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Abstract

This paper presents a framework where sellers, an online platform with monopoly power, and consumers transact. We aim to study the interaction between the imposition of liability on the platform, the reputational sanctions exerted by consumers, and the internal measures adopted by the platform to keep in check the sellers,

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whenever a product generates losses to consumers. We show that introducing direct legal liability of the platform may have both positive and negative effects for safety investments. Additionally, when sellers are heterogeneous (with respect to their sensitivity to the sanctions from consumers or from the platform), legal liability on the platform will have an impact on the selection of participating sellers, although the sign and size of the effect largely depend on paremeter values.

Keywords: platform liability, third-party sellers, reputation.
JEL Classification: K13; L15; L51.

1 Introduction

On January 2015, Heather Oberdorf returned home from work, put a retractable leash on her dog, and went for a walk. The animal suddenly lunged at an unspecified object, and the ring on the collar broke. The leash recoiled back and hit Heather Oberdorf in the eye, breaking her eyeglasses, and blinding her permanently in one eye.

As many consumers do concerning a large variety of products, Heather Oberdorf had bought the collar at an online platform (Amazon). This incident gave rise to one of the most famous cases to date[1] concerning the potential liability of online platforms vis-à-vis consumers who had used the platform to buy from an independent -i.e., different from the platform operator- seller, who offers its products, alongside many others, on the platform.

Online platforms play a leading role in many of our activities, from shopping for all kinds of goods to entertainment, from travel and tourism to keeping track of friends and people we know. How to deal with them is a major theme in legal and regulatory policy affecting many of the relevant fields: antitrust, consumer protection, advertising and trade, and tort liability, just to cite a few.

One of the most disputed issues in this area hinges around whether platforms should be held liable towards consumers for third-party transactions where the platform had played -at least apparently- the role of a mere intermediary. In other words, the existence, grounds, and scope of the liability of an online platform for the malfunction of the products bought from sellers through the platform is a key -but hotly debated- dimension of the regulatory regime of online platforms. The questions arise both with respect to minor instances of non-conformity or dissatisfaction with the product and to more serious ones involving bodily harm to consumers.

In the US, courts (both at the Federal and Statel levels) have struggled with the proper characterization of the role of online platforms and whether their position fits with the categories leading to the imposition of liability for online sales.

In Oberdorf v. Amazon, the US Court of Appeals held Amazon liable, finding that it was a "seller" with substantial control over vendors. However, in Stiner v. Amazon the Supreme Court of Ohio ruled that Amazon was not a "supplier" under the Ohio Products Liability Act, as it had no relationship with the manufacturer or entities in the seller's distribution channel. In Bolger v. Amazon, the California Court of Appeals held Amazon liable, as Amazon had placed itself between the seller and the buyer and controlled the listing, payment, and shipment of the product. Conversely, in McMillan v. Amazon, the Supreme Court of Texas determined that Amazon was not a seller under Texas law

[1] It already belongs to the US Tort Law canon: Epstein and Sharkey (2020).

and therefore was not liable for harm caused by a third-party product. In Papataros v. Amazon, the US Dictrict Court in New Jersey found that Amazon was a seller under the New Jersey Product Liability Act in relation to the purchase of a defective scooter, as Amazon had control over the sale process and was in the position to spread the cost of defects as if it were a quasi-insurer. Apparently, no consensus has emerged yet among courts in the US.

In Europe, although case law does not seem to be so agitated by controversy, a number of proposed legal rules seek to resolve the issue. For instance, the Proposal for a Directive on liability for defective products of September 2022 (a piece of legislation that would eventually replace the current 1985 product liability directive) would make ¡according to art. 7.5 and 7.6 online platforms serving as intermediaries between sellers and buyers, liable on a subsidiary basis for harm caused by a defective product sold through the platform, when the manufacturer, its representative agent, the importer or the fulfilment service provider cannot be identified or are located outside the EU. Legal liability is attached when the online platform presents the information or otherwise enables the specific transaction at issue in a way that would lead an average consumer to believe that the information, or the product that is the object of the transaction, is provided either by the online platform itself or by someone acting under its authority or control. Along similar lines, the European Law Institute Model Rules on Online Platforms (European Law Institute (2019)) advocate that platforms holding a "predominant influence" over a seller or supplier in the platform should be subject to the same liabilities as the seller vis-à-vis the consumer (art. 20). And a number of factors (inspired in part by the US case law) are listed to facilitate the determination about when such a predominant influence exists and can be reasonably relied upon by a consumer: exclusive use of the platform by the seller, payment systems controlled by the platform, terms of contract, including price, essentially determined by platform, marketing focused on platform and not on individual sellers, monitoring commitments by platform are some of these factors.

