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Retailer's Ordering and Discounting Policies Under Advance Sales Discount and Trade Credit Based on Sharia

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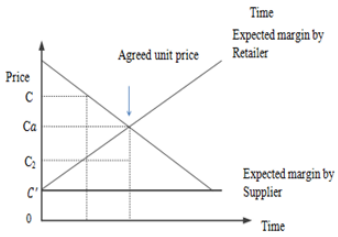
Graphical abstract



Abstract

The use of conventional model to minimize the inventory cost creates a disturbance between the sellers and buyers. It creates a usury since the payment conducts to interest paid and interest earned. In this paper, sharia principle is implemented, that is Bai Al Istishna which allows credit period and margin agreement as the payment. The model is engaged to replenishment cycle time and price discount policy to attract the customer's demand which based on sharia principle. This paper provides a useful mathematical model based on sharia principles in order to usury/interest can be eliminated in the trading process.

Keywords: Conventional model; sharia principle; Bai Al Istishna; credit period; price discount

Abstrak

Dalam penggunaan model konvensional untuk meminimumkan kos inventori kadang-kadang membuat gangguan di antara penjual dan pembeli. Itu dapat menciptakan usury sejak pembayaran menjalankan bunga yang dibayar dan bunga yang diperoleh. Dalam penelitian ini, prinsip sharia dilaksanakan, yaitu Bai Al Istishna yang membolehkan tempoh kredit dan perjanjian margin sebagai pembayaran. Model yang digunakan untuk pengisian waktu semula dan harga diskaun dasar untuk menarik permintaan pelanggan yang berdasarkan prinsip sharia. Penelitian ini menyediakan satu model matematik yang berguna yang berasaskan prinsip sharia, agar untuk menghapus usury dalam proses perdagangan.

Kata kunci: Model konvensional; prinsip sharia; Bai Al Istishna; tempoh kredit; diskaun harga

1.0 INTRODUCTION

Purchasing is an activity to achieve a product and service in order to acquire its goal. The activity of selling goods or service impacts to the number of inventories in warehouse, in which the holding cost is a sensitive problem for the company. To date, some sellers offer price discount to attract customers. The impact of attracting customers leads to minimizing inventory cost because of its advance sales. Giving price discount is not only to attract customers but also to reach competitiveness in the market place.

Inventory becomes a sensitive problem in business competition. It is related to customer's demand. Since few years ago, inventory management has been being elaborated to find the best solution of inventory control in order to reduce holding cost and ordering cost. Moreover, some researches deal with deterministic customer's demand rather than stochastic customer's demand.

Recently, credit payment is a popular practice to attract customer in order to minimize uncertainty customer's demand, such as price discount and credit period. Such kind of manufactures which deal with price discount strategy and credit period, sellers offer items to customers on selling session, includes price discount and delay payment to reduce inventory holding cost and optimize replenishment cycle time. Tsao [1] and Huang [2] developed mathematical model Economic Order Quantity (EOQ) under trade credits in order to find the minimum inventory cost. Related to price, Thangam and Uthayakumar [3] defined the optimal selling price, credit period, and replenishment time to attract customer's demand and maximize the profit. Ouyang *et al.* [4] defined the inventory replenishment policies based on trade credit and told how the cash discount supports the purchasing activity. Chung and Lin [5] proposed inventory model for trade credit to find optimal cycle time. Huang [6] investigated retailer's inventory model by applying trade credit. Huang [7] and Jaggi *et al.* [8] considered not only supplier offer credit period to the retailer, but also a retailer offers credit period to the customer. Chung [9] elaborated optimal replenishment based on ordering quantity under two levels credit. Huang and Hsu [10] continued the previous model by Huang [7] to find inventory policies for retailer under supply chain management. The research on Tsao and Sheen [11] still investigates the retail pricing policy, multi-item replenishment cycle time and credit period in order to

maximize profit. Huang [12] and Liao [13] developed a framework based on EPQ model, less than two levels credit period to determine the optimal cycle time and ordering policy. Hu and Liu [14] used Economic Production Quantity (EPQ) framework to determine optimal replenishment policy related to delay payment and shortage allowed. Kreng and Tan [15] took the real situation in business environment such a credit period applied for the supplier to its wholesaler then continue to its retailer. Then, a research which also related to *sharia*, such Dede *et al.* [16] introduced *Al Murabahah* to optimize inventory management based on EOQ model. The research is not implementing any interest in credit period or delay in payment hence the aim of the research is to continuously reviewing the inventory.

