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The Effect of Brand Credibility to the Pricing of

New and Remanufactured Short Life-cycle Product **Shu-San Gan*,** 1

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, dwahjudi@petra.ac.id , julianaa@petra.ac.id , yopi.tanoto@petra.ac.id (*corresponding author) Abstract—Remanufacturing is one of the recovery process that has become significant among many attempts to mitigate the landfill exhaustion, especially from mountain of wastes that come from short life-cycle products disposal. However, remanufactured product are often perceived to have lower quality compared to the new one. There are misconception about remanufactured product and lack of knowledge about its characteristics. On the other hand, brand credibility is known to be able to increase product's perceived quality, decrease perceived risk, and hence decrease price sensitivity. This

paper investigates the effect of brand credibility to **the** 27

pricing decision, to maximize the profit of the retailer and **the** 14

manufacturer. We develop

pricing decision model for new and remanufactured short life-cycle product **in a closed- loop supply chain** consists of **a** manufacturer and **a** 2

retailer, where the manufacturer is a Stackleberg leader. We find that lower brand credibility would decrease the retail and wholesale

prices of new and remanufactured products, but does not affect **the** 19

sales volume significantly. Also, the speed of change of demand influences the optimum total profit,

as well as the time boundaries. **Keywords—** remanufacturing; **short life-cycle product;** 11

pricing; brand credibility

I. INTRODUCTION Due to the rapid development in technology **and** 24

research innovation, products' life-cycle has become shorter, especially for technology-based product such as electronics products. The period between launching a product and the introduction of newer model, newer design, or addition of new features has become shorter, and this has convinced customers

to buy new product even though **the** previous **one is still perfectly** functioning. Usually, in **the** 1

introduction phase, the product's demand would increase significantly, but when newer product or model is introduced, it would decrease rapidly. The demand characteristics of short life-cycle product is totally different from durable product. Therefore it is important to develop demand function that could capture the dynamics. Hsueh [1] claims that product life-cycle in electronic industry is getting shorter due to the high-speed technology advancement. Another examples are

mobile phones and computers, where **Lebreton and Tuma** [2] claim **that** they **have shorter innovation cycle, which** 1

leads to faster obsolescence of the previous model or earlier generation. The fact that product's life-cycle that becomes shorter has led to higher consumption of natural resources for raw material and more energy to manufacture new product. Furthermore, the disposal volume is also increasing due to the increased obsolescence, both functionally and desirability, when customers discard the current owned product and replace it with the new one. This situation has been a global concern where issues on sustainable development has become increasingly important. Recently, there are numerous attempt to study

closed-loop supply chain, which is a **study** that **is** 30

not only considering **forward chain but also the reverse** 22

chain. In the reverse chain, a used product is collected and sent for a recovery process and then put back to the market with higher value than its discarded stage. This approach could extend product's useful life and slower the disposal rate. There are several recovery processes i.e. repair, refurbishing, and remanufacturing [3]. Steinhilper [4] claims that

> **remanufacturing is the ultimate form of recycling,** where product **is** 17

recovered into one with a quality similar to the new product. Lund and Hauser [5], as well as Gray and Charter [6] argue that remanufacturing

> **is a process of transforming used product into** “like-new” **condition,** 1

where the value added during manufacturing is recaptured. Several studies show that one of the critical factors to ensure successful remanufacturing is durability of the product. However, Gan

> **et al.** [7] **show that** a **short life-cycle product is** 3

also suitable for remanufacturing, and doing so could be beneficial for the environment and yet maintaining profitability. Moreover, they

> **develop a framework for remanufacturing** a **short life-cycle** product. Pricing decision **is** 3

one of the important tasks in attempting to gain economic benefit from remanufacturing practices. Guide & Wassenhove [8] show that

> **there are three** main **activities in** a **reverse supply chain,** namely return management, **remanufacturing** 12

operations, and market development. They emphasize the importance of the business aspect such as profitability, product valuation, pricing and marketing issues. Atasu et al. [9] point out that remanufacturing could become an effective marketing strategy, where manufacturer perform price discrimination to protect its market share. Also, a proper pricing strategy developed based on the market composition could avoid cannibalization effect i.e. remanufactured product cannibalizes the sales of new product [10]. Similarly, Souza [11]

