Gilje et al. (2020) : Drilling and Debt

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Motivation

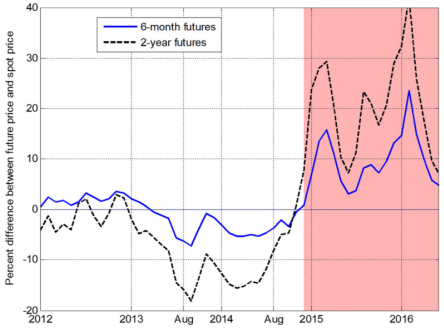
- Debt distorts real investment of firms, leading to inefficiencies (Jensen and Meckling, 1976).
  - Underinvestment
  - Risk shifting

  $\Rightarrow$ Debt accelerates investments, sacrificing long-run project returns

- RQ: Does leverage accelerate investment decisions during debt renegotiations?
  - Oil and gas industry
  - Project level

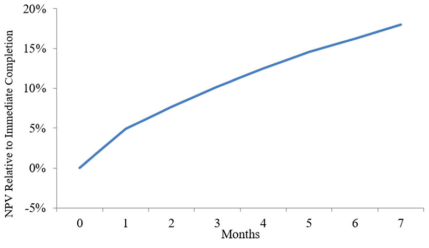
Institutional Setting: Oil Price Contango (2014Dec–2015)

- Severe contango: Futures prices exceeded spot prices
  - Incentive to delay well completion to capture higher future prices.



Institutional Setting: Shale Oil Drilling

- Two-stage process: Spudding (drilling) and completion (fracking).
  - Drilling: 3 days to 3 weeks, $2.97M average cost.
  - Completion: 2–3 days, $3.5M average cost; production starts immediately.
- Production declines rapidly post-completion.
- Contango disincentivizes early completion due to lower spot prices.



Data Description

- Sample: 3,557 shale oil wells from 69 public firms
  - in Texas, North Dakota, Oklahoma, New Mexico, Colorado
- Data sources
  - Project-level: RigData (drilling), state regulatory filings (completion)
  - Firm-level: Compustat (firm financials)
- Key variables:
  - Time from drilling to completion (median: 4 months).
  - Well location for geographic fixed effects.

Empirical Strategy

- **Setting**
  - Contango episode (Dec 2014–Mar 2015): completion decisions for well drilling btw Sep 2014–Nov 2014
  - Backwardation (Dec 2013–Mar 2014): completion decisions for well drilling btw Sep 2013–Nov 2013
- **Methodology**: Difference-in-difference (DiD)

$$\text{Time to Completion}_{ijt} = \beta_1 \text{Contango}_t + \beta_2 \text{HighLev}_i \times \text{Contango}_t + \text{FirmFE}_i + \text{GeoFE} + \epsilon_{ijt} \quad (1)$$

- Controls: Firm fixed effects, 6x6-mile township fixed effects to control for investment opportunity.

$\Rightarrow$ We expect that $\beta_2 < 0$

Main Findings

Dependent Variable = Months to Production	Panel A: Full Sample			Panel B: ABL Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Contango_t	1.090***	1.077***	1.262***	1.202*	0.967***	1.264**
	(0.331)	(0.210)	(0.347)	(0.675)	(0.343)	(0.508)
$\text{Contango}_t \times$ Leverage Q2$_i$	−0.276			−0.588		
	(0.631)			(0.714)		
$\text{Contango}_t \times$ Leverage Q3$_i$	0.147			−0.506		
	(0.553)			(0.992)		
$\text{Contango}_t \times$ Leverage Q4$_i$	0.184			0.251		
	(0.428)			(0.812)		
$\text{Contango}_t \times$ Leverage Q5$_i$	−1.014**	−1.002**		−1.303*	−1.071**	
	(0.442)	(0.383)		(0.722)	(0.423)	
$\text{Contango}_t \times$ Continuous Leverage$_i$			−1.088			−1.676*
			(0.848)			(0.955)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
6-Sq-Mile-Geo FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,557	3,557	3,557	1,244	1,244	1,244
R^2	0.54	0.54	0.54	0.54	0.54	0.54

- High-leverage firms complete wells 1 month earlier during contango.

