Price premiums for certified wood products in Japan: A case study on cutting boards made of Japanese Cypress (Chamaecyparis obtusa)

Ikuo Ota1 · Masumi Kamakura2 · Masashi Konoshima1

Accepted: 13 May 2022 / Published online: 21 June 2022
© Steve Harrison, John Herbohn 2022

Abstract
Forest certification is slowly but steadily expanding in Japan, with the total area of certified forest being around 2.5 million ha or 10% of all forestland. However, FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification) products are still uncommon because few companies undertake CoC (Chain of Custody) certification. We conducted experimental sales of FSC certified and non-certified cutting boards with different designs and sizes made of Hinoki or Japanese Cypress (Chamaecyparis obtusa) on an internet shopping website. We prepared the same products from FSC certified and non-certified wood and sold them simultaneously at different prices. Customers interested in purchasing cutting boards could choose either and were aware of the prices. The largest cutting board was 460 mm × 240 mm × 30 mm, with the basic price of JPY 3,600, and the smallest was 200 mm × 200 mm × 25 mm, with the basic price of JPY 2,950. We considered four price difference levels, between 20% and 50%, for a period of around six months. In total, 22% of customers chose certified products at a 20% price premium, 14% chose a certified product at a 30% price premium, 10% chose a certified product at a 40% price premium, and 10% chose a certified product at a 50% price premium. All price premiums were found to be statistically significant. Therefore, price premiums for FSC certified products are feasible up to 50% for small wood products such as cutting boards. These findings can help forest owners and the wood industry consider the potential of forest certification.

Keywords Cutting board · Experimental sales · Forest certification · FSC · Price premium

Ikuo Ota
ikuota@agr.u-ryukyu.ac.jp

1 University of the Ryukyus, 903-0213 Okinawa, Japan
2 Shikoku Kako Co. Ltd., 792-0856 Ehime, Japan

Springer
Introduction

Japan is one of the most forested countries in the developed world. Two-thirds of its land area or 25 million ha are covered by dense forests. Around 57% of the forest areas are privately owned, most properties being small in scale. There are around 830,000 households with forestland over 1 ha, with an average size of 6.2 ha.

The annual consumption of wood fiber in Japan is around 80 million m$^3$, of which 30 million is domestically produced. More specifically, timber demand in 2016 was 78.1 million m$^3$, of which domestic production was 27.1 million m$^3$ (self-sufficient rate was 34.8%). In 2019, timber demand was 81.9 million m$^3$, of which domestic production was 31.0 million m$^3$ (self-sufficient rate was 37.8%). In recent years, the trend has indicated an increase in domestic timber production and a gradual decrease in the volume of imported timber. Japan’s major trading partners in timber are the USA, Canada, Russia, Malaysia, Indonesia, Australia, Chile, and Vietnam. More than half of the imported wood fiber is represented by wood chips for paper, while around 30% is for construction timber and boards. Conversely, the majority of domestic wood is used for housing construction. The main tree species of domestic timber are Sugi or Japanese Cedar (Cryptomeria japonica) and Hinoki or Japanese Cypress (Chamaecyparis obtusa), which account for more than 70% of production.

Forest certification is important for the Japanese society, both in terms of supply and demand, from the perspective of national land conservation and for the sound utilization of finite natural resources. However, the forest certification system is not popular yet; it has been expanding slowly after its introduction in 2000. Three schemes of forest certification have been introduced in Japan: Forest Stewardship Council (FSC), Sustainable Green Ecosystem Council (SGEC), and Programme for the Endorsement of Forest Certification (PEFC). SGEC is a forest certification scheme, original to Japan, developed in 2003, by mutual recognition with PEFC in 2016. The area of FSC certified forest was 414,629 ha and that of SGEC/PEFC certified forest was 2,166,470 ha as of June 2021. Currently, the total area of certified forest in Japan is around 2.5 million ha or 10% of the forest area.

From the suppliers’ viewpoint, price premiums for certified forest products are crucial for sales promotion. This is an especially important topic for most of the small-scale forest owners, who do not have an economy of scale advantage. The purpose of this study is to verify the existence of price premiums for certified wood products. If a price premium exists, we also investigate how the percentage of certified product purchasers changes as the price premium increases.

