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Research Paper

Comparing Two Inspection Policies for an EOQ Model with Imperfect Quality Items under Inspection Errors

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Abstract

This article investigates the effect of two inspection policies on an EOQ model with imperfect quality items, where defective and non-defective items have different holding costs. In this regard, the inventory system should decide to adopt a full inspection or no inspection policy. When no inspection policy is conducted, the presence of defective items is ignored. As a result, the additional reputation damage cost incurs to the system. On the contrary, if a full inspection process is instituted to ensure the delivery of serviceable items to customers, the cost associated with the inspection process grows. Besides, we assume an erroneous inspection process to consider more practical situations. In other words, the inspector may commit type I and II errors. For both policies, we obtain the order size, which maximizes the total profit per unit time by analytical method. Finally, a numerical example is presented to discuss the advances of inspection policies to each other. We examine the desirable range of the fraction of imperfect quality items for each policy, then analyze which cost components make it.

Keywords: Inventory System, Economic Order Quantity, Different Holding Costs, Full Inspection, No Inspection, 100% Inspection.

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1. Introduction

Traditional inventory models determine the lot-sizing policy, which balances ordering/setup cost and holding cost. These models assume that there are no defective items in the order or production lot. In practice, it rarely occurs for several reasons, such as a deteriorating production process, inspection errors, natural disasters, etc. therefore, in recent decades, many researchers have been making efforts to extend traditional inventory models by relaxing this assumption. In one of the pioneering studies of this research line, Salameh and Jaber (2000) introduced an EOQ model in which a fraction of received items are of imperfect quality [1]. A full inspection process is instituted to recognize these items, and at the end of it, defective items are sold at a discounted price. Chiu (2008) obtained the optimal production run time for an EPQ model with a random defective rate and machine breakdown [2]. Besides, defective items are repaired through a rework process that begins upon the end of the regular production process or the restoration of the machine. Kazemi et al. (2010) proposed a fuzzy economic order quantity model with imperfect quality items. In this work, shortages are also allowed and are completely backorders. Hsu and Hsu (2012), presented an EOQ model with imperfect quality items and permissible backorder [3-7]. In this stream of literature, incorporating more practical terms such as different holding cost and inspection errors in inventory problems has been a significant concern among researchers. De et al. (2018) developed an EPQ model with stock-dependent demand whose production process shifts to out-of-control state in a random time and works to a defective rate. Moreover, the defective rate is a function of production rate, time, and the deterioration time of production process [4-8].

It is clear that non-defective items are more expensive than defective items; therefore, in a real-world manufacturing setting, they are often maintained in a different warehouse that has more holding cost. Hereupon, Hayek and Salameh (2001) studied an EPQ model with a random defective rate in which defective items are reworked after the regular production process. Besides, the holding cost of non-defective and defective items differs. Tsai (2012) considered an inventory model with recoverable items whose recycling process rate can be improved due to the learning effect. He assumed that the holding cost of non-defective items is much more than recoverable items. In this regard, Khanna et al. (2017) investigated the impact of trade credit on an EPQ model with a deteriorating production and rework process. They also considered different holding cost for non-defective and reworked items [9-11].

During the last decade, a substantial number of studies have dealt with the consideration of inspection errors in inventory models with imperfect quality items. The occurrence of inspection errors is inevitable for reasons such as human errors, non-calibrated tools, etc. Khan et al. (2011) proposed an economic order quantity model with imperfect quality items in which inspectors may commit inspection errors in recognizing the quality of items. Hsu and Hsu (2014) extended Khan et al. (2011) model for a case where backorders are allowed. Mokhtari and Asadkhani (in press) suggested an EOQ model with imperfect items under an error-prone inspection process. They also considered an error-free supplementary inspection process which prevents delivering defective items more than one time to customers. Rout et al. (2019) addressed an EPQ model with imperfect quality items and a fuzzy deteriorating rate in which the inspection process is imperfect. In addition, recognized defective items are reworked at the end of the regular production process [8-12].