Nowadays, the things that must be considered are that almost all marketing strategy related to credit period has involved interest paid and earned in payment. This condition of payment is in contrary to Islamic perspective. In terms of Islamic perspectives, interest belongs to *Usury/Interest*. Moreover, *Usury/interest* is forbidden asset since it is prohibited by Allah [19]. Antonio [17] stated that *usury* is an activity to earn goods, things, or money in a transaction, purchasing or load in a bad behavior.

Related to purchasing in manufacturing activity, it is considered that *sharia* principle is the moral responsibility and religious law of Islamic law based on Allah's order. This current research proposes the development of replenishment cycle time and price discount policy based on *sharia* principle, which is *Bai Al Istishna* by considering the credit period and margin agreement. This kind of principle is implemented in a purchase by order or manufacture field.

■2.0 REVIEW OF TSAO'S MODEL

Tsao [1] considered two echelons trade credits that consist of one supplier and one retailer supply chain by giving credit period and Advance Sales Discount (ASD) to attract customer. The supplier offers a credit period to the retailer and retailer offers a credit period to the customers. If customers can commit their orders to sales period early, Retailer will give advance sales discount. The advantages of doing these activities are to eliminate demand uncertainty and inventory can also be reviewed continuously. Tsao [1] tried to models this situation by involving permissible delay in payment and advance sales discount into EOQ. This proposed model is used to determine the optimal replenishment cycle time and the optimal price discount in ASD program which has purpose to minimize total cost. The credit period that was proposed by Tsao [1] incorporate the interest/*usury* inside the model. Antonio [17] stated that this interest/*usury* is the additional payment of the loan with a certain percentage that charged to the customers which is indirectly demanded its customers to achieve profit, thus they are able to pay them the loan. In the Islamic perspective *usury* or interest is forbidden. It is caused by the interest is already determined at the beginning of the agreement. Therefore, the study knows the yield of payment certainly. Different with the Islamic sharia concept, this concept emphasizes to eliminate *usury* in sales activities. The explanation of Islamic Sharia will be described in the next phase.

■3.0 REVIEW OF SHARIA FINANCE PRINCIPLE

Islamic finance is a part of *sharia principle* which includes bank and non-bank transaction [17]. Moreover, this kind of transaction uses the concept of fraternity which means helping each other. Islamic finance does not allow *usury*/interest as the conventional concept, since it brings out disturbance between debtor and creditor (related to the bank or loan transaction) or between seller and buyer (related to credit payment). In terms of purchasing, *sharia* consists of *Bai Al Murabahah*, *Bai As Salam* and *Bai Al Istishna*. Each of them has its role in term of purchasing, for example, *Bai Al Murabahah* plays its role in face to face purchasing, then Bai As Salam and *Bai Al Istishna* are covering the manufacturing field, such as ordering – purchase the product. The thing should be underlined that, *Bai Al Istishna* is the *Bai As Salam's* development. It is because of the need of credit becomes higher among buyer in term of ordering the product.

This research uses *Bai Al isthina* which suitable with this case study, as Antonio [17] mentioned that *Bai Al Istishna* transaction is about agreement between seller, buyer and producer. Here, the buyer orders to the producer, then the goods sold to end user. For the first, the seller contacts a producer to produce or buy a certain product ordered by end buyer, and then both of them make an agreement for the payment. The payment could be such kind of credit, to pay in advance or delay payment for certain time.