To achieve these objectives, we conducted a series of experimental sales of FSC certified wood products. Specifically, several types of cutting boards, made of Hinoki, with different designs and sizes, were sold on an internet shopping site. We prepared the same types of products from FSC certified and non-certified wood and sold them simultaneously at different prices. Customers who were interested in purchasing a cutting board were aware of the prices and could choose either.
Literature review

There are numerous studies on price premiums for logs, timber, and wood products in the field of forest certification. While some articles on the existence of price premiums have a negative perspective on this approach, some are neutral, and others are positive. Further, the literature showed that consumers’ willingness to pay for certified forest products tends to be largely positive, and sawmills’ and/or wholesalers’ willingness to pay for certified logs and lumber is either small or zero. The results of the empirical studies on certified forest products are largely mixed. While many studies suggested no price difference between certified and non-certified forest products, others found the existence of positive price differences.

Since forest certification has certain monetary costs, certified companies and those considering obtaining certification in the future naturally expect a price premium on their products (Jenkins and Smith 1999; Overdevest and Rickenbach 2006; Zubiarrarreta et al. 2021). However, getting a price premium is not easy. Sedjo and Swallow (1999) theoretically analyzed the conditions for generating price premiums in the market and showed that a price premium can only emerge when the cost of obtaining forest certification is fairly low and the demand for certified products is comparatively high.

Several studies reported that price premiums mostly do not exist in countries such as the USA (Anderson and Hansen 2004; Anderson et al. 2005; Overdevest and Rickenbach 2006), Canada (Wilson et al. 2001), Mexico (Madrid and Chapela 2003), Bolivía (Nebel et al. 2005), Brazil (Humphries and Kainer 2006), Ecuador and Bolivia (Ebeling and Yasué 2009), South Africa (Morris and Dunne 2004), Cameroon (Alemagi et al. 2012), Finland (Owari et al. 2006), Czech Republic and Slovakia (Paluš et al. 2017), and Japan (Ota 2006; Owari and Sawanobori 2007; Chen et al. 2010) reviewed related studies and determined that it would be difficult to realize a price premium, especially for commodity products. As a result of interview surveys within the European Union timber industry, Gomez-Zamalloa and Capsrros (2011) found that most companies sell certified timber products at the same prices as non-certified ones.

Conversely, many studies predicted the existence of price premiums using willingness-to-pay (WTP) questionnaire surveys. For example, Ozanne and Vlosky (1997) calculated an average WTP of 12% for certified versus non-certified wood products in the United States (US). Similarly, Aguilar and Vlosky (2007) determined that the price premium level for wood products would most likely be between 10% and 25%, while Jensen et al. (2003) estimated a 15.9% price premium for an oak shelving board in the US. Paletto and Notaro (2018) found that 29.7% of their respondents (secondary wood manufacturers in Italy) would be willing to pay a mean premium price of 2.4% for certified wooden planks. Cha et al. (2009) estimated an average WTP of 5.6% for wood products in South Korea. Mohamed and Ghani (2010) found that 57% of the respondents were willing to pay a positive price premium for certified products in Malaysia.

Some WTP studies yielded more conservative results. For instance, Brusselaers et al. (2017) demonstrated that a certain price premium exists for certified wood, but this type of wood is not very profitable considering the transportation cost for export.
Cai and Aguilar (2013) determined that the price premium percentage tended to be higher for lower prices of wood products and vice versa. Luo et al. (2018) conducted a comparative study on consumer WTP for modern wooden structures (residences and hotels) in China and Japan, and found that the Japanese consumers tended to pay a higher price premium for residences, while the Chinese tended to pay more for hotels.

Therefore, empirical studies have identified the possibility of price premiums for certified wood products. Through their comparative analysis based on the status of FSC certification in Argentina and Brazil, Espach (2006) reported no price premium in Argentina and a relatively large price premium (between 20% and 50%) for tropical native wood in Brazil. Schreiber (2012) concluded that certified wood products had an average price premium of 10.5% but a much lower rate (between 1.6% and 4.3%) for stumpage in a large timber management organization in the US. Halalisan et al. (2018) reported the results of a questionnaire survey administered to Forest District officers in Romania, where 61% chose a negative and 39% a positive price premium. Within the latter category, the price premiums were largely between 5% and 10%.

In Asian countries, researchers have been recently studying price premiums for certified logs and wood products. Kollert and Lagan (2007) showed that the price premiums for high quality hardwood tended to be higher (between 27% and 56%), while those for lower quality timber tended to be lower (between 2% and 30%) in Sabah, Malaysia. Through a case study in Yogyakarta, Indonesia, Fujiwara et al. (2015) stated that the price of certified timber is usually 10–15% higher than the local average trading price. Hoang et al. (2019) identified that the price premium for FSC certified timber was 23% in 2015 and 17% in 2016, based on their case study in Vietnam. Yamamoto et al. (2014) found a 1.4% price premium for logs by analyzing log auction transaction data in Shizuoka, Japan. Therefore, the existence of price premiums for certified wood products is still controversial. However, the accumulation of empirical studies, especially market research, and long-term follow-ups are important (Jaung et al. 2016; Van der Ven and Cashore 2018). Our study adds empirical evidence of the existence of price premiums for certified wood products and thus, contributes to the literature in this field.

