

# Oil Price Shocks and the Cost of Debt in the Oil Industry

Empirical Analysis

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# Motivation and Research Questions

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# Motivation

- The effects of oil price shocks on the world economy have been extensively studied over the last decade
- It is widely accepted that the oil price is a driving factor for the world economy and vice versa
- e.g. Alquist and Kilian (2010), Bachmeier et al. (2008), Hamilton (2011), Kilian and Vigfusson (2011), Ravazzolo and Rothman (2013) and references therein
- Yet, little is known of the effects of oil price shocks on the oil industry on a firm level basis

# Price Development on the Oil Market



**Figure 1:** Development of WTI crude oil spot price

## Effects of Oil Price Shocks

- Oil price decline reduces oil firm revenues and increase uncertainty around future oil prices and earnings
- Lower profit margins might reduce oil firms' creditworthiness
- Firms with a higher risk to default are likely to pay higher rates (Valta 2012)
- Banks require a higher spread to compensate for the borrower's increased default risk

## Research Questions

- How do firms along the oil industry supply chain respond to oil price shocks?
- How does their capital structures change with changes in the price of oil?
- How did the oil price shocks in 2008 and 2014 affect the cost of debt for these companies?

## Summary of Preliminary Results

- We find that Upstream and Support Service companies are most affected by declining oil prices
- Upstream and Support Service companies pay higher average loan spreads
- Earnings of Support Services react less sensitively and with a time lag compared to the more directly affected Upstream companies
- Credit conditions significantly tightened after the global financial crisis
- We find no effect of the oil price shock in mid-2014

# Creating the Dataset

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# Datasets

- We mainly use three different databases of financial data
- Data on syndicated loans in the Thomson Reuters' Dealscan database
- We combine the Dealscan data with financial data of the borrowing companies provided by the Compustat – Capital IQ database
- Currently, we work on including the Trade Reporting and Compliance Engine (TRACE) database provided by the Financial Industry Regulatory Authority (FINRA)

- Quarterly Data 1988Q1 - 2017Q2
- Contains loan information from public company filings and reportings by banks
- Comprehensive overview on the characteristics of syndicated loans, like pricing, contract details and additional terms and conditions
- We focus solely on the lead bank of the syndicated loan as discussed by Roman (2016) and used by Sengupta et al. (2017)

- Quarterly financial data from 2002Q2 - 2018Q1
- Database covers a wide range of publicly listed companies in both the US and Canada
- Information on the financial data of the borrowing companies
- Includes e.g. total assets, liabilities, capital expenditures, EBITDA

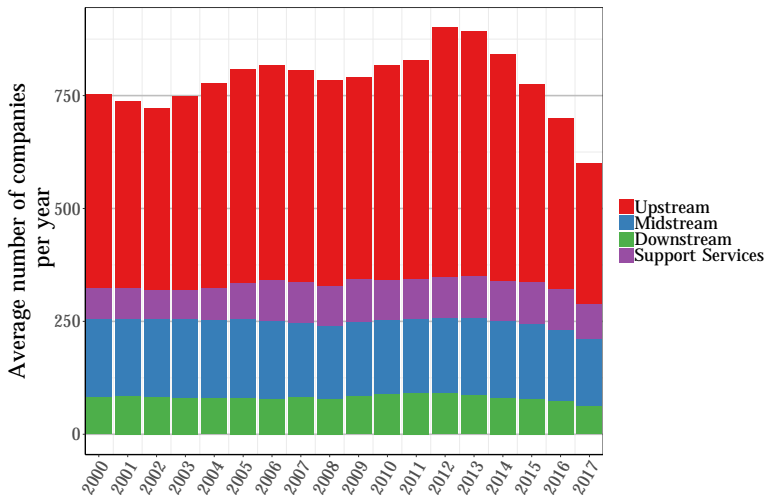
# Trace Database

- Syndicated loans represent only a small part of the corporate bond market
- TRACE database was introduced in 2001 to enhance the transparency in corporate bond markets
- All members of the FINRA are obliged to report their over-the-counter (OTC) transactions of fixed-income securities.
- Allows for a detailed analysis of all fixed-income transactions on the secondary market.
- Price, volume and yield of the traded security are provided

