Critics, audience scores and the film industry: Expert services and user reviews in a market for experience goods*

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Abstract

We study the role of expert services in a market for experience goods, a framework analogous to the one observed in online review sites. We define experience goods as those whose quality becomes known to the consumers only after purchase. We focus on the film industry, a market horizontally and vertically differentiated, with a good having a known feature (a type or genre) and another that is unknown to the consumers (a quality). All consumers prefer a high quality good, with the utility derived from the type being match-dependent. An expert (the critic) offers to reveal information on the good's quality (the film) to the consumers in exchange for a fee. We find expert services to increase consumers' welfare, reducing their uncertainty and allowing for lower-type consumers to enter the market. Next we introduce user reviews in the form of a free-to-access rating of the good as found in review aggregators. The presence of user reviews alters the composition of the market, allowing for high-type consumers to buy low-quality goods and viceversa. The expert is sensitive to the competing source of information, serving a smaller demand and charging a lower fee. However, regardless of its source, additional information is welfare-improving for the consumers, most significantly when both user and expert reviews are present.

Keywords— film, expert reviews, user reviews, critics, information, experience goods

JEL classification: D8, L82, L1, D4, Z1

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1 Introduction

Expert services play an important role in markets where the consumers are uncertain about a good's quality (Eliashberg and Shugan, 1997; Basuroy et al., 2003; Chen and Xie, 2005; Friberg and Grönqvist, 2012). Faced with the decision to buy a good whose quality is difficult to observe, consumers are known to rely on the opinions of others. An expert can mediate between the firm and the consumers, offering to reveal information on the good's quality in exchange for a fee. Within the frame of this interaction the experts act as third-party agents who provide an assessment of a good without being directly involved in its sale. In effect, they initiate an information exchange with the consumers that is not controlled by the firm. This is the case of professional critics who write reviews which consumers can access through paid outlets like magazines, consumer guides, subscription-based websites or newspapers[1]. Take the example of a literary critic reviewing an upcoming novel, a financial analyst surveying a company's assets for clients interested in buying their stock, or a personal trainer recommending a new workout app. Certainly, film critics fit this scenario as well.

Experience goods entail an essential informational asymmetry between the firm and the consumers. In our analysis we understand experience goods as those with a quality unknown to the consumers prior to their purchase, but which is learned once consumption takes place (Nelson (1970)). The entertainment, arts, and culture industry is a prime example of an experience goods market, although many other consumer goods are also subject to critical review (automobiles, electronics, wine, food, commodities, luxury items, and the travel and hospitality sector). Reviews about movies, restaurants or electronic goods are commonplace in this type of market, since the experts are believed to provide both the consumers and the firm a valuable service. Indeed, the literature suggests that expert services play a positive role in experience goods markets, inducing more demand for the firm and leading to higher profits while decreasing the consumers' uncertainty (Sawhney and Eliashberg (1996), Reinstein and Snyder (2005), Dellarocas et al. (2007)).

Our first objective in this paper is to develop a theoretical framework to study the role expert services play in a market for experience goods. We use this design to examine the film industry. We model an environment where a firm sells a good of unobservable quality to a mass of consumers with idiosyncratic types. Unlike the quality, the good's type is public. That is, a studio releases a film for an audience with specific tastes to decide whether to watch it or not. Aside from a type-specific bonus, all consumers derive more utility from the good the higher its quality is. The consumers know how well the good's type matches their own, obtaining a higher utility the closer such match is. We use this design to examine the film industry. Thus, in our setup a comedy fan might enjoy a high-quality drama more than a lousy comedy, though in general he would favor the latter film's genre. The audience know their taste and the movie genre, but not the quality. We include an expert in the market, who observes the quality of the good and reports it to the consumers in exchange for a fee. In our film industry model, this would be a professional critic like Roger Ebert, Pauline Kael or Peter Bradshaw. These reviews can be accessed by consumers both on and offline.

We find expert services to increase consumers' welfare, allowing low-type consumers to participate in the market. That is, comedy lovers who have a very low tolerance for dramas consider watching a drama when a critic is available to ask him about the film's quality before deciding to go to the cinema. The expert serves some of those consumers, but also others who would have bought the good based on their priors had the expert not been available. That is, some drama-lovers still read the critic before deciding. However, in the equilibrium the firm is indifferent between serving a market where expert services are present and another where consumers purchase based entirely on their priors. The firm's decisions are impervious to the presence of an expert in the market. This might be due to the relatively small segment of consumers who consult the expert before buying the good in our set-up.

[1]Instances where the fee is implicit, likely in the form of ads which later translate into the salary a professional critic is paid, are also part of the set-up we describe. Thus, this framework is able to encompass professional reviews found both online and in print.

As intuition would suggest, more information on the good is beneficial to the consumers. Technological advances in the last decades have allowed consumers to access different sources of information before they make the purchase decision. Chief among these are user reviews, which have become more prevalent and easy to access than ever before. The main difference between expert services and user reviews is that the latter are written by consumers who happen to have bought the good in a previous period. Thus, although they are free to access or have a very small cost, the quality of the information they provide is lower than that offered by a professional critic. Naturally, a film critique published in *Cahiers du Cinéma* or *Film Comment* is hardly comparable to one posted by a user on *IMDb.com* or *FilmAffinity*, the same comparison applies to *Yelp* and a *Michelin Guide* review. To be clear, both user and expert reviews are informational, with the latter having an inherently superior quality.[2] Nevertheless, user reviews offer a refinement on the priors the consumers have regarding the good's quality, thus having an effect on experience goods markets (Chevalier and Mayzlin (2006), Duan et al. (2008), Cheung and Thadani (2012)).

Due to their immediacy and ease of access, user reviews are becoming more important when informing the decisions of consumers in experience goods markets. From the perspective of the expert, this represents the existence of a competing source of information in the market. Consumers can actually decide to skip the critic and base their decisions on the information they obtain from user reviews. The second objective of our paper is to understand the effect of user reviews on expert services in an experience goods market. We first analyze the role of user reviews on their own, which we model through a mechanism that aggregates all the past-consumers' opinions in a binary rating system. That is, user reviews tell the consumers whether the good's quality is above the expected level or not, with the former case being awarded a *star review*. This type of reporting system is quite common in experience goods markets, and can be observed in Amazon's *star reviews*, Rotten Tomatoes' *Certified Fresh* category, Netflix's user-ratings, or any other "thumbs up/thumbs down" system. Indeed, aggregated scores and ratings are the prevalent form of user reviews a consumer can find online.

We find that whether a *star review* is observed or not alters the composition of the market, with higher-type consumers buying the good when its quality is revealed by the reviews to be low, and more low-type consumers entering the market when the users review the good positively. This might explain why low-rated films sometimes reach unexpected box-office performances. In the presence of user reviews, the consumers' surplus increases with respect both to the case when expert reviews are available and the no-information benchmark. The firm, on the other hand, remains indifferent between these three scenarios, obtaining identical profit levels in each equilibrium. Critics are sensitive to competing sources of information, serving a smaller demand, charging a lower fee, and obtaining less profit when user reviews become available. Although the firm remains indifferent to the increase in information availability, charging the same price as in the benchmark and all the other informational scenarios, the consumers' surplus further improves when both user reviews and expert services are simultaneously present in the market.

These results are in line with what anecdotal evidence indicates. Expert services are clearly sensitive to changes in the information flow in a market. Earlier this year the *New Musical Express*, the last surviving British periodical devoted to music reviews, closed its print edition after 66 years. Not long ago three Spanish magazines dedicated to publishing cultural goods reviews (*Go Mag*, *H magazine*, and the local version of *Cahiers du Cinema*) similarly closed their print edition due to their precarious financial situation. Over the last couple of years this has also been the fate of seasoned US outlets like *Crawdaddy!*, *Paste magazine*, *The Village Voice*, and even *Newsweek*, among many others who have either migrated to online platforms (*Spin* magazine, *The Onion*) or shut down business entirely (*The Dissolve*). This in contrast to the boom in notoriety and influence, if not revenue, online review aggregators like *Rotten*

[2]Here we understand informational quality as how close the reviewer's assessment is to capturing the actual quality of the good. Evidently, this does not involve tastes, types or how much a good matches the preferences of a reviewer and/or consumer. Hence, a movie deemed by the critics to have a low quality can still be appealing to the mass of consumers who have a strong taste-match with its genre. Here one thinks of horror or action movies, often poorly rated by critics but nonetheless successful among their niche audiences.

Tomatoes have recently experienced. Our findings seem to support the argument that traditional expert-opinion outlets are negatively affected by the expansion and pervasiveness of user reviews. Nevertheless, considerable welfare-positive effects are generated when both expert services and user reviews are available simultaneously. To the best of our knowledge, this is the first paper to theoretically assess the role expert services and user reviews play in experience goods markets, particularly in the film industry.

The rest of this paper is organized as follows: We first present a survey of the literature on expert services and user reviews in experience goods markets, then we introduce the model and study the market only when expert reviews are available. We later dedicate a section to an analysis of the behavior of the consumers, the firm, and the expert. Next, we introduce user reviews and look at the impact they have on the equilibrium behavior of the consumers, the firm, and particularly the expert. We finally discuss the interaction between user reviews and expert services, concluding with a review of the welfare effects arising from the presence of these sources of information in the market. All the proofs are included in a technical appendix, available upon request.

2 Literature Review

The study of expert services goes as far back as the analysis of markets with asymmetric information itself. This line of research was arguably pioneered by Pitchik and Schotter (1987), who considered the expert as an agent who did not produce the good being exchanged but was better informed about it than the consumers. However, the authors allow the expert to "sell" the good despite not being in control of its quality, to some extent merging the expert's role with the firm's. More relevant to our model, Wolinsky (1993) included "diagnose-only" agents in the market, who reported to the consumers whether they needed a given treatment or not. This role is similar to the one played by the uninvolved experts whose behavior we examine here (critics), though Wolinsky still permits some agents to offer both to diagnose and treat the consumers, not contemplating these two services as completely independent.

Many variations of the firm-expert-consumer setup have been explored in the literature. However, most studies focus on credence goods markets, where the expert identifies the service best suited to a consumer who remains uncertain about it even after the purchase (Wolinsky (1995), Emons (1997, 2001), Pesendorfer and Wolinsky (2003), Hyndman and Ozerturk (2011), Liu (2011), etc.), which is not the case of the film industry. Several of these works are interested in the opportunities for fraudulent behavior that a persistent informational asymmetry creates.[3] Given that consumers learn an experience good's quality once they try it, our model forgoes all concerns about advantageous behavior from the experts, since they have no incentives to deviate from truthful reporting. The experts in our framework neither benefit from over-diagnose, for they do not sell the good, nor do they face different costs from biased reporting.

Spurred by the increased access to consumption data, the inquiry of expert services in experience goods markets has mainly been pursued from an empirical perspective. A seminal paper for this line of research is Reinstein and Snyder (2005), who look into the influence of film critics on a movie's box-office performance. Focusing on Siskel & Ebert's reviews, the authors use a difference-in-differences design to study the ticket sales of movies in relation to the critics' opinion. They find that once the effects of quality and publicity have been controlled, positive reviews have a positive influence on a movie's box-office performance. The effect is particularly strong on a film's opening-weekend revenue and for limited releases (*i.e.*, not blockbusters). These results fall in line with preceding studies, which hinted at a limited but positive relation between critics' reviews and a film's box-office run (Eliashberg and Shugan (1997)).[4]

[3] A complete primer on expert services in credence goods markets can be found in Dulleck and Kerschbamer (2006).

[4] A complete survey on the economics of the film industry, including sections devoted to user and professional reviews, can be found in Chisholm et al. (2015)

Building on Reinstein and Snyder (2005)'s foundation, a large number of works examining the role of expert services in different experience goods markets have appeared in recent years. For instance, looking at the publishing sector (Clement et al., 2007; Caliendo et al., 2015), the wine market (Dubois and Nauges (2010), Hilger et al. (2011), Friberg and Grönqvist (2012), Ashenfelter and Jones (2013)), and the video game industry (Zhu and Zhang (2006)), not to mention the film industry ((Gemser et al., 2007; Hennig-Thurau et al., 2012; Souza et al., 2018)); always from empiric or experimental perspectives and finding positive reviews to increase the demand for the goods.

To the best of our knowledge, the present paper is the first theoretical study of an experience goods market where the expert and the firm act as completely independent agents. Let alone one that incorporates user reviews as an alternative source of information for the consumers. The literature establishes an essential distinction between the information coming from professional critics and users, both from a qualitative and quantitative perspective (de Jong and Burgers (2013), Cox and Kaimann (2015)). Moreover, the analysis of user reviews and the role they play in experience good's markets has also been approached from an empirical perspective.

Moretti (2011) was one of the first to quantify the influence of user-generated information on the consumption decisions of individuals who are unaware of a given good's quality. Studying the film industry like Reinstein and Snyder (2005), Moretti finds that the effect of users' opinion on a movie's revenue is stronger when the *ex ante* uncertainty on the good is more significant, with a positive review playing a demand-enhancing role and a negative one going in the opposite direction. Other authors have argued the strength and nature of this relationship, focusing on the volume of online user reviews instead of their content, in the film (Duan et al. (2008)), music (Dhar and Chang (2009), Dewan and Ramaprasad (2014)), and hospitality industries (Ye et al. (2009, 2011)). Despite the different approaches and nuances of these works, they all point at the existence of a relevant interaction between the demand for an experience good and the information user-generated reviews provide to the consumers.

Studies considering the simultaneous role of user reviews and professional critics' opinions are few and, by and large, empirical. In the current paper we theoretically investigate the role these two informational sources play, how they interact and affect the decisions of the agents in an experience goods market. We find a close precedent for our inquiry in Chakravarty et al. (2010), who look at consumers' evaluations of upcoming films through an experimental design. The authors suggest that different sources of information affect certain types of consumers differently, with less frequent consumers relying more on user-generated reviews and frequent consumers being more influenced by critics; in both cases with positive reviews leading to higher pre-purchase evaluations. The heterogeneous reaction to user reviews and expert opinions is not a concern in our framework. We can compare users and experts' reviews because, in our set-up, they become available at the same time and we focus on a single shot game.[5] Souza et al. (2018) develop the most recent study on the subject, looking at the effect of critics and users reviews on the box-office survival of movies, finding no effect on wide-releases but a significant one over limited-releases or niche films.

A few other papers support the hypothesis that the information coming from users and professional critics has a similar effect on the consumers' decisions. Amblee and Bui (2007) find that additional information has a significant impact on the consumption of software downloads, without any economic or statistical difference owing to its source. Similarly, Vermeulen and Seegers (2009) find a very small premium on expertise when comparing the effect of user and expert reviews in the hotel market, with both types of opinions increasing consumer awareness, irrespective of the valence of the review. This is important for our framework, since we build a model where user reviews can be positive or negative, with both scenarios deemed as equally informative.

[5]Naturally, this is a modelling decision that best reflects a film's situation after the opening day. Nevertheless, our model where only the critic is available covers the case of the first weekend of release and before, when the number of user reviews available is negligible or entirely absent.

In the next section we present the basic components and timeline of our benchmark model of the film industry.

3 The Model

We study a market where a single experience good with a quality $q \sim U(0,1)$ is exchanged. A monopolist sells the good at a price p, which he sets before learning the value of q. The quality of the good is not a strategic variable for the monopolist. The market we are looking at resembles the entertainment industry in general, and film in particular. The prices of a movie ticket or music album are set irrespective of the good's actual quality, which is arguably outside of the control of the cinema or the store selling the good – nobody sets out to make a "bad" film on purpose.

Still with the entertainment industry in mind, we assume the marginal cost of the good to be negligible for the monopolist.[6] This is not a far-fetched hypothesis for the market we are analyzing, considering that the cost of streaming a song, pressing an additional copy of an album or providing a single movie seat, is actually very small. A studio's costs are largely fixed in nature, when producing and distributing a film. Thus, in our model the firm sells the good at no cost.

