

Middleman Finance and Product Market Distortions

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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, financing suppliers has become increasingly critical for middlemen, e.g., Walmart, Amazon, JD.com, etc.

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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.

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Research questions:

- ▶ What are the economic rational behind **trade credit extension** and **supplier selection**?
- ▶ How does middleman finance affect retail prices and product market efficiency?

Related literature

- ▶ Intersection of IO and Corporate Finance
 - ▶ Nocke & Thanassoulis JEEA 2014: Downstream financial constraint leads to risk-sharing between buyer and seller firms, resulting in double-marginalization.
- ▶ Multi-product Intermediaries
 - ▶ Rhodes, Watanabe & Zhou JPE 2021
 - ▶ Liquidity provision and intermediaries' retail advantages
- ▶ Diamond-Dybvig model and Trade Credit
 - ▶ Petersen & Rajan RFS 1997; Burkart & Ellingsen AER 2004; Cunat RFS 2007;
 - ▶ Reallocation of trade credit among suppliers

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
 - ▶ Constant marginal costs, $c \in [\underline{c}, \bar{c}]$, differ among suppliers
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Trade and Liquidity Shocks

- ▶ Suppliers can trade directly with consumers
 - ▶ each supplier can meet all consumers, trade bilaterally
 - ▶ trade surplus is split equally: $p - c = (u - c)/2$

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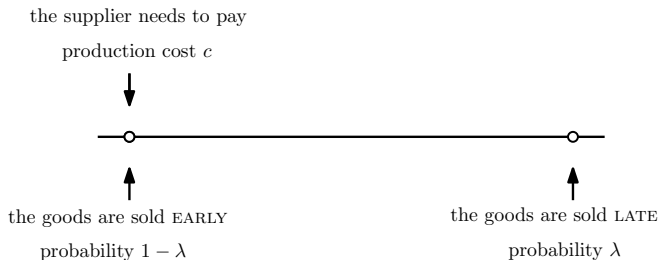
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 - ▶ retail revenue can be used to cover costs c
- ▶ Supplier's liquidity issue matters when:
 - ▶ disparity exists in the timing between production and trade.



- ▶ 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
- ▶ Each supplier's (λ, c) is publicly observable
- ▶ (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 TIOI 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:

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

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

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

Profit-maximizing selection rule

- Solve the problem using Lagrangian:

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

$\mu \geq 0$: 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*

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

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

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

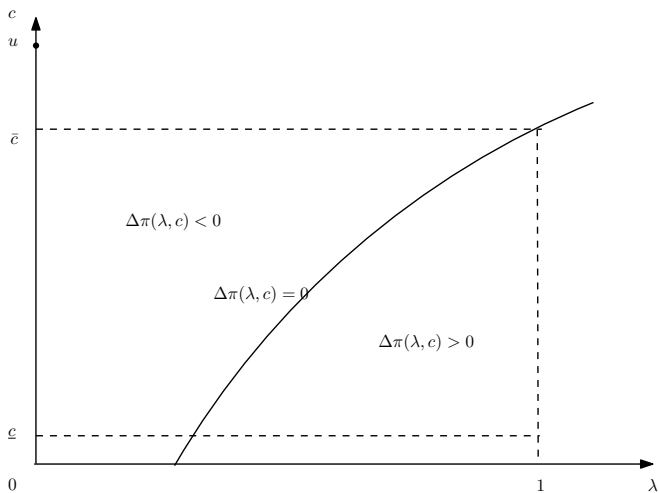


Figure: Incremental profit $\Delta\pi \equiv \pi_F - \pi_M$

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

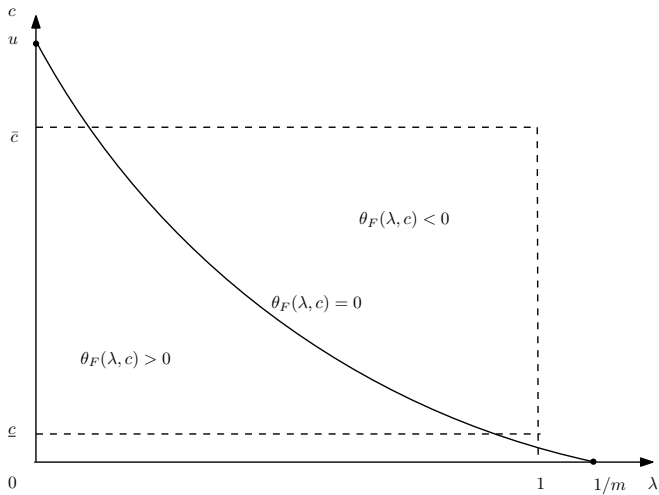


Figure: Liquidity $\theta_F(\lambda, c)$

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

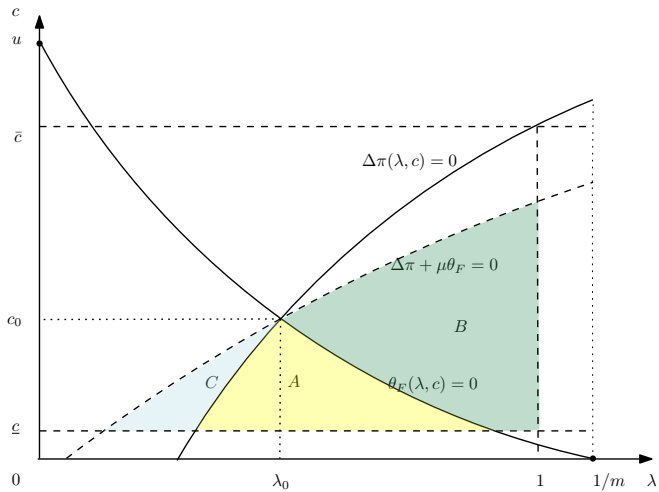


Figure: Profit-based Liquidity Cross-subsidization

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 $p(\lambda, c) \in \mathbb{R}_+$:

$$\begin{aligned} \max_{\{q(\cdot), p(\cdot)\}_{(\lambda, c) \in \Omega}} \int_{\Omega} [q(\cdot) \Delta \pi(\lambda, c, p(\cdot))] dG, \\ \text{s.t. } \int_{\Omega} [q(\cdot) \theta_F(\lambda, c, p(\cdot))] dG + L \geq 0. \end{aligned}$$

- ▶ The corresponding Lagrangian:

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

- 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-maximizing 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 $p^*(c)$

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

Pricing Gain and Risk Resilience

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

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

- ▶ $\mathcal{G}(\cdot)$ 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:

$$\begin{aligned} c^*(\lambda) &> c_{base}^*(\lambda), \rightarrow \text{expanded financed set} \\ \partial c^* / \partial \lambda|_c &> \partial c_{base}^* / \partial \lambda|_c, \rightarrow \text{reduced risk sensitivity.} \end{aligned}$$

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:

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

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

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

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 $\mu \uparrow \implies$ 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 $m \downarrow \implies$ 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.