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Removing Geo-blocking: What are the Effects on Innovation for Vertically Differentiated Goods?

Lisa Hamelmann & Gordon J. Klein*

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Abstract

At present, there is a wide debate on regulating geo-blocking, an online practice that prevents consumers from buying or having access to products and services from another country. This practice is not only used by retailers, but is also of great importance in the market for digital visual broadcasting. We develop a model to identify the cases, in which firms have an incentive to include geo-blocking clauses in their licensing agreements. In addition, we analyze the effects of restricting geo-blocking on the level of innovation of two vertically differentiated goods and on the overall product variety. Our results show that the market outcome primarily depends on the level of competition between the two goods. For instance, regulatory changes do not have any impact if competition is very low or very high. However, if competition is sufficiently high, the removal of geo-blocking decreases the level of innovation of the good that is traded. The product quality of the other firm, instead, increases – as long as R&D costs are sufficiently high. Putting both effects together, it becomes evident that the quality gains do not compensate for the quality losses. In addition, the removal of geo-blocking affects the product variety as well – a lower level of competition increases the product variety and vice versa.

JEL CODES: L 42, L51, L52, K21

KEYWORDS: Digital Markets, Geo-blocking, Vertical Restraints, Regulation, Investment, Quality

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1. Introduction

The market for visual broadcasting services has dramatically changed within the last years. While the consumption of linear broadcasted services by traditional TV broadcaster remained at best constant or has even decreased, a sharp increase in the usage of streamed content via platforms such as Netflix, Amazon Prime, Google Play or Apples iTunes can be observed.¹ Importantly, those platforms often do not only serve as platforms in the traditional sense, but also as content producers, implying that there are important interactions of horizontal and vertical market layers with both traditional broadcasting services as well as traditional content producers delivering. Thereby, the consumers' purchasing decision depends on both, the platforms' quality as well as the offered content. Given heavy investment in the production of content,² including the platforms' in-house productions, it can be presumed that the importance of dynamic variables of competition such as quality enhancing innovative investments are important in those markets.³

A further particularity of these platforms contrasting to broadcasting is the existence of the technical possibility to stream easily any content from any national and international location. Contrarily, companies often artificially limit access to their content, for instance by introducing time delays or limit the content to national territories⁴. This approach of blocking content geographically is called *geo-blocking*. Generally, geo-blocking is an online practice used by retailers and platforms to prevent consumers from buying or having access to products and services from another country. Thereby, Internet Server Provider restrictions (ISP) or other instruments and methods – such as the omission of delivery services – are used to fragment the market and re-establish state borders. Typical examples for services with territorial restrictions are (non-) audio-visual digital media contents (e.g., Netflix, I-Tunes), as they usually have country-specific digital right managements and provide different content in different countries.⁵

¹ For an overview of the popularity of those platforms in an internet article, see e.g. Marketing Charts (2017).

² See for a news statement, e.g. CNN (2017).

³ Innovation at the provision of service can be seen in the way of providing content to consumers individually fitting to the consumers taste as well as in the way of broadcasting via high resolutions (e.g. 4K resolution). Innovation in the content production becomes relevant when using platforms collected data to create new-targeted content (for an example, see the news report by Charr (2013).)

⁴ This is different to traditional broadcasting in two senses. First, content distributed via antenna or cable cannot be made available easily everywhere. Even satellite content requires some technical investment to make content available that may exclude travelers or renter of apartments that are not allowed to install this hardware. Second, limiting content distributed via satellite cannot be limited easily to regional territories without any further hardware such as coding and decoding boxes.

⁵ Although Netflix, e.g., charges the same subscription price for all citizens of the member states of the European Monetary Union, the available content differs significantly. In Belgium, i.e., citizens have access to around 437 TV shows and 1474 movies, in Germany only to 328 shows and 1440 movies

Geo-blocking as a business strategy and its impact on very dynamic markets, such as the one for visual broadcasting services, is of large interest. Already a few years ago, policy makers started to address geo-blocking, however, without taking into account the platforms' interaction between the "pure" provision of content and investments into own-content. For instance, the European Commission early took a skeptical point of view on geo-blocking.⁶ In particular, it announced its strategy to take down artificially created and unjustified barriers hindering the free movement of goods and services.⁷ Only recently, the European Parliament, the Council and the Commission agreed to the first new rules that define three specific situations where there is no justification for a different treatment between customers from different EU member states given, namely "The sale of good without physical delivery", "The sale of electronically supplied services" and "The sale of services provided in a specific physical location" (European Commission 2017). Hence, by the end of 2018, geo-blocking regarding these scenarios will no longer be permitted within the EU.

The academic discussion recently analyzed empirically potential welfare effects (Aguilar and Waldvogel, 2014, Duch-Brown and Martens 2016). Those studies, however, do not directly address the effects of innovation and investment, which are of particular relevance in these very dynamic markets. Few studies try to model the impact of geo-blocking on variety, but neither model the complex market structure in the sector of interest nor explicitly take into account investment in innovation (Alaveras, Gómez and Martens, 2017, or Erutku et al., 2005). Besides those strands of literature, the closest related work is that of parallel trade, which explicitly models the market structure of innovative markets (i.e. mostly pharmaceuticals), and provides some insights in the analysis of geo-blocking, as geo-blocking and the prohibition of parallel imports is highly similar.⁸ Still, this literature does not explicitly model the complex interactions of the horizontal and vertical market layers as it can be observed in the digital

and in Slovakia the number is reduced to 200 and 559 respectively. There is also no pattern based on the language identifiable. See Netflix USA vs The World: Content libraries compared (February 20, 2017). Available at <https://www.finder.com/netflix-usa-vs-world-content>.

⁶ First attempts to prohibit geo-blocking with respect to online content already exist, not just within the EU. In October 2011, the CJEU confirmed that a license, which prohibits broadcasting football matches outside the member state for which the license was granted, was contrary to EU. Although the UK Premier League can legally license exclusively territorial rights to broadcast their matches, it cannot prohibit the cross-border circulation of decoder cards, which transmit the respective content. Furthermore, this decision only applies for the private use, this landmark decision was the first attempt into the direction of lifting country-specific access opportunities. Following this decision, the Commission recently accepted commitments by Paramount on cross-border pay-TV services, following a statement of objection with the preliminary view that geo-blocking clauses in film licensing contracts between Paramount and other studios and Sky UK breach EU antitrust rules. The clauses required Sky UK to block access to the films to consumers outside the licensed countries. Taking up on this idea, this paper aims to refine the various effects of the removal of geo-blocking before further attempts of market intervention are made.

⁷ Commission press releases IP/15/4919 and MEMO/15/4920, May 6, 2015. For a first assessment see Marcus and Petropoulos (2017).