There is a size-one mass of consumers in the market, the audience. All the consumers have a unique valuation for quality equal to 1 and are indexed by their type a, uniformly distributed over $[0,1]$. That is, they all derive the same utility from consuming a good of a given quality q, but obtain an idiosyncratic, type-specific bonus. For instance, if the good were a movie we could say that a "good" movie is equally enjoyable for everyone (it complies with minimum, universal standards, etc.). Yet, we all have particular preferences for different genres of film, which may lead us to derive higher utilities from a comedy rather than a drama if the former is the type of movie we most prefer. Thus, the consumers' utilities for given values of q and a have the following form:

$$U(q,a) = q + a - p,$$

where $a \in [0,1]$ represents how much a consumer's type aligns with that of the good. For notational compactness, from now on whenever we mention the type we denote the extent of this match.

Each consumer knows her own type and can observe the good's, thus being aware of the value of a when estimating their expected utility. The audience knows their taste and the genre of the film, However, owing to the experience nature of the good, the good's quality q is not known by the consumers before purchase. The quality distribution and the price charged by the firm are both publicly known.

There is an expert in the market who perfectly observes the quality of the good and does so at no cost, the critic. The expert can reveal the good's quality to the consumers before they take the participation decision for a fee $\lambda > 0$. It is costless for the expert to report the information to the consumers. In our entertainment industry example, expert services with the characteristics we study could be encountered in the movie reviews one finds in film magazines or newspapers. The fee λ represents the magazine's price or the equivalent per-reader advertising revenue obtained by the outlet. The expert sets his pricing strategy independently from the monopolist. That is, studios have no influence on the critic outlet's (magazine, website) pricing decisions.

The expert plays an uninvolved role in the market, *i.e.*, he has no stake in the profits of the firm selling the good. We can therefore assume he truthfully reports the good's characteristics to the consumers. We also assume that this information is not subject to arbitrage. That is, a consumer who learns q from the expert cannot relay the information to other consumers.[7] The demand for expert services is given by D^{XP}.

[6] Although we choose to use the terms monopolist, good, expert and consumers for their generality in models of experience goods and expert services, we take these to be equivalent to studio, film, critic and audience, respectively, in the set-up we analyze.

[7] In *Section 5* we introduce a specific mechanism to consider information transmission between consumers.

Without loss of generality we assume that p, the price set by the monopolist selling the good, will fall in the interval $\left(\frac{1}{2}, 1\right)$. It is possible to disregard pricing strategies outside such support because for smaller values of p all the consumers in the market would decide to buy the good based only on their priors, which renders the analysis of expert services uninteresting. This might explain why we rarely find expert reviews for low-grade consumer goods. In the case of higher values of p, the demand becomes too small for the firm to be interested in participating in the market, given that both the quality and the type cannot take values above one.

The timing of the game is the following:

1. The monopolist sets a price p for the good.
2. The expert sets a fee for the service of revealing the good's quality to the consumers.
3. The good's quality is drawn by nature: $q \sim U(0, 1)$.
4. The expert observes q.
5. Each consumer decides whether to consult the expert before buying the good. The value of q is revealed to those who consult the expert.
6. The purchase decision is made.

We solve the game by backwards induction, first looking at the decisions of the expert then later paying attention to those of the perfectly-informed monopolist.

4 Market Analysis when Expert Services are Available but not User Reviews

In this section we look at a market where the consumers can learn the good's quality through the expert. We compare the informational situation created by the presence of expert services with a benchmark where the consumers would take the purchase decision based solely on their priors. Our analysis considers the effect of expert services both on the side of the consumers and the monopolist.

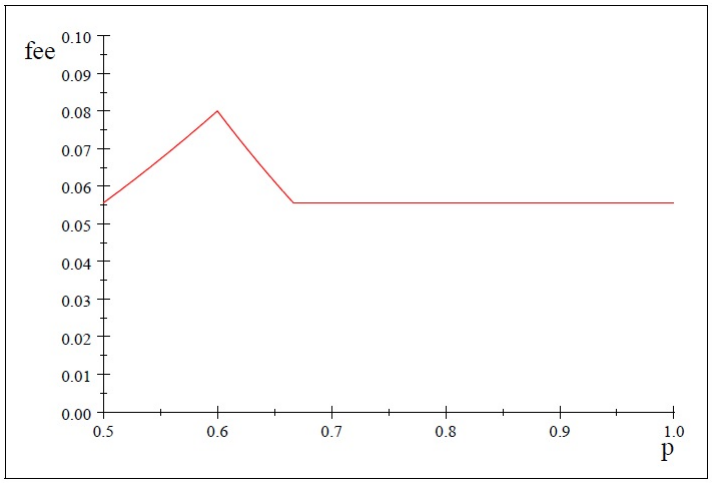
We can think of this market situation as the one that still takes place today with new movie releases. Film studios arrange screenings for a few professional critics to see an upcoming movie some time before its wide release. The critics write and publish their reviews in the days leading to the movie's opening, which means that consumers have not yet seen the movie, thus fending off the appearance of user reviews. For example, if *Avenger: Endgame* opens on April 26 in the US, the reviews published by media outlets before or on that date would stand to be examined under our current framework. Limited releases or festival premieres, such that the number of non-professionals who can see and review the film is insignificant, would similarly fit this situation.

4.1 Consumers' Behavior And Expert's Pricing Strategies

We first study the behavior of the consumers and the pricing decisions of the expert. Generally speaking, the expert's equilibrium fee and demand depend on the price of the good: the more expensive the good becomes, the more consumers would be interested in consulting the expert before purchasing. However, whereas the expert's demand always increases in p, the optimal fee is a convex function of the good's price. Actually, there are different equilibrium fees depending on the price the monopolist sets. To study each of these we define three pricing levels: *low* when $p \in \left(\frac{1}{2}, \frac{3}{5}\right]$, *intermediate* when $p \in \left(\frac{3}{5}, \frac{2}{3}\right]$, and *high* when $p \in \left(\frac{2}{3}, 1\right)$. Figure 1 presents the pricing decisions the expert adopts in the equilibrium when p moves across the three pricing regions.[8]

[8] The formal equilibrium allocations corresponding to this part of the model are presented in detail in the technical appendix, available upon request.

Figure 1: **Expert's optimal fee as a function of the good's price**



The graph above helps us understand how the strategies of the firm and the expert interact with each other, presenting the expert's fee as a function of the good's price across the three pricing regions we have defined. Notice that the highest levels the fee λ can attain occur when the good's price is *low* or *intermediate*. Moreover, when the good's price is *low* the consumers do not have strong incentives to consult the expert before buying. For most consumers in the market, their expectations on the good's quality are enough for them to decide to purchase, with no need for any additional information. It will mainly be consumers with low value types ($a \in \left[0, \frac{p}{3}\right]$) who will consult the expert when the good's price is *low*, checking whether their lackluster type-match bonus can be compensated with the good's quality. Those are the consumers who have incentives to learn the exact quality of the good before taking the purchase decision. That is, given that the film is not my preferred genre, I am interested in learning its quality before going to the cinema.

Accordingly, the expert's fee, demand, and profits positively depend on p within the *low* pricing range. The higher the good's price, the larger the segment of consumers who are potentially interested in demanding the expert's services. This is true even for some consumers with large type values, who become interested in the expert's service as the good turns more expensive and "riskier" to buy based only on their expectations. This effect carries on to the next pricing segment.

In the case where the monopolist charges an *intermediate* price for the good, the higher the good's price, the more the expert's demand expands. While some consumers exit the market as a consequence of the increase in p, others with higher type values enter the market as the good's price increases. Some of the consumers who leave the market might have consulted the expert for lower values of p, but this demand reduction is compensated by the expansion among those who can afford a more pricey good given their type and are interested in learning q before taking the purchase decision.

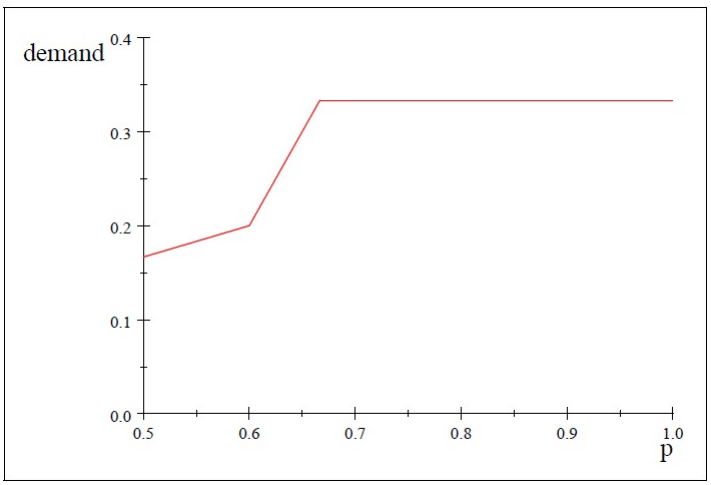
Seen as a function of p, the expert's fee is convex and negatively depends on the good's price. The expert's profits do not behave monotonically as p moves from the *low* into the *intermediate* pricing segment. This happens because a large increase in p has a double-sided effect in the market. First, it disincentives the good's purchase by taking consumers with low types out of the market. Therefore, some consumers who would have asked the expert for lower values of p, abandon the market. To compensate this decrease in his demand, the expert optimally charges a lower fee. Hence, it is possible to say that the increase in p indirectly pulls λ downwards in the equilibrium.

However, the equilibrium λ cannot be too high for *intermediate* values of p. If the expert's service is too expensive for the consumers to obtain sufficient expected utility from learning the quality of the good and later deciding to buy it, then the consumers will drop out of the market altogether. They neither ask the expert nor do they buy the good. Hence, in the equilibrium the expert charges a proportionally lower fee as p gets closer to the *high* pricing region. This is a behavior that extends to superior pricing regions.

When the good is sold for a price in the *high* region the demand for expert services stops being a function of p. Moreover, none of the equilibrium allocations depend on the good's price at all. When p is in the *high* pricing region only those consumers who have large type values ($a \in \left[p - \frac{2}{3}, p - \frac{1}{3}\right]$) consider consulting the expert before buying. The good's price causes all the potential demand for the expert coming from low-type consumers to disappear, as these decide to abandon the market without either buying the good or learning its quality. Thus, the expert services fee or profits he obtains do not depend on p in this case. In this setting, only those very interested in a movie because it matches their taste would read the critic.

In the following graph we present the demand for expert services as a function of p.

Figure 2: **Demand for expert services as a function of the good's price**



Looking at the demand faced by the expert as a function of p we see that its behavior mirrors that of the fee he charges in the equilibrium. When the good's price is *low*, as p moves toward the region's upper bound, more consumers start to consult the expert before buying the good. Thus, the demand has a positive slope. This demand expansion takes place despite the fact that the expert's fee λ also increases in the good's price when p is *low*.

This is not the case when the firm prices in superior regions. Although the demand for expert services positively depends on p for an *intermediate* pricing region, the fee decreases as the good turns more expensive, moving out of the *low* region. The expert follows this strategy in order to attract even more consumers. He tries to compensate the demand drop due to a high p by lowering his own fee. Although some consumers abandon the market because of the *intermediate* p, some others decide to enter. This effect holds for consumers with both low or high type values, who become interested in the expert's service when p is *intermediate*. Hence the rapid growth of the demand in the *intermediate* pricing segment, represented by *Figure 2*'s demand curve taking a much steeper slope.

The demand for expert services reaches a plateau when the good's price enters the *high* region. We can understand this by looking at *Figure 1*, particularly the segment of the curve representing the expert's fee for a *high* value of p. The expert sets a unique optimal fee $\lambda = 0.055$ for the whole region, which means that

a further increase in p will not affect the expert's fee, attenuating the impact changes in the good's price have on the expert's strategies when p is in the *high* region. Therefore, neither more nor less consumers will be willing to consult the expert despite the hypothetical increases in the already *high* value of p. Thus, the demand the expert serves when the good's price is *high* is, so to speak, fixed and equal to the biggest value it can take.

Similarly, the expert's profits grow as a function of p both when the good's price is in the *low* and *intermediate* regions, reaching a plateau in the *high* region due to the non price-dependent optimal fee adopted by the expert in the equilibrium. The expert derives the most profits when the good's price is in the *high* region. It is also when his demand reaches the widest segment of the consumers mass.

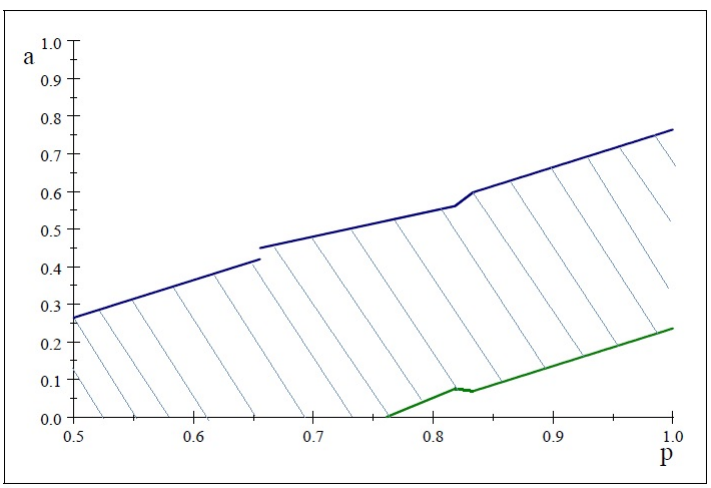
All these results point at a potential demand-attraction effect for the experience good, taking place when the expert is active in the market and regardless of the actual value of p. The monopolist would certainly consider this when choosing the good's price, as both his and the expert's strategies interact. The effects of expert services on the demand for the good are discussed in section 4.3.

4.2 Consumer Type and Expert Services

From our analysis in the preceding section it is quite evident that expert services allow consumers with lower types to consider buying the good. When the expert is not active only consumers with types $a \in \left[p - \frac{1}{2}, 1\right]$ would buy the good. On the other hand, when expert services become available, the whole mass of consumers who consider buying the good expands. A new sub-segment arises: those consumers who ask the expert and then decide to stay out of the market if the value of q is low. A segment of the audience not necessarily matched in type by the film may consider watching it, or at the very leas are interested in reading the critic.

In the following graph we present the demand for expert services as a function of the good's price and type when user reviews are not available.

Figure 3: **Demand for expert services as a function of the good's price and type without user reviews**



The demand for expert services increases in p, with higher types of consumers deciding to ask the expert as the good becomes more expensive. Interestingly, consumers with types as low as zero consult the expert when the price is *low*. Generally speaking, consumers with low type values consult the expert when p is in the *low* and *intermediate* pricing regions. When the monopolist sets an equilibrium price for the good in the *high* region, it is consumers with fairly high values of a who are interested in expert services.

In sum, cheap movie tickets would lead more readers to the critic. coming from those in the audience a priori not interested in the film genre. Also, those whose taste favors the genre start reading the critic as ticket prices increase.

4.3 Firm Behavior

In this section we analyze the behavior of the monopolist when expert services are available in the market. In particular, we look at the firm's demand, price, and profits in light of the preceding section's findings. We compare the decisions of the firm when expert services are available and when they are not, focusing on the interaction taking place between the firm and the expert's equilibrium strategies. We also examine the characteristics of the consumers who participate in the market in each scenario, to later discuss the welfare effects the expert services have over them.

The literature suggests that the information provided by third-party sources plays a demand-inducing role for experience goods (Cf. Reinstein and Snyder (2005), Chevalier and Mayzlin (2006), Liu (2006) Dellarocas et al. (2007)). The results we obtain in section 4.1 seem to confirm this, allowing consumers with lower type values to participate in the market under certain pricing conditions. To verify this hypothesis in our model we need a benchmark where the consumers have no other information but their priors when taking the purchase decision. The following lemma formally presents the equilibrium strategies of the firm when consumers have no additional information to decide whether to buy the experience good or not.

Lemma 1. *When expert services are not available in the market a monopolist sells an experience good at a price* $p = \frac{3}{4}$*, serving a demand* $D^G = \frac{3}{4}$*, and obtaining profits* $\Pi^G = \left(\frac{3}{4}\right)^2$*.*

We can see that the demand served by the monopolist in the equilibrium is quite large, comprising three quarters of the total mass of consumers. To be precise, all those consumers with a type bonus a above $\frac{1}{4}$ purchase the good when they base their participation decision solely on their priors.

