Middlemen and Liquidity Provision

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Middlemen as Liquidity Providers

Middlemen, who purchase goods from suppliers and sell to consumers, provide liquidity support to suppliers.

Historically, middlemen and liquidity provision were closely related:

- *Colonial Trade*: The Dutch East India Company extended credit to local growers in the form of advanced payments
- *Input Financing:* Middlemen provide seeds, fertilizers, and farming equipment to small farmers

Nowadays, with advances in financial technologies, essentially the same form of financing has been widely adopted by most large retailers, e.g., Walmart, Amazon, JD.com, etc.

The Co-op Partners with PrimeRevenue to Protect Suppliers Amid Economic Volatility

By **PrimeRevenue** • 4 minute read

UK's sixth largest food retailer makes strategic transition to PrimeRevenue platform

Atlanta, GA – Manchester, UK, August 11, 2020 – PrimeRevenue, the leading platform for working capital finance solutions, and The Co-operative Group, today announce a new supply chain finance partnership. Barclays Bank PLC, who introduced The Co-op to PrimeRevenue, will be providing funding on the supply chain finance programme followed by other financial institutions as the programme grows.

Co-op has made the strategic decision to partner with PrimeRevenue for its new supply chain finance offering. Fueled by a highly challenging business climate heightened by the pandemic, the company aims to offer suppliers a simple method of early payment to help with their cash flow without having a detrimental impact to Co-op's own cash position. This is particularly relevant in the current environment where the old adage "cash is king" has never been truer.

How Does Co-op Finance Suppliers?

1. Co-op establishes a funding program together with a FinTech company (PrimeRevenue):
   - Co-op invites **selected** suppliers to the program;
   - Co-op **delays** payment to participating suppliers.
2. Once joining the program, suppliers can choose between
   - Holding invoices to maturity;
   - Selling unpaid invoices to Co-op for **early payment**.
3. When the invoice is due, Co-op pays the full invoice amount.

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The global supplier finance market was estimated at \$1.8 trillion (2021), and grew at annual rates of 15% – 20% (2019–2024).

Three Puzzling Facts

1. Divergence in adoptions. Many leading middlemen choose **not** to finance suppliers, e.g., Aldi, IKEA, Costco, Amazon, etc.
2. Trade credit extensions. Why do middlemen require suppliers to give more trade credit?
3. Selective inclusion. Why does middlemen finance select suppliers?

Welfare Implications for the Product Market

- Middlemen financing introduces double marginalization.
- This price distortion can harm product market efficiency.

1. The Benchmark Model

Agents

- A mass of suppliers:
- A mass of consumers:
- One intermediary:

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    - Each produces a unique and indivisible good
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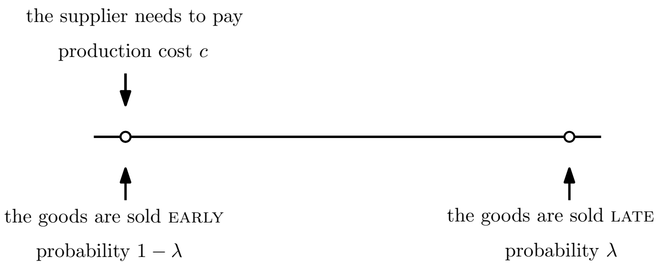
  - retail revenue can be used to cover costs c
- Supplier's liquidity issue matters when:
  - disparity exists in the timing between production and trade.



- Two sub-periods: early and late
  - production occurs only in the early sub-period
  - suppliers may match with consumers early or late
- Prob. $1-\lambda$: consumers arrive early, c can be paid by revenue
- Prob. λ: consumers arrive later, c can not be covered using revenue
- It is one micro-foundation for generating liquidity shocks.

We have introduced the ex ante heterogeneity of suppliers

- Suppliers are indexed by

$$(\lambda, c) \in \Omega = [0,1] \times [\underline{c}, \bar{c}]$$

- λ: Prob. of liquidity shock; c marginal cost
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- (λ, c) follows some c.d.f. $G(\lambda, c)$.

