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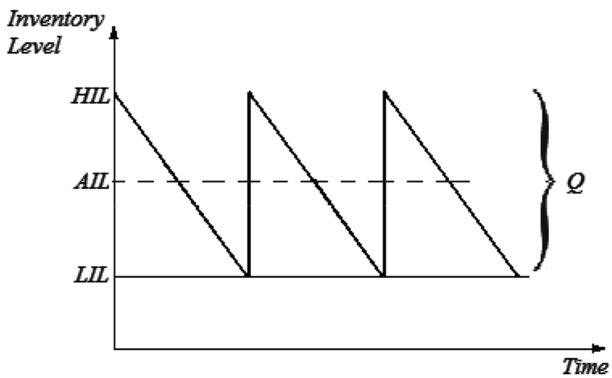
Zarządzanie finansami firm – teoria i praktyka

Grzegorz Michalski
Wroclaw University of Economics

DECREASING NEGATIVE DELIVERY RISK INFLUENCE ON THE RECEPIENT'S FIRM VALUE: PORTFOLIO APPROACH

1. Introduction

The basic financial purpose of an enterprise is maximization of its value. Inventory management should also contribute to realization of this fundamental aim. Many of the current asset management models that are found in financial management literature assume book profit maximization as the basic financial purpose. These book profit-based models could be lacking in what relates to another aim (i.e., maximization of enterprise value). The enterprise value maximization strategy is executed with a focus on risk and uncertainty. This article presents the consequences



where: *LIL* – Low Inventory Level (Precautionary Inventory Level); *AIL – Average Inventory Level; HIL – High Inventory Level; Q – Order Quantity* (*Q = HIL – LIL*).

Fig. 1. Economic Order Quantity model

Source: [Kalberg, Parkinson 1993, p. 538].

for the recipients firm that can result from operating risk that is related to delivery risk generated by the suppliers. The present article offers a method that uses portfolio management theory to chose the suppliers.

When entrepreneur chooses the tradesman, should concentrate his attention, not only at basic knowledge about the contracting party individual shape parameters (i.e. the tradesman financial situation), but also on information from inventory management models.

The Economic Order Quantity model of inventory management is used to mark the optimum size of delivery and to choose the cheapest deliverer. Both of these choices should guarantee minimization of total costs of investments in inventories.

On fig. 1 is shown the way the EOQ (and VBEOQ) model works. Q could be calculated as:

$$EOQ = Q_{opt} = \sqrt{\frac{2 \times P \times K_z}{C_a \times v}} = \sqrt{\frac{2 \times P \times K_z}{K_u}}, \tag{1}$$

where: *EOQ* – target (optimal) order quantity (*economic order quantity)*, *P* – yearly demand for optimized inventories, K_z – creating inventories costs (fixed cost of one order), K_u – operating costs of maintaining inventories (without costs of maintaining safety/precautionary inventories *LIL*), C_a – percentage rate of operating costs of maintaining inventories (with financial/alternative costs of capital and without costs of maintaining safety/precautionary inventories *LIL*), *v* – unit price (cost) of ordered inventories.

The percentage share of retaining the reserves comes from the fact that the costs of retaining the reserves increase proportionally to the level of reserves In the enterprise. Its share is a sum of the following costs: alternative (resulting from the possibility of their potential use somewhere else but without cost of capital financing firm), storage, logistics and internal transport within the factory of the reserves, insurance, decay.

$$TCI = \frac{P}{Q} \times K_z + \left(\frac{Q}{2} + z_b\right) \times v \times C_a, \tag{2}$$

where: *TCI* – total reserves costs, *Q* – magnitude of the part of delivery, z_b – the level of safety margin.

