Does Hedging Affect Firm Value? Evidence from a Natural Experiment*

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Abstract

We study how and why hedging affects firms. To mitigate the endogeneity of hedging decisions, we exploit an exogenous change in basis risk in the oil and gas industry. Using a difference-in-differences framework, we find that firms affected by the basis risk shock reduce investment, have lower valuations, sell assets and reduce debt relative to control firms. Our findings are driven by firms with ex ante high leverage. Overall, our results provide evidence that reducing the probability of financial distress and underinvestment risk are first order channels through which hedging affects firm value.

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1 Introduction

Financial hedging plays a central role in risk management. The use of hedges by firms is consistent with the positive valuation effects found in the literature (e.g., Pérez-González and Yun (2013)). However, as Pérez-González and Yun (2013) point out, much less is known about how hedging affects corporate policies. This study seeks to understand how and why hedging affects firms by exploiting the *frictions* firms face when they engage in hedging. Haushalter (2000) shows that basis risk, a key friction firms face in hedging, impacts the amount of financial hedging firms undertake.[1] This study exploits a change in basis risk to identify how financial hedging affects other corporate policies and ultimately firm value.

The decision to hedge is made concurrently with other corporate policies, therefore causal effects are typically difficult to identify. To mitigate this issue, we focus our analysis on a natural experiment, in which Canadian light oil producers experience a plausibly exogenous increase in basis risk, relative to U.S. light oil producers.[2] The relative effectiveness of West Texas Intermediate (WTI) oil-based derivative contracts used by Canadian firms drops by 51.8% as of the first quarter of 2012. The basis risk shock affects both current and potential hedges; therefore, rather than relying on whether a firm endogenously chooses to hedge, our identification relies on all Canadian (treatment) firms suffering from a relative reduction in their ability to hedge. Our empirical design compares outcomes for Canadian light oil producers (treatment firms) to otherwise similar U.S. light oil producers (control firms), both before and after the basis risk shock in a difference-in-differences (DD) framework.

Following the basis risk shock, shareholder value for Canadian (treatment) firms falls by 17% relative to their U.S. counterparts (the control group). This effect is driven by firms that are ex ante more vulnerable to financial distress, i.e. firms with ex ante high leverage. In contrast, low leverage treatment firms do not suffer from the shock relative to their low leveraged U.S. counterparts.[3] We find a similar relative valuation effect between high leverage

[1]Most financial hedges suffer from basis risk, that is, they offer imperfect insurance because the reference asset in derivative contracts typically differs from the exact nature of the risk faced by firms.

[2]We provide a detailed overview in Section 2.3 of why this basis risk shock should be considered exogenous.

[3]We also note that, prior to the shock, highly leveraged Canadian firms have a significantly greater portion of their future production hedged relative to low leveraged Canadian firms (see Section 3 for details).

and low leverage firms when using Tobin's Q, a proxy for firm value (e.g., Jin and Jorion (2006)). These results are consistent with significant value effects being linked with an increased probability of financial distress, providing support for distressed-based theories of hedging (e.g. Smith and Stulz (1985); Stulz (1996)).

We test the impact of hedging on real activities. While firms with ex ante low exposure to distress do not experience any reduction in investment following the basis risk shock, highly leveraged firms implement a significant reduction in investment. In terms of economic magnitude, the reduction observed for highly leveraged treatment firms corresponds to 53.9% of their investment intensity relative to the control group.[4] This result provides empirical support for hedging theories which suggest mitigating underinvestment is an important motivation for hedging (Bessembinder (1991); Froot et al. (1993)).

Theory also links hedging and financial distress with potential competitive effects (e.g. Bolton and Scharfstein (1990)). Therefore, following the basis risk shock, we would expect firms with ex ante low distress to become relatively better positioned to compete on factor markets such as land, labor and capital. To test this hypothesis, we analyze asset sale patterns among Canadian oil firms and find that high leveraged firms are net sellers of assets following the basis risk shock, while low leveraged firms are net acquirers of assets. This result is consistent with competitive effects having an adverse impact on high leverage firms following their reduced ability to hedge effectively.

We also find that high leveraged Canadian firms undertake significantly less net debt issuance than their low leveraged Canadian counterparts following the basis risk shock. If hedging adds value by providing an alternative to holding additional equity capital, the drop in hedging effectiveness should lead high leveraged firms to reduce their leverage. Our findings on debt issuance are directly consistent with this conjecture.

Lastly, we find that Canadian firms significantly reduce their hedging activity relative to their U.S. counterparts. While high oil prices during the post-period lead U.S. firms to hedge aggressively, Canadian firms do not engage to the same degree in hedging activities. Given

[4] Capital expenditures in this industry can be adjusted quickly (see Gilje and Taillard (Forthcoming)). This large relative magnitude corresponds to only two thirds of the standard deviation of quarterly investment intensity in our sample.

the relative loss in hedging effectiveness of WTI-based contracts for Canadian firms following the basis risk shock, this result is consistent with optimal hedging behavior (see Ederington (1979) and Haushalter (2000)).[5]

A key assumption of the difference-in-differences framework is that, in the absence of treatment, both treated and control firms would behave similarly; this assumption is often referred to as the "parallel trends" assumption. Haushalter (2000) and Jin and Jorion (2006) highlight a considerable degree of homogeneity within the oil and gas industry. By construction, our treatment and control firms are similar in many aspects. First, all producers share a common exposure to oil price risk, and this exposure is the main source of business risk. Second, their technology and cost structure are similar (see Gilje and Taillard (Forthcoming)). Third, prior to the shock, all producers have access to a common set of effective financial hedging instruments. As such, we would expect these firms to behave similarly in the absence of treatment. Furthermore, we offer compelling evidence that financial markets view treatment firms similarly to control firms prior to the basis risk shock. We form equally-weighted portfolios of treatment and control firms and find remarkably similar patterns in stock market performance across the two portfolios *prior* to the shock. Lastly, as suggested by Roberts and Whited (2012), we perform placebo tests to provide further support for the parallel trends assumption.

Standard falsification tests (placebo tests) allow us to assess potential unobserved heterogeneity between treatment and control firms. However, they do not rule out confounding explanations specific to the Canadian price dislocation. In particular, the basis risk shock we rely on leads to both a 51.8% reduction in hedging effectiveness, as well as a 7% average reduction in realized prices for Edmonton Par, the Canadian oil price benchmark, relative to WTI. Therefore the drop in valuation and investments we observe could occur because the investment opportunity set is permanently lower for Canadian firms as of Q1 2012.

To assess whether the primary effect we are identifying is a price effect or a hedging effect we undertake several exercises. First, we highlight that there are many time periods between

[5] While differential swaps between Edmonton Par and WTI prices have since emerged, their use remains very limited among our sample of treated firms. Our discussions with bankers and CFOs of Canadian oil firms point to a significant lack of liquidity for these instruments relative to WTI-based derivatives.

the first quarter of 2012 and the third quarter of 2013 when the differential between Edmonton Par and WTI prices is reduced down to marginal levels. Investments and valuation do not recover during these periods, leading us to believe that the effect is not related specifically to episodes of greater price discounts. Second, if our results were driven by lower prices, we should see low leverage treatment firms in Canada cut capital expenditures relative to their low leverage control group in the U.S. However, there is no evidence of this in the data. Third, we formally estimate the oil price exposure of the portfolio of high leverage firms in the pre-period window, and find that the price drop in the post-event window explains only 4.1% of the shareholder impact we observe. Similarly, we estimate the sensitivity of investment to oil prices, and find that only 3% of the 51.8% change in investment we observe is due to a change in prices.[6] These results are consistent with basis risk being the primary factor behind our findings.

Lastly, to further test the potential confounding effect of lower oil prices on our results, we compare our main results to those obtained from estimating the same tests during a time period that experienced a large price drop, but when effective financial hedging tools were available: the oil price crash of 2008. During that period, we find no statistically significant valuation or investment differences across high and low leverage oil producers. This is consistent with high leverage firms having access to effective hedging tools to mitigate the price crash; moreover we confirm that, at the onset of the 2008 oil price shock, high leverage firms are significantly more hedged than low leverage firms. Given that an increase in basis risk is the primary difference between 2008 and 2012, these results are consistent with a hedging-based interpretation of our results.

Previous research has shown that the use of derivatives allows firms to reduce their cost of debt and improve contracting terms in debt markets (see Campello et al. (2011)). Further, Cornaggia (2013) uncovers productivity gains for farmers that obtain insurance products for their crops from the United States Department of Agriculture (USDA). Pérez-González and Yun (2013) use the plausibly exogenous introduction of weather derivatives to show a positive

[6]Estimated based off sensitivities from Gilje and Taillard (Forthcoming)

relation between financial hedging and firm value for utilities.[7] Moreover, Pérez-González and Yun (2013) find that tax driven capital structure motives are unlikely to explain changes in firm value linked to hedging, and argue that additional empirical work is needed to quantify the different channels through which hedging affects firm value.

We contribute to the literature on several dimensions. First, we document that hedging frictions have economically important effects on firm value and real investments. We highlight that this evidence is consistent with hedging theories related to costly financial distress (Smith and Stulz (1985); Stulz (1996)) and underinvestment (Bessembinder (1991); Froot et al. (1993)); suggesting that these channels are of first order importance when understanding hedging policies. Second, we find that the impact of the *removal* of effective hedging tools on firm valuation and real activities is greater than the *introduction* of hedging tools identified in the literature (see Cornaggia (2013), Pérez-González and Yun (2013)). We attribute this result to effective hedging tools allowing firms to support more leverage. Lastly, we are, to the best of our knowledge, the first to provide empirical evidence that that the inability to hedge effectively can have important competitive effects. Overall, our findings provide empirical support for the widespread use of hedging observed in practice.

2 Methodology

In this section, we first provide some background on hedging, basis risk and several institutional details behind our empirical setup. In doing so, we outline the hypothesis we test in our data. We then describe our natural experiment and the corresponding difference-in-differences (DD) framework we implement. We close this section by describing our triple differences (DDD) specifications.

[7]Using panel regressions, Jin and Jorion (2006) find no valuation differences among oil producers that hedge relative to those that do not, while other panel studies (e.g. Allayannis and Weston (2001) for currency hedgers and Carter et al. (2006) for the airline industry) find a positive relation between hedging and firm value. Haushalter et al. (2002) find that the equity value of oil producers is sensitive to the uncertainty of future oil prices.

2.1 Hedging and Basis Risk

Oil producers face significant volatility in the price they get for their main output. Financial instruments such as puts, forwards and collars can guarantee a minimum price (floor) for their output. As such, oil producers can reduce the probability of a negative cash flow realization by entering into financial derivatives contracts to hedge the price of oil they expect to sell in the future.

Financial derivatives contracts used in hedging are based on the price of an underlying asset. In the case of oil, NYMEX financial contracts are based on the West Texas Intermediate (WTI) price, which is the price of oil obtained in Cushing, OK. If the prices obtained by Canadian firms are not perfectly correlated with WTI prices, then Canadian producers that hedge with WTI-based contracts will suffer from what is known as basis risk. Johnson (1960) and Ederington (1979) show that the weaker the correlation is between the reference price in hedging contracts and the price the producers actually get for their product, the less efficient hedging is. Basis risk has been shown to be an important consideration in hedging decisions made by firms (Haushalter (2000)). Firms that face a greater disconnect between the price underlying their financial hedges and the actual prices of their output are significantly less likely to hedge. Our empirical design builds on Haushalter's work and makes use of an exogenous shock to basis risk in order to analyze how oil producers react to a curtailment of effective hedging instruments for oil price risk.

2.2 Outcome variables and Hypotheses

2.2.1 Valuation impact

As a direct extension to Modigliani-Miller (MM) irrelevance propositions, hedging does not impact firm value in a frictionless world. The presence of market frictions will, however, make hedging value relevant. One of the most significant costs hedging instruments can help alleviate is related to the negative spillover effects associated with financial distress. If deadweight or indirect costs are associated with financial distress and a firm can reduce the probability of financial distress in an efficient manner through risk management, then putting in place a hedging program will add value to the firm by reducing the probability of costly financial distress (see Stulz (1996)).

- Hypothesis 1a: We expect firm value to decrease for producers that face an increase in basis risk.

Given that the likelihood of financial distress will be greater for the more leveraged firm, we would expect a curtailment of effective hedging instruments to have a more detrimental effect on firm value for highly leveraged firms.

- Hypothesis 1b: We expect to see a more significant drop in firm value for high leverage firms relative to low leverage firms in the face of increased basis risk.

