Revisiting the Foundations of EU-Mandated Traceability: A Trademark Signalling Framework

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Abstract

Are European Geographical Indications effective in the presence of a weak trademark mechanism and uneven application costs? I develop a multi-stage game of incomplete information to understand the impact of these forces on EU food quality standards. Under *Decentralised Surveillance* and pre-set charges, a social planner cannot reliably attribute trademarks to deserving producers and separate the market. While a Riley Outcome is unattainable, three equilibria survive the notion of sequential rationality. In showing that these outcomes are all suboptimal, I argue that EU regulators can improve the current application process by *i*) yearly reviewing the testing device and *ii*) replacing *ex-ante* with *ex-post* filing fees. Under its aegis, the WIPO could subsume both reformative proposals.

JEL Codes: D82, K11, L15, O34, Q18

1 Introduction

Consider an environment in which market participants cannot discern among nutritional bundles, but would rationally prefer the alternative that maximises their survival rate [1]. Although sellers are fully aware of their quality level, posted prices can fail to inform buyers on the intrinsic value of a given commodity. Such situations are not uncommon: for instance, trade unions, collusive agreements among food producers, and buyers' entrenched behaviour may prevent full disclosure of dietary information and endorse default options.

In this context, government intervention is necessary to reduce the negative externalities imposed on producers and consumers by the absence of reliable signals. Within the food industry, the adoption of traceability standards has partially reduced the problem of incomplete information. By publicly revealing a dimension of quality, mandated disclosure of worth types enables agents to observe a ranking of *terroirs* and choose accordingly. While it is customary to assume that the use of such certification mechanisms enhances social welfare (WIPO 2013), high transaction fees and imperfect quality controls could disturb signalling and lead to an under-provision of high-value products (HVPs). If the opportunity costs of investing in the signal are substantial, this threat provides ample reason to analyse food trademarks in further detail.

To alleviate concerns related to weak signals, the European Union (EU) has mandated common traceability standards through Geographical Indications (GIs) schemes. The main purpose of this initiative is to entitle eligible producers to a country-of-origin (COO) trademark, which can legally protect producers and consumers from suboptimal food menus and counterfeiting. The rules governing the filing procedure require private entities to apply through national agencies, which are in charge of forwarding valid protocols to the European Commission for further inspection. While the costly procedure should enable deserving producers to excel, the uneven spread of protected Appellations of Origin (AO) casts doubts on the value of the signals emitted and the screening employed across Member States. As posited by Arfini (2019), high a priori expenses and poor testing methods may lead unworthy sellers to apply for and receive a trademark; while deserving producers may be forced out of the market. Overall, this disincentives demand for GIs (DG AGRI 2020). From a regulatory viewpoint, then, the main question that arises is the following: if the European process of GI attribution is inherently imperfect, does mandated traceability still offer transacting parties adequate protection?

In this thesis, I intend to address the problem of weak GI trademarks from a game-theoretic perspective à la Albano and Lizzeri (2001). In particular, I introduce a multi-stage model of incomplete information, which includes two relevant features of agricultural markets, the cost of trademark protection and the imperfect screening of producers. Throughout, I assume that the social planner enters first, pre-committing to a single-part tariff $R(t)$. Fully aware of their types and the fixed fee, producers determine whether or not to file an application. Due to *Decentralised Surveillance*, however, there is a probability that the regulator incorrectly assigns the recognition to low-quality sellers. This, in turn, affects producers' decision to invest in the signal, irrespective of true product worth. In this scenario, consumers update beliefs according to Bayes' rule, choosing whether to buy or not from one of the two sellers [2].

To understand the implications of this model, consider the behaviour of the social planner in further detail. Notice that he is agnostic about producers' worth and strategies prior to setting

[1] See Smith and Tasnádi (2007, pp. 323-326) for an economic treatment of nutritional survival.

[2] In this economy, producers directly sell their commodities. Hereafter, I use the terms producers and sellers interchangeably. The same line of reasoning extends to consumers and buyers.

the trademark tariff. Because he acts *ex-ante*, he is only capable of choosing one of three cost conditions at each stage. Moreover, he adopts *Decentralised Surveillance* as a screening device. Such a mechanism consists of a serially connected system, which can fail to return accurate results anytime one of its components breaks down. I adopt the main features of this instrument from system reliability design and employ them as a metaphor of the administrative process that GI applicants undergo before publication of a final resolution. In an environment in which these two sources of uncertainty coexist, the social planner distorts sellers' incentives to apply for a traceability standard and, thereby, to produce in accordance with their true worth.

Throughout, I determine the equilibrium dynamics following the refinements of sequential rationality proposed by Cho and Kreps (1987) and Banks and Sobel (1987). For each cost condition, I motivate the argument by assessing agents' best responses and ruling out implausible beliefs. The ensuing taxonomy can be articulated as follows:

- If filing fees are very expensive, low-worth producers take the socially efficient decision of not applying for a trademark. In contrast, high-quality sellers are forced to under-signal their true standing.
- With free trademarking, both agents find it profitable to send a candidature. Contrary to the first case, low-worth producers are incentivised to mimic their high-worth counterpart and over-signal.
- Similarly, when charges are in the intermediate range, high types apply; while low-quality producers randomise. Yet, the latter signal in excess of their value.

Notice that these equilibria hinge critically on the size of initial filing expenses, $R(t)$, and the extent of testing imperfections, $\lambda_i \in \{0, 1\}$. Therefore, a modification of the screening device can only partially resolve the existing distortions. For instance, a parallel-combined machine would reduce the probability of high-worth sellers to be incorrectly screened. As I will show, however, the existence of a well-behaved equilibrium is not definitive.

On this basis, I then informally derive the welfare implications of the main results and advance proposals of reform for the current application system. Although the extension of the EU's Regulatory Fitness and Performance Programme (REFIT) to GIs could shorten the administrative timeframe for producers, this initiative may be economically inefficient. This is because any valid instance of reform should subsume both (*i*) cost and (*ii*) testing considerations in the policy mechanism. It is against this backdrop that an amendment of the WIPO's Lisbon System could provide stakeholders with the needed guidance.

While the signalling method proposed herein is not novel, this dissertation paves the way for an understanding of the bureaucratic costs of GI application and registration. In the light of the aforementioned equilibria, it would be worthwhile for the global IP forum to support EU regulators in rethinking the extant legislation and recalibrating their ultimate policy objectives.

Organisation. The remainder of this dissertation is structured as follows. In Section 2, I discursively analyse how the heterogeneity in procedural timing and costs affect European producers' incentives to apply for GI labelling. In Section 3, I present an overview of closely related areas of research, with a particular focus on two main contributions. In Section 4, I proceed to formally describe the imperfect information model and derive three equilibria configurations. Section 5 discusses the theoretical results of the game. In Section 6, I conclude by evaluating the contribution of my study and suggesting potential avenues for future inquiry. If not stated otherwise, formal proofs are delegated to the Appendix.

2 Stylized Facts on EU-Mandated Traceability

In this section, I intend to provide an overview of the regulation and costs of Geographical Indication protection in the European Union. While this contextual information can expedite understanding, I refer readers interested in the formal development of the economic model to the succeeding paragraphs.

2.1 Founding Legislation

Following Council Regulation EEC 2081/92 and its subsequent amendments, the European Union has adopted a unique framework for safeguarding local enclaves of production and consumption from unfair practices and exploitation. Within the Common Market, Geographical Indications are formally defined as follows:

> *Geographical indications establish intellectual property rights for specific products, whose qualities are specifically linked to the area of production.*

European Commission (2021).

In substance, GIs provide traditional agricultural commodities with a tangible recognition of worth and afford producers the privilege to trade specialty products under a collective and distinctive mark. At the moment of writing, the scheme protects around 3220 labels, including food, wines, spirit drinks, and aromatised wines. To be eligible, producers needs to apply for one of three appellations:

- Protected Designation of Origin (PDO)
  According to the updated e-Ambrosia register According to the updated e-Ambrosia register (*ibid.*), this category encompasses foods and wines, whose entire transformation happens within a geographically delimited area.

- Protected Geographical Indication (PGI)
  With this term, regulators identify an agricultural produce, which undergoes a fraction of the ultimate transformation within a geographically delimited area.

- Geographic Indication (GI)[3]
  This recently added class can only be used for alcoholic beverages, in particular spirit drinks and aromatised wines. Although ingredients need not be sourced locally, producers are attributed this trademark, if at least one part of the processing takes place regionally.

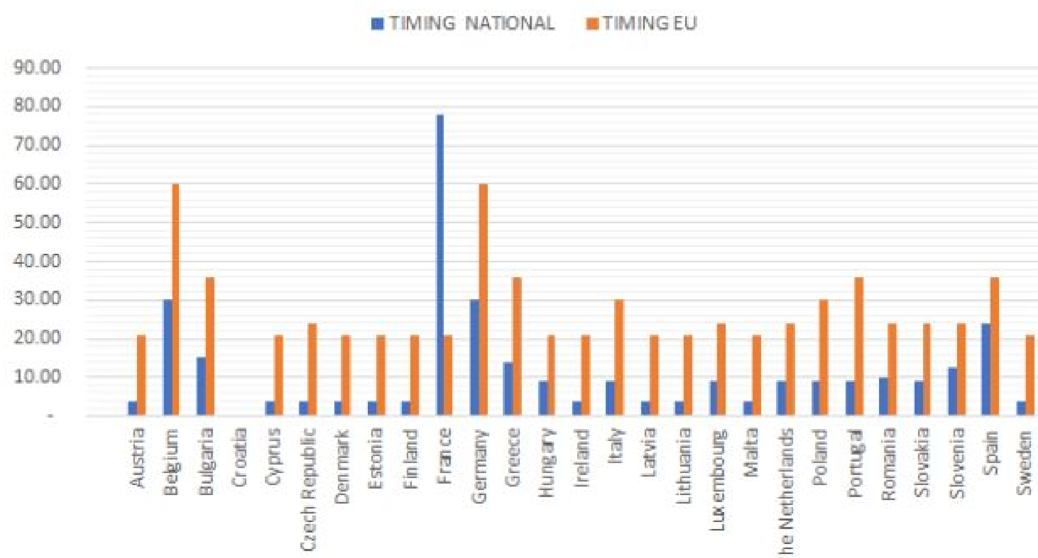
[3]With a slight abuse of terminology, this latter category has been named after the entire phenomenon. To clarify, I refer to GIs / Geographic Indications interchangeably and herewith indicate the whole category of protected labels, which includes PDO, PGI, and GI. For further details, I refer the interested reader to the specifications provided by the European Commission (2021).

While these categories differ in their degree of affiliation with the territory, local sourcing of raw materials, and sustainable processing, the application procedure is uniform. Specifically, it requires intervention of several interest groups. First, local agricultural associations need to file an application on behalf of producers who abide by a regional code of practice; afterwards, deputed national authorities analyse proposals and forward successful entries for further evaluation. Ultimately, the Directorate-General for Agricultural and Rural Development (DG AGRI) is responsible for assessing sellers' compliance. If producers' claims are substantiated, the DG AGRI delegates the Publications Office of the EU to promulgate the Single Procurement Document, notifying the decision. If no objection is raised within six months, the food standard is officially issued to the local party. From beginning to end, there are several hindrances associated with the registration process of GIs, which deserve further consideration.

2.2 Procedural Costs

While the above measures are uniform, there are remarkable differences in the time and costs involved with filing the protocol across the European Economic Area (EEA). In particular, the fact that producers from Member States cannot apply directly through the European Commission exposes them to country-specific delays and higher transaction expenses.

Figure 1: Timing of GIs Issuance (Monthly Average).

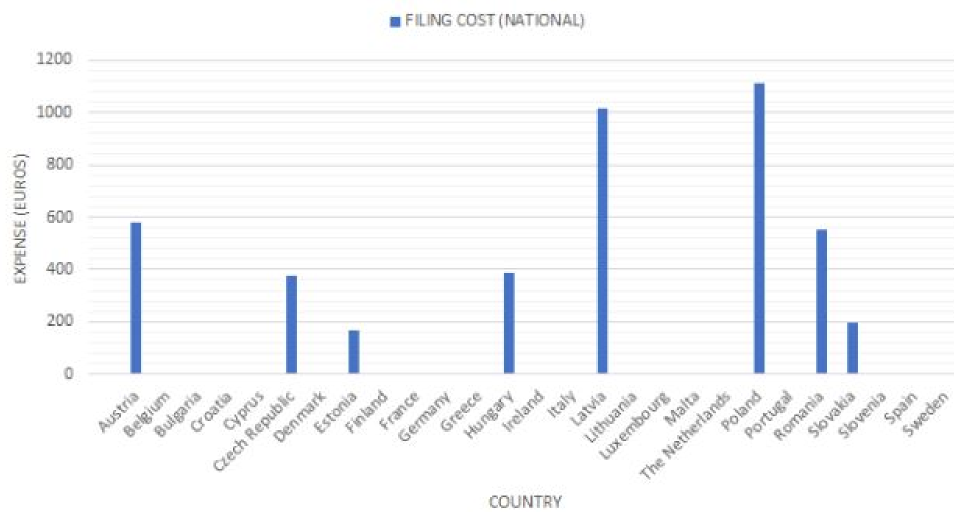


Source: Author's calculations from IPKey (2011).
Notes: The timing variable is an average of months elapsed after the initial filing procedure.

To understand the intuition, consider Figure 1. On average, the first stage of the application requires more than one year at a national level. In France, the procedure takes approximately five years and a half more than the average. While this outlying value could be explained by the high number of registered agri-products, neighbouring countries with more GI-labelled specialties face significantly lower waiting costs (see Appendix A). Further, note that the timing of trademark issuance by the DG AGRI changes across Member States. Verification of compliance takes approximately two years and three months across the EU, but the procedure is longer for

Belgium and Germany, where five years is the benchmark. Although investigating the underlying rationale is beyond the scope of this paper, longer decision lags impose a negative externality on agricultural markets (Giovannucci *et al.* 2009, p. 22).