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Intermediary selects suppliers into either mode:

- Middleman mode (M), pure middleman
- Finance mode (F), middleman and liquidity provider

Middleman Mode (M)

- The intermediary sells on behalf of suppliers
  - prob. of liquidity shocks decreases to $m \cdot \lambda$
  - $m < 1$: middlemen's matching advantage (Rubinstein and Wolinsky 1987)
- The intermediary gives Take-It-Or-Leave-It (TIOLI) offers:
  - Cost: Supplier remains responsible for the production cost c.
  - Payment: Intermediary transfers the direct-selling value, $(1-\lambda)(u-c)/2$, *immediately after* the consumer pays.
- Supplier (λ, c) contributes profits:

$$\pi_M(\lambda, c) = (1-m)\lambda(u-c)/2 > 0 \text{ since } m < 1.$$

Note that $\pi_M = (1-m\lambda)p - (1-\lambda)(u-c)/2$.

Finance Mode (F)

- The intermediary resells and provides liquidity.
- Financing supplier is costly: per-user cost $k > 0$.
- Intermediary gives TIOLI offers to selected suppliers:
  - c is covered by the intermediary early
  - pays to the supplier **by the end of the period**
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and contributes **liquidity** (at the time of production):

$$\theta_F(\lambda, c) = (1 - m\lambda)p - c$$

The Intermediary's Problem

- The intermediary selects suppliers into one of the two modes:

$$\max_{q(\cdot)\in\{0,1\}} \int_{\Omega} \Big((1-q(\lambda,c))\pi_M(\lambda,c) + q(\lambda,c)\pi_F(\lambda,c) \Big) dG$$

subject to the liquidity constraint:

$$\underbrace{\int_{\Omega} q(\lambda,c)\theta_F(\lambda,c) dG}_{\text{total liquidity}} + L \geq 0.$$

- Define $\Delta\pi(\cdot) = \pi_F(\cdot) - \pi_M(\cdot)$. The objective is equivalent to

$$\max_{q(\cdot)} \int_{\Omega} \Big(\pi_M(\lambda,c) + q(\lambda,c)\Delta\pi(\lambda,c) \Big) dG,$$

Profit-maximizing selection rule

- Solve the problem using Lagrangian:

$$\mathcal{L} = \int_{\Omega} \left[\pi_M(\cdot) + q(\cdot)\Big(\Delta\pi(\cdot) + \mu\theta_F(\cdot) \Big) \right] dG(\lambda, c)$$

$\mu \geq 0$: The shadow value of liquidity

- The optimal selection rule is:

$$q(\lambda, c, \mu) = \begin{cases} 1 & \text{if } \Delta\pi(\lambda, c) + \mu\theta_F(\lambda, c) \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Proposition (Selected Suppliers)

The intermediary optimally selects suppliers from three regions

- *Region A:* **positive** *profit and* **positive** *liquidity contributions*

$$\Delta\pi(\lambda, c) \geq 0, \quad \theta_F(\lambda, c) \geq 0$$

- *Region B:* **positive** *profit and* **negative** *liquidity*

$$\Delta\pi(\lambda, c) > 0, \quad \theta_F(\lambda, c) < 0, \quad \underbrace{-\Delta\pi/\theta_F}_{returns} \geq \mu$$

- *Region C:* **negative** *profit and* **positive** *liquidity*

$$\Delta\pi(\lambda, c) < 0, \quad \theta_F(\lambda, c) > 0, \quad \underbrace{-\Delta\pi/\theta_F}_{costs} \leq \mu$$