All aforementioned studies have provided novel features to this context; however, all of them implicitly assumed the proportion of imperfect quality items is so much that a full inspection process should be performed. In these studies, full inspection will incur inspection and inspection errors cost to the inventory system, and in return, minimizes the delivery cost of defective items to customers. When the inventory system ignores the inspection process, there is no inspection and inspection errors cost, and in return, the delivery cost of defective items to customers is maximized[13-19]. We aim to conduct a comparative study for an EOQ model with imperfect quality items that investigates two alternative policies: (i) full inspection and (ii) no inspection. Besides, we consider different holding cost for non-defective and defective items, and in the full inspection policy, the inspection process is erroneous. Engineering inspection is one of the most important parts of engineering and is used in various fields. Using different policies can help different industries to improve quality and provide better services [20-27].

The remainder of this article is organized as follows. Section 2 provides the notations and assumptions and formulates two EOQ models for two inspection policies. In section 3, we present a numerical example to compare the cost-efficiency of two inspection policies in different situations. Finally, section 4 summarizes this study and draws conclusions based on all recent researches [28-34].

2. Model Description

2.1. Notations and Assumptions

The following notations are used throughout this study.

Parameters and variables	
y	The order size (decision variable)
D	The demand rate per unit time
k	The ordering cost per order
C	The variable purchasing cost per item
h_1	The holding cost of non-defective items per item per unit time
h_2	The holding cost of defective items per item per unit time
S	The selling price of a non-defective item
V	The selling price of a defective item
p	The fraction of imperfect quality items
α	The type I error probability
β	The type II error probability
$f(p)$	The probability density function of p
$f(\alpha)$	The probability density function of α
$f(\beta)$	The probability density function of β
x	The inspection rate per unit time
d	The inspection cost per item
c_a	The cost of accepting a defective item
c_r	The cost of rejecting a non-defective item
t_1	The inspection time per cycle
T	The inventory cycle length
B_1	The number of items that are classified as non-defective per cycle
B_2	The number of defective items that are returned per cycle
$\mathrm{E}[*]$	The expected value
$TP(y)$	The total profit per cycle
$TPU(y)$	The total profit per unit time
$TR(y)$	The total revenue per cycle
$TC(y)$	The total cost per cycle

We apply the following assumptions for establishing the inventory models.

- A single stage with a single item inventory system is considered.
- The demand rate is deterministic, known, and continuous. Besides, all of it should be satisfied.
- Lead time is negligible, and replenishment is accomplished instantaneously.

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- Order lot contains a fraction of defective items, which is regarded as a random variable.
- On imperfect quality items, the inventory system can decide to conduct a full inspection process or ignore these items.

2.2. Description and Formulation

2.2.1. Case 1: Full Inspection Policy

We formulate an economic order quantity model with imperfect quality items that applies a full inspection process in order to separate defective items. Moreover, the inspection process is error-prone, and different holding costs are assumed for non-defective and defective items. Figure 1 depicts the inventory level over time for the full inspection policy. In this case, the inventory system places an order lot of y size, to meet the demand rate D. This batch contains the fraction of defective items p, which is a random variable with a known probability density function $f(p)$. Upon receiving the batch, a 100% or full inspection process will be conducted to recognize these items. The inspection process works to a predetermined inspection rate x items per unit time, so the inspection time per cycle t_1 is equal to y/x. Moreover, the inspection process is erroneous that results in two types of inspection errors. Type I error occurs when an inspector recognizes non-defective items as defective. Type II error also occurs when the inspector recognizes defective items as non-defective. α and β, respectively, denote type I and II error probability. Similarly, $f(\alpha)$ and $f(\beta)$, are the probability density functions of α and β.