■4.0 MODEL FORMULATION

The model is initiated by Tsao [1] which belongs to conventional mathematical model. This research develops the model by eliminating interest/ usury and replace with sharia agreement model into Tsao's model. In addition, the study uses same assumptions and notations as Tsao's model but there are additional notations to build *sharia* agreement and few changes in assumptions. The notations are used as follows:

m_1	Expected margin between supplier and retailer
m_2	Expected margin between retailer and customer
Ca	Expected price per unit between supplier and retailer
C'	Production cost per unit of supplier
C	Unit purchase cost
C_2	Expected product cost by supplier
$C_2 - C'$	Expected margin by retailer.
$Ca - C'$	Expected margin by both, supplier and retailer
$C - C'$	Expected margin by supplier
$C - Ca$	Decreasing in price while bargaining between supplier and retailer.
P'	Production cost per unit by retailer.
P	Unit retail price
P_2	Expected product cost by retailer
Pa	Expected price per unit between retailer and customer
$P - P'$	Expected margin by retailer
$P_2 - P'$	Expected margin by customer
$Pa - P'$	Expected margin by both retailer and customer
$P - Pa$	Decreasing in price while bargaining between retailer and customer.
A	Ordering cost per order
H	Unit inventory holding cost per unit time

t_1	Retailer's credit period provided by the supplier
t_2	The customer's credit period provided by retailer, in which $t_2 < t_1$
r	Price discount, $0 \le r < 1$
T	Replenishment cycle time
D_1	Annual demand for the retailer, termed as the retailer 1
D_2	Annual demand for another retailer, not the retailer 1
Y_1	Fraction of retailer 1's customer who uses advanced sales discount program, in which Y_1 is a function of r .
Y_2	Fraction of other retailers' customers who switch to retailer 1 under advance sales discount program, where Y_2 is a function of r, i.e., Y_2 r
$Y_1D_1 + Y_2D_2$	Annual demand of customers who use advanced sales discount program, where Y_2D_2 is the increasing demand when provide ASD program
$1 - Y_1 \ D_1$	Annual demand of customers who are not using advanced sales discount program
D	Total annual demand, $D = Y_1D_1 + Y_2D_2 + 1 - Y_1 \ D_1$
TC_i	Total related cost, $i = 1$ when $T \ge t_1$, i = 2 when $t_2 \le T \le t_1$ and $i = 3$ when $T \le t_2$

The assumptions are used in this model as follows:

1. This problem study focused on a single product
2. If customers can commit their order to the sales period early, retailer will offer a price discount r to customers.
3. Customers should be able to complete the payment at t_2
4. The agreement process is occurred between supplier, retailer, and customer.
5. Margin as the result of agreement process

4.1 Agreement Based on Sharia Model

A purchase based on *sharia* should maintain some conditions in which to avoid a disturbance between seller and buyer [17]. The conditions of sharia principle are as follows:

a. There should be an agreement of margin between both seller and buyer. Nonetheless, buyer should not have informed the main production cost to create a product. The agreement is shown in figure 1 and 2 respectively.

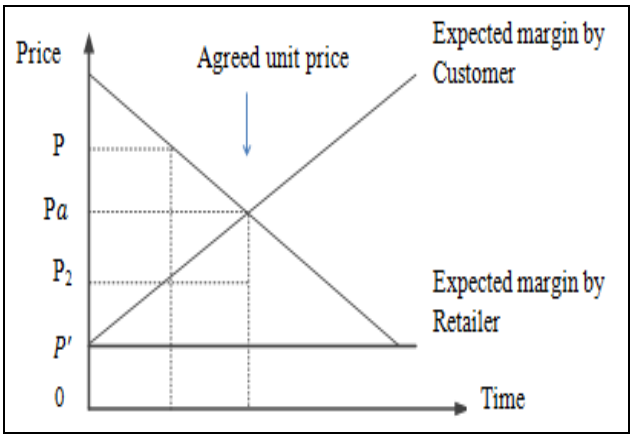


Figure 1 The retail price agreement between retailer and customer [18]

