Chapter 9: Working capital management

The purpose of the chapter is to look at the management of short-term assets and liabilities of a firm. Short-term, or current, assets and liabilities are collectively known as working capital. Current assets mainly consist of cash and marketable securities, inventory and accounts receivable. Current liabilities mainly consist of short-term debt, long-term debt to come due within a year and accounts payable.

Up to now we have focused primarily on long-term investments. Once, however, the investment is made, the firm has to consider also investments in short-term assets required for the operation of the project. These investments, which we define as working capital, create cash outflows or inflows for the firm and can affect the final decision on the project.

In the first part of this chapter we differentiate between investment in noncash working capital and investment in cash and marketable securities, arguing that it is the noncash working capital that affects cash flows and should be considered for investment analysis. We also examine the effects of noncash working capital in investment analysis and on the decision to accept or reject a project.

In the second part, we examine the major ingredients of noncash working capital, i.e., inventory, accounts receivable, and accounts payable. We will examine the management of the last two components, as inventory management lies in the hand of the production, rather than, the financial manager. Accounts receivable are the unpaid bills of goods sold on credit. We will consider the costs and benefits of offering credit, present an overview of the process through which credit decisions are made and examine how the terms of credit affect the firm's cash flows and collection of outstanding debt. Accounts payable are the unpaid bills of the firm on goods and services bought on credit. We will examine how we can manage them to maximize firm value.

Finally, in the last part we will examine the investment in cash and marketable securities. Cash, even if it does not earn a rate of return, is held by firms to meet their operating needs that can be satisfied only by it. The cash manager faces two principal problems. The first is to decide how much cash the firm needs to retain. The second is to ensure that cash payments are handled efficiently.

Marketable securities are liquid assets (that can be converted quickly and cheaply in cash) that earn a rate of return and have little or no risk. We consider the choices that are available to firms on these investments, including Treasury bills, commercial papers issued by safe corporations and repurchase agreements (repos).

9.1. Working capital for investment analysis

9.1.1. Noncash working capital

Working capital is defined as the difference between the current assets and current liabilities of the firm. Current assets are those assets that either are in the form of cash or are expected to be converted into cash in the short-term (usually defined to be less than a year). It consists mainly of:

- Cash and marketable securities: These are the most liquid asset that the firm possesses. Marketable securities (like for example short-term government bonds) can be converted into cash quickly and cheaply.
- Inventory: Refers to the holdings of raw materials, work-in-progress, and finished goods. Inventory can be converted into cash rather quickly.
- Accounts receivable: Refers to the unpaid bills of good sold on credit. When these bills are paid off, accounts receivable are converted into cash.

The firm's current liabilities include those liabilities that are expected to come due within the year. It includes:

- Accounts payable: Refers to the unpaid bills of good that the firm has bought on credit.
- Accrued expenses: In doing business the firm accrues salaries to its employees and taxes to the government.
- Short-term debt: Refers to debt to come due within a year.
- Long-term debt to come due within a year: Refers to the portion of long-term debt (bonds or bank loans) that is expected to mature over the year.

We are interested in the effect of working capital on cash flows. However, some of the components of the working capital definition do not have a net effect on cash flows; in other words, their change in volume cannot be considered a cash inflow or outflow related to the operation of the project.

In particular, the level of cash balance held by the firm is not considered a cash inflow or outflow. This is due to the fact that cash is not *only* held to cover the day-to-day operations. It is also held to finance future investments or as a safety buffer against adverse events. Finally cash held in large amounts may provide a market return and has no opportunity cost. This not the case however with inventory and accounts receivable. Thus, the increase of the cash balance cannot always be considered as a cash outflow due to the operation of the project. As a consequence any cash in excess of that which is required from the day-to-day operations should be removed from the estimation of working capital for investment analysis.

The same is true for marketable securities, since they also earn a market interest rate. Thus, an investment on them cannot be considered as a cash outflow.