## Used Sample

- The final sample includes 1,682 companies from 2002:Q1 to 2017:Q2
- 604 companies have at least one Dealscan loan
- 296 companies are available over the entire horizon
- Companies are active across the whole value chain of the oil industry
- In total, 31 SIC and 22 NAICS codes were used to gather companies' financial data from the Compustat – Capital IQ database

# Company Data



**Figure 2:** Average number of companies per industry classification and year

# The Oil Industry Supply Chain

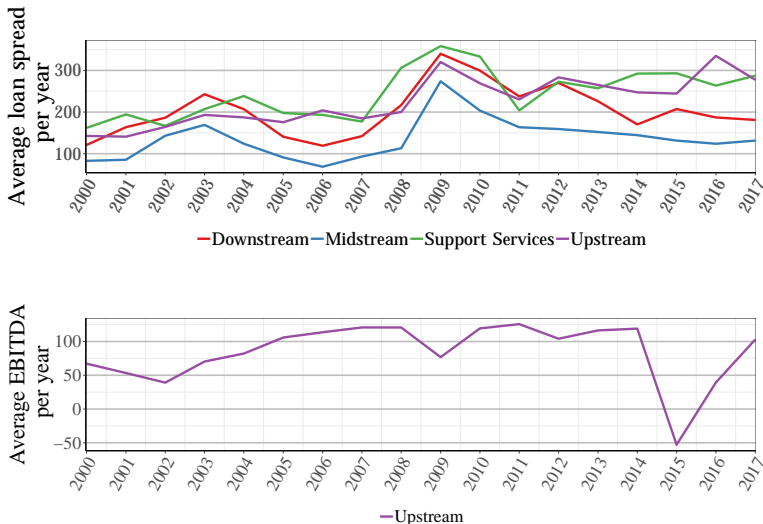
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## Upstream firms

- Upstream companies identify deposits, drill wells and extract the resources from underground
- Are most directly affected by oil price shocks
- Future drilling activity and costs respond strongly to change in prices (Anderson et al. 2018)
- Engage in reserve-based lending which depends on current and expected oil price (Azar 2017)
- Hedging production in the derivative market as a short-term solution (Mnasri et al. 2013)
- Financing constraints and decreased revenues are likely for long lasting oil price declines



## Upstream firms



**Figure 3:** Average loan spread per industry class and the average EBITDA of Upstream firms

## Support Services

- Support Services firms engage with all firms of the supply chain
- Derive stable cash flows from projects in the midstream and downstream segments
- Oilfield service and equipment companies lose revenue if drilling activity falls
- Similar to the Upstream industry, we expect the credit availability and profitability to react sensitively to price shocks

# Average Rig Count

Monthly rig count in select DPR regions (2007 - 2017)

number of rigs

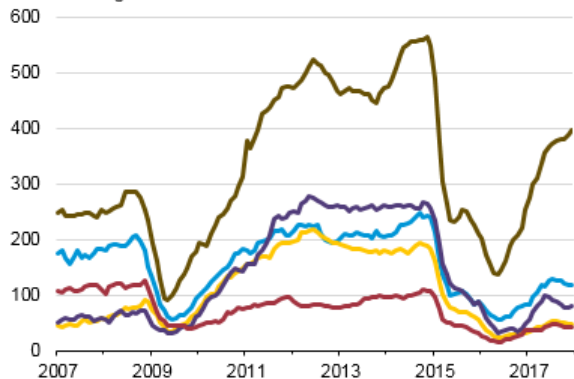
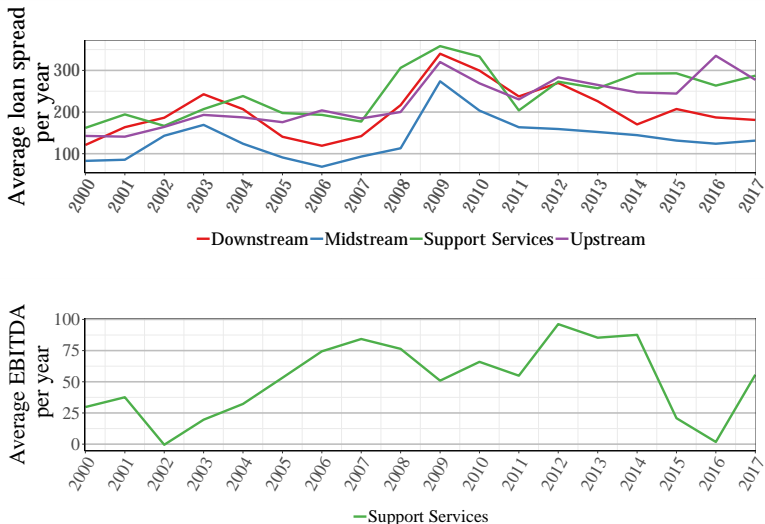