The consumers' welfare for our analysis is measured through their expected *ex post* surplus. Therefore, when they decide to participate in the market based exclusively on their priors the consumers obtain a surplus of $\frac{9}{32}$.

Next, we study the decisions of the firm when an expert is present in the market. That is, when consumers can learn the quality of the good before buying it. In the equilibrium the firm anticipates that the expert's strategy follows the behavior discussed in section 4.1. We formally present the result in the following proposition.[9]

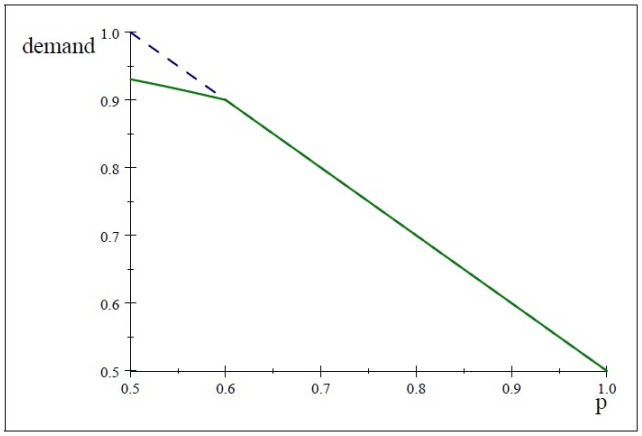
Proposition 1. *In a market where expert services are available a monopolist sells an experience good at a price* $p = \frac{3}{4}$*, serving a demand* $D^G = \frac{3}{4}$*, and obtaining profits* $\Pi^G = \left(\frac{3}{4}\right)^2$*.*

It is interesting to see that the demand-generating effect of expert services, as established in the literature and suggested by our analysis of the market in section 4.1, does not take place in our setup. Indeed, more consumers potentially consider buying the good when they have additional information in the form of expert reviews. Namely, the total mass of consumers who ask the expert is larger than the total of consumers who bought the good based only on their priors. Yet, not all consumers buy the good after asking the expert. Hence, equal-size masses of consumers buy the good in the equilibrium when experts are present in the market and when they are not available.

However, the previous result does not hold for all levels of the good's price p. For any $p \in \left(\frac{1}{2}, 1\right)$ the demand for the good when the expert is present is smaller than or equal to the demand when the service is not available. We present a comparison of the demand for the good as a function of p in the following graph, both when expert reviews are available and when they are not present in the market.

[9] The formal proof for all the propositions discussed in this paper are included in a technical appendix, available upon request.

Figure 4: **Demand for the good with and without expert services**



The demand for the good when the expert is active in the market is presented by the solid line. In a dashed line we present the demand for the good when the expert is not available. Surprisingly, the demand-attraction effect for the good is weak in the *low* pricing segment. This happens because for a *low* p the expert's fee λ is also small, hence more consumers ask the expert before buying the good. As a consequence, a larger mass of consumers stay out of the market after learning the good's quality from the expert. In simpler words, the expert actually dissuades some consumers from buying the good when the quality happens to be low. This effect confirms the intuition of film studios that often withhold or embargo reviews for films whose quality they presume will be deemed as inferior by the critics, thus trying to avoid such information to be revealed before the movie opens.[10] The firm faces an identical demand irrespective of the presence of the expert for *intermediate* and *high* pricing levels.

In the equilibrium the firm obtains the same level of profits in both scenarios: $\Pi^G = \frac{9}{16}$. However, the consumer welfare measured through their *ex post* surplus when expert services are available is 0.2920, which is higher than the surplus obtained without expert reviews. The critic helps the audience to avoid "duds", not paying a ticket for a low quality film. We will further discuss the market-wide welfare effects of expert services and user reviews in section 6.

5 Market Analysis when Expert Services and User Reviews are Available

In this section we introduce user reviews as an alternative source of information for the consumers. We are interested in understanding how the consumers, the expert, and the firm adapt their strategies to the presence of an additional source of information. Namely, the consumers can learn some information on the good's quality through free-to-access user reviews.

This type of competition undermines the most essential characteristic of the service an expert offers: he is no longer in exclusive possession of superior information. In our benchmark, analyzed in section 4, consumers can learn about the good's characteristics only through the expert. In the current section, user reviews provide the consumers with a costless refinement on their priors on the good's quality, which might change the participation decision of some consumers regarding their demand for expert services. Put

[10] Information on review embargoes in the film industry and the strategies studios use when placing and enforcing them can be found here: https://www.denofgeek.com/uk/movies/review-embargoes/53570/review-embargoes-what-are-they-and-do-they-help.

differently, the information obtained from user reviews might make some consumers discard the idea of consulting the expert. How the expert deals with this situation will determine the impact of user reviews both in terms of the profits the expert obtains as well as the demand for the good itself, not to mention consumer welfare.

Formally speaking, we assume that in a previous period past-consumers bought the same good the monopolist is currently selling. Although past consumers are no longer participating in the market, they are able to inform the consumers currently taking the purchase decision. Past-consumers provide those currently taking the participation decision with some information on the good's characteristics, through the reviews they write. Many sites and review aggregators offer this information, often next to expert reviews. See the cases of the IMDb, Rotten Tomatoes, Metacritic or Filmaffinity for some relevant examples.

We assume that the information provided by the user reviews is not as accurate as the information that can be bought from the expert. Although in most cases user reviews are cheaper than expert services, if not entirely cost-free, they do not have the same informational value due to the differences in skills, experience, training, and communication efficiency between the experts and past consumers. We model these differences by adopting a binary reporting mechanism for the user reviews. Namely, user reviews convey the quality of a good by telling the consumers whether the good's quality is above its expected value or not. That is, given that q is uniformly distributed between zero and one, whether the realization of the variable is above or below $\frac{1}{2}$. We say that the good gets a *star review* if $q \geq \frac{1}{2}$ and nothing otherwise.[11] In our model user reviews are available for free to all agents before the participation decision is taken.

The timing of the game is as follows:

1. The monopolist sets a price p for the good.
2. The expert sets a fee for the service of revealing the good's quality to the consumers.
3. The good's quality is drawn by nature: $q \sim U(0,1)$.
4. The expert observes q.
5. User reviews become available to all consumers at no cost. All consumers learn whether $q \geq \frac{1}{2}$ or not.
6. Consumers decide whether to consult the expert or not. The value of q is revealed to those who consult the expert.
7. The purchase decision is made.

We solve the game by backwards induction, focusing first on the decisions of the expert before then considering the strategies of the monopolist selling the good. The user reviews are not strategic.

5.1 Consumer Behavior and Expert Pricing Strategies when User Reviews are Available

In this section we study the behavior of experts when consumers do not know the good's quality but have updated their priors on q through user reviews. That is, at the moment of taking the participation decision each consumer knows whether the good got a *star review* from the users or not.

To carry out our analysis we define four pricing levels for the good: *low* when $p \in \left(\frac{1}{2}, 0.6555\right]$, *intermediate* when $p \in \left(0.6555, \frac{9}{11}\right]$, *high* when $p \in \left(\frac{9}{11}, \frac{5}{6}\right]$, and *very high* when $p \in \left(\frac{5}{6}, 1\right]$.[12] In the following propositions we formally present the equilibrium allocations for the expert, using the pricing levels just described.

[11] This is a binary rating system not uncommon in the industry, found under the form of *thumbs up/thumbs down* mechanisms, Amazon's *star-reviews*, Rotten Tomatoes' *fresh/rotten* categories, etc.

[12] Notice that these regions are loosely defined for presentation clarity only and do not necessarily match the regions similarly denoted for the case without user reviews.

Proposition 2. *When the monopolist sells the experience good for a* low price $p \in \left(\frac{1}{2}, 0.6555\right]$*, with user reviews available in the market, an expert reveals the good's quality to the consumer for a fee* $\lambda = \frac{1}{36}$*, serving a demand* $D^{XP} = \frac{1}{12}$*, and obtaining profits* $\Pi^{XP} = \frac{1}{432}$*.*

When the good's price is in the *low* pricing range the consumers do not have strong incentives to consult the expert before buying the good. This was already the case when user reviews were not available in the market. Actually, if the good's quality is revealed to be above the expected value (*i.e.*, $q \geq \frac{1}{2}$) and p is *low*, no consumer asks the expert before buying. That is, all consumers who buy the good from the monopolist do so based on the information gathered from the user reviews. Thus, for a *low* price, the expert faces some demand for his services only when the good's quality is revealed by user reviews to be smaller than one half. In such case consumers with a small type bonus ($a \in \left[p - \frac{1}{3}, p - \frac{1}{6}\right]$) will want to learn the exact quality before deciding to purchase. As a consequence, the demand the expert faces at this pricing level is not a function of p, and neither is the optimal fee he sets.

However, when the good's price moves outside the *low* region the expert has a chance to attract consumers both in case a *star review* is observed and when it is not. Fewer consumers buy the good based on the user reviews alone, as it is "riskier" to do so given the higher values of p.

Proposition 3. *When the monopolist sells the experience good for an* intermediate price $p \in \left(0.6555, \frac{9}{11}\right]$*, with user reviews available in the market, an expert reveals the good's quality to the consumer for a fee* $\lambda = \frac{4p^2}{81}$*, serving a demand* $D^{XP} = \frac{p}{6}$*, and obtaining profits* $\Pi^{XP} = \frac{2p^3}{243}$*.*

In the case where the monopolist charges an *intermediate* price, some consumers have incentives to learn the exact quality even when they find a *star review*. Hence, the fee that the expert charges is an increasing function of p. Moreover, the demand for expert services positively depends on the good's price as well, and is noticeably bigger than when p was in the *low* region.

The more expensive the good turns, the more attractive expert services become. This also applies to the profits the expert obtains, which move in line with the demand and fee. For these levels of p, the fee the expert charges positively depends on the good's price. Interestingly, in the equilibrium one can observe both a bigger demand and a higher fee for values of p approaching the upper bound of the *intermediate* pricing region. We already found this, somewhat unusual, phenomenon in the demand for expert services when the good's price was *low* and no user reviews were available. What drives this behavior in the current scenario is that some consumers who for lower prices would have found enough information in the user reviews to decide to buy the good, now obtain a higher expected utility from basing their decision on the expert's report. Therefore, despite raising the fee he charges, the expert can attract more consumers.

Proposition 4. *When the monopolist sells the experience good for a* high price $p \in \left(\frac{9}{11}, \frac{5}{6}\right]$*, with user reviews available in the market, an expert reveals the good's quality to the consumer for a fee* $\lambda = (1-p)^2$*, serving a demand* $D^{XP} = \frac{4p-3}{2}$*, and obtaining profits* $\Pi^{XP} = \frac{1}{2}\left(-3 + 10p - 11p^2 + 4p^3\right)$*.*

When the good's price is *high* the expert is able to attract a potential demand both when a *star-review* is found and when it is not. Although the demand for expert services behaves in a similar way in the *intermediate* and *high* pricing regions, there is a major difference: while the demand for expert services continues to depend positively on p, the expert's fee decreases as the good's price increases toward the region's upper boundary. Indeed, the expert's services are more attractive when the good is costly, but the good's relative expensiveness leaves the expert little leeway to charge a high fee. Hence, the optimal λ decreases in p when the good's price is *high*. The reverse is true for the demand, which grows in p as λ drops.

Proposition 5. *When the monopolist sells the experience good for a* very high price $p \in \left(\frac{5}{6}, 1\right]$*, with user reviews available in the market, an expert reveals the good's quality to the consumer for a fee* $\lambda = \frac{1}{36}$*, serving a demand* $D^{XP} = \frac{1}{6}$*, and obtaining profits* $\Pi^{XP} = \frac{1}{216}$*.*

In the case where the good's price is *very high*, the demand for expert services is no longer a function of p. Actually, none of the equilibrium allocations depend on the good's price in this region. Something similar happened when user reviews were not available, since we found that the expert charged the same λ in the equilibrium when p was both in the highest and lowest pricing regions. Moreover, the demand for expert services reaches its biggest value when p is in the highest region both when user reviews are available and when they are not. However, λ does not take its lowest value when p is in the high pricing region when user reviews are available. This was the case in our benchmark, but when user reviews arise as a competing source of information the expert's fee takes the lowest equilibrium value in the *intermediate* pricing segment.

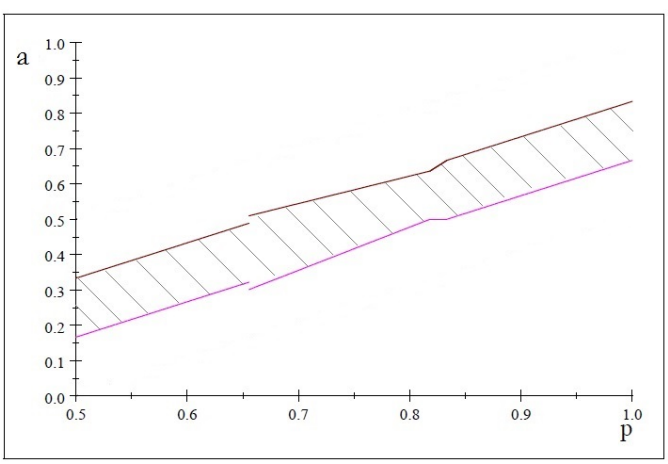
Across all pricing levels, the fee, demand, and profits the expert obtained in the benchmark were significantly bigger than those under the presence of user reviews. Therefore, the experts are sensitive to competing sources of information. This effect is consistent and strong over all the variables he controls. We analyze and compare the strategies the expert adopts, both when user reviews are available and in our benchmark, in section 5.3.

5.2 Consumer Type and Expert Services when User Reviews are Available

The incentives for consumers to consult the expert are quite different depending on the bent of the user reviews. Whether a *star review* causes a consumer to bypass expert services depends on two main variables: the good's price and the consumer's type. These two determine the expected utility a given consumer considers at the time of deciding to consult the expert, buy the good directly or leave the market. Thus, it is interesting for the expert to understand how consumers react to positive and negative reviews, as it will allow him to optimally set a fee that anticipates both scenarios.

From an informational perspective one could say that both when a *star review* is observed and when it is not, more information has become available with respect to our benchmark. By making the distinction between the two scenarios explicit we are able to identify the effect of the new information becoming available and its actual content. In other words, to avoid entangling the potential demand-attraction coming from a *star review* with the fact that even if the review is negative, the consumers have more information and can thus make a better-informed decision. In the following graph we present the demand for expert services as a function of the good's price and the type-match bonus a, when a *non-star review* is observed.

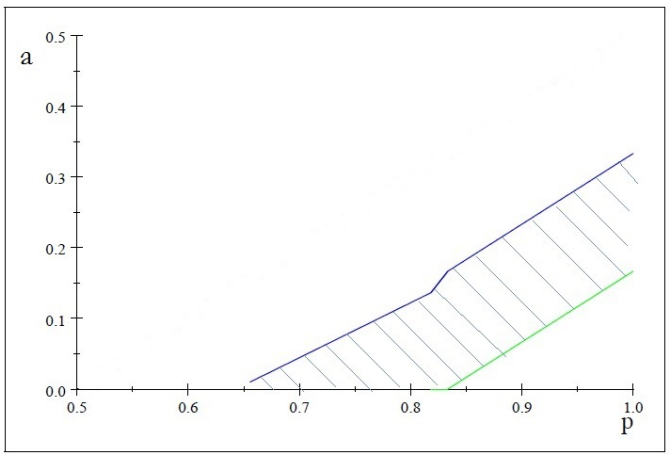
Figure 5: **Demand for expert services as a function of the good's price and type when** $q < \frac{1}{2}$



When a *non-star review* is found, the demand for expert services slightly increases with the good's price. The hashed area in Figure 5 represents the demand the expert faces as a function of p, with the consumers' type-match bonus a in the vertical axis. Though the mass of consumers who buy the good is quite consistent across the pricing regions, the biggest segment of consumers demanding the good is found when p falls just above the *low* pricing region's upper bound. On the other hand, the smallest segment is served when p falls in the boundary between the *intermediate* and *high* pricing regions. Notice that these are also the prices where the expert's equilibrium fee respectively takes its smallest and biggest values.