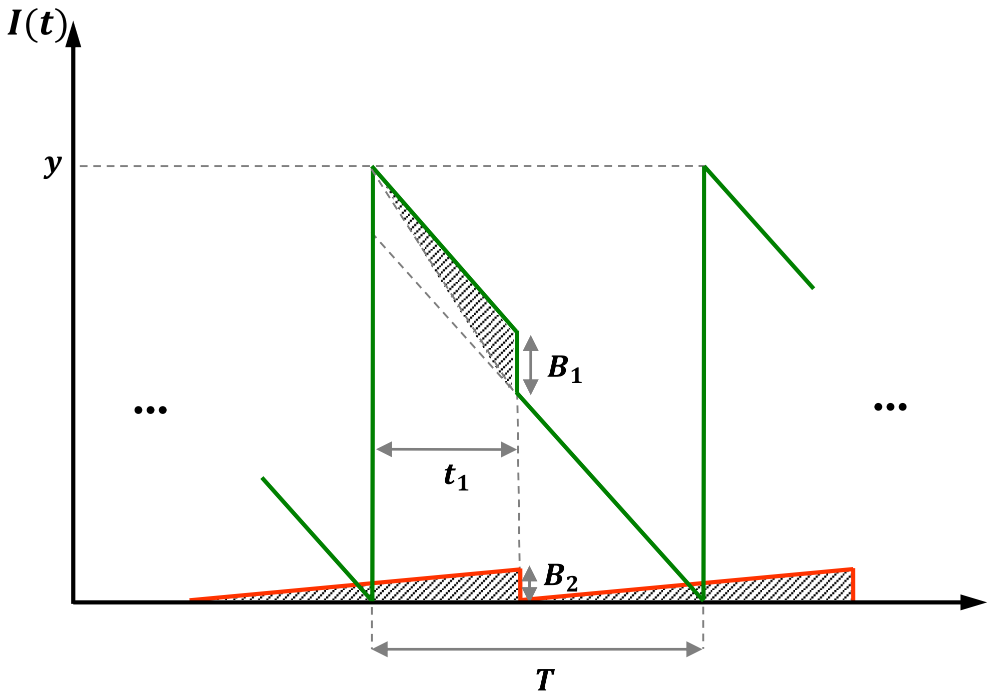

Figure 1: The inventory level over time for full inspection policy

Let us divide the output of the inspection process into three batches: Batch B_1: defective items, which include right and wrong defective items. These items are sold altogether at discounted price V at the end of the inspection process. Batch B_2: wrong non-defective items, which are delivered to customers, and they return these items to replace with non-defective items. These items are also sold at the same time as items in batch B_1 at V price. Batch B_3: right non-defective items, which are sold at S

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price to customers during the cycle ($S > V$). The quantity of these items is obtained as follows:

$$B_1 = y\alpha(1-p) + yp(1-\beta) \tag{1}$$

$$B_2 = yp\beta \tag{2}$$

$$B_3 = y(1-p)(1-\alpha) \tag{3}$$

On the other hand, only items in batch B_3 can be used to meet the demand. So the cycle length T is computed as:

$$T = \frac{y(1-p)(1-\alpha)}{D} \tag{4}$$

To avoid shortages, two conditions should be satisfied: First, items in batch B_3: can be at least equal to the demand in each cycle. Second, the inspection rate must be high enough that items in batch B_3 can meet demand during the inspection process. Hence, we can write:

$$y(1-UB_1)(1-UB_2) \geq DT \tag{5}$$

$$x(1-UB_1)(1-UB_2) \geq D \tag{6}$$

Where UB_1 and UB_2 are the upper bound of the probability density functions of p and α. Now we intend to determine the order size that maximizes the total profit per unit time $TPU(y)$. In this regard, the total revenue per cycle $TR(y)$ includes sales revenue of items in B_1, B_2, and B_3 batches with their associated prices. The total revenue is calculated as follows:

$$TR(y) = Sy(1-p)(1-\alpha) + Vy[\alpha(1-p) + p] \tag{7}$$

The total cost per cycle $TC(y)$ involves procurement, inspection, inspection errors, and holding cost. The procurement cost is equal to the sum of the ordering and purchasing cost. Inspection errors cost is related to the rejection of non-defective items, and the acceptance of defective items by the inspector. Note that holding cost is calculated based on Figure 1; hatched parts are relegated to defective items after recognizing, and remaining parts identify non-defective items. Thus:

