Risk Management for Second-Hand Clothing Imports in Least-Developed Countries: Legislations and Perception of Public-Sector Corruption[1]

Shu Guo,[1] Tsan-Ming Choi[2*]

[1]School of Management, University of Liverpool, Chatham Street, Liverpool, The United Kingdom.

[2]Centre for Supply Chain Research, School of Management, University of Liverpool, Chatham Street, Liverpool, The United Kingdom.

[*]Address correspondence to Tsan-Ming Choi, Centre for Supply Chain Research, School of Management, University of Liverpool, Chatham Street, Liverpool, L69 7ZH, The United Kingdom; tel: +44 (0)151 794 0434; emails: T.M.Choi@liverpool.ac.uk; tmjchoi@gmail.com

Abstract. The second-hand clothing imports are very popular in the Least-Developed-Countries (LDCs). The Social Health Risk (SHR) associated with second-hand clothing products and the lack of relevant legislations in LDCs, however, bring substantial challenges. This paper is therefore developed to explore the sterilization legislation design for second-hand clothing supply chains in LDCs. To address LDCs' different import requirements of fumigation, both the Extended Exporter Responsibility (*EER*) legislation scheme and the Extended Importer Responsibility (*EIR*) legislation scheme are considered. We also examine whether the perception of public-sector corruption in LDCs may affect the performance of sterilization legislation schemes. We compare the performance of sterilization legislation schemes under different public-sector corruption cases, different sterilization legislation structures, as well as market competition. Interestingly, our analyses show that the *EER* and *EIR* legislation schemes can achieve the same performance under a per unit SHR duty, no matter whether there is public-sector corruption or not. However, these two legislation schemes perform differently under the lump-sum SHR duty. Besides, with the presence of the public-sector corruption perception, the prospect of financial benefits from bribing the regulatory agency can induce the firm to choose a higher optimal sterilization level when the bribe is sufficiently small. These implications complement the extant knowledge on risk management of second-hand clothing in LDCs, and provide an important guidance regarding the design of sterilization legislations on second-hand clothing imports.

Summary. This paper explores public health risk management of second-hand clothing imports in LDCs. Our findings complement the knowledge on the design of sterilization legislations on second-hand clothing.

KEY WORDS: Public health risk management; second-hand clothing import; sterilization legislations; public-sector corruption perception; Least-Developed-Countries (LDCs)

[1] We sincerely thank the editor and reviewers for their kind and helpful comments, which led to important improvement of this paper.

1. INTRODUCTION

As released in the research on "experimental approach to alleviating global poverty", which has won the Nobel Memorial Prize in Economic Sciences 2019, more than 700 million people subsist on extremely low incomes nowadays. Under this gigantic pressure of poverty, second-hand clothing has gained a significant market share across various Least Developed Countries (LDCs) like Mozambique, Rwanda, Senegal, Tanzania, and Zambia over the past decades (Guo, Choi, & Zhang, 2021). The second-hand clothing imports, however, come with the Social Health Risk (SHR) problems and can challenge public health risk management. As a typical example of LDCs, Ghana lists the second-hand clothing as one of the high-risk goods, which are defined as the products that have serious health, safety or environmental influences on the public (The Ghana Standards Authority [GSA], 2021). The doctors in practice also emphasize that the public should pay close attention to the health risks associated with the second-hand clothing products, which are usually not properly cleaned and sterilized, and may induce scabies, lice, and ringworm (Akande, 2017). Companies such as Rentadella and Style Theory, for instance, are under the pressure induced by the increasing anxiety over health and hygiene of their second-hand clothing products (Robert, 2020). To address the SHR concerns, therefore, various LDCs (e.g., Ghana, Tanzania, Uganda, and Ethiopia) require the sterilization of the second-hand products at the time of import.[2]

In the meantime, evidence suggests that a company may illegally bribe regulators in practice (Heitz, Wang, & Wang, 2021). Typically, in contrast to the greater aversion to illegal behaviour and closer monitoring of public officials' activities in wealthier countries, public-sector corruption affects poor countries substantially (Lee & Weng, 2013; Sudhir & Talukdar, 2015; Singh, 2017). According to the 2020 Corruption Perceptions Index (CPI) published by Transparency International in 2021, for instance, corruption is much more prevalent in the LDCs compared to developed economies (see Table I below).[3] This is also consistent with the data released by the Worldwide Governance Indicators[4] (by the World Bank). The high incidence of public-sector corruption can facilitate evasion of firms' Corporate Social Responsibility (CSR) (Julian & Ofori-dankwa, 2013). It can decrease social welfare and lead to lower growth and poverty traps of countries like LDCs (Birhanu, Gambardella, & Valentini, 2016; Capasso & Santoro, 2018). In particular, the global second-hand clothing economy is a rapidly expanding market with international networks of dealers, the governance of which is highly complex (Norris, 2015). Examining the impacts of the public-sector corruption perception on LDC markets is thus of great importance.

Table I. Corruption Perceptions Index (CPI) of major second-hand clothing importers[5]

Score	Major second-hand clothing import developed countries	Rank	Score	Major second-hand clothing import LDCs	Rank
85	Singapore	3	38	Tanzania	94
82	Netherlands	8	33	Zambia	117

[2] More details can be found in https://www.fibre2fashion.com/industry-article/7042/buy-the-old-for-a-new-look. (Accessed February, 2020). Examples of the sterilization legislation practices in LDCs are also provided in Table B1a (Online Supplementary Appendix B).
[3] More details about the CPIs of different countries can be found in https://www.transparency.org/en/cpi/2020/index/nzl. (Accessed January, 2021)
[4] See https://info.worldbank.org/governance/wgi/Home/Reports (Accessed November, 2021).
[5] The tables is based on a scale of 0-100 in score with 0 being the most corrupt. Detailed information about the major second-hand clothing importers can be found in https://oec.world/en/visualize/tree_map/hs92/import/show/all/116309/2019/. (Accessed April, 2021).

80	Germany	9	27	Uganda	142
77	United Kingdom	11	25	Mozambique	149
74	Japan	19	19	Burundi	165
67	United States of America	25	12	South Sudan	179

With the above observations, our study is propelled by two motivations. First, in contrast to the rich findings in the corruption literature on compensation corruption and taxation corruption (e.g., Ades and Di Tella (1999), Dzhumashev (2014), and Célimène, Dufrénot, Mophou, and N'Guérékata (2016)), few studies examine the impacts of the public-sector corruption perception on risk management of LDCs' second-hand clothing supply chain. This is, however, an urgent issue given the prevailing second-hand clothing imports in LDCs and the significance of health risk. Second, extant theories imply that there are two opposing predictions regarding the impacts of corruption (e.g., Acemoglu and Verdier (2000), Dzhumashev (2014), and Célimène et al., (2016)). Following this rationale, we address the high CPIs of the LDCs as observed from the practice and devote to exploring the impacts of the public-sector corruption perception. Accordingly, the analytical framework employed in this study (see Table II) addresses the following research questions (RQs).

RQ 1: Comparing between the Extended Exporter Responsibility (*EER*) legislation and the Extended Importer Responsibility (*EIR*) legislation, which one is better for addressing the social health risk problem in LDCs' second-hand clothing supply chain?

RQ 2: How does public-sector corruption impact the performance of the sterilization legislations in LDCs?

RQ 3: What are the impacts of the public-sector corruption perception on public health risk management?

We follow the Centers for Disease Control and Prevention (CDC) (U.S. Department of Health & Human Services)[6] to define 'sterilization' as a process that uses either physical or chemical methods to destroy microorganisms including large numbers of resistant bacterial spores in the product (i.e., the second-hand product in this paper). We use the term 'the regulatory agency' to represent the individual inspector or the related laboratory or any other regulators from the agency of government responsible for import inspection. Our paper targets at exploring the impacts of the public-sector corruption perception caused by the regulatory agency. That is, the public information of a high CPI leads to the perception of weak government enforcement and a corruptible LDC market. Subsequently, the foreign exporter has the strategy of entering the LDC market by bribing the regulatory agency and therefore does not have to sterilize the second-hand product as reported.[7] Following Dzhumashev (2014) and Capasso and Santoro (2018), we define public-sector corruption as an agreement through which the regulatory agency receives a bribe from the private sector (i.e., denoted either by the foreign exporter or the local importer in this paper) in exchange for a favourable decision on the sterilization of the second-hand clothing imports.[8] On this premise, we build a theoretical model to investigate the SHR of the second-hand clothing imports. We capture the real-world practices by rationalizing the foreign exporter's

[6] See https://www.cdc.gov/oralhealth/infectioncontrol/glossary.htm#S. (Accessed March, 2020)

[7] We are not saying all regulatory agencies in the LDCs must take the bribes. In the case with weak government enforcement, firms' social responsibility efforts can be inadequate (Plambeck & Taylor, 2016). Our paper targets at this consequence and studies the case when the government enforcement is weak and the foreign exporter is dishonest. That is, our model can be the story of public-sector corruption after the responsibility violation has occurred.

[8] As explained above, this paper aims to explore the impacts of the public-sector corruption perception. We therefore do not model the regulatory agency's decisions related to take the bribes or any efforts by the Government to eliminate the corruption. Instead, we focus on the case when the agency is with a nonzero probability of taking the bribe. This captures the high CPIs of the LDCs as mentioned in Table I.

sterilization decision under different sterilization legislation schemes and different public-sector corruption cases. We also extend to explore different cost structures of sterilization legislation schemes, as well as market competition. Together with the considerations of the subsequent consumer surplus and social welfare, we examine how the sterilization legislation schemes may perform differently. The models are supported by the practice. Features of different models and relevant practical support are provided in Table II.

Table II. Features of different models and practical supports

Models		**Practical support from LDCs** (More details are available in Table B1a and Table B1b in Online Supplementary Appendix B)
Main Models	1) Model *E*: the *EER* legislation 2) Model *I*: the *EIR* legislation *Discussion 1*: Performance of these two legislation schemes	*Practical support*: 1) Evidence of conformity of the relevant requirements is mandatory for all imports in LDCs. 2) The evidence may be either from the foreign exporter (e.g., Ghana) or the local importer (e.g., Uganda). *Model formulation*: The sterilization legislation can be applied either to the foreign exporter (the *EER* legislation) or the local importer (the *EIR* legislation).
	Discussion 2: Public-sector corruption perception for passing the inspection and conformity assessment	*Practical support*: At the points of entry in LDCs, inspection and conformity assessment will be conducted by local government agencies (e.g., the GSB, the KEBS, and the UNBS). These agencies collect additional fees from their services of quality assurance and testing activities. Dong, Rashkova, and Shi (2022) also highlighted that in practice, local government agencies in developing economies, such as the auditing bodies, usually operate under the jurisdiction of multiple government branches and these agencies may shirk their responsibilities (e.g., in maintaining food safety). *Model formulation*: It is reasonable to explore the impacts of the public-sector corruption perception for passing the inspection and conformity assessment for the sterilization responsibility.
Extended Models	*Extension 1*: Public-sector corruption perception for reducing the sterilization evasion risk	*Practical support*: When a non-compliance behaviour is uncovered, imported goods can be subject to additional inspections with extra surcharges in LDCs (e.g., Trade Policy Review of Uganda). *Model formulation*: Considering the impacts of the public-sector corruption perception for reducing the sterilization evasion risk contributes to the robustness of our paper.
	Extension 2: Different cost structures of sterilization legislation schemes	*Practical support*: In practice, LDC governments like Tanzania and Uganda charge the tariff duty on the second-hand product import by a lump-sum fee rather than by per unit product. *Model formulation*: By extensively considering various cost structures, our paper tests robustness of findings regarding the influences of different cost structures of sterilization legislations.
	Extension 3: Market competition	*Practical support*: Foreign exporters can enter the LDC market either by providing external fumigation certificates for the second-hand products (e.g., for the LDCs like Ghana, Tanzania, and Uganda) or by claiming the approval-based duty (e.g., for the LDCs like Ethiopia). *Model formulation*: We consider two competing supply chains with asymmetric sterilization credibility, this contributes to the comprehensiveness of our findings.

The analysis along these lines yields several important findings. For instance, it is interesting to note that under a per unit SHR duty, the *EER* legislation and the *EIR* legislation can always achieve the same performance no matter whether public-sector corruption is present or not. While under a lump-sum SHR duty, the performances of these two legislations are different due to the SHR duty's scale effect. In addition, given the high sterilization cost, the prospect of financial benefits from bribing the regulatory agency can induce a higher optimal sterilization level of the second-hand product in the case of a sufficiently small bribe. These findings complement the knowledge on risk management of second-hand clothing in LDCs and the impacts of the public-sector corruption perception, and can serve as an important reference to the LDC governments regarding the design of sterilization legislation schemes on second-hand clothing imports.