**Methods**

We conducted experimental sales of wooden cutting boards using an internet shopping website that sells various wood products. Wooden cutting boards have been an indispensable part of Japanese cuisine and are popular among people who like cooking. Specifically, consumers prefer Hinoki because of its color and fragrance as well as appropriate hardness.

Preferable sizes and shapes of cutting boards depend on users’ specific needs. For example, if you need to prepare meals for a big family, you may want a larger chopping board with extra room; for singles, a large cutting board takes too much space for their daily needs (Nakashima and Kishimoto 2011; Radhika and Lakshmi 2021). Therefore, stores usually carry cutting boards available in a wide variety of lengths,
widths, as well as thicknesses. This experimental study is not an exception in this regard.

Six types of cutting boards were prepared for the experimental sales. Table 1 shows their sizes and selling prices. A-series were professional thick cutting boards with right-angled corners and B-series were casual types of cutting boards with rounded corners. During the experimental sales, the prices of non-FSC certified wooden cutting boards were fixed, as shown in the table, while the FSC certified products were sold at premium prices from 20 to 50% higher than those of their non-FSC counterparts. For example, for the A-Large type, the price of the non-certified product was JPY 3,888, of which JPY 288 was an 8% consumption tax on the list price of JPY 3,600; for FSC certified products with 20%, 30%, 40%, and 50% price premiums, the sales prices were JPY 4,666, 5,054, 5,443, and 5,832, respectively.

Non-certified and FSC certified products were sold simultaneously and detailed explanations of the forest certification system were provided. Those who wished to purchase cutting boards could decide whether to buy products with price premiums. We explained the purpose of FSC forest certification system on the site as follows: “FSC forest certification system refers to the system wherein a third-party organization examines the implementation of sustainable forest management from three perspectives, namely, economic viability, social responsibility, and environmental soundness, using 10 original Principles.” In addition, we added a commentary on

| Types   | Size (mm x mm x mm) | Price (Non-FSC) | Price (FSC certified) |
|---------|---------------------|----------------|-----------------------|
| A-Large | 460×240×30          | 3,888 JPY      | +20%, +30%, +40%, +50% |
| A-Medium| 430×210×30          | 3,780 JPY      | +20%, +30%, +40%, +50% |
| A-Small | 350×180×30          | 3,456 JPY      | +20%, +30%, +40%, +50% |
| B-Large | 430×210×25          | 3,780 JPY      | +20%, +30%, +40%, +50% |
| B-Medium| 350×180×25          | 3,456 JPY      | +20%, +30%, +40%, +50% |
| B-Small | 200×200×25          | 3,186 JPY      | +20%, +30%, +40%, +50% |

| Price premium | Sales period                          | Actual number of sales days |
|---------------|---------------------------------------|-----------------------------|
| 20%           | June 24, 2016 to December 16, 2016     | 144 days                    |
| 30%           | December 17, 2016 to June 30, 2017     | 183 days                    |
| 40%           | November 6, 2017 to June 30, 2018      | 222 days                    |
| 50%           | September 20, 2018 to May 9, 2019      | 171 days                    |

Note: Due to lack of stock and inability to ship, the products were not sold for all days during the above sales period. The actual number of sales days represents a number excluding such periods when sales was not possible.
the CoC (Chain of Custody) system that guarantees traceability of the products with illustrations.

Our web store required customers to understand the FSC forest certification system before making a purchase. When purchasing a cutting board, there was a button to select either a certified or a non-certified product, and those who wished to purchase had to select either of the buttons. Those who skipped the explanation could not make a selection unless they understood the meaning of FSC at this point. Therefore, it may be assumed that all cutting board purchasers read the explanation of FSC.

All types of cutting boards at all prices were sold for roughly six months, ranging from 144 days to 222 days. The numbers sold were sufficient for statistical analysis. The specific sales periods are shown in Table 2. During this period, all the prices were constant for each product, and no information on future prices was disclosed.

Before the experimental sales, we conducted a survey to find whether similar products were sold online and at what prices. Consequently, we found that at the time of our experimental sales, similar products were not sold at Rakuten Market, Amazon Japan, and Yahoo Shopping, the three major online malls in Japan. Hence, we assume that there was no price anchoring effect during the experimental sales.

