	26.300	23.900	23.500	22.200	20.600	19.600
	% of σ^2	-17.205 %	-22.384 %	-17.055 %	-16.594 %	-16.368 %	-16.525 %
Ethanol	δ_σ	-0.344	-0.387	-0.278	-0.206	-0.208	-0.263
	Mean σ^2	4.920	4.980	4.800	4.720	4.590	4.590
	% of σ^2	-6.991 %	-7.771 %	-5.791 %	-4.364 %	-4.531 %	-5.729 %

Table A9: **Average Treatment Effect of Introductions on Variance controlling for the Market Factor, Weekly and Monthly Grids.** The table reports the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME including the weekly effect within the first 4 weeks after the introduction. The specification employed is as in equation (6) and then (3) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns									
		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6
Butter	Monthly	-0.735	-0.592	0.592	-1.854	-0.492	-5.081**	-6.843***	-2.136	-3.397	-3.570*
		(2.752)	(2.725)	(3.253)	(3.088)	(1.944)	(2.578)	(2.487)	(3.256)	(2.669)	(2.159)
	Cumulative	-0.735	-0.506	-0.131	-0.492	-0.492	-2.739	-4.019**	-3.618**	-3.227*	-3.067*
		(2.752)	(2.257)	(1.985)	(1.944)	(1.944)	(1.942)	(1.803)	(1.807)	(1.857)	(1.779)
Pork belly	Monthly	-1.645	-5.837*	-7.283***	-3.714	-3.787*	-5.454**	-6.368**	-2.408	-5.440**	-5.313*
		(2.371)	(3.025)	(2.697)	(3.276)	(1.960)	(2.171)	(2.878)	(2.748)	(2.616)	(2.898)
	Cumulative	-1.645	-2.849	-4.239**	-3.787*	-3.787*	-4.833**	-5.314***	-4.543**	-4.661**	-4.781**
		(2.371)	(2.157)	(1.935)	(1.960)	(1.960)	(2.087)	(2.023)	(2.064)	(2.115)	(2.165)
Whey	Monthly	-3.168	-3.825	-1.709	-8.614***	-4.000**	-5.510**	-3.318	-7.749***	-8.202***	-5.471**
		(3.649)	(2.927)	(3.574)	(2.571)	(2.037)	(2.147)	(2.359)	(2.308)	(3.099)	(2.781)
	Cumulative	-3.168	-3.459	-2.446	-4.000**	-4.000**	-4.609***	-3.836**	-4.510***	-5.036***	-5.075***
		(3.649)	(2.426)	(2.320)	(2.037)	(2.037)	(1.779)	(1.688)	(1.635)	(1.716)	(1.723)
Benzene	Monthly	-5.742	-8.452	-8.253***	3.409	-4.535	-5.292**	-0.883	-0.813	-1.846	-1.581
		(6.053)	(5.985)	(3.187)	(5.793)	(4.149)	(2.362)	(5.768)	(3.327)	(2.942)	(3.146)
	Cumulative	-5.742	-6.230	-7.494*	-4.535	-4.535	-5.347*	-4.014**	-3.732*	-3.408*	-3.268*
		(6.053)	(5.267)	(4.233)	(4.149)	(4.149)	(2.863)	(1.876)	(1.992)	(1.869)	(1.898)
Ethanol	Monthly	-1.324***	0.457	-0.065	0.809**	-0.397*	-0.118	0.124	0.154	-0.145	-0.530**
		(0.327)	(0.303)	(0.318)	(0.367)	(0.237)	(0.241)	(0.241)	(0.218)	(0.203)	(0.247)
	Cumulative	-1.324***	-0.728***	-0.610**	-0.397*	-0.397*	-0.321	-0.260	-0.161	-0.168	-0.254
		(0.327)	(0.268)	(0.242)	(0.237)	(0.237)	(0.219)	(0.200)	(0.186)	(0.172)	(0.170)
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.