The rest of this paper is organized as follows. Section 2 provides a literature review covering the fields of corporate risk management, operations in LDCs and developing economies, second-hand market, and public-sector corruption. Section 3 explains basic model formulation. The *EER* legislation and the *EIR* legislation are introduced, the performances of which are further compared in Section 4. The impacts of the public-sector corruption perception are also discussed in Section 4. Afterwards, extended exploration on different cost

structures of the sterilization legislations and market competition is conducted in Section 5. Section 6 then concludes the paper by highlighting the key findings and future research directions.

2. LITERATURE REVIEW

In the literature of operational risk management, popular areas include sustainable sourcing (e.g., supplier risks in Fang and Cho (2020), Saunders, Paul-Brooks, Merrick, and Autry (2020), Liu, Wei, Choi, and Yan (2022), and Lu and Tomlin (2022)), ecolabels and environmental certifications (e.g., label confusion risks in Harbaugh, Maxwell, and Roussillon (2011), credibility risk of firms' self-labelled environmental qualities in Murali, Lim, and Petruzzi (2019)), and public health risk management (e.g., food safety risk in Veflen, Scholderer, and Langsrud (2020), Wang, van der Fels-Klerx, and Lansink (2020), and Yin, Li, Gu, Huang, and Zhang (2021), and health externalities and policies in Alfaro, Faia, Lamersdorf, and Saidi (2022)). This paper focuses on the underexplored public health risk management of sterilizing the second-hand product import. There are also some prior studies covering corruption in global supply chains. However, both our analysis and results are fundamentally different from them. For instance, in contrast to the private sector's corruption risk explored in Fan, Chen, and Tang (2021a), our paper addresses corporate risk management on the public-sector corruption perception in the LDC markets. Furthermore, the objective of Fan et al. (2021a) is to demonstrate the effectiveness of the optimal incentive-compatible mechanism. While our paper is for discussing the performance of the sterilization legislation schemes on the second-hand product import.

Our paper relates to the scant research stream on operations in LDCs and developing economies. The recent research in this emerging area covers the topics of agricultural operations and economics (e.g., de Zegher, Iancu, and Lee (2019), Hu, Liu, and Wang (2019), Zhou, Fan, Chen, and Tang (2021), Xiao, Chen, and Tang (2020)), retailing operations (e.g., Zhao, Lim, Guo, Ding, and Song, (2019), Zhang and Swaminathan (2020)), sourcing negotiations (e.g., Mu, Hu, Reddy, and Gavirneni (2022)) and corporate social responsibility (e.g., Dong, Rashkova, and Shi (2022)). Similar to these studies, our paper considers key operating characteristics of a fragmented market base in developing economies (e.g., small-scale firms with low bargaining power) and develop a non-cooperative game based on a multi-stage supply chain. While unlike these studies, we examine the socially responsible operations in global supply chains. In this stream, Cho, Fang, Tayur, and Xu (2019) also discuss socially responsible operations in developing economies. However, our paper considers the SHR associated with the second-hand product import and the sterilization responsibility. In addition, Cho et al. (2019) do not consider the enforcement of government legislations and social welfare, which is the major focus of our paper. These listed characteristics, to the best of our knowledge, have not appeared so far in models in LDCs and developing economies.

This paper relates to the second-hand market, which has been studied extensively under the topics including extended producer responsibility (EPR) legislations (e.g., Atasu and Souza (2013), Mazahir, Verter, Boyaci, and Van Wassenhove (2019), Tian, Sošić, and Debo (2019)), market competition (e.g., Toyasaki, Boyacı, and Verter

(2011), Chen and Chen (2019)), and inventory management under warranty service (e.g., Pinçe, Ferguson, and Toktay (2016)). Similar to these papers, this paper also highlights the cost of the second-hand product and explore the second-hand market under the considerations of government intervention and social welfare. Innovatively, our paper emphasizes consumers' sensitivity to both the retail price and the sterilization level of the second-hand product, and investigate government intervention in the form of sterilization legislation schemes. All of these appears novel in the second-hand market literature.

This paper is also related to the public-sector corruption problem in operations. In the extant corruption models, the public sector basically interacts with the private sector in two broad fields: compensation corruption and taxation corruption. Examples include Ades and Di Tella (1999), Acemoglu and Verdier (2000), Fan, Chen, and Tang (2021b), Dzhumashev (2014) and Célimène et al. (2016). Different from them, this paper investigates firms' CSR evasion. In addition, consumer surplus, which is ignored in these studies, is also emphasized in this paper. Besides, there are some empirical works on public-sector corruption, including Montiel, Husted, and Christmann (2012), Bennett, Pierce, Snyder, and Toffel (2013), and Birhanu, Gambardella, and Valentini (2016). In addition, Jeong and Weiner (2012) and Lee and Weng (2013) both address the globalization trend (Yatsenko, Nitsenko, Mardani, & Tananaiko, 2018). Differently, this paper addresses the impacts of the public-sector corruption perception on firms' sterilization actions over the second-hand clothing imports in LDCs.

3. MODEL SETTING

We have Supply Chain *SH* (with *SH* representing for second-hand) as shown in Figure 1, which consists of a local importer (*I*) in the LDC market and a foreign exporter (*E*). Capturing the fragmented market base in developing economies (de Zegher, Iancu, & Lee, 2019; Zhao, Lim, Guo, Ding, & Song, 2019), the local importer has a low bargaining power while the foreign exporter plays as the Stackelberg leader.[9] The foreign exporter and the local importer maximize their own profits by controlling the values of w_{SH}, and p_{SH}, respectively. Besides, given the SHR of the second-hand product (defined as the health risk), the foreign exporter sterilizes the second-hand product at the level s. Such a CSR related decision is also addressed in the economics and social sciences literature, like the "cleanup" decision explored in Viscusi and Hamilton (1999). The sterilization cost follows $\frac{ks^2}{2}$. The quadratic cost structure is commonly used in the literature like Atasu and Souza (2013), and Xiao et al. (2020).

In line with Guan, Geng, and Gurnani (2021) and Shi, Tang, and Dong (2021), we consider a consumer market with size normalized to be 1. Each consumer buys at most one unit (Chen, Wang, Niu, & Chen, 2022; Hu, Wang, & Feng, 2020). Consumer heterogeneity in product valuations (i.e., the consumer's willingness to pay) is captured by taking v to be uniformly distributed over $[0, 1]$ (Li, Feng, Govindan, & Xu, 2019; Niu and Zou, 2017; Pun, Swaminathan, & Hou, 2021). The utility a consumer generated from buying a second-hand

[9] The second-hand clothing trade in LDCs is mainly managed by the Small and Medium Enterprises (SME) (or family business in some instances) (Gui, Tang, & Yin, 2019; Guo et al., 2021). Typical examples include but not limit to Rwanda and Uganda (Katende-Magezi, 2017). Besides, we do not consider the exchange rate, since it will only influence the supply cost by a fixed percentage which however is a constant.

product is $U_{SH} = v - (p_{SH} - \theta s)$. The assumption of the consumer's sensitivity to the sterilization level of the second-hand product (θ) is consistent with the literature which highlights that firms would risk losing consumers if the product quality is low on dimensions like health outcomes (Gaynor, 2006; Bennett, Pierce, Snyder, & Toffel, 2013). The hygiene risks are also reported as one of the key reasons behind the limited popularity of second-hand clothing in countries like Poland, Philippines, and Pakistan.[10] Accordingly, the demand of the second-hand product is $q_{SH} = 1 - (p_{SH} - \theta s)$.

Following the observed real-world practice, we assume the LDC government imposes a per unit SHR duty on the imported second-hand product either by the *EER* legislation or the *EIR* legislation. The per unit SHR duty is served as a penalty against the threats to consumer health by the second-hand product. Under the *EER* legislation, the foreign exporter has to pay a SHR duty t_E to the LDC government; while under the *EIR* legislation, a SHR duty t_I is charged on the local importer. Besides, we aim at exploring the industry-level performance of the sterilization legislation. Accordingly, we proxy the SHR duty faced by a firm by an average value experienced by all other firms in the same industry. The SHR duty therefore is assumed to be the same under the *EER* legislation and the *EIR* legislation, with $t_E = t_I = t = a - \phi s > 0$.

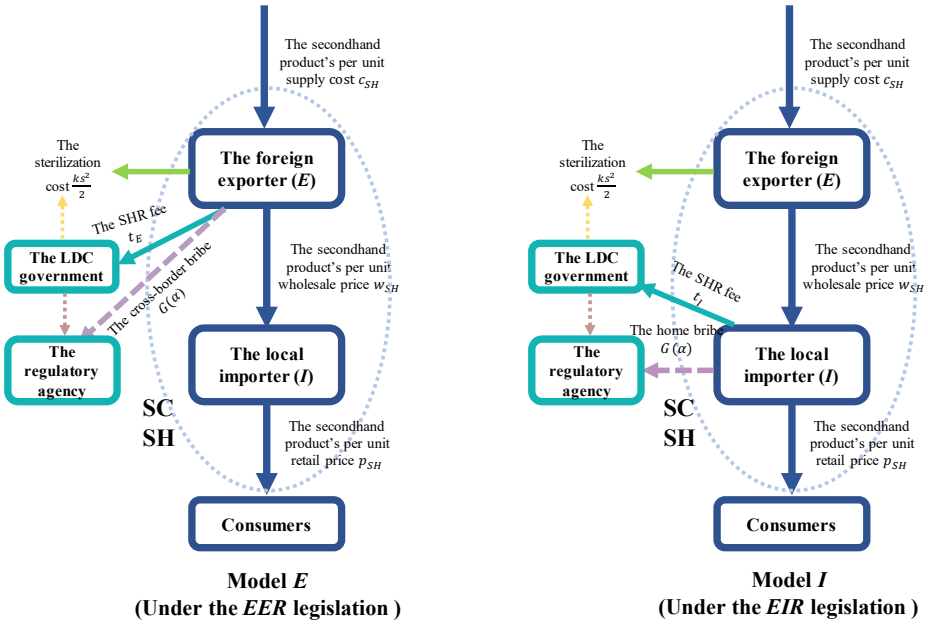

Figure 1. The supply chain structure under the basic model.

Social responsibility policies for firms are developed at the strategic level (Thekdi, 2016). The high CPI leads to the perception of weak government enforcement and a corruptible market. Subsequently, the foreign exporter (under the *EER* legislation) or the local importer (under the *EIR* legislation) has the strategy of bribing the regulatory agency for passing the inspection and conformity assessment.[11] As a result, the foreign exporter

[10] See https://www.fibre2fashion.com/industry-article/7042/buy-the-old-for-a-new-look. (Accessed April, 2020) Sterilizing a product does not mean to remove all microorganisms as it is impractical and basically impossible (Jildeh, Wagner, & Schöning, 2021). Accordingly, we explore the sterilization level. In practice, there are multiple factors that can impact the output of the sterilization process, such as the surrounding conditions and the exposure time to the sterilant (Jildeh et al., 2021). The company can flexibly adjust their sterilization efforts by changing the settings of these factors.

[11] We are not saying regulatory agencies in the LDCs must take the bribes. Instead, we explore the impacts brought by the high CPIs observed from the

may reduce the actual sterilization level by $\alpha_i s$. The evasion rate α_i is exogenously given and satisfies $0 \le \alpha_i \le 1$, where $i = L, H$ stands for a low evasion rate and a high evasion rate, respectively.[12] That is, different from the sterilization level s as publicly reported, the real sterilization level is $(1-\alpha_i)s$. Following the literature (e.g., Cho et al. (2019)), we assume $\alpha_L = 0$, and $\alpha_H = \alpha$. As explained previously, our paper targets at investigating the case after the responsibility violation has occurred (i.e., when the foreign exporter has reduced his sterilization level) in an environment with weak regulatory enforcement. Accordingly, we retain our main focus on the case of $\alpha_H = \alpha$. Following the corruption literature (e.g., Fan et al. (2021b)), the bribe amount is known as an "open secret" in the market. The total bribe amount follows $G(\alpha) = (g + \tau\alpha s)q_{SH} + f$, with $g, \tau, f > 0$.[13] Without loss of generality, we have $\theta + \phi > \tau\alpha$, and $p_{SH} > c_{SH} + a + g$. Besides, consumers do not observe the firm's sterilization evasion behaviour or the bribe transfer, because in most cases, no official record of these two actions exist.[14] Similar to the literature on CSR (e.g., Murali, Lim, and Petruzzi (2019)), government intervention (e.g., Esenduran, Kemahlıoğlu-Ziya, and Swaminathan (2017)) and corruption (e.g., Fan et al. (2021b)), we capture the practices by setting the government parameters (i.e., a, ϕ) non-negative and exogenously given. For ease of reference, we present all the notations and definitions in Table III, and evidence support for key assumptions in Table IV.

