The Economics of Geographical Indications in International Markets*

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*The study has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 861932. There are no conflicts of interest to be acknowledged for this research.

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Abstract

This article develops a general equilibrium model of international trade, including protection of designations of origin through Geographical Indications (GIs). The framework captures the main features of GI production and protection in domestic and international markets, including high levels of craftsmanship in production, collective management of GIs through producer groups, and administrative protection of the GI label. We perform simulation exercises to determine the welfare-maximising domestic and international GI protection policies and describe the impact of GI protection on exporting behaviour and the allocation of market shares across the GI and non-GI sectors. We identify a novel mechanism for welfare gains in international markets driven by the interplay between domestic GI protection (i.e. organisation into producer groups) and international GI protection (i.e. administrative protection of GIs in international markets through trade agreements), which creates an inter-sectoral reallocation of market shares towards firms of higher productivity. Finally, we derive empirically testable hypotheses to be addressed once appropriate data related to the inclusion of GIs in trade agreements become available.

Keywords: Geographical Indications, International Trade, Intellectual Property Rights Protection, Trade Agreements.

JEL codes: F13, L22, Q13, Q17

1 Introduction

Intellectual property rights (IPR) protection is crucial in the global framework of international trade, particularly as trade increasingly emphasises value addition through research and development activities (Gstöhl & De Bièvre, 2017). The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), signed in 1994 by all World Trade Organisation (WTO) members, obligates parties to adopt and enforce minimum standards of IPR protection (Saggi, 2016). This agreement covers not only well-known forms of IPR, such as trademarks, but also prominently includes Geographical Indications (GIs) (TRIPS, 1994). GIs, such as Prosciutto di Parma, Florida oranges, and Kobe beef, identify goods as originating from specific territories, where product characteristics are essentially attributable to their geographical origin. Unlike trademarks, which establish individual brand identities, GIs represent a collective form of intellectual property limited to and shared by producers within defined geographical areas.

The justification for providing IPR protection to GIs stems from the economics of information and reputation. Through reputation, firms can signal certain qualities to consumers, thus mitigating information asymmetries (Menapace & Moschini, 2012). As noted by Belletti (1999), reputation can only enhance market efficiency if adequately protected through an institutionalisation process supported by legal instruments. TRIPS requires WTO member countries to provide legal measures to prevent consumer deception regarding the origin of products and to reject trademark registrations imitating a GI label. However, TRIPS allows for flexibility in implementing specific policies for GI protection (Marie-Vivien & Biénabe, 2017). In this article, we explore the economics of such policies in international markets by presenting a theoretical model of international trade that captures the main features of GI production and policies. These features and policies are briefly introduced next.

GI production often occurs in marginal and mountainous areas, where altitude, terrain, and climate contribute to the distinctive features of GI products while also hindering mechanisation and the adoption of cost-saving technologies. Additionally, GI production typically involves a high level of craftsmanship, resulting in specific and complex production methods compared to industrialised processes (Belletti, 1999, 2021; Barjolle & Chappuis, 2000; Chilla et al., 2020). Consequently, these geographical conditions and production methods lead to higher production costs for GIs compared to industrialised products.

Further characteristics of GIs are geographical proximity, shared traditions, and strong social ties among producers within the same GI area (Rangnekar, 2004). These aspects foster a cooperative culture among GI producers. Existing GI policies typically mirror this cooperative spirit, often incorporating institutional frameworks and financial support for the collective management of GIs. For instance, the *sui generis* GI system of the European Union (EU) mandates the establishment of a producer group empowered to collectively monitor the commercial use of a GI name, enforce legal measures for GI protection, and enhance the value and reputation of the GI (European Union, 2024). Within this institutional framework for collective management, individual GI producers collaborate to establish a unified brand identity based on the geographical name (Barjolle & Chappuis, 2000). This collective brand identity is frequently complemented by individual trademarks (Menapace & Moschini, 2012). Through collective management, GI producers can capitalise on economies of scale in branding and mitigate the costs associated with developing individual reputations (Menapace & Moschini, 2012). Similar models of collective management, albeit to varying degrees, are also observed in GI systems based on certification and collective marks, as seen in the United States (US) (Le Goffic & Zappalaglio, 2017).

Various forms of subsidies are also common aspects of GI policies. For example, the EU GI system includes the following subsidies. Firstly, the already mentioned financial support for the collective management by GI groups, such as in the context of advertising and promotion (Vandecandelaere et al., 2018). Secondly, it provides administrative protection of GIs (also known as *ex officio* protection) within the EU domestic market. This means that designated authorities monitor the market for potential infringements or misuse of GIs and proactively initiate legal actions, effectively reducing producers' costs for litigation (Barjolle

& Sylvander, 1999). In international markets, instead, the level of protection granted to GIs is essentially on par with that granted to trademarks, in the sense that enforcement of property rights is left to individual right holders. To enhance protection in international markets by securing administrative protection of GIs, the EU increasingly advocates for the integration of administrative protection into multilateral and bilateral trade agreements.

In this article, we explore the economics of administrative protection in foreign markets alongside policies supporting the institutional framework for collective management and subsidising collective efforts as the main features of GI policy. Importantly, all these policy aspects vary in degree, existing along a spectrum rather than in binary form. For instance, the level of involvement of public bodies in monitoring the market and enforcing actions against infringements determines the extent of administrative protection, affecting how much of the costs of protecting GIs in foreign markets remains with the right holders or is "transferred" to foreign public institutions. Therefore, our objective is to identify the welfare-maximising degrees for such policies.

The existent theoretical literature on GIs primarily focuses on closed economy settings and addresses issues such as alleviating information asymmetry, building reputation, and ensuring quality.[1] Furthermore, many of these theoretical models assume products to be vertically differentiated, implying that GI varieties inherently possess quality advantages over generic alternatives. We depart from the vertically differentiated quality framework to align with the current understanding of GIs as horizontally differentiated products. This understanding, informed by existing empirical literature, recognises GIs' role in increasing product variety, a key feature of modern wine and food markets (Gergaud & Ginsburgh, 2008; Costanigro et al., 2010; Chandra et al., 2021).

We base our model on the seminal work by Melitz (2003), which presents a general equilibrium model featuring heterogeneous firms producing horizontally differentiated varieties in a monopolistically competitive market. Firms exhibit varying levels of productivity, with

[1] Studies include Lence et al. (2007), Moschini et al. (2008), Menapace & Moschini (2012), Mérel & Sexton (2012), and Menapace & Moschini (2014).

the least productive ones unable to operate profitably. Exporting incurs additional costs, restricting viable sales abroad to the most productive firms. Unlike Melitz (2003), our model incorporates two sectors: GI and non-GI. We assume that, on average, the GI sector exhibits lower productivity compared to the non-GI sector, reflecting the high level of craftsmanship required in GI production. Additionally, we integrate a cost-sharing mechanism among GI producers, reflecting the cooperative culture within the GI sector.

Domestically, we model GI policies that permit varying degrees of collective management ("GI collective management policy") and public financial support for producer groups ("subsidy to the GI producer group"). Internationally, we model administrative protection ("administrative GI protection") as a mechanism that transfers the costs of protecting GIs in foreign markets from exporting GI producers to foreign public institutions. Lastly, we assume a functioning trademark system for all firms to protect their varieties in both domestic and international markets. We analyse the effects of GI policies on different sector-specific outcomes, including size, productivity, exporting behaviour, and market shares, as well as on aggregate market outcomes. In particular, we focus on the aggregate productivity of all firms in the economy and the number of available varieties, as these are the primary determinants of overall welfare in Melitz-type models. The mechanisms and primary insights derived from our model can be summarised as follows.

The level of the GI collective management policy determines the extent to which operating costs are shared among producers, influencing the decisions of individual GI firms to enter the market and participate in cost-sharing. Notably, the level of collective management generates a positive externality, as each additional member reduces the costs associated with the GI label for all incumbent GI firms. Since individual firms do not internalise this effect, a subsidy to the collective efforts of the GI producers can be used to incentivise firms to enter the market and join the producer group. Overall, increasing the levels of domestic GI policies leads to a significant increase in the number of available varieties at the expense of lower aggregate productivity. As the increase in varieties outweighs the decrease in productivity, there is a net welfare gain. Welfare increases monotonically with either of the domestic policies: GI collective management saves resources by all producers partaking in the producer group, and the subsidy to the producer group corrects the positive externality induced by the GI collective management policy. Nevertheless, practical constraints impose an upper limit on the extent to which certain costs can be shared among producers. Even with the most favourable institutional framework outlined by the GI policy, there will be a limit to the degree of cost-sharing among independently operating firms.

The introduction of administrative GI protection in international markets significantly influences the export behaviour of GI firms: it reduces the cost of exporting for GI firms, leading to an increase in the number of GI firms entering foreign markets, albeit with lower average productivity, and a rise in the market share of exporting GI firms. At the aggregate level, introducing the optimal level of administrative GI protection results in an economy with a lower number of available varieties and firms with higher aggregate productivity, a trade-off that yields overall welfare gains with substantial returns on the investment cost used to finance administrative protection. Consequently, we conclude that the efforts of the EU to integrate administrative protection into trade agreements have the potential to achieve overall welfare gains.

The welfare gains of administrative protection originate from a novel mechanism identified in this article, centred on an inter-sectoral reallocation of market shares. Specifically, in a two-sector economy, reallocating export market shares to the sector with relatively more productive exporting firms and domestic market shares towards the relatively more productive domestically operating firms results in increased aggregate productivity across all firms in the economy and, consequently, higher welfare.

Note that the reduction in fixed operating costs faced by individual GI firms resulting from domestic GI policies makes exporting relatively less attractive than domestic sales for GI firms. Consequently, a higher degree of collective management (or a higher level of subsidisation of collective efforts) leads to fewer but, on average, more productive exporting GI firms and a reallocation of international market shares to the non-GI sector. Domestic GI policies thus foster an exporting GI sector that is more productive than the non-GI exporting sector, a condition conducive to the welfare gains driven by administrative protection. Conversely, an increase in the level of administrative protection for GIs in foreign markets favours the reallocation of international market shares to the GI sector, thereby achieving the aforementioned welfare gains. We conclude that while domestic and international GI policies exert opposing influences on the exporting behaviour of GI firms, they are "complementary" in terms of their impact on welfare. Specifically, the higher the level of domestic GI policies (i.e. the more productive the exporting GI sector), the larger the welfare-maximising level of administrative GI protection.

In summary, this article contributes to the literature in several ways. Firstly, we develop a coherent model of GI policy in an open economy setting, addressing a significant gap in existing research. Secondly, we identify a novel mechanism for welfare gains in Melitz-type models, based on the reallocation of market shares across two structurally distinct sectors. Thirdly, we derive empirically testable hypotheses regarding the effects of changes in GI policies on the productivity and exporting behaviour of GI firms, as well as on the domestic and international market shares of GI and non-GI firms. These hypotheses can be tested once sufficient trade data become available following the recent inclusion of GI policies in international trade agreements. Finally, we derive policy implications suggesting that coordinating and modulating domestic and international GI policies enhances welfare.

The remainder of this article is organised as follows. In Section 1.1, we briefly discuss the related literature. In Section 2, we derive and solve the theoretical model, while in Section 3, we conduct simulation exercises to derive welfare-maximising GI policies and determine the response of equilibrium outcomes to changes in the GI policy parameters. In Section 4, we conclude.

1.1 Related literature

There has been a long debate about how GIs, as a specific type of IPR, should be treated in international agreements. Josling (2006) notes that some countries see GIs as unnecessary protection of producers against competition from new entrants; others argue that GI labels provide consumers with important information and must thus be protected from imitation and misuse. The EU–US negotiations on the Transatlantic Trade and Investment Partnership (TTIP) failed (among other reasons) due to conflicting positions on GIs, with the EU advocating a system of GI-specific protection with administrative enforcement and the US favouring a trademark system, where actions against counterfeiting and misuse are left to individual firms (Mancini et al., 2017).

GI provisions are ubiquitous in newly signed trade agreements. Engelhardt (2015) looks at five bilateral and regional general trade agreements signed by the EU and finds that the EU has largely succeeded in reaching its negotiation objectives, such as securing protection for a concrete list of GIs, phasing out generic uses of GI names, and ensuring administrative protection. Detailed provisions on GI protection are also part of the US–South Korea free trade agreement (KORUS) and the Trans-Pacific Partnership (TPP) agreement, in which the protection of GIs is regulated through a trademark system (Matthews, 2016).