We can also see that the higher the price becomes, the higher the type of the consumers who consult the expert before buying. For instance, when p is *low* consumers with types $a \in [0.15, 0.35]$ ask the expert, whereas when the good's price is *very high*, only those with a type $a \in [0.6, 0.8]$ will ask the expert. Consumers with type bonuses smaller or larger than those respectively stay out of the market or get enough information to make the purchase decision from the user reviews. Nevertheless, the expert always faces some demand when a *non-star review* is found, irrespective of the good's price or type. This is not the case when a *star review* is observed, which we present in the following graph.

Figure 6: **Demand for expert services as a function of the good's price and type when $q \geq \frac{1}{2}$**



When a *star review* is found the expert faces some demand only if the good's price is at least in the *intermediate* pricing region, as indicated by the hashed area in Figure 6. Still, even in that case only consumers with low type values will be interested in the service. The biggest mass of consumers is served when the price of the good falls in the boundary between the *high* and *very high* regions. We can understand this as the case where a lot of good word of mouth is available for a movie not matching the type of the consumer, who thus decides to read the critic before spending in a pricey ticket.

Generally speaking, when a *star review* is found, consumers with small types are the ones most interested in asking the expert before buying. In fact, no consumer with a type a above 0.3 will ever consider asking the expert when $q \geq \frac{1}{2}$, no matter the size of p. Consumers with type bonuses as small as zero can ask the expert for prices in the *intermediate* and *high* regions. When the good's price is in the *very high* region, the type of the consumers who ask the expert increases in p. For such a p, consumers with type values close to zero will no longer consider asking the expert before buying.

It is worthwhile noting that, for all price levels, the types of the consumers who ask the expert when a *star review* is found are smaller than those of the consumers who consult him when the review is negative. For example, a consumer with a type 0.3 would ask the expert only if a *star review* is found and p is *very high*. For any other p, he would buy the good based on the positive user review alone. On the contrary, the same consumer would stay out of the market if a *non-star review* is observed, unless the good's price is *low*.

Such a hypothetical consumer would never buy the good based on the negative review alone, irrespective of the good's price. Either she would ask the expert first or refrain from buying. Similarly, a consumer with a type value 0.5 would never even consider asking the expert before buying if she observes a *star review*, but she would certainly be interested in the expert's service if the good's price is *high*. Her type match bonus is sufficiently high for her to decide to buy the good based on the user reviews, even if they are negative, when the good's price is *low*. She will abandon the market if p becomes *very high*, but has incentives to consult the expert before buying if the good's price is somewhere in between *high* and *very high*.

We have found that a similarly sized segment of consumers (with higher values of a) enter the market as the one comprising those (with very low types) who stop asking the expert before buying, when p rises through the pricing regions. Hence the relative consistency of the total mass of consumers who ask the expert; particularly, when a *non-star review* is found or when the good's price is *high*. Thus, a more expensive good attracts more high-type consumers to the expert services. In the next section we compare these results with the benchmark where the expert was the only informational channel available to the consumers.

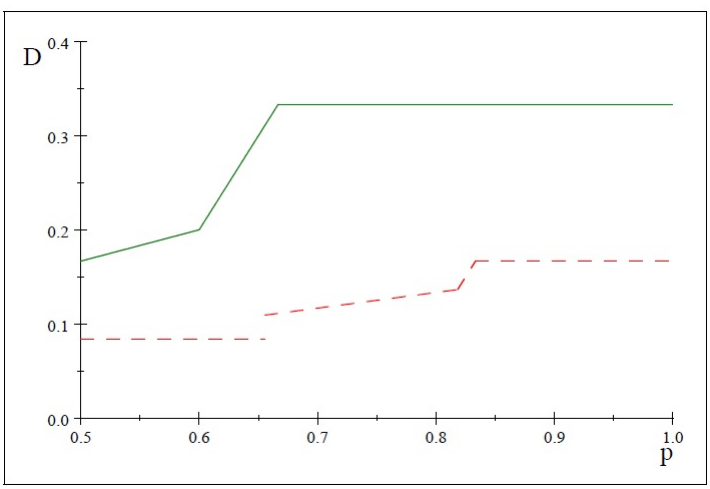
5.3 Effect of User Reviews on the Behavior of the Expert

In this section we use the results discussed in sections 4.1 and 5.1 to analyze the way user reviews affect the expert's strategies. We compare the expert's equilibrium pricing decisions, his profits, and demand, both in our benchmark and when user reviews become available.

User reviews offer the consumers a refinement on the information they have at the moment of taking the participation decision, and this fundamentally alters their incentives to consult the expert. A twofold effect will take place. First, directly influencing the demand for expert services due to the consumers who now have enough information to purchase based on the user reviews, and thus dismiss the expert. Second, and perhaps less directly, by changing the decisions of the firm. These two effects do not need to go in the same direction, as a loss in demand due to the informational competition might be simultaneous to a decrease in the good's price, carried out by the firm to attract consumers in case the users review was not positive.

To better understand these dynamics, in the following graph we present a comparison of the demand served by the expert as a function of p, for the benchmark and when user reviews are available.

Figure 7: **Demand for expert services as a function of the good's price with and without user reviews**



The demand the expert faces in the presence of user reviews (the dashed line) is a non-decreasing function of p. However, it is much smaller than when the expert is the only source of information available to the consumers (the solid line). A free-to-access competing source of information is bound to detract from the expert's potential demand.

There is a discontinuity in the demand function with user reviews at the *intermediate* pricing region. This happens due to the entry of consumers who observe a *star review*. For *low* prices the expert only faces some demand from consumers who observe a negative review. Nevertheless, this increase is smaller than in the benchmark, as we can see by comparing the slopes of the demand functions in this pricing region. That said, the behavior of the demands as functions of p is quite similar in the two cases: more consumers are attracted as p increases, with a maximum demand segment being reached the closer p gets to the *very high* region. Interestingly, the maximum demand in the benchmark is served at a significantly lower price, $p = \frac{2}{3}$, while in the presence of user reviews this occurs at a price $p = \frac{5}{6}$.

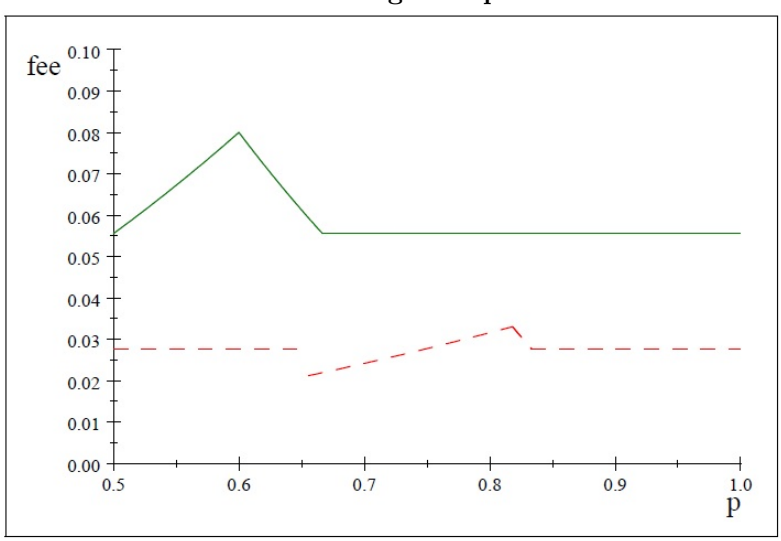
In terms of the types of consumers who consult the expert, we find that consumers with higher types are the ones interested in asking the expert when user reviews become available. If the user reviews are negative, only consumer with types $a \in [0.6, 0.8]$ will consider asking the expert.

This effect takes the opposite direction when a *star review* is found. If the price of the good is *intermediate*, consumers with types as low as zero ask the expert both in the benchmark and when user reviews are available. However, no consumer with a type bonus above 0.15 will ask the expert if the user review is positive and p is close to the *intermediate* region lower bound.

Therefore, some high-type consumers enter the expert services market when the user reviews are negative, while low-type consumers are the ones who may ask the expert if the user reviews are positive. The relative sizes of the masses of consumers who enter and leave the market under each scenario will determine whether the demand for expert services as a whole increases or decreases as a result of user reviews being freely available. As we can see in Figure 7, the overall effect of user reviews on the demand for expert services is negative.

Now we look at the fee the expert charges – the only variable under his control. Figure 8 presents a graph where the equilibrium fee λ is a function of p, comparing the decisions of the expert both when user reviews are available and in the benchmark.

Figure 8: **Expert's fee as a function of the good's price with and without user reviews**

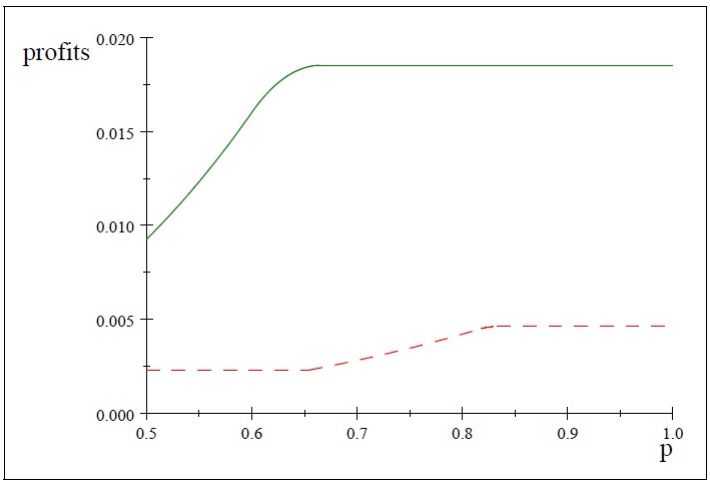


The expert can charge a much lower fee under the presence of user reviews, irrespective of the size of p. The highest fees the expert sets in the equilibrium occur when user reviews are not available and the good's price is *low*, as we can see in the solid line in Figure 8. When user reviews are present (the dashed line), the equilibrium λ attains its maximum value in the boundary of the *intermediate* and *high* regions.

Although still quite smaller than the fee charged when user reviews are not present, the equilibrium λ increases as a function of p through the *intermediate* pricing region in the presence of user reviews. This is explained by the demand the expert obtains in this region from the consumers who find a *non-star review*. Observing a negative review makes their expectations on q "worse," reinforcing the incentives they have to consult the expert and thus allowing him to price highly despite the already high level of p.

In terms of profits, given the benchmark's dominance in the fee and demand, we expect them to be smaller when user reviews are present. The following graph presents the equilibrium profits for the expert as a function of the good's price, both when user reviews are available and when they are not.

Figure 9: **Expert's profits as a function of the good's price with and without user reviews**



We can see that an expert who charges a lower fee and serves a smaller demand in the presence of user reviews, also obtains lower profits when a free-to-access source of information is available in the market. In Figure 9 we see that the expert's profit level increases in p both when user reviews are available and in our benchmark. Nevertheless, even at the highest level of profits the expert attains with user reviews ($\Pi = 0.035$ in the dashed line), these barely approach half the value of the lowest profits level the expert obtains when there are no competing sources of information ($\Pi = 0.0185$ in the solid line). Furthermore, the expert starts to obtain the maximum level of profits in the benchmark for values of p that are bigger or equal than $\frac{2}{3}$, while the maximum profit level is attained for prices above 0.833 when user reviews are present in the market. Hence, the availability of alternative sources of information constrain the expert's strategies, allowing him to obtain large profits only for *very high* values of p.

We have completed the analysis of the expert's behavior when the good's type is publicly known and user reviews are freely available in the market. Clearly, the potential demand for expert services decreases when new information appears in the market. The same effect is observed in his pricing strategy and profits, which are quite smaller than the benchmark when user reviews appear. Evidently, the expert is worse off in such a scenario, confirming what anecdotal evidence had suggested: many outlets devoted to publishing film, music, and other entertainment goods reviews have closed down in recent years, as user reviews became more abundant and easier to access. Our model supports such intuition, describing an

equilibrium where an expert serves a smaller demand segment and obtains significantly lower profits when competing with free-to-access user reviews. One could even argue that for a high enough cost of providing the service (in our setup it is assumed to be zero), the expert would ultimately decide to exit the market, as often observed.

5.4 Firm Behavior when Expert Services and User Reviews are Available

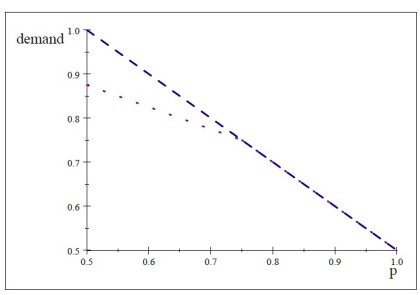
In this section we analyze the firm's decisions when consumers can access information from the expert and user reviews before purchasing the experience good. We compare the equilibrium pricing strategies of the monopolist in the benchmark and when the expert must compete with user reviews as a rival source of information, focusing as well on the demand served by the firm and the profits it obtains in each case.

From the analysis of the benchmark carried out in section 4.3 we know that, in the equilibrium the firm is indifferent between serving the market with or without expert services. That is, it obtains the same level of profits when the expert is present and when the service is unavailable. We first study whether user reviews alone have a similar effect on the decisions of the firm, without yet introducing the expert in the market. We find that the presence of user reviews does not change the equilibrium decisions of the firm, a result we formally present in the following proposition.

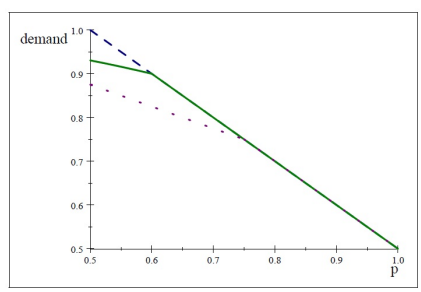
Proposition 6. *A monopolist producing an experience good in a market where user reviews are available, sells the good at a price* $p^G = \frac{3}{4}$*, serving a demand* $D^G = \frac{3}{4}$ *and obtaining profits* $\Pi^G = \left(\frac{3}{4}\right)^2$.

We can see that the monopolist obtains the same level of profits, serves an identical demand, and charges the same equilibrium fee both when user reviews are available as the only source of information for consumers, than when they decide to purchase based exclusively on their priors, or when expert services are present. Therefore, the appearance of just one source of information in the market does not affect the decisions of the firm in the equilibrium.

In order to understand whether this might be the case when more than one source of information appears, it is interesting to first consider the demand for the good as a function of p. In the following graphs we present the demand for the good as a function of p in the three scenarios currently under discussion: with user reviews, with expert services, and without additional information.



(a) **Demand for the good with user reviews**



(b) **Demand for the good with user reviews and expert services**

Figure 10: **The monopolist's demand a function of p when only one source of information is available**

On the left we see the demand for the good as a function of p when no additional information is available (the dashed line) and when only user reviews appear in the market (the dotted line). The demand is predictably price-sensitive, although it is surprising that fewer consumers buy the good when user reviews are available and p is *low* than when the consumers decide based only on their priors. This happens because

of all the consumers who drop out of the market when they find a negative review. Of course, this effect continues to take place at higher pricing levels, but it is compensated by the demand expansion due to a positive review. The consumers who enter the market because of a positive user review even-out those who exit due to a negative one or a high price. Actually, the demands are equal for any value of p in the *intermediate*, *high* or *very high* regions, as we can see in Figure 10a.

In the graph on the right we add the demand for the good as a function of the price when the expert is present but there are no user reviews (the solid line). We find that the mass of consumers who buy the good in any of the three scenarios decreases in p. However, the demand drop for *low* pricing levels that we also observe in the presence of user reviews, is smaller. That is, less consumers drop out of the market after learning q from the expert when p is *low*, than those who at the same pricing level abandon the market after observing a negative user review. Evidently, the demand drop is attenuated because the consumers do not underestimate the quality of the good as they did when observing a *non-star review*. They learn the actual value of q from the expert. This is also why the demand with user reviews equalizes the one where no information is available at a much lower value of p.

