POMS ANNUAL MEETING 2022

SUPPLY CHAIN FINANCE: A PRACTICAL REVIEW AND ANALYSIS

ISIK BICER

SUPPLY CHAIN FINANCE: GOOD INTENTION BUT BAD IMPLEMENTATION

- Cash-constrained suppliers (e.g., SMEs) benefit from SCF to reduce their working capital needs
- Risk #1: Some consider it a sleeping risk as SCF masks financial distress
- Risk #2: Strong buyers use it to negotiate longer payment terms
  - Keurig Dr Pepper delayed payments worth $2.1B (payment terms ranging up to 360 days)
- Risk #3: High default risk of buyers would put the suppliers in a risky situation
  - JP Morgan introduced vendor-put instrument as a supplier insurance

Ref #1: https://www.wsj.com/articles/supply-chain-finance-is-new-risk-in-crisis-11585992601

Ref #2: https://www.wsj.com/articles/your-holiday-presents-arrival-could-depend-on-these-fund-managers-11603790891

CORRECTION FOR SOME MISUNDERSTANDINGS

- It is **SUPPLY CHAIN finance**, not **supply chain FINANCE**
- SCF should be analyzed from the perspective of operations management
- We just need the interest rates for outside financing options of supply chain parties as inputs
- For modeling purposes, we can use the cost of capital for the buyer and the supplier as an approximation of the interest rates
- CoC: Percentage cost of capital invested in a company. From an investment point of view, it is the required rate of return

SUPPLY CHAIN FINANCING OPTIONS

- Early payment schemes
- Reverse factoring
- Letter of credit
- Dynamic discounting
    1. Sliding-scale mechanism
    2. Market mechanism

EARLY PAYMENT SCHEME

- A buyer ordering 1000 units of a product from a supplier
- The wholesale price is $10 per unit
- Payment term is 60 days
- Suppose that the supplier offers 2% discount if the buyer pays in 20 days, rather than 60 days
- This early-payment scheme is referred to as “2/20, net 60”
- The buyer’s return on paying 40 days earlier is:

$$\frac{365}{40} \times 2\% = 18.25\%$$

EARLY PAYMENT SCHEME

- If the buyer's CoC is less than the annual rate of 18.25%, paying early is feasible for the buyer
- If the supplier's CoC is higher than 18.25%, getting early payment is feasible for the supplier

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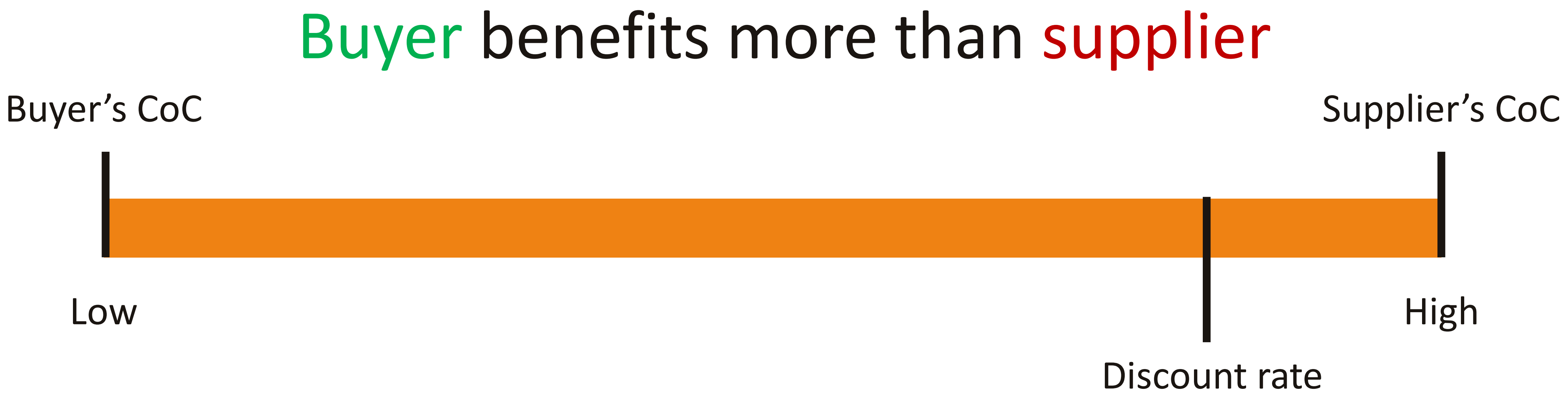


