A New Theory of Credit Lines (with Evidence)

by Donaldson, Koont, Piacentino and Vanasco

Discussion by Nicolas Crouzet (Kellogg)

Spring 2024 Kentucky Finance conference
A new theory about a thing

Door 1: How does this new theory work?

Door 2: Why is it better than old theories at explaining the thing?
A new theory about a thing

**Door 1:** How does this new theory work?

**Door 2:** Why is it better than old theories at explaining the thing?
Coase (1972)

Producer facing demand curve \( p \), marginal cost \( mc \).
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$$p(Q^{(e)}) + Q^{(e)} p'(Q^{(e)}) = mc$$  \[\text{[Monopoly/Exclusivity]}\]

$$p(Q^{(ne)}) = mc$$  \[\text{[Perfect competition/Non-exclusivity]}\]

$$Q^{(e)} < Q^{(ne)}$$

Suppose $Q$ is durable. After initially selling $Q^{(e)}$, would a monopolist be tempted to sell $dQ$ more? Yes.

$$\begin{align*}
\frac{p}{\Delta Q} &= p(Q^{(e)}) + Q^{(e)} p'(Q^{(e)}) - mc \\
\Delta Q &\geq 0 \text{ if } Q^{(e)} + dQ \leq Q^{(ne)}.
\end{align*}$$
Coase (1972)

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Suppose $Q$ is durable. After initially selling $Q^{(e)}$, would a monopolist be tempted to sell $dQ$ more? Yes.

\[ \left( p \left( Q^{(e)} + dQ \right) - mc \right) dQ \geq 0 \text{ if } Q^{(e)} + dQ \leq Q^{(ne)}. \]
Coase (1972)

**Coase’s conjecture:** The firm will never be able to charge more than the competitive price.

"Consumers [...] fear an increase in supply if they buy at the monopoly price.””
Coase’s (1972) solutions

How could the firm charge the monopoly price?

Commit not to sell more!

Lease the good for short periods of time, or make it less durable

What if you can’t do any of these things?

Producer surplus is 0 — despite being a monopolist
Coase (1972) in finance

Durable good = debt: DeMarzo and He (2021)

Borrower is monopoly supplier

Debt has flow benefits to borrower e.g. because of taxes

Yet, without commitment, borrower NPV of issuing debt = 0

This paper: a new solution to Coase’s conjecture — a “put option”, interpreted as a credit line
Environment

Durable good, quantity $Q_t$  

Firm/Seller:
- Flow profits $(y - c(Q_t))dt$  
- Can sell extra $dQ_t$ at price $p_t$

Bank/Buyer:
- Participation constraint: $p_t \leq \int_0^{+\infty} e^{-\rho s} \gamma(Q_{t+s})ds$
Full commitment

\[ V^e = \max_{\{dQ_t, p_t\}_{t \geq 0}} \int_{0}^{+\infty} e^{-\rho t} (y - c(Q_t)) \, dt + \int_{0}^{+\infty} p_t \, dQ_t \]

s.t. \[ p_t \leq \int_{0}^{+\infty} e^{-\rho s} \gamma(Q_{t+s}) \, ds \]
Full commitment

\[ V^e = \max_{\{dQ_t, p_t\}_{t \geq 0}} \int_0^{+\infty} e^{-\rho t} (y - c(Q_t)) \, dt + \int_0^{+\infty} p_t dQ_t \]

s.t. \[ p_t \leq \int_0^{+\infty} e^{-\rho s} \gamma(Q_{t+s}) \, ds \]

\[ dQ_t = \begin{cases} Q_e & \text{if } t = 0 \\ 0 & \text{otherwise} \end{cases} \]
Full commitment

\[ V^e = \max_{\{dQ_t, p_t\}_{t \geq 0}} \left( \int_0^{+\infty} e^{-\rho t} (y - c(Q_t)) \, dt + \int_0^{+\infty} p_t dQ_t \right) \]

s.t. \[ p_t \leq \int_0^{+\infty} e^{-\rho s} \gamma(Q_{t+s}) \, ds \]

\[ dQ_t = \begin{cases} Q_e & \text{if} & t = 0 \\ 0 & \text{otherwise} \end{cases} \]

\[ p_e(Q_e) = \frac{\gamma(Q_e)}{\rho} \]
Full commitment

\[ V^e = \max \left\{ \{dQ_t, p_t\}_{t \geq 0} \right\} \int_0^{+\infty} e^{-\rho t} (y - c(Q_t)) \, dt + \int_0^{+\infty} p_t dQ_t \]