Summarizing the previous discussion we conclude that the only components of current assets that affect working capital calculation for investment analysis are inventory and accounts receivable.
In the liability side we also remove all current liabilities that earn an interest rate. This eliminates short-term debt and the portion of long-term debt that matures within a year. The only remaining components are accounts payable, taxes payable and salaries payable. Given the previous discussion we define the **noncash working capital** as

Noncash working capital =
Noncash current assets – non-interest-bearing current liabilities

Remember that this was the definition of the working capital that we have used in Chapter 6 when we have estimated the cash flows of a project for investment analysis. In particular increases in noncash working capital are cash outflows because they tied up cash. Investments in inventory require cash and accounts receivable represent cash not yet receive on sales that have been made. Thus, increases in these investments from period to period create cash outflows. On the other hand, decreases in working capital are cash inflows. For example the increase of accounts payable releases cash for the firm.

9.1.2. Measuring working capital needs

The demand of working capital is related to the number of units that the firm expects to manufacture and sell, which affects inventory, and the growth in credit sales, which affect accounts receivable. The amount of inventory is related to the number of unit sold, and this in turn is reflected in revenues or operating expenses. So, as revenues or operating expenses increases, investment in inventory and consequently in working capital also increases. Similarly, we can argue that revenues are positively related to accounts receivable. As credit sales increase, so do the revenues of the firm. Thus, we can argue that the estimates of working capital should be related to the revenues or cost of goods sold on the project.
A first approach is to specify working capital requirements as a *percentage of revenues* (remember that this is what we have done in the example of Chapter 6). In that case change in working capital reflects expected changes in revenues. A second approach (which is equivalent to the first one if operating margin remains constant across time) is to specify working capital requirements as a *percentage of operating expenses*. Third, we can link the working capital needs to the *number of good sold* rather than to dollar revenues.
Companies can also use other information when estimating the working capital for a specific project. They can base their estimate of working capital on:

1. Experience from past project: If the new project is similar to firm's existing projects (for example a retail firm opens a new store) then the company can estimate quite accurately working capital needs for the new project given its experience on past similar projects.

2. Overall working capital requirements: For a firm in a single business the overall working capital needs of the firm can give a guide for the working capital requirements of a specific project in the same line of business.
3. Industry practice: When a firm operates in multiple businesses or enters into a new business this could be the most reasonable approach to estimate working capital needs.

9.1.3. The effect of working capital in cash flows and NPV

Working capital affects the cash flows at all stages of the project. For many projects, investments in working capital will be part of the initial investment. This working capital may represent inventory that should be stored before production begins.
As the project operates working capital needs may further change. In particular if we measure working capital requirements as a percentage of revenues, and we expect revenues to grow over time, then working capital would also increase. This increase in working capital from period to period generates a cash outflow which decreases the cash flow of the project. Similarly, if working capital decreases from period to period this generates a cash inflow which increases the project's cash flow. Thus, it is the change of working capital from one period to the next that affect the cash flows of the project (we have already seen that in Chapter 6). Though working capital changes throughout the year we make the simplifying assumption, for purpose of cash flow estimation, that working capital investments occur at the beginning of the year in which they are expected to change. Thus, if working capital is expected to increase from $50 million in year 1 to $60 million in year 2, we assume that the investment of $10 million occur at the beginning of year 2.
At the end of the life of the project there is a final cash inflow due to working capital. This can be considered as the salvage value of it. This cash inflow represents the sales of inventory and the collection of outstanding debt.
As already argued a positive investment in working capital has a negative impact on cash flows and consequently in the NPV of the project. Thus, if we decrease working capital needs, holding other things constant, we will increase the NPV of the project. However, there are practical limits on how much we can lower working capital investments. A firm that reduces inventory to the point that cannot meet customers demand or cause unexpected operating costs will lose sales or increase operating expenses thus decreasing cash flows and value. Similarly, the decrease in accounts receivable would affect revenues. Finally, using accounts payable recklessly to finance noncash current assets might increase the default risk of the firm.
Thus, reducing working capital can increase cash flows, but this benefit has to be offset against these costs. Given the tradeoff between the negative effects on cash flows of increasing working capital and the positive effects on reducing default risk and potentially increasing revenues, working capital should be increase if the benefits exceed the costs. At least initially, increases in working capital typically increase firm value since the marginal benefits are likely to exceed the costs. At some level of

working capital the firm value is maximized. This is the optimal level of working capital. After this optimal point marginal costs exceed the benefits and the value decreases. Although this approach has intuitive appeal, using it requires a number of information, like for example, the impact on revenues and revenues growth from changes in inventory and credit policy, or the effect on risk of reducing working capital needs. The following example provides a numerical illustration of this approach.