2.2.2 Investment policies

Hedging can affect firm value through its impact on investment policies. If hedging lowers the probability of financial distress and if financial distress can lead to costly curtailments in capital expenditures, we would expect the ability to hedge (or lack thereof) to influence a firm's investment policies. One channel through which financial distress can cause costly curtailments in capital expenditures is through the underinvestment problem whereby management, acting in the interest of shareholders, will forgo positive NPV projects if most of the benefits accrue to debt holders (see Myers (1977)). Campello et al. (2011) show evidence consistent with another channel through which hedging affects investment programs. They show empirically that hedging lowers the cost of debt and reduces the number of restrictive covenants put in place. This in turn improves the firm's ability to invest (see Bessembinder (1991)). As such, our second hypothesis is the following:

- Hypothesis 2a: We expect firms to reduce their capital expenditures in the face of increased basis risk.

The literature has shown that hedging can alleviate financial distress costs, the underinvestment problem and restrictive debt covenants. As a consequence, we would expect that the more leveraged a firm is, the more severe these debt-related distortions to investment become if access to efficient hedging instruments is suddenly curtailed.

- Hypothesis 2b: We expect highly leveraged firms to reduce their capital expenditures significantly more than low leveraged firms in the face of increased basis risk.

2.2.3 Factor market competition

When hedging effectiveness is significantly reduced, we expect all affected oil producers to be relatively more exposed to downside risk. There are well established theories that link financial strength and predation in product markets (e.g. Bolton and Scharfstein (1990), Brander and Lewis (1986), Maksimovic (1990)). In our context, product market predation effects are unlikely given that firms are price takers. However, oil producers compete for the same production factors; namely land, labor and capital. According to these theories, we would expect that any impact related to debt capacity constraint issues might be exacerbated by factor market competition. This reasoning leads us to our third hypothesis:

- Hypothesis 3: Following an industry-wide reduction in hedging effectiveness, we expect low leverage firms to benefit in terms of factor market competition relative to high leverage firms.

2.3 Natural experiment

Our natural experiment is based on unexpected events in the North American oil industry that led to a significant increase in basis risk for Canadian oil producers relative to U.S. oil producers. Specifically, in the first quarter of 2012 the price movements of Edmonton Par and WTI decoupled due to (1) a lack of refining capacity in Canada, (2) limited takeaway capacity on the four main pipelines taking Canadian oil to the U.S. and (3) a lack of other means to transport the oil to other markets. In the two years prior to the first quarter of 2012, production from new shale discoveries in North Dakota doubled, capturing pipeline capacity that would have otherwise been used for Canadian oil. The decoupling between Canadian oil prices and WTI prices first became apparent when a primary consumer of

Canadian light oil, the BP refinery in Whiting, IN, undertook unplanned maintenance in February 2012, thereby significantly reducing demand for Canadian light oil (see Dow Jones Newswire (February 3rd, 2012)). As it became clear that producers had limited ability to re-route oil to other end-users, the Canadian market suffered a major price dislocation. Given that the dislocation is due to a tightening of pipeline capacity caused by unanticipated shale oil development, as well as refinery outages, the dislocation should be considered exogenous from the perspective of Canadian producers.[8] Compounding these events was the decision by the Obama administration to reject the Federal permit for the Keystone XL pipeline, which would have provided some visibility to easing pipeline constraints (see Eilperin and Mufson (January 18th, 2012).[9] The lack of adequate and consistent takeaway capacity for Canadian oil has meant that there has been a significant change in hedging effectiveness for Canadian firms with Canadian oil prices being significantly more volatile and less correlated with the WTI benchmark prices on which most hedging contracts are written.[10]

Hedging effectiveness can be defined as the reduction in variance of the hedged position relative to the unhedged position. Johnson (1960) and Ederington (1979) show that this measure of hedging effectiveness can be calculated by computing the R^2 of the regression explaining weekly changes in the prices of the underlying asset being hedged with changes in the prices of the benchmark asset used in the financial hedging contracts. The benchmark for Canadian light oil prices is given by the Edmonton Par index. The benchmark asset used in North American energy hedging contracts is the WTI index. The R^2 of the regression relating changes in Canadian light oil prices with changes in WTI prices stands at 0.54 during 2011. The measure exhibits a sudden drop as of the first quarter of 2012. Between the second

[8]We show compelling evidence in the next section that the markets did not anticipate this price decoupling.

[9]Transportation by rail offers an operational hedge for Canadian firms. Despite a doubling of transportation costs, transportation from oil rail tank cars increased 10 fold between Q1 2012 and Q1 2014, representing approximately 5% of all oil exports out of Canada in 2013.

[10]The price dislocations appear sporadically, can extend for several months and be severe in magnitude. It is important to note that our sample firms do not have the capacity to store their production to "smooth out" these price spikes and troughs. For instance, in July 2012, Enbridge had to shut down some of its pipeline routes to the U.S. causing a price dislocation that lasted more than a month (see O'Brien (July 29th 2012)). The U.S. Energy Information Administration (EIA) expects volatility in prices for Canadian oil and the Bakken relative to WTI prices to persist. See for instance: http://www.eia.gov/todayinenergy/detail.cfm?id=10431.

quarter of 2012 and the end of the first quarter in 2013 (the post-event window), the R^2 between Edmonton Par and WTI prices drops by half to 0.26.

This jump in basis risk is significant and clearly illustrated in Figure 1, whereby the correlation between Canadian light oil prices, as proxied by the Edmonton Par reference prices, and WTI prices breaks down after the first quarter of 2012. The lower correlation between Edmonton Par prices and prices for the underlying oil derivative contracts renders WTI-based hedging instruments significantly less effective for Canadian producers after Q1 2012. We use this event to identify the effect of hedging on firm value and real activities by comparing Canadian light oil producers (treatment firms) to otherwise similar U.S. oil producers (control firms), both before and after this basis risk shock in a difference-in-differences (DD) framework.

2.4 Difference-in-differences (DD)

Firms typically determine their hedging policy jointly with other financial and operating policies. Hence in a non-experimental setting, causal links between hedging and firm value are difficult to establish. In this section, we describe how we make use of the quasi-natural experiment described above to test whether the curtailment of effective hedging instruments has a significant impact on firm value, real investment and other corporate activities.

2.4.1 Implementation of DD

The implementation of our causal tests relies on a quasi-experimental setting whereby we obtain plausible exogenous variation in the availability of effective hedging instruments for a subset of firms (treatment group) relative to a comparable set of control firms. The treatment group is comprised of Canadian light oil producers while the control group is comprised of their U.S. counterparts. We compare both sets of oil producers before and after the event in a difference-in-differences (DD) framework.

In our baseline difference-in-differences regressions, we explain an outcome variable $y_{i,t}$ with a post-event dummy variable ($Post_t$), a treatment dummy ($CADummy_i$) and the post-event dummy interacted with the treatment dummy ($Post_t * CADummy_i$):

$$y_{i,t} = \alpha + \beta_1 CADummy_i + \beta_2 Post_t + \beta_3 Post_t * CADummy_i + FirmFE_i + \varepsilon_{i,t}$$

We include firm fixed effects to account for time invariant heterogeneity of firm corporate policies across firms. With firm fixed effects, the direct effect $CADummy_i$ is not identified. The key coefficient of interest in determining whether treated firms respond differently after the sharp increase in basis risk is β_3, the coefficient on the interaction term $Post_t * CADummy_i$. The magnitude and sign on the coefficient of this term is an indication of how treated firms respond relative to control firms once their ability to hedge effectively has been curtailed. With the post-event dummy, the DD framework has the advantage of also controlling for time-invariant differences such as differences in access to capital markets between Canadian and U.S. oil firms.

We estimate the model on three different outcome variables $y_{i,t}$. The first model estimates the effect of the basis risk shock on shareholder value comparing the cumulative stock returns from January 1st 2012, the beginning of the event quarter, up to September 30th 2012 and March 31st 2013, respectively six months and one year after the event quarter. The specifications based on cumulative stock returns can be viewed as a DD model on the market value of equity. The second model extends the first by taking the average quarterly log of Tobin's Q over the year prior to the event quarter for the pre-event observation and the average quarterly log of Tobin's Q over the year that follows the event quarter for the post-event observation. Tobin's Q is often used as a proxy for firm value in the literature (e.g. Jin and Jorion (2006)). The third model uses the average quarterly investment intensity over the year prior to the event quarter for the pre-event observation, and the average quarterly investment intensity over the year that follows the event quarter for the post-event observation. Averaging all quarterly observations in the pre and post period alleviates potential econometric issues related to time dependence in the outcome variable within each firm (see Bertrand et al. (2004)).

Lastly, to ensure the validity of our quasi-natural experiment, the dislocation between

Canadian and U.S. oil prices should not have been anticipated by Canadian producers. To verify the unanticipated nature of the price dislocation, we first read the financial statements and in particular the management discussion and analysis (MD&A) section in Q3 2011 and year-end 2011 of every treated Canadian firm. None of them mention any specific anticipation of a dislocation between realized light oil prices in Canada and WTI prices. Given the regulatory need to disclose any event that could materially impact their results, we take this lack of disclosure as evidence that the event was not anticipated by Canadian oil producers. Our second test is market-based. We separately form two equally-weighted portfolios of treatment and control firms; we then compare their performance in the year prior to the shock to assess whether market participants predicted the impending price dislocation. Figure 2, 3A and 3B show no anticipation of the event by market participants in the run-up to the basis shock.

2.5 Triple differences (DDD)

Finance theory predicts that hedging is valuable for reducing the probability of distress and enabling better access to external capital. Therefore, a negative shock to the effectiveness of hedging instruments should affect firms with higher leverage relatively more (see hypotheses 1b and 2b in Section 2.2 above).

To directly test these hypotheses, we perform a triple difference (DDD) test. We implement this test by splitting both our treatment and control sample into high and low ex ante leverage firms, defined as above and below their respective median group market leverage in the quarter *prior* to the shock.

In our baseline DDD regressions, we explain an outcome variable $y_{i,t}$ with a post-event dummy variable ($Post_t$), a treatment dummy ($CADummy_i$), a high leverage dummy ($HighLev_i$), the double interaction terms ($Post_t * CADummy_i$; $Post_t * HighLev_i$; $CADummy_i *$

$HighLev_i$), and the triple interaction term ($Post_t * CADummy_i * HighLev_i$) :

$$\begin{aligned} y_{i,t} &= \alpha + \beta_1 CADummy_i + \beta_2 Post_t + \beta_3 Post_t * CADummy_i \\ &+ \beta_4 HighLev_i + \beta_5 Post_t * HighLev_i + +\beta_6 CADummy_i * HighLev_i \\ &+ \beta_7 Post_t * CADummy_i * HighLev_i + FirmFE_i + \varepsilon_{i,t} \end{aligned}$$

We include firm fixed effects to account for time invariant heterogeneity of firm policies across firms. With firm fixed effects, all three terms $CADummy_i$, $HighLev_i$, and $CADummy_i * HighLev_i$ are not identified. However, the coefficient of interest is β_7, the coefficient on the triple interaction term. This coefficient estimates whether the difference between the differential response of the ex ante highly levered treated firms relative to their highly levered control group and the differential response of the low leverage treated firms relative to their low leverage control group is significant after the basis risk shock.

3 Data

3.1 Data Construction

Our empirical design requires us to construct a dataset of Canadian light oil producers and a corresponding dataset of U.S. light oil producers. In terms of sample size, a key advantage is the fact that the Canadian and U.S. oil industries are among the largest in the world.[11]

The first significant increase in basis risk occurs during the first quarter of 2012; we define this quarter as our event quarter. We use the four quarters from Q1 2011 to Q4 2011 as our pre-event window; and the four quarters after the event from Q2 2012 to Q1 2013 as our post-event window. All quarterly accounting data comes from Worldscope for Canadian firms and Compustat for U.S. firms. We also collect data on insider ownership from proxy statements.

We complement this data with hand-collected measures of light oil production relative to total production for both Canadian and U.S. firms as of Q4 2011. Detailed disclosure

[11] As of 2011, Canada's oil industry produced over 2.1 million barrels of oil per day and is currently the sixth largest producer of oil in the world (source: http://www.capp.ca/canadaIndustry/oil/Pages/default.aspx).

on production and hedging policies allows us to carefully construct a treatment (Canadian) and control (U.S.) group for our study. This data is necessary in order to determine which Canadian firms are exposed to the basis risk jump in light oil prices that occurs as of Q1 2012 and which U.S. firms can serve as an appropriate control group within the oil and gas Exploration and Production (E&P) universe of firms.