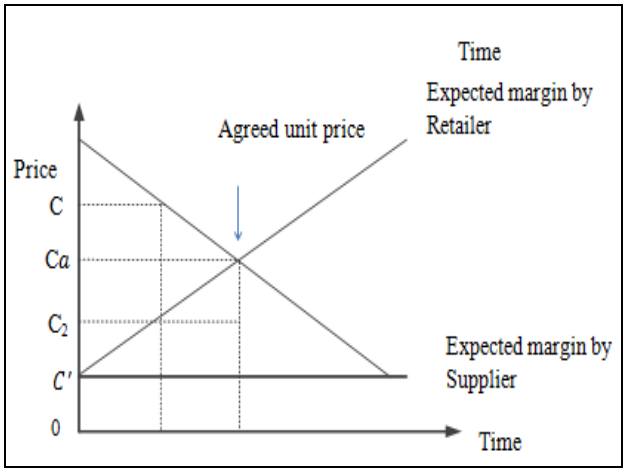


Figure 2 The purchase price agreement between supplier and retailer [18]

Those figures above lead to bargaining processes which have aimed to find agreement of price between supplier, retailer, and customer toward bargaining process. The figures show the increasing of price based on influence of time therefore the study will obtain the value of Pa and Ca . Hence, the study adopts the equation to find agreement price between supplier and retailer; and between retailers and end customer. Then, the equation for retail price agreement can be expressed as follows:

$$\frac{P - P'}{P_2 - P'} = \frac{Pa - P'}{P - Pa}$$

$$Pa = \frac{P^2 - P'^2 - P' P - P_2}{P_2 - 2P' + P}$$

Then, the equation for purchase price agreement can be expressed as follow:

$$\frac{C - C'}{C_2 - C'} = \frac{Ca - C'}{C - Ca}$$

$$Ca = \frac{C^2 - C'^2 - C'C - C_2}{C_2 - 2C' + C}$$

Those figures above explain how the agreement occurred due to some factors which influence the selling price. Thus, the margin per unit for m_1 and m_2 is obtained as follows:

$$m_1, m_2 = \frac{Ca - C'}{C'}, \frac{Pa - P'}{P'}$$
$$m_1, m_2 \geq 0$$

m_1, m_2 is the agreement which shows the proportion of supplier's margin m_1 and retailer's margin m_2 of production cost. Thus, the margin should be higher or equal to zero in order to prevent the loss.

b. Since *sharia* principle is *Bai Al Istishna*, therefore, there should be an existence of agreement of payment. It means that buyer may choose whether it is credit payment, prepaid payment or pay back.
c. This condition is not being influenced by the changing of monetary value.

4.2 Model Formulation Based on Sharia Agreement

The model formulation is adopted from Tsao [1]'s model, thus the model should fulfill some conditions as follow:

a. Annual ordering cost $\left(\frac{A}{T}\right)$,
b. Annual holding cost $\left(\frac{1 - Y_1 \; D_1 TH}{2}\right)$,
c. Then, the condition when credit payment is necessary for trading, in which the margin for retailer and customer, those are:

Case 1: When $T \geq t_1$

The revenue of selling time during sales period based on *sharia* principle is:

$$\frac{P'm_2(1 - Y_1)D_1(t_1^2 - t_2^2)}{2T}$$

Then, revenue from selling item before sales period based on *sharia* principle is:

$$Y_1D_1 + Y_2D_2 \;\; P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Since, payment is using *sharia* principle, and then the annual margin earned is:

$$\frac{P'm_2(1 - Y_1)D_1(t_1^2 - t_2^2)}{2T} + \; YD_{1\,1} + YD_{2\,2} \;\; P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Case 2: When $t_2 \leq T \leq t_1$

The revenue of selling time during sales period based on *sharia* principle is:

$$\frac{P'm_2(1 - Y_1)D_1(2Tt_1 - T^2 - t_2^2)}{2T}$$

Then, revenue from selling item before sales period based on *sharia* principle is:

$$Y_1D_1 + Y_2D_2 \;\; P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Since, payment is using *sharia* principle, and then the annual margin earned is:

$$\frac{P'm_2(1 - Y_1)D_1(2Tt_1 - T^2 - t_2^2)}{2T} +$$

$$YD_{1\,1} + YD_{2\,2} \;\; P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Case 3: When $T \leq t_2$