From the point of view of maximizing the enterprise value a part of delivery can be determined based on the formula for VBEOQ:

$$VBEOQ = \sqrt{\frac{2 \times (1 - T) \times K_Z \times P}{v \times (k + C \times (1 - T))}}, \tag{3}$$

where: k – alternative cost (equal to the enterprise financing capital), $VBEOQ$ – optimal magnitude of single order from the point of view of maximizing the enterprise value, C – percentage rate of operating costs of maintaining inventories (without financial/alternative costs of capital and without costs of maintaining safety/precautionary inventories LIL).

$$TCI = \frac{P}{Q} \times K_z + \left(\frac{Q}{2} + z_b \right) \times v \times C. \tag{4}$$

And:

$$VBEOQ_{*\#} = \sqrt{\frac{2 \times \left[(1-T) \times K_Z^{\#} + K_Z^{*} \right] \times P}{v \times \left(k + C^{*} + C^{\#} \times (1-T) \right)}}, \tag{5}$$

where: $K^{\#}_{z}$ – tax-deductible creating inventories costs (fixed cost of one order), K^{*}_{z} – non- tax-deductible creating inventories costs (fixed cost of one order), $C^{\#}$ – percentage rate of tax-deductible operating costs of maintaining inventories (without financial/alternative costs of capital and without costs of maintaining safety/precautionary inventories LIL), C^{*} – percentage rate of non-tax-deductible operating costs of maintaining inventories (without financial/alternative costs of capital and without costs of maintaining safety/precautionary inventories LIL).

And:

$$TCI = \frac{P}{Q} \times K_z^{\#} + \frac{P}{Q} \times K_z^{*} + \left(\frac{Q}{2} + z_b \right) \times v \times C^{\#} + \left(\frac{Q}{2} + z_b \right) \times v \times C^{*}. \tag{6}$$

The problem, we are going to deal with in this paper is to select a counterpart amongst the suppliers in a situation where the parameters we know carry the risk resulting from deliveries out of schedule.

Example 1. Enterprise X producing special fireproof curtains uses raw material D-18. The annual demand for this raw material is 8000 m^3. There are two suppliers (A and B) on the market offering similar delivery terms. The price of the material for both of them is 3000$ for m^3, the lead-time is 20 days, the cost of inventory retaining is 38%, the cost of enterprise financing capital is 30%, effective tax rate is 19%, the costs of ordering is 200$ and the cost of lack of reserves is 5000 000$. The analysis of recommendation given by the companies showed that both suppliers were not equally reliable. Supplier A was nearly perfect, supplier B often did not deliver on time, he happened to show up 4 days before the agreed date , but equally often used to come 8 days later.

Based on the gathered data it was estimated the standard deviation of the delivery time in case of supplier A was 4 days, and for supplier B 6 days. In order to evaluate who is more reliable it is necessary to determine the safety margin for supplier A and then for supplier B. The next step is to check the impact of suppliers risk on the enterprise value. We assume that the enterprise in order to estimate the optimal order magnitude uses the *VBEOQ*. model

$$VBEOQ_A = VBEOQ_B = \sqrt{\frac{2 \times (1-0{,}19) \times 200 \times 8000}{3000 \times (0{,}3 + 0{,}38 \times (1-0{,}19))}} = 37{,}7 \text{ m}^3.$$

Differences in reliability of deliveries have a great impact on different levels of safety margins required for suppliers A and B. For this purpose the following formula is used [Piotrowska 1997, p. 57]:

$$Z_b = \sqrt{-2 \times s^2 \times \ln \frac{C \times Q \times s \times v \times \sqrt{2\Pi}}{P \times K_{bz}}}, \tag{7}$$

where: s – standard deviation for reserves usage, K_{bz} – cost of lack of inventory reserves.