3.1.1 Treatment (Canadian) sample

We describe in this subsection how we obtain the treatment sample. We first download the universe of Canadian oil and gas exploration firms from Worldscope. We then sort the list of firms by total assets at the end of the fourth quarter 2011 (pre-event quarter). From that list, we hand-collect information on the 150 largest publicly-traded firms.

The Canadian Oil and Gas industry is somewhat heterogeneous with regards to the goods they produce and sell on the market. In particular, while most of the oil produced in the U.S. is light to medium grade oil, Canada has a broader variety of oil extracted. For instance, the oil sands of Alberta produce bitumen and heavy oil, which are harder to transport and refine and hence trade at a discount relative to WTI prices. The differential in prices between light oil (WTI benchmark) and heavy oil (WCS benchmark) can actually be hedged and is commonly hedged by heavy oil producers in Canada. As such, we screen the sample based on the amount of *light oil* produced. To do so, we compute the percentage of light oil revenues relative to total revenues for each firm in the sample. We require a minimum of 30% of all 2011 revenues to be derived from light oil sales in order to be included in the final sample. Furthermore, we also exclude a very small number of Canadian producers that operate in the Labrador region (East Coast) and in Alaska, both of which obtain Brent pricing and as such are not affected to the same extent by the price dislocation. The other exclusion criteria include the removal of (1) firms with major midstream (pipelines) and downstream (refining) operations, such as Suncor; (2) firms with significant international operations; (3) firms that have significant exposure to industries outside of oil (conglomerates) and lastly, (4) firms with less than $50M in total assets at the end of 2011. We obtain a treatment sample of 46 Canadian light oil producers.

3.1.2 Control (U.S.) sample

We describe in this subsection how we obtain the control sample. We first download the universe of publicly-traded U.S. oil and gas exploration and production (E&P) firms from Compustat (SIC 1311). We obtain 109 firms. This exclusion criterion based on industry already screens out several oil conglomerates such as ExxonMobil. However, we still need to hand-collect information on all 109 firms to gauge whether these firms are appropriate matches to their Canadian counterparts; in particular we need to screen out firms that are not E&P firms and also those that do not have a significant percentage of their production derived from oil.

There has been a significant rise in the number of studies using propensity score matching (PSM) techniques in order to define a control group (e.g. Almeida et al. (2012)). We do undertake PSM as a robustness check throughout the study, however, we believe our industry focus allows us to perform a reasonable match using a sample based on business characteristics and exposure to similar risks and investment opportunities. To do so, we impose the same list of criteria that we applied to the universe of Canadian oil and gas producers.

Specifically, in terms of type of production, we require at least 30% of total revenues to be derived from oil. We exclude every firm with significant operations outside of the U.S. (for instance Apache) and we remove firms that are not focused on exploration and production (E&P). The restriction to SIC 1311 firms automatically removes oil conglomerates but we still have a handful of midstream operators (pipelines) in the sample. All of them are removed. Lastly, given that our sample of Canadian firms focuses on onshore operations, we also remove every U.S. firm that has a majority of its operations in the Gulf of Mexico. Offshore drilling has very different characteristics from onshore drilling; namely its capital projects require significantly greater capital outlays and take much longer to complete. We are left with a control sample of 38 U.S. oil producers.

3.2 Variable definition and descriptive statistics

In this subsection, we describe our sample along several accounting-based measures of size, leverage, profitability and production characteristics. The variable definitions follow the literature. Namely, Tobin's Q is defined as the ratio of total assets plus market capitalization minus common equity minus deferred taxes and investment tax credit (atq + prccq $\times$ cshoq $-$ ceqq $-$ txditcq) to total assets (atq). Firm size is measured by total assets (atq). Investment intensity is defined as capital expenditures (capxq) normalized by total assets (atq). Market leverage is defined as the ratio of total debt (dlcq + dlttq) to total capitalization (dlcq + dlttq + cshoq * prccq). Profitability is defined as operating profits (oancfq) normalized by total assets (atq). We also compute insider ownership defined as the number of shares held by all directors and officers normalized by the total number of shares outstanding. Lastly, we compute the share of light oil sales for each firm (Light Oil Percentage) by computing the proportion of light oil revenues to total revenues for the fiscal year ending on December 31st 2011.

The hedging measure we construct is similar to the one used by Jin and Jorion (2006) and Bakke et al. (Forthcoming). In particular, we measure both at the year-end 2011 (pre-period) and at the year-end 2012 (post-period) the percentage of oil production that is hedged for the following year. As for the total hedged position, we treat all hedging instruments equally. That is, we apply a $\Delta = -1$ to all linear hedging instruments such as futures, forwards, fixed-price contracts and receive-fixed swaps, as well as all non-linear hedging instruments such as puts and collars. Although the deltas for puts and collars are typically lower than one, we are assuming that firms select puts and collars with guaranteed price levels (floors) that hedge them as effectively as linear hedging instruments against a negative price outcome for oil.

Panel A of Table 1 contains the information for the treatment sample of Canadian light oil producers and control sample of U.S. producers as of Q4 2011. A significant portion of production is comprised of light oil production for both treatment and control firms which both generate, on average, more than 60% of their revenues from light oil production in 2011.

This level of exposure to light oil production is an attractive feature of our research design: It guarantees a significant exposure to the surge in basis risk that occurs as of Q1 2012 for Canadian firms while providing a good match in terms of business characteristics for the control group of U.S. firms.

While Panel A of Table 1 shows similar firm characteristics across treatment and control, it also highlights some heterogeneity across treatment and control firms in terms of firm size, hedging, and leverage. To address these differences, we create a matched sample using propensity score matching (PSM) techniques, whereby we match on all observed firm characteristics, with replacement in order to obtain the best possible match. As can be seen from Panel B of Table 1, the sample of treatment and matched control firms are similar across all observable dimensions.

Panel A and B of Table 2 compare the characteristics of high and low leverage firms within the treatment (Canada) and control (U.S.) sample as of December 31, 2011. Within the treatment group we see in Panel A of Table 2 that high and low leverage Canadian firms match on most firm characteristics, including insider ownership. As theory would suggest, we do observe significant differences in hedging activity, whereby high leverage firms hedge more of their future production at the onset of the basis risk shock.

4 Results

4.1 Stock price performance

In this section, we measure how shareholder value is affected by comparing cumulative stock price returns over the event window. Figure 2 provides a graphical representation of the stock price performance of equally-weighted portfolios of treatment (Canadian) and control (U.S.) oil producers. The figure highlights the close correlation between the two groups of firms throughout 2011, and the strong impact of the basis risk shock on stock returns after Q1 2012. We formally test the magnitude of this difference in Table 3. We measure stock returns over a nine month and a fifteen month window, respectively six months and one year after the event quarter. We find that on average stock prices of treatment firms suffer a greater drop than stock prices of control firms (specifications (1) and specifications (5)), but the drop is not statistically significant for the longer window.[12]

When we subdivide our sample into firms with ex ante high and low exposure to financial distress, as proxied by high and low ex ante leverage levels. We observe that high leverage treatment firms have significantly lower stock returns relative to the high leverage control firms, both for the short and long window of analysis (columns (2) and (6)). We provide graphical evidence of changes in stock prices in the pre-event and post-event periods for the high and low leverage subgroups separately in Figure 3A and Figure 3B. The results are striking. While high leverage treatment (Canadian) firms significantly under-perform their high leverage control (U.S.) group in Figure 3A, the low leverage treatment (Canadian) firms maintain a stock performance almost on a par with their low leverage control (U.S.) firms in Figure 3B. We formally test whether the impact on stock prices for high leverage firms is larger than the difference we observe for low leverage treatment and control firms in specifications (4) and (8) of Table 3. The coefficient on the interaction term in both (4) and (8) of Table 3 is statistically significant, indicating that high leverage firms are affected relatively more by the loss of effective financial hedging than low leverage firms. We also confirm in columns (3) and (7) that low leverage treatment firms do not underperform low leverage control firms after the basis risk shock. Overall, these results are supportive of hypotheses 1a and 1b.

4.2 Firm valuation

In this section we test whether the increased exposure to downside risk caused by the basis risk shock has an effect on firm value. Firm value is proxied by Tobin's Q as is common in the literature (e.g. Jin and Jorion (2006)). Table 4 reports the results. Specification (1) in Table 4 documents that there is no overall effect on treatment firms, a result not supportive of hypothesis 1a. However, when we subdivide the sample into high distress exposure firms (high

[12]Longer time windows may have more statistical noise, which could reduce the power of the tests in specifications (5) through (8) of Table 3.

leverage) and low distress exposure firms (low leverage) firms, we find significant differences in estimates. For high leverage firms, the interaction coefficient in (2) is negative, large in magnitude and statistically significant. For low leverage firms, the interaction coefficient in (3) is positive, but not statistically significant. These specifications imply that firm value is only adversely affected by the basis risk shock for the subset of high leverage firms.

To formally test whether these two types of firms are affected differently, we undertake a triple differencing (DDD) specification in column (4) of Table 4. The triple interaction coefficient β_7 is -0.234, negative and statistically significant. This result implies that the drop in value of high leverage treatment firms relative to high leverage control firms is significantly greater than the change in value of low leverage treatment firms relative to low leverage control firms. Because we are taking the logarithm of Tobin's Q, the -0.234 coefficient represents a 23.4% relative decrease in firm value, a result consistent with hypothesis 1b.

We estimate the regressions presented in Panel A of Table 4 on the matched sample in Panel B of Table 4.[13] Coefficients are similar to those of Panel A, and the triple interaction term in Panel B remains statistically significant. This result suggests that observable differences in treatment and control firms are not a primary driver of the overall effect on firm value we find.

4.3 Investment policies

In this section we measure the impact of having access to effective hedging instruments on firm investment policies. Table 5 Panel A reports the results of our difference-in-differences (DD) and triple differencing (DDD) specifications. We find that Canadian firms reduce investment intensity by 0.024 after the effectiveness of hedging has been reduced. This drop corresponds to 29.6% of the average quarterly investment intensity or 0.457 of the standard deviation of quarterly investment intensity, relative to the investment intensity of U.S. firms. This figure is both economically and statistically significant, and provides evidence consistent with hypothesis 2a.

[13]The number of observations across columns (2) and (3) are not equal due to matching with replacement.

The loss of effective hedging instruments might not affect all treatment firms uniformly. According to hypothesis 2b, firms with ex ante exposure to distress (high leverage firms) should be more affected. In specifications (2) and (3) of Table 5 Panel A, we subdivide our sample into firms with high leverage (2) and firms with low leverage (3), and find that our main result is being driven by firms with high leverage. The economic interpretation of the -0.042 coefficient in specification (2) implies that high leverage firms experience a relative reduction of 53.9% of their average quarterly investment intensity, or 0.67 of the standard deviation of quarterly investment intensity. Conversely, firms with low leverage have a small negative coefficient that is not statistically significant. To formally test whether firms with high leverage are more affected than firms with low leverage, we undertake a triple differencing specification in (4), and find that the triple interaction term is negative and statistically significant. These results provide direct evidence that the event under study affects real investment decisions by firms. This adverse impact is significantly more pronounced for firms with ex ante high leverage relative to firms with low leverage.

We estimate the regressions presented in Panel A of Table 5 on the matched sample in Panel B of Table 5. Coefficients are similar to those of Panel A, and the triple interaction term in Panel B is larger in magnitude and statistically significant. This result suggests once again that the observable differences in treatment and control firms in our main sample are not a primary driver of the overall result we observe.

Our empirical tests highlight significant heterogeneity in treatment effects linked to ex ante distress exposure, proxied by leverage. However, leverage is not randomly assigned, which could potentially be a concern regarding our interpretation. We do not take a stance on why firms may elect to take on leverage, instead our identification relies on the fact that our sample firms made their leverage decision without anticipation of a significant basis risk shock. To the extent that there is a fixed omitted variable affecting leverage and our outcome variables, this effect is also differenced out in our specification.

4.4 Factor Market competition

Our valuation results highlight significant differences within the treatment group: After the shock, firm value is reduced for firms with more exposure to distress (high leverage) firms, while firms with less exposure to distress (low leverage firms) are not affected. One interpretation of these results is that low leverage firms gain a competitive edge when competing with high leverage firms for limited resources including land, human capital and external financing from capital markets. As such, our valuation results provide indirect evidence that the impact of the curtailment of effective hedging instruments can be compounded by strategic interactions among industry players. This result extends the scope of the literature on product market competition and leverage (see Bolton and Scharfstein (1990)).

