Chapter 28

Advanced Issues in Cash Management and Inventory Control

Topics in Chapter

- Setting the target cash balance
- EOQ model
- Baumol Model

Setting the Target Cash Balance

- Theoretical models such as the Baumol model have been developed for use in setting target cash balances. The Baumol model is similar to the EOQ model, which will be discussed later.
- Today, companies strive for zero cash balances and use borrowings or marketable securities as a reserve.
- Monte Carlo simulation can be helpful in setting the target cash balance.

Why is inventory management vital to the financial health of most firms?

- Insufficient inventories can lead to lost sales.
- Excess inventories means higher costs than necessary.
- Large inventories, but wrong items leads to both high costs and lost sales.
- Inventory management is more closely related to operations than to finance.

Assumptions of the EOQ Model

- All values are known with certainty and constant over time.
- Inventory usage is uniform over time.
- Carrying costs change proportionally with changes in inventory levels.
- All ordering costs are fixed.
- These assumptions do not hold in the "real world," so safety stocks are held.

Total Inventory Costs (TIC)

- TIC = Total carrying costs+ total ordering costs
- TIC = CP(Q/2) + F(S/Q).
- C = Annual carrying costs (% of inv.).
- P = Purchase price per unit.
- Q = Number of units per order.
- F = Fixed costs per order.
- S = Annual usage in units.

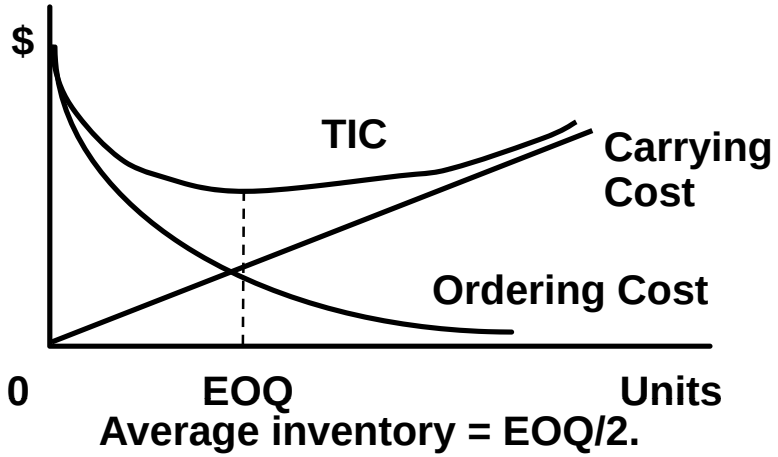
Derive the EOQ model from the total cost equation

$$\frac{d(TIC)}{dQ} = \frac{CP}{2} - \frac{FS}{Q^2} = 0$$

$$Q^2 = \frac{2FS}{CP}$$

$$EOQ = Q^* = \sqrt{\frac{2FS}{CP}}\ .$$

Inventory Model Graph



Average inventory = EOQ/2.

Assume the following data:

- P = $200.
- F = $1,000.
- S = 5,000.
- C = 0.2.
- Minimum order size = 250.

What is the EOQ?

$$EOQ = \sqrt{\frac{2(\$1,000)(5,000)}{0.2(\$200)}}$$

$$= \sqrt{\frac{\$10,000,000}{40}}$$

$$= \sqrt{250,000} = 500 \text{ units.}$$

What are total inventory costs when the EOQ is ordered?

TIC = CP(Q/2) + F(S/Q)

= (0.2)($200)(500/2) + $1,000(5,000/500)

= $40(250) + $1,000(10)

= $10,000 + $10,000 = $20,000.

Additional Notes

Average inventory = EOQ/2

Average inventory = 500/2 = 250 units.

# of orders per year = S/EOQ

# of orders per year = $5,000/50 = 10.

At EOQ, total carrying costs = total ordering costs.

What is the added cost if the firm orders 400 units or 600 units at a time rather than the EOQ?

400 units:

TIC = CP(Q/2) + F(S/Q)

= 0.2($200)(400/2) + $1,000(5,000/400)

= $8,000 + $12,500 = $20,500.

Added cost = $20,500 - $20,000 = $500.

600 units:

TIC = CP(Q/2) + F(S/Q)

TIC = 0.2($200)(600/2) + $1,000(5,000/600)

= $12,000 +$8,333 = $20,333.

Added cost = $20,333 - $20,000 = $333.