In order to use the formula it is necessary to exchange the deviation of delivery time to deviation of raw material use. It is known average daily use is 8000/360 = 22,2 m^3. Therefore 4 days deviation for delivery date is equal to deviation of use equal to 88,8 m^3. Therefore, for such a situation the safety margin will be equal to:

$$Z_A = \sqrt{-2 \times 88{,}8^2 \times \ln \frac{0{,}38 \times 37{,}7 \times 88{,}8 \times 3000 \times \sqrt{2 \times 3{,}1416}}{8000 \times 5000\,000}} = 362{,}63 \text{ m}^3.$$

In this case the level of resources tied in the reserves is:

$$ZAP_A = 3000 \times \left(\frac{37{,}7}{2} + 362{,}63\right) = 1144\,440 \text{ \$}.$$

Next case reflects a situation in which the entrepreneur uses the services from company B. So the standard deviation will be 6×(8000/360) = 133,3 m^3.

Therefore reserves safety margin will be:

$$Z_B = \sqrt{-2 \times 133{,}3^2 \times \ln \frac{0{,}38 \times 37{,}7 \times 133{,}3 \times 3000 \times \sqrt{2 \times 3{,}1416}}{8000 \times 5000\,000}} = 531 \text{ m}^3.$$

In this case the level of resources tied in the reserves is:

$$ZAP_B = 3000 \times \left(\frac{37{,}7}{2} + 531\right) = 1649\,550 \text{ \$}.$$

Comparing this magnitude to the level of reserves in situation where one would have used supplier A it is obvious that the increase of money resources tied in the reserves will be:

$$\Delta ZAP_{A\to B} = 1649\ 550 - 1144\ 440 = 505\ 110\ \$.$$

The last stage is to compare what impact the risk generated by the counterparts – suppliers has on the value of the enterprise. Therefore we estimate the level of total costs of reserves:

$$TCI_A = \frac{8000}{37{,}7} \times 200 + \left(\frac{37{,}7}{2} + 362{,}63\right) \times 3000 \times 0{,}38 = 477\ 328\ \$,$$

$$TCI_B = \frac{8000}{37{,}7} \times 200 + \left(\frac{37{,}7}{2} + 531\right) \times 3000 \times 0{,}38 = 669\ 269\ \$,$$

$$\Delta TCI_{A\to B} = 669\ 269 - 477\ 328 = 191\ 941\ \$.$$

Obtained results will be used for estimation of fluctuations in the enterprise value:

$$\Delta V_{A\to B} = -505\,110 + \frac{(-191\,941) \times (1 - 0{,}19)}{0{,}3} = -1023\,351\ \$.$$

It is apparent that it is better to select counterpart – supplier A because selection of supplier B may result in destruction of enterprise value.

2. Suppliers' portfolio

Usually the enterprise's suppliers have materials and stock from the same source. It happens though, that their sources of supply are different and therefore the risk of deliveries related to individual suppliers is different. f such a thing occurs, it may be possible to use elements taken from the portfolio theory for supplier's evaluation. Sometimes the counterparts, who although may have defect which exclude them from being suppliers of services in the beginning (like supplier B in example B), it may be possible that having considered the risk of the buyer it may turn out that on the contrary they decrease or stabilize the risk level [Pritchard 2001, p. 48-52].

Portfolio is a set of assets (for example in a non accountant sense : suppliers). The theory of portfolio management is based on the rate of advantages drawn from buying from particular supplier, informing about the relation of advantage generated by such a purchase to the outlay related to such a purchase.

The measure allowing the measurement of risk connected to costs from particular buyer may be defined as this variation:

$$V = \sum_{i-1}^{m} p_i \times (R_i - R)^2,$$
$$s = \sqrt{V} = \sqrt{\sum_{i-1}^{m} p_i \times (R_i - R)^2}, \tag{8}$$

where: p_i – probability of occurrence of the given situation estimated from historical data.