To test for factor market competition effects, we gauge whether low leverage firms behave differently than high leverage firms in terms of asset sales after the shock. Specifically, we define a commonly used measure of net asset acquisitions as asset acquisitions minus asset dispositions divided by beginning of period total assets. We then test whether this measure differs systematically across highly leveraged and low leveraged Canadian oil producers during the post-event period. We compute the net acquisitions measure over two time periods: (1) 2012 and (2) 2012 - Q3 2013.[14] The results are shown in Table 7. We find that high leverage firms have significantly more net asset sales than their low leverage counterpart. The difference between the two groups is statistically significant at the 5% level for both sample periods. On average, low leverage firms are net acquirers, while high leverage firms are net sellers of assets during the post-event period. This test provides more direct evidence that factor market competition effects play a significant role in explaining differences between high and low leverage Canadian oil firms after the basis risk shock.

4.5 Financial policies

We document that treatment firms with ex ante high leverage suffer the most from the basis risk shock. Under the hypothesis that hedging affects firm value by reducing the probability

[14] It corresponds to the most recent quarterly filing for all sample firms at the time of our data collection.

of financial distress, we would expect firms with ex ante high exposure to financial distress to reduce the amount of debt they carry following the basis risk shock. To test this conjecture, we run firm-level regressions that measure the change in debt issuance accross treatment firms with different ex ante exposure levels to distress (High Leverage vs. Low Leverage). Net debt issuance is defined as the end of period total debt minus beginning of period total debt; we normalize the measure by beginning of period total assets.[15] Firm observations are computed for two separate time periods, one for the normalized debt issuance levels in the four quarters prior to the loss of effective hedging instruments (Q1 2011 to Q4 2011) and one for the four quarters after (Q2 2012 to Q1 2013).

Table 7 reports the results. The overall effect of the basis risk on net debt issuance among the treatment group is not significant (see column (1)). However, this overall effect masks considerable heterogeneity within the treatment firms. We find that treatment firms with ex ante high exposure to financial distress actively reduce their net debt issuance by a significantly greater amount than treatment firms with ex ante low exposure to financial distress (columns (2)-(4)). These results are supportive of the hedging theories that emphasize the value of hedging with respect to costly financial distress.

4.6 Hedging policies

Table 8 reports the estimate of regressions that compare the hedging behavior of Canadian oil producers (treatment) relative to U.S. oil producers (control), before and after the basis risk shock. We use a regression form of difference-in-differences for this comparison. As specification (1) in Table 8 shows, Canadian firms reduce hedging relative to U.S. firms, after the basis risk shock. The economic interpretation of the interaction coefficient is that Canadian firms reduce hedging by 31.4% from their average pre-shock level, relative to U.S. firms. It is important to note, that hedging by the control group (U.S. firms) increases overall in the post period. Given historically high prices, U.S. firms may be increasing their hedging activity due to concerns regarding the risk of lower oil prices in the future. We find similar

[15]The results are almost unchanged if we normalize by the average total assets over the period or the end of period total assets.

results when estimating the regression in the matched sample, as shown in specification (2) of Table 8. These results are consistent with hedging theories that predict a decrease in hedging activity following an increase in basis risk (e.g., Ederington (1979)).

5 Validity of Empirical Design

In this section, we provide evidence that our empirical design has internal validity. In particular, the difference-in-differences framework relies on the assumption that treated and control firms behave similarly prior to the treatment period ("parallel trend" assumption). We perform a series of falsification tests to assess the validity of this assumption in our data as well as discuss the influence of other potential confounding factors in the context of our study.

5.1 Parallel trend assumption

The key identifying assumption in DD estimators is the "parallel trend" assumption. The control group acts as the counterfactual in our experiment and the parallel trend assumption implies that, in the absence of treatment, the average change in the outcome variable would be no different across treatment and control firms. Although it is not possible to directly test this assumption, the oil and gas industry has the advantage of offering a relatively homogenous group of firms. In particular, the treatment and control firms are similar across many dimensions, including technology, production output, and cost structure. An informal confirmation of this assumption can be found in Figure 2, 3a and 3b. The graphical evidence shown in these figures highlight a very high degree of correlation in daily stock returns between treatment and control firms both overall and within high and low leverage firms *prior* to the event quarter. This graphical evidence can be construed as evidence that the markets did not view the treatment and control firms as subject to significantly different economic forces.

To more formally gauge the validity of the "parallel trend" assumption, we perform several placebo tests to assess whether firms behave similarly prior to the event (see Roberts and Whited (2012)). For this test, we create a placebo event in Q4 2010, and compare capital expenditures and Tobin's Q in the four quarters after this placebo event with the four quarters before this placebo event.[16] The results from these regressions are presented in Table 9 (Tobin's Q) and Table 10 (Capital Expenditures). None of the interaction coefficients are statistically significant, indicating that both treatment (Canadian firms) and control (U.S. firms) had parallel trends prior to the treatment event. Additionally, none of the interactions with the high leverage dummy variable are statistically significant, indicating that high leverage and low leverage firms also had similar trends prior to treatment. The coefficient on the placebo post dummy in Table 10 is positive and statistically significant, indicating that there was an overall positive trend in investment by all firms over the placebo period. Oil prices were higher in 2011 than in 2010, so a positive coefficient on the placebo dummy is not surprising and does not invalidate the parallel trend assumption as both treatment and control firms increased their drilling activity during the period.

These results provide supporting evidence towards treatment and control firms, as well as low and high leverage firms, having similar trends in firm value in the two years leading up to the oil price dislocation event in Q1 2012.

5.2 Comparison to 2008 macro shock

Standard placebo tests described in the previous section allow us to assess the potential effect of unobserved heterogeneity between treatment and control firms (parallel trend assumption). However, they do not rule out confounding explanations specific to the Canadian price dislocation we analyze in this study. For instance, it could be the case that whenever there is a negative shock to investment opportunities (e.g. lower oil prices), firms with more leverage are more adversely affected. If it is the case that real investment and firm valuation of high leverage firms is always lower when there is a negative macro shock to oil prices, then this might be a cause for concern for the interpretation of our results.

[16] The choice of Q4 2010 as the placebo event quarter is driven by the desire to be as close to the real event quarter as possible without having the placebo post-event window overlap with the real event quarter.

To address this issue, we compare the investment decision and firm valuation effects of high leverage and low leverage Canadian firms during the negative commodity price shock of 2008 and subsequent recovery. Table 11 and Table 12 report regression estimates for changes in firm value and capital expenditures around the negative oil price shock in 2008.[17] The specifications used are the same as those found in Table 4 and Table 5. While the direct effect of the shock is to reduce both investment and firm value, we find no differential effects across U.S. and Canadian firms nor across high and low leverage firms (see $\beta_5 + \beta_7$ in the last row of Table 11 and 12) during the 2008 oil price shock.

To understand this result better, we collected hedging data for our sample firms at the onset of the price shock (Q2 2008). Interestingly, we find that both Canadian and U.S. highly leveraged firms have significantly higher hedging levels relative to their low leverage peers. In 2008, when hedging was effective for both Canadian and U.S. firms, high leverage Canadian (and U.S.) firms did not underperform or reduce drilling more than their low leverage counterparts. In 2012 (our event period), high leverage Canadian firms *did* suffer relatively more than low leverage Canadian firms relative to their U.S. control group. Given that an increase in basis risk is the primary difference between 2008 and 2012, these results are consistent with a hedging based interpretation of our results.

Our empirical design sets a high bar for alternative non-hedging based interpretations of our results. First, all the results for the treatment firms are relative to the control group, their U.S. counterparts. As such, any shock affecting both Canadian and U.S. oil firms are differenced away. Second, all time-invariant differences between treatment and control firms are also differenced away. Third, our empirical specification requires that a non-hedging based interpretation explain valuation and investment responses of high leverage Canadian firms relative to low leverage Canadian firms before and after the basis risk shock, relative to the difference observed between high leverage and low leverage U.S. firms. Therefore, an argument linked to investment opportunities being different in Canada would need to apply only to high leverage firms, as any joint effect on high and low leverage Canadian firms is

[17] Because several firms were not publicly-traded at the time, the sample size is lower than in our main tests.

differenced out. Furthermore, an alternative explanation linked to higher leverage firms being more affected by a negative price shock would need to reconcile why both high leverage and low leverage firms are similarly affected by the 2008 negative price shock, a time period when hedging remained effective.

5.3 Hedging changes vs. Investment opportunity changes

A key issue in our study is whether the treatment firm responses we identify are due to the inability to hedge effectively going forward or due to lower investment opportunities, i.e. lower realized Edmonton Par prices. Our comparison with the 2008 price shock already shows that the significant differences observed between high and low leverage firms in our sample are not found during one of the most severe price drop episode in recent history. In this section, we perform another test to distinguish between the two potentially confounding explanations of hedging ability vs. lower investment opportunities.

The idea behind our additional test is straightforward. We first select a pre-period window over which we estimate a one factor model for the equally-weighted portfolios of highly leveraged and low leveraged Canadian firms in our sample. We estimate the one factor model using Edmonton prices over the period 2011. Using the estimated coefficients, we then forecast portfolio values in the post-period (2012-2013) *conditional* on observing the realized Edmonton Par prices. Figures 4A and 4B show the results of this exercise for the high (respectively low) leverage portfolios of Canadian light oil producers. The shaded area provides the 95% confidence interval of the forecasted values for our portfolios. Edmonton Par price movements in the post period predict a 4.1% drop in the portfolio value of high leverage firms. This exercise shows that, although the Edmonton par price drop in the first part of 2012 leads to lower forecasted portfolio values, the realized drop in value for the high leverage portfolio is significantly greater in magnitude; to the point that the portfolio value for the high leverage portfolio remains outside of its 95% confidence interval for the remaining of the post-period. In contrast, the realized values for the low leverage portfolio stay remarkably close to their forecasted values derived from the one factor model throughout the post-period. We conclude from this exercise that high leverage treatment firms experience a price drop that cannot be explained solely by the lower realized Edmonton Par prices in the post-period. This additional test thus provides further support for the hedging-based interpretation of our results.

6 Conclusion

More than 90% of all Fortune Global 500 companies report using derivatives to manage risks. Moreover, the benefits of hedging are theoretically well understood. Yet empirical evidence documenting the channels through which hedging affects firm value is still limited. The main reason for this lack of evidence is due to the endogenous nature of hedging policies. As such, inferring causality is a delicate exercise in most situations. The objective of this study is to exploit an important hedging friction, basis risk, within the context of a natural experiment in the oil and gas industry to identify how and why hedging affects firms.

The empirical design exploits the fact that Canadian light oil producers (treatment firms) suffer from a significant basis risk shock relative to their U.S. counterparts (control firms). We find that investment, firm value, and stock price effects are concentrated among treatment firms that have higher ex ante exposure to financial distress, i.e. those with high leverage at the onset of the shock. This group of firms actively sells assets, cuts back on capital expenditures and reduces debt following the basis risk shock. The economic magnitudes identified in this study point towards significant value implications for hedging, particularly for firms that have high operational and financial leverage. Our results provide direct empirical evidence that reducing the probability of financial distress (Smith and Stulz (1985); Stulz (1996)) and mitigating underinvestment (Bessembinder (1991); Froot et al. (1993)) are first order reasons why firms hedge. Additionally, we highlight that the ability to hedge can have important implications for competition across firms (Bolton and Scharfstein (1990)).

Our study documents the benefits of having access to financial tools that can effectively lower the exposure to a given risk. In the wake of recent financial reforms (e.g. Dodd Frank), there has been a push towards the increased use of standardized exchange traded derivatives, with new regulations being imposed on over-the-counter (OTC) derivatives. The constraints on financial innovation imposed by such new regulations might lead to negative spillover effects for firms relying on the financial services sector to design and provide custom-made hedging tools.