EARLY PAYMENT SCHEME

Schulich
School of Business
York University

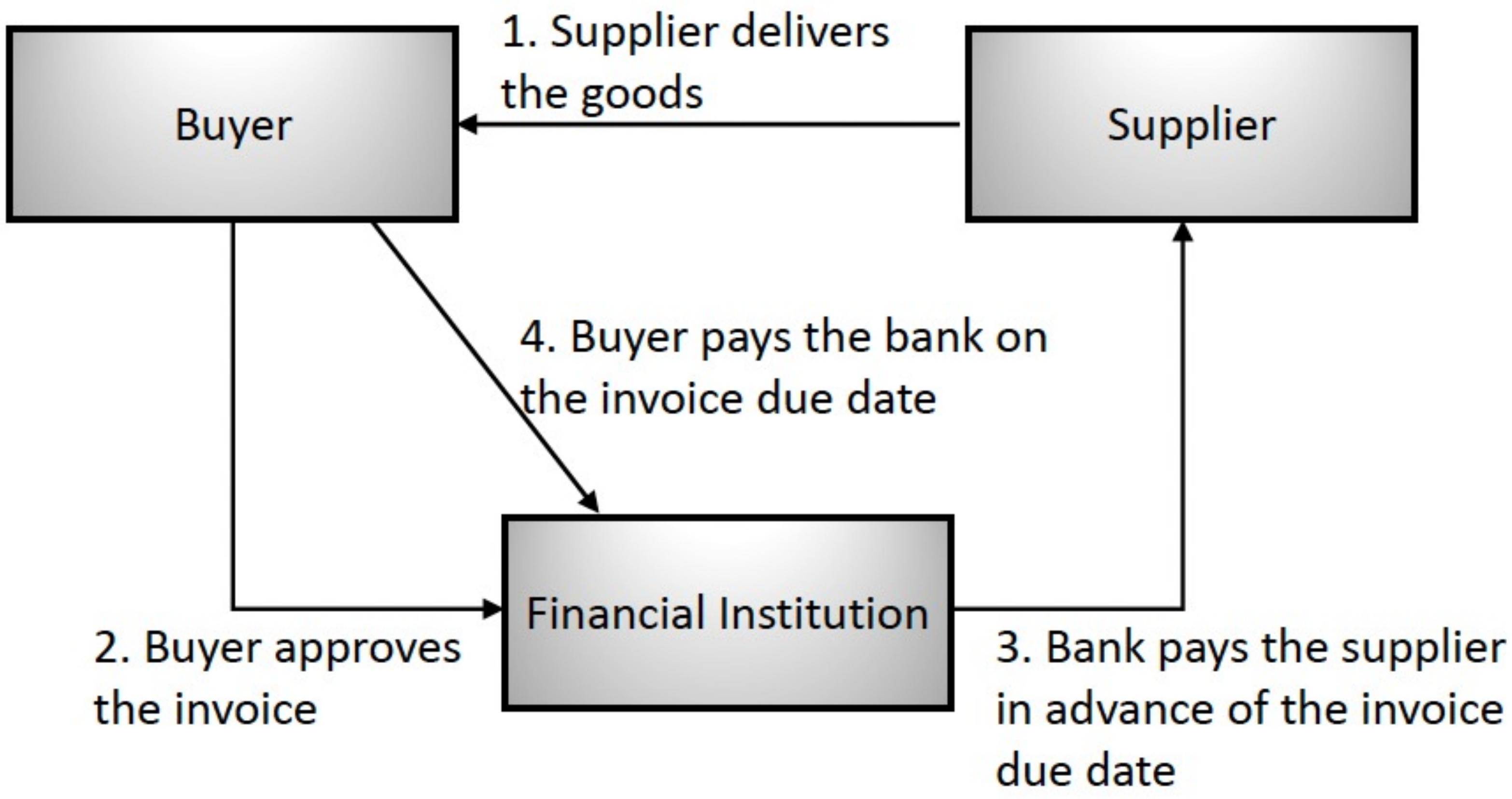
- If the buyer’s CoC is less than the annual rate of 18.25%, paying early is feasible for the buyer
- If the supplier’s CoC is higher than 18.25%, getting early payment is feasible for the supplier

Supplier benefits more than buyer

REVERSE FACTORING

- Early payment: Feasible when there is a difference between CoC values between the supplier and buyer
- Big buyers may not be interested in spending their working capital to pay early
- Solution: Involvement of a financial institution