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\[ \frac{c'(Q_e)}{\rho} = p_e(Q_e) + \frac{p_e'(Q_e)Q_e}{\rho} \]
Full commitment

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\[ p_e(Q_e) = \frac{\gamma(Q_e)}{\rho} \]

\[ \frac{c'(Q_e)}{\rho} = p_e(Q_e) + \overbrace{p_e'(Q_e)Q_e}^{\text{Infra marginal effect}} \]

\[ V^e = \frac{y}{\rho} + \frac{\gamma(Q_e)Q_e - c(Q_e)}{\rho} \]

\[ \text{Gains from trade} \]
Assume that borrowing is smooth: \( dQ_t = q_t dt \).

\[
\rho V(Q_t) = \max_{q_t} y - c(Q_t) + p(Q_t)q_t + V'(Q_t)q_t
\]
Assume that borrowing is smooth: \( dQ_t = q_t \, dt \).

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\[\implies 0 = p(Q_t) + V'(Q_t)\]
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\[
\implies V(Q_t) = \frac{y - c(Q_t)}{\rho}
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["As if" no future debt issuance]
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\Rightarrow \quad 0 = p(Q_t) + V'(Q_t)
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$$
\Rightarrow \quad V(Q_t) = \frac{y - c(Q_t)}{\rho}
$$

$$
= \frac{y}{\rho} \quad \text{if} \quad Q_t = 0
$$

["As if" no future debt issuance]

[No gains from trade]
No commitment

[DeMarzo and He, 2021]

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[Price = marginal cost]
No commitment

[DeMarzo and He, 2021]

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\Rightarrow V(Q_t) = \frac{y - c(Q_t)}{\rho} \quad \text{["As if" no future debt issuance]} \\
= \frac{y}{\rho} \quad \text{if } Q_t = 0 \quad \text{[No gains from trade]}
\]

\[
p(Q_t) = \frac{c'(Q_t)}{\rho} \quad \text{[Price = marginal cost]} \\
q(Q_t) = \frac{\gamma(Q_t) - c'(Q_t)}{-p'(Q_t)} \quad \text{[≈ Ratchet effect]}
\]
Credit lines

A credit line is two fixed numbers: \((\bar{p}, \bar{d}Q)\).

Offered time at \(t = 0\) by banks, in "bundles" with "normal" debt.

Can be drawn at any time \(t \geq 0\); adds to stock of debt outstanding.

Once drawn, is not renewed, so back to no-commitment solution.

The size of the credit line, \(d\bar{Q}\), does not need to be of order \(dt\).

If drawn, \(Q_t\) will "jump."

Ruled out for "normal" debt, for which \(dQ_t = q_t dt\).
Credit lines as deterrents

For any debt level \( Q_0 \), consider credit lines \((\tilde{p}, d\tilde{Q})\) such that:

\[
(y - c(Q_0))dt + e^{-\rho dt} V(Q_0) = \begin{cases} 
(y - c(Q_0))dt + \tilde{p}d\tilde{Q} + e^{-\rho dt} V(Q_0 + d\tilde{Q}) & \text{draw} \\
\text{do not draw, never issue again} & \end{cases}
\]  

\( \star \)
Credit lines as deterrents

For any debt level $Q_0$, consider credit lines $(\tilde{p}, \tilde{d} \tilde{Q})$ such that:

\[
\begin{aligned}
(y - c(Q_0))dt + e^{-\rho dt} V(Q_0) & \quad \text{do not draw, never issue again} \\
(y - c(Q_0))dt + \tilde{p} \tilde{d} \tilde{Q} + e^{-\rho dt} V(Q_0 + \tilde{d} \tilde{Q}) & \quad \text{draw}
\end{aligned}
\]

Suppose the firm is at $Q_0$. 