Table A10: **Individual Regressions of Introductions and Delistings for the Volatility of Quarterly Cashflows and Stock Returns.** The table reports the average treatment effect for the volatility of quarterly cashflows and stock returns, associated with the introduction (Panel a)) and the delistings (Panel b)) of each new derivatives case in the CME. The volatility of quarterly cashflows and stock returns is computed using the rolling standard deviation for the last 4 and 8 quarters. The pre-treatment period considers 2 fiscal years, while the post-treatment period includes 1 fiscal year. All five events are pooled in a single regression. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and year effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

Panel a) Commodity derivative Introductions

Dependent Variable: Rolling Standard Deviation

	Stock Returns		Cashflows		
	4q	8q	4q	8q	# Obs
Butter	-0.043**	-0.056*	-0.015**	-0.012	213
	(0.019)	(0.030)	(0.008)	(0.009)	
Pork belly	-0.054**	-0.066*	-0.003	-0.008	258
	(0.027)	(0.036)	(0.008)	(0.007)	
Whey	-0.094***	-0.126**	-0.007	-0.008	510
	(0.033)	(0.062)	(0.007)	(0.007)	
Benzene	-0.068*	-0.038*	-0.008*	-0.009*	366
	(0.041)	(0.022)	(0.005)	(0.005)	
Ethanol	-0.057***	-0.029**	-0.006*	-0.008*	1,734
	(0.017)	(0.013)	(0.004)	(0.004)	

Panel b) Commodity derivative Delistings

Dependent Variable: Rolling Standard Deviation

	Stock Returns		Cashflows		
	4q	8q	4q	8q	# Obs
Butter	0.075***	0.068**	0.012*	0.013*	249
	(0.026)	(0.034)	(0.007)	(0.007)	
Pork belly	0.059*	0.053**	0.008*	0.007*	345
	(0.034)	(0.027)	(0.004)	(0.004)	
Benzene	0.088**	0.061*	0.011*	0.009	373
	(0.038)	(0.032)	(0.007)	(0.007)	
Ethanol	0.027*	0.034*	0.005	0.006	1,878
	(0.016)	(0.019)	(0.006)	(0.007)	

Table A11: **Economic Significance of the Average Treatment Effect for Accounting Variables.** The table reports the economic significance of the average treatment effect of introductions for accounting variables including, hedging, cash holdings, ebitda over sales, cost of goods sold over sales, leverage, capital expenditures and undrawn credit lines. We measure the economic significance as follows,

$$\text{Economic Significance} = \delta_{firm}\left\{\mu(\text{Treatment}) + \sigma(\text{Treatment})\right\}$$

where δ_{firm} is the ATE of the derivative introduction on the treatment group as compared to the control group; μ(Treatment) is the treatment variable, $DummyPost * DummyTreatment$; and σ(Treatment) is the standard deviation of the treatment variable.

	Hedging	Cash	Ebitda	Cogs	Leverage	Capex	Undrawn
δ_{firm}	0.314	-1.495	6.831	-4.206	2.216	0.703	2.165
σ(Treatment)	0.46	0.46	0.46	0.46	0.46	0.46	0.48
μ(Treatment)	0.31	0.31	0.31	0.31	0.31	0.31	0.38
Mean Effect	n/a	-0.463	2.118	-1.304	0.687	0.218	0.823
Econ Significance	n/a	-1.151	5.259	-3.238	1.706	0.541	1.861
Prob Dummy Hedge	0.559						

