Corporate inventory management with value maximization in view

Management aktiv podniku s důrazem na maximalizaci hodnoty

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Abstract: The basic financial purpose of the firm is maximization of its value. An inventory management should also contribute to the realization of this basic aim. Many current assets management models which we can find in the literature relating to financial management were constructed with the assumption of book profit maximization as the basic aim. These models could be lacking what relates to another aim, i.e., maximization of the enterprise value. This article presents the value based inventory management model modification.

Key words: inventory management, value based management, free cash flow

Abstrakt: Základním finančním cílem podniku je maximalizace jeho hodnoty. Management aktiv má rovněž přispívat k realizaci tohoto základního cíle. Mnohé modely managementu běžných aktiv, které nacházíme v literatuře zabývající se finančním managementem, byly konstruovány s předpokladem základního cíle maximalizace účetního zisku. Tyto modely mnohdy postrádají to, co se vztahuje k dalšímu cíli podniku, tj. k maximalizaci jeho hodnoty. Článek předkládá modifikaci modelu managementu aktiv, založeného na této hodnotě.

Klíčová slova: management aktiv, hodnotový management, volný cash flow

The basic financial aim of an enterprise is maximization of its value. At the same time, a large both theoretical and practical meaning has the research for determinants increasing the firm value. The financial literature contains information about numerous factors influencing the value. Among those factors, there is the net working capital, and elements creating it, such as the level of cash tied in the account receivable, inventories and operational cash balances. The great part of classic financial models proposals relating to the optimum current assets management was constructed with net profit maximization in view. It is the reason why these models need reconstruction, which will be suitable for firms which want to maximize their value. The estimation of the influence of changes in firm decisions in the sphere of inventory management is a compromise between limiting of risk by having a greater inventory level and limiting a costs of inventory. It is the essential problem of the corporate financial management.

The basic financial inventory management aim is holding the inventory on the minimal acceptable level because of its costs. Holding inventory ties the capital used to finance the inventory and links with the inventory storage, insurance, transport, obsolescence, wasting and spoilage costs. On the other hand, the low level of inventory could be source of problems with meeting the supply (Michalski 2004).

VALUE BASED INVENTORY MANAGEMENT

If advantages from holding the inventory on a level defined by the firm is greater than the negative influence of an alternative costs from its holding, then the firms value will grow. The change of the accounts receivable level affects the firm value. To measure that, we use a formula, basing on an assumption, that the firm value is a sum of the future free cash flows to firm (*FCFF*) discounted by the cost of capital financing the firm:

$$\Delta V_p = \sum_{t=1}^{n} \frac{\Delta FCFF_t}{(1+k)^t} \quad (1)$$

where:
ΔV_p = firm value growth
$\Delta FCFF_t$ = future free cash flow growth in period t
k = discount rate[1]

The future free cash flow we have as:

$$FCFF_t = (CR_t - CE_t - NCE) \times (1 - T) + NCE - Capex - \Delta NWC_t \quad (2)$$

where:
CR_t = cash revenues on sales
CE_t = cash expenses resulting from fixed and variable costs in time t
NCE = non cash expenses
T = effective tax rate
ΔNWC = net working growth
$Capex$ = capital expenses resulting from operational investments growth

The similar conclusions about the results of the change inventory management policy on the firm value, can be estimated on the basis of an economic value added, informing about the size of the residual profit (the added value) enlarging the value of the firm in the period:

$$EVA = NOPAT - k \times (NWC + OI) \quad (3)$$

where:
EVA = economic value added
NWC = net working capital
OI = long-term operating investments
$NOPAT$ = net operating profit after tax

estimated on the basis of the formula:

$$NOPAT = (CR_t - CE_t - NCE) \times (1 - T) \quad (4)$$

The net working capital (NWC) is the part of current assets, financed with fixed capital. The net working capital (current assets less current liabilities) results from the lack of synchronization of the formal rising receipts and the real cash receipts from each sale. Net working capital also results from the divergence during the time of rising costs and time, from the real outflow of cash when a firm pays its accounts payable.

$$NCW = CA - CL = AAR + INV + G - AA \quad (5)$$

where:
NWC = net working capital
CA = current assets
CL = current liabilities
AAR = accounts receivables
INV = inventory
G = cash and cash equivalents
AAP = accounts payables

During estimation of the free cash flows, the holding and increasing of net working capital ties money used

