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Does the EU Ecolabel Reduce the Information Asymmetry in Croatia?

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Abstract: *The information asymmetry creates numerous distortions and reduces the efficiency of the real markets. The fact that real product attributes are not observable by a consumer may demotivate some producers although their production would lead to an increase in the social welfare. This is a well-studied phenomenon by economists, but still its empirical testing represents a significant challenge due to its intangible nature.*

Information asymmetry is often present in the exchange of eco-friendly products since very usually the related production materials and techniques are not verifiable by a consumer. This causes the lack of such products in the economy while the brown products prevail. However, the real-world examples show that there exist mechanisms that restore those markets by reducing the information asymmetry, by increasing the trust, or by changing the profile of buyers. One of them elaborated in this paper is the EU Ecolabel in Croatia.

The first part of the research is dedicated to the analysis of adverse selection and the overview of the mechanisms that partly or fully resolve it. The research proceeds with the analysis of the role of the EU Ecolabel as an example of a mechanism that serves to reduce information asymmetry and to restore the markets for eco-friendly products. The previously developed models are applied to analyze Flash Eurobarometer data in order to shed light on the role of the EU Ecolabel in the market for eco-friendly products in Croatia. The empirical findings lead to critical reflection on the existing theoretical frameworks and to an improved understanding of complex empirical testing of information asymmetry models.

1. INTRODUCTION

The global environmental concerns show that the existing relationships between producers and consumers need to be improved to strengthen their markets for environmentally friendly products. The root causes can be searched in the fundamental market anomalies among which are information asymmetries.

This paper takes a closer look at the EU Ecolabel from the perspective of economic models of information asymmetry and by analyzing Flash Eurobarometer 535 data for Croatia dedicated to consumer attitudes about EU Ecolabel. EU Ecolabel is one of the tools for resolving information asymmetry in markets for commodities with unobservable characteristics. The empirical results show that the knowledge about EU Ecolabel, as well the care about the environmental impact of the products, as well as the trust in Ecolabel, might link to the frequency of purchase of the products with EU Ecolabel. Such findings suggest efforts to increase knowledge and trust in third-party certification might be suitable tools to tackle information asymmetry in the markets.

The second section presents the hidden action and hidden information, as well as adverse selection and moral hazard, followed by the overview of the literature on the mechanisms that can diminish the relevant problems. The third section is dedicated to the literature that studies information

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asymmetry problems in the markets for eco-friendly products. The fourth chapter presents the results of the empirical analysis based on Flash Eurobarometer 535 for Croatia, which is followed by a discussion and conclusion in the fifth and seventh chapters respectively.

2. INFORMATION ASYMMETRY PROBLEMS

The main properties of the free market setting are numerous buyers and sellers, homogeneous divisible goods, complete mobility of the product inputs and final products as well as complete information of all market players. However, Mas-Collel et al. (1995) group information asymmetry problems as hidden action and hidden information elaborated in this paper.

Milgrom and Roberts (1987) discuss the usefulness and the role of information asymmetry games. They differentiate complete information, incomplete information and information asymmetry games. Information asymmetry is a type of incomplete information market situation. However, some incomplete information situations do not involve asymmetry. In other words, all the market agents have the same knowledge, i.e. they are equally informed. It is important to note that puzzling situations occur not in all but in some cases of information asymmetry. Furthermore, two types of information asymmetry can be distinguished, hidden information and hidden action problems elaborated further.

2.1. Hidden Information

Hidden information is a type of information asymmetry where important properties of a product are known to a seller but are hidden from a buyer. A simple case of hidden information is modeled as follows.

For the matter of tractability, suppose that there is one producer and one consumer in the market. They exchange a product of a given quality θ with the expected quality $E\{\theta\}$. While the $E\{\theta\}$ is common knowledge, the exact product quality θ is known by the producer, but unknown to the consumer. If the consumer is a rational agent he will choose to buy the product only if the expected quality $E\{\theta\}$ is not lower than a product price p, that is, if $E\{\theta\} \geq p$.