REVERSE FACTORING



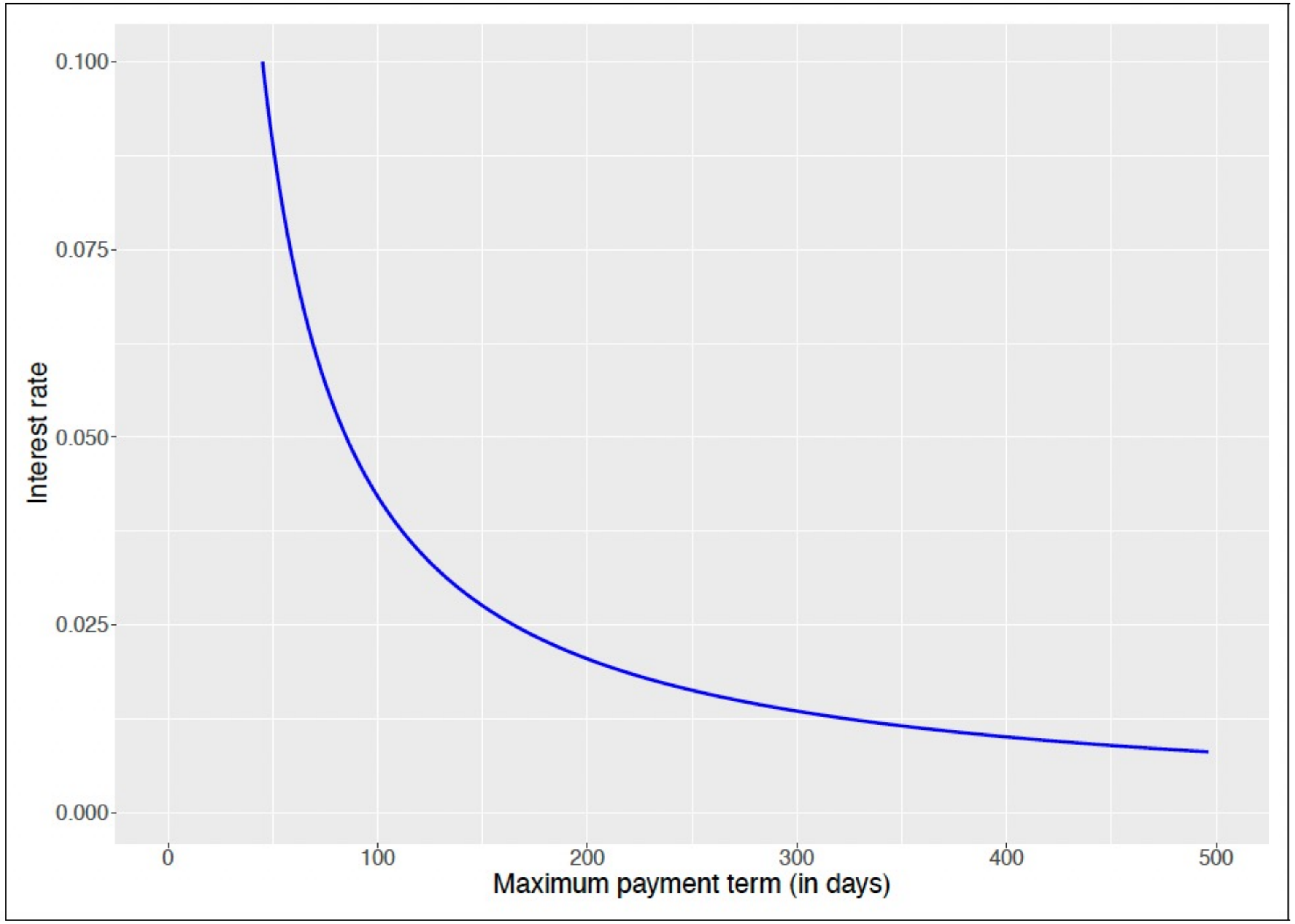
REVERSE FACTORING

- Suppose that the payment term is 45 days for an invoice
- CoC for the supplier is 10%
- The supplier wants to get paid in 5 days
- If the supplier borrows from a bank at an annual rate of 10%, it costs: 10%*40/365 = 1.09% of invoiced amount
- Reverse factoring makes it possible for the supplier to have access to low-cost financing (due to the buyer's high credibility)
- Suppose that the reverse factoring interest rate is 2%