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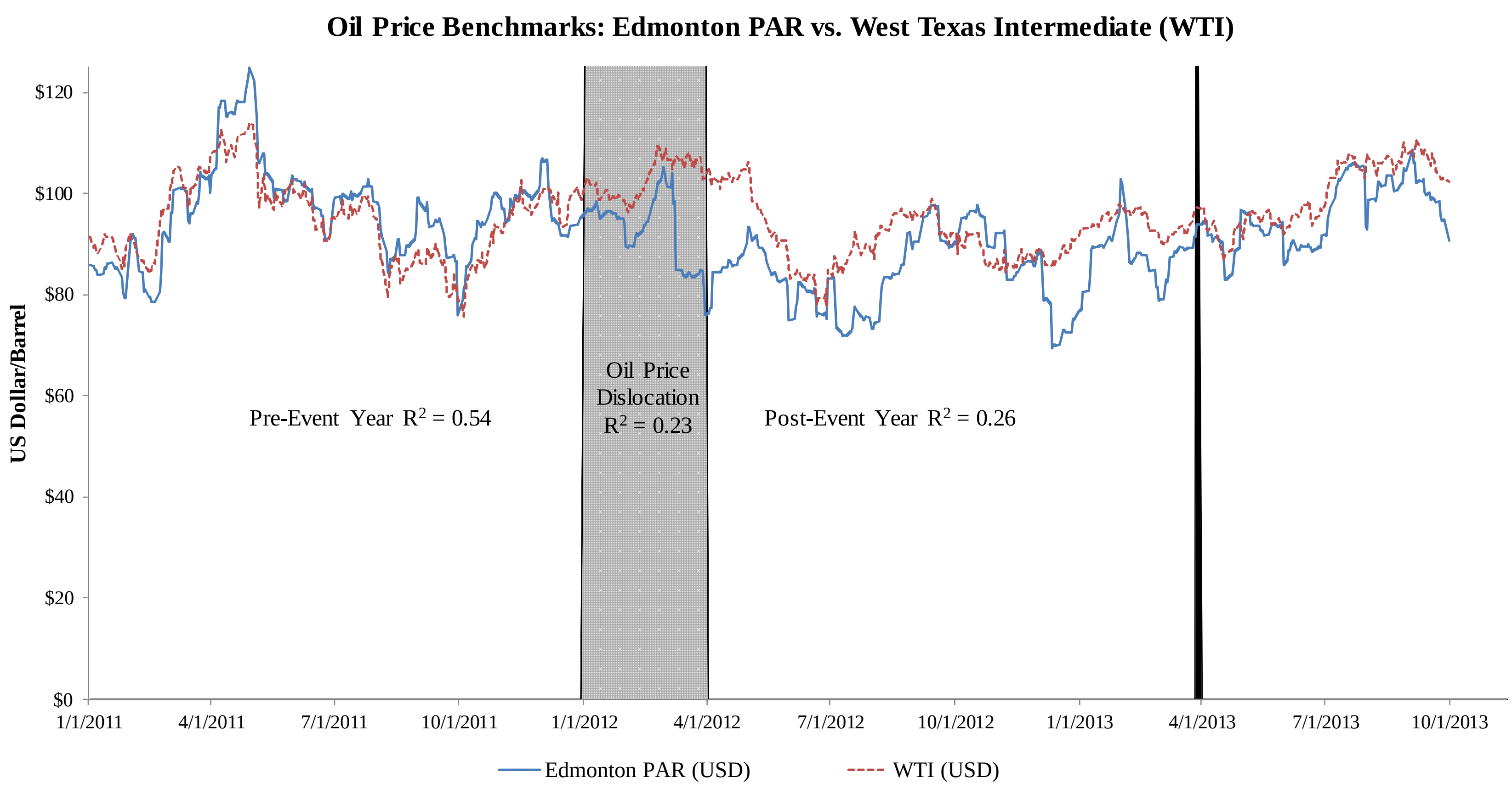

Figure 1. Oil Price Benchmark Comparison

This figure plots separately the benchmark light oil prices for the treatment (Canadian) and control (U.S.) firms in this study. The Canadian benchmark is the Edmonton PAR and the U.S. benchmark is the West Texas Intermediate (WTI). The Edmonton PAR prices were converted to U.S. dollars (USD) to take into account the exchange rate between the two countries. All data is from Bloomberg. The pre-event year used in the main tests in this study is 2011, the year prior to the price dislocation. The post-event period used to measure firm outcomes in this study is the post-event year, running from Q2 2012 to Q1 2013. The first major dislocation is highlighted in Q1 2012. The R^2 of the regression of weekly changes in Edmonton Par prices on weekly changes in WTI prices provides a measure of the comovement between the two oil price indices. It is a commonly used measure of basis risk (see Ederington (1979)).

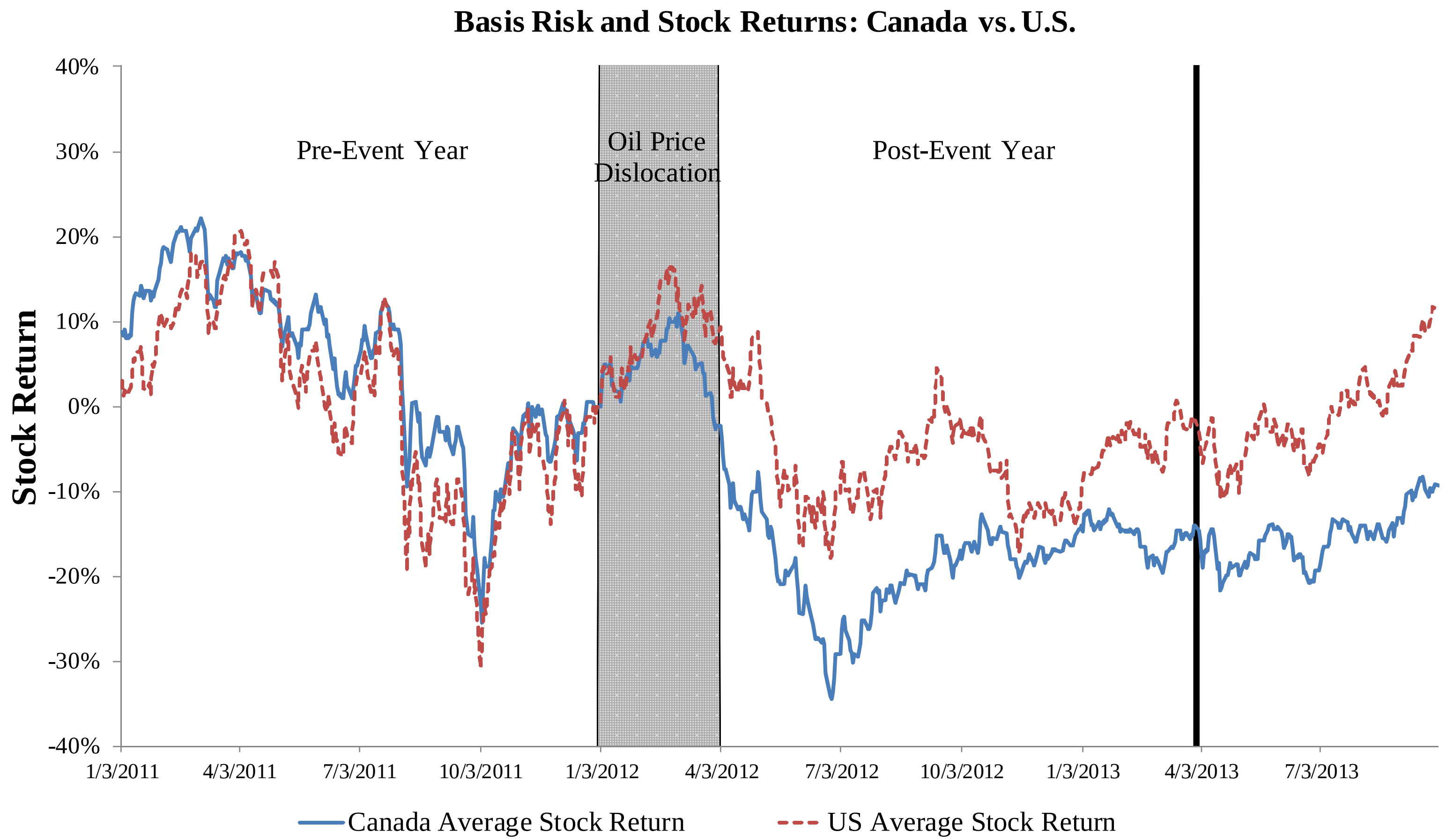

Figure 2. Effect of an Increase in Basis Risk on Stock Returns

This figure plots separately the cumulative stock returns for the equal weighted portfolio of treatment (Canadian) and control (U.S.) firms used in this study. The pre-event year used in the main tests in this study is the year prior to the basis risk shock, running from Q1 2011 to Q4 2011. The first major price dislocation and drop in correlation between Canadian and U.S. benchmark prices is highlighted in Q1 2012. The post-event period used to measure firm outcomes in this study is the post-event year, running from Q2 2012 to Q1 2013.

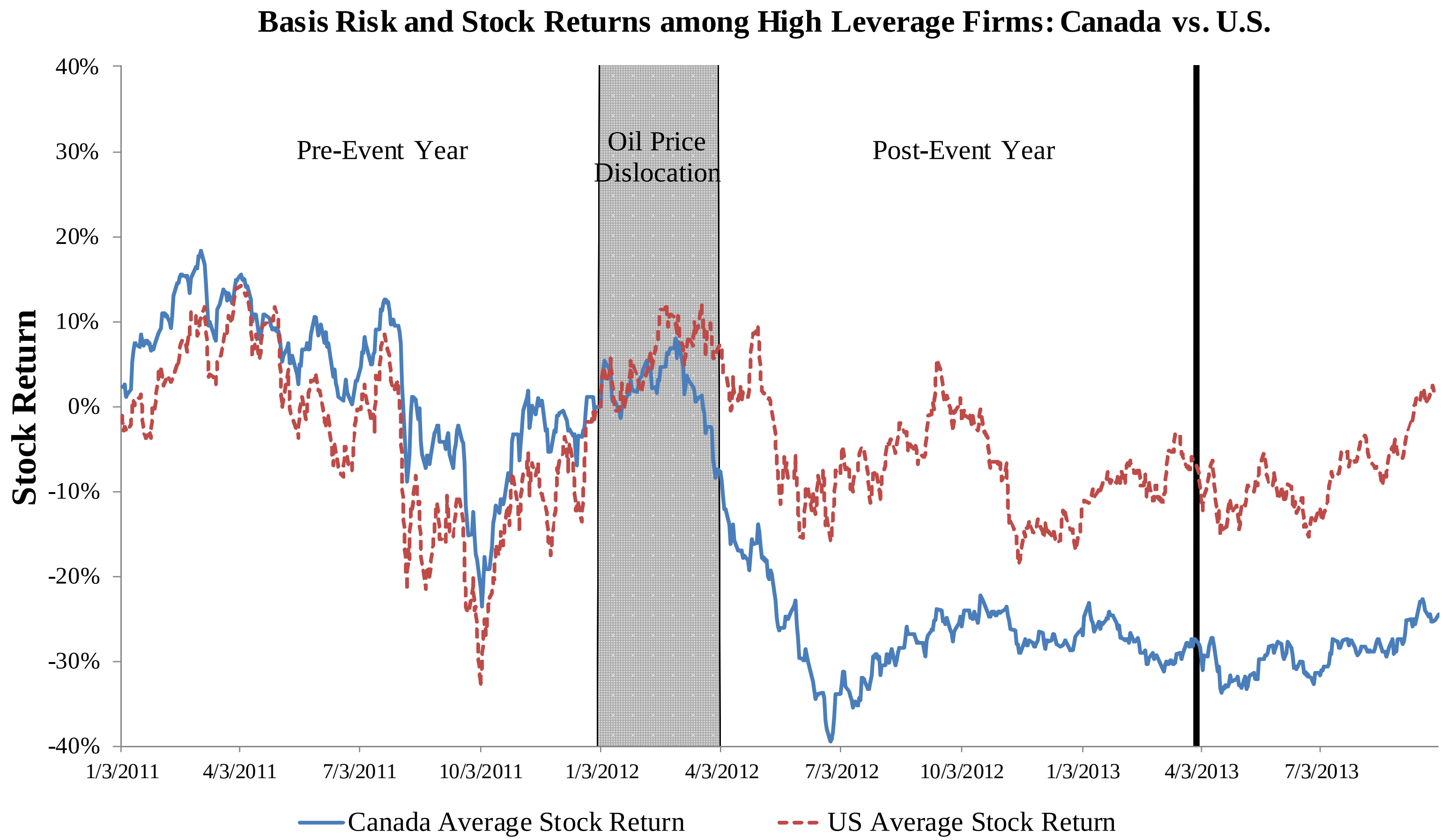

Figure 3A. Effect of an Increase in Basis Risk on Stock Returns: High Leverage Firms
This figure plots separately the cumulative stock returns for the equally-weighted portfolio of highly leveraged treatment (Canadian) and control (U.S.) firms used in this study. High leverage firms are defined as firms with market leverage above their peer median market leverage as of Dec 31, 2011.