$$\begin{aligned} TC(y) = k + Cy + dy + y\alpha c_r(1-p) + yp\beta c_a + \frac{h_1 y^2 \beta p(1-p)(1-\alpha)}{2D} \\ + \frac{h_1 y^2 (1-p)^2(1-\alpha)^2}{2D} + \frac{h_1 y^2 \alpha(1-p)}{2x} + \frac{h_1 y^2 p(1-\beta)}{2x} \\ + \frac{h_2 y^2 \alpha(1-p)}{2x} + \frac{h_2 y^2 p(1-\beta)}{2x} + \frac{h_2 y^2 \beta p(1-p)(1-\alpha)}{2D} \end{aligned} \tag{8}$$

Where k, C, and d respectively describe the ordering cost per order, the variable purchasing cost per item, and the inspection cost per item. Besides, c_a and c_r correspond to the cost of accepting a defective item and the cost of rejecting a non-defective item. We also consider different holding costs of h_1 and h_2 to represent the holding cost of non-defective items per item per unit time and the holding cost of defective items per item per unit time. By subtracting $TR(y)$ from $TC(y)$, the total profit per cycle $TP(y)$ is obtained as:

$$\begin{aligned} TP(y) = Sy(1-p)(1-\alpha) + Vy[\alpha(1-p) + p] - k - Cy - dy - y\alpha c_r(1-p) - yp\beta c_a \\ - \frac{h_1 y^2 \beta p(1-p)(1-\alpha)}{2D} - \frac{h_1 y^2 (1-p)^2(1-\alpha)^2}{2D} - \frac{h_1 y^2 \alpha(1-p)}{2x} \\ - \frac{h_1 y^2 p(1-\beta)}{2x} - \frac{h_2 y^2 \alpha(1-p)}{2x} - \frac{h_2 y^2 p(1-\beta)}{2x} \\ - \frac{h_2 y^2 \beta p(1-p)(1-\alpha)}{2D} \end{aligned} \tag{9}$$

Using the renewal reward theorem, the expected total profit per unit time $E[TPU(y)]$ can be expressed as:

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$$E[TPU(y)] = \frac{E[TP(y)]}{E[T]} \tag{10}$$

We can replace $TP(y)$ and T with relationships 9 and 4. So:

$$\begin{aligned} E[TPU(y)] = {} & SD + \frac{VDE[p]}{(1-E[p])(1-E[\alpha])} + \frac{VDE[\alpha]}{1-E[\alpha]} - \frac{kD}{y(1-E[p])(1-E[\alpha])} \\ & - \frac{CD}{(1-E[p])(1-E[\alpha])} - \frac{dD}{(1-E[p])(1-E[\alpha])} - \frac{DE[\alpha]c_r}{1-E[\alpha]} \\ & - \frac{DE[p]E[\beta]c_a}{(1-E[p])(1-E[\alpha])} - \frac{h_1 yE[\beta](E[p]-E[p^2])}{2(1-E[p])} \\ & - \frac{h_1 yE[(1-p)^2]E[(1-\alpha)^2]}{2(1-E[p])(1-E[\alpha])} - \frac{h_1 yDE[\alpha]}{2x(1-E[\alpha])} - \frac{h_1 yDE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} \\ & - \frac{h_2 yDE[\alpha]}{2x(1-E[\alpha])} - \frac{h_2 yDE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} - \frac{h_2 yE[\beta](E[p]-E[p^2])}{2(1-E[p])} \end{aligned} \tag{11}$$