> **shows that** adding **remanufactured product to the market alongside with the new product could** expand the **market,** 1

but 978-1-5386-1887-5/17/$31.00 ©2017 IEEE on the other hand it could result in cannibalization, hence it is very critical to correctly decide the prices. Pricing decision model for remanufactured product has been widely studied. There are pricing models that consider remanufactured product as identical to the new product, hence they

are sold in the same market and **at the same price.** 5

Ferrer & Swaminathan [12] consider three planning horizon under monopoly and duopoly setting, which are infinite, two period, and multi period planning horizon. Qiaolun et al. [13]

not only consider **manufacturer, but also retailer and collector in** the **pricing** model **under** 1

the whole selling horizon. Shi et al. [14] use stochastic demand under single period planning horizon, and consider understocking as well as overstocking risks. Wei & Zhao [15] add another perspective, which is a competition between two retailer. Gao et al. [16] consider several power structure in the pricing game, which are manufacturer Stackelberg, retailer Stackelberg, and vertical Nash. They also investigate pricing decision given a price dependent demand and effort dependent one. There are also other studies that differentiate new and remanufactured products. These studies accommodate the situation where remanufactured product is perceived to have a lower quality hence should be given lower price. Atasu et al. [9] study manufacturer's pricing decision and consider green segment, market diffusion, and competition with other Original Equipment Manufacturer (OEM). Ferrer & Swaminathan [17] extend their previous work [12] and now differentiate new and remanufactured products. Ovchinnikov [18] adds customers' switching behavior in their pricing decision model under the whole selling horizon. Wu considers the pricing decision of OEM and remanufacturer, and consider level of interchangeability [19] and degree of disassemblability [20]. Chen & Chang (2013) [21] consider static unconstrained model, and then assume limited supply of used product (constrained model) under dynamic pricing. They treat new and remanufactured products as partially substitutable items. Since remanufactured product's raw material comes from returned used product, return management and acquisition price are important factors to ensure optimal remanufacturing operations. Therefore, collector's pricing decision is also important. Gan et al. [22] consider a pricing model that involves three supply chain's members i.e. manufacturer, retailer, and collector. They consider a short life-cycle product and the

effect of diffusion rate in a time-dependent demand. 1

Moreover, they extend the study by considering pricing decision under separate sales channel, where new product is offered in the retail store

and remanufactured product is sold **under manufacturer's direct channel** 1

[23]. Regardless of remanufacturing product's key feature which is a product

as good as the new one, remanufactured product is often perceived to 1

have lower quality compared to the new product [24],[25]. Gaur et al.[26] identify

environmental consciousness level, individual values, post-use perceptions, nature of purchase, and socio-cultural norms as main drivers for 6

purchase intentions through grounded theory-based interview. In addition, they indicate that price, brand, product quality, and service quality are the underlying factors behind customers' decision to purchase remanufactured products over new ones. van Weelden et al. [27] conducting

in-depth interviews with consumers of remanufactured and new mobile phones, 7

identify that misconception of remanufactured products, lack of awareness, lack of availability, and

lack of the thrill of newness as the 7

barriers for remanufactured mobile phones to be considered in the consideration phase. In addition, they find that personal, contextual, and product-related factors play important role during the evaluation phase. Wahjudi et al. [28] shows that product knowledge and purchase attitude have positive correlation with purchase intention. Perceived benefit and perceived risk do not directly correlate with purchase intention, but they correlate indirectly through purchase attitude. Erdem et al. [29] perform a survey and find empirically that brand credibility may decrease perceived risk and decrease information cost, also it may increase perceived quality. Furthermore, they show that brand credibility affects price sensitivity.

In this paper we would investigate the effect of brand credibility to the pricing of 9

new and remanufactured short life-cycle products. 2

II. OPTIMIZATION MODELING We consider

a closed-loop supply chain that consists of two members of the 5 supply chain, i.e. retailer and manufacturer, under the 26

selling horizon. Initially, manufacturer performs the production of new products, and customers can buy them via a retailer. After a particular period of time, customers start to sell end-of-use

products to the manufacturer. The used product 29

is then remanufactured and sent to the retailer. Now, customer

have the option to purchase a new or remanufactured product. Therefore, during the 2

selling horizon, both retailer and

manufacturer sells new and remanufactured products with different 16

time boundaries as shown in Fig. 1. The pricing decision model is developed under a Stackelberg power structure, where