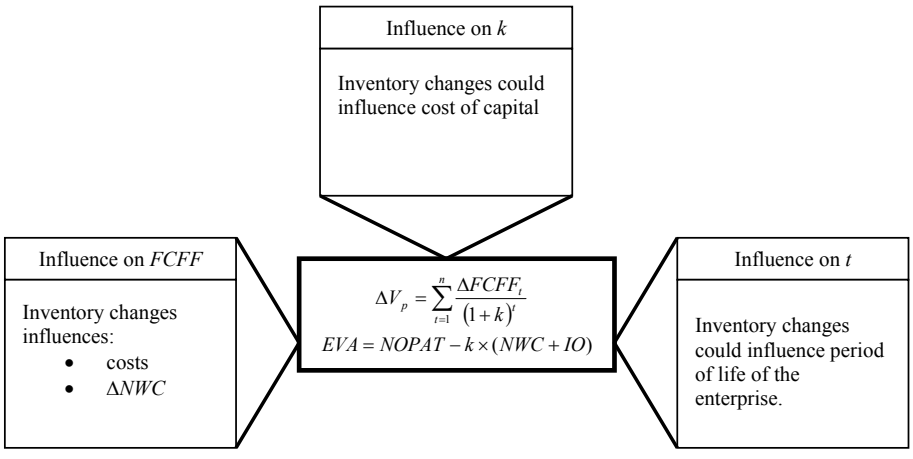

Figure 1. The inventory management decision influence on firm value

FCFF = Free Cash Flows to Firm; ΔNWC = Net Working Capital Growth; k = cost of the capital financing the firm; t = the lifetime of the firm and time to generate single *FCFF*
Source: Pluta, Michalski (2005)

[1] To estimate changes in accounts receivable levels, we accept the discount rate equal to the average weighted cost of capital (WACC). Such changes and their results are strategic and long term in their character, although they refer to accounts receivable and short run area decisions (Maness, Zietlow 1998, pp. 62–63; Kalberg, Parkinson 1993).

for financing it. If net working capital increases, the firm must tie much money and it decreases free cash flows. The production level growth usually makes the necessity of enlargement of cash levels, inventories, and accounts receivable. Part of this growth will be covered with current liabilities, since current liabilities also usually automatically grow up together with the growth of production. The rest (which is noted as net working capital growth) will require other form of financing (Sartoris, Hill 1983).

The inventory management policy decisions create the new inventory level in the firm. It has the influence on the firm value. It is the result of alternative costs of the money tied in inventory and generally of costs of the inventory managing. Both the first and the second involve modification of the future free cash flows, and in consequence the firm value changes. In Figure 1, we have the influence of inventory management decisions on the firm value. These decisions change the future free cash flows (*FCFF*). These decisions could also influence the life of the firm (t) (by the operational risk, which is the result of possibility to break production cycles if the inventory level is too low), and rate of the cost of capital financing the firm (k). The changes of these three components have influence on the creation the firm value (ΔVp) – Figure 1.

Inventory changes (resulting from changes in the inventory management policy of the firm) affect the net working capital level and as well the level of operating costs of the inventory management in a firm. These operating costs are the result of storage, insurance, transport, obsolescence, wasting and spoilage of inventory) (Scherr 1989).

EOQ AND VBEOQ

The economic order quantity model is a model which maximizes the firm income by the total inventory costs minimization (Figure 2).

To form the EOQ model, we have two equations:

$$EOQ = \sqrt{\frac{2 \times P \times K_z}{C \times v}} = \sqrt{\frac{2 \times P \times K_z}{K_u}} \quad (6)$$

where:
EOQ = economic order quantity
P = demand for the product/inventory in the period (year, month)
K_z = cost per order event
K_u = holding cost per unit in the period (year, month)
C = holding cost factor
v = purchase cost per unit

The holding cost factor (K_u) is a result of costs (Sier-pińska, Wędzki 2002, p. 112):
– Alternative costs (price of money tie in inventory),
– Storage, insurance, transport, obsolescence, wasting and spoilage costs.

$$TCI = \frac{P}{Q} \times K_z + \left(\frac{Q}{2} + z_b\right) \times v \times C \quad (7)$$

where:
TCI = total costs of inventory
Q = order quantity
z_b = minimal stock

Example 1. P = 220 000 kg, K_z = 31\$, v = 2\$ / 1kg, C = 25%. Effective tax rate, T = 20%. Cost of capital financing the firm $WACC = k$ = 15%. z_b = 300 kg.

