Journal of Engineering and Applied Sciences 13 (15): 6173-6180, 2018
ISSN: 1816-949X

Virtual Merchant Model in e-Marketplace System

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Abstract: Nowadays, e-Marketplace such as Tokopedia, Bukalapak or Blibli plays significant role in the rise of e-Commerce in Indonesia. Unfortunately because of its free competition nature, price war cannot be avoided. In one side, this condition is good for customers. In the other side, merchant is difficult to make sustainable profit. So, long term growth for e-Commerce, especially in Indonesia cannot be guaranteed. Based on this problem in this research, we propose virtual merchant model that offer same products from joined merchants, so that, fierce competition can be avoided. In this research, rather than concerning only in price, delivery cost and stock size are also, parameters that are concerned. We propose three models: least cost model, two-step model and score based model. These models performance then will be compared to each other and with the conventional least price model. Based on the simulation data, these proposed models perform better in making equity among merchants rather than conventional least price model. The two-step model performs the best in reducing the gap. In the other side, the conventional least price model performs the worst one. Meanwhile, the least cost model and the score based model perform moderate result with the least cost model is slightly better than the score based model.

Key words: Virtual merchant, e-Marketplace, e-Commerce, least cost, least price, delivery cost

INTRODUCTION

Now a days by the increasing of e-Commerce trend, some e-Marketplaces also, grow significantly (Laumeister, 2014; Taniwan, 2015; Harsono, 2016; Bland, 2014; Reeves, 2014). One of the reasons is that online marketplace creates many new categories rather than the conventional one (Laumeister, 2014). This condition also occurs in Indonesia. Indonesia is predicted as Asia's next biggest e-Commerce market (Harsono, 2016). This e-Market size is projected at $130 billion by 2020 (Harsono, 2016). There are some big e-marketplaces in Indonesia such as: Blibli, Tokopedia, Bukalapak, Lazada and many more. Some of them are predicated as unicorn because of their huge capitalization (Harsono, 2016). The example is Lazada which gets $250 million of investment from Temasek (Reeves, 2014). The existence of the marketplace benefits large of customers and ignites new economy activity, especially in Indonesia which its geographical characteristics is very large and it consists of lots of islands (Harsono, 2016). So, by using marketplace, people from any place such as Papua or Celebes still can purchase latest goods as fast as people in central city like Jakarta. In the other side, people in rural area or difficult location can also sell their product in wider market size through e-Marketplace. The fast growing of the market size triggers the fast growing of the merchants to join into the marketplace. It makes the products that are offered in the marketplace more various. In the e-Marketplace, the same product may be offered by more than one customer. So, customer can choose which merchant that he will purchase from.

Unfortunately because many same products are offered by more than one merchant, price competition cannot be avoided (Taniwan, 2015; Moreno, 2017; Loeb, 2014; Gerbig, 2017). This condition may be good for the customer. It is because customer can choose the merchant who offers more competitive price (Taniwan, 2015; Gerbig, 2017). The negative aspect is harder price competition may trigger price war between merchants. The price reduction that grows fast in e-Marketplace not only harms online merchants but also, the conventional offline merchants too (Loeb, 2014). This condition reduces the merchant's profit margin so that the profit margin will be slimmer. Longer price war will harm e-marketplace business continuity. It will burn merchant's capital and if at certain point, the merchant thinks that doing business in e-Marketplace is not profitable, he will leave from the ecosystem.

In the other hand, getting the lowest price does not guarantee either the e-Marketplace company's or merchant's financial health. It is because the lowest price is not always offered by the merchant that are the nearest to the customer. So, the delivery cost is not always the cheapest one. The problem is in some e-Marketplace companies, the delivery cost is charged to

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the e-Marketplace company (Moreno, 2017; Kaplan, 2017) or the merchant (Kaplan, 2017). In many cases, many large retailers give low or no delivery cost to the customer (Moreno, 2017). This situation burns the slim profit margin that is received by the merchant if the delivery cost is charged to the merchant or burns the company's shared revenue portion if the delivery cost is charged to the company (Kaplan, 2017). This condition sometimes creates no profit transaction. So, even there is lot of transactions in the marketplace, the profit is still questioned. This situation is one of the reasons why many e-Marketplaces is still fail to make profit even they handle lots of transactions. So, calculating delivery cost will be one the important things in ecommerce system (Kaplan, 2017).