Results

The results of the experimental sales with the 20% price premium for FSC certified cutting boards against non-certified products are as follows. Within the six considered types, 102 certified products were sold compared to 357 non-certified products. That is, the sales proportion of certified products was 22.2%. The sales figures for each of the six types of cutting boards are shown in Table 3. A comparison of the sales

| Types       | Number of sales | Proportion of FSC certified products (%) |
|-------------|-----------------|------------------------------------------|
|             | Non-certified   | Certified                                | Total                   |
| A-Large     | 115             | 47                                        | 162                     | 29.0***     |
| A-Medium    | 62              | 15                                        | 77                      | 19.5***     |
| A-Small     | 10              | 7                                         | 17                      | 41.2***     |
| A-series total | 187             | 69                                        | 256                     | 27.0***     |
| B-Large     | 122             | 24                                        | 146                     | 16.4***     |
| B-Medium    | 41              | 7                                         | 48                      | 14.6***     |
| B-Small     | 7               | 2                                         | 9                       | 22.2        |
| B-series total | 170             | 33                                        | 203                     | 16.3***     |
| Ground Total | 357             | 102                                       | 459                     | 22.2***     |

*** indicates p-value < 0.01 resulting from statistical testing of the existence of price premiums (see Appendix I)

** indicates p-value < 0.05 resulting from statistical testing of the existence of price premiums (see Appendix I)

* indicates p-value < 0.10 resulting from statistical testing of the existence of price premiums (see Appendix I)
performance of the cutting boards revealed that the sales proportion of FSC certified products was considerably higher for the authentic A-series (27.0%) than that for the casual B-series (16.3%).

A total of 85 certified products were sold at a 30% price premium compared with 538 non-certified products, the sales proportion of the certified products being 13.6%. The sales figures for each of the six types of cutting boards are shown in Table 4. A comparison of the sales performance of the cutting boards revealed that the sales pro-

### Table 4  Sales performance of the cutting boards at a price premium of 30%

| Types    | Number of sales | Proportion of FSC certified products (%) |
|----------|-----------------|-------------------------------------------|
|          | Non-certified   | FSC certified | Total   |                                      |
| A-Large  | 151             | 36            | 187     | 19.3***                                |
| A-Medium | 72              | 11            | 83      | 13.3***                                |
| A-Small  | 17              | 5             | 22      | 22.7**                                 |
| A-series total | 240          | 52            | 292     | 17.8***                                |
| B-Large  | 223             | 23            | 246     | 9.3***                                 |
| B-Medium | 59              | 8             | 67      | 11.9***                                |
| B-Small  | 16              | 2             | 18      | 11.1                                   |
| B-series total | 298           | 33            | 331     | 10.0***                                |
| Ground Total | 538           | 85            | 623     | 13.6***                                |

*** indicates p-value < 0.01 resulting from statistical testing of the existence of price premiums (see Appendix I)

** indicates p-value < 0.05 resulting from statistical testing of the existence of price premiums (see Appendix I)

* indicates p-value < 0.10 resulting from statistical testing of the existence of price premiums (see Appendix I)

### Table 5  Sales performance of the cutting boards at a price premium of 40%

| Types    | Number of sales | Proportion of FSC certified products (%) |
|----------|-----------------|-------------------------------------------|
|          | Non-certified   | FSC certified | Total   |                                      |
| A-Large  | 231             | 29            | 260     | 11.2***                                |
| A-Medium | 94              | 11            | 105     | 10.5***                                |
| A-Small  | 23              | 3             | 26      | 11.5*                                  |
| A-series total | 348           | 43            | 391     | 11.0***                                |
| B-Large  | 273             | 27            | 300     | 9.0***                                 |
| B-Medium | 77              | 7             | 84      | 8.3***                                 |
| B-Small  | 27              | 2             | 29      | 6.9                                    |
| B-series total | 377           | 36            | 413     | 8.7***                                 |
| Ground Total | 725           | 79            | 804     | 9.8***                                 |

*** indicates p-value < 0.01 resulting from statistical testing of the existence of price premiums (see Appendix I)

** indicates p-value < 0.05 resulting from statistical testing of the existence of price premiums (see Appendix I)

* indicates p-value < 0.10 resulting from statistical testing of the existence of price premiums (see Appendix I)
portion of FSC certified products was considerably higher for the A-series (17.8%) than that for the B-series (10.0%). However, for all the types, the 30% price premium resulted in a lower percentage of certified product sales compared to the 20% price premium.

A total of 79 certified products were sold at a 40% price premium compared with 725 non-certified products, the sales proportion of the certified products being 9.8%. The actual sales figures for each of the six types of cutting boards are shown in Table 5. A comparison of the sales performance of the two types revealed that the sales proportion of FSC certified products was higher for the A-series (11.0%) than that for the B-series (8.7%). Similar to the results for 30% price premium, for all the product types, the 40% price premium resulted in a lower percentage of certified product sales than the 30% price premium.