Different studies have aimed to quantify the effects of GIs in international markets. Raimondi et al. (2020), using data on trade margins over the 1996–2014 period, find that the presence of GIs in an exporter country exerts a positive trade effect on both the extensive and intensive margins. When registered only in the importer country, GIs seem to act weakly as a trade-reducing measure on the intensive margin. Duvaleix et al. (2021) analyse firm-product level data from French customs combined with data on Protected Designations of Origin (PDO) products from the cheese sector. They do not find evidence that PDO firms export higher volumes. However, these firms benefit from better access to countries with similar GI policies, providing an argument that including GIs in trade agreements could increase the market access for firms producing such varieties. Curzi & Huysmans (2022) look at data on cheeses from the 2004–2019 period and find that legal protection of GIs does not lead to significant additional exports beyond the general export-promoting effects of trade agreements. However, they find that GIs of higher quality and with higher market shares do benefit from stronger external legal protection. This is in line with an empirical study by Huysmans (2020), who analysed data from 11 EU trade agreements and found these trade agreements more likely to protect GIs with higher sales values and originating from southern European countries.

Theoretical works on the effect of GI protection in international markets are scarce, except for Chambolle & Giraud-Héraud (2005), who model certifications of origin as a non-tariff barrier (NTB). In their model, firms can make investments to increase quality, and the certification of origin acts (partly) as a quality cost subsidy. The authors find that such certification can have opposing effects on consumer surplus: When the domestic firm offers the high quality good, consumer surplus is weakened (compared to free trade). If, however, the domestic firm offers the low quality good, consumer surplus is increased by GI certification. The present article is most closely related to studies using the heterogeneous firms model suggested by Melitz (2003). Contrary to most theoretical models on GI policies, assuming horizontally differentiated varieties imposes no judgement about the inherent quality of the available varieties. The elasticity of substitution is equal among all available varieties in the market, and only the individual productivity of a firm determines if (and which quantity) it produces, the price it sets, and whether it is profitable for the firm to export.

2 Setup of the model with two sectors

2.1 Demand

Consumers are characterised by C.E.S. preferences over a continuum of varieties of a given good:[2]

$$U = \left[\int_{\omega \in \Omega} q(\omega)^{\rho} d\omega \right]^{1/\rho},$$

with Ω the mass of all available varieties, including GI and non-GI varieties, and ω a single variety. The representative consumer distributes her income across all available varieties in the market. As $0 < \rho < 1$, varieties are (imperfect) substitutes, with a constant elasticity of substitution between any two goods of $\sigma = 1/(1-\rho) > 1$. The resulting aggregate price is equal to

$$P = \left[\int_{\omega} p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}. \tag{1}$$

Given the C.E.S. preference structure, the resulting consumption pattern is equivalent to a representative consumer using her entire income R to consume an aggregate good $Q \equiv U$ at price P (with P the aggregate price as defined above). Therefore, aggregate expenditure is given by $R = PQ$. Optimal consumption and expenditure for individual varieties are given by

$$q(\omega) = Q \left[\frac{p(\omega)}{P} \right]^{-\sigma}, \qquad r(\omega) = R \left[\frac{p(\omega)}{P} \right]^{1-\sigma}.$$

2.2 Production and exporting

There is a continuum of firms from two sectors (GI and non-GI, denoted by the subscript $i \in \{GI, T\}$), where each firm produces one variety.[3] Only firms from specific regions are

[2] The good in question could be, for example, dried ham. Its varieties are represented by firm-specific versions of the product, some of which make use of a GI label.

[3] Note that GI varieties are produced according to product specifications; hence, all are produced following production practices and the production technology laid down in such product specifications (European Union, 2024). Each GI-certified firm is free to differentiate its product as long as product specifications are met, giving rise to differentiated varieties of the same GI product.

entitled to produce a GI variety and make use of the GI label, meaning that the division of firms into those who use a GI label and those who use trademarks to protect their variety is exogenously determined by the geographic area in which firms produce. We consider a market in which there is only one GI area, meaning that all firms producing in the GI area can make use of the same GI label and organise accordingly. We define the share of land available for the production of GI varieties as $\alpha \in [0, 1]$, while $1 - \alpha$ represents the share of land available for the production of non-GI varieties. We assume that per unit of land, the number of firms that can potentially produce is fixed and equal across sectors.

We consider a setting of $n + 1$ symmetric countries in which wages are equal and normalised to one. Labour is the only production factor, while firm technology is represented by a cost function with fixed costs and constant marginal costs. Labour is a linear function of output $q: \; l_i = f_i + q/\varphi$, where φ measures a firm's individual productivity and f_i denotes the fixed operating costs in sector i. The higher φ, the lower the amount of labour needed per unit of output. The total amount of labour available in the economy is inelastically supplied and given by the size of the population L. The pricing rule in domestic markets turns out to be given by $p^d(\varphi) = 1/\rho\varphi$. The profit maximising markup that firms charge is thus equal to $1/\rho = \sigma/(\sigma - 1)$. Revenue from domestic sales as a function of productivity φ is given by $r^d(\varphi) = R(P\rho\varphi)^{\sigma-1}$, which holds for any firm (independently of its sector i) with a productivity draw equal to φ.

Exporting entails a fixed cost f_i^x in every period (which has to be paid for each country a firm exports to) and a per-unit trade cost τ. The latter is modelled as an "iceberg" cost, meaning that to sell one unit, an exporting firm has to ship $\tau > 1$ units to the foreign country. Therefore, exporting firms charge higher prices in foreign markets, which is represented by the pricing rule $p^x(\varphi) = \tau/\rho\varphi = \tau p^d$. Revenues from export sales are therefore $r^x(\varphi) = \tau^{1-\sigma} r^d(\varphi)$. As trade costs are the same for each country, a firm from any given country either does not export or exports to all n foreign countries.

Profits can be split into profits earned in the domestic market and profits earned from exporting:

$$\pi_i^d(\varphi) = \frac{r^d(\varphi)}{\sigma} - f_i = \frac{R}{\sigma}(P\rho\varphi)^{\sigma-1} - f_i, \tag{2}$$

$$\pi_i^x(\varphi) = \frac{r^x(\varphi)}{\sigma} - f_i^x = \tau^{1-\sigma}\frac{R}{\sigma}(P\rho\varphi)^{\sigma-1} - f_i^x. \tag{3}$$

A firm that produces for the domestic market also exports if $\pi_i^x(\varphi) \geq 0$. Each firm's combined profits, depending on its sector i, are thus equal to

$$\pi_i(\varphi) = \pi_i^d(\varphi) + \max\{0, n\pi_i^x(\varphi)\}.$$

The aggregate price P as defined in (1), expressed as a function of individual firm productivity φ, can be written as $P = M^{\frac{1}{1-\sigma}} p(\tilde{\varphi})$, where

$$\tilde{\varphi} = \left[\int_0^\infty \varphi^{\sigma-1}\mu(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}, \tag{4}$$

with $\mu(\varphi)$ the distribution of productivity levels over a subset of $(0, \infty)$ across all firms in the economy. $\tilde{\varphi}$ is the weighted average of firm productivity levels φ and represents aggregate productivity of all incumbent firms. All aggregate variables (aggregate price, quantity, revenue, and profits) are entirely determined by $\tilde{\varphi}$ as follows:

$$P = M^{\frac{1}{1-\sigma}} p(\tilde{\varphi}), \qquad Q = M^{\frac{\sigma}{\sigma-1}} q(\tilde{\varphi}),$$

$$R = M r(\tilde{\varphi}), \qquad \Pi = M\pi(\tilde{\varphi}).$$

2.3 Firm entry and the relation between sectors

Before production occurs, each firm must make an initial investment represented by the fixed entry cost f_i^e with $i \in \{GI, T\}$ to enter the market. After paying the fixed entry costs, firms draw their productivity from a distribution common within each sector but differing across them. We assume that the expected value of the productivity distribution in the GI sector is lower than or equal to that in the non-GI sector. This assumption reflects that the production of GIs often involves high levels of craftsmanship and occurs in areas where production costs are high, making it more costly than comparable industrialised production methods (European Union, 2024). We capture these features in Assumption 1.

Assumption 1 (Craftsmanship in production)

GI producers draw their productivity from a distribution with probability density function (PDF) $g_{GI}(\varphi)$ and cumulative density function (CDF) $G_{GI}(\varphi)$. Non-GI producers draw from a distribution with PDF $g_T(\varphi)$ and CDF $G_T(\varphi)$. To reflect that GI firms are, on average, less (or equally) productive than non-GI firms, we assume:

$$E_{GI}(\varphi) = \int_0^\infty \varphi g_{GI}(\varphi) d\varphi \leq \int_0^\infty \varphi g_T(\varphi) d\varphi = E_T(\varphi).$$

It is obvious but important to note that Assumption 1 does not exclude the case in which some GI firms are more productive than some non-GI firms.

Further, any firm (independently of its sector and individual productivity draw) faces a probability δ of a shock that forces it to exit the market, and so the discounted value function for a firm from sector i with productivity φ is equal to

$$v_i(\varphi) = \max\left\{0, \sum_{t=0}^{\infty} (1-\delta)^t \pi_i(\varphi)\right\} = \max\left\{0, \frac{1}{\delta}\pi_i(\varphi)\right\}.$$

Define $\varphi_i^* = \inf\{\varphi : v_i(\varphi) > 0\}$ as the productivity level at which a firm from sector i makes exactly zero profits from sales in the domestic market (i.e. $\pi_i^d(\varphi_i^*) = 0$), which we will refer to as the domestic cutoff productivity level. Firms from sector i who draw a productivity $\varphi_i < \varphi_i^*$ would thus incur losses from production and consequently decide not to produce and immediately exit the market. The productivity distribution per sector i

conditional on successful entry to the domestic market is given by $\mu_i(\varphi)$ as follows:

$$\mu_i(\varphi) = \begin{cases} \frac{g_i(\varphi)}{1-G_i(\varphi_i^*)} & \text{if } \varphi \geq \varphi_i^* \\ 0 & \text{otherwise} \end{cases}.$$

The ex-ante probability of successful entry to the domestic market for a firm from sector i is given by $p_i^{in} = 1 - G_i(\varphi_i^*)$. Using (4), the sector-specific aggregate productivity conditional on successful entry as a function of the sector-specific cutoff value φ_i^* is equal to

$$\tilde{\varphi}_i(\varphi_i^*) = \left[\frac{1}{1-G_i(\varphi_i^*)}\int_{\varphi_i^*}^{\infty} \varphi^{\sigma-1} g_i(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}. \tag{5}$$

Define M as the total mass of incumbent firms from both sectors and η as the share of GI firms in M with a productivity draw $\varphi > \varphi_{GI}^*$ (i.e. the successful entrants to the GI sector). Consequently, $1-\eta$ reflects the share of non-GI firms in M who draw $\varphi > \varphi_T^*$ and therefore successfully enter the market. The market is then characterised by $\eta M \equiv M_{GI}$ incumbent GI firms and $(1-\eta)M \equiv M_T$ incumbent non-GI firms. The overall productivity distribution $\mu(\varphi)$ is given by a mixture of the productivity distributions of the two sectors with weights equal to the share of firms from each sector:

$$\mu(\varphi) = \eta\mu_{GI}(\varphi) + (1-\eta)\mu_T(\varphi). \tag{6}$$

Using (6), aggregate productivity of all firms in the economy can be expressed as the weighted average of sector-specific aggregate productivities (see Section A.1 of the Appendix for details):

$$\tilde{\varphi}(\varphi_{GI}^*, \varphi_T^*) = \left\{\eta[\tilde{\varphi}_{GI}(\varphi_{GI}^*)]^{\sigma-1} + (1-\eta)[\tilde{\varphi}_T(\varphi_T^*)]^{\sigma-1}\right\}^{\frac{1}{\sigma-1}}. \tag{7}$$

Additionally, $\varphi_i^{x*} = \inf\{\varphi : \varphi \geq \varphi_i^* \text{ and } \pi_i^x(\varphi) > 0\}$ represents the cutoff productivity level for successful entry into exporting markets for firms from sector i.[4] The ex-ante probability that a firm from sector i exports (conditional on successful entry into the domestic market) is equal to

$$p_i^{ex} = \frac{1 - G_i(\varphi_i^{x*})}{1 - G_i(\varphi_i^*)}.$$

The ex-post fraction of exporting firms from each sector is also represented by p_i^{ex}, and, given the mass of incumbent firms from sector i is M_i, the mass of exporting firms from sector i is $M_i^x = p_i^{ex} M_i$. The total mass of exporting firms is given by $M^x = M\left[\eta p_{GI}^x + (1-\eta) p_T^x\right]$. The mass of firms competing in one country from sector i (or, likewise, the amount of available varieties from sector i in each country) is equal to $M_i^c = M_i + nM_i^x = (1 + np_i^{ex})M_i$. The total mass of competing firms in a given country is equal to $M^c = M + nM^x$.