3.1 The *EER* Legislation (Model *E*)

We consider a two-stage Stackelberg gaming model, which is commonly adopted in the literature (e.g., see Ma, Ho, Ji, and Talluri, (2018), Wang, Leng, Song, Luo, and Hui (2019)). Following the practices (e.g., Baden and Barber (2005)), we have the sequence of events as follows. In the first stage, the foreign exporter as the Stackelberg leader simultaneously determines the wholesale price w_{SH} and the sterilization level s of the second-hand product exported to the LDC market. In the second stage, the local importer follows by taking the foreign exporter's decisions into considerations and choosing the unit retail price p_{SH} for the second-hand product. All supply chain members are profit-maximizing (Feng, Govindan, & Li, 2017; Perera, Dawande, Janakiraman, & Mookerjee, 2020) and have the same assess to the market information (Niu, Dai, & Li, 2022). Accordingly, we have the objectives and social welfare function under the *EER* legislation as:

1) Local importer: $\max_{p_{SH} \ge 0} \Pi_I = (p_{SH} - w_{SH})q_{SH}.$ (1)

2) Foreign exporter: $\max_{w_{SH} \ge 0, s \ge 0} \Pi_E = (w_{SH} - c_{SH})q_{SH} - \frac{k[(1-\alpha)s]^2}{2} - t_E q_{SH} - [(g + \tau\alpha s)q_{SH} + f].$ (2)

3) Social welfare: Following Zhang and Zhang (2018), and Guan, Liu, Chen, and Wang (2020), the social welfare is defined as the sum of supply chain members' expected profits (denoted by Π_I and Π_E) and the

practice by studying the firms' strategic decisions in the case when the regulatory agency has a nonzero probability of taking the bribe. We report the comparisons with the case without public-sector corruption in later discussions.

[12] The evasion rate is affected by external factors. To mitigate the endogeneity concerns, we define the evasion rate by the average level in an industry which is fixed in practice. We thus follow the binary distribution as widely applied in the literature (e.g., Acemoglu and Verdier (2000), and Shi, Zhang, and Srinivasan (2019)).

[13] The structure is in line with the survey in Amin and Soh (2021), which reports that firms in practice experience the bribe amount as a percentage of their sales. The structure is also supported by the literature like Dzhumashev 2014 and Oliva (2015). Besides, we have explored other bribe structures in Online Appendix C1. These bribe structures all show similar equilibrium results. This bribe structure is hence robust.

[14] Here, capturing a consumer's perceived sterilization level of the second-hand product by $(1-x)s$ dose not influence our equilibrium results.

consumer surplus (denoted by CS) net the expected government social health expenditure of the second-hand product (denoted by $H_{SH}(s)$):

$$SW = \Pi_E + \Pi_I + CS - H_{SH}(s).^{15} \quad (3)$$

The LDC government's expected social health expenditure $H_{SH}(s)$ is: $H_{SH}(s) = \frac{l(\Omega - s)^2}{2}$.[16] Ω denotes the initial healthcare system cost without any sterilization legislation. l is the healthcare system's cost coefficient with respect to the sterilization level of the second-hand product. Health concerns and the social health expenditure have been emphasized in economics and social sciences literature, such as Viscusi and Hamilton (1999). This also addresses the highlights in Taylor and Xiao (2019), which indicates that the expensive drugs to treat diseases can lead to a heavy burden on the developing economies' public health systems. The consumer surplus CS is: $CS = \int_{p_{SH}-\theta s}^{1} U_{SH} f(v) dv = \frac{[1-(p_{SH}-\theta s)]^2}{2}$.

3.2 The *EIR* Legislation (Model *I*)

Following the same logic, we have the objectives and social welfare function under the *EIR* legislation as:

1) Local importer: $\max_{p_{SH} \geq 0} \Pi_I = (p_{SH} - w_{SH}) q_{SH} - t_I q_{SH} - [(g + \tau \alpha s) q_{SH} + f]$. (4)

2) Foreign exporter: $\max_{w_{SH} \geq 0, s \geq 0} \Pi_E = (w_{SH} - c_{SH}) q_{SH} - \frac{k[(1-\alpha)s]^2}{2}$. (5)

3) Social welfare: The LDC government's social welfare function SW_G is the same as in Model *E*.

Table III. Notations and Definitions.

w_{SH}	The wholesale price of the second-hand product paid by the local importer to the exporter
p_{SH}	The retail price of the second-hand product charged by the local importer
c_{SH}	The supply cost of each second-hand product
s	The sterilization level of the second-hand product
k	The foreign exporter's cost coefficient of sterilization (i.e., the sterilization effort cost factor).
t	The total SHR duty
a	The fixed component in the SHR duty
ϕ	The per unit sterilization-level based SHR duty reduction
U_{SH}	The utility a consumer gets from purchasing the imported second-hand product
v	The consumer's valuation for the second-hand product
θ	The consumer's sensitivity to the sterilization level of the second-hand product, which reflects the consumer's SHR awareness
α_i	The foreign exporter's evasion rate
τ	The proportional rate of the bribe to the degree of the evaded sterilization level (i.e., αs)
g	The proportional rate of the bribe to the market demand
f	The minimum bribe amount the firm needs to pay for participating in the bribing game

[15] This paper targets at understanding the impacts of public-sector corruption perception instead of discussing the LDC government's trade-off between the revenues from SHR duties and the associated public health expenses. Accordingly, we assume the collected SHR duties are fully used to compensate the medical expenses in the public health system. We therefore do not contain the public revenues in the function of social welfare. This assumption is in line with the fact emphasized by United Nations (2016) that many trade policies do not generate revenue for the treasury. For example, the tariffs or taxes imposed at the border will be used to support public services such as health.

[16] The expenditure function is widely adopted in the literature (e.g., He, Wang, Shi, and Liao (2021)) and is also reasonable in practice. For example, the government may either invest money to employ some technologies to reduce the SHR or invest extra money to their public health system for better preparations (e.g., PPEs). Under both cases, the health expenditure $H_{SH}(s)$ can be a one-time investment and has no effect on the marginal cost of the social welfare.

Ω	The initial healthcare system cost without any sterilization legislation
l	The healthcare system's cost coefficient with respect to the sterilization level of the second-hand product
h_p	The chance that the evasion on product sterilization will be identified by the inspection and conformity assessment activities
γ	The extra penalty for the identified evasion of product sterilization
h_b	The chance of being bribed
φ	The coefficient of the SHR duty's scale (economies/diseconomies) effect
ξ	The extra third-party certification fee
δ	The consumers' willingness to pay for the third-party certification
Π_I	The local importer's profit
Π_E	The foreign exporter's profit
$H_{SH}(s)$	The LDC government's social health expenditure
CS	The consumer surplus
SW_G	The social welfare

Table IV. Evidence Support for Key Assumptions

Key Assumptions	Evidence Support
1) The foreign exporter is responsible for the sterilization.	LDCs like Ghana, Tanzania, and Uganda (see more details in Table B1a and Table B1b in Online Supplementary Appendix B) require all second-hand clothing to be cleaned and fumigated by the foreign exporter before import.
2) The LDC government imposes either the *EER* or the *EIR* legislation.	Evidence of conformity for fumigation standards (i.e., the statutory sterilization responsibility) is required in LDCs, which can either be provided by the foreign exporter or the local importer (see Table II).[17]
3) The government parameters (i.e., a, ϕ) are non-negative and exogenously given.	1) Given the complexity of the global market, the LDC government can never maximize its social welfare when imposing their legislations. Especially, for the East African Community (EAC) members like Burundi, Rwanda, Tanzania, Uganda, and South Sudan, the governments have limited flexibility in setting their legislations for second-hand clothing product imports. As reported by the U.S. Trade Data, for example, Burundi, Tanzania, and Uganda all charge a same value of import tariff on the worn textile products (The International Trade Administration, 2021).[18] 2) The extant literature (e.g., Acemoglu and Verdier (2000)) highlights that in the presence of corruption, it is much harder to achieve "optimal" government intervention.

4. ANALYSIS

4.1 Equilibrium Decisions

Using backward induction, it can be found that under the condition of $k > \frac{(\theta+\phi-\tau\alpha)^2}{4(1-\alpha)^2}$,[19] we have the respective equilibrium results of Model E and Model I as Table V, where $A = 4k(1-\alpha)^2 - (\theta+\phi-\tau\alpha)^2$. All abbreviations are available in Table A1 in Online Supplementary Appendix A. Observations and implications from Proposition 1 and Lemma 1 are listed in Table B2 in Online Supplementary Appendix B.

Table V. Equilibrium results of Model *E* and Model *I*

	Model *E*	Model *I*
Optimal sterilization level	$s^{ME*} = \frac{(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{A}$;	$s^{MI*} = \frac{(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{A}$;
Optimal wholesale price	$w_{SH}^{ME*} = \frac{[2k(1-\alpha)^2-(\phi-\tau\alpha)(\theta+\phi-\tau\alpha)] + [2k(1-\alpha)^2-\theta(\theta+\phi-\tau\alpha)](c_{SH}+a+g)}{A}$;	$w_{SH}^{MI*} = \frac{2k(1-\alpha)^2+[2k(1-\alpha)^2-(\theta+\phi-\tau\alpha)^2]c_{SH}-2k(1-\alpha)^2(a+g)}{A}$;

[17] The expenditure to meet the minimum standard is fixed and does not influence equilibrium results. We therefore exclude the fixed cost.
[18] To better elaborate the impacts of the public-sector corruption perception on the design of sterilization legislations, the import tariff is not considered in our paper. Given the fact that the import tariff is a fixed percentage in practice, our models are robust and our key insights continue to hold.
[19] The condition addresses the fact that the cost of sterilization can be high relative to the price of the second-hand product. This is in line with the practice observed by Katende-Magezi (2017) through the interviews with major importers of the second-hand clothing in LDCs like Ghana, Tanzania, and Uganda.

Optimal retail price	$p_{SH}^{ME*} = \frac{[3k(1-\alpha)^2-(\phi-\tau\alpha)(\theta+\phi-\tau\alpha)]+[k(1-\alpha)^2-\theta(\theta+\phi-\tau\alpha)](c_{SH}+a+g)}{A}$;	$p_{SH}^{MI*} = \frac{[3k(1-\alpha)^2-(\phi-\tau\alpha)(\theta+\phi-\tau\alpha)]+[k(1-\alpha)^2-\theta(\theta+\phi-\tau\alpha)](c_{SH}+a+g)}{A}$;
Market demand	$q_{SH}^{ME*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-g)}{A}$;	$q_{SH}^{MI*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-g)}{A}$;
Expected profit of foreign exporter	$\Pi_E^{ME*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-g)^2}{2A} - f$;	$\Pi_E^{MI*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-g)^2}{2A}$;
Expected profit of local importer	$\Pi_I^{ME*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-g)]^2}{A^2}$;	$\Pi_I^{MI*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-g)]^2}{A^2} - f$;
Consumer surplus	$CS^{ME*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-g)]^2}{2A^2}$;	$CS^{MI*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-g)]^2}{2A^2}$;
Overall social welfare	$SW^{ME*} = \frac{k(1-\alpha)^2[3k(1-\alpha)^2+A](1-c_{SH}-a-g)^2}{2A^2} - \frac{-l[\Omega A-(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)]^2}{2A^2} - f$;	$SW^{MI*} = \frac{k(1-\alpha)^2[3k(1-\alpha)^2+A](1-c_{SH}-a-g)^2}{2A^2} - \frac{-l[\Omega A-(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)]^2}{2A^2} - f$.

Proposition 1. *a)* $s^{ME*} = s^{MI*}$*; b)* $p_{SH}^{ME*} = p_{SH}^{MI*}$*; c)* $q_{SH}^{ME*} = q_{SH}^{MI*}$*; d)* $CS^{ME*} = CS^{MI*}$*; e)* $SW^{ME*} = SW^{MI*}$.