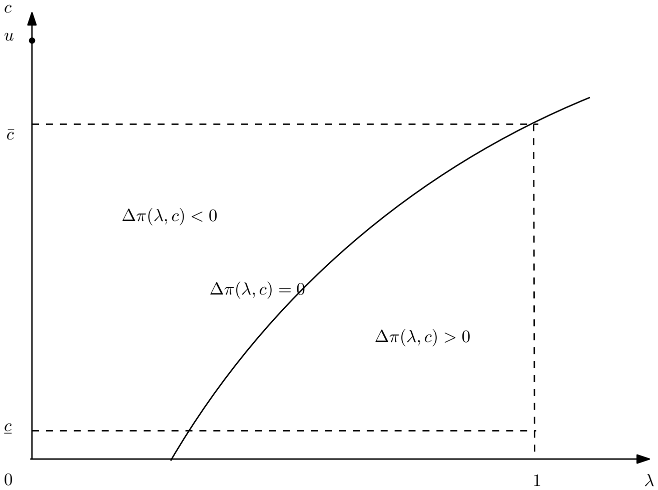

Figure: Incremental profit $\Delta\pi \equiv \pi_F - \pi_M$

$$\Delta\pi(\lambda, c) = m\lambda(u - c)/2 - k$$

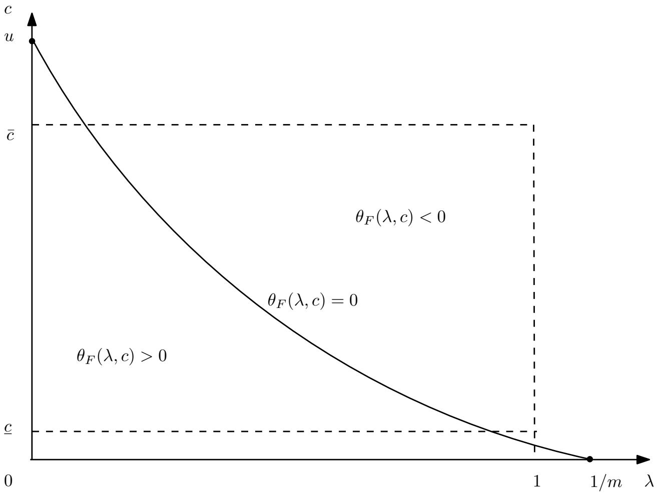

Figure: Liquidity $\theta_F(\lambda, c)$

$$\theta_F(\lambda, c) = (1 - m\lambda)(u + c)/2 - c$$

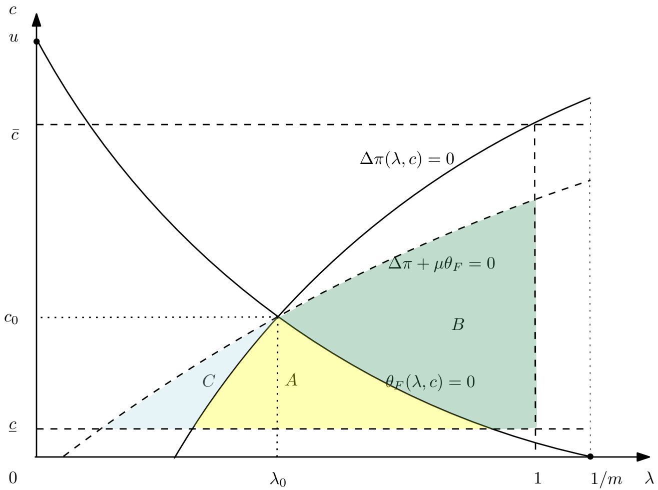

Figure: Profit-based Liquidity Cross-subsidization

Proposition

The F mode is active as long as $\Delta\pi(1, \underline{c}) > 0$*, or*

$$k/m < (u - \underline{c})/2.$$

When F mode is active, suppliers are selected and liquidity is cross-subsidized ($\mu > 0$*).*

- Small k: Fin-tech cost is low.
- Large m: sufficient late matches so that liquidity is an issue.
- This proposition explains all three puzzling facts:
  Adoption / Trade credit extension / Selection.

Generalize suppliers' direct selling value

- Let suppliers' direct selling value be $w(\lambda, c)$.
- We have profit contributions of F and M contracts:

$$\pi_F(\lambda, c) = (u - c)/2 - w(\lambda, c) - k,$$
$$\pi_M(\lambda, c) = (1 - m\lambda)(u - c)/2 - w(\lambda, c).$$

- What matters for our analysis is

$$\Delta\pi(\lambda, c) = m\lambda(u - c)/2 - k.$$

Endogenous L

- So far, a downward sloping demand curve for liquidity $\mu(L)$
- Suppose the intermediary faces a liquidity cost i
- The intermediary's liquidity holdings $L \geq 0$ satisfy

$$\begin{cases} \mu(L) = i & \text{if } \; i < \mu(0); \\ L = 0 & \text{if } \; i \geq \mu(0). \end{cases}$$