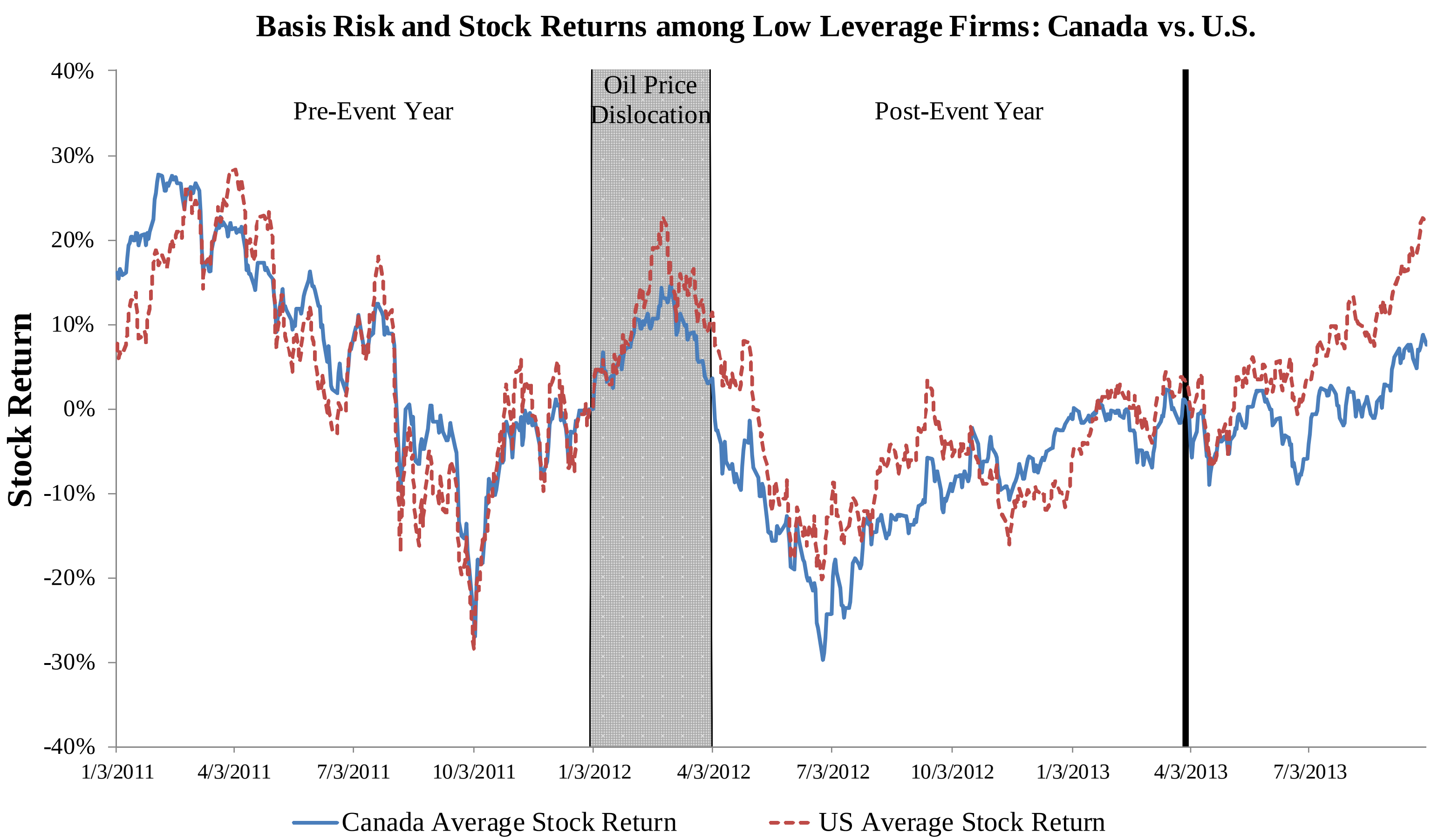

Figure 3B. Effect of an Increase in Basis Risk on Stock Returns: Low Leverage Firms

This figure plots separately the cumulative stock returns for the equally-weighted portfolio of low leverage treatment (Canadian) and control (U.S.) firms used in this study. Low leverage firms are defined as firms with market leverage below their peer median market leverage as of Dec 31, 2011.

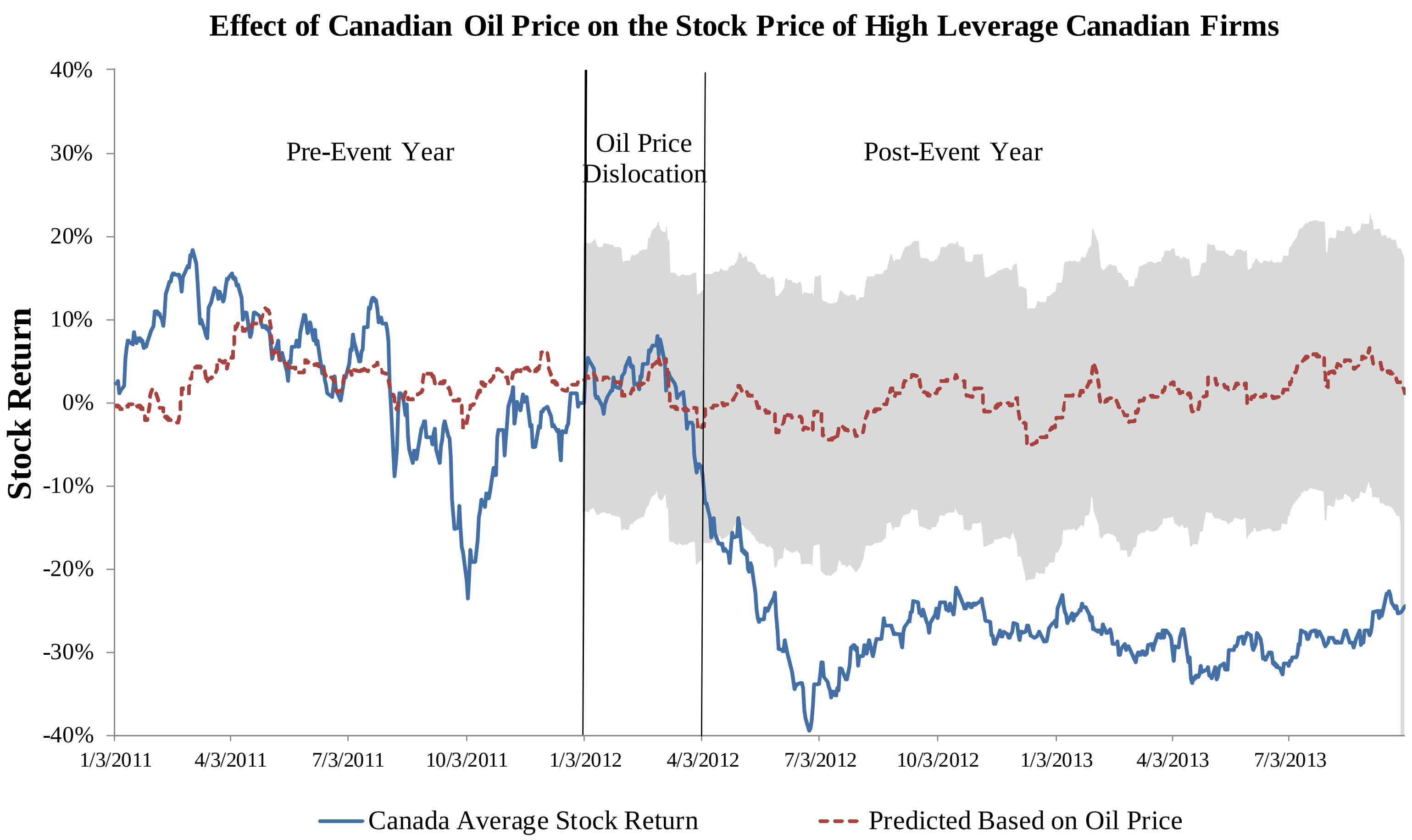

Figure 4A. Effect of Canadian Oil Price on the Stock Price of High Leverage Canadian Firms
This figure plots separately the cumulative stock returns for the equally-weighted portfolio of highly leveraged treatment (Canadian) and the predicted cumulative return for highly leveraged Canadian returns based on a one factor model estimated over the pre-event year (factor: Edmonton Par benchmark). The shaded area is the 95% confidence interval for the predicted returns.

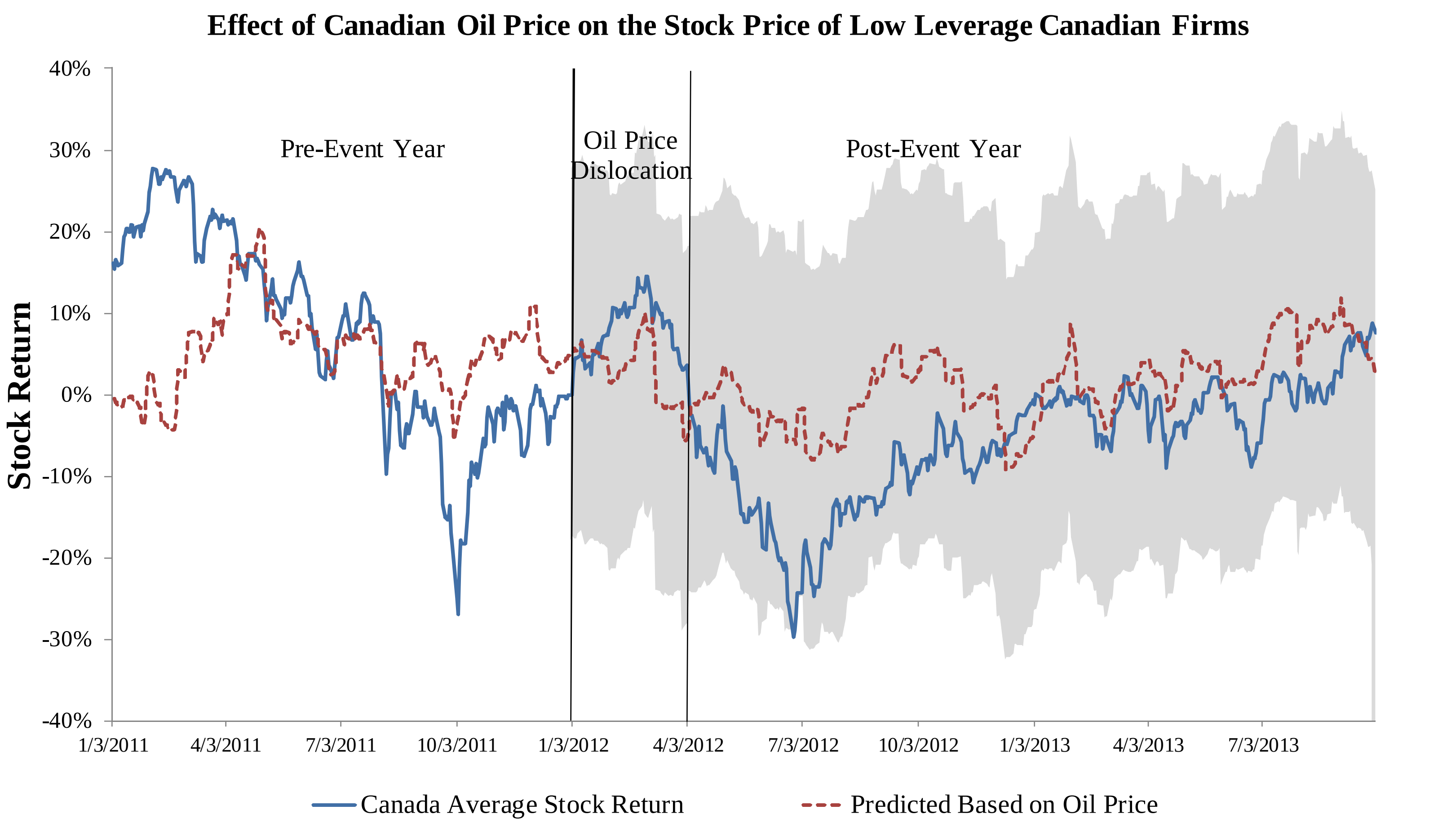

Figure 4B. Effect of Canadian Oil Price on the Stock Price of Low Leverage Canadian Firms
This figure plots separately the cumulative stock returns for the equally-weighted portfolio of low leveraged treatment (Canadian) and the predicted cumulative return for low leveraged Canadian returns based on a one factor model estimated over the pre-event year (factor: Edmonton Par benchmark). The shaded area is the 95% confidence interval for the predicted returns.