⁸ For related parallel import literature, see, for instance, Li and Robles (2007), Cournot. Matteucci and Reverberi (2014) Hwang et al. (2014), which are discussed in detail in the literature section.

visual broadcasting market where regulation may differently affect the innovative investment of traditional and new content producers.

This is where our paper steps in. We analyze the effects of removing geo-blocking on innovation and on overall product variety by focusing on the investments in innovative services and content that leads to market expansion. By using a theoretical model, which incorporates the complex market structures of horizontal and vertical relations, we study the structural changes within each market if two companies are no longer able to enforce exclusive territory clauses.⁹ The aim of this paper is to reduce the explained gaps in the literature by explicitly taking into account the effects on product innovation and quality of new and traditional broadcasting distribution and production. Additionally, our paper focuses on access to online content, thus it incorporates a more complex licensing structure, in which market participants have a vertical and horizontal relation.

In order to frame arguments for and against the removal of geo-blocking, we consider two key figures: Investment incentives for innovation and product variety measured as options available. As our analysis reveals, regulation has ambiguous effects on product innovation;, however, the positive effects on one good can never compensate the loss of innovation of the other. Concerning the product variety, counter-intuitively, geo-blocking can facilitate greater access to content, depending on the level of competition.¹⁰ These findings provide important information for the current policy debate, and highlight the necessity of tailoring potential regulatory measures to the individual markets.

The paper is organized as follows. First, the relevant economic literature is reviewed, followed by a description of the theoretical model in section three. In this context, the three possible market equilibria are analyzed. Either, the contracting parties refuse to enter into an agreement (no deal), agree to an exclusive territory clause (geo) or enter into an agreement without any geo-blocking clause (no geo). Subsequently in section four, we use a comparative static analysis to compare the different scenarios and to determine the preferred scenario for each of the market participants. The results depend on, among others, the level of substitution between the offered goods, the unit R&D costs, but only limitedly on the bargaining power of the firms. In the specific case, in which both market participants prefer geo-blocking, we further examine the overall effects on innovation and product variety if geo-blocking is prohibited. Section five concludes.

⁹ The movie industry exemplifies the complexity of the market structures. For instance, Netflix, a streaming platform, offers, e.g., Hollywood movies as well as in-house productions. Some of the in-house productions, however, are initially broadcasted by other platforms such as Sky before they are available at Netflix. Simultaneously, Sky may also broadcast the Hollywood movies.

¹⁰ Concerning the latter, the ability to do geo-blocking can sometimes be the only way to publish or distribute the work online. This is in line with the findings in our analysis.

2. Literature

Within (economic) literature, there are hardly any studies about the implications of geo-blocking beyond the traditional price discrimination literature.¹¹ The closest directly related literature is the report by Aguiar and Waldvogel (2014), who empirically analyze the effects of free trade on the digital music industry. They conclude that consumers and producers overall gain from free trade, however, some producers lose more because of increased competition in their home country than they gain from selling to foreign markets.

The positive results on consumer and producer surplus are confirmed in a study by Duch-Brown and Martens (2016), who determine the welfare impact of lifting geo-blocking restrictions to cross-border e-commerce in the EU. Based on a dataset on consumer electronics products in ten European countries, they simulate the effect as a reduction of trade costs and conclude that both, producers and consumers, benefit from trade as the sales volume increases.

According to standard trade literature, it appears intuitive that consumer as well as producer surplus increase, however, the removal of geo-blocking cannot unambiguously have positive effects for most producers, as otherwise exclusive territory clauses would not be as common.¹² Hence, these studies only limitedly reflect the various effects of the removal of geo-blocking, as they, for instance, do not consider the effects on innovation and quality, which are particularly relevant in the digital content industries with high production costs.

Literature on the effect of geo-blocking on quality and variety barely exists as well. Alaveras, Gómez and Martens (2017), for instance, a-priori conclude that geo-blocking reduces the extent of product variety available to consumers. This hypothesis is confirmed by Erutku et al. (2005), who consider an innovator that licenses its cost-reducing technology with contracts specifying a fixed fee and an exclusive territory clause. The analysis, which is limited in its application as it refers to one innovative upstream firm and its downstream firms, reveals that exclusive territory clauses with fixed fees can reduce product variety. Ferreira et al. (2012) affirm the relevance of quality in an empirical structural model. They quantify the components of trade's benefit operating through the endogenous quality channel and find that consumers benefit from quality gains in the movie industry under free trade. In contrast to our analysis, the paper by Ferreira et al. focuses on the effects of European subsidies and neglects the complex licensing structures in the movie industry.

¹¹ For a textbook description see Tirole (1994, pp. 133-166).

¹² Besides the sector inquiry of the Commission, e.g., Alaveras, Gómez and Martens (2017) also confirm the widespread existence of geo-blocking combined with cross-country price differentiation on online media stores.

As there is hardly any literature on geo-blocking, we take advantage of the similarities to the case of parallel trade. A significant amount of research has been devoted to study the effects of parallel trade on product variety and innovation – primarily applied to pharmaceuticals. A main distinction to this literature is the particular industry setup in digital markets. Still, these models provide a useful framework for our study, as the effects of parallel trade are partly transferable to the scenario when geo-blocking is restricted. For example, Szymanski and Valetti (2005) develop a model of vertical product differentiation with consumer preferences à la Mussa-Rosen in a price-cap regulated industry. They show that welfare may increase if parallel trade is permitted, but that it has detrimental effects on investments. Li and Maskus (2006) confirm the finding that parallel import leads – as the standard price discrimination literature may suggest – to lower levels of investment.¹³

However, these studies based on cost-reducing and process innovations neglect that innovation may change the volume of trade and overall sales together with the prices in the respective market. As the study by Li and Robles (2007) indicate, the effects of parallel import on product innovation differ from the ones on process innovation.¹⁴ They find that there is scope for higher investments in innovation due to parallel trade as long as the goods are sufficiently differentiated. Yet, the results are limited to horizontal product differentiation and the manufacturer and the distributor compete à la Cournot.

Matteucci and Reverberi (2014) also find that product innovation – and possibly overall welfare – can increase if re-imports are allowed, depending on the consumers' preferences for innovation between the two countries. Hwang et al. (2014) add that the effect on the manufacturer's product innovation depends on the market structure. In a monopolistic market, parallel import necessarily decreases the manufacturer's product innovation; instead, the result is reversed if the market is duopolistic or oligopolistic.

Although the literature on parallel import studies the effects on innovation, which are neglected by the existing literature on geo-blocking, the findings of parallel trade cannot directly be applied to the digital online and e-commerce sectors with its distinct market structures. The most popular case for that is the market for electronic video streaming. For instance, content providers are no longer unambiguously assigned to the downstream market, but also compete

¹³ This result confirmed in many other papers: Barfield and Groombridge (1998) show that parallel imports reduces the returns to innovation. Danzon (1997) argue that allowing parallel trade is strictly welfare-reducing as the inability to profit from segmented markets could significantly damage incentives for innovation. Maskus (2000) points out that those findings are exactly in line with the legal justification for national exhaustion policies, as PI hampers the originator's ability to earn a return on investment.