The profit allocation between two firms in a supply chain is determined by the agreed price that the downstream firm pays to the upstream firm (Zhong, Zhou, & Leng, 2021). It is surprising to notice that although the *EER* legislation and the *EIR* legislation can lead to different profit allocations between the firms, the market demand, consumer surplus as well as social welfare are always the same. That is, in response to different sterilization legislations, the foreign exporter as the Stackelberg leader changes the profit allocations between the firms by adjusting the wholesale price while without influencing the overall equilibrium decisions of the sterilization level and the retail price of the second-hand product.

Lemma 1. *For the influences of the EER legislation and the EIR legislation* ($j \in ME, MI$)*: a) i)* $\frac{ds^{j*}}{da} < 0$, $\frac{d\Pi_E^{j*}}{da} < 0$, $\frac{d\Pi_I^{j*}}{da} < 0$, $\frac{dCS^{j*}}{da} < 0$*; ii)* $\frac{dp^{j*}}{da} > 0$ *if and only if* $k > \frac{\theta(\theta+\phi-\tau\alpha)}{(1-\alpha)^2}$*, otherwise* $\frac{dp^{j*}}{da} \leq 0$*; b) i)* $\frac{ds^{j*}}{d\phi} > 0$, $\frac{d\Pi_E^{j*}}{d\phi} > 0$, $\frac{d\Pi_I^{j*}}{d\phi} > 0$, $\frac{dCS^{j*}}{d\phi} > 0$*; ii) When* $\phi < \theta + \tau\alpha$, $\frac{dp^{j*}}{d\phi} > 0$*; When* $\phi > \theta + \tau\alpha$, $\frac{dp^{j*}}{d\phi} > 0$ *if and only if* $k < \frac{\theta(\theta+\phi-\tau\alpha)^2}{2(1-\alpha_i)^2(\phi-\theta-\tau\alpha)}$*, otherwise* $\frac{dp^{j*}}{d\phi} \leq 0$.

As can be seen from Lemma 1, a higher fixed SHR duty and a lower sterilization-level based SHR duty reduction can both lower the sterilization level of the second-hand product, profits of the foreign exporter and the local importer, as well as the consumer surplus. In particular, when the foreign exporter's cost coefficient of sterilization is sufficiently large (i.e., $k > \frac{\theta(\theta+\phi-\tau\alpha)}{(1-\alpha)^2}$), a high fixed SHR duty can only do more harm than good to consumers, since in addition to a low sterilization level, the consumers will also bear a subsequently high retail price of the second-hand product. For this case, the LDC government should set a high sterilization-level based SHR duty reduction (i.e., $\phi > 3\theta + \tau\alpha$)[20] instead, which can contribute to a low retail price of the second-hand product (i.e., a higher affordability to the low-income consumers) but a high sterilization level.

Theorem 1. *To stimulate a high sterilization level and achieve a high consumer surplus level, the LDC government can use a sterilization legislation (either EER or EIR) that consists of a low fixed SHR duty but a high sterilization-level based SHR duty reduction*.

[20] Notice that when $\phi > 3\theta + \tau\alpha$, $\frac{\theta(\theta+\phi-\tau\alpha)}{(1-\alpha)^2} > \frac{\theta(\theta+\phi-\tau\alpha)^2}{2(1-\alpha)^2(\phi-\theta-\tau\alpha)}$. As a result, when $k > \frac{\theta(\theta+\phi-\tau\alpha)}{(1-\alpha)^2}$ and $\phi > 3\theta + \tau\alpha$, $\frac{dp^{j*}}{da} > 0$ but $\frac{dp^{j*}}{d\phi} < 0$.

Lemma 2. *For the influences of the EER legislation and the EIR legislation ($j \in ME, MI$): a) When* $\Omega < \frac{(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{A}$*: i)* $\frac{dSW^{j*}}{da} > 0$ *if and only if* $l > \frac{k(1-\alpha)^2[3k(1-\alpha)^2+A](1-c_{SH}-a-g)}{(\theta+\phi-\tau\alpha)[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]}$*, otherwise* $\frac{dSW^{j*}}{da} \leq 0$*; ii)* $\frac{dSW^{j*}}{d\phi} > 0$ *if and only if* $l > \frac{3k^2(1-\alpha)^4(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{B[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]}$*, otherwise* $\frac{dSW^{j*}}{d\phi} \leq 0$*; b) When* $\Omega > \frac{(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{A}$, $\frac{dSW^{j*}}{da} < 0$, $\frac{dSW^{j*}}{d\phi} > 0$.

Lemma 2 complements Proposition 1 and Lemma 1. In particular, Lemma 2 shows the dominant advantage of the sterilization legislation structure proposed in Theorem 1 in achieving a high social welfare level under the condition of a sufficiently large initial healthcare system cost[21]. In addition, Theorem 1 also holds when the LDC government's initial healthcare system cost is low but the healthcare system's cost coefficient (with respect to the second-hand product's sterilization level) is moderate (i.e., $\frac{3k^2(1-\alpha)^4(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{B[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]} < l < \frac{k(1-\alpha)^2[3k(1-\alpha)^2+A](1-c_{SH}-a-g)}{(\theta+\phi-\tau\alpha)[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]}$)[22].

4.2 Discussions: Public-Sector Corruption Perception

To analyse the impacts of the public-sector corruption perception, we first explore the equilibrium decisions under the case without public-sector corruption and the foreign exporter has to strictly sterilize the second-hand product as reported (i.e., $\alpha_L = 0$). Following the same logic, under the condition of $k > \frac{(\theta+\phi)^2}{4}$, we have the equilibrium results in Table VI. Accordingly, we have Proposition 2 and Proposition 3, with observations and implications summarized in Table B3 in Online Supplementary Appendix B. Besides, although the comparisons in Proposition 3 are based on the bribe format of $G(\alpha) = (g + \tau\alpha s)q_{SH} + f$ (for the case with public-sector corruption), similar results can be found in other bribe formats as shown in Online Appendix C1.

Table VI. Equilibrium results

	Model *E*	**Model *I***
Optimal sterilization level	$s^{\overline{ME}*} = \frac{(\theta+\phi)(1-c_{SH}-a)}{c}$;	$s^{\overline{MI}*} = \frac{(\theta+\phi)(1-c_{SH}-a)}{c}$;
Optimal wholesale price	$w_{SH}^{\overline{ME}*} = \frac{(2k-\phi\theta-\phi^2)+(2k-\phi\theta-\theta^2)(c_{SH}+a)}{c}$;	$w_{SH}^{\overline{MI}*} = \frac{2k+[2k-(\theta+\phi)^2]c_{SH}-2ka}{c}$;
Optimal retail price	$p_{SH}^{\overline{ME}*} = \frac{(3k-\phi\theta-\phi^2)+(k-\phi\theta-\theta^2)(c_{SH}+a)}{c}$;	$p_{SH}^{\overline{MI}*} = \frac{(3k-\phi\theta-\phi^2)+(k-\phi\theta-\theta^2)(c_{SH}+a)}{c}$;
Market demand	$q_{SH}^{\overline{ME}*} = \frac{k(1-c_{SH}-a)}{c}$;	$q_{SH}^{\overline{MI}*} = \frac{k(1-c_{SH}-a)}{c}$;
Expected profit of foreign exporter	$\Pi_E^{\overline{ME}*} = \frac{k(1-c_{SH}-a)^2}{2c}$;	$\Pi_E^{\overline{MI}*} = \frac{k(1-c_{SH}-a)^2}{2c}$;
Expected profit of local importer	$\Pi_I^{\overline{ME}*} = \frac{k^2(1-c_{SH}-a)^2}{c^2}$;	$\Pi_I^{\overline{MI}*} = \frac{k^2(1-c_{SH}-a)^2}{c^2}$;
Consumer surplus	$CS^{\overline{ME}*} = \frac{k^2(1-c_{SH}-a)^2}{2c^2}$;	$CS^{\overline{MI}*} = \frac{k^2(1-c_{SH}-a)^2}{2c^2}$;

[21] Without sterilization, the second-hand product can cause various diseases. The expensive drugs to treat diseases can lead to a heavy burden on the developing regions' public health systems (Taylor and Xiao, 2019). The high mortality rates of associated diseases such as the louse-borne relapsing fever can also lead to a high healthcare system cost. Together with the challenges induced by epidemic outbreaks and pandemics like the COVID-19, it is true that the initial healthcare system cost associated with the second-hand product can be high in practice.

[22] As a remark, given that $k > \frac{(\theta+\phi-\tau\alpha)^2}{4(1-\alpha)^2}$, $\frac{3k^2(1-\alpha)^4(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)}{B[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]} < \frac{k(1-\alpha)^2[3k(1-\alpha)^2+A](1-c_{SH}-a-g)}{(\theta+\phi-\tau\alpha)[(\theta+\phi-\tau\alpha)(1-c_{SH}-a-g)-\Omega A]}$ always hold.

Overall social welfare	$SW^{\overline{ME}*} = \frac{k(3k+C)(1-c_{SH}-a)^2-l[\Omega C-(\theta+\phi)(1-c_{SH}-a)]^2}{2C^2}$;	$SW^{\overline{MI}*} = \frac{k(3k+C)(1-c_{SH}-a)^2-l[\Omega C-(\theta+\phi)(1-c_{SH}-a)]^2}{2C]^2}$;

Proposition 2. *a)* $s^{\overline{ME}*} = s^{\overline{MI}*}$; *b)* $p_{SH}^{\overline{ME}*} = p_{SH}^{\overline{MI}*}$; *c)* $q_{SH}^{\overline{ME}*} = q_{SH}^{\overline{MI}*}$; *d)* $CS^{\overline{ME}*} = CS^{\overline{MI}*}$; *e)* $SW^{\overline{ME}*} = SW^{\overline{MI}*}$.

Proposition 2 complements Proposition 1 by showing that the *EER* legislation and the *EIR* legislation can always contribute to the same equilibrium results, no matter whether there is public-sector corruption or not.

Proposition 3. *Impacts of public-sector corruption perception* ($i \in ME, MI$)*: a)* $s^{j*} > s^{\overline{j}*}$ *if and only if* $g < \frac{(1-c_{SH}-a)[(\theta+\phi)(C-A)-\tau\alpha C]}{(\theta+\phi-\tau\alpha)C}$, *otherwise* $s^{j*} \leq s^{\overline{j}*}$; *b)* $CS^{j*} > CS^{\overline{j}*}$ *if and only if* $g < \frac{(1-c_{SH}-a)[(1-\alpha)^2C-A]}{(1-\alpha)^2C}$, *otherwise* $CS^{j*} \leq CS^{\overline{j}*}$; *c)* $SW^{j*} > SW^{\overline{j}*}$ *if and only if* $f < \frac{kD-lE}{2A^2C^2}$, *otherwise* $SW^{j*} \leq SW^{\overline{j}*}$.

Proposition 3 explains the drivers of public-sector corruption and identifies the conditions under which the public-sector corruption perception reduces the social health responsibility effort. Sterilization, as mentioned by Oxfam International, can lead to a high cost for the second-hand product.[23] With such a high sterilization cost, there is a strong motivation for the foreign exporter to reduce his sterilization level. The prospect of financial benefits from bribing the regulatory agency therefore creates an incentive for the foreign exporter to join the corruption. Besides, it is believed that the presence of the public-sector corruption perception promotes violation instead of responsibility. Interestingly, Proposition 3 indicates that if the expected bribe is sufficiently small (i.e., $g < min\left(\frac{(1-c_{SH}-a)[(\theta+\phi)(C-A)-\tau\alpha C]}{(\theta+\phi-\tau\alpha)C}, \frac{(1-c_{SH}-a)[(1-\alpha)^2C-A]}{(1-\alpha)^2C}\right)$, and $f < \frac{kD-lE}{2A^2C^2}$), the public-sector corruption perception will still contribute to a higher optimal sterilization level of the imported second-hand product (sterilization responsibility). As a consequence, the increased sterilization level brings more consumer surplus and more social welfare[24].

4.3 Public-Sector Corruption for Reducing the Sterilization Evasion Risk

Public-sector corruption can happen for reducing the evasion risk and expenditure (Célimène, Dufrénot, Mophou, & N'Guérékata, 2016). In the LDC market, firms are required to renew their import licences and product registration periodically. As mentioned in Trade Policy Review of Uganda, for example, importers' import licences are valid for six months and product registration is valid for one year. The sterilization evasion record can challenge the firms' credibility and affect the possibility of renewal. This brings the firms the motivation of corruption. We next examine the case when the firms face a corruptible regulatory agency to whom they propose bribes for reducing the sterilization evasion risk (Case *P*, with *P* denotes for penalty of the sterilization evasion) and maintaining their market permit. Relevant notations are summarized in Table III. Governmental policies are long-term decisions in practice. Changes in the policies therefore are rare.