REVERSE FACTORING

- Why do the buyer do such a favor to the supplier?
- Answer: To further increase the payment term
- 2%*200/365 = 1.09%
- So, the supplier is indifferent between original setting and the reverse factoring with a new payment term of 205 days

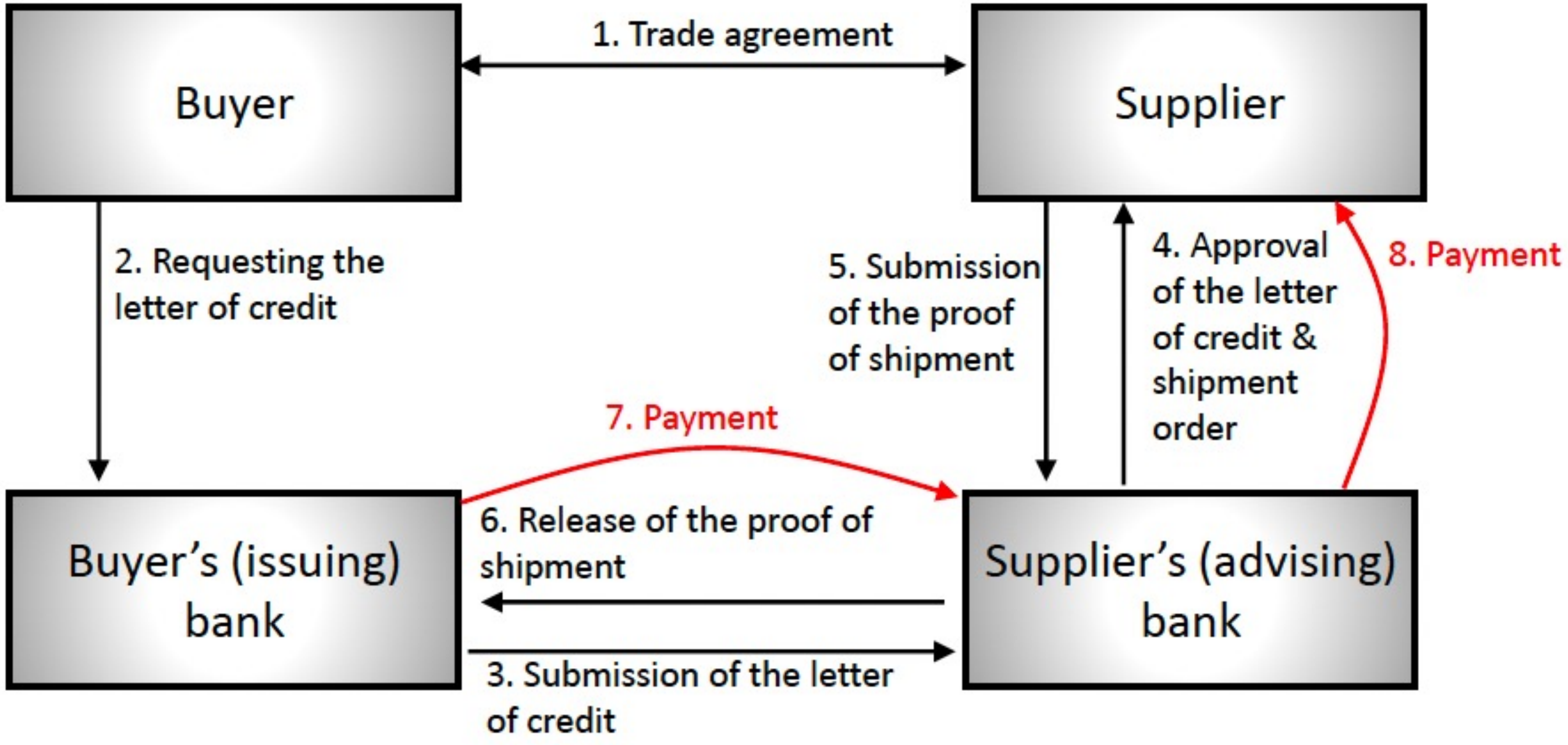
REVERSE FACTORING



LETTER OF CREDIT

- First-time interaction between a supplier and a buyer
- No trust between supply chain parties
- A letter of credit can be issued to establish trust
- Two banks are involved in the transaction