Example: A firm has current revenues of $1 billion and operating profits after taxes of $100 million. If the firm maintains no working capital its revenues and operating profits after taxes are expected to grow by 3% a year and the firm would have a cost of capital of 12.5%. As the working capital increases as a percentage of revenues, the expected growth in operating profits will increase, at a decreasing rate, according to the following function:

$$g(x) = 0.03(1 + \ln(1 + x))$$

where x denotes the working capital as a percentage of revenues. Also, the cost of capital will decrease by 0.05% for every 10% increase in working capital as a percentage of revenues.

If the firm has no working capital then next year after-tax operating profits would be $100 \times 1.03 = 103$ million and the expected cash flows would also be same, as there is no investment in working capital. Thus, the value of the firm would be

$$\text{PV} = \frac{103}{0.125 - 0.03} = 1,084.21$$

Now assume that the working capital is 10% of revenues. Then the expected growth rate would be $0.03(1 + \ln(1 + 0.1)) = 0.0329$ or 3.29%. Next year expected cash flow would be equal to $100 \times 1.0329 - 1,000 \times 0.1 \times 0.0329 = 100$. Also the cost of capital would be equal to 12.45%. Thus, the value of the firm would be

$$\text{PV} = \frac{100}{0.1245 - 0.0329} = 1,091.22$$

So, as working capital increases, next year cash flow decreases, the cost of capital increases but these two negative effects are offset by the increase in the growth rate. Working analogously when the working capital is 20% of revenues we find that the PV = 1,089.49 (see also excel file Chapter_9.xlsx). So, we observe that the firm is value is maximized when working capital is equal (or close) to 10% of revenues.

9.2. Components of noncash working capital

In this section we examine two major components of noncash working capital, i.e., accounts receivable and accounts payable, and examine how we can manage them to maximize firm value.

9.2.1. Accounts receivable

Accounts receivable consists of bills awaiting payment from another firm, known as **trade credit**, or from the final customer, known as the **customer credit**. Trade credit composes the bulk of accounts receivable.

9.2.1.1. The decision to offer credit

Firms offer credit mainly because they wish to generate sales that would not have been occurred otherwise, either because customers do not have the cash to pay for or because credit increases the likelihood of selling the product. Offering credit involve two costs. First, the customer may default on the payment, resulting in losses even if the firm is able to reclaim the item that was sold. Second, the firm bears the cost of the interest that it loses between the time of the sale and the time of payment, i.e., the time value of money. This cost can be partially or fully offset by charging customers interest costs for buying products on credit. Thus, there is a trade-off in offering (or loosing existing) credit. From the one hand, it is likely that it will increase revenues, but on the other hand it increases the potential costs as well. A credit manager should examine if the net benefit is negative or positive. The following example shows how a decision to offer credit can be taken based on the value that it creates (or destroys) for the firm.

Example: A large retail chain examines the possibility to extend credit on its customers. The current revenues of the chain are $10 million and the pre-tax operating income is $2 million. If it offers 1-year credit to its customers, it expects the following changes to occur:

- Revenues will increase by $1 million with the pre-tax operating income to remain at the 20% of these incremental revenues.
- The chain can earn a 5% interest rate by investing cash elsewhere.
- The bad debts are expected to be 5% of the credit sales.
- This credit strategy will remain for 5 years. At the end of this period it is expected that 95% of the accounts receivable will be collected.

Also assume that the tax rate is 40% and the cost of capital is 10%.

The chain expects to generate additional operating income as a consequence of the credit sales, but it also expects to generate additional costs in terms of the interest forgone and bad debts.
At year 0 the firm would make an initial investment in accounts receivable equal to $1 million.
From year 1 to 4 the incremental pre-tax operating income is equal to $0.2 \times 1,000,000 = 200,000$. We subtract from this amount the interest that we lose during the year, equal to $0.05 \times 1,000,000 = 50,000$ and we obtain a pre-tax operating profit of 150,000. The incremental after-tax operating profit is equal to the sum of $150,000 \times (1 - 0.4) = 90,000$ and the tax benefit of credit sales loses of 50,000 (bad debt) equal to $0.4 \times 50,000 = 20,000$, thus 110,000. Also, at year 1, customers return $950,000 of cash and the company makes a new investment of $1 million in accounts receivable. The net effect is a cash outflow of 50,000. So, the incremental cash flow is 110,000 – 50,000 = 60,000.
At year 5 outstanding accounts receivable are collected and the company does not make a new investment on them. So, the incremental cash flow is 110,000 + 950,000 = 1,060,000.
The incremental PV related to the credit decision is equal to:

$$\text{PV} = -1,000,000 + 60,000 \times \text{Annuity factor}(4,10\%) + \frac{1,060,000}{1.1^5} = -151,631$$

So, offering credit will decrease the value of the firm by 151,631, so the firm should not take this decision.