Increasing the price premium by 50% for certified cutting boards with respect to the non-certified ones resulted in a significant difference. The sales proportion of certified products was almost the same as for the 40% price premium. A total of 69 certified products were sold compared to 628 non-certified products, the sales proportion of certified products being 9.9%. This figure was 0.1% points higher than that for the 40% price premium. The sales proportion of FSC certified products in the A-series (10.3%) was not significantly different from the B-series (9.4%), as shown in Table 6.

Discussion

At the outset, we checked to ensure that there were no major economic changes in the Japanese society and the forest sector during the period of the experimental sales. The consumer price index was very stable, and there was no significant change in

| Types         | Number of sales | Proportion of FSC certified products (%) |
|---------------|-----------------|------------------------------------------|
|               | Non-certified   | FSC certified   | Total   |                                |
| A-Large       | 199             | 19             | 218     | 8.7***                         |
| A-Medium      | 104             | 14             | 118     | 11.9***                        |
| A-Small       | 27              | 5              | 32      | 15.6**                         |
| A-series total| 330             | 38             | 368     | 10.3***                        |
| B-Large       | 212             | 21             | 233     | 9.0***                         |
| B-Medium      | 65              | 9              | 74      | 12.2***                        |
| B-Small       | 21              | 1              | 22      | 4.5                            |
| B-series total| 298             | 31             | 329     | 9.4***                         |
| Ground Total  | 628             | 69             | 697     | 9.9***                         |

*** indicates p-value<0.01 resulting from statistical testing of the existence of price premiums (see Appendix I)

** indicates p-value<0.05 resulting from statistical testing of the existence of price premiums (see Appendix I)

* indicates p-value<0.10 resulting from statistical testing of the existence of price premiums (see Appendix I)
the price of Hinoki logs between 2016 and 2019. Therefore, although different price
premium levels were assigned to different sales periods, we assume that economic
factors other than the price premium did not affect our findings.

Based on the experimental sales, 22.2% of all purchasers selected the FSC certi-
fied cutting boards at a 20% price premium against the non-certified ones. Testing
this figure confirmed the existence of a price premium at significance level of 0.01.
The results of testing for each individual product showed that there was a price pre-
mium in five out of the six products at significance level of 0.01. (see Table 3). The
details of the statistical test are shown in Appendix 1.

As indicated in Tables 4 and 5, and 6, price premiums were also statistically sig-
ificant for the 30–50% premiums. In case of 30% price premium, four out of six
products showed the existence of a price premium at significant level of 0.01, one
showed the existence of a price premium at significant level of 0.05 (see Table 4). In
case of 40% price premium, four out of six products showed the existence of a price
premium at significant level of 0.01, one showed the existence of a price premium at
significant level of 0.1 (see Table 5). In case of 50% price premium, four out of six
products showed the existence of a price premium at significant level of 0.01, one
showed the existence of a price premium at significant level of 0.05 (see Table 6).

Regardless of their prior knowledge, some customers who read the explanations
on the environmentally friendly forest certification system chose to purchase certified
wood products even if they were more expensive than their non-certified counter-
parts. In fact, the recognition of the forest certification system in Japan is not high.
According to our Internet survey conducted in 2015, only 3.0% of the respondents
were familiar with the forest certification system, 13.2% had heard the name, and
more than 80% did not know of it at all (Ota and Kamakura 2016). In addition,
according to a survey on ethical consumption conducted by the Consumer Affairs
Agency of Japan, of all the respondents, only 4.6% in 2016 and 7.9% in 2019 were
able to identify the FSC logo mark (Consumer Affairs Agency 2020). Therefore,
in the experimental sales, many cutting board purchasers would not have had prior
knowledge of the forest certification, but they decided to purchase certified products
at a premium price after reading the explanation on the web. This suggests that rais-
ing awareness is extremely important for encouraging the use of forest certification
products.

Important results were obtained regarding the relationship between the amount of
price premiums and the sales percentage. Figure 1 shows the proportion of certified
product purchasers by price premium using the aggregated data of all types (A and
B) and sizes (S, M, and L). As shown in Fig. 1, the number of certified products pur-
chasers decreased as the price premiums increased from 20 to 40%. This tendency is
understandable and consistent with previous studies (Anderson et al. 2005; Aguilar
and Cai 2010). However, regarding the dynamics when the price premium exceeded
40%, there was almost no change when the price premium increased from 40 to 50%.
In order to evaluate significant differences of proportions of certified product pur-
chasers between adjacent price premium levels (20% and 30%, 30% and 40%, 40%
and 50%), the z-test statistic for testing the equality of proportions between the two
groups was computed (Currel 2015). We also performed the chi-square test for the
equality of two proportions. As indicated in Table 7, proportion of certified product
purchasers significantly decreased from price premium of 20–30%, and also from 30 to 40%, but did not from 40 to 50%.