Figure 4: Average rig count - Source: EIA (2018)

# Support Services

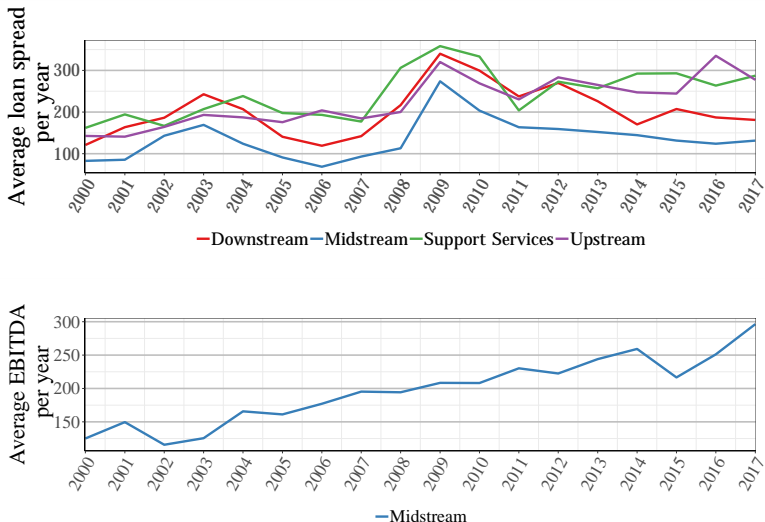


**Figure 5:** Average loan spread per industry class and the average EBITDA of Support Services firms

## Midstream firms

- Midstream firms are the link between Upstream and Downstream entities
- Engage mostly in oil resource transportation and storage, such as pipelines and gathering systems
- Revenue streams are fee-based and tied to long-term contracts
- A decline in upstream production will affect the profitability in the long term when contracts are renegotiated
- Face increased capital expenditure due to the "Shale Oil Revolution"

## Midstream firms

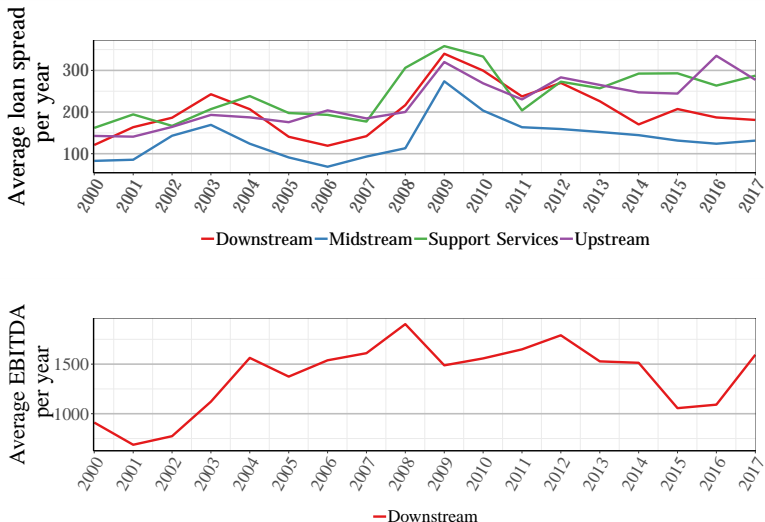


**Figure 6:** Average loan spread per industry class and the average EBITDA of Midstream firms

## Downstream firms

- Downstream firms are responsible for refining, marketing, distributing and selling of petroleum products
- Profitability is largely determined by the spread between the price of crude oil and the price of finished products (Sengupta et al. 2017)
- Falling prices may increase refining margins and vice versa
- Face a double risk between the raw materials market and petroleum products market
- Downstream firms engage in hedging strategies due to price fluctuations (Ji and Fan 2011)