¹⁴ In addition, empirical studies provide evidence that product innovation has a different and particularly more significant influence on foreign direct investments and firm's propensity to export. See, e.g., Becker and Egger (2013) and Cassiman, Golovko and Martinez-Ros (2010). Further, e.g., Arundel and Kabla (1998) find that the percentage of product innovations is significantly higher than process innovations in Europe's industrial firms.

in the upstream market, thus producers and providers are simultaneously competitors and collaborators. Consequently, market structures become more complex and the outside options vary significantly, which can distort the overall market outcome as, for instance, the study of Hwang et al. (2014) reveals. As described, literature on geo-blocking likewise does not account for the complex licensing structures.

3. Model setup

3.1. Model Primitives

We consider the problem of a duopolistic industry in two scenarios: With and without geo-blocking. Our model captures two firms ($i=1,2$) offering digital content in two countries. We assume there are two platforms producing their own content. While one firm can only sell its content in one country and cannot be streamed by users in the other country, the second firm can (technically) broadcast in both countries. It is assumed that to access the second country, the firm that is limited to its own market requires the other firm's platform. This platform, however, also produces content exclusively for the second market, which we assume also to be only of interest for this market. One may think of a local television broadcasting pay-per-view platform only broadcasted in national cable-tv networks in market 1 and an internet-streaming platform in market 2 that can be streamed by customers in both markets.

In the initial scenario, we assume that there are two countries, a home country h and a foreign country f . A local producer m located in country h sells q_1 units of its intangible good 1 with an innovation level of x_1 in its own (home) market. The other firm d acts as a platform selling its own intangible good 2 with an innovation level x_2 in country f . Platform d can additionally acquire good 1 from firm m to provide it on its own platform.

If geo-blocking is allowed, producer m can restrict platform d to sell good 1 solely in country f . Contrarily, if governments prohibit geo-blocking or if the firms do not have an incentive to enforce geo-blocking, platform d sells good 1 in both countries, h and f . Selling the same good to another firm in the market is driven by the model's setup leading to the good being differentiated by selling at someone else's outlet. In addition, we assume that consumers are restricted by procedural requirements or language barriers to purchase the goods in their respective country, and they do not have the possibility for arbitrage.

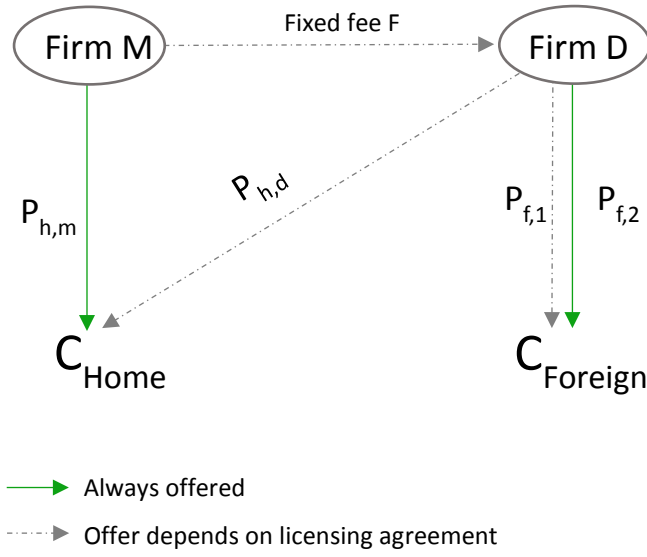
Based on the idea that higher investments (e.g., in R&D) lead to higher innovation, we consider a model of product differentiation in which the innovation levels x_1 and x_2 represent the quality level of each good. Both firms compete á la Bertrand and each of them incurs a constant marginal cost c (retail costs), which is assumed to be zero. Furthermore, there are no transaction costs, according to the assumption that the goods are online provided and

intangible. The producer m charges a fixed fee F if selling its good 1 to platform d .¹⁵ Altogether, we analyze how regulatory changes of removing geo-blocking affects firms' decisions to invest in innovation and product variety (measured as options available). We concentrate on a comparative static analysis of variations in the innovation level x_i with $i = 1,2$ as well as the overall product diversity because we consider this comparison to be most relevant from a consumer welfare perspective and consequently for regulatory policy purposes.

The game in question consists of four stages. In the first stage, the level of the fixed fee F is determined. In the second stage, both firms individually determine the optimal innovation level x_i with $i = 1,2$ for each good. For simplicity, we assume that investments in innovation lead to a certain expected value and utility of the innovation. This assumption allows treating it as a common investment in the model. We assume that the output directly reflects the chosen innovation level. Taking the quality as given, both firms simultaneously set the end consumer prices for good 1 $p_{h,i}$ sold by firm $i = m, d$ in country h and $p_{f,k}$ for the goods $k = 1,2$ sold by firm d in country f . In a last step, the consumers choose their optimal quantity of the good(s) provided in the respective country. We let $q_{h,i}$ denote firm $i=m,d$ sales of good 1 in country h , and $q_{f,k}$ denote firm d sales of good $k = 1,2$ in country f . This sequence reflects the idea that innovation decisions are rather strategic long-term decisions compared to pricing decisions, which can be adjusted more quickly. Determining the fixed fees before the investment decision is also in accordance with advance payments in the audio-visual and music industry. Long-term contracts ensure that producers have reliable knowledge about their buyers and the chosen sales channels before investing in productions. While deriving the Subgame Perfect Nash Equilibrium via backward induction, we use a comparative static analysis of variations of one or two goods in the different countries. The producer can either i) license good 1 and impose geo-blocking, ii) license good 1 without a geo-blocking clause, or iii) not enter into an agreement. We then compare the firms' preferred scenario with respect to the profitability, and subsequently use the scenarios, in which geo-blocking is identified as most profitable, to compare the resulting levels of innovations to the outcome if geo-blocking is restricted. The following figure depicts the different market structures.

¹⁵ Fixed fees are commonly charged for intangible goods. The sector inquiry confirmed that right holders who license popular content tend to make use of payment structures that are not linked to the number of end consumers, such as advance payments and fixed fees. See European Commission (2017) Report from the Commission to the Council and the European Parliament. Final Report on the E-Commerce Sector Inquiry, COM(2017), para 70.

Figure 1: Market Structure: Geo-Blocking vs. Open Market



Source: Own illustration.

We use a representative consumer approach to model the demand of this market, because we aim to explain markets that may be subject to an increase in the markets overall demand, i.e. a market expansion that is typically not modelled in hoteling approaches. This market expansion effect is important to consider the nature of digital broadcasting markets, which are typically characterized by very dynamic competition with increasing market volumes, instead of being in a steady state. Further, a demand and price per unit can also easily be motivated by pay-per view content, which is typically available on traditional pay-TV platforms as well as streaming platforms such as google play, amazon video or Apple's I-tunes.