Figure 2: GIs Filing Costs - Selected EU Member States.



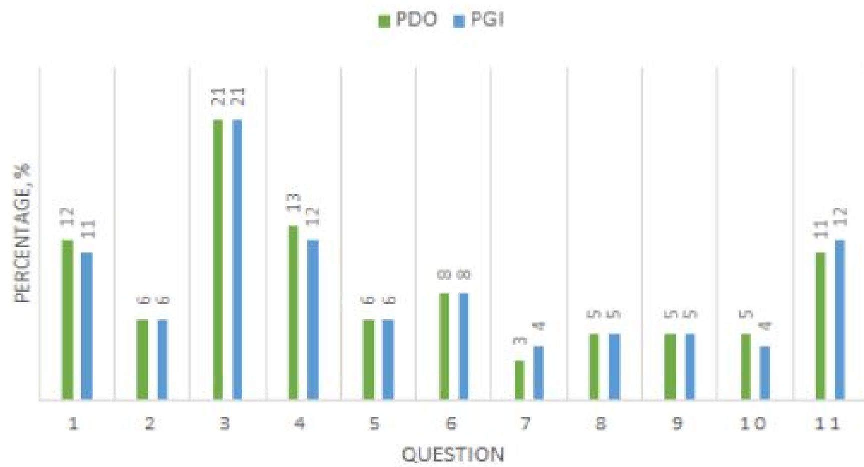
Source: Author's calculations from IPKey (2011), the European Commission (2021), and the International Comparison Program, World Bank (2021).
Notes: Numbers are an average of published filing costs. Notice that, with the exception of Austria (GDP, PPP 2020: \$ 55,097.5) and the Czech Republic (GDP, PPP 2020: \$ 41,737.4), filing expenses are higher for Estonia (GDP, PPP 2020: \$ 38,394.9), Hungary (GDP, PPP 2020: \$ 33,084.1), Latvia (GDP, PPP 2020: \$ 32,019.2), Poland (GDP, PPP 2020: \$ 34,264.8), Romania (GDP, PPP 2020: \$ 31,945.7), and Slovakia (GDP, PPP 2020: \$ 31,832.4). Data on filing costs for Croatia and Bulgaria are unavailable and reported as null.

As well as concerns about the timing of GIs decisions, national offices have discretion to request additional charges for completing the process. Consider, by way of example, Figure 2. Poland and Latvia have noticeably higher filing costs than other Member States. Note that fees are lower than the standard required to register a trademark at the European Union Intellectual Property Office (EUIPO). For instance, none of the EU-12 imposes a procedural fee. However, filing expenses are generally higher for countries with the lowest GDP per capita at purchasing power parity (PPP).

To further substantiate this claim, consider Figure 3. The graph provides an overview of the most prominent reasons behind producers' failure to apply for GI protection at the European level. According to the available evidence, the high cost of application and registration of local specialties constitutes the main hindrance for 21% of respondents. Moreover, between 11-13% of the sample refer to the excessive costs of production (Question 1), the continuous monitoring of quality (Question 3), as well as the insufficient application support (Question 11).

Although this breakdown offers a non-exhaustive list of the onerous application procedure across the EU, it serves the purpose of informing readers about an unspoken drawback. While it is not possible to quantify with certainty how much such costly delays weigh on producers' quality decision, the sources available suggest that there are significant transaction costs associated with mandated traceability. The purpose of the coming sections is to provide a simple mathematical framework to understand this problem.

Figure 3: Disincentives to Apply for PDO / PGI in the EU.



Source: Adapted from DG AGRI, European Commission, Directorate General for Agriculture and Rural Development (2020).
Notes: The sample includes N = 218 respondents. The EU Consultation aimed to assess the main reasons behind the lack of application from EU MS. Numbers 1-10 attributed to each category represent the following areas: (1) production expenses; (2) marketing expenses; (3) GI application / registration expenses; (4) quality controls; (5) lack of supervision across the supply chain; (6) weak consumer interest; (7) poor regional culture; (8) low degree of originality; (9) pre-existent label; (10) established market; (11) insufficient application support.

3 Related Literature

The crucial assumptions that differentiates this study from extant scholarships using a signalling approach to trademark modelling is that regulators act through a mechanism of *Decentralised Surveillance* and may fail to correctly certify sellers' types. Before filing an application, the latter are unaware of this imperfection. If the screening device is weak and the probability of rejection is high, sellers may be forced to over- or under-emphasise their worth, irrespective of trademark attribution.

In modelling such a distortion, I focus on the failure of standards to provide an efficient public signal. While this thesis has no close correspondent in the trademarking domain, there is a vast literature on third-party quality certification in the presence of information asymmetry (Dranove and Jin 2010). Reference models include Albano and Lizzeri (2001) and Stahl and Strausz (2017). Although both studies adopt the concept of sequential equilibrium to explain how transparency can reduce the externalities of a lemons' market, they derive very different implications. Albano and Lizzeri (2001) evaluate the effectiveness of third-party certification when buyers are ill-informed about product quality. In addressing the problem, they consider how different sets of fees and disclosure rules affect sellers' behaviour. Throughout, they verify that the certifying agent can enhance efficiency with respect to the no-information context. However, the public signal does not directly translate into a quality improvement. This thesis differs from the stated paper in two important respects. First, I narrow down the analysis considering one particular scenario, in which the planner fixes a fee under a poor trademarking mechanism. Specialising the focus affords me the opportunity to discuss the distortions arising in the EU context, where the regulator presets filing rates and screens types with the available technology. Further, I demonstrate that, due to

Decentralised Surveillance, such intervention is always suboptimal. In spite of these differences, the framework and equilibrium concepts that they use are very close to the one proposed herein. Stahl and Strausz (2017) compare seller- and buyer-induced certification as signalling and screening devices, respectively. While they find that the first improves market efficiency and abates communication barriers; the latter may putatively increase the level of information asymmetries. Contrary to their setting, I directly investigate the consequences of mandated trademarks, ruling out the side effects associated with hiring an intermediary. I pursue this path by assuming that sellers' quality is endogenous and unknown to buyers. This can be contrasted with their model, in which the rating agency is omniscient and operates with a perfect screening mechanism.

Other closely related papers address how reputational incentives influence players' decision to seek certification (Board and Meyer-Ter-Vehn, 2013; Marinovic, Skrzypacz and Varas, 2018; Van der Schaar and Zhang 2015). To formalise the argument, such a strand models firms' decisions dynamically and enables agents to learn from past histories. While noteworthy, I depart from these tenets by disregarding the impact of forces other than the fee structure in producers' decision to invest. In addition, I consider a static, extensive-form game with sequential entry structure. Following Albano and Lizzeri (2001), I show that this rationale may be admissible under some assumptions.

Aside from addressing concerns on food standards, this paper develops an argument derived from the literature on costly signalling. Although this framework was initiated by the pioneering work of Spence (1973; 1974) and Swinkels (1999) in the field of education, studies closest to mine include Admati and Perry (1987) and Kremer and Skrzypacz (2007). While different in scope, both scholarships evaluate how externalities in the release of a public signal affect the classic bargaining relationship. I differ from both of these papers in that I introduce the figure of the social planner as a mediator.

Note that I have purposely selected signalling as a preferred method of analysis, because of its tractability and ease of exposition. However, there is growing theoretical interest in the field of information design to address such a situation. Following the leading contributions of Myerson (1983; 1986) and Forges (1986), recent developments include Bayesian persuasion (Kamenica and Gentzkow, 2011), Bayes correlated equilibrium (Bergemann and Morris, 2016), sequential Bayes correlated equilibrium (Makris and Renou, 2021) and Bayesian coordinated equilibrium (Doval and Ely, 2020). Although these refinements do not enter the analysis directly, they have considerably enriched the author's viewpoint on the topic.

Ultimately, since I address the consequences of food trademarks, this study also relates to subject-specific papers in the area of agricultural economics. Caswell and Mojduszka (1996) consider the effects of labelling from a normative perspective. While their treatment is discursive, I attempt to describe the dynamics just recounted through the lenses of microeconomic theory. Further, their design uses Nelson's (1970) classical differentiation between good attributes. Conversely, I assume heterogenous food menus.

Overall, the model that I describe lends credence to the bureaucratic costs of trademark registration which producers face when choosing to apply for mandated traceability. Despite involuntarily, the interplay between inadequate fees and imperfect trademarking may have implications for the ensuing stability.

4 Model

In this section, I propose a game theoretic approach to analyse the equilibrium dynamics of trademark attribution. At the initial node, the social planner chooses a trademark fee, $R(t)$. On this basis, producers decide whether to apply for a standard or exit the market. If they seek protection, the regulator screens applications using *Decentralised Surveillance*. Here, *ex-ante* filing expenses and an imperfect screening device affect sellers' decision to invest in the signal. This, in turn, increases uncertainty over buyers' choices. To evaluate the results of this analysis, I use the concept of sequential rationality.

4.1 Trademark Signalling Game

4.1.1 Setup

Consider a perfectly competitive marketplace for a heterogenous commodity. In this economy, there are two producers, two consumers, and a social planner. Producers sell food menus of different worth, $\xi_i \in \Xi_i = \{\xi_L, \xi_U\}$. Since I assume quality to be endogenous, producers must have perfect information on the value of their goods. They post a positive price of $\nu \in \{\nu_L, \nu_U\} \in \mathbb{R}_+$ and incur a cost of $C(\xi_i) \geq 0$, which depends on quality. Throughout, I maintain that high-worth producers face higher investments than low-worth types. Therefore, $C(\xi_U) > C(\xi_L)$.

The two consumers can select whether to acquire one quality bundle ξ_i or exit the market. Let $b \in \{0, 1\}$ represent this decision. If $b = 1$, consumers choose to buy the commodity. If $b = 0$, they do not buy any menu. To enhance survival[4], consumers purchase strictly less than their budget threshold, $y \in Y$. Unlike producers, they are imperfectly informed about quality and only observe a discrete common prior distribution $\theta(\xi_i)$, with $0 \leq \theta \leq 1$.

Without further refinements, consumers cannot reliably infer sellers' worth from posted prices[5]. For this reason, a social planner can provide a trademark, which serves as a public signal of quality. Producers can decide whether to apply ($d = 1$) or not to apply ($d = 0$). Yet, to obtain a label, they must pay a one-part tariff with a fixed time component of t, $R(t) \geq 0$. Since the social planner is agnostic about sellers' types, he employs *Decentralised Surveillance* as a quality assurance mechanism. Let $\tau_j \in \{0, 1\}$ be the discrete random variable, which describes the realisation of the trademark process. With $\tau = 0$ no signal is attributed; with $\tau = 1$, a recognition is successfully conferred. The realisation of τ_j can be observed by both sellers and buyers. Part D of this Section describes why *Decentralised Surveillance* may fail to provide the proper food standard to deserving sellers.

4.1.2 Timing and Sequential Entry

Throughout, timing is discrete with periods $p \in \{1, 2, 3, 4\}$. As illustrated in Figure 4, each player enters sequentially and behaves as follows:

- Period 1: The regulator selects an optimal one-part tariff to enhance its own welfare. Next, producers observe the fee and decide whether to apply or not.

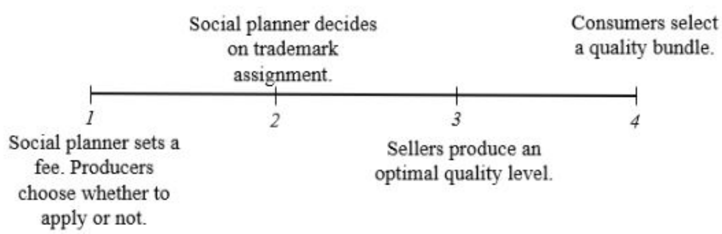
[4] See Smith and Tasnádi (2007), supra note 1.

[5] Buyers trade in a posted-offer market, which is in contrast to Albano and Lizzeri (2001) who consider a traditional first-price auction mechanism. Wang (1993) offers an excellent discrimen between these trading institutions.

- Period 2: The social planner assigns the trademark through a mechanism of *Decentralised Surveillance.*
- Period 3: Given the outcome, producers choose an optimal quality level.
- Period 4: Consumers select a preferred food menu, subject to the available mark and their income constraint[6].

If producers' accept consumers' offers, the game ends; otherwise, a rejection leads old agents to retire, forcing new ones to enter the marketplace in subsequent stages[7]. Note that the duration of time spans does not affect production costs and, therefore, the ultimate selling price. This is in contrast with Kremer and Skrzypacz (2007), in which periods are divided into Δ fractions of variable length.

Figure 4: Timing of the Game with $p \in \{1, 2, 3, 4\}$.



Source: Author's Analysis.
Notes: This figure displays the sequential entry of players in the Bayesian game. As shown, the social planner acts *ex-ante*. In other words, he chooses a fee level at the start. This will directly affect the observed equilibrium dynamics.

4.1.3 Payoffs

Similar to Board and Meyer-Ter-Vehn (2013), I consider a setting where players are risk neutral. For tractability, I assume that consumers have Rosen's type utility functions. In the absence of outside options, their payoff U_β is

$$U_{\beta,b=1} := b[(\xi_i|\tau_j) - \nu(\xi_i)] \tag{1}$$

where $E(\xi_i|\tau = 1) = \sum_{\xi_U} \xi_U \; pr_{\xi i|\tau j}(\xi_U|\tau = 1) < \infty$ and $E(\xi_i|\tau = 0) = \sum_{\xi_L} \xi_L \; pr_{\xi i|\tau j}(\xi_L|\tau = 0) < \infty$ are finite for all realisations of the screening process. These conditional expectations imply that consumers can infer producers' value from mandated standards. Note that, if buyers could perfectly distinguish between sellers' types, discrete random variables ξ_i and tau_j would no longer be dependent. This would hence simplify the problem to $E(\xi_i|\tau_j) = E(\xi_i)$[8]. Moreover, if

[6]Contrary to Lizzeri (1999), consumers can only observe trademarks and prices of products. They have no awareness of the true information disclosed to the certification agency.