To avoid this destructive price war in e-Marketplace, we propose collaborative virtual merchant model in e-Marketplace system. The basic concept is there is a virtual merchant for merchants that sell similar products. When a customer wants to buy a product, he faces the virtual merchant rather than the real merchants. The purchase order then will be allocated or dispatched to the real merchant who sells the product. The question is how to dispatch the purchase order to the specified merchant.

Based on this research question, the research purpose is developing the collaborative virtual merchant model in e-Marketplace, so that, the system is fair and benefits the stakeholders, especially in creating equity among merchants. In this research, we propose some virtual merchant models and these models then will be compared among them. Parameters that are being concerned are price, delivery cost and stocks.

Problems in e-Marketplace: In e-Marketplace ecosystem, there are lots of merchants who offer various products. In the other hand, lots of customers visit the system to buy products. The e-Marketplace company plays two roles. The first role is providing the ecosystem. The second role is providing the payment process intermediary. In some marketplaces such as Lazada or Blibli, the second role is mandatory. This means all transactions that occur in the system will be handled by the e-Marketplace company. When the customer creates purchase order, the customer must pay through the e-Marketplace system, so that, the money will be received by the e-Marketplace company. After the payment is received, the e-Marketplace will create delivery order to the merchant to deliver the specified product to the customer. After the product is successfully delivered by the courier service, the e-Marketplace then transfers the money to the merchant role is not mandatory. It means that the customer can make direct relation to the merchant. So, if there is a deal,

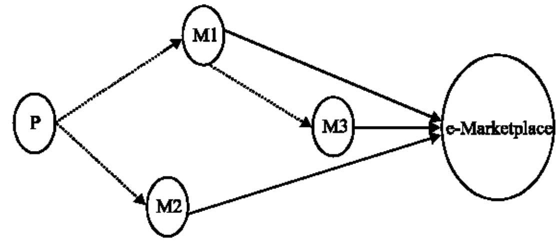

Fig. 1: Merchants in e-Marketplace environment

the customer transfers the payment direct to the merchant's bank account. Based on this mechanism, the transaction that occurs is not recorded in e-Marketplace system.

In both systems, there are two problems. The first problem is the fierce price competition among merchants. The e-Marketplace can be viewed as a market that consists of lots of merchants. Some merchants offer same products. But there is different price that are offered by the merchants for same product. Customer usually tends to buy the product from the merchant who offer the lowest price (Yoo *et al.*, 2002). The price competition cannot be avoided. In the traditional market, merchants that provide similar products are usually grouped in the same area. There is communication among them to determine the price range to avoid price war. In the e-Marketplace, this communication does not occur. In the other side in e-Marketplace, the customer can move from one merchant to other merchants easily by clicking the web site, so that, price comparison can be done easily and fast (Yoo *et al.*, 2002). The most significant competitive aspect is price. This condition is not good because merchants will cut the price as low as it is still competitive. So, the challenge for the merchants is how to keep the price still competitive while maintaining margin in the other side. It makes the sustainable profit is more difficult to achieved. For merchant who cannot cut the price, this condition is worse because it will be very difficult to sell his product. The illustration is shown in Fig. 1.

Based on the illustration in Fig. 1, there are three merchants that receive product that are produced by producer P and they enter the e-Marketplace. Merchant M_1 and M_2 receive product directly from producer p. The price that producer p sells product to M_2 is 25,000 rupiah. The price that producer p sells product to M_1 is 20,000 rupiah because m_1 buys in bigger quantity. If the minimum profit margin is 10% from the purchasing price, then the minimum offering price is 22,000 rupiah for M_1 and 27,500 for M_2. Merchant m_3 receives product from M_1 at the price is 26,000 rupiah. So, the minimum offering price for M_3 is 28,600 rupiah. All of the merchants enter the