- The equilibrium liquidity value $\mu = \min\{\mu(0), i\}$ is shaped by
  - richness of suppliers' liquidity: $\mu(0)$
  - cost of external liquidity: i

2. Financing and Product Market

Downward-sloping demand $D(p)$

- A continuum of consumers; demand for each product: $D(p)$
- c is a per-unit cost

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Direct-selling:

- With Prob. $1-\lambda$, match with consumers early.
- The supplier sets the monopoly price

$$p^*(c) \equiv \arg\max_{p \geq c} (p-c)D(p)$$

Assume the objective is strictly quasi-concave in p and let the monopoly profit be

$$\pi^*(c) \equiv (p^*(c)-c)D(p^*(c)).$$

The Intermediary

The intermediary can offer M or F contracts to suppliers.

M contract:

- With prob. $1 - m\lambda$, match with consumers early.
- The intermediary sets the monopoly price $p^*(c)$ for that state and pays to suppliers direct selling value.
- Supplier of (λ, c) contributes profit of

$$\pi_M(\lambda, c) = (1 - m)\lambda\pi^*(c).$$

Recall that in the benchmark:

$$\pi_M(\lambda, c) = (1 - m)\lambda\frac{u - c}{2}.$$

F contract:

- Intermediary advances production cost $c \cdot D(p)$ to the supplier.
- The expected profit at retail price p is

$$\pi_F(\lambda, c, p) = (p - c)D(p) - (1 - \lambda)\pi^*(c) - k.$$

- The incremental profit is

$$\Delta\pi(\lambda, c, p) \equiv (p - c)D(p) - (1 - m\lambda)\pi^*(c) - k.$$

- The liquidity contribution from supplier (λ, c):

$$\theta_F(\lambda, c, p) = [(1 - m\lambda)p - c]\, D(p).$$

- The intermediary chooses $q(\lambda, c) \in 0, 1$ and $p(\lambda, c) \in \mathbb{R}_+$:

$$\max_{\{q(\cdot), p(\cdot)\}_{(\lambda,c)\in\Omega}} \int_\Omega [q(\cdot)\Delta\pi(\lambda, c, p(\cdot))] \, dG,$$

$$\text{s.t.} \int_\Omega \Big[q(\cdot)\theta_F(\lambda, c, p(\cdot))\Big] dG + L \geq 0.$$

- The corresponding Lagrangian:

$$\mathcal{L} = \int_\Omega \Big[q(\lambda, c) \underbrace{\Big(\Delta\pi(\lambda, c, p(\lambda, c)) + \mu\theta_F(\lambda, c, p(\lambda, c))\Big)}_{\equiv S(\cdot)}\Big] dG.$$

- The net value of financing supplier (λ, c):

  $$S(\cdot) = (1 + \mu(1 - m\lambda))\,(p - \tilde{c})\,D(p) - k - (1 - m\lambda)\pi^*(c),$$

  with effective cost $\tilde{c} = \gamma c$. γ captures liquidity-related costs:

  $$\gamma \equiv \frac{1 + \mu}{1 + \mu(1 - m\lambda)} \geq 1.$$

  γ increases in μ and λ, $\gamma = 1$ iff $\mu = 0$ or $\lambda = 0$.

- The profit-maximizng retail price:

  $$p(\lambda, c) = p^*(\tilde{c})$$

  $p^*(\tilde{c}) - p^*(c)$: liquidity-driven double marginalization.