9.2.1.2. Credit analysis

Although you have decided to offer or extend your credit policy, this decision should be followed by additional analysis as to which firm or customer will be offered credit and in what terms. In making this decision firms rely on credit analysis, which is intended to analyze the creditworthiness of other firms or customers.
For existing customers an obvious indication is whether they have promptly paid in the past. For new customers you can use firm's financial statement to make your own assessment or for a publically traded large firm you can look at the bond ratings provided by Moody's or Standard & Poor (as we have seen in Chapter 5).
However, bond ratings are not available for small companies. In that case you can ask for an advice from a credit agency or a credit bureau that possess credit information on millions of business worldwide. Finally, you can also ask your bank to do a credit examination for a specific customer. It will contact the customer's bank and ask for information on the customer's average balance, access to bank credit, e.t.c.

9.2.1.3. Terms of sale and credit

The terms of sale specify how the credit will be offered, including the length of the period, and the interest rate on the credit. Several times instead of charging an interest rate we provide customers with a discount to pay in cash. For example a terms of sale could be: A customer who makes payment within 15 days of the sale will receive a 4% discount; if the customer chooses not to take advantage of this discount, he/she has an extra 45 days to make the payment (this terms of sale are referred as 4/15 net 60). Although no interest rate on the credit is charged, the 4% discount implies an effective interest rate that the customer who buys with credit should pay. For $1 of goods sold the effective annualized interest rate is equal to:

$$\left(\frac{1}{0.96}\right)^{(365/45)} - 1 = 39.25\%$$

Thus, a policy of providing cash discount 4% and allowing an extra 45 days for payment is equivalent of offering credit at an annualized interest rate of 39.25%.

9.2.2. Accounts payable

The need for accounts payable arises as a consequence of a firm's purchase of goods and services. Since these goods and services are used by the firm to produce revenues, accounts payable tend to increase with both revenues and current assets which are also linked to revenues. If all other things remain constant an increase in accounts payable decrease working capital requirements and increase firm value. There may be a cost however: there is often a discount on the price that the firm foregoes when it uses credit, since it can uses the discount only if it pays immediately. The discount can be translated into an implicit interest cost, as we have seen in the discussion of the previous section. If this interest cost is higher than the cost of debt then the increase in accounts payable will decrease firm value as it would be better for the firm to borrow and buy the goods in cash. For example if the terms of trade credit are 1/10 net 30 then this implies an effective annualized interest rate of 20.13%. If the cost of short-term debt for the firm is 8% it would be better for the firm, either to negotiate better terms or to borrow at 8% in order to buy the goods in advance.

9.3. Cash

Operating cash is held by corporations either in the form of currency or as investments earning no interest or below-market interest rates. Investment in bank checking or saving accounts even if they provide interest they are considered as part of the operating cash, since the interest rate earned on these accounts will be below the risk-free rate (i.e., the rate of government bonds).

9.3.1. Reasons for holding cash

Short-term securities pay interest, cash doesn't (or it pays to little). So why do corporations or individuals hold cash? The answer is that cash gives you more *liquidity* than securities. This is also known as the *transaction motive*. So, cash is held to meet needs that arise in the course of doing business. Retail firms, such as Home Depot, are likely to have a greater need for operational cash than firms such as Boeing that manufacture and sell a few planes every year. The transactions demand for cash is also affected by any seasonal factors that may affect revenues or operation. For example, retail firms are likely to maintain higher cash balances in the last quarter of the each year, reflecting the higher sales they anticipate during the Christmas holidays.

Firms also hold cash as a *precaution*, that is, to meet unexpected needs. Again, this would vary across firms. Firms with stable or predicable revenues and expenses need less cash than firms with volatile revenues and expenses. In addition, the demand for cash to cover unexpected expenses is affected by the firm's access to external financing; firms that can borrow easily and at low cost are much less likely to keep large cash balances to cover unexpected events.