Following the Chamberlin-Robinson approach, a variation of the representative consumer model in which consumers have a “love for variety”, we get the following demand within each respective country¹⁶:

$$q_{h,i}(p_{h,i}, p_{h,j}) = \frac{p_{h,i} - a_{h,i} - x_1 + (x_1 + a_{h,i} - p_{h,j})\gamma}{\gamma^2 - 1} \text{ with } i, j = m, d ; i \neq j .$$

$$q_{f,i}(p_{f,i}, p_{f,j}) = \frac{p_{f,i} - a_{f,i} - x_i + (x_j + a_{f,i} - p_{f,j})\gamma}{\gamma^2 - 1} \text{ with } i, j = 1, 2 ; i \neq j .$$

¹⁶ The underlying utility function is $U(q) = (ai * xi) \sum_{i=1}^n q_i - \frac{1}{2} (\sum_{i=1}^n q_i^2 + 2\gamma \sum_{j \neq i}^n q_i q_j)$, condition to large enough income. For a general description see, e.g., Vives (2001, pp. 144–148) or Singh and Vives (1984). Utility therefore is quadratic in the consumption of good 1 and 2.

Assumption 1. The general demand in country h with good 1 and in country f , in which both goods can be sold is $q_{h,i}(p_{h,i}, p_{h,j}) = \frac{p_{h,i} - a_{h,i} - x_1 + (x_1 + a_{h,i} - p_{h,j})\gamma}{\gamma^2 - 1}$ with $i, j = m, d$; $i \neq j$, and $q_{f,i}(p_{f,i}, p_{f,j}) = \frac{p_{f,i} - a_{f,i} - x_i + (x_j + a_{f,i} - p_{f,j})\gamma}{\gamma^2 - 1}$ with $i, j = 1, 2$ and $i \neq j$. Note that the utility of minimum quality in a vertical sense is given by $a_{h,i} = a_{f,i} = a$, whereas $a > 0$. Hence, the innovation level x denotes the quality upgrade above the minimum quality level. The level of substitution between good 1 and 2 is described by γ , which can be interpreted in terms of horizontal product differentiation, thus determining the intensity of competition. We restrict it to $\gamma \in (0, 1)$. Consequently, the two goods are perfect substitutes when $\gamma = 1$ and unrelated when $\gamma = 0$.

Assumption 2. The fixed fee F is charged by firm m if selling its good 1 to firm d . If the offer is refused, there is no resale of good 1 in either country, else equal. Firms are assumed to maximize their profit with:

$$\pi_m = p_{h,m}q_{h,m} - \frac{1}{2}k_1x_1^2 + F$$

$$\pi_d = p_{f,2}q_{f,2} + p_{f,1}q_{f,1} + p_{h,d}q_{h,d} - \frac{1}{2}k_2x_2^2 - F$$

with $k_1 = k_2 = k$.

The profit function consists of the prices $p_{f,j}$ with $j = m, d$ in country h and $p_{f,i}$ with $i = 1, 2$ in country f , multiplied by the respective quantity demanded, less the (quadratic) investment costs resulting if raising the innovation level x_i . R&D costs are strictly increasing and convex in R&D, exhibiting diminishing returns, thus k is a measure of unit R&D costs. This requires $k_i \geq \frac{1}{2}$, to ensure the investment levels are non-negative. We assume symmetric firms with homogeneous R&D unit costs, which implies equal R&D capabilities of firms.

Market Structures

Prior to the comparative static analysis, we examine the scenario under geo-blocking, and the scenario in which geo-blocking is prohibited. Before, we briefly depict the scenario without any cross-border sales, as this is a constant outside option for both firms.

3.2. No Deal

Based on the idea of contractual freedom and absent of any contractual obligation, both firms can decide not to enter into a licensing agreement. In this case, either firm sells its own good in its respective country (good 1 in country h and good 2 in the foreign country), leaving consumers with only one product choice:

$$q_{h,1}(p_{h,1}) = a + x_1 - p_{h,1} \text{ and } q_{f,2}(p_{f,2}) = a + x_2 - p_{f,2}. \quad (1)$$

Consequently, both firms are monopolists in their country. Given the demand, each firm sets its optimal price level independently with:

$$\pi_g = p_i q_i - \frac{1}{2} k x_i^2 \Rightarrow p_i = \frac{a+x_i}{2} \text{ with } g = m, d; i = h1 \text{ if } g = m. \text{ Otherwise } i = f. \quad (2)$$

Taking into consideration the monopoly prices and sales figures, both firms choose their optimal level of innovation with:

$$x_i = \frac{a}{2k-1} \text{ with } g = m, d; i = h1 \text{ if } g = m, \text{ otherwise } i = f2. \quad (3)$$

Most important for the further analysis are the profits each firm can attain. This benchmark serves as the key figure of whether the firms eventually enter into an agreement or not. If at least one firm's profit resulting from geo-blocking or open market is below this benchmark, no licensing agreement is concluded – leaving the consumers with only one available good in the respective country. In this case, the resulting profits for each firm are:

$$\pi_g = \frac{a^2 k}{4k-2} \text{ with } g = m, d. \quad (4)$$

3.3. Geo-Blocking

In absence of the prohibition of geo-blocking, firm m can introduce its good 1 to the foreign market f by restricting any re-import. Hence, it can launch good 1 in country f through platform d without having to worry about facing competition in the home country h . In this scenario, consumers in country h have the same utility function as in the scenario without a licensing agreement (demand function 1). For consumers in country f , instead, the utility changes as they now have the choice of two goods. The demand function yields:

$$q_{f,i}(p_{f,i}, p_{f,j}) = \frac{p_{f,i} - a - x_{f,i} + (a - p_{f,j} + x_{f,j})\gamma}{\gamma^2 - 1} \text{ with } i, j = 1, 2; i \neq j. \quad (5)$$

We restrict $\gamma < 1$, thus requiring at least a minimum level of product differentiation. Given the output and taking the other firm's price(s) as given, both firms simultaneously choose their optimal price level:

$$\pi_m = p_{h,1} q_{h,1} - \frac{1}{2} k x_1^2 + F \quad (6)$$

$$\pi_d = p_{f,2} q_{f,2} + p_{f,1} q_{f,1} - \frac{1}{2} k x_2^2 - F. \quad (7)$$

The price level for each good equals the price without any cross-border sales (see function 2). Hence, it becomes evident that not only the producer m in country h continues charging a monopoly price for its good, but platform d also charges the monopoly price for both goods in the foreign market if geo-blocking is enforced.