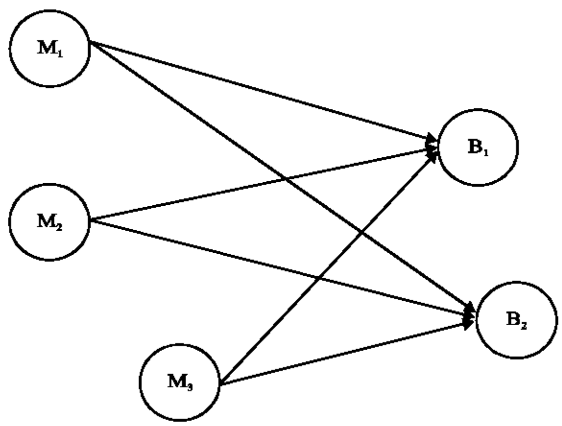

Fig. 2: Merchants-buyers relationship in e-Marketplace environment

e-Marketplace. In this situation, the most competitive merchant is M_1 and the least competitive merchant is M_3. Based on this situation if the price is the only parameter that is concerned by the customers, merchant M_2 cannot sell his product until M_1's all products are sold.

Besides price, parameter that must be concerned in e-Marketplace is delivery cost. In many situations, sometimes cost is more expensive rather than the product price itself. For example, the delivery cost for the product that is shipped from Yogyakarta to Papua is approximate 100,000 rupiah per kg. If the merchant sells a baby shirt that the price is 50,000 rupiah per piece, then the product price is only a half of the delivery cost. In case that the merchant must set single price for the product and the delivery cost is ignored, the transaction is not profitable for actor who bears the delivery cost. Unfortunately, to benefit the customer, some e-Marketplace companies give free delivery cost to the customer (Moreno, 2017). So, the delivery cost will be charged to the merchant or the company.

In the other side, the merchants that offer higher price may be closer to the customer, so that, the delivery cost is lower than the merchant who offers the lowest price. The illustration is shown in Fig. 2. In the environment, there are three merchants who sell same product $\{M_1, M_2, M_3\}$. The product price that is offered by each merchant is 25,000; 30,000 and 32,000 rupiah consecutively. There are two buyers who want to buy the product $\{b_1, b_2\}$. The total cost is shown in Eq. 1 where the total cost is the summation of the purchasing cost ($c_{purchase}$) and the delivery cost ($c_{delivery}$). The purchasing cost is calculated by using Eq. 2, where p is the product price and q is the purchasing quantity. The delivery cost is calculated by using Eq. 3 where c_{del_min} is the minimum delivery cost, c_{del_unit} is the delivery cost per weight unit, w_{unit} is the weight of single product and w_{del_unit} is the weight unit. Let

Table 1: The relation between price, delivery unit cost and total cost

$n_{package}$ (unit)	p (rupiah)	c_{del_unit} (rupiah)	c_{tot} (rupiah)
M_1-B_1	25,000	20,000	45,000
M_1-B_2	25,000	25,000	50,000
M_2-B_1	30,000	10,000	40,000
M_2-B_2	30,000	30,000	60,000
M_3-B_1	32,000	40,000	72,000
M_3-B_2	32,000	10,000	42,000

assume that the w_{unit} is 1 kg, w_{del_unit} is 1 kg and q is 1 unit. The c_{del_unit} map and c_{tot} from merchants to buyers is shown in Table 1:

$$C_{total} = C_{purchase} + C_{delivery} \quad (1)$$

$$C_{purchase} = p \times q \quad (2)$$

$$C_{delivery} = C_{del\_min} + \left(\text{int}\left(\frac{q \times w_{unit}}{w_{del\_unit}} \right) \right) \times C_{del\_unit} \quad (3)$$

Based on illustration in Table 1, it can be seen that even merchant M_1 offers the lowest price, both buyer B_1 and B_2 prefers not to choose M_1. For B_1, the best option is choosing M_2 because the total cost is 40,000 rupiah. It is because the delivery cost between M_2 and B_1 is the lowest one rather than m_1 or M_3. In the other side, for B_2, the best option is choosing M_3 because the total cost is 42,000 rupiah. It is because the delivery cost between M_3 and B_2 is the lowest one rather than M_1 or M_2. So, based on this illustration, it is shown that the lowest price does not guarantee the lowest total cost. Sometimes, it is more efficient to purchase from nearer merchant even this merchant offers higher price as long as the total cost is still economic.