manufacturer acts as the leader. We use the whole selling periods as the 20

planning horizon. The pricing game is started by manufacturer's move to issue initial wholesale prices. It is followed by retailer's move to find her optimum retail prices given the issued wholesale prices. The manufacturer is then adjust the wholesale prices to maximize her profit. In this model, we consider a single item short life-cycle product, which is typically prone

to obsolescence in function and/or desirability. This type of product 1

would have brief introduction, growth, and maturity phases, before declining. Product demand is constructed to cover the time frames according to the given time boundaries, and to allow price-dependent relation. Remanufactured short life-cycle

product is often considered to be inferior to its new counterpart and 1

customers' willingness to pay is typically lower for remanufactured short life-cycle product [[30]],[31]. Therefore, a remanufactured product usually is more sensitive to price changes, or is having higher price sensitivity index. However, brand credibility is empirically known to have a significant effect to price sensitivity [29], thus we introduce a brand credibility factor to the pricing model to study its impact to the overall pricing decision.

Notations: Decision Variables : new product's wholesale price : remanufactured product's wholesale price : new product's retail price : remanufactured product's retail price Parameters: : maximum price, the upper limit of customer's willingness to pay 1 : time when the remanufactured product is introduced to the market : time when the new product's demand attains its highest level 3 : time when the remanufactured product's demand attains its highest level : time when the demands 1

for both new and remanufactured products 2

end :

maximum possible demand for new product 0 : demand at the beginning of new product's introduction (when = 0) : speed of change in new product's demand : maximum possible demand for remanufactured product 0 : demand at the beginning of remanufactured product's introduction (when = 1) : speed of change in remanufactured product's demand : unit manufacturing cost for new product : unit remanufacturing cost for remanufactured product, 1

including the cost of buying used product : remanufactured product's brand credibility coefficient : brand credibility factor

The selling horizon consists of four periods, as in Gan et al. 1

[23], as shown in Fig. 1. In the first part [0, t1],

there are only new products in the market. For the 10

second [t1, ?] and third [?, t3], new and remanufactured products are both offered to the market. 1

In the fourth part [t3, T], new product is no longer offered, and only

remanufactured product exists **in the market. The** pattern **of** 25

potential demand for short life-cycle product is modified from Wang and Tung [32], and the governing

demand functions, for new and remanufactured product, **are** formulated **as** 18

follow: () = { 1() = 1+− ; 0 ≤ ≤ where = 0−1 2() = (−)+ ; ≤ ≤ 3; where = 1 + − (1) () = {2() = (−3)+ ; 3 ≤ ≤ ; where = 1 + h−(3−1) 1() = 1+h−(−1) ; 1 ≤ ≤ 3 ; where h = 0−1 (2) () is the demand pattern for new product and () is for remanufactured products. Total demand volumes during the selling horizon

can be determined **by integrating the demand** functions **with respect to time.** 1

= ∫0 1+− + ∫3

(−)+ = **1** ln **((1+**) **−)** 23

+ 1 ln ((3−)+) (3) = ∫13 1+h−(−1) + ∫3 (−3)+ = 1 ln ((1+h)−(3−1)) + 1 ln ((−3)+) (4) We introduce a brand credibility factor, which is inversely proportional to the customers' perceived brand credibility. It means the lower the brand credibility of the product, the higher the factor value. Erdem et al. [29] shows that value of credibility has a linear relationship with product price, therefore we use linear factor to represent brand credibility factor to the demand. Accordingly, the

demand functions become: Demand of new product during[1

0, 3]: (1 −) (5) Demand of remanufactured product during[1,]: (1 −) (6) Under a symmetrical information setting, both retailer and manufacturer share the demand information. Retailer finds her optimum

retail prices (**for new product, and** for **remanufactured product)** 21

that maximize her profit. Based on retailer's optimum prices, manufacturer is then find the wholesale prices (,) that maximize manufacturer's profit. Considering the product has short life-cycle, we assume remanufacturing process is only applied to 1

used product that is originated from new product, hence remanufacturing is only applied one time during the whole product's life.