[7]Since agents are memoryless, they cannot learn about past quality as modelled in Van der Schaar and Zhang (2015).

[8]Because $pr_{\xi i|\tau j}(\xi_U|\tau_j) = pr_{\xi i}(\xi_U)$ and $pr_{\xi i|\tau j}(\xi_L|\tau_j) = pr_{\xi i}(\xi_L)$, where pr denotes the conditional frequency function.

the game is over by $p = 1$ or if $b = 0$, consumers do not acquire any food level and attain a payoff of $U_{\beta,b=0} := 0$.

As stated above, producers decide whether to apply or not for a trademark, once per-unit fees become common knowledge. If they choose to send a candidature and pay the tariff, their payoff U_σ is defined as

$$U_{\sigma,d=1} = b[E(\hat{(}\xi_i)|\tau_j) - C(\xi_i) - R(t)] \tag{2}$$

where $E(\nu(\xi_i)|\tau_j) < \infty$ is the expected revenue from selling a commodity, conditional on the outcome of the screening procedure. In contrast, no filing fee is charged if sellers do not undergo the trademark process. Therefore, their problem simplifies to $U_{\sigma,d=0} := b[\hat{(}\xi_i) - C(\xi_i)] = 0$. As noticed above, $d = 0$ or exit in time period $p = 1$ yield zero profits.

Given producers' payoffs, it is now possible to establish that the decision to apply for a trademark depends on the following conditions:

Claim 1 (Trademark Decision):

$$[E(\nu(\xi_U)|\tau_j)] \geq [C(\xi_U) + R(t)] \tag{3}$$

$$[E(\nu(\xi_L|\tau_j)] \geq [C(\xi_L) + R(t)] \tag{4}$$

$$[E(\nu(\xi_U|\tau = 1)] \geq [E(\nu(\xi_L)|\tau = 1) > 0] \tag{5}$$

$$[E(\nu(\xi_U|\tau = 1)] \geq [E(\nu(\xi_L)|\tau = 1)] > [E(\nu(\xi_U)|\tau = 0)] = [E(\nu(\xi_L)|\tau = 0)] \tag{6}$$

Condition (3) imposes that the expected value of sales revenues from a high-quality commodity conditional on the binomial realisation of signal τ_j should equal or exceed its total cost of production and registration. Condition (4) extends this line of reasoning to low-quality menus. Condition (5) says that, conditional on receiving a trademark, expected sales revenues are strictly higher than zero. In other words, producers with a trademark will never go bankrupt, regardless of their true worth. Lastly, Condition (6) requires that expected returns from a labelled produce are strictly higher than for non-labelled commodities.

Additionally, I will adopt the following tenets throughout the analysis:

Assumption 1 (Cost Function):

$$C(0) = 0$$

$$\frac{\partial C(\xi_i)}{\partial \xi_i} > 0; \frac{\partial^2 C(\xi_i)}{\partial \xi_i^2} > 0, \forall \xi_i$$

Assumption (A1) means that sellers face no expense, if they do not produce. Further, Assumption (A2) requires the cost function to be strictly increasing and convex in quality[9].

In this framework, the social planner maximises his own payoff by capitalising on the single-part tariff, $R(t)$. While most of the literature assumes that regulators act to improve social welfare[10], I consider a selfish agent. For the purpose of this analysis, an egoistic government can justify the

[9] This is a standard assumption in the literature. Among the others, Albano and Lizzeri (2001) and Kremer and Skrzypacz (2007) model the slope of the cost function as (strictly) increasing with respect to quality.

[10] Examples include Bueler and Schuett (2014), Janssen and Roy (2015), and Stahl and Strausz (2017).

use of *Decentralised Surveillance* and his reluctance to improve the testing device. Overall, the regulator's problem is

$$U_R := R(t)\sigma_n \tag{7}$$

where $R(t)$ is the monetary value of the trademark tariff and n is the total number of sellers in the economy. In words, this expression implies that the social planner maximises its payoff, as either the number of applicants or the filing fee increase. Part B.1 of the Appendix illustrates the Bayesian game in its extensive form.

4.1.4 Decentralised Surveillance

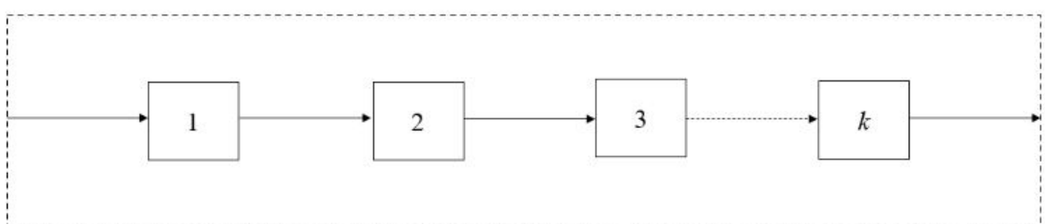
One may wonder how the social planner screens producers' effectively to accredit only the most deserving. As stated before, he believes in the accuracy of the quality control mechanism. However, there is a probability that the mechanism will incorrectly certify weak producers.

To understand the intuition, consider the one-dimensional unit simplex S in Figure 5. Suppose that blocks are combined serially with the other components. Each element represents a stage of the trademark application process. This form of interaction implies that, if any one component fails, the overall mechanism breaks down. Let k denote the number of mutually independent elements and x the probability that any of these works suboptimally. Then, the probability of failure of the overall mechanism is

$$Pr(F) = 1 - (1 - x)^k$$

where $Pr(W) = (1 - x)^k$ is the probability that the system works correctly. Note that, if the block layout is combined differently, then this outcome cannot be supported by the stated probabilities.

Figure 5: *Decentralised Surveillance* (Serially Combined Mechanism).



Source: Adaptation performed by the author from Rice (2007).
Notes: This figure represents the *Decentralised Surveillance* machine. As highlighted by the disposition of blocks, the mechanism is combined serially and enables assessment of trademark claims one at a time. In other words, components can evaluate producers' applications sequentially, with substantial delays. If a failure occurs in one block, then the system faces complete disruption. To define such a device, I draw inspiration from the literature on system reliability design and its natural extensions in the realm of economics. See the seminal contribution of Musinanghe and Gellerson (1979).

While this mechanism resembles the screening procedure adopted at the European level, it may be well extended to other scenarios. Examples include the job and educational contexts, in which there is a multi-stage procedure to monitor one player's claims. After using such a mechanism, the regulator assigns candidates the market standard with probability $0 \leq \lambda_i \in \{\lambda_L, \lambda_U\} \leq 1$. For tractability, I assume that, on average, $\lambda_U > \lambda_L$. This means that the probability of high-worth producers to be correctly screened is higher than the probability of low-types to be identified. In the text, I dub this procedure as *Decentralised Surveillance*. Formally,

Definition 1 (Decentralised Surveillance - I): Fix a trademark signalling game, Γ. Let $\xi_i \in \Xi = \{\xi_U, \xi_L\}$ be producers' types and $\tau_j \in \{0, 1\}$ the binomial outcome of the trademark process. With a serial screening device, *Decentralised Surveillance* amounts to the following:

$$Pr(\tau = 1|\xi_L) = \lambda_L = 1 - (1 - x)^k = Pr(F)$$
$$Pr(\tau = 0|\xi_U) = \lambda_L = 1 - (1 - x)^k = Pr(F)$$
$$Pr(\tau = 1|\xi_U) = \lambda_U = (1 - x)^k = Pr(W)$$
$$Pr(\tau = 0|\xi_L) = \lambda_U = (1 - x)^k = Pr(W)$$

such that $Pr(F) < Pr(W)$. Note that this holds true whenever the trademarking mechanism is imperfect. In cases in which trademarking is perfect, there is no testing defect to account for.

4.1.5 Belief System

Here, I intend to specify three main facts about the initial setup. While I do not introduce novel conditions, I deem these essential to define an equilibrium concept in the coming paragraphs. To see why, first recall that consumers hold *ex ante* beliefs about producers' food worth. I have previously denoted the common prior distribution as $\theta(\xi_i)$, with $0 \geq \theta \geq 1$. Practically, this implies that, before observing producers' strategies, consumers' quality expectation is a weighted average of the two available bundles. Formally, I define

$$E(\xi_i) = \sum_i \xi_i \theta(\xi_i)$$
$$= \theta\xi_U + (1 - \theta)\xi_L$$

where E is the traditional expectation operator and $\sum_i \xi_i \theta(\xi_i) < \infty$. Since the prior $\theta = \frac{1}{2}$ by construction, each outcome is *ex ante* equally likely. Hence, the common prior represents the amount of knowledge shared by consumers before the actual realisation of the standard, τ_j. Since consumers act following sequential rationality, they can update beliefs in the light of the actions taken by other agents. Having observed the realisation of the signal, the *ex-post* distribution of ξ_i conditional on τ_j is proportional to the product between the likelihood function and the ex-ante distribution of ξ_i. In other words, consumers follow Bayes' Rule to construct beliefs and decide on their utility-maximising moves. Implementing this rationale requires an understanding of the following:

Fact 1 (Bayes' Theorem): *Let $\xi_i \in \Xi = \{\xi_L, \xi_U\}$ be producers' types and $\tau_j \in \{0, 1\}$ the binomial outcome of the trademark process. In this case, $\xi_L \cap \xi_U = \varnothing$ and . According to Bayes' Rule, it must be true that*

$$Pr(\xi_i|\tau_j) = [Pr(\tau_j|\xi_i)Pr(\xi_i)] / \sum_{i=1} = Pr(\tau_j|\xi_i)Pr(\xi_i)$$

where Pr is a probability measure. The above applies if and only if $Pr(\xi_i) > 0$.

Notice that this Rule is critical to explain how buyers generate beliefs. In particular, let be the Bayesian probability of observing a worth level ξ_i, conditional on realisation of the trademark process. Based on the above, I can now formally express consumers' ex-post beliefs as

$$\mu(\xi_i|\tau = 1) = \frac{\mu(\tau = 1|\xi_i)\mu(\xi_i)}{\mu(\tau = 1)}$$

$$\mu(\xi_i|\tau = 0) = \frac{\mu(\tau = 0|\xi_i)\mu(\xi_i)}{\mu(\tau = 0)}$$

where $\mu(\xi_i|\tau = 1)$ reflects a buyer's posterior belief that a commodity is of a given worth, if it has received a trademark. Conversely, $\mu(\xi_i|\tau = 0)$ indicates a consumer's *ex-post* belief that the good is of a certain quality, when it has not obtained the food standard. Based on these posteriors, it is possible to characterise buyers' conditional expectation of sellers' worth, given the realisation of signal . These are as follows:

$$E(\xi_U|\tau = 1) = (\xi_U|\tau = 1)\xi_U + (1 - (\xi_U|\tau = 1))\xi_L$$

$$E(\xi_L|\tau = 1) = (\xi_L|\tau = 1)\xi_U + (1 - (\xi_L|\tau = 1))\xi_L$$

$$E(\xi_U|\tau = 0) = (\xi_U|\tau = 0)\xi_U + (1 - (\xi_U|\tau = 0))\xi_L$$

$$E(\xi_L|\tau = 0) = (\xi_L|\tau = 0)\xi_U + (1 - (\xi_L|\tau = 0))\xi_L$$

where $E(\xi_U|\tau = 1)$ represents the conditional expectation that a commodity is high-quality, if it has attained a labelling standard. Likewise, $E(\xi_L|\tau = 1)$ is the conditional expectation that a product is low-quality, given a positive realisation of the trademark process. In contrast, $E(\xi_U|\tau = 0)$ and $E(\xi_L|\tau = 0)$ indicate buyers' conditional expectations that a good is either high- or low-quality, subject to the negative outcome of the application procedure.

While defining Bayes' Theorem is necessary to characterise the system of beliefs, it is not sufficient to understand how players behave. This is why I follow Osborne and Rubinstein (1994, p. 222) and Jehle and Reny (2011, p. 352) to introduce two auxiliary notions. They include:

Fact 2 (Common Beliefs): *At the same node, each agent shares equal information and beliefs.*

This means that, when different players reach the same subgame, they are all alike in the beliefs held about other players' plans of action. Moreover, I will assume that an agent's updating of beliefs is independent of the actions that other players take at the same node. To be more precise, notice that the following fact must hold:

Fact 3 (Independence): *Each agent's posterior updating depends on the history of the game up to (but excluding) their decision node and is independent of the moves that other players will take.*

While a mathematical treatment of Fact 2 and 3 is beyond the scope of this thesis, I will show how their informal conceptualisation can improve the readers' understanding of this framework.

4.2 Foundations

Following from the previous setup, I now turn to establish necessary and sufficient conditions for the existence of an equilibrium. Following Kremer and Skrzypacz (2007), I term the paragraph "Foundations", because it paves the way for assessing the validity of the results proposed hereafter. In particular, I begin this section by illustrating how players' strategies, beliefs, and payoffs contribute to the constitution of a sequential equilibrium.