Notes about EOQ

- At any quantity ≠ EOQ, total inventory costs are higher than necessary.
- The added cost of not ordering the EOQ is not large if the quantity ordered is close to EOQ.
- If Q < EOQ, then total carrying costs decrease, but ordering costs increase.
- If Q > EOQ, total carrying costs increase, but ordering costs decrease.

Suppose delivery takes 2 weeks. Assuming certainty in delivery and usage, at what inventory level should the firm reorder?

- Weekly usage rate = 5,000/52 = 96 units.
- If order lead time = 2 weeks, firm must reorder when:
- Inventory level = 2(96) = 192 units.

Assume a 200-unit safety stock is carried. What effect would this have on total inventory costs?

Without safety stocks, the firm's total inventory costs = $20,000.

Cost of carrying additional 200 units = CP(Safety stock)= 0.2($200)(200) = $8,000.

Total inventory costs = $20,000 + $8,000

TIC = $28,000.

Alternatively

Average inventory = (500/2) + 200 = 450 units.

TIC = CP(Avg. Inv.) + F(S/Q)

= 0.2($200)(450) + $1,000(5,000/500)

= $18,000 + $10,000

= $28,000.

What is the new reorder point with the safety stock?

- Reorder point = 200 + 192 = 392 units.
  - The firm's normal 96 unit usage could rise to 392/2 = 196 units per week.
  - Or the firm could operate for 392/96 = 4 weeks while awaiting delivery of an order.

Suppose the firm could receive a discount of 1% on orders of 1,000 or more. Should the firm take the discount?

- Discount affects operating inventory only.
- Discount price = $200(0.99) = $198.

TIC= CP(Q/2) + F(S/Q)

TIC = 0.2($198)(1,000/2) +1,000(5,000/1,000)

TIC = $19,800 + $5,000 = $24,800.

(More...)

Firm should take the discount.

Savings = 0.01($200)(5,000) = $10,000
Added costs = $24,800 - $20,000 = $ 4,800
Net savings = $10,000 - $4,800 = $ 5,200

Can the EOQ be used if there are seasonal variations?

- Yes, but it must be applied to shorter periods during which usage is approximately constant.

How would the following factors affect an EOQ analysis?

- Just-in-time system: Eliminates the need for using EOQ.
- Use of air freight for deliveries: Reduces the need for safety stock.
- Computerized inventory control system: Reduces safety stocks.
- Flexibility designed plants: Reduces inventory holdings of final goods.

The Baumol Model

- The EOQ model can be applied to cash management if you view cash as an operating assets, just like inventory.
- In this view, cash has a carrying cost, which is the opportunity cost for investing the funds, and an order cost, which is the cost per transaction of liquidating marketable securities and transferring the money to a checking account.

- C = cash raised each time by selling securities or borrowing
- r = opportunity cost of holding cash—equal to the rate of return on marketable securities or cost of borrowing
- T = total amount of cash needed for transactions during the year
- F = fixed per transaction cost of selling securities or obtaining a loan

Costs of cash—Holding costs

- Holding cost = (average cash balance) x (opportunity cost rate)
- Average cash balance = C/2
- Holding cost = C/2 x r = rC/2

Costs of cash transactions costs

- T = total new cash needed in the year
- T/C = number of transactions
- (T/C)(F) = FT/C = total cost of all of the transactions

Costs of cash

Total cost of cash
= Holding Costs + Transactions Costs
= rC/2 + FT/C

Just like EOQ, optimal C = C* = $\sqrt{\frac{2(F)(T)}{r}}$

Baumol Assumptions

- Total cash outflows per week = $500,000 per month.
- Total cash inflows from operations = $400,000 per month.
- Net cash needs = $500,000 - $400,000=

  $100,000 per month, or $1,200,000 each year.

Costs:

- r = 7% = rate the firm can earn on its marketable securities
- Transaction/order costs = $32 per transaction (F)

$$C^* = \sqrt{\frac{2(32)(1200000)}{0.07}} = \$33{,}123$$

Optimal cash transfer size

- The optimal "order size" is $33,123, so the firm will liquidate marketable securities, or borrow from the bank, in blocks of $33,123. This is approximately $1,200,000/33,123 = 36 times a year, or about every week and a half.

Sensitivity

F, r	C^*
$32, 7%	$33,123
$50, 7%	$41,404
$32, 5%	$39,192

Higher order costs, lower carrying costs increase the optimal order size.