2.4 Aggregation within and across sectors

Using the average weighting function defined in (5), $\tilde{\varphi}_i = \tilde{\varphi}_i(\varphi_i^*)$ represents the aggregate productivity of all incumbent firms from sector i, while $\tilde{\varphi}_i{}^x = \tilde{\varphi}_i(\varphi_i^{x*})$ reflects the aggregate productivity of exporting firms from sector i. Further, define $\tilde{\varphi}_i^c$ as the weighted average productivity of sector i, which reflects the additional export shares of more productive firms and the proportion τ of units lost in the exporting process:

$$\tilde{\varphi}_i^c = \left\{ \frac{1}{M_i^c} \left[M_i \tilde{\varphi}_i^{\sigma-1} + nM_i^x (\tau^{-1} \tilde{\varphi}_i^x)^{\sigma-1} \right] \right\}^{\frac{1}{\sigma-1}}.$$

The overall average productivity of all incumbent firms can be expressed as

$$\tilde{\varphi}^c = \left\{ \frac{1}{M^c} \left[M \tilde{\varphi}^{\sigma-1} + nM^x (\tau^{-1} \tilde{\varphi}^x)^{\sigma-1} \right] \right\}^{\frac{1}{\sigma-1}}, \tag{8}$$

where $\tilde{\varphi}$ is as defined in (7) and $\tilde{\varphi}^x$ is equal to

[4] If $\varphi_i^{x*} > \varphi_i^*$, then only the firms of sector i with a productivity draw $\varphi \in [\varphi_i^{x*}, \infty)$ export, while firms with a productivity draw $\varphi \in [\varphi_i^*, \varphi_i^{x*})$ produce only for the domestic market. In the following, we assume that the cost of exporting is such that this partitioning of firms by export status takes place (i.e. we assume $\tau^{\sigma-1} f_i^x > f_i$).

$$\tilde{\varphi}^x = \left\{ \frac{1}{M^x} \left[M^x_{GI} \left(\tilde{\varphi}^x_{GI}\right)^{\sigma-1} + M^x_T \left(\tilde{\varphi}^x_T\right)^{\sigma-1} \right] \right\}^{\frac{1}{\sigma-1}},$$

which therefore represents aggregate productivity of all exporting firms in both sectors. The aggregate price index P and the expenditure level R can then be expressed as functions of the aggregate productivity level $\tilde{\varphi}^c$ and the mass of available varieties M^c:

$$P = (M^c)^{\frac{1}{1-\sigma}} p(\tilde{\varphi}^c) = (M^c)^{\frac{1}{1-\sigma}} \frac{1}{\rho\tilde{\varphi}^c}, \qquad R = M^c r^d(\tilde{\varphi}^c).$$

We use aggregate productivities $\tilde{\varphi}_i$ and $\tilde{\varphi}^x_i$ to express the average revenue and profit levels of firms from sector i. The overall average revenues and overall average profits in sector i (from domestic and exporting sales), are equal to

$$\overline{r}_i = \frac{R_i}{M_i} = r^d(\tilde{\varphi}_i) + np^{ex}_i r^x(\tilde{\varphi}^x_i), \qquad \overline{\pi}_i = \pi^d_i(\tilde{\varphi}_i) + np^{ex}_i \pi^x_i(\tilde{\varphi}^x_i). \tag{9}$$

The overall average revenues from domestic and exporting sales are given by

$$\overline{r} = \frac{R}{M} = \frac{M^c}{M} r(\tilde{\varphi}^c) = \eta\left(\overline{r}^d_{GI} + np^{ex}_{GI}\overline{r}^x_{GI}\right) + (1-\eta)\left(\overline{r}^d_T + np^{ex}_T\overline{r}^x_T\right) = \eta\overline{r}_{GI} + (1-\eta)\overline{r}_T,$$

Overall average profits are equal to

$$\overline{\pi} = \eta\left(\overline{\pi}^d_{GI} + np^{ex}_{GI}\overline{\pi}^x_{GI}\right) + (1-\eta)\left(\overline{\pi}^d_T + np^{ex}_T\overline{\pi}^x_T\right) = \eta\overline{\pi}_{GI} + (1-\eta)\overline{\pi}_T. \tag{10}$$

2.5 Domestic GI policies

All firms incur fixed operating costs F for promotional and market monitoring activities, which include actions taken to identify and prosecute counterfeit products and potential imitators. In the non-GI sector, firms undertake these activities to promote and protect their individual trademark, meaning they must bear the full cost independently, which implies

$f_T = F$. In contrast, GI firms can leverage the collective nature of GIs and an institutional framework that facilitates coordinated monitoring and advertising activities through a producer group, thereby sharing some of the fixed operating costs.

We use the parameter $\lambda \in [0, 1]$ to represent the varying degrees of collective management across various implementations of the sui generis GI system, which range from loosely integrated producer organisations to strongly integrated collective organisations (Barham & Sylvander, 2011). A higher λ indicates a stronger degree of collective management, meaning a larger share of the fixed operating costs is shared among GI firms.

Consistent with the findings of Moschini et al. (2008) and in line with the new regulation on GIs which states that "in the interest of all the producers concerned, it is necessary to allow *one single producer group* to perform specific actions in the name of the producers" (European Union, 2024), we allow for only one producer group for all (potential) GI firms to join. Additionally, we ensure that individual producers' financial contributions to the GI producer group are proportionate to the quantity they produce, reflecting the fact that larger producers contribute more to the collective effort than smaller ones (Sautier, 2019). Lastly, any subsidies paid to the producer group to cover collectively managed costs are denoted as $s \in [0, 1]$. The complete structure of fixed operating costs is determined by Assumption 2.

Assumption 2 (Domestic GI policies)
Each firm in the non-GI sector carries the fixed operating costs individually, hence $f_T = F$. Fixed operating costs in the GI sector are given by

$$f_{GI}(\varphi) = [\lambda(1 - s)\phi(\varphi)(M_{GI})^{-1} + (1 - \lambda)]F,$$

where λ reflects the GI collective management policy, s the subsidy from the government to the producer group, M_{GI} the number of GI firms in the producer group, and $\phi(\varphi) = (\varphi/\tilde{\varphi}_{GI})^{\sigma-1} > 0$ the weight that determines the individual contribution of a GI firm with productivity φ to the producer group.

A GI firm with productivity lower (higher) than the average productivity in the GI sector therefore contributes less (more) than the average amount to the producer group. In expectation, a GI firm draws a productivity equal to $\tilde{\varphi}_{GI}$ and thus pays fixed operating costs equal to $f_{GI}(\tilde{\varphi}_{GI}) = \lambda(1-s)F/M_{GI} + (1-\lambda)F$. The decision to join the GI producer group is made ex ante (prior to entry), and each firm eligible to use the GI label joins the group if it is at least indifferent in terms of expected fixed operating costs ($f_{GI}(\tilde{\varphi}_{GI}) \leq F$), which, in the most restrictive case (i.e. when GI firms receive no subsidy, $s = 0$), holds as long as $M_{GI} \geq 1$, implying that a GI firm is always at least as well off when participating in the GI producer group and thus chooses to do so.

Aggregated over all GI firms, the amount paid to the collective is the same as it would be if each GI firm contributed $f_{GI}(\tilde{\varphi}_{GI})$. All GI firms together pay fixed operating costs equal to $M_{GI} f_{GI}(\tilde{\varphi}_{GI}) = [\lambda(1-s) + M_{GI}(1-\lambda)]F$. The total amount of the government subsidy is thus independent of the total mass of incumbent GI firms and equal to $\lambda s F$.

Profits from domestic sales of GI and non-GI firms with a productivity draw φ, respectively, are given by

$$\pi^d_{GI}(\varphi) = \frac{r^d(\varphi)}{\sigma} - f_{GI}(\varphi), \qquad \pi^d_T(\varphi) = \frac{r^d(\varphi)}{\sigma} - F$$

2.6 International GI policy

Firms incur fixed exporting costs to protect intellectual property rights in foreign markets, such as the costs for monitoring the market for imitators and prosecuting infringements. The extent of these costs for private firms varies based on the legal protection available in foreign markets. The TRIPS agreement establishes a minimum level of protection for GIs in international markets, equating the protection of GIs to that provided for trademarks. Under this minimum level of protection, firms privately bear the costs of market inspections and legal actions against infringements. Higher levels of GI protection, including administrative protection (a priority for the EU, as emphasised in Moir (2016)), are attained through international agreements. In such instances, the costs of market inspections and legal actions against infringements are partially borne by public authorities. Consequently, administrative protection effectively shifts some of the export costs from individual GI firms to the public sector of the countries to which the GI products are exported.

We let $\Delta f^x_{GI} = f^x_T - f^x_{GI}$ measure the level of administrative GI protection, where f^x_T denotes the fixed exporting costs each GI firm would have to cover in the absence of adminstrative GI protection. It is natural to assume that these coincide with the fixed exporting costs of non-GI firms, as both sectors experience the same level of basic protection in international markets granted through TRIPS. The amount of fixed exporting costs that each GI firm effectively pays to export in the presence of adminstrative GI protection is given by f^x_{GI}. A higher value of Δf^x_{GI} indicates a higher level of administrative GI protection in international markets, as a public institution covers more of the costs associated with protecting the GI label abroad. The equivalence of the costs of this policy is collected as a tax from labour income.

Assumption 3 captures the features of administrative GI protection in international markets.

Assumption 3 (International GI policy)

Administrative GI protection shifts a portion of exporting costs from individual GI firms to the foreign governments, reducing the exporting costs for GI firms compared to non-GI firms:[5]

$$f^x_{GI} \leq f^x_T.$$

This cost shift must be financed for all exporting GI firms M^x_{GI} from all n foreign countries. Thus, the total costs of administrative GI protection for each government are $nM^x_{GI}\Delta f^x_{GI} \equiv$

[5]Note that a publicly financed reduction in exporting costs could be seen as an export subsidy subject to reduction commitments by all members of the WTO (WTO, 1994). This would be the case if the domestic country financed the reduction in fixed exporting costs for domestic GI producers contingent on their exporting behaviour. In the present scenario, however, it is the foreign countries financing the protection of the domestic GI (and, by symmetry, the domestic country financing the protection of the foreign GIs) in compliance with an international agreement obliging all signing members to protect IP rights of GIs in their markets.

nT^x.