One of the reasons for this phenomenon is that the consumers who purchase products at a fairly high price, in case of a 40% or higher price premium, might be paying attention not to the price but to the forest certification, and are more likely to buy the products they want regardless of the price.

Alternatively, consumers who accept price premiums above 40% may be so-called “True-Blue” Greens. Since the 2000s, people in the US who are deeply concerned about environmental problems and act adaptively are called “True-Blue” Greens; they account for about 10% of the population (Anderson and Hansen 2004; Rex and Baumann 2007). It is unclear how many such people are in Japan, but the approximately 10% figure shown here is very interesting. We had to pause the study after 2020 due to COVID-19, but if the pandemic ends and the social situation stabilizes, we would like to proceed further. Hence, even if the price premium were set to 60% or more, it can be expected that about 10% of Japanese “True-Blue” Greens would continue to buy certified products.

Finally, let us consider what this study adds to the previous research in Japan. Owari and Sawanobori (2007) revealed that 90% of the forest certified products sold in Japan are paper, and the amount of timber and wood products is small. They also revealed that it is difficult to give a price premium to construction timber producers and wood manufacturers because of the absence of radical consumer campaigns by
environmental groups, unlike in European countries. Yamamoto et al. (2014) found a 1.4% price premium for logs for sawmills at the auction market but not for the final products. In contrast, Ota (2006) and Ota (2010) reported a case in which a forest owners cooperative made a profit by selling certified logs directly to a housing company without going through the auction market. Here, the traceability of wood was an important factor. Our study reveals that there is definitely a price premium for small wood products such as cutting boards. This is a new discovery. In other words, our study reveals that there are certain consumers in Japan who are willing to pay extra for eco-friendly products like certified wood products. This finding is hoped to boost the production and sales of certified wood products in the future.

Conclusions

Numerous studies on the economic benefits of certified wood products have been conducted to date, and this study contributes to this literature stream. We set the prices of certified products 20%, 30%, 40%, and 50% higher than those of non-certified products in a series of experimental sales of wooden cutting boards. There are consumers who are willing to purchase certified products with price premiums up to 50% or more.

The finding that consumers purchase certified wood products even in case the price premium over 20% raises a question regarding the negative results of previous studies concerning the existence of price premiums. In this study, the existence of WTP at price premiums was observed more accurately based on the number of purchasers, in contrast to analyzing the WTP based on virtual questions.

Recently, some studies that analyzed the drivers of forest certification based on consumer behavior (Brusselaers et al. 2020) or corporate behavior toward certification (Zubizarreta et al. 2021) also found the market advantage being always ranked high. Empirical market research is becoming increasingly important.

Furthermore, we analyzed the differences in the proportion of certified products purchased by the age and gender of the purchasers, but found no statistically significant difference. Analysis of consumer attributes and purchasing behavior will be an issue for our future study.

The sale of wooden cutting boards is a niche market. However, in countries such as Japan, where there are many small-scale forest owners and small-scale sawmills or wood processing companies, niche markets are an important sales target. Clarifying the existence of price premiums for certified products can provide a boost to forest certification among small-scale forest owners.

Appendix I

Statistical testing of the existence of price premiums.
Total number of cutting board sales: N.
Number of purchases of FSC certified products: X.
Sample proportion of products certified by FSC: p*, where p* = X/N.
Population proportion of products certified by FSC: $p$. The 99% confidence interval is defined by the following equation:

$$p^* = \frac{X}{N} \text{ should be in the following range with 99% of statistical probability:}$$

$$p^* - 2.58 \sqrt{\frac{p^*(1-p^*)}{N}} \leq p \leq p^* + 2.58 \sqrt{\frac{p^*(1-p^*)}{N}}.$$

Therefore, in case the left side of this equation is positive (the right side is always positive), then $p=0$ (non-existence of a price premium) is outside the 99% confidence interval.

Hence, $p$ is positive and significantly different from zero. Similarly, 95% and 90% confidence intervals are defined by the following equations:

$$p^* - 1.96 \sqrt{\frac{p^*(1-p^*)}{N}} \leq p \leq p^* + 1.96 \sqrt{\frac{p^*(1-p^*)}{N}}.$$ for 95%.

$$p^* - 1.65 \sqrt{\frac{p^*(1-p^*)}{N}} \leq p \leq p^* + 1.65 \sqrt{\frac{p^*(1-p^*)}{N}}.$$ for 90%.