The revenue of selling time during sales period based on *sharia* principle is:

$$(1 - Y_1)D_1P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Then, the revenue from selling item before the sales period based on *sharia* principle is:

$$Y_1D_1 + Y_2D_2 \;\; P'm_2 \;\; 1 - r \;\; t_1 - t_2$$

Since, payment is using *sharia* principle, and then annual margin earned is:

$$Y_1D_1 + Y_2D_2 \;\; 1 - r \;\; + (1 - Y_1)D_1 \;\; P'm_2 \;\; t_1 - t_2$$

Then, conditions when credit payment is necessary for trading, in which margin for supplier and retailer, those are:

Case 1: When $T \geq t_1$

Annual margin paid: $\frac{Cm_1\ (1-Y_1)D_1\ \ T-t_1\ ^2}{2T}$

Case 2: When $t_2 \le T \le t_1$

Annual margin earned, $Cm_1 = 0$

Case 3: When $T \le t_2$

Annual margin earned, $Cm_1 = 0$

d. Based on the elaboration above, then the total related cost is:

Case 1: When $T \ge t_1$

$$TC_1 = \left(\frac{A}{T}\right) + \frac{1-Y_1\ D_1TH}{2} - \frac{P'm_2(1-Y_1)D_1(t_1^2-t_2^2)}{2T}$$

$$- Y_1D_1 + Y_2D_2\ P'm_2\ 1-r\ \ t_1-t_2\ + \frac{Cm_1\ (1-Y_1)D_1\ \ T-t_1\ ^2}{2T}$$

Case 2: When $t_2 \le T \le t_1$

$$TC_2 = \left(\frac{A}{T}\right) + \frac{1-Y_1\ D_1TH}{2} - \frac{P'm_2(1-Y_1)D_1(2Tt_1-T^2-t_2^2)}{2T}$$

$$- Y_1D_1 + Y_2D_2\ P'm_2\ 1-r\ \ t_1-t_2$$

Case 3 When $T \le t_2$

$$TC_3 = \left(\frac{A}{T}\right) +$$

$$\frac{1-Y_1\ D_1TH}{2}\ Y_1D_1 + Y_2D_2\ \ 1-r\ + (1-Y_1)D_1\ P'm_2\ \ t_1-t_2$$

4.3 Determination of Ordering Policy Based on Sharia

The point of this part is defining the replenishment cycle time based on *sharia*. Notes, this mathematical model is adopted from Tsao [1] .Then the following expression below is finding the replenish cycle time based on *sharia* for each case:

Case 1: When $T \ge t_1$

$$T_1^{\wedge} = \sqrt{\frac{2A + \ 1-Y_1\ \ D_1\ t_1^2\ C'm_1 - P'm_2\ + t_2^2P'm_2}{1-Y_1\ \ D_1\ \ H + C'm_2}}$$

Case 2: When $t_2 \le T \le t_1$

$$T_2^{\wedge} = \sqrt{\frac{2A + \ 1-Y_1\ \ D_1\ t_2^2P'm_2}{1-Y_1\ \ D_1\ \ H + C'm_2}}$$

Case 3 When $T \le t_2$

$$T_3^{\wedge} = \sqrt{\frac{2A}{1-Y_1\ \ D_1H}}$$

4.4 Determine the Ordering and Discounting Policies Based on Sharia

In this section, discount rate (r) belongs to decision variable since it is used to attract customer's demand. To find the value of decision discount rate (r^*), then What-If Analysis may necessary. In order to limit the large number of $r_i\ \ T$ which reflects to P', the condition can be expressed as

$$P - \ P \times r\ > P'$$

Formula above shows that in term of defining the r value, and then the condition of should higher then P'. When the value of price discount r_i^* (T) is found, the next step is determining the value of cycle time T for each branch by changing the value of Y_1 and Y_2 by substituting the value of r into this equation $Y_1 = \alpha.r$ and $Y_2 = \beta.r$. After obtaining Y_1 then substitute into equation (18), (19), and (20) to find the value of cycle time T for each branch. Then, determine the total related cost for each branch first $TC_i^*\ \ T,r\ \ T$. To find the solution procedures, this research further proposes an algorithm.