Profits from exporting of GI and non-GI firms with a productivity draw φ (given that $\varphi \geq \varphi_i^{x*}$), respectively, are thus given by

$$\pi_{GI}^x(\varphi) = \frac{r^x(\varphi)}{\sigma} - f_{GI}^x, \qquad \pi_T^x(\varphi) = \frac{r^x(\varphi)}{\sigma} - f_T^x.$$

2.7 Equilibrium conditions

2.7.1 Zero profit conditions

As individual firm revenue is given by $r = R(P\rho\varphi)^{\sigma-1}$, the ratio of the revenues of firms with different productivity levels φ_1 and φ_2 depends only on the ratio of the respective productivities, i.e. $r(\varphi_1)/r(\varphi_2) = (\varphi_1/\varphi_2)^{\sigma-1}$. As the average productivity level $\tilde{\varphi}_i$ of sector i is entirely determined by the cutoff productivity level φ_i^*, the average revenue and profit levels are also tied to this value. Average revenues from domestic sales $\overline{r}_i^d$ and average revenues from exporting $\overline{r}_i^x$ of firms from sector i are thus given by

$$\overline{r}_i^d = r(\tilde{\varphi}_i) = \left(\frac{\tilde{\varphi}_i(\varphi_i^*)}{\varphi_i^*}\right)^{\sigma-1} r^d(\varphi_i^*), \qquad \overline{r}_i^x = r^x(\tilde{\varphi}_i^x) = \left(\frac{\tilde{\varphi}_i(\varphi_i^{x*})}{\varphi_i^{x*}}\right)^{\sigma-1} r^x(\varphi_i^{x*}). \tag{11}$$

Using (2) and (11), we write average profits from sales in the domestic market for firms from sector i as

$$\overline{\pi}_i^d = \pi_i^d(\tilde{\varphi}_i) = \left(\frac{\tilde{\varphi}_i(\varphi_i^*)}{\varphi_i^*}\right)^{\sigma-1} \frac{r^d(\varphi_i^*)}{\sigma} - f_i,$$

where $f_i \in \{f_{GI}(\tilde{\varphi}_{GI}); F\}$. Further, using (3) and (11), we write average profits from exporting in sector i as

$$\overline{\pi}_i^x = \pi_i^x(\tilde{\varphi}_i^x) = \left(\frac{\tilde{\varphi}_i^x(\varphi_i^{*x})}{\varphi_i^{x*}}\right)^{\sigma-1} \frac{r^x(\varphi_i^{x*})}{\sigma} - f_i^x.$$

The zero cutoff profit (ZCP) conditions imply that a firm from sector i that drew a productivity of φ_i^* makes exactly zero profits from sales in the domestic market, meaning that $\pi_i^d(\varphi_i^*) = 0$ must hold. The ZCP conditions further imply that a firm from sector i with productivity draw φ_i^{x*} makes zero profits from sales in the exporting markets, i.e. $\pi_i^x(\varphi_i^{x*}) = 0$ must hold. Therefore, revenues at the respective cutoff productivity values are equal to

$$r^d(\varphi_{GI}^*) = \sigma f_{GI}(\varphi_{GI}^*), \qquad r^d(\varphi_T^*) = \sigma F,$$
$$r^x(\varphi_{GI}^{x*}) = \sigma f_{GI}^x, \qquad r^d(\varphi_T^{x*}) = \sigma f_T,$$

The ZCP conditions thus imply four relationships linking average profits per firm $\overline{\pi}_i$ and the cutoff productivity level φ_i^* for each of the two sectors:

$$\overline{\pi}_{GI}^d = (1-\lambda) F k_{GI}(\varphi_{GI}^*), \qquad \overline{\pi}_T^d = F k_T(\varphi_T^*),$$
$$\overline{\pi}_{GI}^x(\tilde{\varphi}_{GI}^x) = f_{GI}^x k_{GI}(\varphi_{GI}^{x*}) \qquad \overline{\pi}_T^x(\tilde{\varphi}_T^x) = f_T^x k_T(\varphi_T^{x*})$$

where $k_i(\varphi) = \left(\frac{\tilde{\varphi}_i(\varphi)}{\varphi}\right)^{\sigma-1} - 1$. These conditions allow φ_i^{x*} to be expressed as a function of φ_i^*. That is,

$$\frac{r^x(\varphi_i^{x*})}{r^d(\varphi_i^*)} = \tau^{1-\sigma}\left(\frac{\varphi_i^{x*}}{\varphi_i^*}\right)^{\sigma-1} = \frac{f_i^x}{f_i}.$$

Consequently, the export cutoff productivity levels in the GI and non-GI sectors, respectively, are given by

$$\varphi_{GI}^{x*} = \varphi_{GI}^* \tau \left(\frac{f_{GI}^x}{f_{GI}(\varphi_{GI}^*)}\right)^{\frac{1}{\sigma-1}}, \qquad \varphi_T^{x*} = \varphi_T^* \tau \left(\frac{f_T^x}{F}\right)^{\frac{1}{\sigma-1}}.$$

This implies that each variable dependent on φ_i^{x*} implicitly depends on φ_i^*. Using (9), we can therefore express $\overline{\pi}_{GI}$ and $\overline{\pi}_T$ as functions of φ_{GI}^* and φ_T^*, respectively:

$$\overline{\pi}_{GI} = (1-\lambda) F k_{GI}(\varphi_{GI}^*) + n p_{GI}^{ex} f_{GI}^x k_{GI}(\varphi_{GI}^{x*}),$$
$$\overline{\pi}_T = F k_T(\varphi_T^*) + n p_T^{ex} f_T^x k_T(\varphi_T^{x*}).$$

2.7.2 Free entry condition

All incumbent firms (except the firm(s) from sector i with a productivity draw of φ_i^*) make positive profits, which is the only reason firms consider paying the fixed cost f_i^e to enter the market. The present value of average profit flows of a firm from sector i is defined as $\overline{v}_i = \int_{t=0}^{\infty}(1-\delta)^t\overline{\pi}_i = (1/\delta)\overline{\pi}_i$. Also, $\overline{v}_i$ represents the average value of firms from sector i that have successfully entered: $\overline{v}_i = \int_{\varphi_i^*}^{\infty} v(\varphi)\mu_i(\varphi)d\varphi$. Define v_i^e to be the net value of entry for sector i:

$$v_i^e = p_i^{in}\overline{v}_i - f_i^e = \frac{1-G_i(\varphi_i^*)}{\delta}\overline{\pi}_i - f_i^e,$$

In equilibrium, the net value of entry is equal to zero, which must hold in each sector individually. If negative, no firm would want to enter the market (and some firms would exit). If positive, additional firms would enter the market until net expected profit is driven to zero. The free entry (FE) condition of sector i is thus given by

$$\overline{\pi}_i = \frac{\delta f_i^e}{p_i^{in}}. \tag{12}$$

2.8 Equilibrium outcomes

The ZCP and FE conditions define two relationships between average profits $\overline{\pi}_i$ and the cutoff productivity level φ_i^* for each sector i. Aggregated over both sectors, economy-wide average profits are given by $\overline{\pi} = \eta\overline{\pi}_{GI} + (1-\eta)\overline{\pi}_T$, see (10). The two conditions linking average profits $\overline{\pi}$ to cutoff productivity levels φ_{GI}^* and φ_T^* are thus equal to

$$\overline{\pi} = \eta\left[(1-\lambda)Fk_{GI}(\varphi_{GI}^*) + np_{GI}^{ex}f_{GI}^x k_{GI}(\varphi_{GI}^{x*})\right] + (1-\eta)\left[Fk_T(\varphi_T^*) + np_T^{ex}f_T^x k_T(\varphi_T^{x*})\right], \tag{ZCP}$$

$$\overline{\pi} = \delta\left[\eta\frac{f_{GI}^e}{p_{GI}^{in}} + (1-\eta)\frac{f_T^e}{p_T^{in}}\right]. \tag{FE}$$

In a stationary equilibrium, the aggregate variables must remain constant over time.

This implies that the total mass of successful entrants M_i^e must exactly replace the mass of incumbents δM_i who exit the market following a bad shock. This must hold individually in each sector. Given the assumption that a share $\alpha \in [0, 1]$ of total land is available for GI production, the mass of possible entrants from the GI sector is given by $M_{GI}^e = \alpha M^e$, while the mass of possible entrants from the non-GI sector is given by $M_T^e = (1 - \alpha)M^e$.

The process of entry and exit is as follows: Each period, a share δM_i of incumbent firms from sector i drops out of the market. From the firms from sector i who pay the fixed costs f_i^e and try to enter the market, only a share p_i^{in} draws a productivity $\varphi \geq \varphi_i^*$ and can successfully enter the market. This implies that $p_{GI}^{in} \alpha M^e$ is the mass of GI producers who successfully enter the market, while the mass of successful entrants from the non-GI sector is given by $p_T^{in}(1-\alpha)M^e$. Put together, this results in the following aggregate stability conditions for each sector:

$$p_{GI}^{in} \alpha M^e = \delta M_{GI}, \qquad p_T^{in}(1 - \alpha)M^e = \delta M_T. \tag{13}$$

Using (13), the equilibrium share of incumbent GI firms is given by

$$\eta = \frac{\alpha p_{GI}^{in}}{\alpha p_{GI}^{in} + (1 - \alpha)p_T^{in}}, \tag{14}$$

which also defines the equilibrium share of incumbent non-GI firms given by $1 - \eta$.

Now, define L_i^e as the wage paid to workers employed by entering firms from sector i (investment workers), and $L^e = L_{GI}^e + L_T^e$ the total amount of investment workers. The wage paid to workers employed in production by incumbent firms from sector i is L_i^p, which, accumulated over workers in both industries is equal to $L^p = L_{GI}^p + L_T^p$. As labour is the only factor of production, workers' wages are the only cost firms are facing. Consequently, production workers' incomes must be equal to the difference between aggregate revenues and aggregate profits. The production workers in the GI sector receive aggregate payments equal to $L_{GI}^p = R_{GI} - \Pi_{GI}$, while production workers in the non-GI sector receive aggregate payments equal to $L_T^p = R_T - \Pi_T$. Put together, production workers in both sectors receive aggregate payments equal to $L^p = L_{GI}^p + L_T^p = R - \Pi$, which is the labour market clearing condition for production workers. For investment workers, the labour market clearing condition is $L_{GI}^e = \alpha M^e f_{GI}^e$ in the GI sector and $L_T^e = (1-\alpha) M^e f_T^e$ in the non-GI sector. Combining the aggregate stability conditions (13) with free entry conditions (12) yields

$$L_{GI}^e = \alpha M^e f_{GI}^e = \frac{\delta M_{GI}}{p_{GI}^{in}} f_{GI}^e = \overline{\pi}_{GI} M_{GI} = \Pi_{GI},$$

and

$$L_T^e = (1-\alpha) M^e f_T^e = \frac{\delta M_T}{p_T^{in}} f_T^e = \overline{\pi}_T M_T = \Pi_T,$$

which implies $L^e = L_{GI}^e + L_T^e = \Pi_{GI} + \Pi_T = \Pi$, i.e. that, in equilibrium, total income of investment workers corresponds to the total profits made by all firms in the economy. To finance (domestic and international) GI policies, the government collects a lump sum tax on total labour income L. We assume that each period, the government collects the exact amount needed to cover the subsidy, which gives the government budget balance condition as:[6]

$$T = L - R = \lambda s F + n T^x.$$

Aggregate post-tax income is thus equal to $R = L - \lambda s F - n T^x = L^e + L^p$. Average revenue per firm is determined by the ZCP and FE conditions as follows:

$$\overline{r} = r^d(\tilde{\varphi}) + n[\eta p_{GI}^{ex} r^x(\tilde{\varphi}_{GI}^x) + (1-\eta) p_T^{ex} r^x(\tilde{\varphi}_T^x)] = \sigma \left[\overline{\pi} + \eta f_{GI}(\tilde{\varphi}_{GI}) + (1-\eta) F + n \overline{f}^x \right],$$

where $\overline{f}^x = \eta p_{GI}^{ex} f_{GI}^x + (1-\eta) p_T^{ex} f_T^x$. The equilibrium mass of incumbent firms is thus equal to

$$M = \frac{R}{\overline{r}} = \frac{L - T}{\sigma \left[\overline{\pi} + \eta f_{GI}(\tilde{\varphi}_{GI}) + (1-\eta) F + n \overline{f}^x \right]}.$$

[6] Where $\lambda s F$ is the cost of the subsidy to the producer group and $n T^x$ is the cost of administrative GI protection arising for the government.

This likewise defines the total mass of available varieties given by $M^c = M^c_{GI} + M^c_T = M\{1 + n[\eta p^{ex}_{GI} + (1-\eta)p^{ex}_T]\}$, with their price index $P = (M^c)^{\frac{1}{1-\sigma}} / \rho\tilde{\varphi}^c$. Futher, we define η^c as the share of available GI varieties (domestically produced and imported), and η^x as the share of exporting GI firms in international markets:[7]

$$\eta^c = \frac{M^c_{GI}}{M^c} = \frac{\alpha p^{in}_{GI}(1 + np^{ex}_{GI})}{\alpha p^{in}_{GI}(1 + np^{ex}_{GI}) + (1-\alpha)p^{in}_T(1 + np^{ex}_T)}, \quad \eta^x = \frac{M^x_{GI}}{M^x} = \frac{\alpha p^{in}_{GI}p^{ex}_{GI}}{\alpha p^{in}_{GI}p^{ex}_{GI} + (1-\alpha)p^{in}_T p^{ex}_T}.$$

As aggregate utility is, per definition, equal to the aggregate quantity Q (while aggregate profits are equal to zero), total welfare is given by $W = Q$. As $Q = R/P$ and $R = L - T$, the expression for total welfare per worker is given by

$$W = L^{-1}(L - T)\,(M^c)^{\frac{1}{\sigma-1}}\,\rho\tilde{\varphi}^c. \tag{15}$$

The main determinants of welfare per worker are thus the total number of varieties M^c, aggregate productivity of all firms in the economy $\tilde{\varphi}^c$, and the amount of tax collected to finance the GI policies T. Finally, we define the return on investment from introducing a subsidy to the producer group s (given that $\lambda > 0$) as $\Delta W_s / C^w_{s,\lambda}$, and from introducing administrative GI protection Δf^x_{GI} as $\Delta W_x / C^w_x$.[8] We will use these expressions to determine the effectiveness of the different GI policies in creating welfare gains.