Since this study is focusing on pricing decision, we do not make an attempt to show detailed derivation of production and operational costs, and instead treat those costs as given parameters, which consist of unit manufacturing cost for new product (), and unit manufacturing cost (). Unit manufacturing cost includes raw material, manufacturing cost, etc. Unit remanufacturing cost includes cores' acquisition, collecting cost, remanufacturing cost, etc. Optimization Models Retailer's Optimization 1

Given manufacturer's initial wholesale prices, and , retailer's optimization

model is constructed to find retail prices that maximize retailer's profit 2

ma,x Π = (1 −) · (−) + (1 −) · (−) (7) First order conditions are Π (−2 + +)2 + (2 −) = = 0 (8) Π (−2 + +) = 0 = (9) Π is concave with respect to retail prices, therefore optimum prices can be found by solving (8) and (9), i.e. Demand t1 ? t3 T time Fig.

1. Demand pattern of a product with gradual obsolescence over time 1

2 3 − ((+) + 4) 2 2 = 0 + 4 = 12 (+) (10) (11) Manufacturer's Optimization ma,x Π = (1 −) · (−) + (1 −) · (−) (12) subject to (10), (11), and 0 ≤ ≤ ≤ , 0 ≤ ≤ ≤ , ≤ , ≥ , ≥ Due to the optimization problem's complexity, we use a computational approach and use Matlab to find the optimum prices. III. RESULT AND DISCUSSION Numerical Example In this numerical example, the parameters are taken from [23]. Demand capacity parameters for new product are = 1,000, 0 = 90, and demand capacity parameters for remanufactured product are = 500, 0 = 50. The speed of change in demands are = 0.05, = 0.05.

Selling horizon is divided into four time frames where t1=1, ?=2, t3=3, and T=4. The unit manufacturing cost for new product cn=2,500, unit remanufacturing cost cr=1,800, maximum price is Pm=12,000. The initial wholesale prices are 6000 and 1

4000. The brand credibility factor and remanufactured product's brand credibility coefficient will be varied to study their effects to the pricing decision. The decision variables are , and , which represent the retail price of new product, retail price of remanufactured product, wholesale price of new product, and wholesale price of remanufactured product. 1

a. The effect of brand credibility In order to observe the effect of brand credibility, brand credibility factor () and remanufactured product's brand credibility coefficient () values are varied as follows: =[1,1.1,1.2,1.3], = [1,1.1,1.2]. The optimization results can be seen in Table 1. The results show

that the higher the brand credibility factor (which means the lower brand credibility in the 15

market), the lower profit of both retailer and manufacturer. The effect is significantly recognized in the lower prices, both

new and remanufactured, wholesale and retail prices. Interestingly, the new 13

product's sales quantity is least affected. It is also observed that despite the shared prices decrease, the percentage of relative decrease is bigger for remanufactured products prices compared to new products'. The average relative decreases are 8.17%, 6.64%, 14.66%, 12.94% for new retail price, new wholesale price, remanufactured retail price, and remanufactured wholesale price. On the other hand, the relative decrease of profit is almost the same for manufacturer and retailer, i.e. 15.55% and 16.06% respectively. The effect of remanufactured product's brand credibility coefficient can be seen in Table 1 as well. The remanufactured prices are the ones most affected, with relative decreases 8.40% and 7.39% for retail and wholesale prices, on average. As for new product retail price, the relative decrease is relatively small, which is 0.40%. However, new product wholesale price is unexpectedly increasing even though the relative increase is very small i.e. 0.18%. Also, the sales of new product is increasing with average relative increase as much as 1.98%.

b. Sensitivity analysis for time boundaries There are four time boundaries 1

that are varied as follow: 1 = [1,1.25,1.5,1.75], = [2,2.25,2.5,2.75], 3 = [3,3.25,3.5,3.75], and = [4,4.25,4.5,4.75]. Table 2 shows the optimization results. When 1 is increasing, that implies that

time to introduce remanufactured product is delayed, and it would decrease 1

both retailer's and manufacturer's profit. The sales quantity of new product is increasing, but since new product's price becomes lower, total 1

profit is decreasing. As for the second and third time boundaries, which are time of

new and remanufactured products reach the peak demand, and 31

3, extending them would increase the total supply chain profit as well as individual profits. As expected, the sales quantity of new product is increasing when is increasing and similarly remanufactured product when 3 is increasing. The least effect observed when we extend T, the time when remanufactured product demand is diminishing. The wholesale prices are not much affected by the changing in time boundaries. In addition, brand credibility does not significantly affect time boundaries' changes. c. Sensitivity analysis for demand's speed of change

In order to study the effect of demand's speed of change, and 1

, we varied , = [0.01,0.05,0.1,0.2]. Table 3 shows the optimization results. The highest profit is attained at 0.05.