[23] By selling donated second-hand clothes, Oxfam International raised £76m during the year of 2019/2020 to support people in need. Interested readers can also refer to https://www.oxfam.org.uk/about-us/faq/common-faq/ for more information. (Accessed August, 2021).

[24] This paper examines the sterilization legislation design. We hence consider direct stakeholders including the local importer in the LDC market, the foreign exporter, consumers and the government. However, we do not mean that the public-sector corruption would benefit the whole society. Regarding the impacts of public-sector corruption on other stakeholders or components different from economic efficiency of the private sector, we leave it for further research.

Accordingly, making changes in the level of the inspection and conformity assessment or in the sterilization evasion penalty is also difficult. To address this fact, h_p and γ are both set as exogenous. The expected sterilization evasion expenditure follows $\hat{G}(\alpha) = h_p[h_b G(\alpha) + (1-h_b)\gamma] = h_p h_b[(g+\tau\alpha s)q_{SH}] + [h_p h_b f + h_p(1-h_b)\gamma]$, with $0 \le h_p < 1$ and $0 \le h_b \le 1$. Such a structure can be supported by prior literature like Célimène et al. (2016), Singh (2017), and Capasso and Santoro (2018). The objective functions of the local importer and foreign exporter under Model *E* are:

$$\max_{p_{SH} \ge 0} \Pi_I^{ME-P} = (p_{SH} - w_{SH})q_{SH}. \tag{6}$$

$$\max_{w_{SH} \ge 0, s \ge 0} \Pi_E^{ME-P} = (w_{SH} - c_{SH})q_{SH} - \frac{k[(1-\alpha)s]^2}{2} - t_E q_{SH} - \{h_p h_b[(g+\tau\alpha s)q_{SH}] + [h_p h_b f + h_p(1-h_b)\gamma]\}. \tag{7}$$

The objective functions of the local importer and foreign exporter under Model *I* are:

$$\max_{p_{SH} \ge 0} \Pi_I^{MI-P} = (p_{SH} - w_{SH})q_{SH} - t_I q_{SH} - \left\{h_p h_b[(g+\tau\alpha s)q_{SH}] + [h_p h_b f + h_p(1-h_b)\gamma]\right\}. \tag{8}$$

$$\max_{w_{SH} \ge 0, s \ge 0} \Pi_E^{MI-P} = (w_{SH} - c_{SH})q_{SH} - \frac{k[(1-\alpha)s]^2}{2}. \tag{9}$$

When $k > \frac{(\theta+\phi-\hat{\tau}\alpha)^2}{4(1-\alpha)^2}$, we have the equilibrium results in Table VII, where $\hat{\tau} = h_p h_b \tau$, $\hat{g} = h_p h_b g$. Observations from Lemmas 3 and 4 are listed in Table B4 in Online Supplementary Appendix B.

Table VII. Equilibrium results of Case *P*

	Model *E*	**Model *I***
Optimal sterilization level	$s^{ME-P*} = \frac{(\theta+\phi-\hat{\tau}\alpha)(1-c_{SH}-a-\hat{g})}{\hat{A}}$;	$s^{MI-P*} = \frac{(\theta+\phi-\hat{\tau}\alpha)(1-c_{SH}-a-\hat{g})}{\hat{A}}$;
Optimal wholesale price	$w_{SH}^{ME-P*} = \frac{[2k(1-\alpha)^2-(\phi-\hat{\tau}\alpha)(\theta+\phi-\hat{\tau}\alpha)] + [2k(1-\alpha)^2-\theta(\theta+\phi-\hat{\tau}\alpha)](c_{SH}+a+\hat{g})}{\hat{A}}$;	$w_{SH}^{MI-P*} = \frac{2k(1-\alpha)^2+[2k(1-\alpha)^2-(\theta+\phi-\hat{\tau}\alpha)^2]c_{SH}-2k(1-\alpha)^2(a+\hat{g})}{\hat{A}}$;
Optimal retail price	$p_{SH}^{ME-P*} = \frac{[3k(1-\alpha)^2-(\phi-\hat{\tau}\alpha)(\theta+\phi-\hat{\tau}\alpha)] + [k(1-\alpha)^2-\theta(\theta+\phi-\hat{\tau}\alpha)](c_{SH}+a+\hat{g})}{\hat{A}}$;	$p_{SH}^{MI-P*} = \frac{[3k(1-\alpha)^2-(\phi-\hat{\tau}\alpha)(\theta+\phi-\hat{\tau}\alpha)] + [k(1-\alpha)^2-\theta(\theta+\phi-\hat{\tau}\alpha)](c_{SH}+a+\hat{g})}{\hat{A}}$;
Market demand	$q_{SH}^{ME-P*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-\hat{g})}{\hat{A}}$;	$q_{SH}^{MI-P*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-\hat{g})}{\hat{A}}$;
Expected profit of foreign exporter	$\Pi_E^{ME-P*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-\hat{g})^2}{2\hat{A}} - [h_p h_b f + h_p(1-h_b)\gamma]$;	$\Pi_E^{MI-P*} = \frac{k(1-\alpha)^2(1-c_{SH}-a-\hat{g})^2}{2\hat{A}}$;
Expected profit of local importer	$\Pi_I^{ME-P*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-\hat{g})]^2}{\hat{A}^2}$;	$\Pi_I^{MI-P*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-\hat{g})]^2}{\hat{A}^2} - [h_p h_b f + h_p(1-h_b)\gamma]$;
Consumer surplus	$CS^{ME-P*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-\hat{g})]^2}{2\hat{A}^2}$;	$CS^{MI-P*} = \frac{[k(1-\alpha)^2(1-c_{SH}-a-\hat{g})]^2}{2\hat{A}^2}$;
Overall social welfare	$SW^{ME-P*} = \Psi - [h_p h_b f + h_p(1-h_b)\gamma]$;	$SW^{MI-P*} = \Psi - [h_p h_b f + h_p(1-h_b)\gamma]$;

Lemma 3. *For the influences of the inspection and conformity assessment ($j \in ME, MI$): a)* $\frac{ds^{j*}}{dh_p} < 0$*; b)* $\frac{dCS^{j*}}{dh_p} < 0$*; c)* $\frac{dSW^{j*}}{dh_p} > 0$ *if and only if* $\gamma < \hat{\gamma}_p$*, otherwise* $\frac{dSW^{j*}}{dh_p} \le 0$.

Results in Table VII show the same equilibrium decisions for Model *E* and Model *I*. This verifies the robustness of Proposition 1 under the case of public-sector corruption perception for reducing the sterilization

evasion risk. While surprisingly, Lemma 3 reveals that any increase in the chance of being identified (regarding sterilization evasion) can lead to a decrease in the optimal sterilization level and consumer surplus. The strategic rationale is the following. If the chance of being identified is small, the expected expense of sterilization evasion is low. In this case, the foreign exporter will be induced to select a high sterilization level which can contribute to a large demand. As a result, the consumers can still be benefited despite of their sterilization evasion behaviour, which partially reduces the actual sterilization level. When the chance of being identified increases, however, the firm becomes less likely to do sterilization evasion as it implies that the expected expense of sterilization evasion now is high. This forces the firm to select a relatively low sterilization level. Consequently, consumers suffer. In particular, if the sterilization evasion penalty is sufficiently large (i.e., $\gamma > \hat{\gamma}_p$), a higher possibility of identifying the sterilization evasion behaviour reduces social welfare.

Lemma 4. *For the impacts of public-sector corruption perception ($j \in ME, MI$):a)* $\frac{ds^{j*}}{dh_b} < 0$*; b)* $\frac{dCS^{j*}}{dh_b} < 0$*; c)* $\frac{dSW^{j*}}{dh_b} > 0$ *if and only if* $\gamma > \hat{\gamma}_b$*, otherwise* $\frac{dSW^{j*}}{dh_b} \leq 0$.

Lemma 4 presents the impacts of the public-sector corruption perception regarding the chance of bribing the regulatory agency for reducing the sterilization evasion risk. As known by the extant literature (e.g., Acemoglu and Verdier (2000)), when the fines are large, there is usually more room for public-sector corruption. The firm-level survey data in Amin and Soh (2021) also reports that firms in practice experience a significantly higher level of corruption when the regulatory burden is heavier. Interestingly, Lemma 4 reveals that a higher chance to bribe the regulatory agency cannot lead to a higher optimal sterilization level. Instead, it reduces the optimal sterilization level and consumer surplus. This proves the importance of corruption management regarding the chance to bribe the regulatory agency. Together with the findings in Lemma 3, Lemma 4 provides an important guideline for how to improve the optimal sterilization level and consumer surplus. To be specific, the LDC government is advised to give a higher priority to reduce the chance of bribing the regulatory agency compared to increase the chance of identifying the sterilization evasion.

5. EXTENSIONS

5.1 An Alternative Cost Structure of the Sterilization Legislations

In practice, the LDC government may charge the SHR duty by other cost structures. For instance, LDC governments like Tanzania and Uganda are known to charge the tariff duty on the second-hand product import by a lump-sum fee rather than by per unit product.[25] In this section therefore, we explore the case of a lump-sum SHR duty (i.e., Case *L*). In Case *L*, the SHR duty follows the general lump-sum structure of $\hat{t}_E = \hat{t}_I =$

[25] See https://www.theeastafrican.co.ke/business/East-African-states-defend-tariff-on-used-clothes/2560-4016600-15n85y/index.html. (Accessed April, 2020) The SHR duty helps shift the social health expenditure burden induced by the SHR of second-hand clothing products back to the firms who are responsible for. Similar social responsibility costs can also be found in practice. One typical example is carbon pricing, different forms of which have been widely applied by various governments as an instrument to manage firms' social responsibility.

$ms - ns^2$, with $m > 0$, and $n > 0$.[26] Define the coefficient of *the SHR duty's scale (economies/diseconomies) effect* as $\varphi = \frac{2n}{m}$. We assume that φ is low enough to ensure a nonnegative SHR duty (i.e., $s < \frac{2}{\varphi}$ always holds). Besides, the quadratic term captures the characteristics of the SHR duty which can either be decreasing in s (*scale economies* when s is higher than $\frac{m}{2n} = \frac{1}{\varphi}$) or increasing in s (*scale diseconomies* when s is lower than $\frac{m}{2n} = \frac{1}{\varphi}$). This allows us to generate different circumstances of the SHR duty and capture the fact that scale economies and diseconomies can both happen in practice. This ensures the comprehensiveness of our paper. The popularity of such a cost structure can also be supported by literature like Souza (2013), and Guo, Zhao, Hao, and Liu (2019). The objective functions of the local importer and the foreign exporter under Model *E* thus become:

$$\max_{p_{SH} \geq 0} \Pi_I^{ME-L} = (p_{SH} - w_{SH}) q_{SH}. \tag{10}$$

$$\max_{w_{SH} \geq 0, s \geq 0} \Pi_E^{ME-L} = (w_{SH} - c_{SH}) q_{SH} - \frac{k[(1-\alpha)s]^2}{2} - (ms - ns^2) - [(g + \tau\alpha s) q_{SH} + f]. \tag{11}$$

The objective functions of the local importer and foreign exporter under Model *I* are updated as:

$$\max_{p_{SH} \geq 0} \Pi_I^{MI-L} = (p_{SH} - w_{SH}) q_{SH} - (ms - ns^2) - [(g + \tau\alpha s) q_{SH} + f]. \tag{12}$$

$$\max_{w_{SH} \geq 0, s \geq 0} \Pi_E^{MI-L} = (w_{SH} - c_{SH}) q_{SH} - \frac{k[(1-\alpha)s]^2}{2}. \tag{13}$$

Consequently, under the condition of $k > max(\frac{(\theta-\tau\alpha)^2+4n}{4(1-\alpha)^2}, \frac{(\theta-\tau\alpha)^2}{4(1-\alpha)^2})$, we have the equilibrium results in Table VIII. Accordingly, we have Propositions 4, 5 and 6, with observations listed in Table B5 in Online Supplementary Appendix B.