As the equilibrium demands in the three cases are equal and the demand functions themselves overlap from that price onward, a similar behavior is observed for the profit functions. Indeed, the profits functions when no information is available, the expert is present in the market, and user reviews appear are all convex in p, overlapping and decreasing from the equilibrium price forward. Thus, the firm is evidently indifferent between either scenario, meaning that it is not concerned about where the consumers can obtain extra information on the good's quality or if there is any information available for them to begin with. The firm's indifference lies on the fact that the mass of consumers who exit the market due to the positive information received on the good, neutralizes the mass that abandon the market because of some negative information.

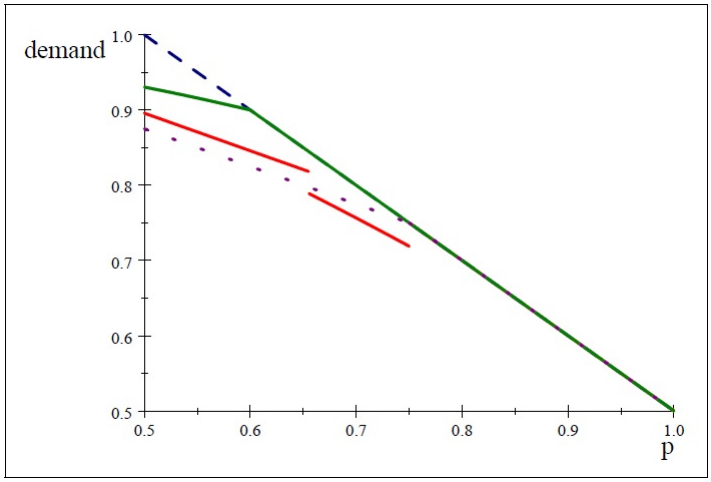
However, it is not clear that this will also be the case when more than one source of information is available in the market at the same time. The simultaneous presence of expert services and user reviews might lead to less underestimation (and overestimation) in the equilibrium. In the following proposition we present the decisions of the firm when user reviews and expert services are available at the same time.

Proposition 7. *A monopolist producing an experience good of quality q unknown to the consumers and a type a publicly known, in a market where user reviews and expert services are available simultaneously, sells the good at a price $p^G = \frac{3}{4}$, serving a demand $D^G = \frac{3}{4}$, and obtaining profits $\Pi^G = \left(\frac{3}{4}\right)^2$.*

We find that the firm is indifferent between a scenario where both the user reviews and expert services are available at the same time and when the consumers have no information to base their decisions other than their priors. The monopolist's equilibrium strategies are the same in the two cases. He obtains the same level of profits, serves an identical demand, and charges the same price. Moreover, the monopolist is also indifferent between these two informational situations and the one where only user reviews or expert services are present. That is, the firm's strategies are not affected by the additional information coming from having two instead of a single source of information for consumers to learn about the good.

Before wholly discarding the demand-attraction effect of information in our model, we look at the demand functions in all four of the cases we analyze. In the following graph we present the demand for the good as a function of p when no information is available, user reviews and expert services are simultaneously present, and when either of the two are available separately.

Figure 11: **Demand for the good as a function of p when one or more sources of information are available**



As was the case when only one of the sources of information was available, the demand for the good is a decreasing function of p when user reviews and expert services are simultaneously present. However, the demand for the good when the two sources appear at the same time is not continuous (the solid red line in Figure 10: we keep the same notation as in Figure 11 for the other demands depicted). This demand comprises three separate segments corresponding to the *low*, *intermediate*, and *high* pricing regions. The consumers behave differently when the good's price falls in each of these regions. Their incentives to ask the expert despite already having the information from user reviews depend on p, which causes the jumps we observe in the demand for the good.

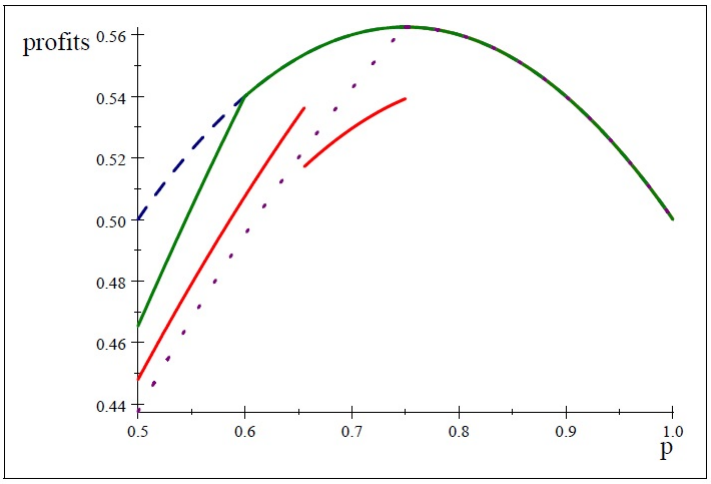
When a single source of information is available all the demands are equalized from the equilibrium price onwards. In the case where user reviews and the expert appear at the same time, this happens when p is in the *high* region. In the *low* pricing region the demand for the good when the two sources are available falls in-between the demands when only user reviews and the expert were active, above the former and below the latter. This indicates that there is some demand induction taking place at this pricing level. The effect comes from the consumers who decide to buy the good after asking the expert but who would have otherwise stood out of the market if they had to base their decisions solely on the user reviews. However, that demand is still quite smaller than the one the monopolist would face for a *low* price if there was no extra information in the market at all. Actually, it is even smaller than the demand the firm would serve if only the expert were present in the market. This hints at some underestimation from consumers who observe a negative user review and stay out of the market without asking the expert. But also, in the case with no extra information, there is some overestimation due to the low price and the crude expectations the consumers originally have. In both of these cases the over/underestimation is measured with respect to the demand the firm would serve when the real q is learned by some consumers through the expert.

For *intermediate* levels of p the demand when both sources of information are available falls below all other cases' demands. This happens because more consumers exit the market after learning the quality of the good from the expert. The *intermediate* price level also entails that more consumers will drop out of the market after learning q. Adding to this effect, from the mass of consumers who abandon the market simply because of the price, particularly upon observing a negative review, we can understand the significant drop in demand when the two sources of information are available simultaneously and p is *intermediate*.

We observe a very similar behavior in the monopolist's profits, with the firm obtaining the same level at

the equilibrium price $\frac{3}{4}$ across the four scenarios we analyze. In the following graph we present the profits the monopolist obtains as a function of p when all the combinations of informational sources discussed are available, either alone or simultaneously.

Figure 12: **Profits for the monopolist as a function of p when one or more sources of information are available**



For a price bigger or equal than $\frac{3}{4}$, the firm is indifferent between any of the informational situations. That is, it obtains identical profits $\Pi^G = \frac{9}{16}$ when no additional information is available (the dashed line), only the expert (the solid green line) or the user reviews (the dotted line) are present at once, or simultaneously (the solid red line). For *low* pricing levels we find that the firm is worse off when only user reviews are present, as it obtains the lowest profits of the four cases. The scenario without extra information continues to dominate all others, but at a *low* pricing level the firm would prefer only the expert to be available as that yields him the second highest profits, bigger than when both user reviews and the expert –or only user reviews– are present. Hence, we can say that the firm would, in general, prefer to keep user reviews out of the market when the good's price is *low*.

The situation is somewhat similar for *intermediate* values of p. The worst scenario for the firm is the one where both sources of information are simultaneously active. This outcome derives from the fact that the demand served by the monopolist is also the smallest at this pricing level. Interestingly, for *intermediate* values of p the firm is indifferent between the scenario where no information is available and the one where only the expert is present. Similarly, the firm would prefer the user reviews to be available on their own, over both the expert and user reviews being simultaneously present. This shows that for *low* prices the firm benefits from the consumers' overestimation of the good's quality, as scenarios with increasing levels of information diminish his demand. On the other hand, the monopolist suffers from underestimation when the good's price is *intermediate*, with more consumers dropping out when their information is refined by the user reviews but not entirely accurately.

Although the firm is indifferent between all the informational scenarios in the equilibrium, this does not mean that user reviews or expert services do not play a role in the market. While it is true that their information-refining effects "cancel out" in the equilibrium demand, the internal dynamics of the market are quite different in each informational situation. The types of consumers who enter the market and consider the purchase, be it due to the information provided by user reviews or the expert, are not the same in the four scenarios. We examine this in the following section, looking at the market-wide effects of expert services and user reviews through a measure of consumer welfare.

6 Welfare Effects of Expert Services and User Reviews

In this section we study the welfare implications of the presence of different sources of information in a market for experience goods. From our analysis in sections 4 and 5 we know that in the equilibrium the firm is indifferent between all of these scenarios. However, in section 5.4 we already perceive the potential gains in consumer welfare coming from the increased availability of information. Over and underestimations of the good's quality become diminished as more accurate information regarding q is acquired by a wide range of consumers.

In the following table we present the monopolist's profits, the consumer surplus, and the expert's profits in the equilibrium, across the four informational cases we have been studying.

Table 1: **Social Welfare when User Reviews and Expert Services are Available in a Market for Experience Goods**

Informational Situation	Consumer Surplus	Firm Profits	Expert Profits	Total Welfare
No Information	0.2812	0.5625	0	0.8437
Expert Only ($\lambda = 0.0555$)	0.2920	0.5625	0.0185	0.8730
User Reviews Only	0.3125	0.5625	0	0.8750
Both Simultaneously ($\lambda = 0.0278$)	0.3308	0.5625	0.0035	0.8969

We already know that the firm is indifferent between the four informational scenarios. This is made evident by the monopolist's profits being identical in the four scenarios. On the other hand, as described in section 5.3, the expert is worse off when competing with user reviews as a source of information. The expert charges a fee barely half the value of what he would if user reviews were not available, obtaining a sixth of the profit level.

The consumers' welfare, measured through their *ex post* surplus, increases as more information becomes available. Thus, it is the highest when the expert and user reviews are simultaneously active. This is also true for the total social welfare, taken as the sum of our three agents' profits and/or surplus. However, notice that the consumers' welfare is smaller when expert services are the only source of information than when user reviews alone are present. This is due to the fee the expert charges for his service.

The quality of the information obtained by the consumers is important, despite both the total welfare and the consumers' surplus being higher when only user reviews are available than when only the expert is. We can clearly see this in the case where both are simultaneously available, causing over and underestimation to drastically reduce among the consumers. The effect of the finer information offered by the expert is partially mitigated by the transfer taking place between the consumers and the expert in the form of λ. Hence consumers, on the grounds of their surplus, would seem to prefer only the user reviews to be available over only the expert being active. However, the consumers' welfare significantly improves when both sources of information are available simultaneously. Hence, more (if not better) information leads to socially-desirable states.

Therefore, we can conclude that the consumers are better off with some information, no matter its cost or source, rather than none. This confirms what the theory has long suggested: better-informed consumers make better decisions in markets where information is not symmetric.

We believe that the lack of an effect over the firm's equilibrium decisions is a consequence of some modeling choices, namely the linearity of the utility functions. Some consumers improve their welfare by deciding not to buy the good after consulting the expert and paying his fee, while they would have bought the good (to an *ex post* loss) if the decision had been based only on their priors or information obtained from user reviews. Some others decide to buy the good after learning q through the expert, though they

would not have participated in the market in any other informational scenario. These masses of consumers have equivalent sizes given the characteristics of our model, which causes their effects to seemingly cancel out. That said, the society at large is better off the more information becomes available, as we can infer from the evolution of the total welfare in Table 1.

7 Notes on the "critic-proofness" of films

The film industry calls a film "critic proof" when it is able to obtain a high box office revenue despite bad or lackluster critic reviews. Two recent cases are *Venom* and *Bohemian Rhapsody*, panned by critics but otherwise among the most commercially successful films of their year. While there are plenty of examples of movies where bad reviews seem to have an effect on a film's box office performance, something the literature widely suggests, it would seem that not all movies are affected equally.

This phenomenon has become more salient in recent years, with the prominence of review aggregators like Rotten Tomatoes, where the audience can see both the global critic and audience scores. The so-called "critic proof" movies tend to have a low aggregate critic score and a rather higher audience rating. While it is hard to hold the argument that professional critics are not the best equipped to assess the quality of a film, it appears that users are including some sort of type or genre bonus in their assessment of the film, instead of just the "objective" quality.

We believe our model provides some insights on this effect. First, by characterizing niche and genre films (often the ones less appreciated by critics but with large and devout fan bases). In our model, some consumers actually buy a good of low or unknown quality based on the utility they expect to get from the type-match alone. Critics and user reviews play no role in their decisions.

Indeed, the segment of consumers who consult the critic before going to the cinema is generally small. On the contrary, a positive review by the users allows a significant portion of consumers with low-types to enter the market. Given the technology and expertise limitations of users when reviewing a film, in our model their signal only reveals whether the quality of the film is above or below the mean. Therefore, a movie with a quality marginally above the average, which perhaps would get middling to bad critic ratings, attracts a segment of consumers whom would otherwise stay out of the market. This may hint at the effect observed in "critic proof" films. Going back to the case of *Venom*, while 83% of users liked it, the aggregate score they gave the movie is 4.2/10. On the other hand, only 29% of critics liked the movie, with an aggregate rating of a 4.4./10.[13]

Our model has limitations that stop us from drawing further conclusions, but we are convinced that by developing a theoretical framework where films are goods with type and quality differentiation, and users can convey some information to future audiences as well as the critics, we open a path for further exploration on the interaction between the many agents involved in the film industry.

8 Conclusions

In this paper we study the role of expert services and user reviews in experience goods markets, in an attempt to model the informational aspects of the film industry. We first develop a theoretical model to understand how the information provided to the consumers by the critics affects the market outcomes. Later we introduce free-to-access user reviews in the market, from which consumers can learn some information on the good. We find that both expert services and user reviews increase consumers' welfare with respect

[13]These scores were obtained from Rotten Tomatoes. The Tomatometer indicates the proportion of positive reviews a film receives, not the average rating. The discussion on whether audiences have that nuance when processing the information is still open. Regardless, in the case of our model the critic review would indeed be the average score, whereas the user reviews would fall closer to the Tomatometer regarding the information they reveal.

to a benchmark where they decide to purchase based on their priors. In particular, user reviews grant the consumers a superior surplus to expert services. Despite user reviews offering less accurate information on the good's quality, they are available for free and diminish the negative effects of under/overestimation in the consumers. On the contrary, although expert services reveal the good's exact quality, they are costly for the consumers. This downplays the welfare-enhancing effect the service has. Moreover, the total welfare in the market is also smaller than when only user reviews are present. Thus, even though user reviews might still lead to under/overestimation in the good's purchase, the effect they have over the consumers' surplus is large enough to compensate this.

On the other hand, the firm selling the experience good (the studio) is not affected by the presence of expert services. In the equilibrium the monopolist charges the same price and serves the same demand as in the benchmark. Direct demand-inducing effects do not appear to take place. Nevertheless, the composition of the market does change. Consumers with low valuations enter the market, while some at the upper end of the valuations distribution stop purchasing after learning the good's quality. That is, consumers who would otherwise not have entered the market, participate in the informational exchange with the expert, in some cases buying the good afterwards. Others, who would have bought the good based on their priors, learn its real quality and no longer purchase. The intermediate market thus generated is much bigger than the demand for the good, although in the equilibrium the consumers who enter the experience good's market after consulting the expert cancel out the mass of those who stop buying once they learn the good's quality.

Later, in what we believe to be the first theoretical effort to pursue this question, we analyze the effect of user reviews on the behavior of the expert when both are simultaneously active. Expert services are sensitive to competing sources of information. In the equilibrium the expert charges a fee nearly half the value of what he could charge when operating alone. The expert also serves a smaller demand and obtains lower profits. The firm stays indifferent to the appearance of two sources of information. The experience good's price, the demand served, and profits obtained are identical in the benchmark, when either the expert or user reviews appear, and even when both are available simultaneously. Nevertheless, a significant increase in the total consumers' surplus is observed when the two sources of information appear. Over/underestimation is thoroughly reduced when consumers can further refine the information obtained from user reviews by asking the expert if they so desire. Therefore, there are clear welfare-improving effects from the increase in information due to user reviews and expert services becoming available in the market.