Definition 2 (Sequential Equilibrium): *Fix a trademark signalling game* $\Gamma(R(t), d\{0,1\}, \xi_i \in= \{\xi_L, \xi_U\}, \mu(), b \in \{0,1\}$. *A sequential equilibrium for* Γ *must satisfy the following conditions:*

i) $\forall R(t) \geq 0$, *the social planner sets a payoff-maximising trademark fee:*

$$U_R^* := maxR^*(t)\sigma_n$$

ii) $\forall d \in \{0,1\}, \xi_i \in \Xi = \xi_L, \xi_U$, *sellers maximise expected revenues:*

$$U_\sigma^* := maxU_\sigma \geq U_\sigma$$

iii) $\forall b \in \{0,1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, *buyers update beliefs according to Bayes' Theorem. This implies the following:*

$-\mu(\xi_U|\tau = 1) = \frac{\mu(\tau=1|\xi_U)\mu(\xi_U)}{\mu(\tau=1)}$, *when high worth-sellers apply and pass;*

$-\mu(\xi_U|\tau = 0) = \frac{\mu(\tau=0|\xi_U)\mu(\xi_U)}{\mu(\tau=0)}$, *when high worth-sellers apply and do not pass;*

$-\mu(\xi_L|\tau = 1) = \frac{\mu(\tau=1|\xi_L)\mu(\xi_L)}{\mu(\tau=1)}$, *when low worth-sellers apply and pass;*

$-\mu(\xi_L|\tau = 0) = \frac{\mu(\tau=0|\xi_L)\mu(\xi_L)}{\mu(\tau=0)}$, *when low worth-sellers apply and do not pass;*

$-E(\xi_i) = \sum_i \xi_i\theta(\xi_i) = \theta\xi_U + (1-\theta)\xi_L$, *when both apply and do (not) pass or when none applies.*

iv) $\forall b \in \{0,1\}$ and $\xi_i \in \Xi = \{\xi_L, \xi_U\}$, *buyers select an optimal food menu to maximise expected utility:*

$$U_\beta^* := maxU_\beta \geq U_\beta$$

In words, Condition *i)*, *ii)*, and *iv)* says that players want to maximise earnings and attain the highest available surplus. In other words, agents' behaviour is incentive-compatible. Further, Condition *iii)* imposes that consumers follow Bayes' Rule to update beliefs on sellers' types. In the absence of public signals, however, it requires consumers to choose the optimal bundle in accordance with the objective prior. Throughout, this ensures that beliefs are consistent along the path of play. Taken together, these four tenets indicate that agents act following sequential rationality.

The definition just described allows to rule out implausible equilibria and focus the attention on three potential scenarios:

- *Scenario I (Perfect Pooling):* Given $R^*(t)$, both types of producers decide to apply for a trademark - often termed "bunching" (Albano and Lizzeri 2001, p. 274) or "symmetric equilibrium" (Janssen and Roy 2015, p. 103). In this case, a perfect pooling equilibrium exists.

- *Scenario II (Perfect Separating):* Given $R^*(t)$, only one type decides to send its candidature, while the other finds it too costly. If this holds, then the necessary conditions for a perfectly separating equilibrium exist.

- *Scenario III (Partial Pooling):* Given $R^*(t)$, one type decides to apply for a trademark, while the other randomises between the available strategies $d \in \{0, 1\}$.

While *Scenarios I* and *II* can be generally derived in the standard Spence's education model (1973; 1974), I argue that not all of them are viable under imperfect trademarking. Following Swinkels (1999), I demonstrate that the existence of $\lambda_i \in \{0, 1\}$ leads to either full or partial pooling. These concepts will become clearer in the sequel of the study.

4.3 Feasible Equilibrium Dynamics

The trademarking game illustrated in the previous paragraphs has more than one sequential equilibrium. This section attempts to analyse whether players' actions survive the refinements of the concept as proposed by Cho and Kreps (C-K, 1987) and Banks and Sobel (B-S, 1987). In particular, I turn to illustrate three distinct taxonomies, which result from the defects of the trademarking mechanism. In contrast with the ideal scenarios, the Riley Outcome cannot be attained, because full separation does not exist. As disclosed at the start, (i) the configuration of the filing fee and (ii) the size of the imperfections play a crucial role in determining the observed dynamics. Let us consider first the case of very costly licenses.

4.3.1 High Trademark Fee

Recall that the social planner acts egotistically to maximise his private welfare. To do so, he has to select a filing fee at the very start of the game. In practice, he does not know producers' available strategies or their payoffs. Because of this, it is easy to assume that he sets a bad trademark fee.

Suppose that the two-part tariff chosen exceeds the upper bound of the commonly-known prior[11], such that $R_H^*(t) > 1$. In this case, the first step is to analyse producers' decision to apply or not for a trademark. Recall that the choice depends on Conditions *(3) - (6)*. Intuitively, producers decide to candidate when the expected value of the product conditional on the realisation of the trademark process exceeds input and application costs. For this reason, producers would not be willing to sustain any expense in excess of this upper bound. When $R_H^*(t) > 1$, the strategy of seeking a trademark is not incentive-compatible. In fact, sellers can expect a higher profit, if they do not apply. Therefore, $d = 1$ cannot be sequentially rational. Note that this holds true for both types: in the presence of a very costly signal, sellers can expect to achieve the highest payoff by shutting trade and producing zero quality.

Now, consider consumers' purchasing decisions. Although they cannot observe sellers' types, they see that no producer has applied for a trademark. In this case, their *ex-post* beliefs must

[11] This design spurs from the characterisation of the certification fee provided by Lizzeri (1999).

coincide with their objective ones. This is because, with no available standard, there is no public signal which could help them distinguish between sellers. Under $R^*_H(t) > 1$, their expected valuation of a commodity conditional on the outcome of the trademark process would be (strictly) lower than the price they would need to pay to obtain it. Thus, to secure the highest possible utility, the only rational strategy would be for them to reject every menu and exit the game. The next proposition summarises the underlying reasoning of this section.

Proposition 1 (Pooling - P1): In any imperfect trademarking game with high licensing fees, there exists a C-K pooling equilibrium where neither type applies for a trademark if and only if $R^*_H(t) > 1$. Thus, the following conditions must hold:

1. $d \in \{0,1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, sellers choose $d^* = 0$ and produce $\xi^*_i = 0$;
2. $b \in \{0,1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers choose $b^* = 0$ and buy $\xi^*_i = 0$;
3. $b \in \{0,1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers update beliefs according to the following:

$$\mu^*(\xi_i|\tau_j) = E^*(\xi_i) = \sum_i \xi_i \theta(\xi_i) = \theta\xi_U + (1-\theta)\xi_L,$$

when none applies.

See Appendix B.2 for the proof.

While the reasoning and selected equilibrium concept are very different, this theorem parallels Proposition 1 in Marinovic, Skrzypacs, and Varas (2018), who consider a dynamic certification context à la Board and Meyer-Ter-Vehn (2013). In both cases, when trademarking expenses are very high, no seller is willing to apply for a credential. Thus, the only feasible equilibrium involves no production and trade.

4.3.2 Low Trademark Fee

Next, I examine the instance in which the social planner sets another suboptimal value for the application fee. Specifically, I turn to evaluate the case of extremely low filing expenses. This scenario is the opposite of the one analysed above.

To illustrate this point, consider the following argument. Assume that the social planner sets the cost of a food standard equal to the infimum bound of the common prior distribution, such that $R^*_L(t) \equiv 0$[12]. Then, both sellers would have an incentive to send their candidature. To see why, recall that *Decentralised Surveillance* imposes $\lambda_U > \lambda_L$. Because high-worth producers are more likely to attain a recognition, it is always in their best interest to apply. If correctly screened, they have the opportunity of increasing their expected payoff at no additional cost. However, since the trademark mechanism is imperfect, non-deserving sellers could also be awarded a trademark.

[12] Within the realm of GIs, zero trademark expenses emerge in practice as proved by Part A of the Appendix. To the author's knowledge, there is no instance in which the regulator sets negative fees. In the pharmaceutical industry, however, charges below the infimum bound are a sign of a "pay-for-delay" agreement between patent holders and generic-drug patentees. In particular, such a scenario arises when patent owners settle (potential) infringements by paying the sued party. The EU Court of Justice and US Supreme Court have long ruled this behaviour as anti-competitive. See Shapiro (2003) and Subiotto (2014) for an overview.

Therefore, as long as filing expenses are zero, low-quality types find it profitable to mimic their high-worth counterpart and send a candidature. Although the outcome of the test is uncertain, they have the opportunity to increase expected profits, without changing the quality level produced. If incorrectly screened, in fact, low-worth producers can expect lower production costs and higher revenues per unit sold. On the other hand, consumers know that both producers seek trademark protection, when the regulator sets free rates. For this reason, a sequential best-response would be for them to buy any quality bundle that receives a trademark. In contrast, consumers should pick $b^* = 0$, if commodities do not attain the standard. Intuitively, this is because any deviation from this equilibrium path would earn them a lower expected payoff and threaten their survival[13]. Let me formalise the economic intuition behind this reasoning in a second proposition.

Proposition 2 (Pooling - P2): In any imperfect trademarking game with low licensing fees, there exists a C-K pooling equilibrium where both producers' types apply for a trademark if and only if $R_L^*(t) \equiv 0$. It then follows that

1. $d \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, sellers choose $d^* = 1$ and produce $\xi_i^* \in \Xi^* = \{\xi_L^*, \xi_U^*\}$ according to their types;

2. $b \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers choose $b^* = 1$ and buy the labelled commodity.With no trademark, they choose $b^* = 0$;

3. $b \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers update beliefs according to the following:

$$\mu^*(\xi_i|\tau_j) = E^*(\xi_i) = \theta^*(\xi_i) = \theta\xi_U + (1 - \theta)\xi_L$$

.

The Proof follows the rationale introduced in Proposition 1. For ease of exposition, I provide it in Appendix B.2.

Overall, if $R_L^*(t) \equiv 0$, both sellers have an incentive to send their candidature. As proved above, the converse is true when the cost of a trademark is above unity. To complete this taxonomy, I now turn to understand the impact of intermediate charges.

4.3.3 Intermediate Outcome

Let us return to the agnostic regulator. Suppose that he sets a fee in the intermediate range, that is between the upper and infimum bound of the common prior. Compared to the previous instances, the underlying reasoning is more articulate. Due to the absence of a reliable screening device, high-worth sellers are better off applying; while low-worth ones ought to mix between the two available strategies.

Let $0 < R_I^*(t) < 1$ denote the intermediate fee range. Before solving for this equilibrium, consider producers' incentives to apply. Despite the imperfect screening technology, high types have a higher probability to be correctly screened $\lambda_U > \lambda_L$. While the outcome is less profitable for them than in the second scenario, it would still generate a surplus compared to the no trademark condition. This is because the expected value of the recognition conditional on a positive outcome of the test exceeds total production and filing expenses (Conditions (*3*) - (*6*)). As a result, they

[13] See Smith and Tasnádi (2007), *supra* note 1.

should always choose $d^* = 1$ and produce ξ_U accordingly. Given the limitations of the testing device, the unique equilibrium path for low types is one in which each player randomises between applying and not applying. At first, this can appear counterintuitive. Practically, it imposes that some agents send a candidature, while others do not. To evaluate the decision to protect their products, consider that low-worth producers can either pass or fail the test with probability λ_L and $(1 - \lambda_L)$, respectively. For randomisation to be profitable, it must hold that

$$C(\xi_L) + R_I^*(t) < (1 - \lambda_L)[b(E[(\nu(\xi_L)|\tau_j) - C(\xi_L) - R_I^*(t))] <$$
$$< \lambda_L[b(E[(\nu(\xi_L)|\tau_j) - C(\xi_L) - R_I^*(t))]$$

In words, this means that low-worth sellers' decision to apply for a trademark depends on the expected returns conditional on the outcome of the screening procedure, total investment expenses, and the probability to be attributed a recognition. If the probability of low-worth producers to pass the test exceeds the probability of failure, then $\lambda_L > (1 - \lambda_L)$. In this instance, the testing mechanism is highly imperfect and producers are always better off applying for a trademark. If *Decentralised Surveillance* imposes $\lambda_L > (1 - \lambda_L)$, not sending a candidature Pareto dominates the other decision, $d = 1$. When $(1 - \lambda_L) = \lambda_L$, sellers are indifferent between seeking protection or not. Intuitively, this explains that, with $0 < R_I^*(t) < 1$, there is only one equilibrium strategy in which low-types randomise. Due to the testing imperfections, mixing enables them to attain the highest expected payoff. If they deviate from this path, they can only expect zero or negative profits.

As argued in the preceding paragraph, consumers see whether producers have sought trademark protection. Therefore, a sequential best-response would be for them to buy with positive probability the quality bundle that has received a trademark. Indeed, if they choose not to buy from protected sellers, they can expect to earn a negative payoff. Thus, the unique equilibrium path would be for consumers to select $b^* = 1$ in the presence of a certification mark and $b^* = 0$ otherwise. Throughout, they update beliefs as specified in Part E of Section 4.1. The following Proposition summarises the main content of my argument.

Proposition 3 (Partial Pooling - P3): In any imperfect trademarking game, there exists a unique partial pooling equilibrium where high-worth producers apply for a trademark and low-worth producers randomise between the two available strategies, if and only if $0 < R_I^*(t) < 1$. Part B.2 of the Appendix proves the following:

1. $d \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, high-worth sellers choose $d^* = 1$ and produce ξ_U^*. Low-worth sellers mix between $d^* \in \{0, 1\}$ and produce ξ_L^*;

2. $b \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers choose $b^* = 1$ and buy the labelled commodity. With no trademark, they choose $b^* = 0$;

3. $b \in \{0, 1\}, \xi_i \in \Xi = \{\xi_L, \xi_U\}$, buyers update beliefs according to the following:

   - $\mu(\xi_U|\tau = 1) = \frac{\mu(\tau=1|\xi_U)\mu(\xi_U)}{\mu(\tau=1)}$, when high-worth sellers apply and pass.
   - $\mu(\xi_U|\tau = 0) = \frac{\mu(\tau=0|\xi_U)\mu(\xi_U)}{\mu(\tau=0)}$, when high-worth sellers apply and do not pass.
   - $\mu(\xi_L|\tau = 1) = \frac{\mu(\tau=1|\xi_L)\mu(\xi_L)}{\mu(\tau=1)}$, when low-worth sellers apply and pass.

- $\mu(\xi_L|\tau=0) = \frac{\mu(\tau=0|\xi_L)\mu(\xi_L)}{\mu(\tau=0)}$, when low-worth sellers apply and do not pass.
- $E(\xi_i) = \sum_i \xi_i \theta(\xi_i) = \theta\xi_U + (1-\theta)\xi_L$, when both apply and do (not) pass.

Proposition 3 gives necessary and sufficient conditions under which type ξ_U always applies, while ξ_L mixes. Compared to very costly licenses, intermediate charges increase high- and low-worth producers' surplus. However, players' payoffs are lower than under free certification. This is because the cost of trademark protection is greater than zero. Thus, the net effect of this cost condition is uncertain.