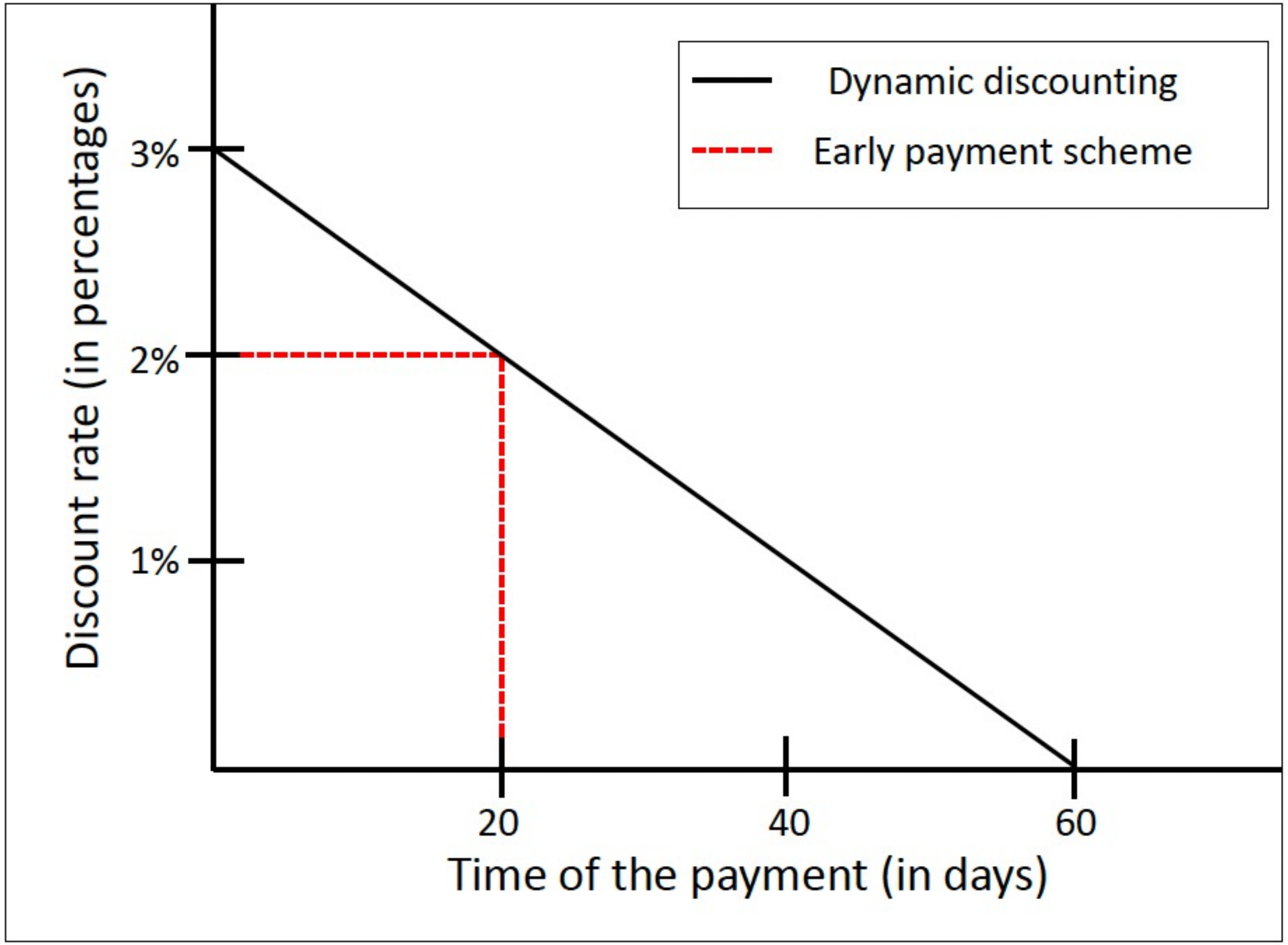
LETTER OF CREDIT



DYNAMIC DISCOUNTING

- Solving some inefficiencies of the early-payment scheme
- Two types
  - Sliding-scale mechanism
    - Initiated by a cash-rich buyer
  - Market mechanism
    - The buyer is cash constrained
    - Suppliers bid for receiving early payment

SLIDING SCALE



MARKET MECHANISM

- Suppose that the buyer has excess capital of
  - $350 K as of March 1, 2022
  - $250 K as of April 1, 2022 (expected)
  - $50 K as of May 1, 2022 (expected)
- There are four invoices to be paid to four different suppliers
- All suppliers offered the same annual rate for receiving the payment on March 1