From the latter result we see that although the firm is not interested in keeping user reviews and expert services active in a market for experience goods, a planner would be. Particularly considering the experts, whose situation deteriorates when user reviews appear. Some external agent could sustain expert services in the market through subsidies or direct transfers. This scheme is not entirely unlike what one can observe in everyday life, where native advertising and sponsored content have become prevalent in many critical outlets. While these could be considered as direct transfers from the firm, they still operate as a way to replace consumer purchase/subscription as a regular source of revenue for the critic. The magazine is no longer sold as an object but some revenue is generated for it by the readers.

We chose the entertainment industry, and movies in particular, because films offer the clearest, most representative, and quotidian example of an experience good. Other characteristics that make the film industry interesting to showcase are: the timing of expert and user reviews, with the former becoming available prior to a film's release, the use of non-quality related prices, and the possibility of considering a horizontal and vertical differentiation in the goods. However, expert services and user reviews of the type we study here are also found outside across the entertainment industry, which makes our findings potentially relevant to other sectors.

It is interesting to consider the research paths opened by our results, mainly allowing us to refine our understanding of the expert's behavior in a market of this ilk. First, we could look at repeated interactions, where the consumer can choose between buying some good that she is completely unfamiliar with and another she has tried before. This gives the expert room to offer bundles of reviews, considerably

expanding his pricing and reviewing strategies. Second, we could let the firm strategically decide the good's quality, which is given by nature in this work. Thus, we would move closer to markets with more persistent informational asymmetries; *i.e.*, credence goods. Making the good's type unknown to the consumers is another intriguing route to pursue. So is exploring alternative ways to model the expert's revenue. For example, including advertising aside from the direct sale of information. Finally, allowing the firm to signal the good's quality to the consumers directly, thus augmenting the information sources available to the consumers at the time of making the participation decision. All these, along the results we discuss, will help us set the foundations toward a finer understanding of experience goods and the role information plays in them, either through expert services, user reviews or both.

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A Technical Appendix

Proof of Propositions 1, 2, and 3. We begin by finding the segment of consumers who would buy the good based only on their priors; that is, those whose expected utility is such that:

$$EU^{BB}(a,p) = \frac{1}{2} + a - p \geq 0 \iff a \geq a_0 \equiv p - \frac{1}{2}.$$

We know that the participation cut-off a_0 always falls in the region where the types are supported: $a_0 \in (0,1)\, \forall p \in \left(\frac{1}{2}, 1\right)$.

Thus, consumers with types $a \in (p, 1]$ would be willing to demand the expert's services given the good's price and their type. After consulting the expert, the consumer acquires the good if its quality is high enough. That is:

$$U^{ex-post}(q,a,p) = q + a - p \geq 0 \iff q \geq q^X \equiv p - a.$$

The minimum quality will fall in the supported values for the variable if:

$$\begin{aligned} q^X \geq 0 &\iff a \leq p, \quad \text{and} \\ q^X \leq 1 &\iff a \geq p - 1. \end{aligned}$$

Therefore, the consumers who consult the expert will obtain a positive ex-post utility from consulting the expert and buying the good (*i.e.*, the information will be *useful* to them) if the quality reported is $q \in \left[q^X, 1\right]$ and the consumer's type is $a \in [0,p]$ $\forall p \in \left(\frac{1}{2}, 1\right)$. No consumer with a type superior to p will ever consider consulting the expert before purchase, no matter how small λ is.

Hence, the expected utility from consulting the expert is given by:

$$EU^{XP}(a,p) = \begin{cases} \int_{p-a}^{1} (q + a - p)dq - \lambda & \text{if } a \in [0,p] \\ 0 & \text{otherwise.} \end{cases}$$

An expression we can rewrite as follows:

$$EU^{XP}(a,p) = \begin{cases} \frac{(1+a-p)^2}{2} - \lambda & : \text{ if } a \in [0,p] \\ 0 & \text{otherwise.} \end{cases}$$

We now consider the participation decision of the consumers who may be willing to consult the expert. For that to be the case, the expected utility obtained must be positive and superior to what the consumers would get from buying the good based on their priors. That is:

$$\begin{aligned} EU^{XP}(a,p) \geq 0 &\iff a \geq a_1 \equiv p - 1 + \sqrt{2\lambda}, \\ EU^{XP}(a,p) \geq EU^{BB}(a,p) &\iff a \leq a_2 \equiv p - \sqrt{2\lambda}. \end{aligned}$$

We can easily see that $a_1 > 0 \iff \lambda > \frac{(1-p)^2}{2}$, $a_1 < p \iff \lambda < \frac{1}{2}$ and $a_2 > 0 \iff \lambda < \frac{p^2}{2}$. Therefore, the relevant values for the type are:

$$\begin{aligned} EU^{XP}(a,p) \geq 0 \;\; \text{for all} \;\; a \in [0,1] \text{ if } \lambda \in \left[0, \frac{(1-p)^2}{2}\right] \;\; \text{or} \\ \text{for all} \;\; a \in [a_1, 1] \text{ if } \lambda \in \left(\frac{(1-p)^2}{2}, \frac{1}{2}\right), \\ EU^{XP}(a,p) \geq EU^{BB}(a,p) \;\; \text{for all} \;\; a \in [0, a_2] \;\; \text{if } \lambda \in \left[0, \frac{p^2}{2}\right]. \end{aligned}$$

Also, notice that $a_2 > a_1 \iff \lambda \in \left(0, \frac{1}{8}\right)$.

With this information we can build the demand system for the expert, conditional on the fee he charges and the price of the good.

First, consider the case where $\lambda \in \left(0, \frac{(1-p)^2}{2}\right]$. A graphic representation of the demand faced by the expert, considering the arrangement of the relevant cut-off levels, is given by the dashed segment:

Figure 13: Expert services market when $\lambda \in \left(0, \frac{(1-p)^2}{2}\right]$ and $p \in \left(\frac{1}{2}, 1\right)$

Where $a_1 < 0$ implies that for the given λ and p, $EU^{XP}(p, \lambda) > 0 \; \forall a \in [0, 1]$. Moreover, $EU^{XP}(p, \lambda) \geq EU^{BB}(p, \lambda) \; \forall a \in [0, a_2]$. Hence, the demand for expert services in this case is given by:

$$D^{XP}(\lambda, p) = a_2.$$

Next, consider the case where $\lambda \in \left(\frac{(1-p)^2}{2}, \frac{1}{8}\right]$. Again, the demand faced by the expert is given by the dashed segment:

Figure 14: Expert services market when $\lambda \in \left(\frac{(1-p)^2}{2}, \frac{1}{8}\right]$ and $p \in \left(\frac{1}{2}, 1\right)$

Here $a_1 > 0$, which implies that for the given λ and p, $EU^{XP}(p, \lambda) > 0 \; \forall a \in [a_1, 1]$. Moreover, $EU^{XP}(p, \lambda) \geq EU^{BB}(p, \lambda) \; \forall a \in [0, a_2]$. Hence, the demand for expert services in this case is given by:

$$D^{XP}(\lambda, p) = a_2 - a_1.$$

Last, consider the case where $\lambda \in \left(\frac{1}{8}, \frac{p^2}{2}\right]$. Here $a_1 > a_2$, which implies that there is no demand for the expert for the given λ and p. Hence:

$$D^{XP}(\lambda, p) = 0.$$

Therefore, the demand for expert services can be written as follows:

$$D^{XP}(\lambda, p) = \begin{cases} p - \sqrt{2\lambda} & : \text{ if } \lambda \in \left[0, \frac{(1-p)^2}{2}\right] \\ 1 - 2\sqrt{2\lambda} & : \text{ if } \lambda \in \left[\frac{(1-p)^2}{2}, \frac{1}{8}\right] \\ 0 & \text{otherwise.} \end{cases}$$

There are two cases to consider, corresponding to each segment of the demand function, when solving the expert's maximization problem. We denote these *Case I* and *II*, such that:

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP-I} = \lambda(p - \sqrt{2\lambda}) \\ \text{s.t.} \quad & \lambda \geq 0 \\ & \lambda \leq \frac{(1-p)^2}{2}, \end{aligned}$$

is the maximization problem for *Case I*, and

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP-II} = \lambda(1-2\sqrt{2\lambda}) \\ \text{s.t.} \quad & \lambda \geq \frac{(1-p)^2}{2} \\ & \lambda \leq \frac{1}{8}, \end{aligned}$$

is the maximization problem for *Case II*.

From the respective Kuhn-Tucker conditions we find that each maximization problem has two valid solutions, depending on the size of p. For *Case I*:

$$\lambda_1^I = \frac{2}{9}p^2 \text{ if } p \in \left(\frac{1}{2}, \frac{3}{5}\right] \text{ and } \lambda_2^I = \frac{(1-p)^2}{2} \text{ if } p \in \left(\frac{3}{5}, 1\right).$$

And for *Case II*:

$$\lambda_1^{II} = \frac{(1-p)^2}{2} \text{ if } p \in \left(\frac{1}{2}, \frac{2}{3}\right] \text{ and } \lambda_2^{II} = \frac{1}{18} \text{ if } p \in \left(\frac{2}{3}, 1\right).$$

However, one can easily find the expert's optimal fee for each pricing region. When $p \in \left(\frac{1}{2}, \frac{3}{5}\right]$ both λ_1^I and λ_1^{II} are feasible candidates, but λ_1^I dominates the other since they are respectively an internal and corner solution for the maximization problem under the established values of p. The same happens when $p \in \left(\frac{2}{3}, 1\right)$, where both λ_2^I and λ_2^{II} are valid but the latter dominates the former, being an interior solution. There is only one valid candidate when $p \in \left(\frac{3}{5}, \frac{2}{3}\right]$: $\lambda_2^I = \lambda_1^{II} = \frac{(1-p)^2}{2}$.

The demand the expert serves and the profits he obtains given a pricing level, are:

$$\begin{aligned} &\text{If } p \in \left(\frac{1}{2}, \frac{3}{5}\right] \text{ then } D^{XP} = \frac{p}{3},\ \Pi^{XP} = \frac{2}{27}p^3. \\ &\text{If } p \in \left(\frac{3}{5}, \frac{2}{3}\right] \text{ then } D^{XP} = 2p-1,\ \Pi^{XP} = \frac{(1-p)^2}{2}(2p-1). \\ &\text{If } p \in \left(\frac{2}{3}, 1\right) \text{ then } D^{XP} = \frac{1}{3},\ \Pi^{XP} = \frac{1}{54}. \end{aligned}$$

□

Proof of Lemma 1. The segment of consumers who would be willing to buy the good based only on their expectations is:

$$EU^{BB}(a,p) = \frac{1}{2} + a - p \geq 0 \iff a \geq a_0 \equiv p - \frac{1}{2}.$$

Clearly, for the values of p that the firm can set, the participation cut-off computed falls in the region where the types are supported: $a_0 \in (0,1)\ \forall p \in \left(\frac{1}{2}, 1\right)$.

Therefore, the demand is given by:

$$D^G = 1 - a_0 = \frac{3}{2} - p.$$

The firm's maximization problem is the following:

$$\max_{p} \quad \Pi^G = p\left(\frac{3}{2} - p\right).$$

From which we find that the optimal price is:

$$p = \frac{3}{4}.$$

The demand the firm serves is $D^G = \frac{3}{4}$, obtaining profits $\Pi^G = \left(\frac{3}{4}\right)^2$. □

Proof of Proposition 4. From the proof of *propositions 1, 2, and 3* we know that consumers with a type $a \in [a_0, 1]$ obtain a positive utility from buying the good based only on their priors.

We also know the expected utility for those consumers who buy the good after consulting the expert:

$$EU^{XP}(a,p) = \begin{cases} \frac{(1+a-p)^2}{2} - \lambda & : \text{ if } a \in [0,p] \\ 0 & \quad \text{otherwise.} \end{cases}$$

Moreover:

$$EU^{XP}(a,p) \geq 0 \iff a \geq a_1 \equiv p - 1 + \sqrt{2\lambda},$$
$$EU^{XP}(a,p) \geq EU^{BB}(a,p) \iff a \leq a_2 \equiv p - \sqrt{2\lambda}.$$

There are three cases to consider:

1. When the price is in the *low* region, $p \in \left(\frac{1}{2}, \frac{3}{5}\right]$.
   We know that the demand for the good will comprise those consumers who would have bought the good based only on their priors and those who, once they learn q from the expert, obtain a positive *ex post* utility. That is, those consumers who ask the expert and learn that the quality is at least $q^X \equiv p - a$. The expert sets an optimal fee $\lambda = \frac{2p^2}{9}$ in this region. Therefore, the demand for the good is given by:

   $$D^G = (1 - a_2) + \int_0^{a_2} (1 - (p - a))da = 1 - \frac{5p^2}{18}.$$

   From solving the maximization problem we get $p = \sqrt{\frac{6}{5}}$ as a candidate solution. However, it falls outside of the supported pricing region, being bigger than 1. Hence, the maximization problem's solution is not interior, taking the maximum value for the price: $p^G = \frac{3}{5}$, with profits $\Pi^G = \frac{27}{50}$.

2. When the price is in the *intermediate* region, $p \in \left(\frac{3}{5}, \frac{2}{3}\right]$.
   Here the demand continues to be given by:

   $$D^G = (1 - a_2) + \int_0^{a_2} (1 - (p - a))da,$$

   although the fee charged by the expert is: $\lambda = \frac{(1-p)^2}{2}$. Therefore, the demand for the good in this case is given by:

   $$D^G = \frac{3}{2} - p.$$

   From solving the maximization problem we get the candidate solution $p = \frac{3}{4}$. However, it falls outside of the supporting pricing region. Thus, the optimal price set by the firm is: $p^G = \frac{2}{3}$, obtaining profits for $\Pi^G = \frac{5}{9}$.

3. Finally, when the price is in the *high* region, $p \in \left(\frac{2}{3}, 1\right]$.

   As in the previous two cases, the demand for the good is given by:

$$D^G = (1 - a_2) + \int_0^{a_2} (1 - (p - a))da,$$

   with the expert charging a fee $\lambda = \frac{1}{18}$. Therefore, the demand for the good in this pricing region is:

$$D^G = \frac{3}{2} - p.$$

   In this case the candidate solution obtained from solving the maximization problem $p = \frac{3}{4}$ is supported by the pricing region. Hence, the optimal price set by the firm is $p^G = \frac{3}{4}$, with profits $\Pi^G = \frac{9}{16}$.

By comparing the different profits levels we can see that the expert gets the highest profits when setting a price in the *high* region. Thus, his optimal fee is $p^G = \frac{3}{4}$.

□

Proof of propositions 5, 6, 7, and 8. This proof follows the general structure of *Proposition 1, 2 and 3*'s proof, although we adjust the consumers' decisions to include the new information available from user reviews (from now on UR). Therefore, we must consider two cases: *Case A* when the UR tell the consumers that the good's quality is above $\frac{1}{2}$, and *Case B* when the UR reveal the quality of the good to be below $\frac{1}{2}$.

We begin by studying *Case A*, where $q \geq \frac{1}{2}$. Upon seeing a *star review* from the UR, the consumers update their priors on the good's quality, such that: $q \sim U\left(\frac{1}{2}, 1\right)$. Thus, the consumers' expected value for the quality is $\int_{\frac{1}{2}}^{1} 2q\, dq = \frac{3}{4}$. Hence, the expected utility for the consumers who purchase without consulting the expert is:

$$EU^{BB}(p, a) = \frac{3}{4} + a - p.$$

Furthermore, consumers with a type such that:

$$EU^{BB}(p, a) \geq 0 \iff a \geq a_{BB} \equiv p - \frac{3}{4},$$

will consider buying the good based solely on their UR-updated priors. Notice that $a_{BB} \geq 0 \iff p \geq \frac{3}{4}$. Thus, we need to consider two participation scenarios: the first when $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$ so that any consumer in the market obtains positive expected utility from buying the good based on the UR, and the second when $p \in \left(\frac{3}{4}, 1\right)$ and only consumers with $a \in (a_{BB}, 1]$ would buy the good based on the information coming from the UR.