4.3.4 Non-Existence of Separation

The last question that I pose is whether there is a separating equilibrium, which survives the C-K and B-S refinements. Previously, I have hinted that players would find it profitable to pursue different strategies, if their expected payoff from separation is higher than from perfect or partial pooling. In what follows, I assess whether this tenet is incentive-compatible. As I will show, a perfectly separating equilibrium does not exist.

Given the imperfections in the trademarking mechanism, producers attain a strictly higher payoff from mimicking each other. To understand this remark, let us start from the decision of high-worth sellers. As noted previously, they always have an incentive to apply for a certification mark with $R^*_L(t) \equiv 0$ or $0 < R^*_I(t) < 1$. This is due to the extent of the testing imperfections, $\lambda_U > \lambda_L$. While, on average, they receive a surplus from applying, they still have to account for the probability of weak testing. In the case of incorrect screening, high-worth producers are signalling in excess of their expected returns. For this reason, I say that they are over-signalling. Conversely, when $R^*_H(t) > 1$, they produce zero and obtain the lowest available payoff $0(E[(\xi_U)|\tau_j] - C(\xi_U))$. In this case, high-worth sellers are under-signalling their true worth. Now, consider low-worth producers. Their decision to apply should also be weighted against the usual cost configuration. Throughout, they always signal in excess of their true worth, if $R^*_L(t) \equiv 0$ or $0 < R^*_I(t) < 1$. Again, this follows from the fact that $0 \leq \lambda_L < \lambda_U \leq 1$. While, on average, their expected surplus should not exceed the one obtained by high-types, *Decentralised Surveillance* enables them to profiteer from disguising. Conversely, when $R^*_H(t) > 1$, they signal the efficient amount and obtain zero from the usual payoff, $0(E[(\xi_L)|\tau_j] - C(\xi_L))$. The next Proposition attempts to formally summarise this argument.

Lemma 1 (No Perfect Separation - S1): *Under a serial screening device, low types are never prevented from mimicking high-quality producers. Thus, there is no perfectly separating equilibrium satisfying sequential rationality.*

Proof. By way of contradiction, assume the opposite. The fact that low-types cannot disguise as high-worth producers implies that their highest attainable profit is $b((\xi_L) - C(\xi_L))$. Since, in principle, ξ_L cannot achieve $\tau = 1$, this payoff must represent the highest bound on their expected returns. But, with no labels available, consumers would assign zero probability to the off-equilibrium beliefs that these producers are high-worth. By the Divinity Criterion, they would best-respond by rejecting all ξ_L products, which, in turn, implies that sellers would earn zero profits in equilibrium. This holds true only when $R^*_L(t) > 1$. However, the above is clearly not incentive-compatible with $R^*_L(t) \equiv 0$ or $0 < R^*_I(t) < 1$. In fact, it would contradict payoff maximisation.

This is a severe result. Practically, it means that, with weak trademarking and filing fees set *ex-ante*, the regulator is unable to discriminate effectively between high- and low-worth producers. This fact, in turn, implies that high types over- or under-signal in every equilibrium, because only a pooling outcome survives the proposed refinements. On the other hand, low types attain a strictly higher payoff from over-signalling. Notice that this result agrees with the concept of productive signalling advanced by Kremer and Skrzypacz (2007) in Proposition 4. In their model, however, high-caliber individuals can either be under- or over-educated, according to the different time dimension in which trade takes place.

To conclude, pre-set trademark tariffs and imperfections in the trademark process disturb the information channel and exacerbate the problem of adverse selection. Together, they generate welfare gains for undeserving producers and losses for all the other parties. Since the social planner is the main enabler of the observed noise, he is well-placed to undertake a reformative process to alleviate the side-consequences of weak testing and improve efficiency.

5 Model Variations

5.1 Alternative Mechanism Design

Due to the inherent imperfections of the screening device, *Decentralised Surveillance* transforms mandated traceability into a socially wasteful exercise. As previously highlighted, the regulator distorts producers' and consumers' choices, failing in the attempt of separating the market effectively. In this paragraph, I pose the following question: can the imperfections disappear completely if the regulator changes the machine structure?

The answer is far from definitive. To see why, suppose that the regulator introduces a partial improvement into the initial testing device. Before advancing a novel paradigm, recall that, in essence, the application process involves multiple stages, in which each component is critical. Anytime a failure occurs in one of these elements, the serial mechanism breaks down. Now consider Figure 6. In a legislative environment of this type, a defective block does not impair the functioning of the entire system. This is because a single part can process multiple requests at one time, without affecting the quality control mechanism. In other words, failure of an element is independent of the whole structure[14]. Thus, the probability of bad trademark attribution becomes the following:

$$Pr(F_R) = x^k$$

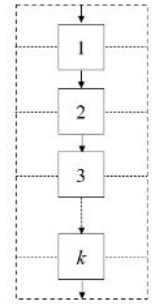
with $Pr(W_R) = 1 - (x)^k$ being the probability of correct screening. Notice that this scheme improves accuracy, because $Pr(F_R) = x^k < Pr(F) = 1 - (1 - x)^k$. This, in turn, translates into a higher probability for worthy producers to be attributed a GI label after application. That is, $\lambda_{UR} > \lambda_U > \lambda_{LR} > \lambda_L$.

I am now ready to reformulate *Decentralised Surveillance* in the presence of a parallel-combined machine.

Definition 3 (Decentralised Surveillance - II): *Fix a trademark signalling game,* Γ. *Let* $\xi_i \in \Xi = \{\xi_U, \xi_L\}$ *be producers' types and* $\tau_j \in \{0, 1\}$*, the binomial outcome of the trademark process.*

[14] It is possible to find examples of such a machine outside the boundaries of GI and intellectual property (IP) legislation. Without loss of generality, one such instance is parallel computing. As previously mentioned, another notable example is system reliability, which has first inspired this formulation.

Figure 6: *Decentralised Surveillance* (Parallel Combined Mechanism).



Source: Adaptation performed by the author from Rice (2007).
Notes: The improved mechanism involves a parallel connection among the elements of the system. Notice that a slight change in the configuration can reduce the probability of error, thereby increasing the chances of high-worth producers to be favourably screened.

With a parallel screening device, Decentralised Surveillance amounts to the following:

$$\begin{aligned}
Pr(\tau = 1|\xi_L) &= \lambda_{LR} = x^k = Pr(F_R) \\
Pr(\tau = 0|\xi_U) &= \lambda_{LR} = x^k = Pr(F_R) \\
Pr(\tau = 1|\xi_U) &= \lambda_{UR} = 1 - (x)^k = Pr(W_R) \\
Pr(\tau = 0|\xi_L) &= \lambda_{UR} = 1 - (x)^k = Pr(W_R)
\end{aligned}$$

where $Pr(F_R) < Pr(W_R)$. Part B.3 of the Appendix proves that this modification may or may not prevent low-quality sellers from mimicking their high-worth counterpart. For example, if the probability of error is minimal, the resulting equilibrium would allow for perfect separation. In contrast, when the value of λ_{LR} is sufficiently high, the resulting patterns will be consistent with the initial equilibria.

To summarise: while minor improvements can substantially reduce the probability of being incorrectly screened, conditions for the existence of a well-behaved equilibrium are far from certain. This is due to the coexistence of two tenets, which directly affect optimality: they are (i) the degree of testing imperfection and (ii) the distortions induced *ex-ante*, when the social planner announces the filing fee.

6 Discussion

Thus far, I have cast this study in terms of necessary and sufficient conditions for an equilibrium to exist. In the light of the model developed above, I now reflect informally upon the need for a reform of mandated traceability within the European context. From a policy perspective, it is instructive to expand on the (in)stability observed to understand how regulators can ameliorate the extant legislation. In this section, I specifically pursue this avenue by assessing the welfare impact of the current application process and evaluating how the DG AGRI could strengthen overall GI protection.

6.1 Welfare Implications of Mandated Traceability

Allegedly, EU quality labels provide transacting parties with indispensable guidance, safeguarding them from suboptimal food production and consumption. Despite being acknowledged as a public good, however, weak traceability standards can reduce the availability of HVPs and enable low-worth sellers to exploit the situation. In light of the previous assessment, I turn to comment on the welfare consequences of poorly enforced GIs and highlight three economic grounds for regulatory intervention.

As a starting point, consider the case in which trademark fees exceed the upper bound of the objective prior, $R^*_H(t) > 1$. In such a circumstance, there is only one sequential equilibrium in which no seller applies for a labelling recognition and no buyer acquires a strictly positive quality level. If the regulator sets very high trademark expenses, producers' and consumers' welfare is independent of the traceability standard. This is because there is no economic exchange among agents, with the latter being replaced at game-end. However, such a scheme generates a loss for the regulator, who capitalises on filing fees.

Second, recall the instance in which the cost of a certification mark is equal to the lower bound of the market prior, $R^*_L(t) \equiv 0$. Here, the unique sequential equilibrium involves signalling from both producers, with the undeserving type choosing to send a candidature. Consumers best respond by selecting $b^* = 1$ and buying any bundle with a labelling standard. With no available standard, they can expect to be better off picking $b^* = 0$. Notice that this outcome is more desirable than the previous one, because total surplus increases on average for all agents; in practice, however, those high types who are mistaken for low-worth producers obtain a negative payoff. That is, depending on the imperfections of the testing device, mandated traceability can increase net application costs. This, in turn, generates a loss for undervalued types. The same reasoning extends to consumers, who may wrongfully exchange a low- for a high-quality producer in the presence of a weak trademark.

Lastly, consider the intermediate cost configuration with $0 < R^*_I(t) < 1$. The analysis highlights that, in equilibrium, high-types apply for GI protection and low-worth ones mix between the two available strategies. Consumers choose $b^* = 1$, acquiring either quality level based on their own wealth and the available mark. Generally, this creates less surplus for the regulator, because fewer low types find it profitable to apply. Still, his payoff is higher than in the first case, in which no player seeks trademark protection. Among producers, the availability of GI protection generates monetary gains for the high- and low-quality ones who manage to pass the test. Yet, weak screening can result in welfare losses for those HVPs who are incorrectly identified. Likewise, consumers can expect to make or lose money, depending on the value of λ. Note that this equilibrium is the closest to the best attainable outcome under perfect testing.

From a welfare perspective, mandated traceability improves, on average, net gains for all stakeholders. Unsurprisingly, this applies when filing expenses are equal to the lower bound of the common prior or in an intermediate range. Still, there is considerable uncertainty about consumers' and producers' payoffs, because surpluses depend critically on *ex-ante* expenses and the size of the testing imperfections. To understand these challenges contextually, I will now advance how a revision of the current administrative process could leverage the full significance of European GIs.

6.2 Lessons for European Agricultural Policy

As part of the Regulatory Fitness and Performance Programme (REFIT), the European Parliament (2021) has recently launched an initiative to expedit the filing procedure and increase the overall appeal of GIs among contracting parties. The main change involves the application process, which could be progressively shortened with a unique and standardised registration system. While legislative efforts are merely focusing on the time dimension, I contend that competent authorities should aim to simultaneously tackle both aspects of the problem. In what follows, I focus on three complementary paradigms of reform. These proposals expand on the logic of uncertain patents first posited by Lemley and Shapiro (2005).

6.2.1 Independent and Consistent Assessment

Even if time-to-approval is efficiently reduced, the ability of EU examiners to correctly screen individual filings will remain a matter of substantial concern. Previously, I have established that eradicating the defects of the screening machine can only in part be proficuous. However, when the testing device is highly imperfect, it may be economically significant to reconfigure the entire system.

Because the serial mechanism currently employed can fail to return accurate results, EU regulators should consider adopting an alternative screening process. In particular, a reorganisation of the current testing architecture would enable stakeholders to take full advantage of shorter waiting times and benefit from the ensuing improvements. To achieve this aim, a continuous assessment of the filing process should take place annually within the regulatory body. This would be in line with yearly procedural reviews at the EUIPO, with which the legislator can ensure independence and inherent consistency of the ultimate result (EUIPO 2020). This practice requires deputed committees at the main Office to re-evaluate application instructions annually, based on previous stakeholders' recommendations. After publication of an initial blueprint, the latter can suggest further amendments to the registration process. If no objection is raised, then the regulatory entity can proceed to approve the standard (*ibid.*).

Notice that, in this scenario, interested parties within and outwith the main Office are actively engaged to ameliorate the entire mechanism from the start. This, in turn, should translate into an increased dependability of examiners and a substantial reduction in improper GI attributions.

While promotion of a single, electronic filing can lessen hold-up costs, standardisation alone will be insufficient to resolve the imperfections of the testing device. Rather, continuous involvement of stakeholders and yearly reviews of the entire mechanism could improve GI visibility and turn approval timing into a worthwhile exercise.

6.2.2 *Ex-Post Filing Expenses*

An additional reason for regulatory intervention concerns the uneven filing expenses, which producers face at a national level. Although an increase in trademark costs can reduce the workload for competent authorities and the number of illegally filed claims (Harhoff 2016), these incongruences can negatively affect producers' incentives to apply for a GI label. For this reason, a revision of the subject matter has to incorporate an upgrade of extant commissions.

Prior to submitting the entire application, producers need to pay an issuance fee. As claimed by the EU regulatory body, this upfront cost is necessary to cover total handling and assessment expenses. However, when a GI label is legally robust but improperly attributed, the system imposes a substantial burden on deserving producers. This is because the latter can solely initiate trademark litigation or withdraw their candidature at an additional cost[15]. In this framework, concerns about *ex-ante* expenses can dissuade HVPs from sending a candidature in the first place. To avoid the adverse consequences of poorly enforced fees, such costs need to be weighted against producers' expected returns from the label attained. In practice, this means that the regulator should decide on the cost of GI registration *ex-post*. In the face of this novel payment schedule, legislative authorities could then alleviate the economic burden on worthy producers and implement a fairer application system. Indeed, choosing trademark fees after a complete assessment of legitimacy would reduce filing expenses for those high-types who are exchanged for non-deserving sellers and impose a penalty on producers who are found liable for disguise. Together with the continuous strengthening of the testing mechanism, this change could increase the number of high-worth applicants and, in turn, benefit consumers.