First we estimate EOQ:

$$EOQ = \sqrt{\frac{2 \times 220\,000 \times 31}{0.25 \times 2}} = 5\,223 \text{ kg}$$

Next we estimate the average inventory level:

$$INV_{EOQ} = \frac{5\,223}{2} + 300 = 2\,912 \text{ kg} \Rightarrow INV_{EOQ} = 2\,912 \times 2 = 5\,824\,\$$$

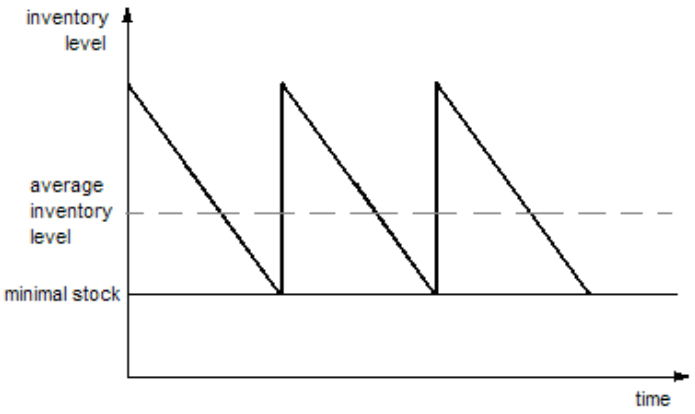

Figure 2. EOQ and VBEOQ model

Source: Kalberg, Parkinson 1993, p. 538

$$TCI = \frac{220\,000}{5\,223} \times 31 + \left(\frac{5\,223}{2} + 300\right) \times 2 \times 0.25 =$$
$$= 2\,762\ \$$$

If we rather order 5 000 kg than EOQ = 5 223 kg:

$$TCI_{5000} = \frac{220\,000}{5\,000} \times 31 + \left(\frac{5\,000}{2} + 300\right) \times$$
$$\times 2 \times 0.25 = 2\,764\ \$$$

We will have a greater TCI, but if we check how it influences the firm value, we will see that if we decide to order less than EOQ suggest, we will increase the firm value:

$$\Delta TCI_{5000} = 2\,764 - 2\,762 = 2\ \$$$

$$INV_{5000} = 2 \times \left(\frac{5\,000}{2} + 300\right) = 5\,600\ \$$$

$$\Delta INV_{5000} = 5\,600 - 5\,824 = -224\ \$$$

$$\Delta NWC = \Delta INV$$

$$\Delta V_{5000} = 224 - \frac{2 \times (1 - 0.2)}{0.15} = 213.33\ \$$$

The EOQ model minimizes operational inventory costs, but in firm management we also have alternative costs of holding inventories. These costs need that we order less than EOQ if we want to maximize the firm value. Knowing that we can use $VBEOQ$ model:

$$VBEOQ = \sqrt{\frac{2 \times (1 - T) \times K_Z \times P}{v \times (k + C \times (1 - T))}} \qquad (8)$$

where:
k = cost of capital financing the firm ($WACC$)
$VBEOQ$ = value based economic order quantity

For Alfa data, we have:

$$VBEOQ = \sqrt{\frac{2 \times (1 - 0.2) \times 31 \times 220\,000}{2 \times (0.15 + 0.25 \times (1 - 0.2))}} =$$
$$= 3\,948.24 \approx 3\,948\ \text{kg}$$

$$TCI_{3948} = \frac{220\,000}{3\,948} \times 31 + \left(\frac{3\,948}{2} + 300\right) \times$$
$$\times 2 \times 0.25 = 2\,864.46\ \$$$

$$\Delta TCI_{3948} = 2\,864.46 - 2\,762 = 102.46\ \$$$

$$INV_{3948} = 2 \times \left(\frac{3\,498}{2} + 300\right) = 4\,548\$$$

$$\Delta INV_{3948} = 4\,548 - 5\,824 = -1\,276\ \$$$

$$\Delta V_{3948} = 1\,276 - \frac{102.46 \times (1 - 0.2)}{0.15} = 729.55\ \$$$

POQ AND VBPOQ

The production order quantity model *(POQ)* is the EOQ modification which we can use when we have grater production possibilities than market capacity (Figure 3).

The POQ could be estimated as (Sariusz-Wolski 2002, p. 162):

$$POQ = \sqrt{\frac{2 \times K_Z \times P}{C \times k \times \left(1 - \frac{P}{m}\right)}}, P < m \qquad (9)$$

where:
POQ = production order quantity
K_z = switch of production cost
P = demand intensity (how much we can sell annually)
v = cost per unit
m = maximum annual production ability
c = holding cost factor

$$TCI = \frac{Q}{2} \times \left(1 - \frac{P}{m}\right) \times v \times C + \frac{P}{Q} \times K_Z \qquad (10)$$

where:
Q = production quantity
TCI = total costs of iventories

$$INV = \frac{Q}{2} \times \left(1 - \frac{P}{m}\right) \qquad (11)$$

where:
INV = average inventory level

Example 2. Maximum demand, P = 2 500 000 kg, m = 10 000 000 kg annually. WACC = k = 15%, C = 25%, T = 19%. K_z = 12 000 $, v = 0.8$.