This result shows that increasing speed of change in demand does not always increasing the profit. 1

The lower the brand credibility, which means the higher brand credibility factor, the sales quantity is decreasing as well as the profits. While the first three values (0.05, 0.01, 0.1) show decreasing rate along with lower brand credibility, the last value, 0.2, shows an exception. The percentage of decrease is 8.93% when brand credibility factor is increasing from 1 to 1.2, then 8.12% from 1.1 to 1.2, and 9.45% from 1.2 to 1.3. It appears that for higher speed of change the effect of brand credibility becomes more significant. IV.

CONCLUSION This paper studies the effect of 28

brand credibility to the pricing decision of

new and remanufactured short life-cycle products in a closed-loop supply chain. We develop a 2

pricing decision model involving brand credibility factor (which is inversely proportional to the factual brand credibility), and the optimization is conducted under Stackelberg pricing game with manufacturer as the leader. The results show that

1

lower brand credibility could increase price sensitivity and hence decrease the sales quantity and the profits. As for the effect of time boundaries, the most crucial

is the time to introduce remanufactured product, and the

8

least

is the time when demand of remanufactured product

8

ends where brand credibility effect is not significant. The speed of change in demand influence pricing decision, when it reach a higher value, the effect of brand credibility becomes more significant.

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[31] Subramanian, R., Subramanyam, R., Key Factors in the Market for Remanufactured Products, Manufacturing and Service Operations Management, 2011, pp.1-31. [32] Wang, K.-H., Tung, C.-T., Construction of a Model towards EOQ and Pricing Strategy for Gradually Obsolescent Products, Applied Mathe- matics and Computing, 217(16), 2011, pp.6926–6933. Table 1. Numerical example's result – brand credibility factor b g Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 1 1 10,010.05 8,283.40 7,160.40 6,556.75 2,405,395.59 1,263,036.99 3,668,432.58 336.71 175.79 1 1.1 9,112.54 6,938.78 6,638.91 5,593.44 2,011,823.96 1,049,809.35 3,061,633.31 334.39 165.50 1 1.2 8,369.89 5,917.85 6,201.97 4,860.80 1,698,048.66 880,820.62 2,578,869.28 330.99 154.45 1 1.3 7,745.09 5,124.07 5,830.49 4,290.38 1,443,561.69 744,586.82 2,188,148.51 326.80 142.61 1.1 1 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 169.47 1.1 1.1 9,076.21 6,336.90 6,650.05 5,172.81 1,949,223.29 1,011,791.62 2,961,014.92 341.15 158.16 1.1 1.2 8,338.80 5,412.45 6,211.00 4,507.63 1,646,954.87 849,788.35 2,496,743.22 337.30 145.97 1.1 1.3 7,718.00 4,693.40 5,837.84 3,989.59 1,401,688.11 719,176.58 2,120,864.69 332.76 132.89 1.2 1 9,930.44 6,949.53 7,185.58 5,623.69 2,265,131.33 1,177,681.12 3,442,812.45 350.18 163.28 1.2 1.1 9,045.73 5,838.00 6,659.06 4,823.18 1,898,708.75 980,903.15 2,879,611.90 346.82 150.92 1.2 1.2 8,312.63 4,993.34 6,218.24 4,214.03 1,606,056.41 824,792.39 2,430,848.80 342.62 137.58 1.2 1.3 7,695.10 4,336.13 5,843.66 3,739.52 1,368,556.27 698,954.22 2,067,510.49 337.80 123.26 Note: 'sales 1': total sales of the new product, 'sales 2': total sales of the remanufactured product Table 2. Sensitivity analysis for time boundaries t1 Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 1 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 