Table 1. Sample Descriptive Statistics

This table provides summary statistics of firm characteristics for our sample of oil and gas firms. The means are computed as of Q4 2011, the quarter prior to the event under study. Our sample consists of treatment (Canadian) firms and control (U.S.) firms. In Panel A, we include all firms that satisfy our screening criteria detailed in Section 3 of the main text. In Panel B, we provide a one-to-one matched sample by allowing for resampling among control firms. The procedure used is the same as in Almeida et al. (2012). The variable definitions are as follows. Tobin's Q is defined as the ratio of total assets plus market capitalization minus common equity minus deferred taxes and investment tax credit (atq + prccq × cshoq − ceqq − txditcq) to total assets (atq). Firm size is measured by total assets (atq). Investment intensity is defined as quarterly capital expenditures (capxq) normalized by total assets (atq). Market leverage is defined as the ratio of total debt (dlttq + dlcq) to total capitalization (dlttq + dlcq + cshoq * prccq). Profitability is defined as quarterly operating profits (oancfq) normalized by total assets (atq). Insider ownership is the number of shares held by insiders divided by the number of shares outstanding. We compute the share of light oil sales for each firm (Light Oil Percentage) by computing the proportion of light oil revenues to total revenues for the fiscal year ending on December 31st 2011. Lastly, hedging activity is measured as the percentage of future light oil production hedged, where future production is measured as the realized light oil production for the following 12 months. N is the number of firms. The p-values of the differences in means (t-tests) between treatment and control are given in the third column.

Panel A: All Firms

	Sample		
	Treatment Firms (Canada)	Control Firms (U.S.)	p-value
Assets ($ Millions)	1466.51	3035.77	0.072
Light Oil Percentage	0.61	0.65	0.381
Percent of Oil Production Hedged	0.36	0.49	0.039
Tobin's Q	1.33	1.54	0.162
Market Leverage	0.20	0.27	0.043
Profitability	0.18	0.23	0.050
Investment Intensity	0.08	0.10	0.119
Insider Ownership	0.09	0.12	0.468
N	46	38	

Panel B: Matched Sample

	Matched Sample		
	Treatment Firms (Canada)	Control Firms (U.S.)	p-value
Assets ($ Millions)	1466.51	1534.09	0.92
Light Oil Percentage	0.61	0.65	0.34
Percent of Oil Production Hedged	0.36	0.43	0.15
Tobin's Q	1.33	1.32	0.93
Market Leverage	0.20	0.17	0.20
Profitability	0.18	0.20	0.47
Investment Intensity	0.08	0.09	0.38
Insider Ownership	0.09	0.10	0.83
N	46	46	

Table 2. Sample Firms: High vs. Low Leverage Comparison

This table compares high and low leverage firms within the treatment (Canadian) group in Panel A and within the control (U.S.) group in Panel B. The comparison is made as of Q4 2011, the quarter prior to the event under study. All variables are defined in Table 1. A firm has high (low) leverage if its market leverage is above (resp. below) the median market leverage within the treatment and control group respectively, as of Q4 2011. The p-values of the differences in means (t-tests) between high and low leverage firms are given in the third column.

Panel A: Treatment firms

	Canadian Firms		
	High Leverage	Low Leverage	p-value
Assets ($ Millions)	1768.55	1164.47	0.477
Light Oil Percentage	0.61	0.61	0.951
Percent of Oil Production Hedged	0.44	0.27	0.074
Tobin's Q	1.03	1.63	0.007
Market Leverage	0.32	0.09	0.000
Profitability	0.18	0.18	0.908
Investment Intensity	0.08	0.08	0.679
Insider Ownership	0.08	0.11	0.279
N	23	23	

Panel B: Control firms

	U.S. Firms		
	High Leverage	Low Leverage	p-value
Assets ($ Millions)	2189.96	3881.57	0.267
Light Oil Percentage	0.58	0.73	0.044
Percent of Oil Production Hedged	0.53	0.46	0.405
Tobin's Q	1.27	1.80	0.003
Market Leverage	0.41	0.14	0.000
Profitability	0.17	0.29	0.003
Investment Intensity	0.09	0.11	0.284
Insider Ownership	0.15	0.09	0.361
N	19	19	

Table 3. Hedging and Stock Returns

This table reports firm-level regressions that measure cumulative stock returns for treatment (Canadian) vs. control (U.S.) firms. The treatment is defined as a loss in hedging effectiveness due to a significant increase in basis risk for Canadian light oil producers as of Q1 2012. U.S. light oil producers serve as the control group. The dependent variable is the nominal cumulative stock return from January 1, 2012 (onset of event quarter) to September 30, 2012 (short window) and March 31st 2013 (long window). The Canada dummy variable takes the value of one for treatment (Canadian) firms. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Dec. 31 2011. The High Leverage dummy variable takes the value of one for firms with high leverage. T-statistics are reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$StockReturn_i = \alpha + \beta_1 CA\ Dummy_i + \beta_2 HighLeverage_i + \beta_3 CA\ Dummy_i * HighLeverage_i + \varepsilon_i$$

Dependent Variable = Cumulative Stock Returns

	Short Window = [Jan 1, 2012 to Sep 30, 2012]				Long Window = [Jan 1, 2012 to Mar 31, 2013]			
	All Firms	High Leverage	Low Leverage	All Firms	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(β_1) Canada Dummy$_i$	-17.044**	-31.178***	-2.910	-2.910	-13.642	-31.774***	4.490	4.490
	[-2.51]	[-4.83]	[-0.25]	[-0.31]	[-1.43]	[-3.53]	[0.29]	[0.36]
(β_2) HighLeverage$_i$				4.167				-7.221
				[0.43]				[-0.55]
(β_3) High Leverage$_i$ * Canada Dummy$_i$				-28.268**				-36.264**
				[-2.16]				[-2.03]
R^2 Within	0.072	0.368	0.002	0.153	0.024	0.237	0.002	0.164
N - Total Firm Years	84	42	42	84	84	42	42	84

Table 4 Panel A. Hedging and Firm Value

This table reports firm-level regressions that measure the change in firm value for treatment (Canadian) vs. control (U.S.) firms. The treatment is defined as a loss in hedging effectiveness due to a significant increase in basis risk for Canadian light oil producers as of Q1 2012. U.S. light oil producers serve as the control group. Firm value is proxied by the logarithm of Tobin's Q. Firm quarter level observations are aggregated into two separate time periods, one for the average firm value in the four quarters prior to the loss of effective hedging instruments (Q1 2011 to Q4 2011) and one for after (Q2 2012 to Q1 2013). The resulting dataset has two time periods per firm; one pre-treatment, one post-treatment. The Canada dummy variable takes the value of one for treatment (Canadian) firms. The Post dummy takes a value of one for the time period after the event. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Dec. 31 2011. The High Leverage dummy variable takes the value of one for firms with high leverage. Column 1 shows the results for the difference-in-differences specification. Columns 2 and 3 show the results for the difference-in-difference specification estimated on the subset of high (respectively low) leverage firms. Column 4 presents results for the triple difference specification. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * Post_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * Post_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Logarithm of Tobin's Q

	Pre-Period = [Q1 2011 to Q4 2011], Post-Period = [Q2 2012 to Q1 2013]			
	Full Sample			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $Post_t$	-0.206***	-0.135***	-0.276***	-0.276***
	[-6.60]	[-3.56]	[-6.20]	[-6.23]
(β_3) Canada $Dummy_i$ * $Post_t$	-0.020	-0.137**	0.097	0.097
	[-0.43]	[-2.33]	[1.36]	[1.37]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $Post_t$				0.142**
				[2.44]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $Post_t$				-0.234**
				[-2.55]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.495	0.575	0.496	0.531
N - Total Firm Years	168	84	84	168

Table 4 Panel B. Hedging and Firm Value, Matched Sample

This Panel reports the same regression specifications as Panel A, but estimated on the matched sample (see Section 3 for details). Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * Post_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * Post_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Logarithm of Tobin's Q

	Pre-Period = [Q1 2011 to Q4 2011], Post-Period = [Q2 2012 to Q1 2013]			
	Matched Sample			
	All Firms	High Leverage	Low Leverage	All Firms
	(5)	(6)	(7)	(8)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $Post_t$	-0.269***	-0.219***	-0.307***	-0.307***
	[-11.06]	[-6.03]	[-9.83]	[-9.88]
(β_3) Canada $Dummy_i$ * $Post_t$	0.043	-0.053	0.127*	0.127**
	[0.99]	[-0.92]	[2.01]	[2.02]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $Post_t$				0.088*
				[1.86]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $Post_t$				-0.180**
				[-2.12]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.593	0.636	0.595	0.613
N - Total Firm Years	184	86	98	184

Table 5 Panel A. Hedging and Capital Expenditures

This table reports firm-level regressions that measure the change in investment activity for treatment (Canadian) vs. control (U.S.) firms. The treatment is defined as a loss in hedging effectiveness due to a significant increase in basis risk for Canadian light oil producers as of Q1 2012. U.S. light oil producers serve as the control group. The dependent variable is capital expenditures scaled by beginning of quarter assets. Firm quarter level observations are aggregated into two separate time periods, one for the average investments in the four quarters prior to the loss of effective hedging instruments (Q1 2011 to Q4 2011) and one for the four quarters after (Q2 2012 to Q1 2013). The resulting dataset has two time periods per firm; one pre-treatment, one post-treatment. The Canada dummy variable takes the value of one for treatment (Canadian) firms. The Post dummy takes a value of one for the time period after the event. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Dec. 31 2011. The High Leverage dummy variable takes the value of one for firms with high leverage. Column 1 shows the results for the difference-in-differences specification. Columns 2 and 3 show the results for the difference-in-difference specification estimated on the subset of low (respectively high) leverage firms. Column 4 presents results for the triple difference specification. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * Post_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * Post_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Capital Expenditures/Assets

	Pre-Period = [Q1 2011 to Q4 2011], Post-Period = [Q2 2012 to Q1 2013]			
	Full Sample			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $Post_t$	-0.001	0.004	-0.006	-0.006
	[-0.19]	[0.36]	[-0.83]	[-0.83]
(β_3) Canada $Dummy_i$ * $Post_t$	-0.024***	-0.042***	-0.006	-0.006
	[-2.66]	[-3.00]	[-0.55]	[-0.55]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $Post_t$				0.010
				[0.78]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $Post_t$				-0.036**
				[-2.04]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.171	0.293	0.074	0.223
N - Total Firm Years	168	84	84	168

Table 5 Panel B. Hedging and Capital Expenditures, Matched Sample

Columns 1-4 in Panel B show the results for the same specifications as in columns 1-4 in Panel A, but estimated on the matched sample (see Section 3 for details). Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 Post_t + \beta_3 Post_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * Post_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * Post_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Capital Expenditures/Assets

	Pre-Period = [Q1 2011 to Q4 2011], Post-Period = [Q2 2012 to Q1 2013]			
	Matched Sample			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $Post_t$	-0.009	0.015	-0.028***	-0.028***
	[-1.27]	[1.13]	[-6.24]	[-6.26]
(β_3) Canada $Dummy_i$ * $Post_t$	-0.016*	-0.054***	0.016*	0.016*
	[-1.71]	[-3.25]	[1.70]	[1.71]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $Post_t$				0.043***
				[3.03]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $Post_t$				-0.070***
				[-3.69]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.149	0.250	0.342	0.278
N - Total Firm Years	184	86	98	184

Table 6. Asset Acquisitions/Dispositions by Treatment Firms

This table reports acquisition and disposition activity by Canadian light oil producers (treatment firms) after the basis risk shock. Specifically, it reports the net acquisitions conducted by Canadian firms, scaled by total assets: ($Acquisitions_t$ - $Dispositions_t$)/$Assets_{t-1}$ The reported acquisitions and dispositions activity periods correspond to (1): Q1-Q4 2012 and (2): Q1 2012-Q3 2013. Mean activity is computed for high and low leverage Canadian oil producers separately. High (low) leverage firms are defined as having market leverage above (below) median market leverage as of Q4 2011, the quarter prior to the event under study. Differences in means (t-tests) are computed where *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

	Canadian firms		
	High Leverage	Low Leverage	Difference
(1) 2012 Net Acquisitions (Dispositions)	-6.61%	1.54%	-8.15%**
(2) 2012 and 2013 Net Acquisitions (Dispositions)	-6.91%	3.93%	-10.84%**