4.4 Algorithm

Step 1 : Determine the price agreement (Ca and Pa) and solve $m_1 = \frac{Ca - C'}{C'}$, $m_2 = \frac{Pa - P'}{P'}$ in order to define the value of percent margin. Verify that $m_1, m_2 \ge 0$

Step 2 : Set $r = 0$ as initial value of discount

Step 3 : Determine the local minimum points by solving for $\frac{dTC_i\ \ T,r\ \ T}{dT} = 0$ and find the value of T_1^*, T_2^*, T_3^*

Step 4 : Find $TC_1\ \ T_1$

Step 5 : Determine the local minimum points by solving for $\frac{dTC_2\ \ T,r\ \ T}{dT} = 0$

Step 6 : Find $TC_2\ \ T_2$

Step 7 : Determine the local minimum points by solving for $\frac{dTC_3(T,r)}{dT}=0$

Step 8 : Find $TC_3(T_3)$

Step 9 : When r is a decision variable, then determine the value of r^* by using What-If Analysis and verify that $P-(P\times r)>P'$.

Step 10 : Substitute r^* in order to solve $\frac{dTC_i(T,r)}{dT}=0$ and find the value of T_1^*, T_2^*, T_3^*

Step 11 : Let $TC_1^*(T_1^*,r)$ associate with the local minimum points or any of two boundaries point t_2 and t_1, which gives the smallest value of $TC_1(T_1,r)$.

Step 12 : Substitute r in order to solve $\frac{dTC_2(T,r)}{dT}=0$ and find the value of T_2^*,

Step 13 : Let $TC_2^*(T_2^*,r)$ associate with the local minimum points or any of two boundaries point t_2 and t_1, which gives the smallest value of $TC_2(T_2,r)$.

Step 14 : Substitute r in order to solve $\frac{dTC_3(T,r)}{dT}=0$ and find the value of T_3^*.

Step 15 : Let $TC_3^*(T_3^*,r)$ associate with the local minimum points or the boundary point t_2, which gives the smallest value of $TC_3(T_3,r)$

Step 16 :

$$TC^*(T^*,r^*)=\min\left[TC_1^*(T_1^*,r^*),TC_2^*(T_2^*,r^*),TC_3^*(T_3^*,r^*)\right]$$

5.0 NUMERICAL EXAMPLE

This numerical example shows how the *sharia* mathematical model corresponds to total related cost. In fact, there is no limitation in term of defining margin value as long as *akad/agreement* between buyer and seller exist. The research may present the numerical example as follow

5.1 Example 1

Consider such A = 100 dollars/order, P = 8 dollars/U, C = 5 dollars/U, H = 0.08 dollars/U/year, Pa = 7.2 dollars/U, Ca = 4.56 dollars/U, t_1 = 0.3 years, t_2 = 0.15 years, D_1 =3000 U/year, D_2 = 3000 U/year, $Y_1 = 1.02 \cdot r$, $Y_2 = 1.01 \cdot r$, P' = 6,432 dollars/U, C' = 4 dollars/U.

When margin plays an important role in *sharia* trading, there should be an agreement between supplier - retailer and retailer – customer. In this case, m_1 = 0.317919 and m_2 = 0.119403. If the decision making is to find the replenishment cycle time based on agreement, then it shows the smallest value of TC_i. In this case, replenishment cycle time is T_1^* = 0.319 with the value of TC_1 is 108.948 dollars.

When r belongs to decision variable to support the trading, Sensitive analysis may be the solution to find the value of r, then it is 0.125 with T^* = 0.342 years (assumed, there is no changing of Pa and Ca), then the total related cost TC_1 = 56.872 dollars

5.2 Example 2

Consider such A = 55 dollars/order, P = 8 dollars/Unit, C = 5 dollars/Unit, H = 1.0 dollars/Unit/year, Pa = 6.7 dollars/Unit, Ca = 4 dollars/Unit, t_1 = 0.3 years, t_2 = 0.15 years, D_1 =3000 Unit/year, D_2 = 3000 Unit/year, $Y_1 = 1.02 \cdot r$, $Y_2 = 1.01 \cdot r$, P' = 6.432 dollars/Unit, C' = 3.46 dollars/Unit.