Cash is also held by firms in order to maintain *compensating balances*. Firms need the services of banks, and in order to get these services, they are sometimes required to maintain a specific cash balance, which is called a compensation balance.

9.3.2. How much operating cash to hold

The answer on the question, how much cash firms need to hold, depend on a number of factors, including the kind of business the firm is in, the size of the firm, and the sophistication of the banking system in which the firm operates.

The operating cash balance that a firm has to maintain is determined largely by the nature of its business. For example, retail firms need more cash than manufacturers. Second, it also depends on its size. We would expect that larger firms would hold fewer amounts of cash, relative to revenues, than smaller firms. This is because large firms enjoy both economies of scale and greater bargaining power against their banks and suppliers. Finally, the sophistication of banking system and payment procedures also determines the amount of cash balances. Naturally, we expect that in a more sophisticated financial system, where suppliers and employees are paid with checks and customers pay with checks or credit cards, the firm will use less cash.

In choosing between cash and marketable securities the financial manager faces a task like that of the production manager. After all, cash can be considered as a "raw material" that you need to do business, and they are costs and benefits to holding large "inventories" of cash. If the cash were invested in securities, it would earn interest. On the other hand, you can't use those securities to pay the firm's bills. If you had to sell them every time you had to pay a bill, you would incur heavy transactions costs.

Thus, the financial manager must trade-off the cost of keeping cash (the lost interest) against the benefits (the saving of transactions costs). This approach can be applied to estimate an optimal cash balance based on the annual cash usage rate of the firm. This is defined as the demand for cash every year. In this model, called the **Baumol model**, the optimal cash balance is equal to:

$$\text{optimal cash balance} = \sqrt{\frac{2 \times \text{cash usage rate} \times \text{cost per sale of securities}}{\text{interest rate}}}$$

(See Appendix at the end of the Chapter for a proof). The optimal cash balance is an increasing function of the cash usage rate and the transaction cost and a decreasing function of the interest rate provided by marketable securities.

For example if the annual cash usage rate of a firm is $10 million, the cost per sale of securities is $50 and the interest rate is 10%, then the optimal cash balance is equal to

$$\text{optimal cash balance} = \sqrt{\frac{2 \times 10,000,000 \times 50}{0.1}} = \$100,000$$

Thus, the firm should maintain a cash balance equal to $100,000.

9.3.3. The effect of cash on firm value

Investments in operating cash, like investments in accounts receivable, reduce value (other things being equal) because cash earns no or below-market interest rates. A firm that has a substantial need for operational cash will need to set aside cash flows to meet this need. This reduces the cash flows available to claimholders of the firm, making the firm less valuable.

9.3.4. How purchases are paid for

Most small face-to-face transactions are made with physical currency (dollars or euros for example). However, as you probably know, there are other ways to pay for your purchases or send money to another location. These ways include, checks (very frequently used in US and France but not in other European countries), credit or debit cards, credit transfer (the bank set up for you a standing order to make regular payment to a supplier), direct payment (this is an instruction to your bank to allow a company to collect varying amounts from your account. For example an electric or telephone utility company may ask you to arrange a direct payment for your bills from your bank account), and electronic bill presentment and payment (EBPP) in which the company sends its bills over the internet and customers pay these bills electronically.

9.4. Marketable securities

Marketable securities are short-term investments that earn a market return, with little or no risk, and can be quickly converted in cash. An example is the treasury bills (zero-coupon bonds with less than a year maturity period), which have no default risk, and they have a very low exposure on interest rate risk as it is short-term investment. The market for these securities is generally known as the **money market**. This market has no physical marketplace. It consists of a loose collection of banks and dealers linked together by telephones or through internet.
Most large corporations manage their own money-market investments, but small companies sometimes find it more convenient to hire a professional investment management firm or to put their cash on money-market mutual funds.

9.4.1. Money-market instruments

Money-market instruments are pure *discount securities*. They don't offer a nominal interest. The return consists of the difference between the amount you pay to acquire the security and the amount you receive at maturity. The principal money-market instruments are presented below.