The other problem is the quantity of stock. Each merchant has limited stock. So, in the e-Marketplace if buyer want to purchase product from the specified merchant but this merchant's stock is lower than the purchase order, the buyer must purchase the rest from the other merchant. For example, Let B_1 wants to purchase 5 units. The stocks that are owned by these merchants are 2 and 3 units, consecutively. Based on the total cost rank in Table 1, the order is M_2, M_1 and M_3. Based on this order, B_1 will purchase 2 units from M_2, 2 units from M_1 and 1 unit from M_3, so that, the purchasing option will be the most economic. In the existing e-Marketplace, this activity is done manually by the buyer.

Based on the explanation above, it will be better that there is virtual merchant that serves all buyers. This virtual merchant will dispatch the purchasing order from the buyer to the merchants automatically, so that, the transaction benefits all of stakeholders. This virtual merchant calculate the total cost, so that, the merchant who offer higher price still has opportunity to get order as far as the delivery cost is competitive.

MATERIALS AND METHODS

Based on the mentioned problem, we propose three virtual merchant models. In the first model, least cost model is proposed. In the second model, two-step model is proposed. In the third system, score based model is proposed. Different from the first and the second model that concern on the total cost only in the third model, the stock quantity is being concerned too. In all proposed models, the delivery cost aspect is being concerned because in ecommerce business, delivery is a one of key aspect in successful ecommerce business (De Figueiredo, 2000) and delivery cost and time reduction is an important issue in e-Commerce business.

The first proposed model is the least cost model. In this model, the cost is the total cost. It is because in supply chain system, all cost must be calculated (Ling and Jun, 2014; Qiong and Runxiang, 2014) and e-Marketplace can also be viewed as a supply chain system too. The total cost concept places the price as part of the costs (Qiong and Runxiang, 2014). So, the concept is the purchase order will be allocated to merchant whose total cost is the lowest one. If this merchant's stock is not enough to fulfill the order, the rest of the order quantity will be allocated to the next lowest total cost merchant. This process is iterated until this order is fully fulfilled. The least cost method is described in Eq. 4. In Eq. 4, m_{sel} is the selected merchant and s_m is the stock of merchant m. The least cost algorithm is shown in algorithm 1:

$$m_{sel} = m/m \in M \wedge s_m > 0 \wedge \min\left(C_{total}(m)\right) \tag{4}$$

Algorithm 1; Least cost model algorithm:

```
Begin
  q_now←q
  complete←false
  while complete = false do
  begin
     m_sel←findleastcostmerchant( )
     if m_sel = 0 then
     begin
        complete←true
     end
     else
     begin
        stock-s(m_sel)
        if stock = q_now then
        begin
           complete←true
           s(m_sel) ≥ s(m_sel)-q_now
           q_now-0
     end
     else
     begin
        s(m_sel)←0
        q_now-q_now-s(m_sel)
      end
    end
  end
end
```

The second proposed model is two-step model. This model is divided into two steps. The first step is sorting the delivery cost model. The merchant whose delivery cost is the lowest one will be prioritized. The concept is usually lower delivery cost means lower delivery time. This concept is adopted based on the idea that the delivery speed is also, the key factor for successful e-Commerce business (Gerbig, 2017). If there is only one merchant with the lowest delivery cost then this merchant will become the selected merchant. The second step is if there is more than one merchant with the lowest delivery cost, then the lowest delivery cost merchants will be grouped into merchant candidate set (M_{cand}). Then, the selected merchant is the merchant who offers the lowest price. This model is formally explained in Eq. 5 and 6. This two-step model algorithm is shown in algorithm 2. Similar to the first proposed model in this model, the process will iterate until all order quantity is accomplished or there is not any merchants can provide the product:

$$M_{cand} = \left\{ m/m \in M \wedge s_m > 0 \wedge_{min} \left(C_{delivery}(m)\right)\right\} \tag{5}$$

$$m_{sel} = m/m \in M_{cand} \wedge_{min} \left(p(m)\right) \tag{6}$$

The illustration of two-step model is as follows. Suppose that there are three merchants: M_1, M_2 and M_3 that offer product with price 28,000; 30,000 and 27,000 rupiah consecutively. The delivery costs are 10,000; 15,000 and 15,000 rupiah consecutively too. So, the lowest delivery cost is 10,000 rupiah. Because there is only one merchant whose delivery cost is 10,000 rupiah and he is M_1 then the selected merchant is M_1. In the other scenario, there is another merchant in the system called M_4. His delivery cost is 10,000 rupiah and his offering price is 25,000 rupiah. Because his delivery cost is the lowest one too and his price offering price is lower than M_1's offering price then the selected merchant is M_4.

Algorithm 2; Two-step model algorithm:

```
Begin
   // first step
  c_lowestdelivery←c_delivery(m_1)
  for I = 2 to n(M)
  begin
     if c_delivery(m_i) < c_lowestdelivery then
        c_lowestdelivery←c_delivery(m_i)
  end
  for I = 1 to n(M)
  begin
     if (c_delivery(m_i) = c_lowestdelivery) and
(s(m_i)>0) then
        add(M_cand,m_i)
  end
  //second step
  if n(M_cand) = 1 then
```

```
    m_sel ? m_1
  else if n(M_cand)>1 then
  begin
    p_lowest←p(m_cand,1)
    m_sel←m_cand,1
    for I= 2 to n(M_cand)
    begin
       if p (m_cand,i)<p_lowest then
       begin
          p_lowest←m_cand,i
          m_sel←m_cand,i
       end
    end
  end
end
```

The third proposed model is score based model. In this model, the price and the delivery cost is classified into certain levels. Merchant whose price is lower will get higher price score (l_{price}). Merchant whose delivery cost is lower will get higher delivery cost score ($l_{delivery}$). Then, these scores are summed and become the merchant total score (l_{total}). The merchant that the score will be calculated is the merchant who has stock. If the highest score is owned by only one merchant then this merchant will be the selected merchant. If the highest score is owned by more than one merchant then the selected merchant is the merchant who has maximum stock. This model is formalized in Eq. 7-10. The score based model algorithm is shown in algorithm 3:

$$M_{cand1} = \{ m/m \in M \wedge s_m > 0 \} \quad (7)$$

$$l_{total} = l_{price} + l_{delivery} \quad (8)$$

$$M_{cand2} = \{ m/m \in M_{cand1} \wedge \max(I_{total}(m)) \} \quad (9)$$

$$m_{sel} = \begin{cases} m_{cand2,1} \mid m_{cand2,1} \in M_{cand2} \wedge n(_{Mcand2}) = 1 \\ m/m_{cand2} \in M_{cand2} \wedge n\left(M_{cand2}\right) \\ > 1 \wedge \max\left(s\left(m_{cand2}\right)\right) \end{cases} \quad (10)$$

Algorithm 3; Score based model algorithm:

```
begin
  //searching for merchant who has
stock
  for i = 1 to n(M)
  begin
     if s(m_i)>0 then
        add(M_cand1,m_i)
  end

  //finding the highest score
  l_totalmax←0
  for i=1 to n(M_cand1)
  begin
    l_total(m_cand1,i)←l_price(m_cand1,i)+
l_delivery(m_cand1,i)
    if l_totalmax<l_total(m_cand1,i) then
      l_totalmax←l_total(m_cand1,i)
  end

  //searching for merchant who has
highest score
  for i = 1 to n(M_cand1)
  begin
   if l_totalmax = l_total(m_cand1,i) then
     add(M_cand2,m_cand1,i)
  end

  //choosing selected merchant
  s_max←0
  for i=1 to n(M_cand2)
  begin
    if s(m_cand2,i)>s_max then
    begin
       s_max-s(m_cand2,i)
       m_sel-m_cand2,i
    end
  end
end
```