Anticipating the optimal price-to-quantity ratio in each country, both firms simultaneously choose their optimal innovation level. Accordingly, the innovation level x_1 equals the level where no agreement is concluded and is consequently independent of the rival's chosen level of innovation and level of substitution between the two goods. The innovation level x_2 , however, changes and amounts to:

$$x_2 = \frac{a(\gamma-1)+x_1\gamma}{1+2k(\gamma^2-1)} \Rightarrow x_2 = \frac{2ak\gamma-a(2k-1)}{\beta} \text{ with } \beta = (2k-1)(1+2k(\gamma^2-1)) \text{ , s. t. } x_2 \geq 0 . \quad (8)$$

Consequently, the innovation level x_2 is strictly positive as long as the level of competition between the two goods is either low or high. Here, it decreases in x_1 as well as in γ , and lower unit R&D costs k decrease the level of competition at which x_2 is positive. If $x_2 < 0$, we assume that firm d chooses its second-best option with $x_2 = 0$.¹⁷

In the first stage, the license fee in form of a fixed fee is determined. Thereby, we consider two options: First, we assume that producer m imposes take-it-or-leave-it offers, thus having full bargaining power. It extracts its maximum revenue from the fixed fees by fully exploiting platform d , thus the latter is indifferent between accepting the offer and not accepting the offer.¹⁸ Consequently, the profits of platform d equals to profit function (4). The fixed fees amount to¹⁹:

$$F = -\frac{a^2k^2(\gamma-1)^2}{\beta}, \quad (9),$$

hence F and x_2 are positive if the level of competition is sufficiently low. Consequently, if producer m has full bargaining power, its profits result in

$$\pi^m = \frac{a^2k(1+4k(\gamma-1))}{2\beta}, \quad (10)$$

which is also strictly positive as long as competition is not too intense. Comparing these results with the one resulting if the parties refuse entering into an agreement, producer m maximizes its profit by using the following strategy²⁰:

¹⁷ Hence, in we consider the possibility of $x_2 = 0$ in the respective range for the chosen market outcome. As x_1 is independent to x_2 , it is not affected by the change.

¹⁸ If platform d is indifferent between accepting and refusing the offer, we assume that it accepts the offer.

¹⁹ To reduce complexity, we assume that there is no variable cost of production, thus we normalize both firms' cost of production to zero ($c = 0$).

²⁰ In this step, we assume that geo-blocking is always imposed. In the further sections, we investigate whether this is an incentive compatible strategy, allowing the firm to lift geo-blocking without being forced by regulation.

$$\pi^m = \begin{cases} \pi_{Geo}^m = \frac{a^2(4\gamma-3)}{4\gamma^2-2} \text{ if } \gamma \leq 0.5 \\ \pi_{Geo}^m = \frac{a^2(4\gamma-5)}{4\gamma^2-4} \text{ if } 0.5 < \gamma \leq 0.71, \text{ with } x_2 = 0 \\ \pi_{No Deal}^m = \frac{a^2}{2} \text{ if } \gamma > 0.71. \end{cases} \quad (11)$$

For simplicity and visibility, we set the unit R&D costs $k = 1$. A lower level of R&D costs simply reduces the respective thresholds. These initial results indicate that the enforcement of geo-blocking depends on the level of competition. A high level of competition reduces the incentives for cross-border trade, but also decreases the incentive for the platform d to invest in own innovation as it benefits from selling the other good.

Secondly, we consider the option of equal bargaining power resulting in equal revenue-sharing contracts.²¹ Hence, the profits generated from the resale of good 1 are split between producer m and platform d .²²

$$F = \frac{p_{f,1} * q_{f,1}(p_{f,1}, p_{f,2})}{2} = \frac{a^2 k^2 (\gamma - 1)}{2\beta}, \quad (12)$$

which is strictly positive if competition is not too intense. Plugging this result into function 6 and 7, and comparing these profits with the one resulting if the parties refuse to enter into an agreement, the firms apply the following strategies:

$$\pi^m = \begin{cases} \pi_{Geo}^m = \frac{a^2(2\gamma^2+\gamma-2)}{4\gamma^2-2} \text{ if } \gamma \leq 0.5 \\ \pi_{Geo}^m = \frac{a^2(2\gamma^2+\gamma-4)}{4\gamma^2-4} \text{ if } 0.5 < \gamma < 0.71, \text{ with } x_2 = 0 \\ \pi_{No Deal}^m = \frac{a^2}{2} \text{ if } \gamma \geq 0.71 \end{cases} \quad (13)$$

and

$$\pi^d = \begin{cases} \pi_{Geo}^d = \frac{a^2(3\gamma-2)}{4\gamma^2-2} \text{ if } \gamma \leq 0.5 \\ \pi_{No Deal}^d = \frac{a^2}{2} \text{ if } \gamma > 0.5. \end{cases} \quad (14)$$

When comparing the profits, it becomes evident that platform d benefits more from geo-blocking compared to producer m , if the additional earnings are split by half: $\pi_{Geo}^d > \pi_{Geo}^m$ if $\gamma \leq 0.5$. However, if the level of substitution increases above a threshold (here: $\gamma = 0.5$), the additional income from good 1 cannot compensate platform d for the losses resulting from higher competition in the foreign country. Altogether, it emphasizes that the results for the preferred strategies hold for various degrees of bargaining power.

²¹ The adoption of revenue-sharing contracts is, e.g., observable in the video rental industry, see, e.g., Mortimer (2008).

²² If platform d has full bargaining power, the scenario of geo-blocking would not take place, thus we neglect this option in our analysis.

In sum, geo-blocking and the resulting increase of competition in the foreign country f does not affect the price level of good 1 and 2. Hence, platform d acts as a multiproduct monopolist and can set the price for good 2 independent to the competitive good 1. Neither is the level of innovation of the good 1 affected by the cross-border trade. The scope of competition is solely captured in the innovation level of good 2 and the fixed fees. The magnitude of this effect positively depends on the level of substitution – a higher substitution level γ enhances the effect.

Proposition 1. Cross-border trade under geo-blocking only takes place if the substitution level between the two differentiated goods is not too high. It decreases in the level of unit R&D costs k . Producer m gains higher profits from cross-border trade than platform d if revenue-sharing contracts are adopted and the profits resulting from the resale of good 1 are split.

Proposition 2. The innovation level of good 1 is always positive. The level of the unit R&D costs k negatively affects the innovation level. Neither the level of substitution γ nor the level of x_2 have an effect on the innovation level of good 1.

Proposition 3. The innovation level of good 2 is positive if the substitution level is sufficiently low and the level of the unit R&D costs k is not too low. It decreases in the level of substitution γ and in the level of x_1 .