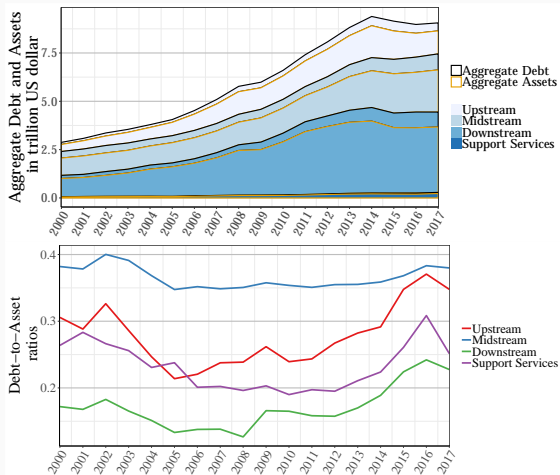
## Downstream firms



**Figure 7:** Average loan spread per industry class and the average EBITDA of Downstream firms



# Debt and Assets of the Supply Chain



**Figure 8:** Development of aggregate debt and assets in each part of the value chain and the resulting debt to asset ratio

# **Empirical Strategy and Preliminary Results**

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## Empirical Approach

- We examine whether syndicated loan spreads for energy companies are significantly different following the 2008 and 2014 oil price shock
- Loan spread can be seen as a summary measure for changes in borrowers creditworthiness
- The loan spread is measured in basis points over the LIBOR
- Preliminary results are obtained using Panel Least Squares regression with time fixed effects

## Variables I - Lender Characteristics

- *Leverage ratio* - lenders Leverage ratio
- $EBITDA_{t-1}$  - lenders EBITDA
- *Lender size* - lenders size as natural logarithm of total assets measured in million dollars
- $Z\text{-Score}_{t-1}$  - computed according to Valta (2012). Higher values indicate a lower probability of bankruptcy

## Variables II - Loan Characteristics

- *Loan size* - natural logarithm of the loan facility amount measured in million dollars
- *Maturity* - loan term measured in month
- *Not Secured* - dummy variable that equals one if the loan is not secured by collateral and zero otherwise
- *SecuredNA* - dummy variable that equals one if there are no information if the loans are secured and zero otherwise

## Variables III - Control Variables

- $TED\ spread_{t-1}$  - Spread between 3-month LIBOR and 3-month treasury bill
- $Credit\ spread_{t-1}$  - Spread between corporate bond yield for US companies rated as AAA and Baa
- $Oil\ volatility_{t-1}$  - Quarterly volatility of real WTI spot price
- $Oil\ price_{t-1}$  - Real average quarterly WTI spot price
- $Oil\ exports_{t-1}$  - Logarithm of U.S. crude oil exports measured in million dollars

# Estimation Results - All Firms, Within Estimator and Time Fixed Effects

<i>Leverage ratio</i>	203.2804*** (26.6848)	<i>SecuredNA</i>	-41.9190*** (7.0873)
<i>EBITDA<sub>t-1</sub></i>	-6.4003* (3.7518)	<i>Oil volatility<sub>t-1</sub></i>	7.1418*** (2.2718)
<i>Lender size</i>	2.9713 (6.7290)	<i>Oil price<sub>t-1</sub></i>	0.1013 (0.5145)
<i>Loan size</i>	-14.8216*** (3.2813)	<i>Z-Score<sub>t-1</sub></i>	7.2889*** (2.5546)
<i>Maturity</i>	0.0951 (0.1375)	<i>Oil exports<sub>t-1</sub></i>	-11.2782 (7.4252)
<i>Credit spread<sub>t-1</sub></i>	-46.1977** (19.9761)	<i>D2008</i>	115.6497** (45.6794)
<i>TED spread<sub>t-1</sub></i>	5.1455 (20.9045)	<i>D2014</i>	-34.1264 (32.1725)
<i>Not Secured</i>	-38.1248*** (8.4209)		
Year fixed effects	Yes		
Observations	1,996		
R <sup>2</sup>	0.2233		
Adjusted R <sup>2</sup>	0.0036		
F Statistic	13.5507*** (df = 33; 1555)		