RESULTS AND DISCUSSION

Implementation and analysis: The proposed models then are implemented into e-Marketplace simulation. In this simulation, there is virtual area with size is 1,000 km width and 1,000 km length. There are twenty merchants who join the e-Marketplace and offer single and same product among merchants. The merchant location is randomized around the area and is distributed uniformly. Every merchant offers product in certain price. The price and the stock are randomized and they follow Poison distribution and it is described in Eq. 11 for the price. In Eq. 11, p_{min} represents the product minimum price and p_{av_fluc} represents the price fluctuation average. During simulation, there are buyers who create the purchase order for the product with specified order quantity. The order quantity is randomized and it follows Poison distribution. The buyer location is randomized and it follows uniform distribution. In this simulation, some variables use default value. The default value of the variables is shown in Table 1:

$$p = p_{min} + \text{random Poisson}\left(p_{av\_fluc}\right) \quad (11)$$

The simulation is used as a tool to observe the observed variables based on the adjustment in controlled variable. In this test, the n_{buyer} ranges from 50-150 persons with the step size is 10 persons. The observed variables are the merchant revenue and the number of transactions that are handled by merchants. There are 10 simulation sessions for each n_{buyer}. The test is done as comparison between the proposed models and the least price model (Yoo *et al*., 2002) as the existing model. The result of the

Table 2: Variable default value

Variables	Default values	Units
$n_{merchant}$	30	Person
p_{min}	50,000	Rupiah
p_{av_fluc}	10,000	Rupiah
c_{min}	10,000	Rupiah
d_{step}	100	km
c_{step}	2,000	km
s	300	Unit
q	5	Unit

Table 3: The simulation result of least cost model

n_{buyer} (person)	Revenue (rupiah) Gap	Revenue (rupiah) Average	No. of transaction (unit) Gap	No. of transaction (unit) Average
50	4,646,600	557,513	13.80	1.67
60	6,167,200	688,280	17.60	2.00
70	6,723,800	784,867	19.70	2.34
80	7,804,800	878,940	23.00	2.67
90	11,994,400	1,157,427	34.50	3.34
100	10,816,800	1,091,573	34.30	3.34
110	11,115,600	1,246,993	33.40	3.67
120	12,774,000	1,338,955	39.33	4.01
130	10,822,600	1,464,687	30.90	4.34
140	11,877,600	1,545,267	36.30	4.68
150	13,279,600	1,682,993	40.40	5.01

Table 4: The simulation result of least cost model

n_{buyer} (person)	Revenue (rupiah) Gap	Revenue (rupiah) Average	No. of transaction (unit) Gap	No. of transaction (unit) Average
50	2,192,000	573,673	5.80	1.67
60	2,879,200	706,680	8.00	2.00
70	2,941,400	809,447	8.20	2.33
80	3,321,800	902,740	9.30	2.67
90	4,706,600	1,197,473	12.90	3.33
100	3,859,000	1,126,833	11.60	3.33
110	5,015,200	1,284,093	13.00	3.67
120	4,347,333	1,377,828	13.33	4.00
130	4,802,200	1,508,393	13.00	4.33
140	5,719,600	1,589,020	16.50	4.67
150	6,198,800	1,724,553	17.50	5.00

Table 5: Price and delivery cost classification

Score	Price (rupiah)	Delivery cost (rupiah)
5	$p \leq 55{,}000$	$c_{delivery} \leq 10{,}000$
4	$55{,}000 < p \leq 60{,}000$	$10{,}000 < c_{delivery} \leq 15{,}000$
3	$60{,}000 < p \leq 65{,}000$	$15{,}000 < c_{delivery} \leq 20{,}000$
2	$65{,}000 < p \leq 70{,}000$	$20{,}000 < c_{delivery} \leq 25{,}000$
1	$p > 70{,}000$	$c_{delivery} > 25{,}000$

least cost model is shown in Table 2. The result of the two step model is shown in Table 3. The result of the score based model is shown in Table 4 and 5. The result of the least price model is shown in Table 6.