169.47 1.25 9,923.31 7,532.05 7,184.55 6,042.91 2,272,321.45 1,182,156.11 3,454,477.57 351.39 147.59 1.5 9,880.32 7,510.47 7,194.54 6,038.83 2,217,904.74 1,148,736.77 3,366,641.51 358.66 126.01 1.75 9,837.73 7,489.15 7,204.25 6,034.91 2,164,689.82 1,115,821.76 3,280,511.58 365.87 104.74 miu Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 2 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 169.47 2.25 9,928.68 7,534.75 7,183.29 6,043.43 2,553,470.45 1,329,121.83 3,882,592.28 392.66 168.38 2.5 9,899.12 7,519.43 7,191.37 6,039.66 2,777,763.30 1,441,170.00 4,218,933.30 440.66 167.58 2.75 9,874.26 7,507.43 7,195.93 6,038.26 2,997,774.91 1,551,641.84 4,549,416.75 487.84 166.79 t3 Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 3 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 137.58 3.25 10,007.68 7,574.59 7,164.44 6,051.29 2,386,315.95 1,250,971.80 3,637,287.75 337.84 190.64 2.5 10,048.25 7,595.13 7,154.52 6,055.49 2,444,061.66 1,285,339.91 3,729,401.56 331.55 211.70 2.75 10,087.40 7,615.01 7,144.81 6,059.64 2,500,078.45 1,318,491.25 3,818,569.69 325.38 232.12 T Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 4 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 129.98 4.25 9,968.20 7,554.65 7,173.93 6,047.31 2,329,896.92 1,217,250.56 3,547,147.48 343.79 170.23 4.5 9,969.44 7,555.28 7,173.64 6,047.43 2,331,492.92 1,218,219.46 3,549,712.38 343.58 170.86 4.75 9,970.49 7,555.81 7,173.39 6,047.53 2,332,849.08 1,219,042.47 3,551,891.55 343.41 171.39 Note: ‘sales 1’: total sales of the new product, ‘sales 2’: total sales of the remanufactured product Table 3. Sensitivity analysis for demand’s speed of change lmb nu g Pn* Pr* Pnw* Prw* Profit M Profit R Total Profit sales 1 sales 2 0.01 0.01 1 9,947.48 7,544.21 7,178.86 6,045.26 2,267,507.28 1,182,401.60 3,449,908.87 341.92 157.29 0.01 0.01 1.1 9,061.04 6,330.04 6,653.34 5,171.62 1,901,415.72 985,390.07 2,886,805.79 338.64 146.79 0.01 0.01 1.2 8,326.74 5,407.52 6,213.35 4,506.90 1,608,782.46 828,910.09 2,437,692.55 334.48 135.48 0.01 0.01 1.3 7,708.40 4,689.83 5,839.50 3,989.16 1,370,988.95 702,562.22 2,073,551.17 329.68 123.34 0.05 0.05 1 9,966.70 7,553.90 7,174.29 6,047.16 2,327,957.35 1,216,073.10 3,544,030.44 344.05 169.47 0.05 0.05 1.1 9,076.21 6,336.90 6,650.05 5,172.81 1,949,223.29 1,011,791.62 2,961,014.92 341.15 158.16 0.05 0.05 1.2 8,338.80 5,412.45 6,211.00 4,507.63 1,646,954.87 849,788.35 2,496,743.22 337.30 145.97 0.05 0.05 1.3 7,718.00 4,693.40 5,837.84 3,989.59 1,401,688.11 719,176.58 2,120,864.69 332.76 132.89 0.1 0.1 1 9,967.19 7,554.14 7,174.18 6,047.21 2,318,950.58 1,211,421.47 3,530,372.04 342.54 169.02 0.1 0.1 1.1 9,076.59 6,337.08 6,649.97 5,172.84 1,941,609.01 1,007,880.25 2,949,489.26 339.67 157.73 0.1 0.1 1.2 8,339.11 5,412.58 6,210.94 4,507.64 1,640,463.78 846,469.56 2,486,933.34 335.84 145.58 0.1 0.1 1.3 7,718.24 4,693.49 5,837.80 3,989.60 1,396,117.35 716,340.54 2,112,457.89 331.33 132.54 0.2 0.2 1 9,966.87 7,553.98 7,174.25 6,047.17 2,309,829.83 1,206,621.89 3,516,451.72 341.31 168.22 0.2 0.2 1.1 9,076.34 6,336.96 6,650.02 5,172.82 1,934,019.82 1,003,914.03 2,937,933.85 338.44 156.99 0.2 0.2 1.2 8,338.91 5,412.49 6,210.98 4,507.63 1,634,089.16 843,160.54 2,477,249.70 334.62 144.89 0.2 0.2 1.3 7,550.52 4,508.70 5,736.54 3,856.41 1,326,646.52 679,581.67 2,006,228.19 328.66 127.85 Note: ‘sales 1’: total sales of the new product, ‘sales 2’: total sales of the remanufactured product