By taking the first derivative and the second derivative of $E[TPU(y)]$ with respect to y, we have:

$$\begin{aligned} \frac{\partial E[TPU(y)]}{\partial y} = {} & \frac{kD}{y^2(1-E[p])(1-E[\alpha])} - \frac{h_1 E[\beta](E[p]-E[p^2])}{2(1-E[p])} \\ & - \frac{h_1 E[(1-p)^2]E[(1-\alpha)^2]}{2(1-E[p])(1-E[\alpha])} - \frac{h_1 DE[\alpha]}{2x(1-E[\alpha])} - \frac{h_1 DE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} \\ & - \frac{h_2 DE[\alpha]}{2x(1-E[\alpha])} - \frac{h_2 DE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} - \frac{h_2 E[\beta](E[p]-E[p^2])}{2(1-E[p])} \end{aligned} \tag{12}$$

$$\frac{\partial^2 E[TPU(y)]}{\partial y^2} = -\frac{2kD}{y(1-E[p])(1-E[\alpha])} \tag{13}$$

Accordingly, $E[TPU(y)]$ is a concave function, and there is a unique and global optimum for order size. It can be determined by setting the first derivative of $E[TPU(y)]$ to zero:

$$y^* = \sqrt{\frac{kD}{[(1-E[p])(1-E[\alpha])]\left[\frac{h_1 E[\beta](E[p]-E[p^2])}{2(1-E[p])} + \frac{h_1 E[(1-p)^2]E[(1-\alpha)^2]}{2(1-E[p])(1-E[\alpha])} + \frac{h_1 DE[\alpha]}{2x(1-E[\alpha])} + \frac{h_1 DE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} + \frac{h_2 DE[\alpha]}{2x(1-E[\alpha])} + \frac{h_2 DE[p](1-E[\beta])}{2x(1-E[p])(1-E[\alpha])} + \frac{h_2 E[\beta](E[p]-E[p^2])}{2(1-E[p])}\right]}} \tag{14}$$

2.2.2. Case 2: No Inspection Policy

In this case, upon receiving the order lot items, the inventory system delivers these items to customers regardless of the presence of defective items. In other words, they adopt a no inspection policy as the inspection policy. Figure 2 depicts the inventory level over time for the no inspection policy. We can divide consumed items into two batches: Batch B_4: defective items that are delivered to customers, and similar to case 1, they return these items to replace with non-defective items. These items are sold altogether at V price at the end of the cycle. Batch B_5: Non-defective Items that are Sold at S Price. The quantity of these items can be obtained as follows:

$$B_4 = yp \tag{15}$$

$$B_5 = y(1-p) \tag{16}$$

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It is clear that only items in batch B_5 can be used to meet demand. Therefore:

$$T = \frac{y(1-p)}{D} \tag{17}$$

The shortages are not permitted, so items in batch B_5 must be more than the demand over a cycle, which means:

$$y(1-UB_1) \geq DT \tag{18}$$

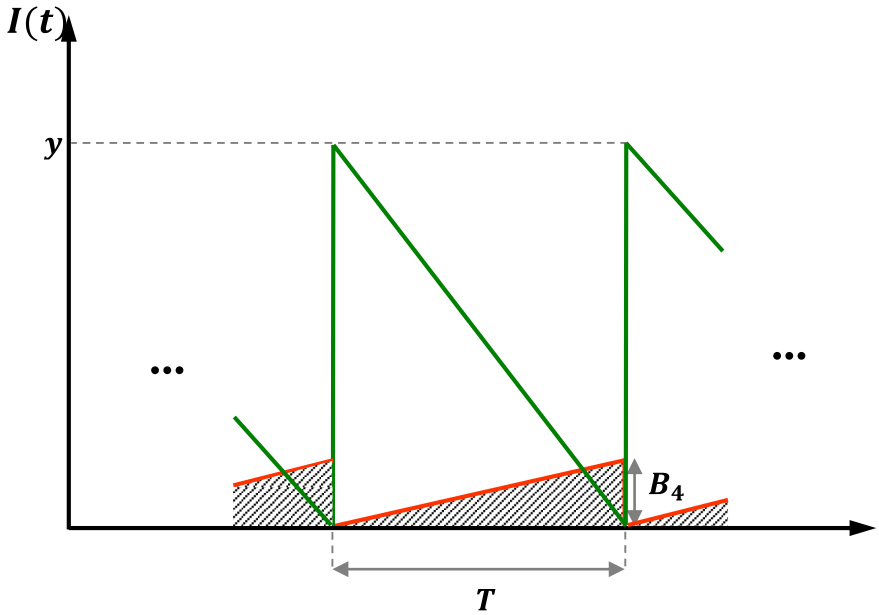

Figure 2: The inventory level over time for no inspection policy

Total revenue per cycle involves sales revenue of items of B4 and B5 batches at their associated prices. Total revenue is given by:

$$TR(y) = Sy(1-p) + Vyp \tag{19}$$

The total cost per cycle $TC(y)$ involves procurement, reputation damage, and holding cost. The procurement and holding cost are computed similar to the full inspection policy. Obviously, there is no inspection and inspection error cost, while reputation damage cost is the same as the cost of accepting defective items owing to type II error. Thus:

$$TC(y) = k + Cy + ypc_a + \frac{h_1 y^2(1-p)}{2D} + \frac{h_2 y^2 p(1-p)}{2D} \tag{20}$$

By subtracting $TR(y)$ from $TC(y)$, the total profit per cycle $TP(y)$ is obtained as:

$$TP(y) = Sy(1-p) + Vyp - k + Cy + ypc_a + \frac{h_1 y^2(1-p)}{2D} + \frac{h_2 y^2 p(1-p)}{2D} \tag{21}$$

Using the renewal reward theorem, and replacing $TP(y)$ and T with relationships 21 and 17, we can calculate the expected total profit per unit time as follows:

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$$E[TPU(y)] = SD + \frac{VDE[p]}{1-E[p]} - \frac{kD}{y(1-E[p])} - \frac{CD}{1-E[p]} - \frac{DE[p]c_a}{1-E[p]} - \frac{h_1 y}{2} - \frac{h_2 y(E[p]-E[p^2])}{2(1-E[p])} \tag{22}$$

By taking the first derivative and the second derivative of $E[TPU(y)]$ with respect to y, we have:

$$\frac{\partial E[TPU(y)]}{\partial y} = \frac{kD}{y^2(1-E[p])} - \frac{h_1}{2} - \frac{h_2(E[p]-E[p^2])}{2(1-E[p])} \tag{23}$$

$$\frac{\partial^2 E[TPU(y)]}{\partial y^2} = -\frac{2kD}{y(1-E[p])} \tag{24}$$

Accordingly, $E[TPU(y)]$ is a concave function, and there is a unique and global optimum for order size. It can be determined by setting the first derivative of $E[TPU(y)]$ to zero:

$$y^* = \sqrt{\frac{kD}{[1-E[p]]\left[\frac{h_1}{2} + + \frac{h_2(E[p]-E[p^2])}{2(1-E[p])}\right]}} \tag{25}$$

3. Numerical Results

In this section, we deal with determining the inspection policy, which is more profitable for different values of parameter p (the fraction of defective items). The following parameters are adopted in this numerical example:

$D = 50000$ item per unit time,

$k = \$100$ per order,

$C = \$25$ per item,

$S = \$50$ per item,

$V = \$20$ per item,

$h_1 = \$20$ per item per unit time,

$h_2 = \$5$ per item per unit time,

$x = 175200$ item per unit time,

$d = \$0.5$ per item,

$c_a = \$500$ per item,

$c_r = \$100$ per item,

$$f(p) = \begin{cases} \frac{1}{b-a} & a < p < b \\ 0 & O.W. \end{cases},$$

$$f(\alpha) = \begin{cases} 20 & 0 < \beta < 0.05 \\ 0 & O.W. \end{cases},$$

$$f(\beta) = \begin{cases} 20 & 0 < \beta < 0.05 \\ 0 & O.W. \end{cases}.$$

One of the most important questions that managers and practitioners have to answer in this context is that in which range the value of defective items can be considered negligible; In other words, when