3.4. Restricting Geo-Blocking

If geo-blocking is removed, firm m may face competition in its home market if good 1 is sold by platform d . While the demand function in country f remains the same as with geo-blocking (function 6), the re-introduction of good 1 by firm d results in the following demand function in country h :

$$q_{h,i}(p_{h,i}, p_{h,j}) = \frac{p_{h,i} - a - x_1 + (a - p_{h,j} + x_1)\gamma}{\gamma^2 - 1} \text{ with } i, j = m, d; i \neq j.$$

Given the output, both firms simultaneously choose their optimal price level. The profit function of firm m equals profit function (6), the profit level by firm d yields:

$$\pi^d = p_{f,2}q_{f,2} + p_{f,1}q_{f,1} + p_{h,1}q_{h,1} - \frac{1}{2}kx_2^2 - F \quad (15)$$

Consequently, the price functions in the foreign country for good 1 and 2 remain the same as in the scenario with geo-blocking and as if no trade takes place, because platform d acts as a multiproduct monopolist. Contrarily, the re-introduction of good 1 decreases the price level in country h to:

$$p_{h,i} = \frac{\gamma^2(a+x_1)+\gamma(a+x_1)-2(a+x_1)}{\gamma^2-4} \text{ with } i = m, d. \quad (16)$$

The innovation level then yields:

$$x_1 = -2\delta \text{ whereas } \delta = \frac{a(\gamma-1)}{2(\gamma-1)+k(\gamma-2)^2(1+\gamma)}, \text{ which is strictly negative, and:}$$

$$x_2 = \frac{\delta(k(\gamma-2)^2(1+\gamma)-2)}{1+2k(\gamma^2-1)}. \quad (17)$$

Consequently, x_1 is strictly positive, however, x_2 is only non-negative if competition is not too intense.²³ A lower level of unit R&D costs k again simply reduces the respective threshold – under the condition that k is sufficiently high. In accordance with the findings under geo-blocking, x_1 is independent of x_2 , and the innovation level x_2 decreases in x_1 . Anticipating the optimal prices and level of innovation, we consider the two options of bargaining power when determining the fixed fees and the resulting profits. If producer m has full bargaining power, the fixed fee and consequently firm m 's profit is positive as long as the innovation level x_2 is non-negative. They decrease in the substitution level γ . Comparing these profits with the one resulting if the parties refuse entering into an agreement, the producers profit maximizing strategy is:

$$\pi^m = \begin{cases} \pi_{No\ Geo}^m = \frac{a^2(\gamma\theta-40)}{\varepsilon} \text{ if } \gamma \leq 0.55 \\ \pi_{No\ Deal}^m = \frac{a^2}{2} \text{ if } \gamma > 0.55, \end{cases} \quad (18)$$

with $\varepsilon = 4(2 + (\gamma - 2)(\gamma - 1)\gamma)^2(2\gamma^2 - 1)$, which is negative if γ is sufficiently low; $\theta = 48 + \gamma(120 - \gamma(176 + (\gamma - 3)\gamma(\gamma(45 + 4(\gamma - 4)\gamma) - 11)))$, which is strictly positive, and $\gamma\theta < 40$ if γ is sufficiently low.²⁴

Secondly, we consider the option of revenue-sharing contracts. The profits generated from re-selling good 1 are split between producer m and platform d with $F = \frac{p_{f,1} * q_{f,1}(p_{f,1}, p_{f,2})}{2}$, which decreases in γ and is positive if competition is not too high. If comparing the resulting profits with the one if the parties refuse to enter into an agreement, the firms' optimal strategies are:

$$\pi^m = \begin{cases} \pi_{No\ Geo}^m = \frac{a^2\vartheta}{2\varepsilon} \text{ if } \gamma \leq 0.51 \\ \pi_{No\ Deal}^m = \frac{a^2}{2} \text{ if } \gamma > 0.51, \end{cases} \quad (19)$$

²³ For the level of competition, at which x_2 is negative, we adapt the outcome of the game to the situation where $x_2 = 0$ while x_1 remains the same as it is independent to x_2 . In contrast to geo-blocking, this situation can be neglected as it always leads to an outcome with lower profits than the profits if no trade takes place.

²⁴ For simplicity and to subsequently compare the results to the one if geo-blocking is allowed, we assume $k=1$.

and

$$\pi^d = \begin{cases} \pi_{No\ Geo}^d = \frac{a^2\mu}{2\varepsilon} & \text{if } \gamma < 0.71 \\ \pi_{No\ Deal}^d = \frac{a^2}{2} & \text{if } \gamma \geq 0.71. \end{cases} \quad (20)$$

whereas $\varepsilon, \mu, \vartheta$ are strictly negative in the respective range, and $\pi_{No\ Geo}^m$ and $\pi_{No\ Geo}^d$ are negatively correlated with the level of competition and $\pi_{No\ Geo}^m < \pi_{No\ Geo}^d$. Hence, in contrast to the findings if geo-blocking is enforced, platform d benefits more from cross-border trade than producer m .

Proposition 4. Cross-border trade without geo-blocking only takes place if the substitution level between the two differentiated goods is sufficiently low. It decreases in the level of unit R&D costs k . Platform d gains higher profits with cross-border trade than producer m if revenue-sharing contracts are adopted and the profits resulting from the resale of good 1 are split.

Proposition 5. For good 1, the innovation level is always positive. It is independent of the innovation level x_2 , and decreases with the level of substitution γ .

Proposition 6. For good 2, the innovation level is positive if the unit R&D costs k are sufficiently low and the level of substitution is not too high. It decreases with the innovation level x_1 .

4. Comparative Static Analysis

4.1. Removing Geo-Blocking: Open Market or No Deal?

The above analysis indicates that both parties do not enter into a contract if the level of competition between the two goods is sufficiently high. Before comparing the innovation level of the scenarios with and without geo-blocking if the level of competition is sufficiently low, we first compare the profit functions of the two scenarios to see which option each party prefers.

If the producer m has full bargaining power, thus his profit function is pivotal for the chosen contract scheme, the comparison of profit functions (11) and (18) gives the following results:

$$\pi^m = \begin{cases} \pi_{No\ Geo}^m = \frac{a^2\theta}{\varepsilon} & \text{if } \gamma \leq 0.29 \\ \pi_{Geo}^m = \frac{a^2(4\gamma - 3)}{4\gamma^2 - 2} & \text{if } 0.29 < \gamma \leq 0.5 \\ \pi_{Geo}^m = \frac{a^2(4\gamma - 5)}{4\gamma^2 - 4} & \text{if } 0.5 < \gamma \leq 0.71, \text{ with } x_2 = 0 \\ \pi_{No\ Deal}^m = \frac{a^2}{2} & \text{if } \gamma > 0.71. \end{cases}$$

The same qualitative outcome (yet with different quantitative values as shown in the appendix) for firm m with respect to the chosen licensing structure results if the additional profits from

reselling good 1 are split in half.²⁵ Hence, if the level of competition is low, the combined profits are optimal if geo-blocking is not enforced. If producer m has sufficiently high bargaining power and the level of substitution is mediate, it is most profitable for the producer to include a specific geo-blocking clause in the contract. As producer m can fully exploit platform d , the results indicate that overall profits are lower without geo-blocking. As soon as the level of substitution is relatively high, the parties have no incentive to enter into a licensing agreement.