References

Aguilar FX, Cai Z (2010) Conjoint effect of environmental labeling, disclosure of forest of origin and price on consumer preferences for wood products in the US and UK. Ecol Econ 70(2):308–316. https://doi.org/10.1016/j.ecolecon.2010.09.002

Aguilar FX, Vlosky RP (2007) Consumer willingness to pay price premium for environmentally certified wood products in the U.S. For Policy Econ 9:1100–1112

Alemagi D, Hajjar R, David S, Kozak RA (2012) Benefits and barriers to certification of community-based forest operations in Cameroon: An exploratory assessment. Small-Scale For 11(4):417–433. https://doi.org/10.1007/s11842-011-9192-9

Anderson RC, Hansen EN (2004) Determining consumer preferences for ecolabeled forest products. J For 102(4):28–32

Anderson RC, Laband DN, Hansen EN, Knowles CD (2005) Price premiums in the mist. For Prod J 55(6):19–22

Brusselaers J, Van Huylenbroeck GV, Buysse J (2017) Green public procurement of certified wood: Spatial leverage effect and welfare implications. Ecol Econ 135:91–102. https://doi.org/10.1016/j.ecolecon.2017.01.012

Brusselaers J, Verbeke W, Mettepenningen E, Buysse J (2020) Unravelling the true drivers for eco-certified wood consumption by introducing scarcity. For Policy Econ 111:102026. https://doi.org/10.1016/j.forpol.2019.102026

Cai Z, Aguilar FX (2013) Meta-analysis of consumer’s willingness-to-pay premiums for certified wood products. J For Econ 19(1):15–31. https://doi.org/10.1016/j.jfe.2012.06.007

Cha J, Chun JN, Youn YC (2009) Consumer willingness to pay price premium for certified wood products in South Korea. J Korean Forest Sci 98(2):203–211

Chen J, Innes JL, Tikina A (2010) Private cost-benefits of voluntary forest product certification. Int For Rev 12(1):1–12. https://doi.org/10.1505/ifor.12.1.1

Consumer Affairs Agency (2020) Report of the survey on ethical consumption (in Japanese). https://www.caa.go.jp/policies/policy/consumer_education/public_awareness/ethical/investigation/assets/consumer_education_ems202_200805_01.pdf. Accessed 20 January 2022

Currel G (2015) Scientific Data Analysis. Oxford University Press, USA

Ebeling J, Yasué M (2009) The effectiveness of market-based conservation in the tropics: Forest certification in Ecuador and Bolivia. J Environ Manage 90(2):1145–1153. https://doi.org/10.1016/j.jenvman.2008.05.003

Espach R (2006) When is sustainable forestry sustainable? The Forest Stewardship Council in Argentina And, Brazil. Global Environ Policies 6(2):55–84

Fujiwara T, Awang SA, Widayanti WT, Septiana RM, Hyakumura K, Sato N (2015) Effects of national community-based forest certification on forest management and timber marketing: A case study of Gunung Kidul, Yogyakarta, Indonesia. Int For Rev 17(4):448–460. https://doi.org/10.1505/146554815817476422
Gomez-Zamalloa M, Carpinteros A (2011) 15 years of forest certification in the European Union: Are we doing things right? Ayenaz ASM. For Syst 20(1):81–94

Halalislan AF, Abrudan IV, Popa B (2018) Forest management certification in Romania: Motivations and perceptions. Forests 9(7):16pp. https://doi.org/10.3390/f9070425

Hoang HTN, Hoshino S, Onitsuka K, Maraseni T (2019) Cost analysis of FSC forest certification and opportunities to cover the costs a case study of Quang Tri FSC group in Central Vietnam. J For Res 24(3):137–142. https://doi.org/10.1080/13416979.2019.1610993

Humphries SS, Kainer KA (2006) Local perceptions of forest certification for community-based enterprises. For Ecol Manag 235(1–3):30–43. https://doi.org/10.1016/j.foreco.2006.07.027

Jaung W, Putzel L, Bull GQ, Guariguata MR, Sumaila UR (2016) Estimating demand for certification of forest ecosystem services: A choice experiment with Forest Stewardship Council certificate holders. Ecosyst Serv 22:193–201. https://doi.org/10.1016/j.ecoser.2016.10.016

Jenkins MB, Smith ET (1999) The Business of Sustainable Forestry: Strategies for an Industry in transition. Island Press, Washington DC, p 256

Jensen K, Jakus PM, English B, Menard J (2003) Market participation and willingness to pay for environmentally certified products. For Sci 49(4):632–641