Table VIII. Equilibrium results of Case *L*

	Model *E*	**Model *I***
Optimal sterilization level	$s^{ME-L*} = \frac{(\theta-\tau\alpha)(1-c_{SH}-g)-4m}{F}$;	$s^{MI-L*} = \frac{(\theta-\tau\alpha)(1-c_{SH}-g)}{I}$;
Optimal wholesale price	$w_{SH}^{ME-L*} = \frac{[2J-\theta(\theta-\tau\alpha)](1+c_{SH}+g)+(\theta+\tau\alpha)(\theta-\tau\alpha-2m)}{F}$;	$w_{SH}^{MI-L*} = \frac{2k(1-\alpha)^2(1-g)+[2k(1-\alpha)^2-(\theta-\tau\alpha)^2]c_{SH}}{I}$;
Optimal retail price	$p_{SH}^{ME-L*} = \frac{3J+[J-\theta(\theta-\tau\alpha)](c_{SH}+g)}{F} \frac{-(\theta+\tau\alpha)(\tau\alpha+m)+2\theta(\tau\alpha-m)}{F}$;	$p_{SH}^{MI-L*} = \frac{[3k(1-\alpha)^2+\tau\alpha(\theta-\tau\alpha)]+[k(1-\alpha)^2-\theta(\theta-\tau\alpha)](c_{SH}+g)}{I}$;
Market demand	$q_{SH}^{ME-L*} = \frac{J(1-c_{SH}-g)-(\theta-\tau\alpha)m}{F}$;	$q_{SH}^{MI-L*} = \frac{k(1-\alpha)^2(1-c_{SH}-g)}{I}$;
Expected profit of foreign exporter	$\Pi_E^{ME-L*} = \frac{J(1-c_{SH}-g)^2+2m[2m-(\theta-\tau\alpha)(1-c_{SH}-g)]}{2F} - f$;	$\Pi_E^{MI-L*} = \frac{k(1-\alpha)^2(1-c_{SH}-g)^2}{2I}$;
Expected profit of local importer	$\Pi_I^{ME-L*} = \frac{[J(1-c_{SH}-g)-(\theta-\tau\alpha)m]^2}{F^2}$;	$\Pi_I^{MI-L*} = \frac{(1-c_{SH}-g)\{(1-c_{SH}-g)[k^2(1-\alpha)^4+n(\theta-\tau\alpha)^2]-m(\theta-\tau\alpha)I\}}{I^2} - f$;
Consumer surplus	$CS^{ME-L*} = \frac{[J(1-c_{SH}-g)-(\theta-\tau\alpha)m]^2}{2F^2}$;	$CS^{MI-L*} = \frac{k^2(1-\alpha)^4(1-c_{SH}-g)^2}{2I^2}$;
Overall social welfare	$SW^{ME-L*} = \frac{7[J(1-c_{SH}-g)-(\theta-\tau\alpha)m]^2-I\{\Omega F-[(\theta-\tau\alpha)(1-c_{SH}-g)-4m]\}^2}{-[(\theta-\tau\alpha)(1-c_{SH}-g)-4m](L+2mF)}{2F^2} - f$;	$SW^{MI-L*} = \frac{(1-c_{SH}-g)\{(1-c_{SH}-g)[7k^2(1-\alpha)^4-(\theta-\tau\alpha)^2J]-2m(\theta-\tau\alpha)I\}}{-I[\Omega I-(\theta-\tau\alpha)(1-c_{SH}-g)]^2}{2I^2} - f$;

[26] Here, by letting $m = 0$ and $n = \frac{\xi}{2}$, the SHR duty captures the widely applied lump-sum structure of $\hat{t} = F - \frac{\xi s^2}{2}$. In addition, interested readers can refer to Online Appendix C2 for Case *L* without public-sector corruption, which shows similar equilibrium results.

Proposition 4. *a) When* $\varphi > \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, $s^{ME-L*} > s^{MI-L*}$, $p_{SH}^{ME-L*} > p_{SH}^{MI-L*}$, $q_{SH}^{ME-L*} > q_{SH}^{MI-L*}$, $CS^{ME-L*} > CS^{MI-L*}$; *b) When* $\varphi < \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, $s^{ME-L*} < s^{MI-L*}$, $p_{SH}^{ME-L*} < p_{SH}^{MI-L*}$, $q_{SH}^{ME-L*} < q_{SH}^{MI-L*}$, $CS^{ME-L*} < CS^{MI-L*}$.

Interestingly, Proposition 4 shows that the SHR duty's scale effect (i.e., φ) plays an important role in determining which sterilization legislation (the *EER* legislation or the *EIR* legislation) is better for addressing the second-hand clothing' SHR problem. For example, when the SHR duty's coefficient of scale effect is sufficiently high (i.e., $\varphi > \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$), the threshold value on achieving economies of scale (i.e., $\frac{1}{\varphi}$) becomes lower. Above this threshold value of φ, as economies of scale increase, the marginal SHR duty of providing a higher sterilization level decreases. As a result, the cost efficiency brought by an increased sterilization level provides the foreign exporter an incentive to enhance the sterilization level further. The *EER* legislation can hence bring a higher sterilization level and more consumer surplus than the *EIR* legislation. In contrast, when the SHR duty's coefficient of scale effect is sufficiently low (i.e., $\varphi < \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$), the threshold value on achieving economies of scale (i.e., $\frac{1}{\varphi}$) becomes higher. The benefit from the scale effect can then be limited to the foreign exporter when compared with the significant cost increase in sterilization and the SHR duty. As a result, compared with the *EER* legislation, the *EIR* legislation can show a superior performance in stimulating a higher sterilization level and more consumer surplus.

Proposition 5. *a)* $\Pi_E^{ME-L*} > \Pi_E^{MI-L*}$ *if and only if* $f < f_E^L$, *otherwise* $\Pi_E^{ME-L*} \leq \Pi_E^{MI-L*}$; *b)* $\Pi_I^{ME-L*} > \Pi_I^{MI-L*}$ *if and only if* $f > f_I^L$, *otherwise* $\Pi_I^{ME-L*} \leq \Pi_I^{MI-L*}$.

Proposition 5 complements Proposition 3 by revealing the influences of the public-sector corruption perception under a lump-sum SHR duty. In the case with a lump-sum SHR duty, if the minimum bribe is high (i.e., $f > \max(f_E^L, f_I^L)$), the foreign exporter can achieve more profits under the *EIR* legislation while the local importer can have more profits under the *EER* legislation. In fact, by checking the equilibrium results in the case with a per unit SHR duty, it can be found that the results hold in both cases.[27]

Proposition 6. *a) When* $\Omega > max\left(\frac{(\theta-\tau\alpha)(1-c_{SH}-g)}{I}, \frac{(\theta-\tau\alpha)(1-c_{SH}-g)-4m}{F}\right)$: *i) If* $\varphi > \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, *then* $SW^{ME-L*} > SW^{MI-L*}$ *if and only if* $l > \hat{l}$, *otherwise* $SW^{ME-L*} \leq SW^{MI-L*}$; *ii) If* $\varphi < \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, *then* $SW^{ME-L*} > SW^{MI-L*}$ *if and only if* $l < \hat{l}$, *otherwise* $SW^{ME-L*} \leq SW^{MI-L*}$. *b) When* $\Omega < min\left(\frac{(\theta-\tau\alpha)(1-c_{SH}-g)}{I}, \frac{(\theta-\tau\alpha)(1-c_{SH}-g)-4m}{F}\right)$: *i) If* $\varphi > \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, *then* $SW^{ME-L*} > SW^{MI-L*}$ *if and only if* $l < \hat{l}$, *otherwise* $SW^{ME-L*} \leq SW^{MI-L*}$; *ii) If* $\varphi < \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$, *then* $SW^{ME-L*} > SW^{MI-L*}$ *if*

[27] Notice that in the case with a per unit SHR duty, given the same equilibrium results of the sterilization level, consumer surplus and social welfare under the *EER* legislation and the *EIR* legislation, we haven't conducted further discussions on the profits of the local importer and the foreign exporter.

and only if $l > \hat{l}$, *otherwise* $SW^{ME-L*} \leq SW^{MI-L*}$.

Proposition 6 complements Proposition 4 by showing how the SHR duty's scale effect (i.e., φ) influences the performance of sterilization legislations from the perspective of social welfare. We find that when the healthcare system cost associated with the second-hand product is sufficiently large (i.e., $\Omega > max\left(\frac{(\theta-\tau\alpha)(1-c_{SH}-g)}{I}, \frac{(\theta-\tau\alpha)(1-c_{SH}-g)-4m}{F}\right)$ and $l > \hat{l}$), the *EER* legislation can bring more social welfare than the *EIR* legislation if the SHR duty's scale effect is sufficiently large (i.e., $\varphi > \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$); otherwise (i.e., if $\varphi < \frac{4(1-\alpha)^2-(\theta-\tau\alpha)^2}{(\theta-\tau\alpha)(1-c_{SH}-g)}$), the *EIR* legislation can bring more social welfare.

5.2 Market Competition and Public-Sector Corruption Perception

Keen market competition may encourage firms to engage in unethical activities, especially when the product is socially costly while the government is unable to adequately monitor and enforce relevant regulations (Ades and Di Tella, 1999; Blundell, Griffith, & Van Reenen, 1999; Bennett et al., 2013). We next extend to a competitive market scenario. Without loss of generality, we consider two competing supply chains, *H* and *L*, with asymmetric sterilization credibility as explained in Table IX. Similar asymmetric supply reliability structures can also be found in literature such as Li, Sethi, and Zhang (2017). The sequence of events is shown as Table X. Using backward induction, it can be found that under the conditions of $k > \underline{k}$ (i.e., k is sufficiently big), we have Proposition 7.[28]

Table IX. Supply Chain Features with Market Competition

Supply Chains	Features and Practical meanings
Supply Chain H	1) A supply chain with high sterilization credibility (i.e., the evasion rate $\alpha_L = 0$). 2) The foreign exporter in Supply Chain *H* enters the LDC market by providing the external fumigation certificate, which can show the reliable sterilization level without any chance of bribing the regulatory agency. 3) Reliable sources of the products play an important role in the second-hand market (Guo, Zhang, Zhang, Liu, & Zhou, 2020). With an extra third-party certification, the consumers' willingness to pay can be enhanced by δv, where $0 < \delta < 1$. This is in line with the literature such as Gaynor (2006) and Bennett et al. (2013), which highlight that under competition, firms risk losing consumers when the product's health quality is low. Accordingly, the utility of a consumer generated from buying a second-hand product from Supply Chain *H* is expressed by $U_{SH}^{H} = (1+\delta)v - (p_{SH} - \theta s)$. 4) One typical example of such third-parties is IDFL, which is a global leader committed to guaranteeing the quality of textiles products and provides audits as well as certifications services including sterilization.
Supply Chain L	1) A supply chain with low sterilization credibility (i.e., the evasion rate $\alpha_H = \alpha > 0$). 2) The foreign exporter in Supply Chain *L* enters the LDC market by claiming the approval-based duty, under which the foreign exporter can have an unreliable sterilization level (i.e., lower than the published sterilization level) by bribing the regulatory agency. 3) The utility of a consumer generated from buying a second-hand product from Supply Chain *L* is $U_{SH}^{L} = v - (p_{SH} - \theta s)$.

Table X. Decision variables in the competition game.

The foreign exporters (E^H, E^L)	The local importers (I^H, I^L)
1) Stage 1: s^H, s^L; 2) Stage 2: w_{SH}^H, w_{SH}^L;	Stage 3: p_{SH}^H, p_{SH}^L;

Proposition 7. *a)* $s^{H-ME*} = s^{H-MI*}$, $s^{L-ME*} = s^{L-MI*}$; *b) When* $\xi > -\frac{P}{Y}$, $s^{H-j*} > s^{L-j*}$ *if: i)* $(1-\alpha)^2 >$

[28] All abbreviations are available in Table A1 in Online Supplementary Appendix A.

$\frac{(\theta+\phi-\tau\alpha)(1+\delta)[Q-(1+2\delta)\xi]}{(\theta+\phi)(P+Y\xi)}$ *and* $k < \hat{k}$ *, or ii)* $(1-\alpha)^2 < \frac{(\theta+\phi-\tau\alpha)(1+\delta)[Q-(1+2\delta)\xi]}{(\theta+\phi)(P+Y\xi)}$ *and* $k > \hat{k}$*; c) When* $\xi < -\frac{P}{Y}$, $s^{H-j*} > s^{L-j*}$ *if: i)* $(1-\alpha)^2 < \frac{(\theta+\phi-\tau\alpha)(1+\delta)[Q-(1+2\delta)\xi]}{(\theta+\phi)(P+Y\xi)}$ *and* $k < \hat{k}$, *or ii)* $(1-\alpha)^2 > \frac{(\theta+\phi-\tau\alpha)(1+\delta)[Q-(1+2\delta)\xi]}{(\theta+\phi)(P+Y\xi)}$ *and* $k > \hat{k}$.