3 Analysis

As the complexity of the modelling choices required for an accurate depiction of GI markets and policies renders a comparative statics exercise unfeasible, we opt for a numerical ap-

[7] The market share of GI firms in domestic markets is given by $\varepsilon = \eta r(\tilde{\varphi}_{GI})/[\eta r(\tilde{\varphi}_{GI}) + (1-\eta)r_T(\tilde{\varphi}_T)]$, while the market share of GI firms in international markets is given by $\varepsilon^x = \eta^x r(\tilde{\varphi}^x_{GI})/[\eta^x r(\tilde{\varphi}^x_{GI}) + (1 - \eta^x)r_T(\tilde{\varphi}^x_T)]$. The overall market share of GI firms is given by $\varepsilon^c = \eta^c r(\tilde{\varphi}^c_{GI})/[\eta^c r(\tilde{\varphi}^c_{GI}) + (1-\eta^c)r_T(\tilde{\varphi}^c_T)]$.

[8] Where $\Delta W_s = W|_{s,\lambda>0} - W|_{s,\lambda=0}$ and $C^w_{s,\lambda} = L^{-1}\lambda s F\,(M^c|_{s,\lambda>0})^{\frac{1}{\sigma-1}}\,\rho\tilde{\varphi}^c|_{s,\lambda>0}$ are, respectively, the gross gains and costs in terms of welfare per worker from introducing a subsidy to the producer group, and $\Delta W_x = W|_{\Delta f^x_{GI}>0} - W|_{\Delta f^x_{GI}=0}$, and $C^w_x = L^{-1}nT^x\left(M^c|_{\Delta f^x_{GI}>0}\right)^{\frac{1}{\sigma-1}}\rho\tilde{\varphi}^c|_{\Delta f^x_{GI}>0}$ are, respectively, the gross gains and costs in terms of welfare per worker from introducing administrative GI protection.

proach to make the model operational. To explore the impact of GI policies on equilibrium outcomes, we thus assume that firms from sector i draw their productivity from a Pareto distribution with probability density function (PDF) $g_i(\varphi) = \kappa(\varphi_i^{min})^\kappa/\varphi^{\kappa+1}$, where φ_i^{min} represents the minimum productivity firms from sector i can draw, while κ is a measure of firm heterogeneity in terms of productivity. This assumption enables us to assign explicit values to all parameters of the equilibrium system of equations (see Section A.2 of the appendix). Specifically, to serve as a baseline, we select a value borrowed from existing literature for each model parameter and, using Matlab, numerically compute the corresponding equilibrium outcomes and welfare.

To investigate the impact of GI policies, we calculate equilibrium outcomes for a range of values of the GI policy parameters - λ, s, and Δf_{GI}^x - varying one parameter at a time. With regard to market outcomes, we analyse sector-specific outcomes, i.e. aggregate productivity per sector, sector size (as measured by the number of firms per sector operating in domestic and export markets), and market shares of GI and non-GI firms in domestic and export markets. We further determine aggregate market outcomes, i.e. aggregate productivity of all firms operating in the economy and the number of available varieties which, in Melitz-type models, determine overall welfare (see Equation (15)) and explore the relationship between optimal domestic and international GI policies. Finally, in a sensitivity analysis, we adjust the structural parameters that capture the degree of craftsmanship in the GI sector φ_{GI}^{min}, the share of land dedicated to GI production α, and the number of foreign countries n (see Section A.4 of the appendix).

3.1 Parameter values

Table 1 lists all model parameters and the corresponding baseline values. Parameters are organised into three groups: GI policy parameters, structural GI parameters, and other parameters. Concerning the latter group, some can be set by normalisation. For instance, we normalise the size of the economy L to be equal to $1,000,000$ and set fixed operating costs

F equal to 10. Following Felbermayr et al. (2012), we then set the baseline values of fixed entry costs in the GI and non-GI sectors (f^e_{GI} and f^e_T, respectively), and fixed exporting costs (f^x_{GI} and f^x_T, respectively), relative to fixed operating costs F, i.e. $f^e_{GI}/F = f^e_T/F = 5.49$ and $f^x_{GI}/F = f^x_T/F = 1.75$. Further, we set the elasticity of substitution equal to $\sigma = 5$, which reflects the relatively high elasticity of substitution for food-related products (Oberfield & Raval, 2021). The exit rate δ is based on Fackler et al. (2013), who estimated the exit rate in the agricultural sector from 1975 to 2006 in West Germany to be 5.8%. Finally, exporting to a foreign country implies iceberg trade costs, whose value $\tau = 1.37$ is based on an empirical estimation by Felbermayr et al. (2012). The value of the Pareto shape parameter κ, is borrowed from Eaton & Kortum (2002), who estimate its value to be equal to $\kappa = 8$. The minimum productivity firms in the non-GI sector can draw, φ^{min}_T, is normalised to one.

Reflecting the results from Bouamra-Mechemache & Chaaban (2010), who find that PDO Brie cheese production costs are estimated to be on average 40% higher than those for non-PDO Brie, we set $\varphi^{min}_{GI} = 0.9487$. This value, together with all parameters at their baseline values, implies that GI producers use 40% more labour per unit of output than non-GI producers in equilibrium (see Section A.3 of the appendix). The share of land available for the production of GI varieties α (which corresponds to the probability that an entering firm is from the GI sector) is based on Jantyik & Török (2020). The authors reviewed different sources of literature in which the share of GI producers in France and Italy was estimated to range from about 5% to around 15%. In our simulations, we set the parameter α equal to 0.1 to reflect the relatively low share of land dedicated to the production of GI varieties.[9] Finally, we consider the implementation of administrative GI protection to be based on a bilateral trade agreement, meaning that the number of foreign countries is equal to one ($n = 1$).

[9]Note that what Jantyik & Török (2020) refer to are estimates of the share of *incumbent* GI firms. In our model, α corresponds to the share of land *available* for the production of GI varieties, while the share of incumbent GI firms η arises endogenously from the model (and can thus deviate from α, depending on the relative entry conditions in the GI and non-GI sectors). The estimates nevertheless reflect the relatively small size of the GI sector and can thus be used as a proxy for α. We explore different values of α in Section A.4 of the appendix.

With regard to the GI policy parameters, we use the following values. We set the parameter capturing the GI collective management policy λ equal to 0.5 (i.e. 50% of the fixed operating costs of GI firms are shared via the GI producer group), and the subsidy to the GI producer group s equal to 0.1 (i.e. the government covers 10% of the shared costs of GI firms). Finally, administrative GI protection Δf_{GI}^{x*} is set equal to zero, corresponding to the absence of an administrative protection policy in foreign markets (i.e. the status quo if no trade agreement on GIs is ratified).

[Insert Table 1 here]

3.2 Optimal GI policies and market outcomes

3.2.1 GI collective management policy and subsidy to the producer group

Market outcomes and testable hypotheses. Consider first the GI collective management policy parameter λ. A higher value of λ reduces the fixed operating costs for GI firms through two mechanisms. First, a larger portion of fixed operating costs is shared among all members of the GI producer group, reducing the costs that GI firms have to carry individually. Second, cost sharing and the associated reduction in fixed operating costs lowers the productivity level sufficient for successful entry into the GI sector. More GI firms thus enter the market and increase the number of firms among which fixed operating costs are shared, further reducing the costs faced by each member of the GI producer group. Overall, by making production less costly for GI firms, a stronger GI collective management policy leads to a larger but less productive GI sector. In Table 2, this result is evidenced by an increasing number of incumbent GI firms M_{GI} and a decreasing level of aggregate productivity in the GI sector $\tilde{\varphi}_{GI}$ for increasing values of λ.

The GI collective management policy also influences the exporting behaviour of GI firms. In Table 2, we report the number and aggregate productivity of exporting GI firms (M_{GI}^x and $\tilde{\varphi}_{GI}^x$, respectively). We find that, with increasing levels of λ, the number of exporting

GI firms decreases while their aggregate productivity increases. The reason is that a larger GI sector (through a higher value of λ) puts pressure on the domestic factor market, where new entrants push up the real wage so that only the most productive firms can continue to export.

The FE and ZCP conditions that determine the cutoff productivity level in the non-GI sector are unaffected by a change in λ, which implies that aggregate productivities of all incumbent and exporting non-GI firms ($\tilde{\varphi}_T$ and $\tilde{\varphi}_T^x$, respectively) are unaffected by a change in the GI policy. However, the increased pressure on the domestic factor market due to a higher value of λ implies that for the same level of aggregate productivity, fewer non-GI firms are able to produce (and export) profitably. Consequently, the number of incumbent and exporting non-GI firms (M_T and M_T^x, respectively) decreases for increasing values of λ in Table 2. Overall, the domestic market share of GI firms ε increases while the international market share of exporting GI firms ε^x decreases in λ.

[Insert Table 2 here]

The foregoing implies four empirically testable hypotheses. A stronger GI collective management policy leads to (i) a decrease in aggregate productivity of the GI sector; (ii) an increase in aggregate productivity of exporting GI firms; (iii) a reallocation of domestic market shares towards GI firms; (iv) a reallocation of international market shares towards non-GI firms.

An increase in the subsidy for GI producer groups s has the same qualitative effects on market outcomes as an increase in λ. However, as the subsidy offered to GI producers only affects a subset of fixed operating costs, the effects are quantitatively smaller, as we will demonstrate in the following sections.

Welfare effects and policy implications. Overall, an increase in λ leads to a higher number of available varieties M^c at the expense of lowering overall aggregate productivity $\tilde{\varphi}^c$. The former effect dominates the latter, meaning that welfare W, as shown in Table 2, increases monotonically with λ. This welfare-enhancing effect speaks in favour of GI policies in support of strong institutional frameworks that enable cost sharing by GI producers and aligns with ongoing efforts of the EU to further empower GI producer groups. Indeed, the new EU regulation on GIs acknowledges that "the recognised producer group is a valuable instrument in enhancing the collective management and protection" of GIs and that producer groups should be equipped with the means to "better market the specific characteristics of their products" and "better enforce their intellectual property rights" (European Union, 2024), concretely expanding the range of tasks that GI producer groups are entitled to conduct on behalf of their members. However, while increasing λ monotonically increases welfare, in practice, there likely exists a "natural boundary" to the cost savings possible by the collective management of promotion and IP protection. Identifying this upper bound (and hence, the feasible maximum value of λ) is beyond the scope of this article.

Similar to Moschini et al. (2008), cost sharing in the GI sector implies that entry of any given GI firm exerts a positive externality on all other firms, as each additional entrant reduces costs for all other incumbent GI firms. However, an individual firm does not consider this effect upon its entry decision; hence, the number of GI firms entering the market is lower than optimal. Such positive externality can be corrected by a subsidy (the second domestic policy parameter s), which fosters entry by reducing the (expected) fixed operating costs of each GI firm. In Table 3, we report the absolute changes in welfare ΔW_s from introducing different levels of s relative to $s = 0$ (with all other parameters at their baseline values). The absolute changes in welfare are positive, albeit small, and increasing in s (although the return on investment $\Delta W_s / C^w_{s,\lambda}$ is decreasing in s). From a policy perspective, this result speaks in favour of financial support for GI firms conditional on collective organisation, meaning financial assistance is provided to the collective rather than individual producers (Barjolle & Sylvander, 1999; Vandecandelaere et al., 2018). However, it also demonstrates that efforts to strengthen the institutional setting for GI producer groups, provided these efforts translate into higher levels of cost-sharing, have a greater potential to increase welfare compared to the gains from the subsidy to the producer group, a result that is reflected in columns (2) and (5) of Table 3. The absolute welfare gains from introducing $\lambda > 0$ (ΔW_λ) are much larger than the welfare gains from introducing the equivalent level of the subsidy $s > 0$ (ΔW_s).

