

Communicating Environmental Quality to Consumers: Impacts of Label Confusion and Blockchain-Based Transparency

Yuqing Pan

Department of Department of Logistics and Maritime studies, The Hong Kong Polytechnic University, Hong Hum, Kowloon, Hong Kong,

yuqing.pan@connect.polyu.hk

Consumers are increasingly aware of sustainability. According to a survey conducted by Accenture, 72% of respondents buy more environmentally sustainable products today than before, and 81% of respondents expect to buy more green products in the future (Accenture 2019). Consumers' sustainability awareness may translate into higher willingness-to-pay for environmentally friendly products.

With consumers growing more aware of the environmental impact of products and services, firms are making efforts to improve their sustainable performance. Such efforts often involve higher costs but allow firms to meet the needs of environmentally conscious consumers and build a competitive advantage. For example, IKEA used recycled material in 10% of its products in 2018 (Ringstrom 2018).

Unlike conventional quality attributes, a product's environmental attributes cannot be observed or experienced by consumers (Baksi and Bose 2007). Indeed, environmental attributes are usually firms' private information. For this reason, environmental labels (also called ecolabels or green labels) have emerged. Environmental labels provide sustainability information about a product or service, such as its material, recyclability, packaging, or level of energy consumption (ISO 2019). Consumers want green labels on products and are willing to pay extra for labeled products (PEFC News 2014, UL Environment 2014).

However, the proliferation of labels leads to label confusion among consumers. Ecolabel Index, a global directory of ecolabels, currently identifies 455 ecolabels in 25 industry sectors (Ecolabel Index 2022). Thus, while environmental labels have the

potential to disclose important information about firms' sustainable efforts, consumers may be unfamiliar with or confused by them, especially given the presence of numerous labels with different standards.

With the increasing use of blockchain technology, blockchain-based transparency is attracting attention as a potential solution to the dilemma caused by label confusion. Blockchain technology improves the information transparency within supply chains and is able to reliably reveal firms' environmental efforts to consumers (see Shen et al. 2022 for evidence on the reliability of such disclosure). Several companies have adopted this approach. For example, beauty brand Tropic Skincare uses blockchain technology to improve shoppers' understanding of its social and environmental impact (Provenance 2022).

Motivated by the above observations, this paper examines how a sustainable firm should communicate its environmental quality to consumers in a competitive market and how the means of communication affects the firm's environmental quality when there exists label confusion among consumers. The research questions are as follows: First, given the existence of label confusion, how should a sustainable firm decide its level of environmental quality when using labels to communicate its environmental efforts? Second, can blockchain-based transparency benefit a sustainable firm more than environmental labels, and if so, under which conditions? Third, what are the effects of blockchain-based transparency on a sustainable firm's environmental quality and a non-sustainable firm's profit?

To answer the above research questions, we develop a game-theoretic model with a sustainable firm and a non-sustainable firm. The sustainable firm offers an eco-friendly product with some level of environmental quality, while the non-sustainable firm sells a regular product without any environmental quality. The sustainable firm needs to communicate its environmental quality to consumers via either environmental labels or blockchain-based transparency. By comparing the performance of these two means of communication when some consumers are confused about label standards, our model provides novel insights into the operational issues faced by sustainable firms.

We highlight several main findings. First, under environmental labels, as the fraction of consumers who are confused about label standards increases, the sustainable firm may switch from a high-tier label to a low-tier label when the fraction of confused consumers is sufficiently high, but may counterintuitively switch from a low-tier label to a high-tier label when the fraction of confused consumers is moderate or low.

Second, the sustainable firm does not always prefer blockchain-based transparency over environmental labels. In particular, if blockchain adoption is free, the cost of environmental quality is low, and there is a great number of confused consumers, then the sustainable firm prefers blockchain-based transparency when the fraction of confused consumers is relatively small and prefers environmental labels otherwise.

Third, when the sustainable firm prefers blockchain-based transparency to environmental labels, the sustainable firm may improve or reduce its environmental quality, and the non-sustainable firm may be better or worse off. Blockchain-based transparency allows the sustainable firm to flexibly choose the desired environmental quality. Lastly, we identify the conditions under which blockchain adoption can lead to a win-win-win situation, wherein both firms make higher profits and the sustainable firm provides a higher quality level than those under environmental labels.

References

- [1] Accenture (2019) More than half of consumers would pay more for sustainable products designed to be reused or recycled, accenture survey finds. URL <https://newsroom.accenture.com/news/more-than-half-of-consumers-would-pay-more-for-sustainable-products-designed-to-be-reused-or-recycled> ledaccenture-survey-finds.htm.
- [2] Baksi S, Bose P (2007) Credence goods, efficient labelling policies, and regulatory enforcement. *Environmental and Resource Economics* 37(2):411–430.
- [3] Ecolabel Index (2022) <https://www.ecolabelindex.com/>, online; accessed April 13, 2022.
- [4] ISO (2019) Environmental labels.

https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB_100323.pdf, online; accessed June 18, 2022.

- [5] PEFC News (2014) Consumers trust certification labels and expect companies to label products, pefc research shows. URL <https://pefc.org/news/consumers-trust-certification-labels-and-expect-companies-to-label-products-pefc-research-shows>.
- [6] Provenance (2022) <https://www.provenance.org/case-studies/tropic-skincare>, online; accessed April 28, 2022.
- [7] Ringstrom A (2018) Ikea to use only renewable and recycled materials by 2030. URL <https://www.reuters.com/article/us-ikea-sustainability/ikea-to-use-only-renewable-and-recycled-materials-by-2030idUSKCN1J31CD>.
- [8] Shen B, Dong C, Minner S (2022) Combating copycats in the supply chain with permissioned blockchain technology. *Production and Operations Management* 31(1):138–154.
- [9] UL Environment (2014) Study proves the influence of green product claims on purchase intent and brand perception. URL <https://pefc.org/news/consumers-trust-certification-labels-and-expect-companies-to-label-products-pefc-research-shows>.