Based on the result that is shown in Table 2, it is shown that the increasing of the number of buyer makes the merchant's average revenue and merchant's number of transaction increases too. Both the average revenue and the average number of transactions increase linearly. But the revenue gap and number of transactions gap grow fast at the beginning and then grow slowly and it tends to stagnant. The gap to average revenue ratio ($r_{gap\_ave\_rev}$) when the number of buyers is 50 persons is 8.33 and it is

Table 6: The simulation result of score based model

n_{buyer} (person)	Revenue (rupiah) Gap	Revenue (rupiah) Average	No. of transaction (unit) Gap	No. of transaction (unit) Average
50	5,493,400	570,653	16.40	1.67
60	6,015,800	704,333	17.70	2.00
70	6,026,400	799,667	17.30	2.33
80	7,590,800	899,213	22.20	2.67
90	10,282,600	1,182,313	28.00	3.33
100	7,986,200	1,115,013	24.40	3.33
110	10,939,400	1,266,267	31.40	3.67
120	9,459,167	1,362,995	27.50	4.00
130	9,382,600	1,486,774	27.70	4.33
140	11,550,600	1,579,827	33.70	4.67
150	11,305,200	1,710,487	33.50	5.00

7.89 when the number of buyers is 150 persons. The gap to average number of transaction ($r_{gap\_ave\_ntrans}$) is 8.28 when the number of buyers is 50 persons and it is 8.07 when the number of buyers is 150 persons.

Based on the result that is shown in Table 3, it is shown that the linear increasing of the number of persons makes all observed variables increase linearly too. The $r_{gap\_ave\_rev}$ is 3.82 when the number of buyers is 50 persons and it is 3.59 when the number of buyers is 150 persons. The $r_{gap\_ave\_ntrans}$ is 3.48 when the number of buyers is 50 persons and it is 3.5 when the number of buyers is 150 persons. It means that by using the two-step model, all observed variables grow linearly with the similar gradient.

In the score based model, classification is implemented both in the price aspect and the delivery cost aspect. In this research, the price and delivery cost are classified into five levels. The classification is shown in Table 4.

Based on the result that is shown in Table 5, it is shown that by using the score based model, the increasing of the number of buyers makes all of the observed variables increase too. The average revenue and the average number of transactions increase linearly. In the other side, the revenue gap and the number of transactions gap grow linearly with some fluctuation. The $r_{gap\_ave\_rev}$ is 9.62 when the number of buyers is 50 persons and it is 8.54 when the number of buyers is 150 persons. The $r_{gap\_ave\_ntrans}$ is 9.84 when the number of buyers is 50 persons and it is 8.85 when the number of buyers is 150 persons.

Based on the result that is shown in Table 7, it is shown that by using conventional least price model, the linear increasing of the number of buyers makes all of the observed variables increase linearly too. The $r_{gap\_ave\_rev}$ is 27.93 when the number of buyers is 50 persons and it is 29.52 when the number of buyers is 150 persons. The $r_{gap\_ave\_ntrans}$ is 27.62 when the number of buyers is 50

Table 7: The simulation result of least price model

n_{buyer} (person)	Revenue (rupiah) Gap	Revenue (rupiah) Average	No. of transaction (unit) Gap	No. of transaction (unit) Average
50	16,859,400	603,700	46.40	1.68
60	21,872,400	741,060	59.00	2.01
70	18,672,400	833,320	53.00	2.36
80	22,234,800	943,560	62.90	2.69
90	23,106,800	1,237,640	62.20	3.37
100	21,919,600	1,182,193	62.40	3.36
110	22,775,800	1,339,800	62.50	3.70
120	23,201,500	1,432,967	64.67	4.04
130	24,533,000	1,579,540	66.50	4.39
140	27,032,600	1,683,020	76.80	4.71
150	26,975,600	1,820,487	74.50	5.05