On the other hand, a fully rational producer buys the product only if its price is not lower than the costs. It is worth mentioning that the costs also include opportunity costs. In this type of model the costs are used to be modeled as an increasing function of quality $C = f(\theta)$ with $f'(\theta) > 0$.

The adverse selection problem initially elaborated by Akerloff (1970) in the market for "lemons" appears as a market anomaly where the market party or fully may disappear since the market price is lower than the producer costs. Thus, if for some θ' market price $p \leq C(\theta')$, then the producer rejects to sell the product since the revenues are lower than the costs. Since the costs are increasing function of quality, such a situation appears in the case of high-quality products. The market price is not sufficiently high to motivate the producer to sell his product. The consumers as rational agents may adapt their quality expectations accordingly such that the expected quality is $E[\theta | c(\theta) \leq p]$. Let's suppose that the costs monotonically increase with quality, i.e. $C = c\theta$, while θ can take a value from 0 to 1 with the same probability. The maximum quality that can be exchanged in the market θ_M must meet condition $c\theta_M \leq p \leq \theta_M/2$, i.e. $c\theta_M \leq \theta_M/2$. If $c \leq 0,5$, the condition holds for every θ, the market transactions are not affected by information asymmetry. Otherwise, if $c > 0,5$, then an adverse selection problem is present and there is no market exchange of such a good.

2.2. Hidden Action

Instead, hidden action occurs when the property of the product is not given, and when it can be chosen by a producer. The consumer does not know the producer's choice or action relevant to the transaction. Let's suppose that product quality θ can vary from *0* to *1*. It is not given but it is chosen by the producer. The cost function is $C=c\theta$. In a one-shot game, the best response of the producer is to provide quality 0 if it is not observable by the consumer. Therefore, the expected quality 0. This mechanism leads to a market failure called a moral hazard problem.

2.3. Information Asymmetry: Solutions

Previous sections present market failures resulting from information asymmetries, that is, from the fact that not all the market players have the same information. In this section, the typical solutions are overviewed.

Lewis (2011) investigates the role of disclosure costs in e-Bay Motors. If the information disclosed is free, all the sellers are willing to disclose the information. However, if the information disclosed is infinitely costly, no information will be disclosed. The author shows how rich media such as photos and videos together with appropriate institutional contract enforcement may resolve adverse selection problems, such as in the case of the market for used cars.

On the other hand, Saeedi (2019) examines the role of reputation mechanisms in online markets. It is shown by an analysis of the counterfactuals that in a case of removing reputation mechanisms market players' surpluses would significantly drop, as well as the total market size. It is concluded that warranties significantly contribute to the resolution of adverse selection in such markets.

Lanz and Reins (2021) investigate the information asymmetry in the markets for energy efficiency which is treated as a credence good such that its real quality is not observed by buyers even after purchase. The possible solutions they review are labeling and certificates, independent energy audits, third-party reimbursements and subsidies, and reputation and repeated interaction.

Pooling and separating equilibria may be identified in information asymmetry games. Different mechanisms that solve adverse selection lead to the emergence of separating equilibria and quality signaling. On the other hand, Cabral (2005, p. 6) explains how repeated interactions can contribute to solving moral hazard present in hidden action models. He presents the model of trust where transactions are maintained even if hidden action is present due to repeated interactions. If the seller is sufficiently patient compared to the costs of providing high quality, the trust is maintained and high quality is provided in the equilibrium.

Neudeck and Podczeck (1996) Study how government regulation may restore the health insurance market affected by adverse selection problem, while Biswas and Koufopoulos (2022) demonstrate how regulation affects adverse selection in the banking sector.