Kollert W, Lagan P (2007) Do certified tropical logs fetch a market premium? For Policy Econ 9(7):862–868. https://doi.org/10.1016/j.forpol.2006.03.005

Luo W, Mineo K, Matsushita K, Kanzaki M (2018) Consumer willingness to pay for modern wooden structures: A comparison between China and Japan. For Policy Econ 91:84–93. https://doi.org/10.1016/j.forpol.2017.12.003

Madrid S, Chapela F (2003) In: Molnar A (ed) Forest certification in Mexico: The case of Durango and Oaxaca. Annex 3 of Forest Certification and communities. Forest Trends, Washington DC, p 12

Mohamed S, Ghani ANA (2010) Willingness to pay a price premium for certified wood products among consumers in Malaysia. Pertanika J Trop Agric Sci 33(2):159–165

Morris M, Dunne N (2004) Driving environmental certification: Its impact on the furniture and timber products value chain in South Africa. Geoforum 35(2):251–266. https://doi.org/10.1016/j.geoforum.2003.09.006

Nakashima K, Kishimoto R (2011) A survey of cutting board used generally at home. Bull Beppu Univ J Coll 30:1–9 (in Japanese)

Ota I (2006) Experiences of forest owners’ cooperative in using FSC forest certification as an environmental strategy. Small-Scale For Econ Manag Policy 5(1):111–126. https://doi.org/10.1007/s11842-006-0007-3

Ota I (2010) Ecology-oriented house builders and FSC-certified domestic timber in Japan. Small-Scale For Econ 9(1):81–92. https://doi.org/10.1016/s11842-009-9103-5

Ota I, Kamakura M (2016) An empirical study on the price premium of certified wood products. J For Econ 62(3):42–48 (in Japanese)

Overdevest C, Rickenbach MG (2006) Forest certification and institutional governance: An empirical study of forest stewardship council certificate holders in the United States. For Policy Econ 9(1):93–102. https://doi.org/10.1016/S1389-9341(05)00034-5

Owari T, Justin H, Rummukainen A, Yoshimura T (2006) Strategies, functions and benefits of forest certification in wood products marketing: Perspectives of Finnish suppliers. For Policy Econ 9(4):380–391. https://doi.org/10.1016/j.forpol.2005.10.005

Owari T, Sawanobori Y (2007) Analysis of the certified forest products market in Japan. Holz Roh Werkst 65(2):113–120. https://doi.org/10.1007/s00107-006-0166-0

Ozanne LK, Vlosky RP (1997) Willingness to pay for environmentally certified wood products; A consumer perspective. For Prod J 47(6):39–48

Paletto A, Notaro S (2018) Secondary wood manufacturers’ willingness-to-pay for certified wood products in Italy. For Policy Econ 92:65–72. https://doi.org/10.1016/j.forpol.2018.04.002

Paluš H, Parobek J, Dudík R, Šupin M (2017) Assessment of chain-of-custody certification in the Czech and Slovak Republic. Sustainability 9(10):1898. https://doi.org/10.3390/su9101898

Radika V, Lakshmi VV (2021) Performance Evaluation of chopping board with ergonomic perspective. In: Chauhan IS (ed) Emerging trends in applied research volume 2. Integrated Publications, New Delhi, pp 45–62
Rex E, Baumann H (2007) Beyond ecolabels: What green marketing can learn from conventional marketing. J Clean Prod 15(6):567–576. https://doi.org/10.1016/j.jclepro.2006.05.013
Schreiber J (2012) A cost benefit analysis of forest certification at the Forestland Group. In: University D (ed.). Masters Thesis. 72 pp
Sedjo RA, Swallow SK (1999) Eco-labeling and the price premium. Discussion Paper 00–04. Resources for the Future. 17 pp
Van der Ven H, Cashore B (2018) Forest certification: The challenge of measuring impacts. Curr Opin Environ Sustainability 32:104–111. https://doi.org/10.1016/j.cosust.2018.06.001
Wilson B, Takahashi T, Vertinsky I (2001) The Canadian commercial forestry perspective on certification: National survey results. Forestry Chron Forestry Chron 77(2):309–313. https://doi.org/10.5558/tfc77309-2
Yamamoto Y, Takeuchi K, Shinkuma T (2014) Is there a price premium for certified wood? Empirical evidence from log auction data in Japan. For Policy Econ 38:168–172. https://doi.org/10.1016/j.forpol.2013.07.002
Zubizarreta M, Arana-Landín G, Cuadrado J (2021) Forest Certification in Spain: Analysis of certification drivers. J Clean Prod 294:126267. https://doi.org/10.1016/j.jclepro.2021.126267

Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.