Table 7. Hedging and Debt Issuance

This table reports firm-level regressions that measure the change in debt issuance across Canadian firms with different ex ante exposure levels to distress (High Leverage vs. Low Leverage). Net debt issuance is defined as the end of period total debt minus beginning of period total debt; we normalize the measure by beginning of period total assets. Firm observations are computed for two separate time periods, one for the normalized debt issuance levels in the four quarters prior to the loss of effective hedging instruments (Q1 2011 to Q4 2011) and one for the four quarters after (Q2 2012 to Q1 2013). The resulting dataset has two time periods per firm; one pre-treatment, one post-treatment. The Post dummy takes a value of one for the time period after the event. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Dec. 31 2011. The High Leverage dummy variable takes the value of one for firms with high leverage. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$Net\ Debt\ Issuance/Assets_{i,t} = \alpha + \beta_1 Post_t + \beta_2 High\ Leverage_i + \beta_3 Post_t * High\ Leverage_i + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Net Debt Issuance/Assets

	Pre-Period = [Q1 2011 to Q4 2011], Post-Period = [Q2 2012 to Q1 2013]			
	All Canadian Firms			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) $Post_t$	-0.021	-0.096**	0.053	0.053
	[-0.76]	[-2.47]	[1.53]	[1.55]
(β_2) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_3) High $Leverage_i$ * $Post_t$				-0.149***
				[-2.89]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.013	0.222	0.098	0.170
N - Total Firm Years	92	46	46	92

Table 8. Changes in Hedging Activity After Basis Risk Shock

This table reports firm-level regressions that measure the change in hedging activity for treatment (Canadian) vs. control (U.S.) firms. The treatment is defined as a loss in hedging effectiveness due to a significant increase in basis risk for Canadian light oil producers as of Q1 2012. U.S. light oil producers serve as the control group. The dependent variable is the percentage of future production hedged, where future production is measured as the realized production for the following 12 months. The pre-period observation is taken as of Q4 2011, one quarter prior to the basis risk shock. The post period is taken as of Q4 2012. The resulting dataset has two time periods per firm; one pre-treatment, one post-treatment. The Canada dummy variable takes the value of one for treatment (Canadian) firms. The Post dummy takes a value of one for the time period after the treatment. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$\textit{Production Hedged}_{i,t} = \alpha + \beta_1 \textit{CA Dummy}_i + \beta_2 \textit{Post}_t + \beta_3 \textit{Post}_t * \textit{CA Dummy}_i + \textit{FirmFE}_i + \varepsilon_{i,t}$$

Dependent Variable = Percentage of Production Hedged

	Pre-Period = Q4 2011, Post-Period = Q4 2012	
	All Firms	Matched Sample
	(1)	(2)
(β_1) Canada Dummy_i	Absorbed by FirmFE_i	
(β_2) Post_t	0.093***	0.058**
	[2.92]	[2.04]
(β_3) Canada Dummy_i * Post_t	-0.118**	-0.084*
	[-2.47]	[-1.83]
FirmFE_i	Yes	Yes
R^2 Within	0.081	0.041
N - Total Firm Years	168	184

Table 9. Placebo Test: Hedging and Firm Value

This table reports firm-level regressions which measure the change in firm value for treatment (Canadian) firms in response to a *placebo* event which occurs in Q4 2010. The placebo event quarter Q4 2010 corresponds to the closest placebo time period prior to the basis risk shock in Q1 2012 while avoiding the post-placebo event window to overlap with the true event under study. The dependent variable is the logarithm of Tobin's Q. Firm quarter level observations are aggregated into two separate time periods, one for the average firm value in the quarters prior to the placebo event (Q4 2009 to Q3 2010) and one for the average firm value in the quarters after the placebo event (Q1 2011 to Q4 2011). The resulting dataset has two time periods for a firm, one for the time period before the placebo treatment and one for the time period after the placebo treatment. U.S. oil producers serve as the control group. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Sep 30, 2010. The PostPlacebo indicator variable indicates a post-placebo event observation. All other indicator variables are defined in Table 4. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPlacebo_t + \beta_3 Post_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPlacebo_t + \beta_3 PostPlacebo_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * PostPlacebo_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * PostPlacebo_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Logarithm of Tobin's Q

	Pre-Period = [Q4 2009 to Q3 2010], Post-Period = [Q1 2011 to Q4 2011]			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $PostPlacebo_t$	0.040	0.089**	-0.008	-0.008
	[0.88]	[2.27]	[-0.10]	[-0.10]
(β_3) Canada $Dummy_i$ * $PostPlacebo_t$	-0.014	0.049	-0.072	-0.072
	[-0.21]	[0.75]	[-0.62]	[-0.62]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $PostPlacebo_t$				0.097
				[1.06]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $PostPlacebo_t$				0.120
				[0.91]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.013	0.270	0.029	0.099
N - Total Firm Years	146	72	74	146

Table 10. Placebo Test: Hedging and Capital Expenditures

This table reports firm-level regressions that measure the change in investment activity for treatment (Canadian) firms in response to a placebo event which occurs in Q4 2010. The placebo event quarter Q4 2010 corresponds to the closest placebo time period prior to the basis risk shock in Q1 2012 while avoiding the post-placebo event window to overlap with the true event under study. The dependent variable is capital expenditures scaled by beginning of quarter assets. Firm quarter level observations are aggregated into two separate time periods, one for the average capital expenditures in the quarters prior to the placebo event (Q4 2009 to Q3 2010) and one for the average capital expenditures in the quarters after the placebo event (Q1 2011 to Q4 2011). The resulting dataset has two time periods for a firm, one for the time period before the placebo treatment and one for the time period after the placebo treatment. U.S. oil producers serve as the control group. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of Sep 30, 2010. The PostPlacebo indicator variable indicates a post-placebo event observation. All other indicator variables are defined in Table 4. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPlacebo_t + \beta_3 PostPlacebo_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPlacebo_t + \beta_3 PostPlacebo_t * CA\ Dummy_i + \beta_4 High\ Leverage_i + \beta_5 High\ Leverage_i * PostPlacebo_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * PostPlacebo_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Capital Expenditures/Assets

	Pre-Period = [Q4 2009 to Q3 2010], Post-Period = [Q1 2011 to Q4 2011]			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_2) $PostPlacebo_t$	0.024***	0.025***	0.023**	0.023**
	[4.10]	[5.26]	[2.14]	[2.15]
(β_3) Canada $Dummy_i$ * $PostPlacebo_t$	-0.012	-0.007	-0.017	-0.017
	[-1.18]	[-0.55]	[-1.04]	[-1.04]
(β_4) High $Leverage_i$	Absorbed by $FirmFE_i$			
(β_5) High $Leverage_i$ * $PostPlacebo_t$				0.001
				[0.11]
(β_6) High $Leverage_i$ * Canada $Dummy_i$	Absorbed by $FirmFE_i$			
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $PostPlacebo_t$				0.010
				[0.49]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.148	0.235	0.100	0.155
N - Total Firm Years	146	72	74	146

Table 11. Placebo Test: Effect of the 2008 Oil Price Shock on Firm Value

This table reports firm-level regressions which measure the change in firm value for treatment (Canadian) and control (U.S.) firms in response to a negative macro oil price shock that occurs in Q3 and Q4 2008. The dependent variable is logarithm of Tobin's Q. Firm quarter level observations are aggregated into two separate time periods, one for the average firm value in the quarters prior to the negative macro oil price shock (Q3 2007 to Q2 2008) and one for the average firm value in the quarters after the negative macro oil price shock (Q1 2009 to Q4 2009). The resulting dataset has two time periods for a firm, one for the time period before the negative macro oil price shock and one for the time period after the negative macro oil price shock. U.S. oil producers serve as the control group. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of June 30, 2008. The PostPriceShock indicator variable indicates a post-macro oil price shock observation. All other indicator variables are defined in Table 4. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPriceShock_t + \beta_3 PostPriceShock_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$Q_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPriceShock_t + \beta_3 PostPriceShock_t * CA\ Dummy_i + \beta_4 High\ Leverage_i$$
$$+ \beta_5 High\ Leverage_i * PostPriceShock_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * PostPriceShock_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Logarithm of Tobin's Q

	Pre-Period = [Q3 2007 to Q2 2008], Post-Period = [Q1 2009 to Q4 2009]			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada Dummy$_i$	Absorbed by FirmFE$_i$			
(β_2) PostPriceShock$_t$	-0.363***	-0.371***	-0.354***	-0.354***
	[-6.56]	[-4.87]	[-4.28]	[-4.31]
(β_3) Canada Dummy$_i$ * PostPriceShock$_t$	0.054	0.067	0.041	0.041
	[0.77]	[0.82]	[0.36]	[0.36]
(β_4) High Leverage$_i$	Absorbed by FirmFE$_i$			
(β_5) High Leverage$_i$ * PostPriceShock$_t$				-0.017
				[-0.15]
(β_6) High Leverage$_i$ * Canada Dummy$_i$	Absorbed by FirmFE$_i$			
(β_7) High Leverage$_i$ * Canada Dummy$_i$ * PostPriceShock$_t$				0.025
				[0.18]
FirmFE$_i$	Yes	Yes	Yes	Yes
R^2 Within	0.649	0.765	0.564	0.649
N - Total Firm Years	110	54	56	110
High Lev Canadian Firms Post vs. Low Lev Canadian Firms Post ($\beta_5 + \beta_7$)				0.008
				[0.1]

Table 12. Placebo Test: Effect of the 2008 Oil Price Shock on Capital Expenditures

This table reports firm-level regressions which measure the change in investment activity for treatment (Canadian) vs. control (U.S.) firms in response to a negative macro oil price shock that occurs in Q3 and Q4 2008. The dependent variable is capital expenditures scaled by beginning of quarter assets. Firm quarter level observations are aggregated into two separate time periods, one for the average investment in the quarters prior to the negative macro oil price shock (Q3 2007 to Q2 2008) and one for the average investment in the quarters after the negative macro oil price shock (Q1 2009 to Q4 2009). The resulting dataset has two time periods for a firm, one for the time period before the negative macro oil price shock and one for the time period after the negative macro oil price shock. U.S. oil producers serve as the control group. High (respectively low) leverage firms are firms with above (respectively below) median market leverage as of June 30, 2008. The PostPriceShock indicator variable indicates a post-macro oil price shock observation. All other indicator variables are defined in Table 4. Standard errors are clustered by firm, with t-statistics reported in brackets below the coefficient estimates. *, ** and *** indicate significance at the 10%, 5%, and 1% level respectively.

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPriceShock_t + \beta_3 PostPriceShock_t * CA\ Dummy_i + FirmFE_i + \varepsilon_{i,t}$$

$$I/K_{i,t} = \alpha + \beta_1 CA\ Dummy_i + \beta_2 PostPriceShock_t + \beta_3 PostPriceShock_t * CA\ Dummy_i + \beta_4 High\ Leverage_i$$
$$+ \beta_5 High\ Leverage_i * PostPriceShock_t + \beta_6 High\ Leverage_i * CA\ Dummy_i + \beta_7 High\ Leverage_i * CA\ Dummy_i * PostPriceShock_t + FirmFE_i + \varepsilon_{i,t}$$

Dependent Variable = Capital Expenditures/Assets

	Pre-Period = [Q3 2007 to Q2 2008], Post-Period = [Q1 2009 to Q4 2009]			
	All Firms	High Leverage	Low Leverage	All Firms
	(1)	(2)	(3)	(4)
(β_1) Canada $Dummy_i$		Absorbed by $FirmFE_i$		
(β_2) $PostPriceShock_t$	-0.041***	-0.044***	-0.037***	-0.037***
	[-5.16]	[-4.42]	[-2.98]	[-3.00]
(β_3) Canada $Dummy_i$ * $PostPriceShock_t$	0.017*	0.028**	0.006	0.006
	[1.78]	[2.32]	[0.44]	[0.45]
(β_4) High $Leverage_i$		Absorbed by $FirmFE_i$		
(β_5) High $Leverage_i$ * $PostPriceShock_t$				-0.007
				[-0.45]
(β_6) High $Leverage_i$ * Canada $Dummy_i$		Absorbed by $FirmFE_i$		
(β_7) High $Leverage_i$ * Canada $Dummy_i$ * $PostPriceShock_t$				0.022
				[1.16]
$FirmFE_i$	Yes	Yes	Yes	Yes
R^2 Within	0.512	0.572	0.494	0.528
N - Total Firm Years	106	51	55	106
High Lev Canadian Firms Post vs. Low Lev Canadian Firms Post ($\beta_5 + \beta_7$)				0.014
				[1.49]