3. INFORMATION ASYMMETRY IN THE MARKETS FOR ECO-FRIENDLY PRODUCTS

Eco-friendly products compared to the standard ones produce lower negative or even positive effects on the environment. However, their production is usually associated with higher production costs. In many cases, the exact technology and product properties are not observable to buyers, and there may exist information asymmetry concerning the eco-friendly properties of the products. Since

the buyer cannot distinguish eco-friendly products from the standard ones the profit-maximizing producer will misreport its type and pool with the eco-friendly producers. If the technology choice is endogenous, such a market situation results in no eco-friendly producers in the equilibrium. Thus, the information asymmetry may be detrimental in the markets for eco-friendly products.

A systematic approach to this problem is provided by McCluskey (2000) who differentiates cases of experience and credence good in markets for organic products. A study by Ikhsan et al. (2024) suggest that the presence of information asymmetry in the markets for green products leads to improved online review quality that further increases trust, and supports the purchase of such products.

Zhu et al. (2024) investigate applying a signaling game to analyse the role of third-party certificates in a market for green bonds. They find that incentives for green bond issuers to adopt third-party certificates can induce the emergence of the separating equilibrium so that third-party certification enables the separation of greenwashing issuers from non-greenwashing bond issuers.

Haas and Kempa (2023) analyse a principal-agent model with adverse where firms can be skilled or unskilled, and high or low polluting. Pigouvian taxation, interest rate subsidies and lean grantees are considered as possible policy tools. In a setting with Pogouvian taxation, only the skilled high-polluting firms apply clean technology. However, under given conditions "without emission tax and with an interest subsidy and a loan guarantee all firms use the clean technology (Haas & Kempa, 2023, p. 122). Sun et al. (2024) further recognize ESG as a suitable tool for firms to reduce information asymmetry in the green market.

Hamilton and Zilberman (2006) find that costly environmental certification may be efficient in reducing equilibrium fraud and contribute to the welfare effect in the markets for environmentally friendly products. Also, the results depend on the market structure. Finally, Sengupta (2012) demonstrates how government regulation in the markets for eco-friendly products may add to the signaling of eco-friendly firms and may present as well a solution to adverse selection problems. Sengupta (2024) investigates the incentives of clean firms to adopt eco-certificates and corresponding market outcomes.

4. THE ATTITUDE OF THE CONSUMERS TOWARDS THE EU ECOLABEL IN CROATIA

Flash Eurobarometer 535 (European Commission, 2023) dataset for Croatia was studied in order to add to the understanding of the environmental labels in general, and of the EU Ecolabel more specifically. The dataset was collected in the period September 5-13, 2023 and it contains the answers to the questions that examine attitudes of the EU citizens about the environmental impact of the products, about environmental labels and the EU Ecolable specifically. This study narrows to the subset of data collected in Croatia analyzed by Excel and STATA.

The attitudes of the respondents towards to environmental impact of the products were compared concerning gender (Table 1 and Figure 1). The relevant survey question is "*How important are the following aspect when making a decision on what products (goods or services) to buy? The impact on the environment of the product.*"

Kruskal-Wallis tests if the two subsamples (male and female) are from the same population. Kruskal–Wallis equality-of-populations rank test. The results are: Chi2(1)= 11 083 with Prob = 0,0009 and Chi2(1) with ties = 13 388 with Prob = 0,0003 and lead to the conclusion that the null-hypothesis that

male and female subsamples with respect to the importance of environmental impact of products are the same, needs to be rejected.

On the other hand, answers to the question about the familiarity with the EU Ecolabel logo show no difference with respect to gender (Table 2 and Figure 2). The relevant question was: *"Please take a close look at the logo shown below. Have you seen this logo before?"*

Table 1. The importance of the environmental impact of the product

gender	very important	rather important	rather no important	not important at all	Don't know	total
male	68	253	128	29	13	491
female	102	296	95	15	19	527
total	170	549	223	44	32	1028

Source: Own research based on European Commission (2023)