Treasury bills: Treasury bills are short-term obligations issued by the US government. They are usually issued weekly and have a maturity period less than a year (typically they mature in 4 weeks, 3 months, 6 months and 1 year). As noted previously Treasury bills are discount securities. For example an investor how buys a 180-day treasury bill with a face value of $100,000 will pay only $97,500. The difference of $2,500 between the face value and the current price is the interest income on this security.
Unlike other bonds, treasury bills are quoted on a *bank discount basis* rather a price basis, where the bank discount basis is calculated as:

$$\text{yield on a bank discount basis} = \left(\frac{\text{FV} - \text{P}}{\text{FV}}\right)\left(\frac{360}{\text{t}}\right)$$

where FV is the face value, P is the purchase price and t is the number of days remaining to maturity. Thus, the yield on a bank discount basis for the aforementioned Treasury bill would be equal to

$$\left(\frac{100,000 - 97,500}{100,000}\right)\left(\frac{360}{180}\right) = 5\%$$

In other words, the interest income is the 5% (in annual basis) of the face value. However, this is not a correct estimate of the true return that this investment provides to investors for two reasons. First, it uses the face value rather than the purchase price in the denominator, and second, it does not consider the compounding effect when computing returns. The return on this Treasury bill would correctly be estimated to be equal to:

$$\left(\frac{100,000}{97,500}\right)^{(365/180)} - 1 = 5.27\%$$

which is higher than the 5% yield on a bank discount basis.

Commercial papers: Commercial papers are short-term debt issued by corporations to raise funds. Corporations issue these papers for two main reasons. First, to cover working capital needs, and second, to fill the gap between funds needed now and long-term funds that can be raised in markets. On the other side of the transaction, firms that find the returns of Treasury bills too low can invest in commercial papers and earn higher returns. Typically the issuer of a commercial paper is a large corporation with little default risk. Their typical maturity is between 30 and 270 days. Commercial papers, like corporate bonds, are rated by independent rating agencies, like for example Moody's, Standard & Poor and Fitch.

Repurchase agreements: A repurchase agreement (or repo) is the sale of a security, with an agreement that the security will be bought back at a specified price at the end of the agreement period. The seller of the security (the dealer) in the agreement raises funds, whereas the buyer earns interest from the agreement. From the buyer's perspective this is called a *reverse repo*. We can view a repo as a secured loan, where the security is the collateral of this loan. It is very often repos to be based on government securities, like for example Treasury bills.

Repos sometimes run for several months, but most frequently they mature after a very short time period, even after one day (overnight). No other money-market investment offers such liquidity. Corporations can treat overnight repos almost as if they were interest-bearing demand deposits.

The return on a repo depends on the price to the dealer selling the security, the period for which it is placed and the specified price at the end of the period. For example, a dealer with $50 million in Treasury bills could approach a corporation with excess fund to invest. The dealer will offer to sell the Treasury bills at the corporation for $49.98 million (making a haircut to the market value) and buy it back two days later at $50 million. The difference of $20,000 represents the interest earned by the corporation and can be measured in annualized terms as the **repo rate**. In this example the repo rate is equal to:

$$\text{repo rate} = \left(\frac{20,000}{50,000,000}\right)\left(\frac{360}{2}\right) = 7.2\%$$

This formula gives the rate of return on a bank discount basis, thus it is not a true measure of return. The return on this repo can be estimated as follows:

$$\left(\frac{50,000,000}{49,980,000}\right)^{365/2} - 1 = 7.57\%$$

The most significant risk in the repo market is the *creditworthiness of the counterparty*. Thus, a corporation that takes securities from a dealer in exchange from cash may find itself left holding the securities if the dealer fails. Of course, this is not

a problem if these securities are default-free and can be sold close the price promised by the dealer. This is also related to the *quality of the underlying collateral*. The more liquid and risk-free the underlying collateral, the lower will be the repo rate. Thus, borrowers with significant credit risk will either have to pay a higher repo rate or to provide collateral with a higher quality.

Appendix: The Baumol model

The Baumol model is based on the following assumptions:

- The firm knows with certainty its cash requirements and receives a specific amount at regular intervals.
- The cash payments of the firm occur uniformly over a period of time.
- The opportunity cost of holding cash (i.e., the interest rate) is known and does not change over time.
- The firm will incur the same transaction cost whenever it converts securities to cash.