First we estimate POQ:

$$POQ = \sqrt{\frac{2 \times 12\,000 \times 2\,500}{800 \times 0.25 \times \left(1 - \frac{2\,500}{10\,000}\right)}} = 630\ (1000)\text{kg}$$

$$TCI_{633} = \frac{633}{2} \times \left(1 - \frac{2\,500}{10\,000}\right) \times 800 \times 0.25 + \frac{2\,500}{633} \times$$
$$\times 12\,000 = 94\,868\ \$$$

Next, we check how the firm value is influenced by the change of production quantity to 90% POQ, 633 000 × 0.9 = 570 000 kg:

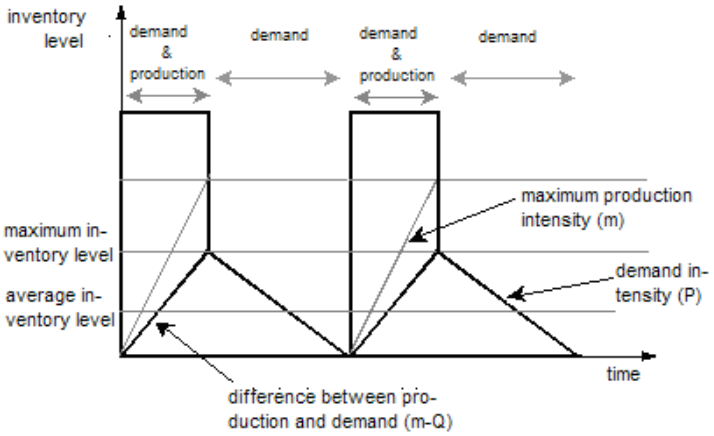

Figure 3. POQ and VBPOQ

Source: Sariusz-Wolski 2002, p. 162

$$TCI_{570} = \frac{570}{2} \times \left(1 - \frac{2\,500}{10\,000}\right) \times 800 \times 0.25 + \frac{2\,500}{570} \times$$
$$\times\, 12\,000 = 95\,382\,\$$$

$$\frac{-\Delta FCFF_{1\ldots\infty}}{0.81} = \Delta TCI_{Q=633\rightarrow Q=570} = 95\,382 - 94\,868 =$$
$$= 514\ \$$$

$$INV_{570} = 800 \times INV_{570} = 800 \times \frac{570}{2} \times \left(1 - \frac{2\,500}{10\,000}\right) =$$
$$= 171\,000\$$$

$$\Delta NWC = (-\Delta FCF_0) = \Delta ZAP_{Q=6\,797\rightarrow Q\,=\,30\,500} =$$
$$= 171\,000 - 189\,600 = (-18\,600)\ \$$$

$$\Delta V_{Q=633\rightarrow Q=570} = +18\,600 + \frac{-514 \times (1 - 0.19)}{0.15} =$$
$$= +15\,824\,\$$$

As we can see, if we produce less than POQ suggest, it will create additional value.

If we want to sign VBPOQ, we can use the Table 1.

VBPOQ will be 479 000 kg. From the table we see also that the costs TCI for VBPOQ will be greater than for the POQ, but the VBPOQ ties less money in inventories what is source of benefits in alternative costs.

Table 1. VBPOQ

Q	TCI	ΔTCI	INV	ΔINV	ΔV
483	98 337	3 469	144 900	–44 700	25 968
482	98 391	3 523	144 600	–45 000	25 978
481	98 445	3 577	144 300	–45 300	25 984
480	98 500	3 632	144 000	–45 600	25 987
479	**98 555**	**3 687**	**143 700**	**–45 900**	**25 988**
478	98 612	3 744	143 400	–46 200	25 985
477	98 668	3 800	143 100	–46 500	25 980

Source: own study

To estimate the VBPOQ, we also could use the equation (12).

CONCLUSION

Maximization of the wealth of its owners is the basic financial aim in the management of enterprise. Inventory management must contribute to the realization this aim. In the article, we have seen the value based *EOQ* model and value based *POQ* model modifications. Inventory management decisions are a complex case. On one side, too much money ties in inventory burdens the enterprise with

$$Q_{VBPOQ} = \sqrt{\frac{2 \times P \times K_Z \times (1 - T)}{v \times \left(1 - \frac{P}{m}\right) \times [k + C \times (1 - T)]}}, P < m \qquad (12)$$

$$Q_{VBPOQ} = \sqrt{\frac{2 \times 2\,500 \times 12\,000 \times (1 - 0.19)}{800 \times \left(1 - \frac{2\,500}{10\,000}\right) \times [0.15 + 0.25 \times (1 - 0.19]}} = 479\ (000)\text{kg}$$

the high costs of inventory service and additionally high alternative costs. From the other side, the higher inventory stock could help to enlarge incomes from sales because purchasers have a greater flexibility in making purchase decisions. In the article the problem connected with the optimal economic order quantity and production order quantity was discussed. Value based modifications of these two models could help managers to make better, value creating decisions in the inventory management.

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