Debt Renegotiations

Dependent Variable = Well Start (1 if well starts producing in month, 0 otherwise)	All (1)	High Lev + Non-ABL (2)	Low Lev + Non-ABL (3)	High Lev Only (4)	Low Lev Only (5)
Month = −2 to Renegotiation D_t	0.020	−0.062	0.017	−0.064	0.017
	(0.038)	(0.061)	(0.039)	(0.065)	(0.045)
Month = −1 to Renegotiation D_t	−0.003	−0.022	−0.007	0.001	−0.008
	(0.030)	(0.049)	(0.031)	(0.065)	(0.028)
Month = 0 to Renegotiation D_t	−0.005	−0.135**	−0.006	−0.117*	−0.007
	(0.036)	(0.050)	(0.037)	(0.061)	(0.039)
Month = 1 to Renegotiation D_t	−0.034	−0.107**	−0.034	−0.086	−0.034
	(0.029)	(0.046)	(0.030)	(0.063)	(0.029)
Month = 2 to Renegotiation D_t	−0.014	−0.111***	−0.015	−0.132**	−0.015
	(0.031)	(0.037)	(0.031)	(0.065)	(0.032)
Month ≥ 3+ to Renegotiation D_t	0.074	−0.092*	0.074	−0.146*	0.074*
	(0.052)	(0.046)	(0.052)	(0.083)	(0.042)
High Lev_i × Month = −2 to Renegotiation D_t	−0.078				
	(0.068)				
High Lev_i × Month = −1 to Renegotiation D_t	−0.010				
	(0.054)				
High Lev_i × Month = 0 to Renegotiation D_t	−0.122**				
	(0.057)				
High Lev_i × Month = 1 to Renegotiation D_t	−0.060				
	(0.047)				
High Lev_i × Month = 2 to Renegotiation D_t	−0.090**				
	(0.042)				
High Lev_i × Month ≥ 3+ to Renegotiation D_t	−0.162**				
	(0.065)				
Firm FE	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes
6-Sq-Mile-Geo FE	Yes	Yes	Yes	Yes	Yes
N	20,297	15,051	18,755	1,569	18,728
R^2	0.052	0.056	0.049	0.080	0.049

Cash Flow and Covenant Channel

- Hypothesis: Firms accelerate completion to meet covenant requirements or cash flow needs.
- Evidence:
  - High-leverage firms have sufficient liquidity (interest coverage: 3.18, current ratio: 2.464).
  - Early completion increases CAPEX ($3.5M) more than immediate EBITDA ($0.35M).
  - Covenant metrics are backward-looking (trailing 12-month EBITDA).
- Conclusion: Cash flow/covenant constraints unlikely to drive results.

Collateral Channel

- Hypothesis: High-leverage firms accelerate completion to boost collateral values.
  - Evidence supports this channel!
- Evidence:
  - Pre-renegotiation wells have 43% higher production (417 vs. 292 barrels/day).
  - High-leverage firms prioritize single-well leases (high collateral impact) before renegotiations.

Collateral Channel

	Initial Production = Barrels of Oil per Day		
	Before Renegotiation	After Renegotiation	Difference
High-leverage firms	417.34	291.71	125.64*
N	151	41	
	Initial Production = Log (Barrels of Oil per Day)		
	Before Renegotiation	After Renegotiation	Difference
High-leverage firms	5.57	5.23	0.34*
N	151	41	

- Pre-renegotiation wells have 43% higher production (417 vs. 292 barrels/day).

Collateral Channel

	Well Starting Production Dummy							Difference
	Time 0 = Month of Debt Renegotiation							Well Starts$_{t=-1}$ − Well Starts$_{t=0}$
	−3	−2	−1	0	1	2	3+	
Panel A: Single-Well Lease (High Collateral Impact)								
High leverage	0.29	0.18	0.26	0.09	0.09	0.05	0.03	0.18***
Low leverage	0.14	0.16	0.12	0.09	0.04	0.05	0.13	0.03
Difference$_{\text{High}}$ − Difference$_{\text{Low}}$								0.15***
p-value								0.002
Panel B: Multi-Well Lease (Low Collateral Impact)								
High leverage	0.17	0.18	0.15	0.10	0.07	0.02	0.07	0.05**
Low leverage	0.17	0.19	0.12	0.06	0.03	0.01	0.09	0.06**
Difference$_{\text{High}}$ − Difference$_{\text{Low}}$								−0.01
p-value								0.891

- High-leverage firms prioritize single-well leases (high collateral impact) before renegotiations.

Conclusion

- High-leverage firms accelerate well completion during contango, sacrificing 4.8% NPV per project.
- Behavior driven by collateral enhancement to mitigate lending frictions at renegotiations.
- Hidden cost of collateral-based financing: Overinvestment, not just underinvestment or risk-shifting.
- Implications for inelastic oil production and global oil price dynamics.

References I

Gilje, Erik P., Elena Loutskina, and Daniel Murphy, "Drilling and Debt," *The Journal of Finance*, 2020, *75* (3), 1287–1325.

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