In Europe, moreover, recent regulatory initiatives have crystallized in the imposition of specific duties on online platforms towards consumers. The Digital Services Act (DSA) of October 2022 includes (art. 25) a broad mandate for platforms not to engage in actions or practices that may deceive or manipulate customers or materially distort or impair the ability of customers to make free and informed decisions. More specifically, online platforms that provide an interface for direct contact between consumers and sellers are subject to further obligations (arts. 30 and 31) concerning the implementation of measures to ensure traceability of sellers and enabling the latter to comply with their obligations regarding pre-contractual information, compliance, and product safety information mandated by EU law.

These regulatory provisions concerning online platforms, however, seem focused on preventing platforms from negatively affecting the functioning of liability mechanisms already in place between sellers and consumers as one would expect them to work in offline (direct) interactions, and also on implementing an online environment where consumers are in the position to identify and obtain redress against those who sell the goods and services. To be sure, the failure of online platforms to live up to these regulatory duties would make them liable for the losses incurred as a result of the failure, but still the DSA does not contain solutions for the general issue of platform liability towards consumers for the problems (major and minor) affecting products exchanged by third-party sellers and buyers in the platform.

This is exactly what we intend to investigate using a theoretical model of the interaction between sellers, an online platform with monopoly power, and consumers. We believe that it is more realistic to think that liability does not operate in a vacuum, but in a setting where consumers may react in the face of adverse events resulting from buying and using goods in an online platform, and where platforms may take action to discipline sellers. Thus, consumers may impose costly reputational sanctions[2]on the platform (refrain from buying for a while, write a negative review, for instance). In an extension, we allow for such sanctions to eventually have a direct impact also on the seller. Platforms, in turn, may adopt measures against the seller involved in an adverse event (delist or postpone them in rankings, for example). We also allow sellers to differ in their sensitivity to such internal platform reprisals. All this would affect the incentives of sellers who can take costly actions to improve safety/quality of the goods they offer to consumers on the platform.

In this setting, we show that introducing direct liability of the platform for the harm incurred by consumers may have both positive and negative effects for safety. Since consumers are -at least partially- compensated by the damages paid by the platform, they reduce the reputational punishment, which may decrease the incentives for sellers to take care when the level of harm is low. However, for higher levels of harm, imposing liability on the platform displaces costly reputational sanctions by consumers. We also show how making the liability regime one that decouples the payment by the platform and the compensation to consumers improves safety levels.

When sellers are heterogeneous in the effectiveness of the platform's disciplinary actions to incentivize them, we show that increases in the legal liability of the platform affects both equilibrium safety levels and participation rates of sellers in the platform, but the

[2]There is evidence showing that consumers react, even harshly, to negative reputational shocks (i.e., In 2000, Amazon.com Inc. infuriated many customers when it sold DVDs to different people for different prices. The Washington Post, December 24, 2012: *Websites Vary Prices, Deals Based on Users' Information*(`https://www.wsj.com/articles/SB10001424127887323777204578189391813881534`)).

overall effect depends on a number of factors (such as the substitutability of consumers' sanctions by platform legal liability).

The above outcome arises for goods with relatively high value for consumers compared to the expected harm they may bring. For the opposite case (low value given expected harm), platform liability may deter valuable transactions over the platform, although a law-maker that places large weight on consumer welfare may impose liability despite its effects on social welfare (given the decrease in platform's profits).