As found in Jildeh, Wagner, and Schöning (2021), there is currently no standard sterilization procedure in the market and products can differ in their sterilization processes and techniques in terms of factors such as choice of the sterilizing agent and operational conditions. Interestingly, Proposition 7 reveals that consumers' extra willingness to pay for the third-party certification and a low third-party certification fee (i.e., $\xi < -\frac{P}{Y}$) do not necessarily guarantee a higher sterilization level than the second-hand product sold under the approval-based sterilization duty. In the meantime, a high third-party certification fee (i.e., $\xi > -\frac{P}{Y}$) may still stimulate a higher sterilization level than the approval-based sterilization duty. As an example of the situation when the third-party certification fee is high (i.e., $\xi > -\frac{P}{Y}$), if the foreign exporter in Supply Chain *L* follows a relatively high non-compliance degree (i.e., $(1-\alpha)^2 < \frac{(\theta+\phi-\tau\alpha)(1+\delta)[Q-(1+2\delta)\xi]}{(\theta+\phi)(P+Y\xi)}$), the foreign exporter in Supply Chain *H* will also vote for a higher sterilization level even under a sufficiently large sterilization cost coefficient (i.e., $k > \hat{k}$).[29] As shown in the numerical results in Online Supplementary Appendix D[30], when the extra third-party certification continues to increase the consumer acceptance level of the second-hand product, the foreign exporter in Supply Chain *H* can achieve a profit increase while the foreign exporter in Supply Chain *L* will suffer a profit decrease. Accordingly, even under a high third-party certification fee and a high sterilization cost coefficient, the foreign exporter in Supply Chain *H* may still increase the sterilization level.

6. CONCLUSIONS

6.1. Main Conclusions

To address the associated public health risk challenges, this paper is developed to explore the sterilization legislations on social health risk (SHR) of the second-hand clothing supply chains in LDCs. Based on the comparisons on different sterilization legislation designs and the explorations on different public-sector corruption perceptions, important observations have been found which are listed as follows.

1) ***Design of the sterilization legislations***: Risk management is largely missing in the development and implementation of CSR policies (Thekdi, 2016). This paper serves as a guideline that considers risk associated with CSR policy implementation and compliance. First of all, it is interesting to note that under a per unit SHR duty, the *EER* legislation and the *EIR* legislation can always achieve the same performance no matter whether

[29] This finding can also be interpreted as follows: In a competitive market, the foreign exporter in Supply Chain *H* will always vote for a higher sterilization level even under a sufficiently large sterilization cost coefficient (i.e., $k > \hat{k}$) and a high third-party certification fee (i.e., $\xi > -\frac{P}{Y}$), as long as the third-party certification fee is not extremely high (i.e., $-\frac{P}{Y} < \xi < \frac{(\theta+\phi-\tau\alpha)(1+\delta)Q-(1-\alpha)^2(\theta+\phi)P}{(1-\alpha)^2(\theta+\phi)Y+(\theta+\phi-\tau\alpha)(1+\delta)(1+2\delta)}$).

[30] The numerical setting is based on the practice, including the interviews conducted by Katende-Magezi (2017) on the second-hand clothing markets in LDCs and the survey reported in Amin and Soh (2021) on the public-sector corruption. Details are provided in Online Supplementary Appendix D.

there is public-sector corruption perception or not. In particular, in response to different sterilization legislations, the foreign exporter can flexibly change the profit allocations by adjusting the wholesale price, without influencing the equilibrium decisions of the sterilization level and the retail price of the second-hand product. While under a lump-sum SHR duty, the performances of these two legislations are different due to the scale (economies/diseconomies) effect. Secondly, to address the SHR associated with the second-hand product but in the meantime to avoid challenging the export market, the LDC government can impose the *EIR* sterilization by a per unit SHR duty that comprises a low fixed SHR duty together with a high sterilization-level based SHR duty reduction. Alternatively, the LDC government can set a lump-sum SHR duty either by the *EIR* sterilization with a small scale effect of the SHR duty or by the *EER* sterilization with a large scale effect of the SHR duty.

2) ***Public-sector corruption perception***: Firms precisely control process parameters to achieve the required sterilization conditions of the products. In the prior risk analysis literature, Braud, Castell-Perez, and Matlock, (2000) highlight that a risk-based design takes into consideration possible factors in the sterilization process that could result in variation in the final sterilization value. We quantify how the public-sector corruption perception can affect the overall risk of the second-hand product. Given the high sterilization cost of the second-hand product, the prospect of financial benefits from bribing the regulatory agency creates an incentive for the firms to commit corruption. In the case of bribing for passing the inspection and conformity assessment, for instance, the prospect of financial benefits from bribing the regulatory agency can induce a higher optimal sterilization level of the imported second-hand product when the bribe is sufficiently small. The social responsibility efforts such as sterilization are expensive in practice. This explains the drivers of having public-sector corruption.

3) ***Enforcement of the sterilization legislations***: In the case of bribing for reducing the sterilization evasion risk, any increase in the chance of being identified (regarding the sterilization evasion behavior) can lead to the decrease in the optimal sterilization level and consumer surplus. In the meantime, a higher chance to bribe the regulatory agency can also reduce the optimal sterilization level and consumer surplus. Accordingly, to improve the optimal sterilization level of the imported second-hand product and consumer surplus, the LDC government is advised to give a higher priority to reduce the "chance of bribing the regulatory agency" rather than to increase the "chance of identifying the sterilization evasion". This also addresses the operational challenge that the second-hand clothing trade in LDCs is mainly managed by the SMEs (Gui et al., 2019; Guo et al., 2021), which requires substantial governance efforts to increase the "chance of identifying the sterilization evasion".

4) ***Market competition***: As found in Choi and Jeon (2020), "public on their own" often does not have the ability to acquire adequate information about risks while companies inherently seek to maximize their benefits in a loose governmental regulation framework. In a competitive LDC market, when the extra third-party certification continues to increase the consumer acceptance level of the second-hand product, the foreign exporter with high sterilization credibility can achieve a profit increase while the foreign exporter with low sterilization credibility may suffer a profit drop. Accordingly, the foreign exporter with high sterilization credibility has the incentive to increase the sterilization level under competition, even if the third-party certification fee and the subsequent sterilization cost are both high.

6.2. Future Research Directions

Several extensions can be investigated in the future. First, we examine the story of the second-hand clothing trade in LDCs with symmetric information. In practice, the foreign exporter and the local importer may not always share all the related information. It therefore can be interesting to examine the design of sterilization legislations and the impacts of public-sector corruption perception in an information asymmetric situation. One potential research area is the impact of asymmetric information relating to the sterilization level of the second-hand product as well as the potential risk (Ullah, Ayat, He, Huang, & Jiang, 2022). This extension may lead to interesting signalling games in product sourcing and risk-averse consumer behaviour problems that deserve further investigation. It is also meaningful to develop a guide to explain how the best-practice cost structure of sterilization legislations can be established to optimize a second-hand clothing product's supply chain with asymmetric information. For example, the SHR duty could be a tool for the LDC government to assess the public health risk and perhaps help reveal some private information in the system. The LDC government may also use it as a tool to evaluate their healthcare investments by including the cost of SHR in economic analyses or to find some of the solutions to alleviate challenges that have been faced. Second, we restrict our attention to the second-hand clothing imports while new products in the market (either domestically produced or imported) are not considered. In the future, we may explore the competitive threats from the new products in the LDC market and explore how public-sector corruption perception on the sterilization evasion behaviour can impact the society. Third, more studies could be done in the area of LDC governments' endogenous responsibility as well as auditing and monitoring. These measures help the LDC governments better manage the SHR of the second-hand clothing imports and overcome the challenges associated with the public-sector corruption perception. Comparisons on the performances of internal auditing with public scrutiny and their respective impacts on foreign exporter actions related to behaving responsibly, for example, could be a fruitful direction for future work.

References

Acemoglu, D., & Verdier, T. (2000). The choice between market failures and corruption. *American Economic Review*, 90(1), 194-211.

Ades, A., & Di Tella, R. (1999). Rents, competition, and corruption. *American Economic Review*, 89(4), 982-993.

Akande, S. (2017). Nigeria's used clothes trade is benefiting from a shrinking economy. https://www.pulse.ng/gist/akube-nigerias-used-clothes-trade-is-benefiting-from-a-shrinking-economy/wbzpxtj. (Accessed April, 2021)

Alfaro, L., Faia, E., Lamersdorf, N., & Saidi, F. (2022). Health externalities and policy: The role of social preferences. *Management Science*, published online.

Amin, M., & Soh, Y. C. (2021). Does greater regulatory burden lead to more corruption? Evidence using firm-level survey data for developing countries. *The World Bank Economic Review*, 35(3), 812-828.

Amin, M., & Ulku, H. (2019). Corruption, regulatory burden and firm productivity. World Bank Policy Research Working Paper, (8911).

Atasu, A., & Souza, G. C. (2013). How does product recovery affect quality choice?. *Production and Operations Management*, 22(4), 991-1010.

Baden, S., & Barber, C. (2005). The impact of the second-hand clothing trade on developing countries. *Internal Briefing Note: Oxfam GB*.

Bennett, V. M., Pierce, L., Snyder, J. A., & Toffel, M. W. (2013). Customer-driven misconduct: How competition corrupts business practices. *Management Science*, 59(8), 1725-1742.

Birhanu, A. G., Gambardella, A., & Valentini, G. (2016). Bribery and investment: Firm-level evidence from Africa and Latin America. *Strategic Management Journal*, 37(9), 1865-1877.

Blundell, R., Griffith, R., & Van Reenen, J. (1999). Market share, market value and innovation in a panel of British manufacturing firms. *The Review of Economic Studies*, 66(3), 529-554.

Braud, L. M., Castell-Perez, M. E., & Matlock, M. D. (2000). Risk-based design of aseptic processing of heterogeneous food products. *Risk Analysis*, 20(4), 405-412.

Capasso, S., & Santoro, L. (2018). Active and passive corruption: Theory and evidence. *European Journal of Political Economy*, 52, 103-119.

Célimène, F., Dufrénot, G., Mophou, G., & N'Guérékata, G. (2016). Tax evasion, tax corruption and stochastic growth. *Economic Modelling*, 52, 251-258.

Chen, K., Wang, X., Niu, B., & Chen, Y. J. (2022). The impact of tariffs and price premiums of locally manufactured products on global manufacturers' sourcing strategies. *Production and Operations Management*, 31(9), 3474-3490.

Chen, Y., & Chen, F. (2019). On the competition between two modes of product recovery: Remanufacturing and refurbishing. *Production and Operations Management*, 28(12), 2983-3001.

Cho, S. H., Fang, X., Tayur, S., & Xu, Y. (2019). Combating child labor: Incentives and information disclosure in global supply chains. *Manufacturing & Service Operations Management*, 21(3), 692-711.

Choi, Y. J., & Jeon, M. S. (2020). How business interests and government inaction led to the humidifier disinfectant disaster in South Korea: Implications for better risk governance. *Risk Analysis*, 40(2), 240-253.

Coughlan, J., Shale, E., & Dyson, R. (2010). Including the customer in efficiency analysis: Evidence of a hybrid relational-transactional approach. *International Journal of Bank Marketing*, 28(2), 136-149.

de Zegher, J. F., Iancu, D. A., & Lee, H. L. (2019). Designing contracts and sourcing channels to create shared value. *Manufacturing & Service Operations Management*, 21(2), 271-289.

Dong, L., Rashkova, I., & Shi, D. (2022). Food safety audits in developing economies: Decentralization vs. centralization. *Manufacturing & Service Operations Management*, published online.

Dzhumashev, R. (2014). Corruption and growth: The role of governance, public spending, and economic

development. *Economic Modelling*, 37, 202-215.

Esenduran, G., Kemahlıoğlu-Ziya, E., & Swaminathan, J. M. (2017). Impact of take-back regulation on the remanufacturing industry. *Production and Operations Management*, 26(5), 924-944.

Fan, X., Chen, Y. J., & Tang, C. S. (2021a). Mechanism design for managing hidden rebates and inflated quotes of a procurement service provider. *Manufacturing & Service Operations Management*, 23(5), 1275-1296.