[Insert Table 3 here]

3.2.2 Administrative GI protection

Market outcomes and testable hypotheses. Administrative GI protection, represented by $\Delta f^x_{GI}/f^x_T$, influences equilibrium market outcomes by reducing the fixed exporting costs for GI firms, thereby encouraging the entry of less productive GI firms into international markets. Table 4 illustrates that higher values of administrative GI protection correspond to a greater number of exporting GI firms M^x_{GI} and lower aggregate productivity $\tilde{\varphi}^x_{GI}$. The additional resources required by these exporting GI firms lead to an increase in labour demand, resulting in higher real wages. Consequently, some of the least productive GI firms exit the market as they can no longer operate profitably, resulting in a GI sector with fewer incumbent firms M_{GI} with higher aggregate productivity $\tilde{\varphi}_{GI}$. The non-GI sector is also affected by the rise in real wages, but the numbers of incumbent and exporting non-GI firms, M_T and M^x_T, respectively, decrease only marginally with increasing levels of administrative GI protection. Overall, higher values of $\Delta f^x_{GI}/f^x_T$ lead to a decrease in the domestic market share of GI firms ε and an increase in the international market share of exporting GI firms ε^x.

[Insert Table 4 here]

The foregoing implies four empirically testable hypotheses. An increase in administrative GI protection leads to (i) an increase in aggregate productivity of the GI sector; (ii) a decrease in aggregate productivity of exporting GI producers; (iii) a reallocation of domestic market shares towards non-GI firms; (iv) a reallocation of international market shares towards GI firms.

Welfare effects and policy implications. The primary finding from our numerical analysis on the effect of administrative GI protection is its potential to increase welfare, a result that is linked to the nature of the two-sector model. Just as in the standard Melitz model with one sector, a reduction in fixed exporting costs implies a domestic market selection effect (the least productive firms exit the market) and an export market selection effect (some of the more productive firms start exporting), which both allocate markets shares towards more efficient firms and thus contribute to an aggregate productivity gain. In the two-sector model, however, administrative GI protection exerts an additional *sectoral* selection effect, as a decrease in fixed exporting costs for the GI sector leads to a reallocation of international market shares towards GI firms and of domestic market shares towards non-GI firms, thus constituting an additional mechanism for potential welfare gains that is not present in the one-sector model.

Referring to Table 4, we observe that increasing the level of administrative GI protection has opposing effects on the key determinants of welfare, i.e. the number of available varieties M^c and overall aggregate productivity $\tilde{\varphi}^c$. Initially, in the absence of administrative GI protection and up to a certain threshold (equal to $\Delta f^x_{GI}/f_T \leq 50\%$ in our baseline scenario), its increase leads to a decrease in the number of varieties and an increase in aggregate productivity. Beyond the threshold, the direction changes, with the number of varieties increasing and aggregate productivity decreasing. The reason is that for low levels of administrative GI protection, the newly exporting GI firms (who replace some of the least productive firms of both sectors) are highly productive, while the domestically operating non-GI firms (who acquire larger market shares following the dropping out of the least productive GI firms) are strongly more productive than the domestically operating GI firms. As higher levels of administrative GI protection lead to a less productive exporting GI sector and a more productive domestically operating GI sector, administrative GI protection eventually leads a reallocation of market shares towards relatively less productive firms and thus to a decrease in aggregate productivity. An additional factor to be considered is that the higher the number of exporting GI firms, the higher the absolute cost of financing administrative GI protection. In our baseline scenario, the magnitude of benefits and costs of administrative GI protection implies that welfare reaches its maximum at $\Delta f_{GI}^{x*}/f_T = 5.6457\%$.

A prerequisite for the inter-sectoral reallocation of market shares to be welfare-enhancing is thus that the GI sector consists of relatively more productive exporting firms, while the non-GI sector consists of relatively more productive domestically operating firms. This result manifests an important relationship between domestic and international GI policies. As described in Section 3.2.1, domestic GI policies provoke a shift in market composition that leads to a GI sector consisting of more productive exporting firms and less productive domestically operating firms.[10] Observe that for low levels of λ in Table 5, exporting GI firms are less productive than exporting non-GI firms, while domestically operating non-GI firms are not sufficiently more productive than domestically operating GI firms for the shifts in market shares induced by administrative GI protection to be welfare-enhancing (e.g. for $\lambda = 0$, we have $\tilde{\varphi}_{GI}/\tilde{\varphi}_T = \tilde{\varphi}_{GI}^x/\tilde{\varphi}_T^x = 0.9487$; the optimal level of administrative GI protection $\Delta f_{GI}^{x*}/f_T^x$ is zero). For increasing levels of the GI collective management λ, the relative productivity of exporting GI firms $\tilde{\varphi}_{GI}^x/\tilde{\varphi}_T^x$ increases while the relative productivity of domestically operating GI firms $\tilde{\varphi}_{GI}/\tilde{\varphi}_T$ decreases. For levels of collective management higher than the threshold value $\lambda = 0.3586$, the relative productivities of the two sectors are such that administrative GI protection is welfare-enhancing, with the optimal level of administrative GI protection $\Delta f_{GI}^{x*}/f_T^x$ and the policy's return on investment $\Delta W_x/C_x^w$ increasing in λ.

[Insert Table 5 here]

[10] In our argument, we focus on the GI collective management policy λ. In Table 5, we also report the results of changes in s, which, as can be verified, have a much smaller impact on the relative productivities and therefore play a subordinate role in determining the optimal level of administrative GI protection and the policy's return on investment compared to changes in λ. However, the direction of changes in relative productivties and the optimal level of administrative GI protection are the same for increases in s as for increases in λ.

These results imply that domestic and international GI policies are complementary; a stronger GI collective management policy leads to GI and non-GI sectors with relative productivties that imply a higher level of administrative GI protection at the welfare-maximising optimum. From a policy perspective, we can conclude that the positive welfare effects achieved by strengthening the role of GI producer groups in the domestic market (increasing λ) can be amplified by efforts to introduce (the optimal level of) administrative GI protection in international markets. In turn, administrative GI protection is only welfare-enhancing if the GI sector is characterised by a sufficient level of collective management.

4 Conclusion

The impact of GI policies on domestic and international markets is a topic of considerable interest to researchers, but the majority of economic analyses focus on empirical rather than theoretical work. In this article, we contribute to the ongoing discussion by developing a first general-equilibrium model of international trade to incorporate a GI sector alongside a non-GI sector in the context of heterogeneous firms that produce horizontally differentiated varieties. The model reflects the main features of GI production and policies: high levels of craftsmanship in the production of GI varieties, collective management and subsidisation of GI producer groups, and administrative protection of GIs in international markets.

The theoretical model we developed provides valuable insights into the impact of GI policies on market outcomes and welfare. For instance, our results show that GI policies significantly impact the GI sector, but, even with some spillover effects, only marginally affect the non-GI sector. This finding is of interest to policymakers; it is possible to strengthen the GI sector without significantly harming the non-GI sector. We also find that domestic GI policies monotonically enhance welfare, but argue that practical considerations provide a limit to the amount of costs that can be shared (and hence the amount of resources that can be saved) among independently operating firms. With respect to the international GI policy, we find that there is a maximum level of administrative GI protection that should be granted to GI firms in international markets, above which the policy's costs exceed the welfare gains. Further, we find a strong complementarity between domestic and international GI policies. An institutional setting in domestic markets that allows GI firms to benefit from their social ties and manage the GI collectively through a producer group provides the basis for a welfare-enhancing GI policy in international markets. Since the optimal level of international GI policies increases with the level of domestic GI policies, it is crucial to consider both domestic and international markets in determining optimal GI policies.

To further generalise the analysis of GI policies and to better reflect the complexity of production and consumption patterns in international markets, we identified two potential ways in which the present model could be extended. First, the effects of GI policy in open markets could be analysed within a framework of asymmetric countries, such as in Falvey et al. (2006) or Demidova (2008), allowing for a theoretical analysis of varying strengths of GI protection across different countries. Second, the effects of GI policy in international markets could be re-examined within a framework in which consumer preferences are adapted to match empirical investigations regarding the consumption of GI and non-GI products, for example to reflect different elasticities of substitution across GI and non-GI products (Stasi et al., 2011; Sorgho & Larue, 2018). Both represent interesting paths for further research.

A Appendix

A.1 Aggregate productivity in the economy

Economy-wide aggregate productivity is given by

$$\tilde{\varphi} = \left[\int_0^\infty \varphi^{\sigma-1} \mu(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}},$$

where $\mu(\varphi)$ is defined as a mixture of productivity distributions from the two sectors

$$\mu(\varphi) = \eta \mu_{GI}(\varphi) + (1-\eta)\mu_T(\varphi),$$

which allows us to write the economy-wide aggregate productivity as

$$\tilde{\varphi} = \left[\int_0^\infty \varphi^{\sigma-1} [\eta \mu_{GI}(\varphi) + (1-\eta)\mu_T(\varphi)] d\varphi \right]^{\frac{1}{\sigma-1}} = \left[\eta \int_0^\infty \varphi^{\sigma-1} \mu_{GI}(\varphi) d\varphi + (1-\eta) \int_0^\infty \varphi^{\sigma-1} \mu_T(\varphi)] d\varphi \right]^{\frac{1}{\sigma-1}}.$$

As sector-specific aggregate productivity is given by

$$\tilde{\varphi}_i = \left[\int_0^\infty \varphi^{\sigma-1} \mu_i(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}},$$

economy-wide aggregate productivity can finally be expressed as

$$\tilde{\varphi} = \left[\eta (\tilde{\varphi}_{GI})^{\sigma-1} + (1-\eta)(\tilde{\varphi}_{GI})^{\sigma-1} \right]^{\frac{1}{\sigma-1}}.$$

A.2 Equilibrium outcomes with Pareto distribution

To being able to explicitly derive the equilibrium values of the model, we assume that firms draw their productivity from a Pareto distribution. The PDF of the Pareto distribution is equal to

$$g_i(\varphi) = \frac{\kappa (\varphi_i^{min})^\kappa}{\varphi^{\kappa+1}},$$

with the CDF equal to

$$G_i(\varphi) = 1 - \left(\frac{\varphi_i^{min}}{\varphi}\right)^{\kappa},$$

where $i \in \{GI, T\}$. To satisfy the assumption that the productivity distribution of the GI sector has a lower expected value, we assume $\varphi_{GI}^{min} \leq \varphi_T^{min}$. Aggregate productivity of sector i is given by $\tilde{\varphi}_i = \left[\frac{1}{1-G_i(\varphi_i^*)}\int_{\varphi_i^*}^{\infty} \varphi^{\sigma-1} g_i(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}$, which can be expressed as

$$\tilde{\varphi}_i = \left[\frac{\kappa}{\kappa + 1 - \sigma}\right]^{\frac{1}{\sigma-1}} \varphi_i^*.$$

The probability of entry for a firm from sector i is given by

$$p_i^{in} = 1 - G_i(\varphi_i^*) = \left(\frac{\varphi_i^{min}}{\varphi_i^*}\right)^{\kappa}$$

Given the assumption that firms draw their productivity from a Pareto distribution, the equilibrium conditions read as follows:

$$\overline{\pi}_{GI} = [(1-\lambda)F + np_{GI}^{ex} f_{GI}^{x}] \frac{\sigma - 1}{\kappa + 1 - \sigma}$$

where $p_{GI}^{ex} = \frac{1-G_{GI}(\varphi_{GI}^{*x})}{1-G_{GI}(\varphi_{GI}^{*})} = \left(\frac{\varphi_{GI}^{*}}{\varphi_{GI}^{*x}}\right)^{\kappa} = \tau^{-\kappa}\left(\frac{f_{GI}^{x}}{\frac{\lambda(1-s)(\kappa+1-\sigma)}{\kappa}\frac{F}{\eta M} + (1-\lambda)F}\right)^{\frac{\kappa}{1-\sigma}}$

$$\overline{\pi}_T = (F + np_T^{ex} f_T^{x}) \frac{\sigma - 1}{\kappa + 1 - \sigma}$$

where $p_T^{ex} = \tau^{-\kappa}\left(\frac{f_T^x}{F}\right)^{\frac{\kappa}{1-\sigma}}$

$$\overline{\pi}_{GI} = \delta f_{GI}^{e} \left(\frac{\varphi_{GI}^{*}}{\varphi_{GI}^{min}}\right)^{\kappa}$$

$$\overline{\pi}_T = \delta f_T^{e} \left(\frac{\varphi_T^{*}}{\varphi_T^{min}}\right)^{\kappa}$$

$$\left(\frac{\varphi_{GI}^{min}}{\varphi_{GI}^{*}}\right)^{\kappa}\alpha M^{e}=\delta\eta M$$

$$\left(\frac{\varphi_{T}^{min}}{\varphi_{T}^{*}}\right)^{\kappa}(1-\alpha)M^{e}=\delta(1-\eta)M$$

$$M=\frac{L-\lambda sF-np_{GI}^{ex}\eta M(f_{T}^{x}-f_{GI}^{x})}{\sigma\left\{\eta\overline{\pi}_{GI}+(1-\eta)\overline{\pi}_{T}+\eta\left[\lambda(1-s)\frac{F}{\eta M}+(1-\lambda)F\right]+(1-\eta)F+n[\eta p_{GI}^{ex}f_{GI}^{x}+(1-\eta)p_{T}^{ex}f_{T}^{x}]\right\}}$$

Which gives a system of seven equation with seven endogenous variables ($\overline{\pi}_{GI}$, $\overline{\pi}_{T}$, η, M, φ_{GI}^{*}, φ_{T}^{*}, and M^{e}).