Obviously, geo-blocking is the optimal licensing strategy for this degree of competition. If geo-blocking is banned, the firms' strategies follow function (18), (19) and (20), respectively. Consequently, the removal of geo-blocking affects the market if the substitution level between the two goods is mediate. Up to a sufficiently high level of competition ($\gamma = 0.5$ if $k = 1$), regulation results in a licensing agreement without limiting platform d to geo-block. In this range ($0.29 < \gamma \leq 0.5$), removing geo-blocking increases the product variety country h , with product variety defined as an additional purchasing option, because good 1 is sold by producer m and platform d . If, however, competition is above this threshold, the removal of geo-blocking restricts cross-border trade entirely, leading to a situation where each firm only sells its own good in its respective country ($0.5 < \gamma \leq 0.71$). Hence, banning geo-blocking decreases the product variety in the foreign country.

Proposition 7. Concerning the product variety, the removal of geo-blocking has ambiguous effects. It can either positively affect the home country by increasing the product choice, if the level of competition is sufficiently low. In contrast, if the level of competition is sufficiently high, it negatively affects consumers in country f by decreasing the product choice as good 1 will no longer be sold. .

As our paper aims to determine the effect of regulatory changes on the innovation level, we focus in the following comparison only on the specific range of substitution level that can be affected by regulatory changes. Hence, we do not consider the situation where geo-blocking is not the first-best option, which results if competition is very low or very high.

4.2. Effects on Innovation

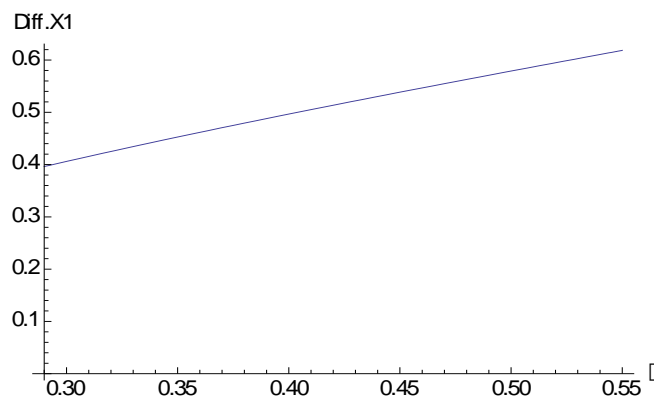
Besides the effects on product variety if geo-blocking is banned, the incentives to invest in innovation change as well. In the following, we first compare the effect on the innovation level of good 1. Then, the impact of regulatory changes on the innovation level of good 2 is determined. Subsequently, we measure the overall effect for the two consumer groups. We split the comparison into three subsections as the comparative static analysis of the different profits reveals. In the first range ($0.29 < \gamma \leq 0.5$), the removal of geo-blocking results in open

²⁵ In contrast, firm d always prefers no geo-blocking over geo-blocking if additional profits are split in half, see Appendix.

trade, thus the product variety in country h increases as good 1 is reintroduced. Given a slightly higher level of competition ($0.5 < \gamma \leq 0.55$), the innovation level of good 2 is set to zero if geo-blocking is allowed. In this subsection, we can anticipate that a restriction of geo-blocking strictly increases the innovation level good 2. In the third subsection ($0.55 < \gamma \leq 0.71$), the restriction of geo-blocking inhibits cross-border trade entirely. The results in this range are straightforward: The innovation level x_1 in the scenarios with geo-blocking and without trade are the same, thus market intervention does not affect the quality of good 1. In contrast, the innovation level x_2 equals zero if geo-blocking is enforced and increases to function (3) if there is no trade. Hence, the combined innovation level is unambiguously higher if cross-border trade is completely restricted. Simultaneously, the product variety decreases in country f .

When comparing the effects on the innovation level x_1 if $0.29 < \gamma \leq 0.55$, we can conclude that the innovation level is generally higher with geo-blocking than without.²⁶ This pattern is shown for illustration in figure 2.

Figure 2: Level of Innovation of Good 1: Geo-Blocking vs. Open Market



Source: Own graph.

Proposition 8: The innovation level x_1 is higher with geo-blocking than without geo-blocking. The difference between the two scenarios is strictly positive if $\frac{1}{2} \leq k \leq 1$. It positively correlates with the level of substitution and yields:

$$x_{Geo}^1 - x_{No Geo}^1 = \frac{a}{2k - 1} + 2\delta.$$

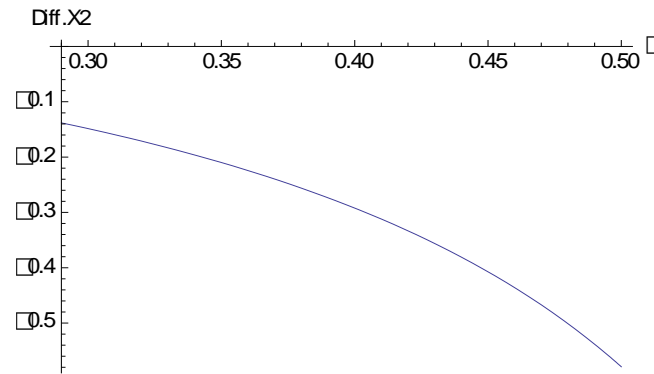
In other words, as long as the level of substitution between the two goods is sufficiently high, firm m invests relatively more if geo-blocking is enforced compared to the scenario without geo-blocking. As can be seen in figure 2, the difference between the innovation outcomes with and without geo-blocking is increasing in the value of product differentiation.

²⁶ For simplicity it is assumed that $a=1$, any $a>1$ does not change the outcome but reinforces the results.

When comparing the effects on the innovation level x_1 if $0.29 < \gamma \leq 0.5$, we can conclude that the innovation level is generally higher in a geo-blocking free environment. This is reinforced if the level of substitution increases slightly to $0.5 < \gamma \leq 0.55$, because in this range the innovation level under geo-blocking is reduced to zero.

Turning to the level of innovation of good 2, figure 3 illustrates that innovation level of good 2 behaves differently – with a higher level of innovation when there is no geo-blocking.

Figure 3: Level of Innovation of Good 2: Geo-Blocking vs. Open Market



Source: Own graph.