Table A12: **Placebo Test and Anticipation Effects.** The table reports the average treatment effect for idiosyncratic variance over different time horizons preceding the introduction of a derivative in the CME. We report both weekly and cumulative effects over time. Panel a) reports the effect when the listing date is moved to 2 months in advance, while Panel b) shows the effect for a month before the introduction. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Panel a) 2 months prior to listing					Panel b) 1 month prior to listing					
		Dependent Variable: Idiosyncratic Variance of Stock Returns										
		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	# Obs
Butter	Weekly	8.287	18.411	5.299	2.117	8.360	5.286	15.346	2.361	-0.808	5.383	3,290
		(6.018)	(15.705)	(7.659)	(7.717)	(6.524)	(5.133)	(15.391)	(6.407)	(6.480)	(5.398)	
	Cumulative	8.287	13.927	10.652	8.360	8.360	5.286	10.893	7.648	5.383	5.383	
		(6.018)	(9.000)	(7.081)	(6.524)	(6.524)	(5.133)	(8.499)	(6.177)	(5.398)	(5.398)	
Pork Belly	Weekly	-3.895	24.804	-11.263	-4.526	0.872	-4.871	23.634	-12.19**	-5.680	-0.185	3,780
		(9.771)	(47.039)	(8.915)	(11.711)	(14.392)	(6.943)	(46.366)	(6.189)	(8.948)	(12.630)	
	Cumulative	-3.895	10.974	2.660	0.872	0.872	-4.871	9.898	1.638	-0.185	-0.185	
		(9.771)	(25.114)	(17.259)	(14.392)	(14.392)	(6.943)	(24.100)	(15.891)	(12.630)	(12.630)	
Whey	Weekly	-2.627	-1.392	4.040	-4.836	-1.508	-7.800	-6.538	-1.034	-10.121*	-6.676	8,160
		(7.829)	(5.994)	(11.97)	(6.355)	(6.232)	(6.526)	(5.248)	(11.053)	(5.921)	(4.997)	
	Cumulative	-2.627	-2.321	-0.124	-1.508	-1.508	-7.800	-7.484	-5.254	-6.676	-6.676	
		(7.829)	(6.342)	(7.322)	(6.232)	(6.232)	(6.526)	(5.161)	(6.054)	(4.997)	(4.997)	
Benzene	Weekly	0.676	-5.496	-14.771	25.723	1.788	-5.162	-4.765	-14.402	25.871	0.549	5,366
		(9.000)	(9.799)	(9.939)	(22.202)	(10.066)	(7.958)	(9.429)	(9.411)	(22.129)	(9.612)	
	Cumulative	0.676	-1.419	-7.103	1.788	1.788	-5.162	-4.215	-8.751	0.549	0.549	
		(9.000)	(8.618)	(8.409)	(10.066)	(10.066)	(7.958)	(7.934)	(7.852)	(9.612)	(9.612)	
Ethanol	Weekly	-22.641**	3.955	-2.698	-1.016	-9.761**	0.459	26.236	19.983	20.981	12.110	14,331
		(10.541)	(4.073)	(6.982)	(5.620)	(4.109)	(10.487)	(20.843)	(15.814)	(22.123)	(14.911)	
	Cumulative	-22.641**	-11.670***	-10.604*	-9.761**	-9.761**	0.459	10.794	11.725	12.110	12.110	
		(10.541)	(4.507)	(5.768)	(4.109)	(4.109)	(10.487)	(15.112)	(13.728)	(14.911)	(14.911)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.												

Table A13: **Alternative Control Group Definition.** The table reports the average treatment effect for idiosyncratic variance, associated with the introduction of new commodity derivatives in the CME with an alternative control group definition (as reported in Table A5 in the Appendix). The specification employed is as in equation (6) and then (3) for all five commodities across different time horizons. We control (unreported) for a set of firm characteristics (book leverage, size, profitability, market to book and dummy for hedging). We include firm and day fixed effects, to capture potentially unobservable heterogeneity across firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