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the inventory system can ignore instituting the inspection process. In order to compare the performance of two proposed inspection policies, we need to change the values of parameter p. Since this parameter follows a uniform distribution on $[a, b]$; we set a and b so that $E[p]$ changes between 0 and 2%. Figure 3 illustrates the optimal total profit per unit time for the full inspection and no inspection policies when $E\ [p]$ increases in its variation range. As can be seen, when the fraction of defective items is less than 0.65%, no inspection policy should be implemented. Also, as soon as this parameter exceeds 0.65%, the inventory system must adopt a full inspection policy. Obviously, when there are no defective items in the order lot, the no inspection policy is much more cost-efficient. However, as this parameter increases, the optimal total profit per unit time for no inspection policy drops dramatically, and for full inspection policy decreases gradually.

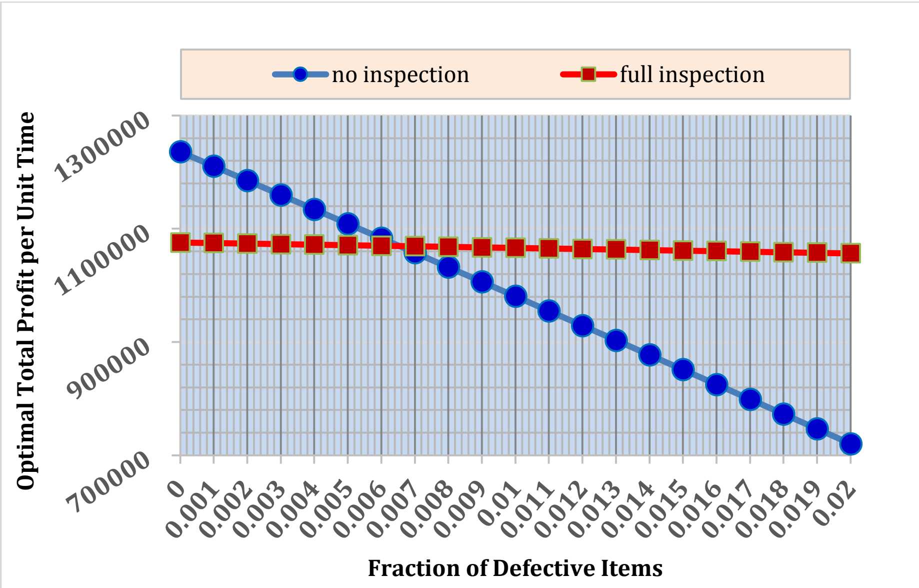

Figure 3: The impact of parameter p on optimal total profit per unit time for inspection policies

Now, we aim to discuss the cause of the sharp drop in the optimal total profit per unit time for the no inspection policy. Table 1 reports the profit components for both policies in the variation range of parameter p. The last row of this table express the difference of each component for $E[p] = 0$ and $E[p] = 0.02$. Accordingly, the total revenue for both policies remains almost steady, while the total cost for the no inspection policy increases strongly. So we can conclude that this significant increase leads to a steep fall in profit. On the one hand, the procurement cost for no inspection climbs almost as much as full inspection, while the holding costs show a slight growth for both policies. On the other hand, it is observed that the reputation damage cost for no inspection rises impressively, although the cost associated with the inspection for the full inspection, comprising inspection and inspection errors cost, increases considerably lower. Therefore, the reputation damage cost plays a determinant role in the supremacy of full inspection policy when E[p] is greater than 0.65%.

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Table 1: the components of optimal total profit per unit time for the variation range of $E[p]$ in two inspection policies