Fan, X., Chen, Y. J., & Tang, C. S. (2021b). To bribe or not in a procurement auction under disparate corruption pressure. *Production and Operations Management*, 30(5), 1220-1245.

Fang, X., & Cho, S. H. (2020). Cooperative approaches to managing social responsibility in a market with externalities. *Manufacturing & Service Operations Management*, 22(6), 1215-1233.

Feng, L., Govindan, K., & Li, C. (2017). Strategic planning: Design and coordination for dual-recycling channel reverse supply chain considering consumer behavior. *European Journal of Operational Research*, 260(2), 601-612.

Gaynor, M. (2007). Competition and quality in health care markets. *Foundations and Trends in Microeconomics*, 2(6), 441-508.

Guan, H., Geng, X., & Gurnani, H. (2021). Peer-to-peer sharing platforms with quality differentiation: Manufacturer's strategic decision under sharing economy. Working paper.

Guan, X., Liu, B., Chen, Y. J., & Wang, H. (2020). Inducing supply chain transparency through supplier encroachment. *Production and Operations Management*, 29(3), 725-749.

Gui, L., Tang, C. S., & Yin, S. (2019). Improving microretailer and consumer welfare in developing economies: Replenishment strategies and market entries. *Manufacturing & Service Operations Management*, 21(1), 231-250.

Guo, H., Zhao, X., Hao, L., & Liu, D. (2019). Economic analysis of reward advertising. *Production and Operations Management*, 28(10), 2413-2430.

Guo, H., Zhang, Y., Zhang, C., Liu, Y., & Zhou, Y. (2020). Location-inventory decisions for closed-loop supply chain management in the presence of the secondary market. *Annals of Operations Research*, 291(1), 361-386.

Guo, S., Choi, T. M., & Zhang, J. (2021). Second-hand-clothing imports in least-developed-countries: The collapse of local clothing manufacturing and remedial measures. *IEEE Transactions on Engineering Management*, published online.

Harbaugh, R., Maxwell, J. W., & Roussillon, B. (2011). Label confusion: The Groucho effect of uncertain standards. *Management Science*, 57(9), 1512-1527.

He, P., Wang, Z., Shi, V., & Liao, Y. (2021). The direct and cross effects in a supply chain with consumers sensitive to both carbon emissions and delivery time. *European Journal of Operational Research*, 292(1), 172-183.

Heitz, A., Wang, Y., & Wang, Z. (2021). Corporate political connections and favorable environmental regulatory enforcement. *Management Science*, published online.

Hu, M., Liu, Y., & Wang, W. (2019). Socially beneficial rationality: The value of strategic farmers, social entrepreneurs, and for-profit firms in crop planting decisions. *Management Science*, 65(8), 3654-3672.

Hu, M., Wang, Z., & Feng, Y. (2020). Information disclosure and pricing policies for sales of network goods. *Operations Research*, 68(4), 1162-1177.

Jeong, Y., & Weiner, R. J. (2012). Who bribes? Evidence from the United Nations' oil-for-food program. *Strategic Management Journal*, 33(12), 1363-1383.

Jildeh, Z. B., Wagner, P. H., & Schöning, M. J. (2021). Sterilization of objects, products, and packaging surfaces and their characterization in different fields of industry: The status in 2020. *Physica Status Solidi* (a), 218(13), 2000732.

Julian, S. D., & Ofori-dankwa, J. C. (2013). Financial resource availability and corporate social responsibility expenditures in a sub-Saharan economy: The institutional difference hypothesis. *Strategic Management Journal*, 34(11), 1314-1330.

Katende-Magezi, E. (2017). The impact of second hand clothes and shoes in East Africa. Geneva. CUTS International, Geneva.

Lee, S. H., & Weng, D. H. (2013). Does bribery in the home country promote or dampen firm exports?. *Strategic Management Journal*, 34(12), 1472-1487.

Li, T., Sethi, S. P., & Zhang, J. (2017). Mitigating supply uncertainty: The interplay between diversification and pricing. *Production and Operations Management*, 26(3), 369-388.

Li, Y., Feng, L., Govindan, K., & Xu, F. (2019). Effects of a secondary market on original equipment manufactures' pricing, trade-in remanufacturing, and entry decisions. *European Journal of Operational Research*, 279(3), 751-766.

Liu, W., Wei, W., Choi, T. M., & Yan, X. (2022). Impacts of leadership on corporate social responsibility management in multi-tier supply chains. *European Journal of Operational Research*, 299(2), 483-496.

Lu, T., & Tomlin, B. (2022). Sourcing from a self-reporting supplier: Strategic communication of social responsibility in a supply chain. *Manufacturing & Service Operations Management*, 24(2), 902-920.

Ma, X., Ho, W., Ji, P., & Talluri, S. (2018). Coordinated pricing analysis with the carbon tax scheme in a supply chain. *Decision Sciences*, 49(5), 863-900.

Mazahir, S., Verter, V., Boyaci, T., & Van Wassenhove, L. N. (2019). Did Europe move in the right direction on e-waste legislation?. *Production and Operations Management*, 28(1), 121-139.

Montiel, I., Husted, B. W., & Christmann, P. (2012). Using private management standard certification to reduce information asymmetries in corrupt environments. *Strategic Management Journal*, 33(9), 1103-1113.

Mu, L., Hu, B., Reddy, A. A., & Gavirneni, S. (2022). Negotiating government-to-government food importing contracts: A Nash Bargaining framework. *Manufacturing & Service Operations Management*, 24(3), 1681-1697.

Murali, K., Lim, M. K., & Petruzzi, N. C. (2019). The effects of ecolabels and environmental regulation on green product development. *Manufacturing & Service Operations Management*, 21(3), 519-535.

Niu, B., Dai, Z., & Li, Q. (2022). Sharing knowledge to an entrant for production investment confronting COVID-19: Incentive alignment and lose-lose dilemma. *Risk Analysis*, 42(1), 177-205.

Niu, B., & Zou, Z. (2017). Better demand signal, better decisions? Evaluation of big data in a licensed remanufacturing supply chain with environmental risk considerations. *Risk Analysis*, 37(8), 1550-1565.

Norris, L. (2015). The limits of ethicality in international markets: Imported second-hand clothing in India. *Geoforum*, 67, 183-193.

Oliva, P. (2015). Environmental regulations and corruption: Automobile emissions in Mexico City. *Journal of Political Economy*, 123(3), 686-724.

Perera, S., Dawande, M., Janakiraman, G., & Mookerjee, V. (2020). Retail deliveries by drones: How will logistics networks change?. *Production and Operations Management*, 29(9), 2019-2034.

Pinçe, Ç., Ferguson, M., & Toktay, B. (2016). Extracting maximum value from consumer returns: Allocating between remarketing and refurbishing for warranty claims. *Manufacturing & Service Operations Management*, 18(4), 475-492.

Plambeck, E. L., & Taylor, T. A. (2016). Supplier evasion of a buyer's audit: Implications for motivating supplier social and environmental responsibility. *Manufacturing & Service Operations Management*, 18(2), 184-197.

Pun, H., Swaminathan, J. M., & Hou, P. (2021). Blockchain adoption for combating deceptive counterfeits. *Production and Operations Management*, 30(4), 864-882.

Robert, L. (2020). How fashion rental services keep their apparel clean and hygienic. https://cnalifestyle.channelnewsasia.com/style/fashion-rental-services-singapore-style-theory-rentadella-253656. (Accessed January 2023)

Saunders, L. W., Paul-Brooks, J., Merrick, J. R., & Autry, C. W. (2020). Addressing economic/environmental sustainability trade-offs in procurement episodes with industrial suppliers. *Production and Operations Management*, 29(5), 1256-1269.

Shi, X., Tang, J., & Dong, C. (2021). Should a domestic firm carve out a niche in overseas markets? Value of purchasing agents. *European Journal of Operational Research*, 300(1), 85-94.

Shi, Z., Zhang, K., & Srinivasan, K. (2019). Freemium as an optimal strategy for market dominant firms. *Marketing Science*, 38(1), 150-169.

Singh, S. (2017). Competition in corruptible markets. *Marketing Science*, 36(3), 361-381.

Souza, G. C. (2013). Closed-loop supply chains: A critical review, and future research. *Decision Sciences*, 44(1), 7-38.

Sudhir, K., & Talukdar, D. (2015). The "Peter Pan syndrome" in emerging markets: The productivity-transparency trade-off in IT adoption. *Marketing Science*, 34(4), 500-521.

Taylor, T. A., & Xiao, W. (2019). Donor product-subsidies to increase consumption: Implications of consumer awareness and profit-maximizing intermediaries. *Production and Operations Management*, 28(7), 1757-1772.

The Ghana Standards Authority. (2021). https://www.gsa.gov.gh/import-inspection/. (Accessed April, 2021)

The International Trade Administration, U.S. Department of Commerce. (2021). https://www.trade.gov/textile-and-apparel-market-report-worn-clothing-requirements. (Accessed December, 2021)

Thekdi, S. A. (2016). Risk management should play a stronger role in developing and implementing social responsibility policies for organizations. *Risk Analysis*, 36(5), 870-873.

Tian, F., Sošić, G., & Debo, L. (2019). Manufacturers' competition and cooperation in sustainability: Stable recycling alliances. *Management Science*, 65(10), 4733-4753.

Toyasaki, F., Boyacı, T., & Verter, V. (2011). An analysis of monopolistic and competitive take-back schemes for WEEE recycling. *Production and Operations Management*, 20(6), 805-823.

Ullah, A., Ayat, M., He, Y., Huang, W., & Jiang, W. (2022). Game-theoretic models for warranty and post-warranty maintenance with risk-averse service providers. *International Journal of Industrial Engineering*, published online.

United Nations (2016). Making trade work for Least Developed Countries: A Handbook on Mainstreaming Trade [English] - Trade and Poverty Paper Series, No. 5 (UNCTAD/ALDC/2015/5). https://unctad.org/system/files/official-document/aldc2015d5_en.pdf. (Accessed January 2023)

Veflen, N., Scholderer, J., & Langsrud, S. (2020). Situated food safety risk and the influence of social norms. *Risk Analysis*, 40(5), 1092-1110.

Viscusi, W. K., & Hamilton, J. T. (1999). Are risk regulators rational? Evidence from hazardous waste cleanup decisions. *American Economic Review*, 89(4), 1010-1027.

Wang, X., Leng, M., Song, J., Luo, C., & Hui, S. (2019). Managing a supply chain under the impact of customer reviews: A two-period game analysis. *European Journal of Operational Research*, 277(2), 454-468.

Wang, Z., van der Fels-Klerx, H. J., & Lansink, A. O. (2020). Optimization of sampling for monitoring chemicals in the food supply chain using a risk-based approach: The case of aflatoxins and dioxins in the Dutch dairy chain. *Risk Analysis*, 40(12), 2539-2560.

Xiao, S., Chen, Y. J., & Tang, C. S. (2020). Knowledge sharing and learning among smallholders in developing economies: Implications, incentives, and reward mechanisms. *Operations Research*, 68(2), 435-452.

Yin, Z., Li, B., Gu, D., Huang, J., & Zhang, L. (2021). Modeling of farmers' vegetable safety production based on identification of key risk factors from Beijing, China. *Risk Analysis*, published online.

Yatsenko, O.M., Nitsenko, V.S., Mardani, A., & Tananaiko, T.S. (2018). The impact of global risks on the world trade and economic environment. *Financial and Credit Activity: Problems of Theory and Practice*, 4 (27), 435-444, 2018.

Zhang, F., & Zhang, R. (2018). Trade-in remanufacturing, customer purchasing behavior, and government policy. *Manufacturing & Service Operations Management*, 20(4), 601-616.

Zhao, X., Lim, A., Guo, H., Ding, C., & Song, J. S. (2019). Retail clusters in developing economies. *Manufacturing & Service Operations Management*, 21(2), 452-467.

Zhang, Y., & Swaminathan, J. M. (2020). Warehouse location in an emerging country: A win–win proposition?.

Production and Operations Management, 29(6), 1487-1505.

Zhong, F., Zhou, Z., & Leng, M. (2021). Negotiation-sequence, pricing, and ordering decisions in a three-echelon supply chain: A coopetitive-game analysis. *European Journal of Operational Research*, 294(3), 1096-1107.

Zhou, J., Fan, X., Chen, Y. J., & Tang, C. S. (2021). Information provision and farmer welfare in developing economies. *Manufacturing & Service Operations Management*, 23(1), 230-245.