A.3 Firm productivity and use of labour

To determine the baseline value of φ_{GI}^{min} for our simulation exercises, we follow Bouamra-Mechemache & Chaaban (2010), who state that variable production costs are, on average, 40% higher for PDO compared to non-PDO producers. As labour is the only production factor, define the production costs per unit of output c_i^u in sector i as $c_i^u = L_i^c/Q_i^c$. To reflect the result of Bouamra-Mechemache & Chaaban (2010), we need $c_{GI}^u/c_T^u = 1.4$, meaning that GI firms use 40% more labour per unit of output than non-GI firms. Using $L_i^c = M_i^c[r_i(\tilde{\varphi}_i^c) - \pi_i(\tilde{\varphi}_i^c)]$ and $Q_i^c = (M_i^c)^{\frac{\sigma}{\sigma-1}}q(\tilde{\varphi}_i^c) = (M_i^c)^{\frac{\sigma}{\sigma-1}}RP^{1-\sigma}(\rho\tilde{\varphi}_i^c)^{\sigma}$ with $P = (M^c)^{\frac{1}{1-\sigma}}(\rho\tilde{\varphi}^c)^{-1}$ and $R = L - \lambda sF - nT^x$, the baseline parameters defined in Table 1, and the equilibrium conditions defined in Section A.2, we are able to derive that for $\varphi_{GI}^{min} = 0.9487$, we have $c_{GI}^u/c_T^u \approx 1.4$. We use this value as a baseline parameter to reflect that GI firms use, on average, 40% more labour per unit of output than non-GI firms.

A.4 Sensitivity Analysis

We now briefly summarise how the optimal level of administrative GI protection $\Delta f_{GI}^{x*}/f_T^x$ depends on different (exogenous) features of the economy. We depict $\Delta f_{GI}^{x*}/f_T^x$ and the corresponding policy return $\Delta W/C_x^w$ for different parameter values in Table 6. As can be verified, $\Delta f_{GI}^{x*}/f_T^x$ decreases with higher levels of craftsmanship in production in the GI sector (i.e. with lower values of $\varphi_{GI}^{min}/\varphi_T^{min}$). If $\varphi_{GI}^{min}/\varphi_T^{min} < 0.920$ (i.e. if GI firms are very unproductive relative to non-GI firms), the optimal level of adminstrative GI protection decreases to zero. If GI firms are equally productive (prior to entry) as non-GI firms ($\varphi_{GI}^{min}/\varphi_T^{min} = 1$), the welfare-maximising level of administrative GI protection increases to 14.743%. Increasing the share of land dedicated to the production of GI varieties α from 0.1 to 0.2 decreases the optimal level of adminstrative GI protection $\Delta f_{GI}^{x*}/f_T^x$ relative to the baseline scenario (to 4.857%), while further increasing α to 0.5 (0.9) decreases $\Delta f_{GI}^{x*}/f_T^x$ to 2.3434% (0.5714%). This results is due to the fact that a larger GI sector (reflected by the share of land dedicated to GI varieties α), implies higher absolute costs of administrative GI protection; the optimal level of administrative GI protection decreases. Finally, the optimal level of administrative protection decreases in the number of foreign countries n, i.e. to 5.086% for $n = 2$ and to 2.343% for n=10. For $n > 18$, the optimal level of administrative GI protection is zero.

[Insert Table 6 here]

Tables

Table 1: Baseline parameter values.

Type	Parameter	Value	Description
GI policy	λ	0.5	GI collective management policy
parameters	s	0.1	Subsidy to producer group
	Δf^x_{GI}	0	Level of administrative GI protection
	φ^{min}_{GI}	0.9487	Degree of craftsmanship in GI production
Structural			(Bouamra-Mechemache & Chaaban, 2010)
parameters	α	0.1	Share of land dedicated to GI production
			(Jantyik & Török, 2020)
	n	1	Number of foreign countries
	L	1,000,000	Size of the economy
	φ^{min}_{T}	1	Minimum value of non-GI productivity distribution
	F	10	Fixed operating costs
	f^e_{GI}	54.9	Fixed entry cost GI firms
	f^e_{T}	54.9	Fixed entry cost non-GI firms
Other			(Felbermayr et al., 2012); $f^e_i/F = 5.49$
parameters	f^x_{T}	17.5	Fixed exporting costs in the absence of international protection
			(Felbermayr et al., 2012); $f^x_T/F = 1.75$
	κ	8	Pareto shape parameter (Eaton & Kortum, 2002)
	σ	5	Elasticity of substitution (Zhai, 2008)
	δ	0.058	Exit rate (Fackler et al., 2013)
	τ	1.37	Iceberg trade cost (Felbermayr et al., 2012)

Table 2: Different levels of GI collective management policy (λ), equilibrium market outcomes, and welfare per worker. Maximum values in bold.

λ	$\tilde{\varphi}_{GI}$	M_{GI}	$\tilde{\varphi}^x_{GI}$	M^x_{GI}	$\tilde{\varphi}_T$	M_T	$\tilde{\varphi}^x_T$	M^x_T	ε	ε^x	$\tilde{\varphi}^c$	M^c	W
0	**1.3090**	955.9804	2.0627	**25.1541**	1.3798	**8,603.8233**	2.1742	**226.3867**	0.1000	**0.1000**	**1.3798**	9,811.3444	10.9859
0.1	1.2912	1,066.8880	2.0889	22.7407	1.3798	8,603.7838	2.1742	226.3856	0.1004	0.0913	1.3775	9,919.7980	10.9976
0.2	1.2716	1,205.5703	2.1187	20.3055	1.3798	8,603.7442	2.1742	226.3846	0.1008	0.0823	1.3745	10,056.0045	11.0114
0.3	1.2499	1,383.9316	2.1531	17.8481	1.3798	8,603.7046	2.1742	226.3835	0.1012	0.0731	1.3706	10,231.8678	11.0281
0.4	1.2254	1,621.8121	2.1937	15.3682	1.3798	8,603.6650	2.1742	226.3825	0.1016	0.0636	1.3654	10,467.2278	11.0487
0.5*	1.1971	1,954.9245	2.2430	12.8656	1.3798	8,603.6254	2.1742	226.3815	0.1020	0.0538	1.3581	10,797.7970	11.0751
0.6	1.1635	2,454.6940	2.3051	10.3399	1.3798	8,603.5859	2.1742	226.3804	0.1025	0.0437	1.3472	11,295.0002	11.1107
0.7	1.1218	3,287.7797	2.3882	7.7908	1.3798	8,603.5463	2.1742	226.3794	0.1029	0.0333	1.3297	12,125.4961	11.1623
0.8	1.0657	4,954.1584	2.5109	5.2180	1.3798	8,603.5067	2.1742	226.3783	0.1033	0.0225	1.2974	13,789.2615	11.2476
0.9	0.9767	**9,953.7152**	**2.7365**	2.6212	1.3798	8,603.4671	2.1742	226.3773	**0.1037**	0.0114	1.2208	**18,786.1809**	**11.4336**

**Baseline value of* λ.

Note: We omit reporting $\lambda = 1$ *as it would lead to division by zero within the system of equations.*

$\tilde{\varphi}_i$: Aggregate productivity of incumbent firms from sector i.

M_i: Number of incumbent firms from sector i.

$\tilde{\varphi}^x_i$: Aggregate productivity of exporting firms from sector i.

M^x_i: Number of exporting firms from sector i.

ε: Domestic market share of GI firms.

ε^x: International market share of exporting GI firms.

$\tilde{\varphi}^c$: Overall aggregate productivity of all incumbent firms.

M^c: Number of available varieties.

W: Welfare per worker.

Table 3: Different levels of subsidy to the producer group (s), and absolute values of welfare gains per worker (ΔW_s) and return on investment ($\Delta W_s / C^w_{s,\lambda}$) from introducing $s > 0$ relative to $s = 0$. As a comparison, we report different levels of administrative GI protection (λ) and the absolute welfare gains (ΔW_λ) from introducing $\lambda > 0$ relative to $\lambda = 0$. In columns (1)-(3), $\lambda = 0.5$ (baseline value) holds. In colums (4) and (5), $s = 0.1$ (baseline value) holds. Maximum values in bold.

(1)	(2)	(3)	(4)	(5)
s	ΔW_s	$\Delta W_s / C^w_{s,\lambda}$	λ	ΔW_λ
0	-	-	0	-
0.1*	1.7384e-10	**0.0031%**	0.1	0.0117
0.2	3.2938e-10	0.0030%	0.2	0.0255
0.3	4.6662e-10	0.0028%	0.3	0.0422
0.4	5.8557e-10	0.0026%	0.4	0.0628
0.5	6.8621e-10	0.0025%	0.5**	0.0892
0.6	7.6856e-10	0.0023%	0.6	0.1248
0.7	8.3260e-10	0.0021%	0.7	0.1764
0.8	8.7835e-10	0.0020%	0.8	0.2617
0.9	9.0580e-10	0.0018%	0.9	**0.4478**
1	**9.1494e-10**	0.0017%	-	-

**Baseline value of s. **Baseline value of λ.*

Note: We omit reporting $\lambda = 1$ as it would lead to division by zero within the system of equations.

Table 4: Different levels of administrative GI protection ($\Delta f^x_{GI}/f^x_T$), equilibrium market outcomes, and welfare per worker. Maximum values in bold.

$\Delta f^x_{GI}/f^x_T$	$\tilde{\varphi}_{GI}$	M_{GI}	$\tilde{\varphi}^x_{GI}$	M^x_{GI}	$\tilde{\varphi}_T$	M_T	$\tilde{\varphi}^x_T$	M^x_T	ε	ε^x	$\tilde{\varphi}^c$	M^c	W
0	1.1971	**1,954.9245**	**2.2430**	12.8656	1.3798	**8,603.6254**	2.1742	**226.3815**	**0.1020**	0.0538	1.35807	10,797.7970	11.07509
5.6457%*	1.1973	1,953.2665	2.2110	14.4316	1.3798	8,603.5028	2.1742	226.3782	0.1019	0.0567	1.35813	10,796.5791	**11.07510**
10%	1.1974	1,949.9919	2.1854	15.8434	1.3798	8,603.3869	2.1742	226.3752	0.1018	0.0593	1.35818	10,795.5974	11.07509
15%	1.1977	1,947.0970	2.1548	17.7358	1.3798	8,603.2249	2.1742	226.3709	0.1017	0.0624	1.35824	10,794.4286	11.07506
20%	1.1979	1,943.8460	2.1228	19.9886	1.3798	8603.0235	2.1742	226.3656	0.1015	0.0660	1.35830	10,793.2237	11.07499
25%	1.1979	1,940.1690	2.0893	22.6996	1.3798	8602.7710	2.1742	226.3590	0.1014	0.0699	1.35837	10,791.9985	11.07487
50%	1.2004	1,911.0355	1.8914	50.3075	1.3798	8,599.8381	2.1742	226.2818	0.1000	0.1000	**1.35867**	10,787.4629	11.07245
75%	1.2069	1,826.6043	1.5991	192.3436	1.3798	8,581.9050	2.1742	225.8099	0.0962	0.1756	1.35757	10,826.6629	11.05038
90%	**1.2250**	1,598.5626	1.29075	**1,052.1399**	1.3798	8,461.0497	2.1742	222.6300	0.0863	**0.3209**	1.33971	**11,334.3822**	10.87532

* *Welfare-maximising level of* $\Delta f^x_{GI}/f^x_T$.