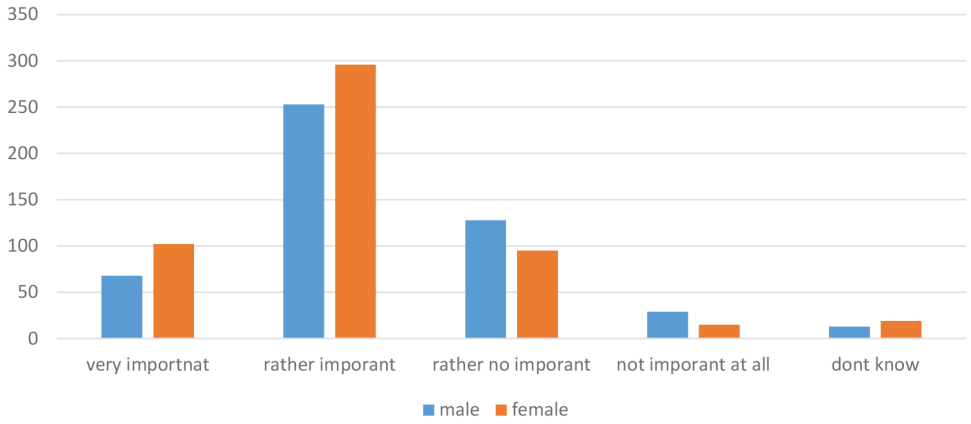

Figure 1. The importance of the environmental impact of the product

Source: Own research based on European Commission (2023)

Table 2. Familiarity with the EU Ecolabel

	yes	no	don't know	total
Male	136	269	86	491
Female	167	238	122	527
Total	303	507	208	1018

Source: Own research based on European Commission (2023)

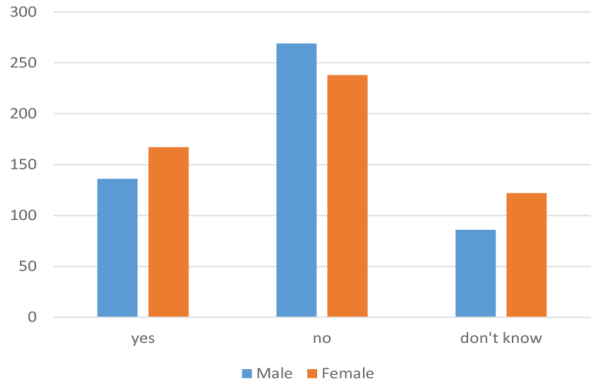

Figure 2. Familiarity with the EU Ecolabel

Source: Own research based on European Commission (2023)

Kruskal-Wallis tests on the answers to question on the familiarity with the EU Ecolabel show no statistically significant difference with respect to gender (Chi2(1)=0,047; Prob = 0,8289; Chi2(1) with ties = 0,055; Prob = 0,0003).

The respondents also expressed their knowledge about the EU Ecolabel by answering four true/false statements (*"The EU Ecolabel is awarded to products with a lower environmental impact than similar products on the market. The EU Ecolabel is independently verified label that companies can decide to display on their products to show that they are environmentally friendly. The EU Ecolabel is the EU label for environmental excellence. To get the EU Ecolabel, products have to comply with strict environmental criteria"*, Flash Eurobarometer 535, question number Q2) presented in Table 3 and while the frequency of buying products with environmental labels is presented in Table 4.

Table 3. Knowledge about the EU ecolabel

Number of correct answers	0	1	2	3	4
Frequency	8	4	19	117	408

Source: Own research based on European Commission (2023)

Table 4. The frequency of buying products with environmental labels

How often do you…	Often (label 1)	Sometimes (label 2)	Rarely (label 3)	Never (label 4)	Don't know
By product with environmental label	161	560	204	36	57
By products with the EU Ecolabel	48	327	204	94	345

Source: Own research based on European Commission (2023)

Kruskal-Wallis tests which compares how often respondent buy products with environmental labels taking into consideration the knowledge about the EU Ecolabel turns suggests that there is no difference between subsamples (null-hypothesis not rejected (probabilities 0,1753 and 0,1029). However, Kruskal-Wallis tests which compares how often respondent buy products with the EU ecolabel taking into consideration the knowledge about the EU Ecolabel turns suggests that there are differences across subsamples (null-hypothesis rejected (probabilities 0,0475 and 0,0310<0,05).