a	b	E(p)	$E[TPU(y^*)]$		$E[TRU(y^*)]$		$E[TCU(y^*)]$		$E[PCU(y^*)]$		$E[IIECU(y^*)]$	$E[RDCU(y^*)]$	$E[HCU(y^*)]$	
			FIP*	NIP	FIP	NIP	FIP	NIP	FIP	NIP	FIP	NIP	FIP	NIP
0	0	0	1075534	1235858	2525641	2492929	1450107	1264142	1289134	1257071	153846	0	7128	7071
0	0/002	0/001	1074607	1210574	2526668	2493926	1452061	1290427	1290418	1258327	154513	25025	7129	7075
0	0/004	0/002	1073678	1185239	2527696	2494924	1454018	1316765	1291706	1259585	155182	50100	7130	7080
0	0/006	0/003	1072747	1159853	2528727	2495925	1455980	1343156	1292996	1260846	155852	75226	7132	7084
0	0/008	0/004	1071815	1134417	2529760	2496927	1457945	1369599	1294288	1262109	156524	100402	7133	7089
0	0/01	0/005	1070881	1108929	2530795	2497932	1459914	1396096	1295583	1263375	157196	125628	7135	7093
0	0/012	0/006	1069944	1083390	2531832	2498939	1461888	1422646	1296881	1264643	157870	150905	7136	7098
0	0/014	0/007	1069006	1057800	2532871	2499947	1463865	1449250	1298181	1265914	158546	176234	7138	7102
0	0/016	0/008	1068066	1032158	2533912	2500958	1465846	1475907	1299484	1267187	159222	201613	7139	7107
0	0/018	0/009	1067124	1006464	2534956	2501971	1467832	1502618	1300790	1268463	159901	227043	7141	7111
0	0/02	0/01	1066180	980718	2536001	2502985	1469821	1529383	1302098	1269742	160580	252525	7142	7116
0	0/022	0/011	1065234	954921	2537049	2504002	1471814	1556202	1303409	1271023	161261	278059	7144	7120
0	0/024	0/012	1064287	929071	2538098	2505021	1473811	1583075	1304723	1272307	161943	303644	7145	7124
0	0/026	0/013	1063337	903169	2539150	2506042	1475813	1610003	1306039	1273593	162627	329281	7147	7129
0	0/028	0/014	1062385	877214	2540204	2507065	1477818	1636985	1307358	1274882	163312	354970	7148	7133
0	0/03	0/015	1061432	851206	2541260	2508090	1479828	1664022	1308680	1276174	163998	380711	7150	7138
0	0/032	0/016	1060476	825146	2542318	2509118	1481842	1691114	1310004	1277468	164686	406504	7151	7142
0	0/034	0/017	1059519	799033	2543378	2510147	1483859	1718261	1311331	1278764	165375	432350	7153	7147
0	0/036	0/018	1058560	772866	2544441	2511178	1485881	1745464	1312661	1280064	166066	458248	7155	7152
0	0/038	0/019	1057598	746646	2545506	2512212	1487907	1772722	1313993	1281366	166758	484200	7156	7156
0	0/04	0/02	1056635	720373	2546572	2513248	1489938	1800035	1315328	1282671	167452	510204	7158	7161
Δ			-18898	-515485	20931	20319	39830	535893	26195	25600	13605	510204	30	90

* FIP: full inspection policy, NIP: no inspection policy, $E[TRU(y^*)]$: optimal total cost per unit time, $E[TCU(y^*)]$: optimal total revenue per unit time, $E[PCU(y^*)]$: optimal procurement cost per unit time, $E[IIECU(y^*)]$: optimal costs associated with inspection per unit time, $E[RDCU(y^*)]$: optimal

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4. Conclusion

In this article, we compared two inspection policies comprising full inspection and no inspection for an EOQ model with imperfect quality items. The practical assumption of different holding costs for defective and non-defective items was considered in both policies. Besides, the inspection process is not idealistic and might be error-prone. We constructed mathematical models for both policies, and then, the optimal order sizes were obtained for them. Finally, a numerical example was provided to examine the performance of inspection policies. Results revealed that no inspection policy is significantly more cost-efficient when there are no defective items in order lot, while reputation damage cost leads to the supremacy of full inspection policy as the fraction of defective items reaches almost 0.65%.

A novel extension of this study can be the consideration of investment opportunity to decrease the fraction of defective items to the range of no inspection supremacy. It can especially result in considerable cost savings when this fraction is close to the point of full inspection necessity.

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