		Dependent Variable: Idiosyncratic Variance of Stock Returns										
		ATE w1	ATE w2	ATE w3	ATE w4	ATE m1	ATE m2	ATE m3	ATE m4	ATE m5	ATE m6	# Obs
Butter	Monthly	-0.427	0.165	1.508	-2.690	-0.324	-5.219*	-6.277**	-1.753	-3.376	-1.695	3,611
		(2.900)	(2.695)	(3.383)	(3.341)	(2.060)	(2.715)	(2.626)	(3.463)	(2.986)	(1.869)	
	Cumulative	-0.427	0.0557	0.563	-0.324	-0.324	-2.666	-3.905**	-3.345*	-2.910	-2.525	
		(2.900)	(2.296)	(2.019)	(2.060)	(2.060)	(2.027)	(1.904)	(1.865)	(1.936)	(1.841)	
Pork Belly	Monthly	-5.150**	-10.42**	-10.54***	-5.030	-6.252**	-5.751*	-8.696**	-3.714	-7.621**	-7.919*	4,158
		(2.346)	(4.249)	(3.688)	(4.958)	(2.814)	(3.137)	(4.196)	(4.269)	(3.640)	(4.263)	
	Cumulative	-5.150**	-6.181**	-7.525***	-6.252**	-6.252**	-4.833**	-5.314***	-4.543**	-4.661**	-4.781**	
		(2.346)	(2.752)	(2.666)	(2.814)	(2.814)	(2.087)	(2.023)	(2.064)	(2.115)	(2.165)	
Whey	Monthly	5.273	-11.78***	-3.585	-4.646	-5.533	-3.252	-6.372***	-4.501**	1.809	-10.42***	7,910
		(6.736)	(3.702)	(5.446)	(5.213)	(3.579)	(5.461)	(2.376)	(2.184)	(4.848)	(0.844)	
	Cumulative	5.273	-4.827	-2.613	-5.533	-5.533	-4.217	-6.482**	-5.851**	-5.000**	-5.291**	
		(6.736)	(3.576)	(3.728)	(3.579)	(3.579)	(4.347)	(2.702)	(2.427)	(2.371)	(2.400)	
Benzene	Monthly	-9.851*	-10.84	-4.665**	-5.187	-5.479**	-10.69**	-10.45**	-1.915	-5.507*	-4.753*	2,989
		(5.392)	(7.962)	(2.295)	(4.161)	(2.383)	(5.189)	(5.276)	(2.958)	(2.841)	(2.661)	
	Cumulative	-9.851*	-7.999*	-5.623**	-5.479**	-5.479**	-7.029**	-7.442***	-6.383**	-5.837**	-5.529**	
		(5.392)	(4.613)	(2.858)	(2.383)	(2.383)	(3.053)	(2.804)	(2.762)	(2.558)	(2.389)	
Ethanol	Monthly	-1.296***	0.755**	0.0232	0.909**	-0.262	-0.0327	0.197	0.258	0.0240	-0.399	33,341
		(0.354)	(0.315)	(0.348)	(0.378)	(0.250)	(0.265)	(0.263)	(0.236)	(0.210)	(0.262)	
	Cumulative	-1.296***	-0.585**	-0.478*	-0.262	-0.262	-0.211	-0.167	-0.0660	-0.0532	-0.133	
		(0.354)	(0.286)	(0.258)	(0.250)	(0.250)	(0.235)	(0.216)	(0.202)	(0.184)	(0.181)	
Clustered SE		Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Day FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Controls: Leverage, Size, Profitability, Market-to-book and Dummy Hedge.

Table A14: **Pooled Regressions of Introductions for Variance.** The table reports the average treatment effect for the idiosyncratic variance of stock returns, associated with the introduction of new derivatives in the CME. All five events are pooled in a single regression. We include commodity type, firm and day fixed effects, to capture potentially unobservable heterogeneity across commodities, firms and time. Errors are clustered at the firm level. Table A3 in the Appendix provides information on variables built by means of textual analysis.

	Dependent variable: Idiosyncratic Variance of Stock Returns					
	m1	m2	m3	m4	m5	m6
ATE	-3.580***	-5.462***	-5.495***	-5.313***	-5.186***	-4.830***
	(0.673)	(0.672)	(0.572)	(0.556)	(0.525)	(0.493)
Market-to-book	0.087	-0.363	-0.383**	-0.383**	-0.362**	-0.365**
	(0.229)	(0.253)	(0.178)	(0.166)	(0.165)	(0.172)
Size	0.001	-0.193	-0.190	-0.175	-0.256**	-0.272**
	(0.147)	(0.143)	(0.123)	(0.125)	(0.129)	(0.122)
Profitability	0.429	0.291	-1.216	-0.973	-0.429	-0.775
	(1.761)	(1.557)	(1.212)	(1.099)	(1.006)	(0.939)
Leverage	1.481	2.254	2.516**	2.527**	3.202***	3.287***
	(1.668)	(1.631)	(1.168)	(1.188)	(1.168)	(1.161)
Dummy Hedge	-0.656	0.909	1.138**	0.902	0.460	0.250
	(0.670)	(0.689)	(0.559)	(0.551)	(0.549)	(0.534)
Clustered SE	Firm	Firm	Firm	Firm	Firm	Firm
Commodity FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs	96,120	129,935	161,839	194,779	227,651	260,132

Table A15: **Correlations of Variance of Commodity Prices with the VIX Index.** The table reports the correlations between the variance of prices of the individual commodities and the VIX. We also include the correlations with Real GDP.

	VIX	Butter	Pork belly	Whey	Benzene	Ethanol	Real GDP
VIX	1						
Butter	0.038	1					
Pork belly	0.420	0.326	1				
Whey	0.093	-0.278	-0.030	1			
Benzene	0.365	-0.046	0.165	0.260	1		
Ethanol	0.256	-0.007	0.253	0.401	0.529	1	
Real GDP	-0.236	0.141	-0.111	-0.260	-0.244	-0.382	1