Additionally, when sellers are heterogeneous with respect to their direct sensitivity to the reputational sanctions from consumers, the legal liability of the platform has an impact on the number of sellers allowed to sell in the platform. Platform liability decreases the relevance of excluding those sellers who suffer less the impact of consumers' reputational penalties, although this effect may be counterweighed, depending on the values of the parameters, by the direct effect of platform liability upon platform's profits, which has a negative sign.

Our approach allows also to provide sensible explanations for trends observed in the market. In recent years, online platforms have attempted to provide their own remedies for the cases of malfunctioning of products sold at the platform. To some extent, this sort of self-regulation can be seen as a deliberate response by those platforms to the potential ambitious regulation by governments, although there may be other reasons at work as well, such as reducing costs for processing consumer claims and compensating them. Moreover, for claims and reimbursement close in time to the online transaction, the platform would merely be an "agent" using sellers' money to provide redress in a way that economizes in administrative costs.

Concerning Amazon, its policy varies depending on whether the sale takes place in the United States or in Europe. In the case of the United States, the internal Business Solution Agreement (BSA)[3] states that third-party sellers must sign in before distributing their products, and that vendors using the Amazon selling service "*are solely responsible for any nonperformance, non-delivery, misdelivery, theft, or other mistake or act in connection with the fulfillment of Your (the sellers') products*", except in cases of credit card fraud. This agreement clearly states that Amazon's obligation for any malfunction, fault, defect, or non-conformity of the goods is exclusively on the seller. Thus, the BSA excludes any liability for Amazon in relation to the quality or the condition of the product. It has been reported (Sharkey (2022)) that Amazon pledges to compensate consumers for bodily harm up to 1,000$ caused by products sold by third parties through the platform.

[3] `https://www.abilityone.gov/laws,_regulations_and_policy/documents/Amazon%20Services%20Business%20Solutions%20Agreement.pdf`

In Europe, according to article 6.1 of the Amazon Services Europe BSA[4], the vendor is required to indemnify Amazon for any claim or harm suffered as a result or consequence of the vendor's products.[5]

Section 8 of both the European and American BSAs requires sellers to have third-party liability insurance if sales of a specific product and over a certain period exceed a threshold (which varies depending on the region) covering products liability and bodily damage.

In the case of AliExpress, despite the fact that there are different contracting rules depending on where the seller is located, the product liability rule does not change for them: liability is transferred to sellers (see, for example, clause 6.7 of the AliExpress Service Agreement for EU Sellers[6]) and, additionally, sellers acquire the obligation of compensating AliExpress for violations of applicable laws and regulations, contractual laws by AliExpress, and consumer's rights.

Similarly, as stated in the US terms and conditions, eBay restricts its liability to a certain amount in disputes or breaches of contract between sellers and buyers, explicitly excluding the damages resulting from non-conformities or defects[7].

The paper is organized as follows: Section 2 provides a short literature review. Section 3 describes the basic features of the setting and the model. Section 4 contains the basic analysis. Section 5 looks into the effects of decoupling liability and consumer compensation. Section 6 considers the effectiveness of platform's disciplinary actions upon sellers. Section 7 considers that sellers also receive reputational consumer sanctions and also that they can have a share in legal liability vis-à-vis consumers. Section 8 provides some policy discussion and implications. Section 9 briefly concludes.

[4] `https://sellercentral.amazon.co.uk/help/hub/reference/external/201190440?ref=efph_201190440_cont_G201190440&locale=en-GB`

[5] In particular, the third-party seller has to "*defend, indemnify, and hold harmless Amazon, and [their] officers, directors, employees, and agents, against any third-party claim, loss, damage, settlement, cost, expense, or other liability [...] arising from or related to (a) [...] non-compliance with applicable laws; (b) [the vendor's] Products, including the offer, sale, fulfillment (except [the vendor] Products fulfilled using the FBA service), refund, cancellation, return, or adjustments thereof, and any personal injury, death (to the extent the injury or death is not caused by Amazon), or property damage related thereto [...]*".