	Invoice # 1	Invoice # 2	Invoice # 3	Invoice # 4
Amount due	$100K	$200K	$50K	$150K
Invoice date	March 1, 2022	March 1, 2022	March 1, 2022	March 1, 2022
Payment term	30 days	60 days	60 days	45 days

IF INVOICE #1 IS PAID

- New excess capital values
  - $250 K as of March 1, 2022
  - $250 K as of April 1, 2022 (expected)
  - $50 K as of May 1, 2022 (expected)
- Excess capital values for the next two months are unaffected

	Invoice # 1	Invoice # 2	Invoice # 3	Invoice # 4
Amount due	$100K	$200K	$50K	$150K
Invoice date	March 1, 2022	March 1, 2022	March 1, 2022	March 1, 2022
Payment term	30 days	60 days	60 days	45 days

IF INVOICE #1, #3, AND #4 ARE PAID

- New excess capital values
  - $50 K as of March 1, 2022
  - $50 K as of April 1, 2022 (expected)
  - $50 K as of May 1, 2022 (expected)
- Excess capital value for the last month is unaffected
- The buyer cannot use the excess capital of $50 K

	Invoice # 1	Invoice # 2	Invoice # 3	Invoice # 4
Amount due	$100K	$200K	$50K	$150K
Invoice date	March 1, 2022	March 1, 2022	March 1, 2022	March 1, 2022
Payment term	30 days	60 days	60 days	45 days

IF INVOICE #1, #2, AND #2 ARE PAID

- New excess capital values
  - $0 K as of March 1, 2022
  - $0 K as of April 1, 2022 (expected)
  - $50 K as of May 1, 2022 (expected)
- The optimal solution

	Invoice # 1	Invoice # 2	Invoice # 3	Invoice # 4
Amount due	$100K	$200K	$50K	$150K
Invoice date	March 1, 2022	March 1, 2022	March 1, 2022	March 1, 2022
Payment term	30 days	60 days	60 days	45 days

KNAPSACK PROBLEM

- If all the invoices have the same payment term
- The allocation of excess capital to invoices becomes a Knapsack problem:

$$\begin{aligned} \underset{z_j, \forall j \in \mathcal{J}_i}{\text{Maximize}} \quad & f(\mathcal{W}_j, \alpha_j, \mathcal{K}_i \mid \forall j \in \mathcal{J}_i) = \sum_{j \in \mathcal{J}_i} \alpha_j z_j \\ \text{st:} \quad & \sum_{j \in \mathcal{J}_i} \mathcal{W}_j z_j \leq \mathcal{K}_i, \\ & z_j \in \{0, 1\}, \quad \forall j \in \mathcal{J}_i. \end{aligned}$$

- W_j: total amount of invoice j
- α_j: discounted amount of invoice j
- K_i: Excess capital in the current month i

GENERAL SOLUTION

Step 0: Set $i = 1$ and calculate the surplus for period i: $\mathcal{K}_{i+1} - \mathcal{K}_i = \Delta\mathcal{K}_i$.

Step 1: If $\Delta\mathcal{K}_i \leq 0$ and $i < n$:

Step 1a: Set $\mathcal{J}_n = \bigcup_{k=i}^{n} \mathcal{J}_k$.

Step 1b: Go to Step 3.

Step 2: If $\Delta\mathcal{K}_i > 0$ and $i < n$:

Step 2a: Solve the Knapsack problem for the invoices in the set $\mathcal{J}_i$ with the capital equal to $\Delta\mathcal{K}_i$.

Step 2b: Separate the selected invoices $\mathcal{J}_i^*$ and update $\mathcal{J}_{i+1} = \mathcal{J}_{i+1} \cup \mathcal{J}_i$.

Step 2c: Set i = i+1.

Step 2d: Go to Step 0.

Step 3: Solve the Knapsack problem for the invoices in the set $\mathcal{J}_n$ with the capital equal to $\min(\mathcal{K}_1, \mathcal{K}_2, \cdots, \mathcal{K}_n)$.

SUMMARY

- Dynamic discounting allows buyers to use their excess capital effectively by capitalizing on the early payment discounts
- To create excess capital, buyers can develop reverse factoring programs with banks
- Not all the suppliers should be accepted to reverse factoring programs