Assume that the firm starts with a cash balance of C. As that the firm spends cash this cash balance reduces to zero. The firm then restores this cash balance by selling securities. The firm spends again this cash reaching zero and then restores it by selling marketable securities. In the process the average cash balance is equal to C/2. The firm holding cost for maintaining this average cash balance is $(C/2)\times r$, where r is the interest rate. Whenever the firm converts marketable securities to cash it incurs a cost, denoted as c. Total number of transactions during a year would be equal to total funds required (annual cash usage), denoted as T, divided by cash balance C. So, the total transaction cost would be equal to $(T/C)\times c$. Thus, the total annual cost for the demand in cash would be $(C/2)\times r+(T/C)\times c$. The optimum cash balance C* is obtained when the total cost is minimized. The first-order condition gives:

$$\frac{r}{2}-\frac{T}{(C^*)^2}\times c=0\Rightarrow C^*=\sqrt{\frac{2\times T\times c}{r}}$$

which the formula of the Baumol model.

Exercises-9

1. The following table is the balance sheet of Ford Motor Company as of December 31, 1994 (numbers in million).

Assets		Liabilities	
Cash	19,967	Accounts payable	11,635
Receivables	61,469	Debt due within 1 year	36,240
Inventory	10,128	Other current liabilities	2,721

Current assets	91,524	Current liabilities	50,596
Fixed assets	45,586	Long-term Debt	73,690
		Equity	12,824
Total assets	137,110	Total liabilities	137,110

The firm has revenues of $154,951 million in 1994 and cost of goods sold of $103,817 million.

a. Estimate the working capital.
b. Estimate the noncash working capital.
c. Estimate noncash working capital as a percent of revenues. If you were asked to estimate the noncash working capital needs for a new automobile factory that Ford was constructing, would you use this ratio? Explain your answer.

2. Company X sells on 1/30, net 60. Customer Y buys goods at $1,000.

a. How much can Y deduct from the bill if Y pays on day 30?
b. What is the effective annual interest rate if Y pays on the due day?

3. A retail electronic firm that has traditionally required customers to pay cash is considering introducing credit sales. The firm currently has revenues of $300,000 and a pre-tax operating income of $150,000. The tax rate is 35% and the cost of capital is 8%. If the retail electronic firm offers 1-year credit to its customers it expects the following changes to occur:

- Sales are expected to increase by $100,000 each year, with the pre-tax operating income remaining at the 50% on these incremental sales.
- The store expects to charge an annualized interest rate of 10% on these credit sales.
- The cost of administration associated with credit sales is expected to be $5,000 every year, along with an initial investment of $20,000 in a computerized-credit-tracking system. The computerized system will be of depreciated straight line over 10 years.
- The bad debts are expected to be 5% of the credit sales.
- The firm expects to keep this credit policy for 10 years. At the end of that period, it is expected that 95% of the accounts receivable would be collected.

Calculate the PV of the credit decision. Should the firm introduce credit sales?

4. You are considering trade credit as a way of reducing your working capital needs. You currently receive 2% discount because you pay in 30 days, but you could give up discount and pay in 90 days. You purchase $100 million worth of supplies (before the 2% discount) every year and your cost of capital is 10%. The tax rate is 40%.

a. Estimate the increase in accounts payable if you go to the 90-day payment period from a 30-day payment period.

b. With your current cost of capital, will using trade credit increase or decrease value? (assume that your purchases will grow 4% a year for ever)

5. Company ABC needs to hold a cash balance that is 2% of its revenues. Assume that revenues are currently $250 million and that they expected to increase 6% every year. The cost of capital is 12%.

a. Estimate the effect that maintaining this cash balance has on firm value.
b. Estimate the increase in ABC value if it is able to reduce its cash balance to 1% of revenues.
c. How would you answer to (b) change if the reduced cash balance makes the firm riskier and increases its cost of capital to 12.5%?

6. A firm with $1 billion in excess cash is considering three alternative investments for the cash:

- It can buy 6-month Treasury bills that are currently being quoted at a yield on a bank discount basis of 5.6%.
- It can buy commercial papers issued by AGGA. AGGA is rated as A1+ by S&P, the highest possible rank. The interest rate over six months (not annualized) is 2.98%.
- It can enter into a repurchase agreement to buy $1.0292 billion of Treasury bills for $1 billion. The dealer promises to deliver $1.0292 in 6 months.

a. Estimate the annualized return on each of these investments.
b. Why do the returns differ across the three investments?
c. How would you decide which investment you would invest your cash in?