To date, this payment plan has never been trialled by the World Intellectual Property Office (WIPO) or the most prominent trademark agencies - the United States Patent and Trademark Office (USPTO), China's National Intellectual Property Administration (CNIPA), and the Japan Patent Office (JPO)[16]. Yet, regulatory bodies who require *ex-post* adjustments of GI expenses are already walking down this path. As hinted above, extending this logic to *ex-ante* filing fees could substantially increase the validity of EU quality schemes.

6.2.3 The Role of the WIPO

Theory indicates that the costs as well as the defects of the testing mechanism can hinder the effectiveness of the GI procedure. Addressing both instances simultaneously may be complicated by the absence of a global entity who oversees the decisions of the DG AGRI and the EUIPO. For the above proposals to work, the WIPO plays a leading role because it has the legal authority to protect the international GI system and harmonise these labelling standards across the globe.

The WIPO is the prime organism deputed to impose a common framework of reference for intellectual property protection worldwide. In an attempt to reduce the administrative burden of filing multiple regional applications, the WIPO has approved the Lisbon Agreement (1967) and, more recently, extended this pact with the Geneva Act (2015)[17]. Such instruments serve the purpose of establishing a standardised system of AO registration and boost the marketability of products with a recognised traceability standard in their COO. While these treaties subsume different policy objectives under a universal code, they assume GIs to be granted after a thorough assessment of producers' claims. This is why international examiners are not legally allowed to raise objections about national agencies' testing procedures. As a result, the EU application process remains tied to local jurisdictions. Although the current WIPO legislation reduces administrative

[15]While the European Commission does not charge any formal fee, national offices and the EUIPO require an average of €500 to complete extra-procedural tasks. By comparison, consider the case of the United States Patent and Trademark Office (USPTO). At the moment of writing, GI applicants would need to pay an additional $250 for withdrawing an application. Among the others, there can be fees of $50 for sending a letter of protest and up to $400 for requesting a revision of initial claims. It is possible to consult the latest breakdowns of charges for GI labelling on the EUIPO (2021) and the USPTO (2021) websites.

[16]I define prominence according to the number of applications filed yearly per trademark office. Readers interested in this discussion should consult the report of the WIPO (2020) titled *World Intellectual Property Indicators 2020* for a discursive overview.

[17]Taken together, the Treaties under scrutiny are formally known as the Lisbon System for International Registration of Appellations of Origin and Geographical Indications (WIPO 2021).

expenses for producers', an expansion of its areas of intervention would ensure a more thorough assessment of producers' claims within the EU. In other words, this regulatory entity is well-suited to perform an independent evaluation of the registrations effected by the DG AGRI, with the awareness that the initial screening procedure may be prone to failure. Note that this is in stark contrast with the principles of the Geneva Act (2015), according to which the International Bureau automatically registers foods with a recognised GI label in the electronic database[18].

Naturally, this would not completely erase the possibility of improper GI attribution. Yet, it would guarantee complementary guidance to national and EU institutions in the subject matter. By acting as a co-certifier, the global IP forum could in fact assist deputed authorities in the processing stage, with the ultimate objective of minimising the probability of error.

In sum, the valorisation of European GIs goes well beyond the one-shot improvement currently debated. While the recent legislative efforts focus on accelerated registration pathways, they are very far from providing conclusive responses. Under its aegis, the WIPO could condense both reformative proposals and attentively balance the interests of all contracting parties.

7 Concluding Remarks

Due to the uneven spread and different fees of Geographical Indications across Europe, the economic impact of mandated traceability is ambiguous. In this thesis, I have modelled how poor screening and variable cost configurations can interfere with players' decision to invest in GI-labelled products. As advanced in the preceding sections, *Decentralised Surveillance* can accentuate the side-consequences of trademark tariffs set *ex-ante*. Since the regulator is agnostic about producers' payoffs when choosing the fee, the weaknesses in the testing mechanism can further distort agents' incentives to seek protection. This inherent uncertainty results in three suboptimal equilibria. In the presence of very costly licenses, it creates a socially efficient outcome for low-types, but leads to under-signalling from high-quality producers. If there are no charges, it enables both agents to send a candidature, with over-signalling from low-worth sellers. Similarly, when tariffs are in the intermediate range, there is a symmetric equilibrium in which high types apply; while low types mix and signal in excess of their value. Consequently, consumers are ill-informed about producers' true worth. This should raise concerns about the main rationale behind mandated traceability and spur regulators to rethink the modeling of European GIs. Overall, the analysis favourably supports the Commission's workings for expediting the current application procedure. Yet, this reform would only in part benefit transacting parties. This is because strengthening the value of GIs requires i) a recalibration of the testing device and ii) the adoption of *ex-post* filing expenses. In this context, the WIPO would have legal standing to address both dimensions and independently assess the validity of granted standards.

There are at least three limitations of this study which deserve further consideration and pose interesting challenges for future work. First, I have assumed that the decision to apply occurs only

[18] Of particular relevance for the purposes of this discussion are Article 18 and Article 19(2) of the Geneva Act (2015). The first establishes that local signatories are legally obliged to inform the WIPO of the type of GI recognition accorded to applying producers. On this basis, the International Bureau is responsible for ratifying and promulgating the decision in the WIPO database.
In contrast, Article 19 provides an overview of the refusal process. In particular, subarticle (2) specifies that the International Bureau is not accountable for the negation of a GI registration, because solely the deputed (EU / national) authorities can object to the filed application. For a complete understanding, see Chapter IV of the aforementioned Treaty.

once for all producers. This conjecture is quite strong, but can be relaxed by rethinking the model in continuous time. If past histories affect players' decisions to invest in the signal, individual actions are no longer independent of reputational forces. In such a scenario, I expect agents who invest in the label to learn from others' responses. As an example, consider the framework proposed by Van der Schaar and Zhang (2015). In this case, the continuous availability of GI protection at $R^*(t) < 1$ would enable agents initially credited with a recognition to operate, irrespective of future screening defects. Otherwise stated, poor testing at the start of the game could either amplify or depress players' gains. To avoid the negative effects of weak testing, the social planner would need to ensure the correct functioning of the machine from the very beginning. This, in turn, requires a preemptive intervention of *super-partes* entities, before the actual screening phase[19].

A second avenue for future research is to substitute the one-off registration payment with a double-part tariff. In practice, GI producers face both fixed and variable expenses to obtain and preserve a traceability standard[20]. This is why it would be crucial to include such an assumption in the model. Even so, I expect the additional fees to potentially discourage application. This is especially true if the testing procedure is particularly weak. Clearly, such a feature would sensibly complicate the baseline model and resulting stability. However, it would be possible to prove that, if the variable component is relatively low, Proposition 1-3 would still hold in equilibrium.

Lastly, I have assumed high-quality menus to increase social surplus relative to low-quality ones. While this tenet has expedited the analysis, it would be worthwhile to explore whether consumers' preferences remain constant under the opposite premise[21]. That is, if low-worth bundles enhance welfare for the majority of consumers, is mandated traceability still economically viable? Probably not. In this situation, there is no equilibrium in which the signal provides players with a strictly higher payoff. Therefore, the social planner would have no incentive to support the GI scheme[22].

Undoubtedly, I have not accounted for other policy-relevant features, which could in fact change the equilibrium dynamics. Independent of such elements, this thesis demonstrates that, within the European context, the effectiveness of mandated traceability crucially depends on the costs of GI protection and the imperfections of the testing mechanism. While the registration process is inherently filled with obstacles, future reformative proposals aimed at nurturing closer collaboration between deputed institutions could partially resolve the underlying uncertainty.

[19] In the case of traceability standards, involvement of third-party certifiers could potentially address this problem and contribute to a correct assessment of producers' claims. For example, the Australian IP Office applies this principle before taking a final decision on GIs. See IP Australia (2021) for an insight.

[20] With variable GI expenses, I refer to eventual litigation costs, additional charges for renewal, correction, or issuance of additional certificates.

[21] Janssen and Roy (2015) have previously delved into this area of research.

[22] There are countries in which the GI system is not in force. Examples include Afghanistan, Cape Verde, Djibouti, East Timor, Eritrea, Micronesia, Nauru, Palau, Somalia, Suriname, the Maldives, the Marshall Islands, Tuvalu, and Vanuatu (O'Connor and Company, 2007). Recently, the United Nations Conference on Trade and Development (UNCTAD) has launched an initiative to support the extension of the scheme to the LDCs. See, for instance, the following source: UNCTAD (2021). *Geographical indications for least developed countries.* Available at: `https://unctad.org/topic/least-developed-countries/geographical-indications` (Accessed: 15 July 2021).

8 References

Admati, A.R. and Perry, M. (1987) "Strategic Delay in Bargaining." *Review of Economic Studies*, *54*(3), 345-364.

Albano, G.L. and Lizzeri, A. (2001) "Strategic Certification and Provision of Quality." *International Economic Review*, *42*(1), 267-283.

Arfini, F. (2019) "EU Food Quality Policy: Geographical Indications." In: Dries L., Heijman W., Jongeneel R., Purnhagen K., Wesseler J. (eds.) *EU Bioeconomy Economics and Policies: Volume II. Palgrave Advances in Bioeconomy: Economics and Policies.* Palgrave Macmillan, Cham. Available at: `https://doi.org/10.1007/978-3-030-28642-2_3` (Accessed: 20 June 2021), 27-46.

Banks, J.S. and Sobel, J. (1987) "Equilibrium Selection in Signaling Games." *Econometrica*, *55*(3), 647-661.

Bergemann, D. and Morris, S. (2016) "Information Design, Bayesian Persuasion, and Bayes' Correlated Equilibrium." *The American Economic Review*, *106*(5), 586-591.

Board, S. and Meyer-Ter-Vehn, M. (2013) "Reputation for Quality." *Econometrica*, *81*(6), 2381-2462.

Buehler, B. and Schuett, F. (2014) "Certification and Minimum Quality Standards When Some Consumers are Uninformed." *European Economic Review*, *70*, 493-511.

Caswell, J.A. and Mojduszka, E.M. (1996) "Using Informational Labeling to Influence the Market for Quality in Food Products." *American Journal of Agricultural Economics*, *78*(5), 1248-1253.

Cho, I.K. and Kreps, D.M. (1987) "Signaling Games and Stable Equilibria." *The Quarterly Journal of Economics*, *102*(2), 179-221.

Council Regulation (EEC) No. 2081/92 of 14 July 1992 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs, OJ L 208, 24.07.1992, p. 1-8.

DG AGRI - European Commission, Directorate-General for Agriculture and Rural Development (2020) *Factual Summary of the Public Consultation on the Evaluation of the Geographical Indications (GIs) and the Traditional Specialty Guaranteed (TSGs).* Available at: `https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/2029-Evaluation-of-Geograph` `public-consultation_it` (Accessed: 4 July 2021).

Doval, L. and Ely, J.C. (2020) "Sequential Information Design." *Econometrica*, *88*(6), 2575-2608.

Dranove, D. and Jin, G.Z. (2010) "Quality Disclosure and Certification: Theory and Practice." *Journal of Economic Literature*, *48*(4), 935-963.

European Commission (2021) *eAmbrosia - The EU Geographical Indications Register.* Available at: `https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/` (Accessed: 16 July 2021).

European Parliament (2021) *Legislative Train Schedule - A European Green Deal. Revision of the EU Geographical Indications (GIs) Systems in Agricultural Products and Foodstuffs, Wines and Spirit Drinks.* Available at: `https://www.europarl.europa.eu/legislative-train/theme-a-european-g` `file-revision-of-geographical-indications-(refit)` (Accessed: 20 July 2021).

European Union Intellectual Property Office (EUIPO, 2020) *Guidelines for Examination - European Intellectual Property Office (EUIPO).* Available at: `https://euipo.europa.eu/tunnel-web/`

secure/webdav/guest/document_library/guidelines/trade_mark_guidelines_track_changes_en.pdf (Accessed: 12 July 2021).

European Union Intellectual Property Office (EUIPO, 2021) *Fees Payable Direct to EUIPO.* Available at: https://euipo.europa.eu/ohimportal/en/fees-payable-direct-to-euipo (Accessed: 12 July 2021).

Farrell, J. and Shapiro, C. (2008) "How Strong are Weak Patents?" *The American Economic Review*, *98*(4), 1347-1369.

Forges, F. (1986) "An Approach to Communication Equilibria." *Econometrica*, *54*(6), 1375-1385.

Fudenberg, D. and Tirole, J. (1991) *Game Theory.* Cambridge, MA: MIT Press.

Geneva Act of the Lisbon Agreement on Appellations of Origin and Geographical Indications and Regulations Under the Geneva Act of the Lisbon Agreement, 20 May 2015. [Online]. WIPO Publication No. 239E. Available at: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_239.pdf (Accessed: 14 July 2021).

Giovannucci, D. et al. (2009) *Guide to Geographical Indications: Linking Products and their Origins.* Geneva: International Trade Center (ITC).

Harhoff, D. (2016) "Patent Quality and Examination in Europe." *The American Economic Review*, *106*(5), 193-197.

International Comparison Program, World Bank (2021) *World Development Indicators database, World Bank — Eurostat-OECD PPP Programme.* Available at: https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=EU (Accessed: 4 July 2021).

IP Australia (2021) *Quality Management.* Available at: https://manuals.ipaustralia.gov.au/pbr/quality-management-at-ip-australia (Accessed: 15 July 2021).

IPKey (2011) *European Legislation on Protection of Geographical Indications Overview of the EU Member States' Legal Framework for Protection of Geographical Indications.* Available at: https://ipkey.eu/sites/default/files/legacy-ipkey-docs/european-legislation-on-protection-pdf (Accessed: 20 June 2021).

Janssen, M.C.W. and Roy, S. (2015) "Competition, Disclosure and Signalling." *The Economic Journal*, *125*(582), 86-114.