In connection to the information about what potential advantages might be brought by giving a loan to a particular buyer, it is possible to estimate the variation coefficient:

$$c = \frac{s}{R}. \tag{9}$$

The next element is a correlation of benefits from purchase from particular supplier with benefits from this purchase from other suppliers. The correlation coefficient is usually the measure of such a correlation:

$$\rho_{1.2} = \frac{\sum_{i=1}^{m} p_i \times (R_{1i} - R_1) \times (R_{2i} - R_2)}{s_1 \times s_2}, \tag{10}$$

where: $\rho_{1.2}$ – correlation coefficient of benefits from purchase from the first and second supplier; R_1 – expected rate of benefits from purchasing from first supplier; R_2 – o expected rate of benefits from purchasing from the second supplier; s_1 – standard deviation for the first supplier s_2 – standard deviation for the second supplier; R_{1i} – possible rates of benefits from the purchases from the first supplier; R_{2i} – possible rates of benefits from the purchases from the second supplier; p_i – probability of occurrence of possible rates of benefits from supplies.

3. Portfolio of two suppliers (groups of suppliers)

Example 2. The enterprise uses two suppliers. One of them operates in sector A, the other represents sector B. The use of portfolio idea is useful when the correlation between the benefits from purchases from these suppliers is negative. We can follow this in the picture below.

Case 1. The correlation coefficient between benefits from purchases from supplier A and B equals to 1. The picture shows that at positive correlation near to 1 there is no possibility to seek advantages resulting from diversification.

Case 2. Correlation coefficient equal to –1. Ideal negative correlation. All possible portfolios at correlation coefficient equal to –1 are contained on the broken line

A-A/B_1-A/B_2-B. Points "A" and "B" represent single-components portfolios (eg. Using only supplier A). As we see, when we move away from point "A" and increase the share of deliveries performed by "B" the risk S decreases and benefits R increases. This happens until point A/B_1 . If this share is exceeded the risk of portfolio will increase together with the increase of income. As we see it is not substantiated to have only supplier A in the portfolio because at identical risk portfolio A/B_2 offers greater benefits.

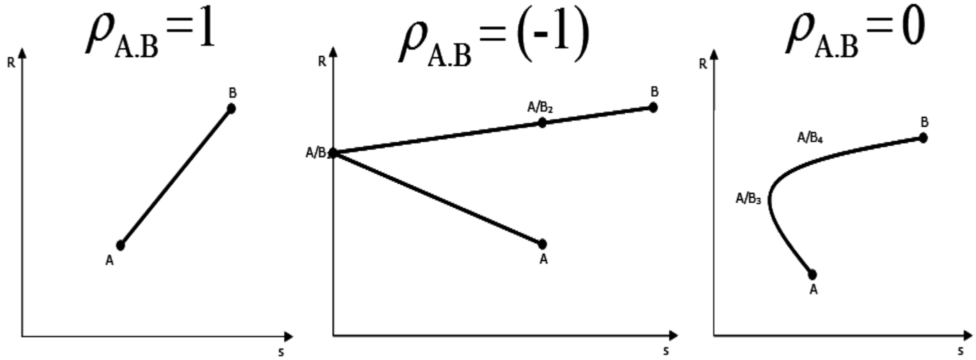


Fig. 2. Relation between benefit and risk for portfolio of two suppliers at different correlation coefficients (equal to 1, (–1) or 0).

Source: own study.

Case 3. Correlation coefficient equals 0. It is a situation in which the benefits from supplier A and supplier B are not connected to each other. In this situation only partial risk reduction is possible. Reasonable entrepreneur should not select any of the portfolios of dues lying on A-A/B_3 arc, because it always possible to find more advantageous complement on A/B_3 – A/B_4 arc which at the same risk s yields higher benefits R.

4. Using the elements of portfolio theory for selection of suppliers

Skilful construction of portfolio of two (groups) of suppliers may lead to a considerable reduction of risk. Inclusion of second component into single-component portfolio (which like in example 1 so far consisted of only one better supplier A and accepting deliveries from less risky supplier) nearly always leads to reduction of risk, sometimes even at simultaneous increase of benefit rate of portfolio.