A consumer who reads the UR and potentially considers consulting the expert before buying, cannot have a type parameter such that his utility from purchasing based on his UR-updated priors is positive even when the quality of the good takes the lowest value ($q = \frac{1}{2}$). That is:

$$EU^{min}(a, p) = \frac{1}{2} + a - p \geq 0 \iff a \geq a_0 \equiv p - \frac{1}{2}.$$

Thus, the segment of consumers who may consult the expert have a type in the following region: $a \in [0, a_0]$. Notice that $a_{BB} < a_0$ for any value of p. Then, there may be a potential demand for the expert between consumers who observe the star review and still want to consult with him before buying the good. These are the consumers with types in the $a \in (a_{BB}, a_0]$ segment.

Out of those consumers some will be interested in asking the expert, given the good's price and their own type, if the quality revealed is high enough for them to obtain an *ex post* positive utility. That is:

$$U^{ex-post}(q, a, p) = q + a - p \geq 0 \iff q \geq q^X \equiv p - a.$$

The minimum quality will fall in the supported interval if:

$$q^X \geq \frac{1}{2} \iff a \leq a_0 \equiv p - \frac{1}{2}, \text{ and}$$
$$q^X \leq 1 \iff a \geq a_1 \equiv p - 1.$$

Notice that $a_1 < 0$ for $p \in \left(\frac{1}{2}, 1\right)$. Therefore, the expected utility consumers with types $a \in [0, a_0]$ obtain from consulting the expert is given by:

$$EU^{XP}(a,p) = \begin{cases} 2\int_{p-a}^{1}(q+a-p)dq - \lambda = (1+a-p)^2 - \lambda & : \text{ if } a \in [0, a_0] \\ 0 & \text{otherwise.} \end{cases}$$

We now consider the participation decisions of the consumers who may be willing to consult the expert. The expected utility they obtain must be positive and superior to what the consumers would get from buying the good based on their priors. That is:

$$EU^{XP}(a,p) \geq 0 \iff a \leq a_2 \equiv p - 1 - \sqrt{\lambda} \text{ or } a \geq a_3 \equiv p - 1 + \sqrt{\lambda}$$
$$\text{and}$$
$$EU^{XP}(a,p) \geq EU^{BB}(a,p) \iff a \leq a_4 \equiv p - \frac{1}{2} - \sqrt{\lambda} \text{ or } a \geq a_5 \equiv p - \frac{1}{2} + \sqrt{\lambda}.$$

However, not all of the cut-offs computed fall in the supported region for the types. We can easily see that $a_2 < 0$ and $a_5 > a_0$ for $p \in \left(\frac{1}{2}, 1\right)$ and $\lambda > 0$. We thus discard these.

Furthermore:

$$a_3 > 0 \iff \lambda > (1-p)^2 \text{ and}$$
$$a_3 < a_0 \iff \lambda < \frac{1}{4} \text{ and}$$
$$a_3 < a_{BB} \iff \lambda < \frac{1}{16}.$$

Similarly:

$$a_4 > 0 \iff \lambda < \frac{(1-2p)^2}{4} \text{ and}$$
$$a_4 < a_0 \text{ for } \lambda > 0 \text{ and } p \in \left(\frac{1}{2}, 1\right), \text{ and}$$
$$a_4 < a_{BB} \iff \lambda > \frac{1}{16}.$$

Also, notice that:

$$a_4 > a_3 \iff \lambda \in \left(0, \frac{1}{16}\right).$$

Hence, we know that the expert faces no demand whenever he charges a fee higher than $\frac{1}{16}$.

We first study *Case I*, where $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$. We know that for this pricing level $(1-p)^2 > \frac{1}{16} > \frac{(1-2p)^2}{4} > 0$. With this information we can build the demand system for the expert, conditional on the fee he charges and the good's price.

First, consider the case where $\lambda \in \left(0, \frac{(1-2p)^2}{4}\right]$. A graphic representation of the demand faced by the expert, considering the arrangement of the relevant cut-off levels, is given by the dashed segment:

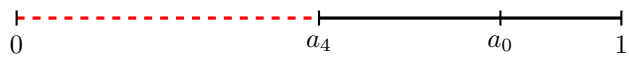

Figure 15: Expert services market when $\lambda \in \left(0, \frac{(1-2p)^2}{4}\right]$ and $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$

Where $a_3 < 0$ implies that for the given λ and p, $EU^{XP}(p, \lambda) > 0 \; \forall a \in [0, a_0]$. Moreover, $EU^{XP}(p, \lambda) \geq EU^{BB}(p, \lambda) \; \forall a \in [0, a_4]$. Hence, the demand for expert services in this case is given by:

$$D^{XP-A}(\lambda, p) = a_4 = p - \frac{1}{2} - \sqrt{\lambda}.$$

Next, we consider the case where $\lambda \in \left(\frac{(1-2p)^2}{4}, \frac{1}{16}\right]$. Here the size of λ implies that $a_4 < 0$, which means that no consumer can get a higher utility from consulting the expert than when buying the good based on their UR-updated priors; the fee is just too high to compensate the value of the information obtained from the expert. Hence, there is no demand for the expert for the given values of λ and p:

$$D^{XP-A}(\lambda, p) = 0.$$

Now we move to *Case II*, where $p \in \left(\frac{3}{4}, 1\right)$. Thus, we know that for this pricing level: $\frac{(1-2p)^2}{4} > \frac{1}{16} > (1-p)^2 > 0$.

First, consider the case where $\lambda \in \left(0, (1-p)^2\right]$. A graphic representation of the demand faced by the expert, considering the arrangement of the relevant cut-off levels, is given by the dashed segment:

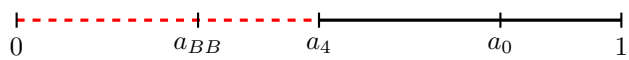

Figure 16: Expert services market when $\lambda \in \left(0, (1-p)^2\right]$ and $p \in \left(\frac{3}{4}, 1\right)$

Where $a_3 < 0$ implies that for the given λ and p, $EU^{XP}(p, \lambda) > 0 \; \forall a \in [0, a_0]$. Moreover, $EU^{XP}(p, \lambda) \geq EU^{BB}(p, \lambda) \; \forall a \in [0, a_4]$. Hence, the demand for expert services in this case is given by:

$$D^{XP-A}(\lambda, p) = a_4 = p - \frac{1}{2} - \sqrt{\lambda}.$$

Next, consider the case where $\lambda \in \left((1-p)^2, \frac{1}{16}\right]$. Again, the demand faced by the expert is given by the dashed segment:

Figure 17: Expert services market when $\lambda \in \left((1-p)^2, \frac{1}{16}\right]$ and $p \in \left(\frac{3}{4}, 1\right)$

Here $a_3 > 0$ implies that for the given λ and p, $EU^{XP}(p, \lambda) > 0 \; \forall a \in [a_3, a_0]$. Moreover, $EU^{XP}(p, \lambda) \geq EU^{BB}(p, \lambda) \; \forall a \in [0, a_4]$. Hence, the demand for expert services in this case is given by:

$$D^{XP-A}(\lambda, p) = a_4 - a_3 = \frac{1}{2} - 2\sqrt{\lambda}.$$

Lastly, consider the case where $\lambda > \frac{1}{16}$. Here $a_3 > a_4$, which implies that there is no demand for the expert for the given levels of λ and p. Hence:

$$D^{XP-A}(\lambda, p) = 0.$$

Having completed the analysis of the case where the good's quality is revealed by the UR to be above the expected value, we move to *Case B*, where $q < \frac{1}{2}$. That is, the consumers do not see a *star review* from the users, updating their priors on the good's quality such that: $q \sim U\left(0, \frac{1}{2}\right)$. Thus, the consumers' expected value for the quality is $\frac{1}{4}$. Hence, the expected utility for the consumers who purchase without consulting the expert, is:

$$EU^{BB-2}(p,a) = \frac{1}{4} + a - p.$$

Furthermore, consumers with a type such that:

$$EU^{BB-2}(p,a) \geq 0 \iff a \geq a_{BB-2} \equiv p - \frac{1}{4},$$

will consider buying the good based only on their UR-updated priors. Notice that $a_{BB-2} \geq 0 \iff p \geq \frac{1}{4}$, which is always the case for $p \in \left(\frac{1}{2}, 1\right)$. Thus, consumers with $a \in (a_{BB-2}, 1)$ would buy the good based on the information coming from the UR.

A consumer who reads the UR and potentially considers consulting the expert before buying cannot have a type parameter such that his utility from purchasing based on his UR-updated priors is positive even when the quality takes the lowest value possible ($q = 0$). That is:

$$EU^{min}(a,p) = 0 + a - p \geq 0 \iff a \geq a_{0-B} \equiv p.$$

Thus, the segment of consumers who may consult the expert have a type in the region $[0, a_{0-B})$. Notice that $a_{0-B} > a_{BB-2}$ for $p \in \left(\frac{1}{2}, 1\right)$.

Out of these consumers some will be interested in consulting the expert, given the good's price and their own type, if the quality revealed is high enough for them to obtain an *ex post* positive utility. That is:

$$U^{ex-post}(q,a,p) = q + a - p \geq 0 \iff q \geq q^{X-B} \equiv p - a.$$

The minimum quality will fall in the supported values for the variable if:

$$q^{X-B} \geq 0 \iff a \leq a_{0-B} \equiv p, \quad \text{and}$$
$$q^{X-B} \leq \frac{1}{2} \iff a \geq a_{1-B} \equiv p - \frac{1}{2}.$$

Where $a_{1-B} \in (0, a_{BB-2})$ for $p \in \left(\frac{1}{2}, 1\right)$. Thus, the consumers potentially ask the expert if and only if their type is $a \in [a_{1-B}, a_{0-B}]$. Consumers with higher or lower type values either buy the good based on their own priors or just stay out of the market.

The consumers' expected utility from consulting the expert is given by:

$$EU^{XP}(a,p) = \begin{cases} 2\int_{p-a}^{\frac{1}{2}}(q+a-p)dq - \lambda = \frac{1}{4}(1+2a-2p)^2 - \lambda & : \text{ if } a \in [a_{1-B}, a_{0-B}] \\ 0 & \text{otherwise.} \end{cases}$$

We now consider the participation decisions of the consumers who may be willing to consult the expert. We proceed as in this proof's first case:

$$EU^{XP}(a,p) \geq 0 \iff a \geq a_{2-B1} \equiv p - \frac{1}{2} + \sqrt{\lambda} \text{ or },$$
$$a \leq a_{2-B2} \equiv p - \frac{1}{2} - \sqrt{\lambda}.$$

and

$$EU^{XP}(a,p) \geq EU^{BB-2}(a,p) \iff a \leq a_{3-B} \equiv p - \sqrt{\lambda} \text{ or,}$$
$$a \geq a_{4-B} \equiv p + \sqrt{\lambda}.$$

However, not all of the cut-offs computed fall in the supported region. We can easily see that $a_{1-B} > a_{2-B2}$ and $a_{4-B} > a_{0-B}$ for all values of p and λ. We thus discard a_{2-B2} and a_{4-B}. Furthermore:

$$a_{2-B1} > a_{1-B} \text{ for } p \in \left(\frac{1}{2}, 1\right) \text{ and } \lambda > 0, \quad \text{and}$$
$$a_{2-B1} > a_{0-B} \iff \lambda > \frac{1}{4}, \quad \text{and}$$
$$a_{2-B1} < a_{BB-2} \iff \lambda \leq \frac{1}{16}.$$

Similarly

$$a_{3-B} < a_{0-B} \text{ for } p \in \left(\frac{1}{2}, 1\right) \text{ and } \lambda > 0, \quad \text{and}$$
$$a_{3-B} > a_{1-B} \iff \lambda \leq \frac{1}{4}, \quad \text{and}$$
$$a_{3-B} < a_{BB-2} \iff \lambda > \frac{1}{16}.$$

Also notice that:

$$a_{3-B} \geq a_{BB-2} \geq a_{2B-1} \iff \lambda \in \left(0, \frac{1}{16}\right] \text{ and}$$
$$a_{2B-1} > a_{BB-2} > a_{3-B} \iff \lambda > \frac{1}{16}$$

We need to consider two cases when computing the demand faced by the expert: *Case I - B* when $\lambda \in \left(0, \frac{1}{16}\right]$ and *Case II - B* when $\lambda \in \left(\frac{1}{16}, \frac{1}{4}\right]$. The expert faces no demand when charging higher fees.

We begin the analysis of the demand with *Case I-B*. A graphic representation of the demand faced by the expert, considering the arrangement of the relevant cut-off levels, is given by the dashed segment:

Figure 18: Expert services market when $\lambda \in \left(0, \frac{1}{16}\right]$ and $p \in \left(\frac{1}{2}, 1\right]$

Where for the given values of λ and p, $EU^{XP}(p,\lambda) > 0 \; \forall a \in [a_{2B-1}, a_{0-B}]$. Moreover, $EU^{XP}(p,\lambda) \geq EU^{BB-2}(p,\lambda) \; \forall a \in [a_{1-B}, a_{3-B}]$. Hence, the demand for expert services in this case is given by:

$$D^{XP-B}(\lambda,p) = a_{3-B} - a_{2B-1} = \frac{1}{2} - 2\sqrt{\lambda}.$$

Next, consider the case where $\lambda \in \left(\frac{1}{16}, \frac{1}{4}\right]$. Charging a fee on this level implies that $a_{2B-1} > a_{3-B}$; hence, no consumer obtains a positive expected utility from buying the good after consulting the expert. Therefore, the expert faces no demand when charging a fee in this level:

$$D^{XP}(\lambda,p) = 0.$$

We can now write the demand for expert services, corresponding to each of the good's pricing levels. In each case, the demand comprises the expected sum of what the expert would face when the good's quality is above and below $\frac{1}{2}$, respectively: $ED^{XP} = \frac{1}{2}D^{XP-A} + \frac{1}{2}D^{XP-B}$.

For $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$, the expected demand is given by:

$$ED^{XP-I}(\lambda, p) = \begin{cases} \frac{1}{2}(p - \frac{1}{2} - \sqrt{\lambda}) + \frac{1}{2}\left(\frac{1}{2} - 2\sqrt{\lambda}\right) = \frac{1}{2}\left(p - 3\sqrt{\lambda}\right) & : \text{ if } \lambda \in \left[0, \frac{(1-2p)^2}{4}\right] \\ \frac{1}{2}(0) + \frac{1}{2}\left(\frac{1}{2} - 2\sqrt{\lambda}\right) = \frac{1}{4} - \sqrt{\lambda} & : \text{ if } \lambda \in \left(\frac{(1-2p)^2}{4}, \frac{1}{16}\right] \\ 0 & \text{otherwise.} \end{cases}$$

For $p \in \left(\frac{3}{4}, 1\right]$, the expected demand is given by:

$$ED^{XP-II}(\lambda, p) = \begin{cases} \frac{1}{2}\left(p - \frac{1}{2} - \sqrt{\lambda}\right) + \frac{1}{2}\left(\frac{1}{2} - 2\sqrt{\lambda}\right) = \frac{1}{2}\left(p - 3\sqrt{\lambda}\right) & : \text{ if } \lambda \in \left[0, (1-p)^2\right] \\ \frac{1}{2}\left(\frac{1}{2} - 2\sqrt{\lambda}\right) + \frac{1}{2}\left(\frac{1}{2} - 2\sqrt{\lambda}\right) = \frac{1}{2} - 2\sqrt{\lambda} & : \text{ if } \lambda \in \left((1-p)^2, \frac{1}{16}\right] \\ 0 & \text{otherwise.} \end{cases}$$

Since the expert is perfectly informed, he maximizes his profits as he is aware of the demand system just described. We first look at *Case I*, when $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$.