# Estimation Results - Industry Classifications

	(Upstream)		(Midstream)		(Downstream)		(Support Services)	
<i>Leverage ratio</i>	180.3500***	(36.2842)	100.9781*	(55.2037)	178.9955	(135.6871)	16.5373	(104.3786)
<i>EBITDA<sub>t-1</sub></i>	1.6114	(6.3045)	-5.5893	(5.9015)	-7.4730	(11.1829)	-7.7603	(13.9565)
<i>Loan size</i>	-29.1615***	(10.6302)	43.5029***	(11.4671)	-27.9381	(36.0821)	6.6441	(32.0699)
<i>Lender size</i>	-22.3790***	(5.2656)	-4.2419	(4.1815)	-11.9111	(11.9939)	-4.1968	(13.8915)
<i>Maturity</i>	0.4354*	(0.2437)	0.2651	(0.1853)	0.2409	(0.3750)	-0.4850	(0.5988)
<i>Credit spread<sub>t-1</sub></i>	-42.3987	(32.2141)	-46.9004*	(26.9867)	-94.7693	(60.4069)	16.9799	(72.9954)
<i>TED spread<sub>t-1</sub></i>	11.8982	(32.2278)	-0.0212	(29.8977)	-33.7044	(73.0181)	-42.5924	(66.8904)
<i>Not Secured</i>	-15.2051	(14.9723)	-76.9331***	(11.6661)	27.9456	(26.5231)	-40.9987	(33.5046)
<i>SecuredNA</i>	-28.3994***	(10.3216)	-84.9056***	(11.5532)	21.4771	(25.5019)	-38.3986	(24.5939)
<i>Oil volatility<sub>t-1</sub></i>	9.5584***	(3.6108)	2.4577	(3.0753)	10.8985	(8.8097)	5.1128	(8.3449)
<i>Oil price<sub>t-1</sub></i>	0.3151	(0.7989)	-0.8491	(0.7081)	-0.9889	(1.6755)	0.1399	(1.9316)
<i>Z-Score<sub>t-1</sub></i>	5.2627*	(3.1680)	-34.5764**	(14.4974)	-22.9104	(21.3313)	-8.4974	(9.2190)
<i>Oil exports<sub>t-1</sub></i>	-17.4430	(12.4626)	-4.3285	(9.1969)	18.7161	(25.5305)	-17.3149	(28.7858)
<i>D2008</i>	121.8704	(75.5358)	42.4622	(61.4843)	450.2696***	(158.8405)	59.6328	(164.0475)
<i>D2014</i>	-58.2985	(55.0805)	-43.8748	(40.2724)	-144.7101	(117.7344)	114.0775	(122.9697)
Year fixed effects	Yes		Yes		Yes		Yes	
Observations	983		628		194		191	
R <sup>2</sup>	0.2422		0.4259		0.5169		0.3611	
Adjusted R <sup>2</sup>	-0.0466		0.3011		0.2357		-0.1136	
F Statistic	6.8865*** (df = 33; 711)		11.5791*** (df = 33; 515)		3.9554*** (df = 33; 122)		1.9254*** (df = 32; 109)	

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01



## **Drawbacks and Future Work**

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## Selection Problem

- We cannot distinguish if companies were constrained to get a loan or did not try to get a loan
- Possible sample selection bias for unbalanced panel as companies might not have dropped out of the sample randomly
- Comparison between 2008 and 2014 not straightforward as 2008 was more than an oil price shock but also a financial market crisis and a recession

## Concluding Remarks





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## Concluding Remarks

- Upstream and Support Service companies pay higher average loan spreads
- Earnings of Support Services react less sensitively than Upstream companies
- Credit conditions significantly tightened after the global financial crisis
- We find no effect of the oil price shock in mid-2014





Thank you for your attention!






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