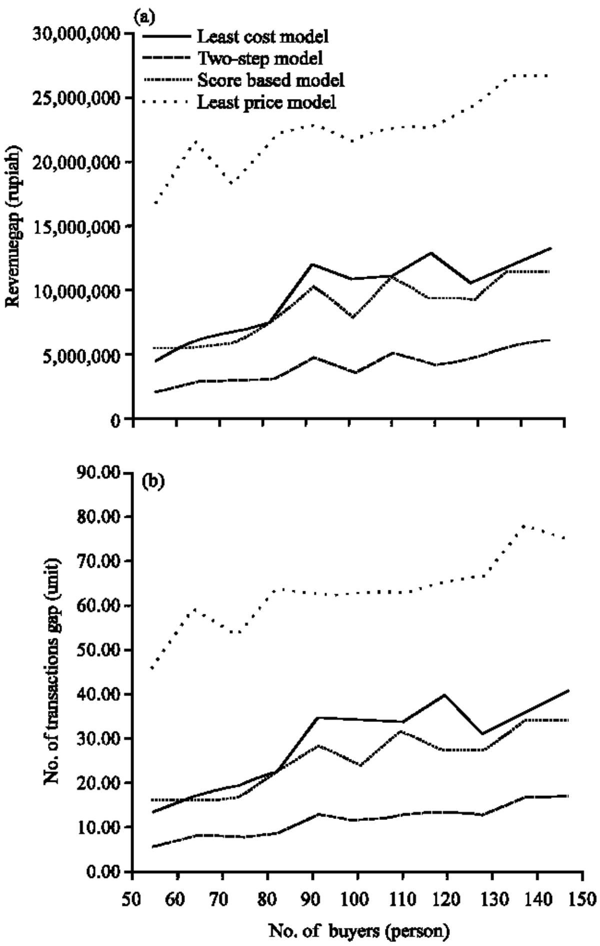

Fig. 3: a, b) Performance comparison among models

persons and it is 29.40 when the number of buyers is 150 persons. It means the gap value grows faster than the average value.

After observing the variables based on the applied model, these variables are compared to each others. The compared variables are the revenue gap and the number of transactions gap. These variables are compared among all of models. The result is shown in Fig. 3ab represents the revenue gap comparison while Fig. 3b represents the number of transactions gap.

Based on data in Fig. 3, it is shown that the two-step model performs the best in making equity among merchants as its gap is the lowest one. This condition occurs both for revenue gap and number of transaction gap. In the other side, the conventional least price model performs the worst in making equity among merchant as its gap is the highest one. This condition occurs both for revenue gap and number of transaction gap. Meanwhile, the least cost model and score based model perform moderate and the least cost model is slightly better than the score based model.

CONCLUSION

Based on the explanation above, it is shown that there are three models that are proposed to develop virtual merchant in e-Marketplace ecosystem: least cost model, two-step model a nd score based model. These models also have been implemented into the e-Marketplace simulation, so that, their performance can be observed. In the least cost model, the purchase order will be allocated to the merchant whose total cost is the lowest one. The total cost means the price pluses the delivery cost. In the two-step model, the purchase order will be allocated to the merchant whose delivery cost is the lowest one. If there are more than one merchant that the delivery cost is the lowest then the purchase order will be allocated to the merchant whose price is the lowest one. In score based model, the purchase order will be allocated to the merchant whose score is the highest one. If there are more than one merchant whose score are the highest, then purchase order will be allocated to the merchant whose stock is the highest one.

RECOMMENDATIONS

Based on data from the simulation, all proposed models perform better than the conventional least price model in making equity among merchants. By using least price model, the merchant whose price is the lowest will dominate the market. It is shown that the revenue gap and the number of transactions gap is the highest one. In the other side by using two-step model, the best equity among merchants is achieved and it is shown that the revenue gap and the number of transaction gap are the lowest one. Meanwhile, the least cost model and the score based model perform at moderate level in making equity among merchants.

There are research potentials in developing virtual merchant in e-Marketplace system. This current research still has limitations. The scenario in this current research is single product. In the real world, merchants usually have multi products and the product portfolio among merchants is various. In other side, buyer usually orders more than one product too. So, the next question is how to allocate or match the multi products purchase order to merchants which their product portfolio is various too. The scenario will be more complex when the system also adopts substitute and complementary products too. So, the research in developing virtual merchant is still challenging.

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