There are two subcases to consider here. The corresponding maximization problems are the following. For *Case I-1*:

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP\ I-1} = \lambda\left(\frac{1}{2}\left(p - 3\sqrt{\lambda}\right)\right) \\ \text{s.t.} \quad & \lambda \geq 0 \\ & \lambda \leq \frac{(1-2p)^2}{4} \end{aligned}$$

From the respective Kuhn-Tucker conditions we find that the maximization problem has the following candidate solutions:

$$\lambda_{I-1} = \frac{(1-2p)^2}{4} \text{ if } p \in \left(\frac{1}{2}, \frac{9}{14}\right] \text{ and } \lambda_{I-1B} = \frac{4p^2}{81} \text{ if } p \in \left(\frac{9}{14}, \frac{3}{4}\right],$$

The profit levels associated to each optimal fee, are:

$$\Pi^{XP\ I-1} = \frac{1}{16}(3 - 16p + 28p^2 - 16p^3) \text{ if } p \in \left(\frac{1}{2}, \frac{9}{14}\right] \text{ and } \Pi^{XP\ I-1B} = \frac{2p^3}{243} \text{ if } p \in \left(\frac{9}{14}, \frac{3}{4}\right],$$

The maximization problem for *Case I-2* is:

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP\ I-2} = \lambda\left(\frac{1}{4} - \sqrt{\lambda}\right) \\ \text{s.t.} \quad & \lambda \geq \frac{(1-2p)^2}{4} \\ & \lambda \leq \frac{1}{16} \end{aligned}$$

From the respective Kuhn-Tucker conditions we find that the maximization problem has the following candidate solutions:

$$\lambda_{I-2} = \frac{1}{36} \text{ if } p \in \left(\frac{1}{2}, \frac{2}{3}\right] \text{ and } \lambda_{I-2B} = \frac{(1-2p)^2}{4} \text{ if } p \in \left[\frac{2}{3}, \frac{3}{4}\right],$$

The profit levels associated to each optimal fee, are:

$$\Pi^{XP\,I-2} = \frac{1}{432} \text{ if } p \in \left(\frac{1}{2}, \frac{2}{3}\right] \text{ and } \Pi^{XP\,I-2B} = \frac{1}{16}(3 - 16p + 28p^2 - 16p^3) \text{ if } p \in \left[\frac{2}{3}, \frac{3}{4}\right].$$

Finally, from comparing the candidate solutions for *Case I*'s maximization problem we get:

$$\Pi^{XP\,I-1B} > \Pi^{XP\,I-2} \text{ for } p \in \left[\left(\frac{243}{864}\right)^{\frac{1}{3}}, \frac{3}{4}\right].$$

Therefore, depending on the good's pricing level, the expert optimally sets the fees:

$$\lambda = \frac{1}{36} \text{ if } p \in \left(\frac{1}{2}, 0.655\right], \text{ and}$$

$$\lambda = \frac{4p^2}{81} \text{ if } p \in \left(0.655, \frac{3}{4}\right].$$

We now look at *Case II*, when $p \in \left(\frac{3}{4}, 1\right)$.

There are two subcases to consider here. The corresponding maximization problems are the following. For *Case II-1*:

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP\,II-1} = \lambda\left(\frac{1}{2}\left(p - 3\sqrt{\lambda}\right)\right) \\ \text{s.t.} \quad & \lambda \geq 0 \\ & \lambda \leq (1-p)^2 \end{aligned}$$

From the respective Kuhn-Tucker conditions we find that the maximization problem has the following candidate solutions:

$$\lambda_{II-1} = \frac{4p^2}{81} \text{ if } p \in \left(\frac{3}{4}, \frac{9}{11}\right] \text{ and } \lambda_{II-1B} = (1-p)^2 \text{ if } p \in \left(\frac{9}{11}, 1\right),$$

The profit levels associated to each optimal fee, are:

$$\Pi^{XP\,II-1} = \frac{2p^3}{243} \text{ if } p \in \left(\frac{3}{4}, \frac{9}{11}\right] \text{ and } \Pi^{XP\,II-1B} = \frac{1}{2}(-3 + 10p - 11p^2 + 4p^3) \text{ if } p \in \left[\frac{9}{11}, 1\right).$$

The maximization problem for *Case II-2* is:

$$\begin{aligned} \max_{\lambda} \quad & \Pi^{XP\,II-2} = \lambda\left(\frac{1}{2} - 2\sqrt{\lambda}\right) \\ \text{s.t.} \quad & \lambda \geq (1-p)^2 \\ & \lambda \leq \frac{1}{16} \end{aligned}$$

From the respective Kuhn-Tucker conditions we find that the maximization problem has the following candidate solutions:

$$\lambda_{II-2} = \frac{1}{36} \text{ if } p \in \left(\frac{5}{6}, 1\right] \text{ and } \lambda_{I-2B} = (1-p)^2 \text{ if } p \in \left(\frac{3}{4}, \frac{5}{6}\right].$$

The profit levels associated to each optimal fee, are:

$$\Pi^{XP\,II-2} = \frac{1}{216} \text{ if } p \in \left(\frac{5}{6}, 1\right] \text{ and } \Pi^{XP\,II-2B} = \frac{1}{2}(-3 + 10p - 11p^2 + 4p^3) \text{ if } p \in \left(\frac{3}{4}, \frac{5}{6}\right].$$

Finally, from comparing the two candidate solutions for *Case II*'s maximization problem we get that depending on the good's pricing level, the expert optimally sets the fees:

$$\begin{aligned}
&\lambda = \frac{4p^2}{81} \text{ if } p \in \left(\frac{3}{4}, \frac{9}{11}\right], \text{ and} \\
&\lambda = (1-p)^2 \text{ if } p \in \left(\frac{9}{11}, \frac{5}{6}\right], \text{ and} \\
&\lambda = \frac{1}{36} \text{ if } p \in \left(\frac{5}{6}, 1\right).
\end{aligned}$$

Therefore, the optimal pricing scheme for the expert is:

$$\lambda_* = \begin{cases} \frac{1}{36} & : \text{ if } p \in \left(\frac{1}{2}, 0.6555\right] \\ \frac{4p^2}{81} & : \text{ if } \lambda \in \left(0.6555, \frac{9}{11}\right] \\ (1-p)^2 & : \text{ if } \lambda \in \left(\frac{9}{11}, \frac{5}{6}\right] \\ \frac{1}{36} & : \text{ if } \lambda \in \left(\frac{5}{6}, 1\right) \end{cases}$$

□

Proof of Proposition 9. Since the user reviews can take two opposite values, we must consider the firm's decisions in two different cases:

1. When the review is positive: $q \geq \frac{1}{2}$

   In this case the consumer's expected value for the good's quality is $\frac{3}{4}$. Thus, the expected utility for a consumer with type a is given by:

   $$EU^{UR} = \frac{3}{4} + a - p.$$

   When only user reviews and no other sources of information are available in the market, consumers who obtain a positive expected utility decide to buy the good. That is:

   $$EU^{UR} \geq 0 \iff a \geq a_{UR} \equiv p - \frac{3}{4}.$$

   We can see that a_{UR} falls in the support for the type distribution for $p \in \left[\frac{3}{4}, 1\right]$. Therefore, there are two subcases to consider:

- When $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$:
  For these values of p, $a_{UR} < 0$. Thus, all consumers with types $a \in [0, 1]$ buy the good. The demand for the good is given by:
  $$D^{G-S} = 1.$$
- When $p \in \left(\frac{3}{4}, 1\right]$: For these values of p, $a_{UR} > 0$. Thus, consumers with types $a \in [a_{UR}, 1]$ buy the good. The demand for the good is given by:
  $$D^{G-S1} = 1 - a_{UR} = \frac{7}{4} - p.$$

2. When the review is negative: $q < \frac{1}{2}$
   In this case the consumer's expected value for q is $\frac{1}{4}$. Thus, the expected utility for a consumer with type a is given by:
   $$EU^{UR} = \frac{1}{4} + a - p.$$
   A consumer will buy the good if:
   $$EU^{UR} \geq 0 \iff a \geq a_{UR-2} \equiv p - \frac{1}{4}.$$
   We can see that a_{UR-2} falls in the support of the type distribution for any value of $p \in \left(\frac{1}{2}, 1\right)$. Thus, the demand for the good is given by:
   $$D^{G-NS} = 1 - a_{UR-2} = \frac{5}{4} - p.$$

We can see that there are two cases to consider when computing the expected demand for the good:

1. If $p \in \left(\frac{1}{2}, \frac{3}{4}\right]$, the expected demand is given by:
   $$ED^G = \frac{1}{2}D^{G-S} + \frac{1}{2}D^{G-NS} = \frac{9 - 4p}{8}.$$
2. If $p \in \left(\frac{3}{4}, 1\right)$, the expected demand is given by:
   $$ED^G = \frac{1}{2}D^{G-S1} + \frac{1}{2}D^{G-NS} = \frac{3 - 2p}{2}.$$

From solving the maximization problem in *Case 1* we find the candidate solution $p = \frac{9}{8}$, which falls outside of the support for the prices. Therefore, we have a corner solution in $p = \frac{3}{4}$. Looking at *Case 2* we find that the candidate solution is also $p = \frac{3}{4}$. Therefore, in the equilibrium the firm charges an optimal price $p^G = \frac{3}{4}$, serves a demand $D^G = \frac{3}{4}$, and obtains profits $\Pi^G = 0.5625$. □

Proof of Propositions 10. To find the optimal pricing allocation for the firm we compare the optimal price for each of the pricing regions we have defined. Throughout this proof we use the utility expressions derived in the proof of propositions 4, 5, 6, and 7.

- **When** $p \in \left(\frac{1}{2}, 0.6555\right]$
  In this region the expert charges a fee $\lambda = \frac{1}{16}$. There are two subcases to consider in the *low* pricing region, depending on the size of q.

1. When $q \geq \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_0 \equiv p - \frac{3}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_3 \equiv p - 1 + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_4 \equiv p - \frac{1}{2} - \sqrt{\lambda}. \end{aligned}$$

   However, a_0, a_3 and a_4 all are smaller than zero for the values of p and λ in the region. Thus, the demand for the good when $q \geq \frac{1}{2}$ is given by:

$$ED^G = 1.$$

2. When $q < \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_{0-B} \equiv p - \frac{1}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_{2B-1} \equiv p - \frac{1}{2} + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_{3-B} \equiv p - \sqrt{\lambda}. \end{aligned}$$

   For the values of p and λ in the region we have that:

$$a_{0-B} > a_{3B} > a_{2B-1}.$$

   Therefore, the demand for the good when $q < \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_{3B}) + \int_{a_{2B-1}}^{a_{3B}} (1 - (p - a))da = \frac{31}{24} - p.$$

Thus, the expected demand for the region is:

$$D^G = \frac{1}{2}ED^G + \frac{1}{2}ED^{G-2} = \frac{55}{48} - \frac{p}{2}.$$

From solving the maximization problem we get the candidate solution $\frac{55}{48}$, which falls outside of the support. Thus, the optimal price is a corner solution: $p^G = 0.6555$. The monopolist serves a demand $D^G = 0.1778$ and obtains profits $\Pi^G = 0.1166$ in this region.

- **When** $p \in \left(0.6555, \frac{3}{4}\right]$
  In this region the expert charges a fee $\lambda = \frac{4p^2}{81}$. There are two sub-cases to consider depending on the size of q.

1. When $q \geq \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_0 \equiv p - \frac{3}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_3 \equiv p - 1 + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_4 \equiv p - \frac{1}{2} - \sqrt{\lambda}. \end{aligned}$$

For the values of p and λ in the region we have that:

$$a_{0-B} > a_4 > 0 > a_3.$$

Therefore, the demand for the good when $q \geq \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_4) + \int_0^{a_4} (1 - (p - a))da = \frac{9}{8} + \frac{p(18 - 77p)}{162}.$$

2. When $q < \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_{0-B} \equiv p - \frac{1}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_{2B-1} \equiv p - \frac{1}{2} + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_{3-B} \equiv p - \sqrt{\lambda}. \end{aligned}$$

   For the values of p and λ in the region we have that:

$$a_{0-B} > a_{3B} > a_{2B-1}.$$

   Therefore, the demand for the good when $q < \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_{3B}) + \int_{a_{2B-1}}^{a_{3B}} (1 - (p - a))da = \frac{763 - 16p(36 + p)}{648}.$$

Thus, the expected demand for the region is:

$$D^G = \frac{1}{2}ED^G + \frac{1}{2}ED^{G-2} = \frac{373 - 9p(14 + 9p)}{324}.$$

From solving the maximization problem we get the candidate solution 0.8245, which falls outside of the support. Thus, the optimal price is a corner solution: $p^G = 0.75$. The monopolist serves a demand $D^G = 0.7189$ and obtains profits $\Pi^G = 0.5392$ in this region.

- **When** $p \in \left(\frac{3}{4}, \frac{9}{11}\right]$
  In this region the expert charges a fee $\lambda = \frac{4p^2}{81}$. There are two sub-cases to consider depending on the size of q.

  1. When $q \geq \frac{1}{2}$:
     The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_0 \equiv p - \frac{3}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_3 \equiv p - 1 + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_4 \equiv p - \frac{1}{2} - \sqrt{\lambda}. \end{aligned}$$

     For the values of p and λ in the region we have that:

$$a_{0-B} > a_4 > 0 > a_3.$$

Therefore, the demand for the good when $q \geq \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_4) + \int_0^{a_4} (1 - (p - a))da = \frac{9}{8} + \frac{p(18 - 77p)}{162}.$$

2. When $q < \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_{0-B} \equiv p - \frac{1}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_{2B-1} \equiv p - \frac{1}{2} + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_{3-B} \equiv p - \sqrt{\lambda}. \end{aligned}$$

   For the values of p and λ in the region we have that:

$$a_{0-B} > a_{3B} > a_{2B-1}.$$

   Therefore, the demand for the good when $q < \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_{3B}) + \int_{a_{2B-1}}^{a_{3B}} (1 - (p - a))da = \frac{763 - 16p(36 + p)}{648}.$$

Thus, the expected demand for the region is:

$$D^G = \frac{1}{2}ED^G + \frac{1}{2}ED^{G-2} = \frac{373 - 9p(14 + 9p)}{324}.$$

From solving the maximization problem we get the candidate solution 0.8245, which falls outside of the support. Thus, the optimal price is a corner solution: $p^G = 0.75$. The monopolist serves a demand $D^G = 0.75$ and obtains profits $\Pi^G = 0.5625$ in this region.

- **When** $p \in \left(\frac{9}{11}, 1\right]$
  In this region the expert charges a fee $\lambda = \frac{1}{36}$. There are two sub-cases to consider depending on the size of q.

1. When $q \geq \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$\begin{aligned} EU^{UR} \geq 0 &\iff a \geq a_0 \equiv p - \frac{3}{4}, \\ EU^{XP} \geq 0 &\iff a \geq a_3 \equiv p - 1 + \sqrt{\lambda}, \text{ and,} \\ EU^{XP} \geq EU^{UR} &\iff a \leq a_4 \equiv p - \frac{1}{2} - \sqrt{\lambda}. \end{aligned}$$

   For the values of p and λ in the region we have that:

$$a_{0-B} > a_4 > 0 > a_3.$$

   Therefore, the demand for the good when $q \geq \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_4) + \int_0^{a_4} (1 - (p - a))da = \frac{11}{9} - \frac{p^2}{2}.$$

2. When $q < \frac{1}{2}$:
   The relevant consumer decisions to calculate the demand for the good are:

$$
\begin{aligned}
EU^{UR} &\geq 0 \iff a \geq a_{0-B} \equiv p - \frac{1}{4}, \\
EU^{XP} &\geq 0 \iff a \geq a_{2B-1} \equiv p - \frac{1}{2} + \sqrt{\lambda}, \text{ and,} \\
EU^{XP} &\geq EU^{UR} \iff a \leq a_{3-B} \equiv p - \sqrt{\lambda}.
\end{aligned}
$$

   For the values of p and λ in the region we have that:

$$a_{0-B} > a_{3B} > a_{2B-1}.$$

   Therefore, the demand for the good when $q < \frac{1}{2}$ comprises consumers who buy based on the user reviews and those who do so after asking the expert, and is given by:

$$ED^{G-2} = (1 - a_{3B}) + \int_{a_{2B-1}}^{a_{3B}} (1 - (p - a))da = \frac{31}{24} - p.$$

Thus, the expected demand for the region is:

$$D^G = \frac{1}{2}ED^G + \frac{1}{2}ED^{G-2} = \frac{181 - 36p(2 + p)}{144}.$$

From solving the maximization problem we get a candidate solution which falls outside of the support. Thus, the optimal price is a corner solution: $p^G = 0.8181$. The monopolist obtains profits $\Pi^G = 0.5567$ in this region.

Finally, by comparing the equilibrium profits in all the regions, we can see that the firm obtains the highest profit level setting a price $p^G = 0.75$.

□