Note: We omit reporting $\Delta f^x_{GI}/f^x_T = 100\%$ *as it would lead to division by zero within he system of equations.*

$\tilde{\varphi}_i$: Aggregate productivity of incumbent firms from sector i.

M_i: Number of incumbent firms from sector i.

$\tilde{\varphi}^x_i$: Aggregate productivity of exporting firms from sector i.

M^x_i: Number of exporting firms from sector i.

ε: Domestic market share of GI firms.

ε^x: International market share of exporting GI firms.

$\tilde{\varphi}^c$: Overall aggregate productivity of all incumbent firms.

M^c: Number of available varieties.

W: Welfare per worker.

Table 5: Different levels of GI collective management policy (λ), relative productivities of domestically operating GI and non-GI firms and of exporting GI and non-GI firms (calculated at $\Delta f^x_{GI}/f^x_T = 0$), and the optimal level and the return on investment of administrative GI protection. As a comparison, we report the same outcomes for different levels of the subsidy (s). Maximum values in bold.

λ	$\tilde{\varphi}_{GI}/\tilde{\varphi}_T$	$\tilde{\varphi}^x_{GI}/\tilde{\varphi}^x_T$	$\Delta f^{x*}_{GI}/f^x_T$	$\Delta W_x/C^w_x$	s	$\tilde{\varphi}_{GI}/\tilde{\varphi}_T$	$\tilde{\varphi}^x_{GI}/\tilde{\varphi}^x_T$	$\Delta f^{x*}_{GI}/f^x_T$	$\Delta W_x/C^w_x$
0	**0.9487**	0.9487	0	0	0	**0.8675461**	1.031626	5.6440%	6.9348%
0.1	0.9358	0.9607	0	0	0.1***	0.8675460	1.031633	5.6457%	6.9388%
0.2	0.9216	0.9744	0	0	0.2	0.8675459	1.031639	5.6469%	6.9435%
0.3	0.9058	0.9903	0	0	0.3	0.8675458	1.031645	5.6509%	6.9444%
0.3545*	0.8957	1.0000	0	0					
0.4	0.8880	1.0090	1.6000%	2.0259%	0.4	0.8675456	1.031652	5.6537%	6.9468%
0.5**	0.8675	1.0316	5.6457%	6.9388%	0.5	0.8675455	1.031658	5.6560%	6.9499%
0.6	0.8432	1.0602	10.4571%	12.9575%	0.6	0.8675454	1.031665	5.6583%	6.9531%
0.7	0.8130	1.0984	16.5714%	20.4123%	0.7	0.8675453	1.031671	5.6606%	6.9563%
0.8	0.7723	1.1548	24.6857%	30.6123%	0.8	0.8675452	1.031678	5.6634%	6.9587%
0.9	0.7078	**1.2586**	**37.2000%**	**46.3980%**	0.9	0.8675450	**1.031684**	**5.6657%**	**6.9619%**

Threshold value of λ (For $\lambda \leq 0.3545$, $\Delta f^{x*}_{GI}/f^x_T = 0$, for $\lambda > 0.3545$, $\Delta f^{x*}_{GI}/f^x_T > 0$).

**Baseline value of λ. ***Baseline value of s.

Note: We omit reporting $\lambda = 1$ as it would lead to division by zero within the system of equations.

Table 6: The optimal level of administrative GI protection $\Delta f_{GI}^{x*}/f_T^x$ and the policy returns relative to its costs $\Delta W/C_x^w$ for different values of the structural parameters. In each row, only the mentioned parameter is altered, while all other parameters remain at their baseline values. In the second row, we report the outcomes with parameters at their baseline values for comparison.

	$\Delta f_{GI}^{x*}/f_T^x$	$\Delta W/C_x^w$
Baseline outcomes	5.6457%	6.9388%
$\varphi_{GI}^{min}/\varphi_T^{min} < 0.9197$	0	–
$\varphi_{GI}^{min}/\varphi_T^{min} = 1$	14.9714%	18.2963%
$\alpha = 0.2$	5.4286%	5.5506%
$\alpha = 0.5$	3.6000%	3.0691%
$\alpha = 0.9$	0.5714%	0.7664%
$n = 2$	5.0857%	6.5961%
$n = 10$	2.3429%	3.0545%
$n > 18$	0	–

References

Barham, E., & Sylvander, B. (2011). *Labels of origin for food: Local development, global recognition*. Cabi.

Barjolle, D., & Chappuis, J.-M. (2000). Transaction costs and artisanal food products. *Economie rurale*, *258*, 90-100.

Barjolle, D., & Sylvander, B. (1999). Some factors of success for origin labelled products in agri-food supply chains in Europe: Market, internal resources and institutions. *No. 730-2016-50586*, 45-71.

Belletti, G. (1999). *Origin labelled products, reputation and heterogeneity of firms* (Tech. Rep.).

Belletti, G. (2021). *Evaluating Geographical Indications: Guide to tailor evaluations for the development and improvement of Geographical Indications*. Food & Agriculture Organization of the United Nations.

Bouamra-Mechemache, Z., & Chaaban, J. (2010). Determinants of adoption of protected designation of origin label: Evidence from the french brie cheese industry. *Journal of Agricultural Economics*, *61*(2), 225–239.

Chambolle, C., & Giraud-Héraud, E. (2005). Certification of origin as a non-tariff barrier. *Review of International Economics*, *13*(3), 461–471.

Chandra, R., Moschini, G., Lade, G. E., & Moschini, G. (2021). Geographical indications and welfare: Evidence from the us wine market.

Chilla, T., Fink, B., Balling, R., Reitmeier, S., & Schober, K. (2020). The EU food label 'Protected Geographical Indication': Economic implications and their spatial dimension. *Sustainability*, *12*(14), 5503.

Costanigro, M., McCluskey, J. J., & Goemans, C. (2010). The economics of nested names: name specificity, reputations, and price premia. *American Journal of Agricultural Economics*, *92*(5), 1339–1350.

Curzi, D., & Huysmans, M. (2022). The impact of protecting eu geographical indications in trade agreements. *American Journal of Agricultural Economics*, *104*(1), 364–384.

Demidova, S. (2008). Productivity improvements and falling trade costs: boon or bane? *International Economic Review*, *49*(4), 1437–1462.

Duvaleix, S., Emlinger, C., Gaigné, C., & Latouche, K. (2021). Geographical Indications and trade: Firm-level evidence from the French cheese industry. *Food Policy*, *102*, 102118.

Eaton, J., & Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, *70*(5), 1741–1779.

Engelhardt, T. (2015). Geographical Indications under recent EU trade agreements. *IIC - International Review of Intellectual Property and Competition Law*, *46*(7), 781–818.

European Union. (2024). Regulation (EU) 2024/1143 of the European Parliament and of the council of 11 April 2024 on geographical indications for wine, spirit drinks and agricultural products, as well as traditional specialities guaranteed and optional quality terms for agricultural products, amending regulations (EU) no 1308/2013, (EU) 2019/787 and (EU) 2019/1753 and repealing regulation (EU) no 1151/2012. *Official Journal of the European Union*.

Fackler, D., Schnabel, C., & Wagner, J. (2013). Establishment exits in germany: the role of size and age. *Small Business Economics*, *41*(3), 683–700.

Falvey, R., Greenaway, D., & Yu, Z. (2006). Extending the melitz model to asymmetric countries. *University of Nottingham research paper*(2006/07).

Felbermayr, G., Jung, B., & Larch, M. (2012). *Tariffs and welfare in new trade theory models* (Tech. Rep.). University of Tübingen Working Papers in Economics and Finance.

Gergaud, O., & Ginsburgh, V. (2008). Natural endowments, production technologies and the quality of wines in bordeaux. does terroir matter? *The Economic Journal*, *118*(529), F142–F157.

Gstöhl, S., & De Bièvre, D. (2017). *The trade policy of the European Union.* Macmillan International Higher Education.

Huysmans, M. (2020). Exporting protection: EU trade agreements, Geographical Indications, and gastronationalism. *Review of International Political Economy*, 1–28.

Jantyik, L., & Török, Á. (2020). Estimating the market share and price premium of GI foods — The case of the Hungarian food discounters. *Sustainability*, *12*(3), 1094.

Josling, T. (2006). The war on terroir: Geographical Indications as a transatlantic trade conflict. *Journal of Agricultural Economics*, *57*(3), 337–363.

Le Goffic, C., & Zappalaglio, A. (2017). The role played by the US government in protecting geographical indications. *World Development*, *98*, 35–44.

Lence, S. H., Marette, S., Hayes, D. J., & Foster, W. (2007). Collective marketing arrangements for geographically differentiated agricultural products: Welfare impacts and policy implications. *American Journal of Agricultural Economics*, *89*(4), 947–963.

Mancini, M. C., Arfini, F., Veneziani, M., & Thévenod-Mottet, E. (2017). Geographical indications and transatlantic trade negotiations: Different US and EU perspectives. *EuroChoices*, *16*(2), 34–40.

Marie-Vivien, D., & Biénabe, E. (2017). The multifaceted role of the state in the protection of geographical indications: A worldwide review. *World development*, *98*, 1–11.

Matthews, A. (2016). What Outcome To Expect On Geographical Indications in the TTIP Free Trade Agreement Negotiations With The United States? *Intellectual Property Rights for Geographical Indications: What is at Stake in the TTIP?*, 2.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6), 1695–1725.

Menapace, L., & Moschini, G. (2012). Quality certification by Geographical Indications, trademarks and firm reputation. *European Review of Agricultural Economics*, *39*(4), 539–566.

Menapace, L., & Moschini, G. C. (2014). Strength of protection for Geographical Indications: Promotion incentives and welfare effects. *American Journal of Agricultural Economics*, *96*(4), 1030–1048.

Mérel, P., & Sexton, R. J. (2012). Will Geographical Indications supply excessive quality? *European Review of Agricultural Economics*, *39*(4), 567–587.

Moir, H. V. (2016). Geographical Indications: EU policy at home and abroad. In *IP statistics for decision makers (IPSDM) conference Sydney, Australia.*

Moschini, G., Menapace, L., & Pick, D. (2008). Geographical Indications and the competitive provision of quality in agricultural markets. *American Journal of Agricultural Economics*, *90*(3), 794–812.

Oberfield, E., & Raval, D. (2021). Micro data and macro technology. *Econometrica*, *89*(2), 703–732.

Raimondi, V., Falco, C., Curzi, D., & Olper, A. (2020). Trade effects of Geographical Indication policy: The EU case. *Journal of Agricultural Economics*, *71*(2), 330–356.

Rangnekar, D. (2004). The socio-economics of Geographical Indications. *UNCTAD-ICTSD Project on IPRs and Sustainable Development, Issue Paper*, *8*, 13–15.

Saggi, K. (2016). Trade, intellectual property rights, and the World Trade Organization. *Handbook of Commercial Policy*, *1*, 433–512.

Sautier, D. (2019). *Seminar on Geographical Indications.* European Union Intellectual Property Office.

Sorgho, Z., & Larue, B. (2018). Do Geographical Indications really increase trade? A conceptual framework and empirics. *Journal of Agricultural & Food Industrial Organization*, *16*(1).

Stasi, A., Nardone, G., Viscecchia, R., & Seccia, A. (2011). Italian wine demand and differentiation effect of geographical indications. *International Journal of Wine Business Research*.

TRIPS. (1994). Agreement on trade-related aspects of intellectual property rights. *Marrakesh Agreement Establishing the World Trade Organization*, *Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197*.

Vandecandelaere, E., Teyssier, C., Barjolle, D., Jeanneaux, P., Fournier, S., & Beucherie, O. (2018). *Strengthening sustainable food systems through Geographical Indications: An analysis of economic impacts.* European Bank for Reconstruction and Development (EBRD).

WTO. (1994). Agreement on agriculture. *Apr. 15, 1994. Marrakesh Agreement Establishing the World Trade Organization, Annex 1A, 1867 U.N.T.S. 410*.

Zhai, F. (2008). Armington meets Melitz: Introducing firm heterogeneity in a global CGE model of trade. *Journal of Economic Integration*, 575–604.