Example 3. (continuation of the previous example) After assessment of supplier A and B , the entrepreneur noticed that the delays connected to services provided by suppliers A and B are negatively correlated with each other, because their sources of supply are different when troubles with deliveries from first source can be expected, the other source does not pose a risk of such difficulties. Thanks to this we can expect a decrease of risk of non forward deliveries . Both suppliers acquire the material D-18 based on different technologies. Therefore one can expect that the impact of deliveries risk on the receiver can be decreased due suing the service of both suppliers, because the correlation of distribution of forward deliveries of suppliers A and B is negative and is equal to –0.56. The orders will be placed in quantities and frequency resulting from VBEOQ model. The orders will be realized by both suppliers: A and B equal shares of 18,85 m^{3}. In order to estimate new level of safety margin it is necessary to use the equation determining the total standard deviation [Piotrowska 1997, p. 60]:

$$s_T = \sqrt{s_A^2 + s_B^2 + 2 \times s_A \times s_B \times \rho_{A\&B}}, \qquad (11)$$

where: s_T – total standard deviation, s_A – standard deviation of the first distribution, s_B – standard deviation of the second distribution, $\rho_{A\&B}$ – correlation coefficient between the first and second distribution.

Assuming that one-day deviation is equal to deviation of use equal to 11,1 m^3; the safety margin is:

$$s_T = \sqrt{44{,}4^2 + 66{,}6^2 + 2 \times 44{,}4 \times 66{,}6 \times (-0{,}56)} = 55{,}6,$$

$$Z_{A\&B} = \sqrt{-2 \times 55{,}6^2 \times \ln \frac{0{,}38 \times 37{,}7 \times 55{,}6 \times 3000 \times \sqrt{2 \times 3{,}1416}}{8000 \times 5000\,000}} = 233{,}3 \text{ m}^3.$$

In this case the level of money resources tied in the reserves will be:

$$ZAP_{A\&B} = 3000 \times \left(\frac{37{,}7}{2} + 233{,}3 \right) = 756\ 450\ \$,$$

comparing this magnitude to the level of reserves in a situation where we would have used supplier A only it is obvious that the increase of money tied in the reserves will be equal to:

$$\Delta ZAP_{A \to A\&B} = 756\ 450 - 1144\ 440 = (-387\ 990)\ \$.$$

The last stage is to compare what impact the risk generated by the counterparts-suppliers has on the enterprise value. Therefore we estimate the total level of costs of reserves:

$$TCI_{A\&B} = \frac{8000}{37{,}7} \times 200 + \left(\frac{37{,}7}{2} + 233{,}3 \right) \times 3000 \times 0{,}38 = 329\ 891\ \$,$$

$$\Delta TCI_{A \to A\&B} = 329\ 891 - 477\ 328 = (-147\ 437)\ \$.$$

Obtained results are used for estimation of changes of the enterprise value.

$$\Delta V_{A\rightarrow A\&B} = +387\,990 + \frac{(147\,437)\times(1-0{,}19)}{0{,}3} = 786\,070\,\$.$$

As we see in particular conditions it is possible to get benefits from using both suppliers (better A and worse B). Such a choice may result in increase of enterprise value.

Literature

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PROPOZYCJA ZASTOSOWANIA TEORII PORTFELA DO OBNIŻENIA NEGATYWNEGO WPŁYWU RYZYKA DOSTAW NA WARTOŚĆ FIRMY ODBIORCY

Streszczenie

Podstawowym finansowym celem zarządzania przedsiębiorstwem jest maksymalizacja jego wartości. Zarządzanie zapasami powinno także przyczyniać się do osiągnięcia tego podstawowego celu. Strategia maksymalizacji wartości przedsiębiorstwa jest realizowana w warunkach ryzyka i niepewności. Niniejszy artykuł przedstawia konsekwencje dla firmy odbiorcy, jakie niesie ze sobą ryzyko czasu dostaw. Rozwiązanie proponowane w opracowaniu, dotyczące doboru dostawców, oparte jest na wykorzystaniu przesłanek płynących z teorii zarządzania portfelem aktywów.