In this case, m_1 = 0.156 and m_2 = 0.0416. If the decision making is to find the replenishment cycle time based on agreement, it shows the smallest value of TC_i. In this case, replenishment cycle time is T_2^* = 0.350 with the value of TC_2 is 124.485 dollars.

When r belongs to decision variable to support the trading, then What – If Analysis may be the solution to find the value of r, and then it is 0.135. Thus, T_2^* = 0.373 years (assumed, there is no changing Pa and Ca) and total related cost TC_2 = 99.682 dollars

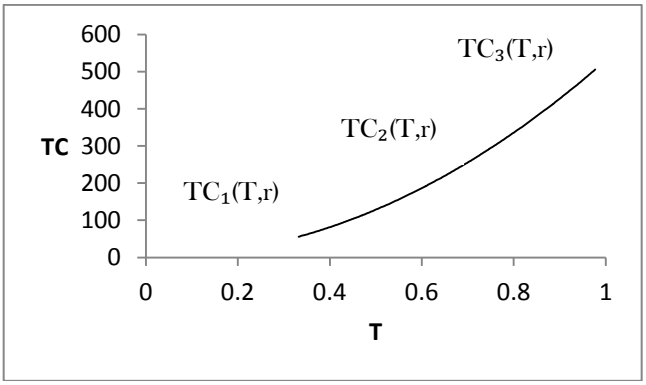


Figure 3 Example 1

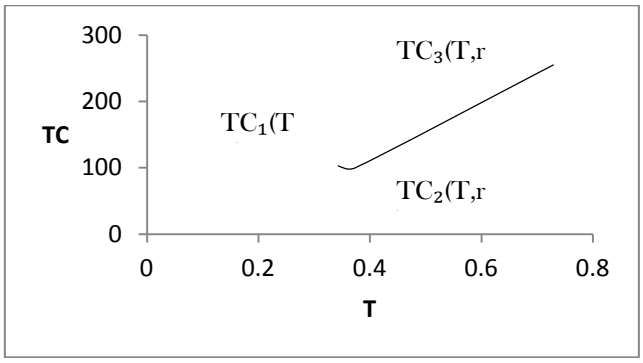


Figure 4 Example 2

6.0 DISCUSSION

Numerical example above shows how *sharia* works on trading. The difference between conventional and *sharia* should be underlined, that there is an existence of agreement in term of *sharia.* It could be seen in Fig. 1 and Fig. 2. The margin in *sharia* is production cost plus margin and the agreement between them. In other words, unit retail prices itself (either provided by supplier) is production cost per unit plus margin. In fact, determining price agreement itself should be more than production cost in order to achieve the expected margin.

Moreover, r variable could be benefits to attract the customer's demand, thus, it must be sensitive since should be profitable for seller. To define the value of r, a seller has to know the production cost per unit, thus when a seller comes with the price times r it must be higher than production cost to achieve profit per unit (agreement still exists).

Related to Tsao [1], when the holding cost (A) is higher, then retailer may offer higher price discount and extend the replenishment cycle time. Nonetheless, in this paper has an idea that when the holding cost (A) is higher, then the retailer may offer lower price discount and lengthen the replenishment cycle time. When the holding cost (H) is higher, then the retailer may offer higher price discount and shorten replenishment cycle time.

7.0 CONCLUSION

This paper provides mathematical model based on *syariah* to find replenishment cycle time and price discount policy based on *syariah* in which the objectives are to minimize total related cost. The first model of replenishment cycle time deals without price discount, but the agreement does exist. In fact this paper introduces how to achieve the margin without *usury* or interest. Then, the second model introduces price discount as a promotional effort, such Tsao (2009)'s explanation, to be determined first in order to achieve benefits, then the agreement may exist eventually.

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