Jehle, G.A. and Reny, P.J. (2011) *Advanced Microeconomic Theory*, 3rd edn. Harlow: Financial Times Prentice Hall.

Kamenica, E. and Gentzkow, M. (2011) "Bayesian Persuasion." *The American Economic Review*, *101*(6), 2590-2615.

Kremer, I. and Skrzypacz, A. (2007) "Dynamic Signaling and Market Breakdown." *Journal of Economic Theory*, *133*(1), 58-82.

Lemley, M.A. and Shapiro, C. (2005) "Probabilistic Patents." *The Journal of Economic Perspectives*, *19*(2), 75-98.

Lisbon Agreement for the Protection of Appellations of Origin and Their International Registration, October 31 1958, as revised, July 14, 1967. [Online]. 923 U.N.T.S. 205. Available at: http://www.wipo.int/treaties/en/text.jsp?fileid=285856/ (Accessed: 14 July 2021).

Lizzeri, A. (1999) "Information Revelation and Certification Intermediaries." *The RAND Journal of Economics*, *30*(2), 214-231.

Makris, M. and Renou, L. (2021) "Information Design in Multi-stage Games." Available at: https://search.ebscohost.com/login.aspx?direct=true&AuthType=shib&db=edsarx&AN=edsarx.2102.13482&site=eds-live (Accessed: 5 July 2021).

Marinovic, I., Skrzypacz, A., and Varas, F. (2018) "Dynamic Certification and Reputation for Quality." American Economic Journal: Microeconomics, 10(2), 58-82. Musinanghe, M. and Gellerson, M. (1979) "Economic Criteria for Optimizing Power System Reliability Levels." *The Bell Journal of Economics*, *10*(1), 353-365.

Myerson, R.B. (1981) "Optimal Auction Design." *Mathematics of Operations Research*, *6*(1), 58-73.

Myerson, R.B. (1983) "Mechanism Design by an Informed Principal." *Econometrica*, *51*(6), 1767-1797.

Myerson, R.B. (1986) "Multistage Games with Communication." *Econometrica*, *54*(2), 323-358.

Nelson, P. (1970) "Information and Consumer Behavior." *Journal of Political Economy*, *78*(2), 311-329.

O'Connor and Company (2007) *Geographical Indications and TRIPs 10 Years Later...A Roadmap for EU GI Holders to Gain Protection in Other WTO Members. Part II: Protection of Geographical Indications in 160 Countries Around the World.* Available at: `https://trade.ec.europa.eu/doclib/docs/2007/june/tradoc_135089.pdf` (Accessed: 20 July 2021).

Osborne, M.J. and Rubinstein, A. (1994) *A Course in Game Theory.* Cambridge, MA: MIT Press.

Rice, J.A. (2007) *Mathematical Statistics and Data Analysis*, 3rd edn. Belmont, CA: Brooks/Cole, Cengage Learning.

Schneider, M. and Stephenson, D.G. (2021) "Bargains, Price Signaling, and Efficiency in Markets with Asymmetric Information." *Games and Economic Behavior*, *128*, 160-181.

Shapiro, C. (2003) "Antitrust Limits to Patent Settlements." *The RAND Journal of Economics*, *34*(2), 391-411.

Smith, T.G. and Tasnádi, A. (2007) "A Theory of Natural Addiction." *Games and Economic Behavior*, *59*(2), 316-344.

Spence, M. (1973) "Job Market Signaling." *The Quarterly Journal of Economics*, *87*(3), 355-374.

Spence, M. (1974) *Market Signaling, Information Transfer in Hiring and Related Processes.* Cambridge, MA: Harvard University Press.

Stahl, K. and Strausz, R. (2017) "Certification and Market Transparency." *The Review of Economic Studies*, *84*(4), 1842-1868.

Subiotto, R. (2014) *The Implications of the Imperfect European Patent Enforcement System on the Assessment of Reverse Payment Settlements. OECD Competition Papers, DAF/COMP/WD(2014)75.* Available at: `https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP/WD(2014)75&docLanguage=En` (Accessed: 3 July 2021).

Swinkels, J.M. (1999) "Education Signalling with Preemptive Offers." *The Review of Economic Studies*, *66*(4), 949-970.

United Nations Conference on Trade and Development (UNCTAD, 2021) *Geographical indications for least developed countries.* Available at: `https://unctad.org/topic/least-developed-countries/geographical-indications` (Accessed: 15 July 2021).

United States Patent and Trademark Office (USPTO, 2021) *USPTO Fee Schedule.* Available at: `https://www.uspto.gov/learning-and-resources/fees-and-payment/uspto-fee-schedule#Trademark%20Fees` (Accessed: 12 July 2021).

Van der Schaar, M. and Zhang, S. (2015) "A Dynamic Model of Certification and Reputation." *Economic Theory*, *58*(3), 509-541.

Wang, R. (1993) "Auctions versus Posted-Price Selling." *The American Economic Review, 83*(4), 838-851.

World Intellectual Property Organization (WIPO, 2013) *World Intellectual Property Report 2013: Brand, Reputation and Image in the Global Marketplace.* Geneva: World Intellectual Property Organization.

World Intellectual Property Organization (WIPO, 2020) *World Intellectual Property Indicators 2020.* Geneva: World Intellectual Property Organization.

World Intellectual Property Organization (WIPO, 2021) *Lisbon – The International System of Appellations of Origin and Geographical Indications.* Available at: `https://www.wipo.int/lisbon/en/` (Accessed: 19 July 2021).

9 Appendix

A. Geographical Indications

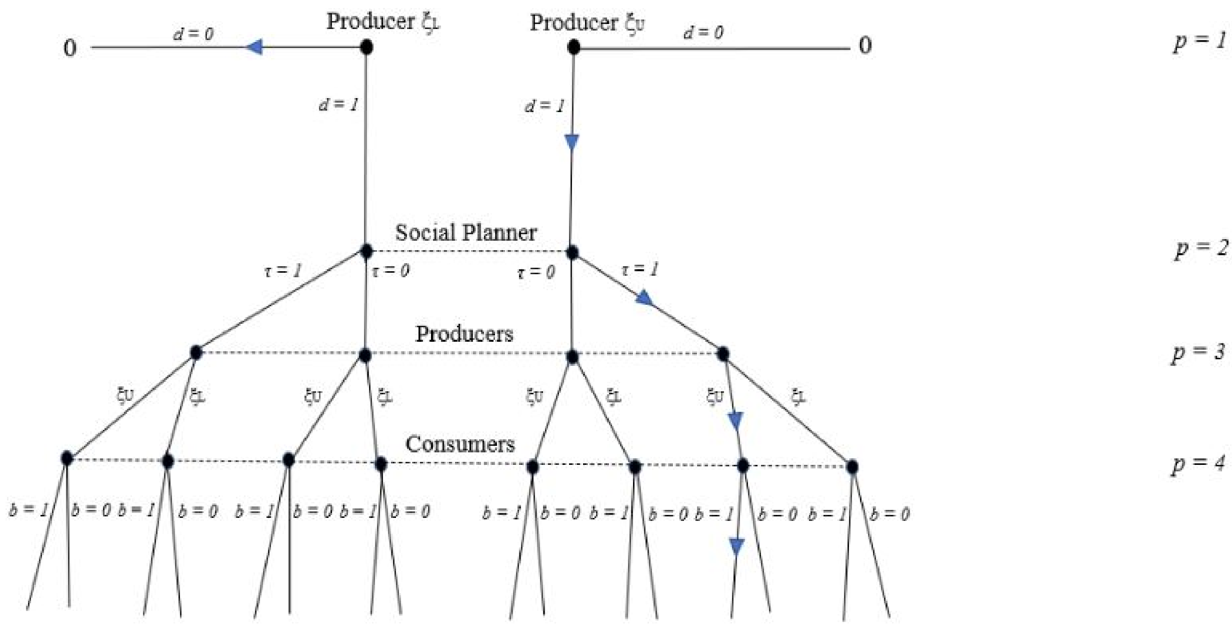
Figure A1: Country Breakdown of GIs Filing Time, Expenses, and Registered Names.

COUNTRY	TIMING (NATIONAL)	TIMING (EU)	FILING COST (NATIONAL)	GIs (FOOD)	GIs (WINE)	GIs (SPIRIT DRINKS)	GIs (AROMATISED WINE)
Austria	4	21	€ 580.00	17	50	10	0
Belgium	30	60	€ -	20	20	10	0
Bulgaria	15	36	€ -	5	66	12	0
Croatia	n/a	n/a	n/a	41	25	6	1
Cyprus	4	21	€ -	11	13	2	0
Czech Republic	4	24	€ 375.00	31	13	0	0
Denmark	4	21	€ -	8	5	0	0
Estonia	4	21	€ 166.15	1	1	1	0
Finland	4	21	€ -	8	72	2	0
France	78	21	€ -	276	512	55	0
Germany	30	60	€ -	101	84	36	2
Greece	14	36	€ -	116	163	15	0
Hungary	9	21	€ 390.00	31	68	16	0
Ireland	4	21	€ -	13	3	3	0
Italy	9	30	€ -	340	584	35	1
Latvia	4	21	€ 1,015.00	5	0	0	0
Lithuania	4	21	€ -	8	7	7	0
Luxembourg	9	24	€ -	7	1	0	0
Malta	4	21	€ -	0	3	0	0
The Netherlands	9	24	€ -	11	26	5	0
Poland	9	30	€ 1,110.00	34	2	2	0
Portugal	9	36	€ -	155	70	16	0
Romania	10	24	€ 550.00	10	65	9	0
Slovakia	9	24	€ 198.50	14	10	1	0
Slovenia	12.5	24	€ -	24	21	4	0
Spain	24	36	€ -	231	171	20	1
Sweden	4	21	€ -	24	3	3	0

Source: Author's calculations from IPKey (2011) and the European Commission (2021).
Notes: Notice that the second and third column refer to the timing of trademark issuance once producers complete the application stage. Values are an average of months elapsed after the regulator thoroughly assesses their claims. The fourth column reports mean filing expenses for GI labels across the EU. As highlighted, I express this cost in the common currency (€). In terms of notation, I denote zero charges with €-. Conversely, the use of n/a indicates the unavailability of a data entry for the country under scrutiny.

B.1. Trademark Signalling Game

Figure B1: Game Tree Specification.



Source: Author's analysis.
Notes: The construction depicted above is the extensive form of the Bayesian game under scrutiny. For tractability, the RHS of the figure reports the periods in which each player intervenes by choosing a sequentially rational strategy. Following the illustration of Doval and Ely (2020), I denote optimal equilibrium paths under perfect information with blue arrows.

B.2. Formal Proof

PROOF OF PROPOSITION 1:

If $R_H^*(t) > 1$, then there exists a C-K pooling equilibrium where no producer applies for a trademark.

Part *1)*. This construct follows the same line of reasoning as Kremer and Skrzypacz (2007) in Proposition 1. In particular, suppose, by way of contradiction, that both types of producers $\xi_i \in \Xi = \{\xi_L, \xi_U\}$ choose $d = 1$. If the social planner sets $R_H^*(t) > 1$, then $E[(\nu(\xi_i)|\tau = 1)] < [C(\xi_i) + R_H^*(t)]$. However, this would be a clear violation of Conditions (*3*) and (*4*). In particular, if expected revenues conditional on obtaining a trademark are lower than total costs of production and registration, the fee level would be far too expensive for both producers. This is because of Condition (*6*). Indeed, given that high-worth sellers expect to lose money, no other type lower than ξ_U can apply for a trademark without incurring a larger loss. Therefore, if producers deviate by selecting $d = 1$ with positive probability, this decision would result into an equilibrium payoff lower than zero for all producers, $U_{\sigma n,d=1} = b[E(\nu(\xi_i)|\tau_j) - C(\xi_i) - R_H^*(t)] < 0$. To recover initial investment expenses and break-even, both types would need to set a price higher than buyers' expected valuation, $\nu(\xi_i) > E(\xi_i|\tau_j)$. But, buyers update beliefs according to the common prior $\theta(\xi_i)$ with $0 \leq \theta \leq 1$. Therefore, if the market price exceeds their price expectation, no trade would take place. As a result, high- and low-worth producers would end up bankrupt, which is yet inconsistent with sequential rationality. Hence, $d = 1$ is an unprofitable deviation. Sellers are, in fact, better off not applying in the first place.

Part *2)* and *3)*. To explain the rationale behind these points, consider that consumers best respond by choosing one of the two quality levels at any node reached with probability 1. Due to the absence of public signals, Bayesian updating implies that consumers' posteriors are equivalent to their *ex-ante* beliefs. This means the following:

$$\mu(\xi_i|\tau_j) = E(\xi_i) = \sum_i \xi_i \theta(\xi_i) = \theta\xi_U + (1-\theta)\xi_L$$

Notice that, for any $R_H^*(t) > 1$, picking $b = 1$ is not a profitable deviation. This is because $U_{\sigma n,b=1} := b[E(\xi_i|\tau_j) - \nu(\xi_i)] < U_{\sigma n,b=0} := 0$, which implies that they would lose money irrespective of the quality bundle selected. Such a restriction leads me to conclude that $b = 1$ is never sequentially rational in the presence of a high trademark fee. Thus, the only equilibrium supported requires consumers to select $b^* = 0$ and attain a payoff of zero.

PROOF OF PROPOSITION 2:

While I provide most of the intuition in the text, the main result that I need to prove is the following:

If $R_L^*(t) \equiv 0$, one pooling equilibrium is feasible, in which both types of producers apply for a trademark.