These results are also consistent with the corresponding correlation coefficients that take the value 0,023 between knowledge of the EU Ecolabel and the frequency of purchase of products with environmental labels. On the other hand, the correlation coefficient between knowledge and purchase of the products with the EU Ecolabel is -0,0349 which indicates the presence of a moderate correlation.

Also, Kruskal-Wallis tests which compare how often respondents buy products with the EU ecolabel with respect to the importance of the impact on the environment of the product Ecolabel suggests that there are differences across subsamples (null-hypothesis rejected (probabilities 0,0001 <0,05).

Finally, a very important variable for the discussion about the environmental certification of the products in the context of information asymmetry and hidden information is trust. The relevant true/false statement from the survey is *"I trust that products with the EU Ecolabel truly have a lower environmental impact than similar products on the market"* (Table 5).

There are no significant differences in trust across genders while most of the respondents (above 50%) somewhat agree with the relevant statement on trust in the EU Ecolabel.

Both Kruskal-Wallis tests which compare how often respondents buy products with environmental, and with the EU Ecolabel, with respect to trust in the EU Ecolabel, suggest that there is a significant difference in frequency of purchase across the subsamples since the probabilities take value of 0,0001<0,05. It can be concluded that trust plays a significant role in consumer decisions about the purchase of the product with environmental labels.

Table 5. Trust in product with the EU Ecolabel

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Don't know	Total
Male	141	246	49	23	32	491
Female	171	267	35	14	40	527
Total	312	513	84	37	72	1 018

Kwallis probabilities: 0,1262 and 0,09957

Source: Own research based on European Commission (2023)

5. DISCUSSION

The EU Ecolabel is a third-party environmental certificate that indicates a reduced negative environmental impact of a product. Looking from the perspective of the theoretical and empirical literature on information asymmetry in the markets, environmental certificates represent a type of mechanisms that reduce information asymmetry. In this case, the information asymmetry is reduced by conveying information by a third party (the state) which should be trusted by consumers. The theory of hidden action shows that repeated actions may resolve the hidden action problem. In the case of the EU Ecolabel, the repeated interactions in the first place occur between a consumer and the state so that the consumer gives the rust to such a scheme.

The majority of respondents at least sometimes buy products with environmental labels with a somewhat lower frequency in the case of the products with the EU Ecolabel since a significant number of respondents could not answer the relevant question. Kruskal-Wallis test indicates that the propensity to buy the product with the EU Ecolabel could vary with the attitude/knowledge of the consumers about this label. Finally, the results about the trust in and purchase of the products with the environmental labels in general and the EU Ecolabel indicate that trust might be an important determinant of the purchase of such products. Such findings further imply that the government needs to invest efforts to increase the trust in the EU Ecolabel to support the purchase of environmentally friendly products.

6. CONCLUSION

The first part of this work demonstrates complex mechanisms that drive markets for products with unobservable characteristics. One of those characteristics is the environmental impact of the product. The research demonstrates how such markets may disappear, and thus several mechanisms that resolve information asymmetry are investigated. Environmental certificates are a type of such mechanism. However, their reliability and effectiveness were scrutinized.

The Flesh Eurobarometer 535 enriches the insights into the consumer perception of the EU Ecolabel. The data are analyzed and demonstrate that the knowledge, but also more importantly trust in the EU Ecolabel might be related to more frequent purchase of products with environmental labels such as the EU Ecolabel. Such results for the Croatian sample imply that the EU Ecolabel is an efficient tool in reducing the information asymmetry present in the market of the products with the reduced environmental impact. However, further investigation of the relationship would be required to improve the robustness of the findings.

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