Proposition 9: The innovation level x_2 is higher without geo-blocking. The difference between the two scenarios is strictly negative if the unit R&D costs k are sufficiently high. The difference increases with the level of substitution and yields:

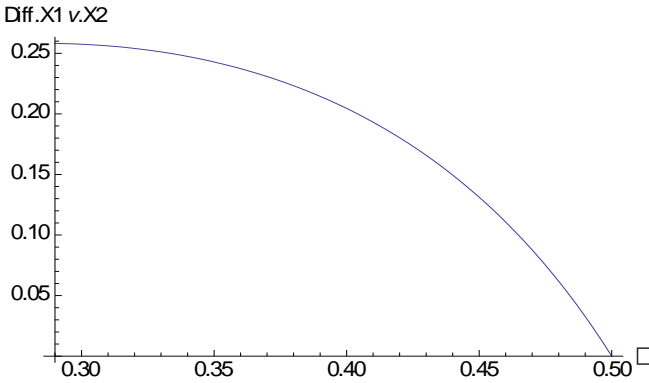
$$x_{Geo}^2 - x_{No Geo}^2 = \frac{ak\gamma^2(4 + \gamma(\gamma - 3))\delta}{a(\gamma - 1)\beta}.$$

In other words, as long as the level of substitution between the two goods is sufficiently high, firm d reduces its level of innovation if geo-blocking is enforced compared to the scenario of free trade.

Comparing the innovation level of the two goods in both scenarios, we can conclude that under geo-blocking and for sufficiently high unit R&D costs k , x_1 is strictly higher than x_2 . In turn, banning geo-blocking reduces the level of x_1 and increases x_2 .

Due to the divergent findings, it is of interest which effect is predominant. Figure 4 illustrates the difference between the changes of x_1 and x_2 . As the function is strictly positive, the change of x_1 is always larger than the change of x_2 .

Figure 4: Comparison of the Effects



Proposition 10: If geo-blocking is prohibited, the negative effect on x_1 dominates the positive effect on the innovation level x_2 , thus the innovation level overall decreases. Even if geo-blocking reduces x_2 to zero for a sufficiently high level of competition, this outcome remains – up to a threshold where both levels are identical. Consequently, the quality losses for the consumers because of the regulatory intervention cannot be compensated. This result holds as long as the unit R&D costs k are sufficiently high and/or the level of substitution sufficiently low.

4.3. Overall Effects

Our analysis reveals that restricting geo-blocking has ambiguous effects on a market with vertically differentiated goods. If the level of substitution between the two goods is either substantially high or low, the regulatory intervention does not influence the market outcome. If the level of substitution is sufficiently high, restricting geo-blocking, on the one hand, increases the product variety in one country (home); on the other, it decreases the level of innovation of this offered good considerably. Evidently, geo-blocking incentivizes the distributor (platform) to lower the innovation level of its own good by profiting from the situation being a multiproduct monopolist since the abolishment of geo-blocking leads to a shift in rents. Hence, although consumers in the foreign country simultaneously benefit from regulatory intervention in form of getting a more innovative good 2 (if the unit R&D costs are sufficiently high), these improvements of good 2 are strictly lower than the innovation decline of good 1. A higher level of substitution, however, alleviates this effect.

In sum, we have shown that regulatory measures and the resulting effects on competition affect the market participants differently. Two measured effects are particularly relevant. They should be considered when reviewing the impact of geo-blocking. First, the removal of geo-blocking can change the product variety, measured as purchasing options available, in a way that either

consumers in one country benefit from the intervention or consumers in the other country suffer a loss of product variety. Second, the prohibition can change the level of innovation of the respective goods, so that one always increases while the other decreases – depending on the given unit R&D costs. Overall, the negative effect dominates the positive effect. It is important that the results of the overall effect depend on the assumption of investment costs being the same for both parties. One may construct situations with different investment costs for both markets either confirming or changing the result of the aggregation of investment levels.

5. Conclusion

We have analyzed the effects of geo-blocking on investments in innovation with regard to vertically differentiated goods. First, our analysis highlights the importance of competition intensity on the impact of restricting geo-blocking. If competition intensity is either very low or very high, regulatory intervention neither changes the market outcome nor the incentives to invest. Otherwise, geo-blocking can increase product variety in one country or decrease product variety in the other, depending on whether or not firms enter into a licensing agreement. Our results show that the firm that wants to impose geo-blocking unambiguously invests less in quality if geo-blocking is banned. In contrast, the firm, which is restricted in its sales opportunities, either invests more or less into quality – depending on the unit R&D costs. In sum, the potential quality gains never compensate the quality losses, however, the difference decreases in the level of substitution. Hence, if competition is sufficiently low (and not too low), the product variety in the home country increases as licenses allow for parallel trade, while the quality – particularly in this country – decreases significantly. If competition is sufficiently high (and not too high), the foreign country incurs losses concerning the product variety as the parties do not conclude a contract, while the quality level in this country increases. The impact of removing geo-blocking on markets for digital visual broadcasting has consequently ambiguous effects on innovation of different goods, yet generally leading to a loss of innovation. In this context, banning geo-blocking may even further spur uneven access to digital content for consumers from different countries, thus having counterproductive effects. Considering the consumers' interest on high-quality content and the corresponding high investments by the content providers, it becomes evident that a regulatory focus on the impact on prices and quantity is too narrow. Instead, geo-blocking – in contrast to the arguments presented in the agenda of a “single digital market” – spurs investments in innovation, albeit it can, under specific circumstances, also partially harm investments. Incorporating the effects on pricing and product variety as well, the decision on the need of a market intervention becomes very complex, thus a detailed view of each market is required.

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Appendix

If the additional profits from reselling good 1 are split in half, the comparison of profit functions 13 (14) and 19 (20) gives the following results:

$$\pi^m = \begin{cases} \pi_{No\ Geo}^m = \frac{a^2 \vartheta}{2\varepsilon} \text{ if } \gamma < 0.21 \\ \pi_{Geo}^m = \frac{a^2(2\gamma^2 + \gamma - 2)}{4\gamma^2 - 2} \text{ if } 0.21 \leq \gamma \leq 0.5 \\ \pi_{Geo}^m = \frac{a^2(2\gamma^2 + \gamma - 4)}{4\gamma^2 - 4} \text{ if } 0.5 < \gamma < 0.71, \text{ with } x_2 = 0 \\ \pi_{No\ Deal}^m = \frac{a^2}{2} \text{ if } \gamma \geq 0.71, \end{cases}$$

and

$$\pi^d = \begin{cases} \pi_{No\ Geo}^m = \frac{a^2 \mu}{2\varepsilon} \text{ if } \gamma < 0.71 \\ \pi_{No\ Deal}^m = \frac{a^2}{2} \text{ if } \gamma \geq 0.71. \end{cases}$$

Hence, if the level of competition is low, neither firm has an incentive to enforce geo-blocking. However, if the level of substitution has is mediate, it is most profitable for producer m to impose a geo-blocking clause in the sales agreement to prevent competition in their home market. Clearly, for firm d it remains most profitable to resell good 1 in both countries. As soon as the level of substitution is relatively high, neither party has an incentive to enter into a sales agreement.