Note that this case is the reverse of the first scenario, hence I derive it symmetrically from the reasoning detailed above. I start from Part *1*) of the Proposition. In particular, suppose the opposite. Examine the subgame in which no producer decides to undergo the screening process with positive probability, such that $d = 0$. By Condition (*3*), $E[\nu(\xi_U|\tau = 1)] > [C(\xi_U) + R_L^*(t)]$ for high-worth sellers. That is, under this fee configuration, expected returns from high-worth bundles conditional on obtaining the trademark are higher than overall expenses. Hence, picking $d = 0$ is a contradiction to payoff maximisation. To see why this is the case, recall that, on average, $U > L$ due to *Decentralised Surveillance*. If correctly screened, high-worth producers can obtain a payoff strictly higher than zero (Condition (*5*)). Thus, it must hold that

$$\lambda_U(1 - \lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))] >$$
$$> (1 - \lambda_U)\lambda_L[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))]$$

and

$$\lambda_U(1 - \lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))] > b[\nu(\xi_U) - C(\xi_U))] = 0$$

for any high-worth seller. Thus, in spite of the imperfection in the screening mechanism, high types find it more profitable to apply, in that a positive outcome allows them to charge a price $0 < \nu(\xi_U) < E(\xi_U|\tau_j)$. Therefore, any strategy $d = 0$ is off-the-equilibrium path. Since the relationship holds for high-quality types, I argue that it must also be true that $E[(\nu(\xi_L)|\tau_j)] > (C(\xi_L) + R_L^*(t))$ by Condition (*4*). Hence, the same line of reasoning can be extended to low-worth sellers. In particular, recall that Condition (*5*) requires $[E(\nu(\xi_U)|\tau = 1)][E(\nu(\xi_L)|\tau = 1)] > 0$. Then, under free trademarking, low-worth producers receive a higher payoff if they are wrongly screened. This is because, while *Decentralised Surveillance* imposes $\lambda_U > \lambda_L$, it does not rule out the possibility for low-quality types to be awarded a recognition, independent of their true product value. Otherwise stated, it must be that

$$U(1 - \lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] >$$
$$> (1 - \lambda_U)\lambda_L[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))]$$

and

$$\lambda_U(1 - \lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] > [b(\nu(\xi_L) - C(\xi_L))] = 0$$

In contrast to an environment with perfect trademarking, *Decentralised Surveillance* enables any low-quality producer to mimic its high-worth counterpart.

Next, let us consider Part *2*) and *3*). For any $R_L^*(t)0$, picking $b = 0$ is not always a profitable deviation. To see why, consider that $0[E(\xi_i|\tau = 1)] - \nu(\xi_i)] < 0$. In the presence of a low filing fee, consumers would attain a negative payoff if they choose not to buy labelled products. Therefore, it is possible to establish that $b^* = 0$ is only sequentially rational with no trademark. Now, consider the opposite scenario. In this case, we have $1[E(\xi_i|\tau = 1)] - \nu(\xi_i)] > 0$. This implies that the only equilibrium supported is one in which consumers pick $b^* = 1$ and acquire the labelled quality bundle. Since both sellers apply for a trademark, buyers' posteriors must equal their ex-ante beliefs. That is

$$\mu(\xi_i|\tau_j) = E(\xi_i) = \sum_i \xi_i\theta(\xi_i) = \theta\xi_U + (1 - \theta)\xi_L$$

This completes the proof.

PROOF OF PROPOSITION 3:

If $0 < R_I^*(t) < 1$, *there is a unique partial pooling equilibrium in which high-worth producers apply for a trademark and low-worth types randomise.*

Note that the first part of the argument is analogous to the one introduced above. To an extent, it parallels the proof of Proposition 6 in Janssen and Roy (2015).

Assume the existence of an equilibrium in which high-worth producers do not apply with probability one. Consider the stage of quality production following $d = 0$. Since $\lambda_U > \lambda_L$, types ξ_U would earn a strictly negative profit by applying. If correctly screened, they could set $[E(\hat{(}\xi_U)|\tau = 1)] > 0$ by Condition (*5*). Then, when the cost of the licensing fee is in the intermediate range, they would still maximise their payoff by sending a candidature. This presumes the following:

$$\lambda_U(1-\lambda_L)[b(E[(\hat{(}\xi_U)|\tau_j)] - C(\xi_U) - R_I^*(t))] >$$
$$> (1-\lambda_U)\lambda_L[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_I^*(t))]$$

and

$$\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_I^*(t))] > [b((\xi_U) - C(\xi_U))] = 0$$

By the same argument developed in Part *1*) of Proposition 2, any other candidate equilibrium in which high-worth producers select not to apply can be ruled out. Now consider the equilibrium strategy for low-worth producers. There are clearly two options available:

(a) *Low-worth producers apply,* $d = 1$;

(b) *Low-worth producers do not apply,* $d = 0$.

I will show that there is no pure strategy equilibrium for low types. Rather, the only possible solution is in mixed strategies. Formally, suppose that $0 < R_I^*(t) < 1$. In this case, low-worth producers would choose $d = 1$ with probability $\epsilon_i \in (0, 1)$. This is because of the following:

$$[E(\nu(\xi_L)|\tau_j)] = [C(\xi_L) + R_I^*(t)] \qquad (B.2.1)$$

$$[E(\nu(\xi_L)|\tau = 1)] = [E(\nu(\xi_L)|\tau = 0)] = 0 \qquad (B.2.2)$$

Notice that Condition (*B.2.1*) is weaker than Condition (*3*). In particular, it implies that expected revenues from a low-quality bundle conditional on the realisation of j equal total production and filing expenses. In addition, I modify Condition (*5*) and (*6*) with (*B.2.2*), which requires expected revenue from labelled products to equal expected revenue with no trademark. In other words, with $\lambda_U > \lambda_L$, low-worth sellers expect to obtain equal returns from either sending a candidature or not. Thus, the following must hold:

$$\epsilon\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] =$$
$$= \epsilon(1-\lambda_U)\lambda_L[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))]$$

and

$$\epsilon\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] = [b(\nu(\xi_L) - C(\xi_L))]$$

Both conditions are necessary to express producers' indifference between applying and not applying. Rearranging the terms, it is possible to rewrite the expressions as

$$\epsilon\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] -$$

$$-\epsilon(1-\lambda_U)\lambda_L[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] = 0 \qquad (I)$$

and

$$U(1-L)[b(E[(v(L)|j)] - C(L) - RI*(t))] - [b(v(L) - C(L))] = 0 \qquad (II)$$

Assuming that these conditions hold, low-worth producers expect net profit after applying for trademark protection to be the following:

$$U_{\sigma L,d=1} := \epsilon[\lambda_U(1-\lambda_L)b(E[\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] +$$

$$+\epsilon[(1-\lambda_U)(\lambda_L)b(E[\nu(\lambda_L)|\tau_j)] - C(\xi_L) - R_I^*(t))]$$

On the other hand, not applying for a certification mark would earn them an equivalent payoff:

$$U_{\sigma L,d=0} := [b(\nu(\xi_L) - C(\xi_)L)]$$

Notice from (I) and (II) that there must be a unique value of ϵ^*, which satisfies $0 < \epsilon^* < 1$. Closely scrutinising the equivalences, it is possible to infer that both equations are increasing in the probability of application. Particularly, when $* = 0$, $0 - R_I^*(t) < 0$. This is in contrast with the case of $^* = 1$, where $1 - R_I^*(t) > 0$. If this holds, then producers are truly indifferent between the two available strategies. Hence, it is possible to state:

$$\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] >$$

$$> (1-\lambda_U)\lambda_L[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] >$$

$$> \epsilon[\lambda_U(1-\lambda_L)b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] =$$

$$= \epsilon[(1-\lambda_U)(\lambda_L)b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] =$$

$$= [b(\nu(\xi_L) - C(\xi_L))]$$

where these expressions hold for fees in the intermediate range, $0 < R_I^*(t) < 1$. Lastly, observe that, as the probability that low-quality sellers apply tends to unity, randomisation converges to the equilibrium conditions described by Proposition 2.

Next, I prove Part *2*) and Part *3*). The C-K Intuitive Criterion suggests that, after observing that some sellers apply and others mix, consumers should believe that products with a trademark are high-worth. In this case, the strategy of picking $b = 0$ is not always profitable. To see why, consider that, in the presence of a certification mark, they attain a negative payoff if they do not buy. This is $0[E(\xi_i|\tau = 1) - \nu(\xi_i)] < 0$. Therefore, selecting $b = 0$, independent of mark attribution, is never sequentially rational. However, since the degree of imperfection in the trademarking mechanism is unknown to both players, there is an instance in which the decision of not buying is utility-maximising. In particular, if producers are not labelled, consumers best respond by choosing $b^* = 0$. To show this tenet, consider the opposite. Notice that the proof is analogous to the one developed in Proposition 2. If they decide to buy, indeed, consumers would lose money irrespective of the quality bundle selected. Under no trademark, they are better off choosing $b^* = 0$. Therefore, the only equilibrium strategy would be for consumers to buy labelled products or not to buy otherwise.

B.3. Alternative Mechanism Design

Based on the reasoning developed above, write $\lambda_{UR} > \lambda_{LR}$. In this instance, I also require that *a)*$\lambda_{UR} > \lambda_U$ and *b)* $\lambda_{LR} < \lambda_L$. In words, the improvement in the screening device could translate into a lower probability of error. On this basis, there are two potential equilibrium configurations to explore[23]:

(a) λ_{LR} is *minimally* lower than λ_L and λ_{UR} is *minimally* higher than λ_U;

(b) λ_{LR} is *substantially* lower than λ_L and λ_{UR} is *substantially* higher than λ_U.

Start first with case *(a)*. In this instance, the proof is analogous to the three equilibria evaluated before. In particular, $\lambda_{UR} \approx \lambda_U$ and $\lambda_{LR} \approx \lambda_L$. High-quality producers invest in the signal *iff* $R^*_L(t) \equiv 0$ or $0 < R^*_I(t) < 1$. This is because the following holds true:

$$\begin{aligned}&\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R^*_L(t))] > \\ &> (1-\lambda_U)\lambda_L[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R^*_L(t))]\end{aligned}$$

and

$$\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R^*_L(t))] > [b(\nu(\xi_U) - C(\xi_U))] = 0$$

Likewise, low-worth sellers choose to send a candidature *iff* $R_L(t)^* \equiv 0$. Yet, recall that $0 < R^*_I(t) < 1$ determines an equilibrium in mixed-strategies. To sum up, the resulting configuration arises when

$$\begin{aligned}&\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R^*_L(t))] > \\ &> (1-\lambda_U)\lambda_L[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R^*_L(t))]\end{aligned}$$

and

$$\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R^*_L(t))] > [b((\xi_L) - C(\xi_L))] = 0.$$

Further, the following must hold:

$$\begin{aligned}&\lambda_U(1-\lambda_L)[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R^*_L(t))] > \\ &> (1-\lambda_U)\lambda_L[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R^*_L(t))] > \\ &> \epsilon[\lambda_U(1-\lambda_L)b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R^*_I(t))] =\end{aligned}$$

[23] Scenarios may be extended to four if the cases *iii)* λ_{LR} is minimally lower than λ_L and λ_{UR} is substantially higher than λ_U or, again, *iv)* if λ_{LR} is substantially lower than λ_L and λ_{UR} is minimally higher than λ_U are considered. Since this configuration will not dramatically change the main results, I focus on two extreme instances, as mentioned.

$$= \epsilon[(1-\lambda_U)(\lambda_L)b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))]$$

Notice that, with $R_H^*(t) > 1$, neither type invests. Therefore, we have an equilibrium with $d^* = 0$ and no applicant.

The only point that is left to demonstrate is *(b)*. In a modified setting, the Riley Outcome is, in principle, attainable. To see how, assume first that $\lambda_{UR} \approx 1$ and $\lambda_{LR} \approx 0$. Then, if *a)* and *b)* hold, I need to consider the usual three cases.

If $R_L^*(t) \equiv 0$, high types have an incentive to apply, because $\lambda_{UR} \approx 1 > \lambda_U$. Therefore, it must be that

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))] >$$
$$> (1-\lambda_{UR})\lambda_{LR}[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))]$$

and

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_I^*(t))] > [b(\nu(\xi_U) - C(\xi_U))]$$

or,

$$1[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))] > 0[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))]$$

and

$$1[b(E[(\nu(\xi_U)|\tau_j)] - C(\xi_U) - R_L^*(t))] > [b(\nu(\xi_U) - C(\xi_U))]$$

In contrast, the probability for low-worth sellers to be incorrectly identified is low. Since they do not bear the cost of choosing $d = 1$, they would not make a loss after sending a candidature. Thus, their best strategy would be to apply, despite the improvements in the testing device. Otherwise stated, the following conditions must hold:

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] >$$
$$> (1-\lambda_{UR})\lambda_{LR}[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))]$$

and

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] > [b(\nu(\xi_L) - C(\xi_L))]$$

or,

$$1[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] > 0[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))]$$

and

$$1[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_L^*(t))] > [b(\nu(\xi_L) - C(\xi_L))]$$

With $0 < R_I^*(t) < 1$, high-quality producers choose to reveal their type by applying for a food standard. The reason is the same as before: $\lambda_{UR} \approx 1 > \lambda_U$. Hence, the equations proposed above can be easily extended to this case.

Yet, low types ought not to apply. Given the existence of a non-zero fee, applying for a trademark would give them a lower payoff than the one attainable without a recognition. Formally, this is because of the following:

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] >$$
$$> (1-\lambda_{UR})\lambda_{LR}[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))]$$

and

$$\lambda_{UR}(1-\lambda_{LR})[b(E[(\nu(\xi_L)|\tau_j)] - C(\xi_L) - R_I^*(t))] < [b(\nu(\xi_L) - C(\xi_L))]$$

In other words, given a substantial improvement in the screening machine, positive application charges can discourage application by decreasing low-worth sellers' payoffs. Therefore, their best strategy would be not to apply in the first place.

As noticed above for case *(a)*, with $R_H^*(t) > 1$, no producer applies. That is, for both types, total costs continue to exceed expected sales revenue, conditional on the outcome of the trademark process. Thus, restating the reasoning of Proposition 1, this implies that both sellers would incur a loss if they pick $d = 1$[24].

Taken together, these results strengthen the main argument by showing that welfare improvements may be only possible if adequate fees and proper testing methods are in force.

[24] I have not discussed consumer behaviour in the presence of an alternative mechanism. This is because buyers' strategies parallel the ones that I have previously described. In fact, the improved device does not change their incentives to buy a given food menu.