The New Selection Rule

- We decompose the net valuation $S(\lambda, c)$ into a baseline component and a premium derived from pricing flexibility:

$$S(\lambda, c, \mu) = \underbrace{S_{base}(\lambda, c, \mu)}_{\text{Baseline value}} + \underbrace{\mathcal{G}(\lambda, c, \mu)}_{\text{Pricing gain}}.$$

- S_{base} represents the valuation if price is fixed to $p^*(c)$

$$S_{base}(\lambda, c, \mu) = \underbrace{m\lambda\pi^*(c) - k}_{\text{Baseline Profit}} + \mu \underbrace{\left[(1 - m\lambda)p^*(c) - c\right] D(p^*(c))}_{\text{Baseline Liquidity}}.$$

Pricing Gain and Risk Resilience

- $\mathcal{G}(\lambda, c, \mu)$, captures the gain by setting $p = p^*(\tilde{c})$:

$$\mathcal{G}(\lambda, c, \mu) \equiv (1 + \mu(1 - m\lambda))\Big[\pi^*\Big(p^*(\tilde{c}), \tilde{c}\Big) - \pi\Big(p^*(c), \tilde{c}\Big)\Big].$$

- $\mathcal{G}(\cdot)$ is strictly positive, strictly increasing in λ and μ.

Proposition

The intermediary's selection rule is characterized by a strictly expanded and less risk-sensitive financing boundary:x

$$c^*(\lambda) > c^*_{base}(\lambda), \rightharpoonup \text{ expanded financed set}$$
$$\partial c^*/\partial\lambda|_c > \partial c^*_{base}/\ \partial\lambda|_c, \rightharpoonup \text{ reduced risk sensitivity.}$$

From Financing to Trade Surplus

- Retail trade surplus: $W(p,c) = \int_p^\infty D(t)dt + (p-c)D(p)$.
- The change in trade surplus by financing:

$$\Delta W(\lambda, c) \equiv \underbrace{W\Big(p^*(\tilde{c})\Big)}_{\text{F contract surplus}} - \underbrace{\Big(1 - m\lambda\Big) W\Big(p^*(c)\Big)}_{\text{M contract surplus}}.$$

- $\lim_{m\lambda \to 1} \Delta W(\lambda, c) > 0$, $\lim_{m\lambda \to 0} \Delta W(\lambda, c) = 0$.
- $\Delta W(\lambda, c) < 0$ for λ close to zero iff

$$\underbrace{\mu c/(1+\mu)}_{\frac{\partial \tilde{c}}{\partial (m\lambda)}} \cdot \underbrace{\rho}_{\frac{\partial p^*(c)}{\partial c}} \cdot \underbrace{D(p^*(c))}_{-\frac{dW}{dp}} > \underbrace{W(p^*(c))}_{\text{covering risk}} \qquad (*)$$

Proposition (Retail Trade Surplus Loss)

Suppose condition $(*)$ holds. There exists a critical threshold $\lambda_{TS} \in (0, 1/m)$ such that financing suppliers strictly reduces retail trade surplus for $\lambda \in (0, \lambda_{TS})$.

Proposition (Consumer Surplus Loss)

There exists a risk threshold $\lambda_{CS} > \lambda_{TS}$ such that financing strictly reduces the consumer surplus for $\lambda \in (0, \lambda_{CS})$.

Funding Cost μ and Matching Efficiency m

- Higher funding costs $\mu \uparrow \Longrightarrow$ Loss-range expands $\lambda_{TS} \uparrow, \lambda_{CS} \uparrow$
- Higher μ exacerbates the double marginalization problem, requiring a higher higher risk λ to offset the price distortion.

- Better matching $m \downarrow \Longrightarrow$ Loss-range expands $\lambda_{TS} \uparrow, \lambda_{CS} \uparrow$
- As $m \downarrow$, the M contract becomes a tougher benchmark to beat. The insurance value of financing drops, but the price distortion remains.

Summary

- Profit-based Liquidity Pooling
- Price Distortion
- As funding costs rise, the intermediary increasingly selects low-λ (safe) suppliers to subsidize the pool.
- For low-λ products, price distortion outweighs the benefit of preventing supply disruption.
- Takeaway: By optimizing for liquidity, the intermediary may decrease the product market surplus.

Related literature

- Multi-product intermediaries:
  - Rhodes, Watanabe & Zhou JPE 2021
  - Liquidity provision and intermediaries' retail advantages
- Banking and Money (Diamond-Dybvig model)
  - Heterogeneous suppliers and selective inclusion
- Trade credit
  - Petersen & Rajan RFS 1997; Burkart & Ellingsen AER 2004; Cunat RFS 2007; Nocke & Thanassoulis JEEA 2014
  - Reallocation of trade credit among suppliers