Result:

There is $(\tilde{p}, \tilde{d} \tilde{Q})$ s.t. (*) and the firm, if it draws the line, does not borrow anymore.

Intuition:

If $d \tilde{Q}$ is really large:

\[
c' \left(Q_0 + d \tilde{Q}\right) \rho \quad \text{min price for borrowing} \quad \Gamma \left(\frac{Q_0 + O(dt) \, dQ + d \tilde{Q}}{\tilde{Q}}\right)
\]

NPV to lenders

A really big $d \tilde{Q}$ drives down the willingness to pay of banks below marginal cost.
Credit lines as deterrents

For any debt level $Q_0$, consider credit lines $(\tilde{p}, \tilde{d} \tilde{Q})$ such that:

\[
(y - c(Q_0)) dt + e^{-\rho dt} V(Q_0) \quad \text{do not draw, never issue again}
\]

\[
\overset{\text{draw}}{(y - c(Q_0)) dt + \tilde{p} \tilde{d} \tilde{Q} + e^{-\rho dt} V(Q_0 + d \tilde{Q})}
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\underbrace{(y - c(Q_0))dt + e^{-\rho dt} V(Q_0)}_{\text{do not draw, never issue again}} = \underbrace{(y - c(Q_0))dt + \tilde{p}d\tilde{Q} + e^{-\rho dt} V(Q_0 + d\tilde{Q})}_{\text{draw}}
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(\star)

Suppose the firm is at $Q_0$.

**Result:** There is $(\tilde{p}, \tilde{d}Q)$ s.t. (\star) and the firm, *if* it draws the line, does not borrow anymore.

**Intuition:** If $d\tilde{Q}$ is really large:

$$
\underbrace{\frac{c'(Q_0 + d\tilde{Q})}{\rho}}_{\text{min price for borrowing}} > \Gamma \left( Q_0 + \underbrace{O(dt)}_{\text{NPV to lenders}} + d\tilde{Q} \right)
$$
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A really big $d\tilde{Q}$ drives down the willingness to pay of banks below marginal cost.
Why do credit lines work? (Heuristically)

For any debt level $Q_0$, can build a credit line such that:

- if $Q_t = Q_0$, the firm is indifferent between staying at $Q_0$ and drawing the line + not borrowing anymore;
- if $Q_t < Q_0$, the firm issues debt once to reach $Q_0$. 

Implication: at $t = 0$, can build a credit line such that:
- the firm borrows once, to $Q_e$;
- never borrows again, nor draws on the line.

$\Rightarrow$ Efficient outcome.
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Some potential clarifications

Intuition for why borrowers “jump” to $Q_0$ with credit line in place, but issue smoothly without it?
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DeMarzo and He (2021): In any MPE, issuance must be “smooth” [$= O(dt)$]

Here, lots of “lumpiness” [$> O(dt)$]: initial borrowing is lumpy; credit line

Not the same framework?

Or, same framework, but not an MPE?

Or, extending contracts to allow for the credit line creates non-smooth MPEs?
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Would banks want to honor credit lines if they were triggered?

No

So, do banks have “a lot of” commitment here? (Revocation is random.)
Connecting to the data

Why use credit lines, as opposed to other solutions to the Coase conjecture?

Covenants; debt maturity
Connecting to the data

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Covenants; debt maturity

Can the model help us think about why firms draw on credit lines, and what happens afterwards?

Off-equilibrium in the model

≠ liquidity insurance theories

[Holmstrom and Tirole, 1998]
Connecting to the data

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- Off-equilibrium in the model
- ≠ liquidity insurance theories
  
  [Holmstrom and Tirole, 1998]

In the data, when leverage “jumps”, is it primarily because of drawdowns?

- Empirically, how lumpy is “normal” debt issuance compared to drawdowns?

  [Leary and Roberts, 2005; Choi, Hackbarth, Zechner, 2018]
Conclusion

New resolution of Coases’ conjecture

“big” put option — could apply to other contexts than long-term debt

Is lack of commitment in debt issuance the main reason why credit lines exist?

Door 2; harder!

Looking forward to future drafts!