[6] `https://sell.aliexpress.com/zh/__pc/ipLvyxlPtW.htm?spm=5261.12657212.101.9.70782aa7QZ98M9%20english`

[7] In particular, "(eBay) *has no responsibility or liability for the safety or performance of any product that you list or sell using our Services, including any product that is subject to a recall. You (the sellers) are solely responsible for any non-conformity or defect in, or compliance with any public or private recall of any product you list or sell using our Services*".

2 Literature Review

Liability of firms for the defective products sold has been widely addressed by the law and economics literature. Spence (1977) was one of the first to formally address this question. This paper proves how the chance of a faulty product might impact the degree of (mis)perception of a product's qualities, and how this can justify regulating or imposing liability on the seller. Landes and Posner (1985) examines the economic rationale of product liability from different angles. It examines the impact on the distribution of liability of, among other things, whether the products are defective due to a problem in the manufacturing process, whether they are defective due to an incorrect design, whether the product is per se dangerous, and whether the defect appears as a result of consumer misuse.

The tension between the costs and benefits at different levels of safety and R&D associated with the imposition of product liability is discussed in Viscusi and Moore (1993). Polinsky and Shavell (2010) show that product liability may be superfluous as a guarantee of safety for those products where regulation and market forces are sufficiently intense, all of which may have a negative impact on end consumers through unjustified rises in the prices of these products. The interaction between the role of reputation and manufacturers' liability for defective products is studied in Ganuza et al. (2016). The authors conclude that these two mechanisms operate as complements to discipline producers' behavior. The existence of heterogeneity of potential consumers is also a factor that affects the incentives of companies to produce safe products. In particular, Hua and Spier (2020) show that firms will try to shirk their responsibility and invest less especially in those cases where they enjoy market power and where consumers who have a higher probability of suffering an accident are also those who are willing to pay more for the potentially hazardous product.

The literature dealing with the possibility of imposing liability on parties not directly involved in causing an accident is anything but new. Sykes (1983) studies the conditions under which a rule of joint and several liability between the principal and the agent is efficient with respect to a rule of individual liability. Arlen (1994) investigates vicarious liability in the context of criminal law. In her research it is illustrated that extending criminal responsibility to corporations is not necessarily an effective approach to curb crime. In the context of medical liability, Hay and Spier (2005) find that the social optimum entails managed care organizations to be held liable for the negligence caused by affiliated physicians. The relationship between the firm and its management is also affected by vicarious liability. The latter, in particular, can dissuade managers from misreporting (Spindler (2017)).

The irruption of digital platforms has resulted in the emergence of new avenues for trade, resulting in increasing degrees of interaction between buyers and sellers, giving rise to so-called two-sided or multi-sided markets. The economic and economically-oriented literature in this field is already very large. Early work on modeling these novel structures was centered on determining the causes of pricing structures in these sorts of marketplaces (Rochet and Tirole (2003) and Caillaud and Jullien (2003)). Some more recent works have addressed other related issues regarding online markets. In particular, Tadelis (2016) reviews the fundamental concepts behind the importance of reputation in fostering trust and trade, as well as providing an overview of how feedback and reputation systems function in online marketplaces. Belleflamme and Peitz (2021) covers extensively the various economic dimensions of platforms (network effects, design, pricing, ratings and recommendations, etc.).

Recently, several authors have begun to examine the specific question of the role of liability in digital platforms. From a pure policy perspective, Buiten et al. (2020), Buiten et al. (2022) and Sharkey (2020) analyze the efficiency of classical liability rules in situations where a platform is involved. Also, without a formal model, Lefouili and Madio (2022) studies the incentives of the parties to use a stricter liability rule for platforms on variables such as pricing, terms and conditions, and investments. In the same vein, Sharkey (2022)tries to explain the recent case law addressing the imposition of liability on platforms such as Amazon, considering the latter as the 'lowest cost avoider' in the economic relationship. De Chiara et al. (2021) studies with the help of a theoretical model the role of liability rules in the development of filtering technology to prevent the presence of copyright infringing content when the technology is inaccurate and leads to errors.

A growing line of research is addressing the consequences associated with imposing a liability regime within a platform structure. The following stand out among this group: Jeon et al. (2021) study platform's incentives to delist IP-infringing products and the effects of introducing a liability regime. Grimmelmann and Zhang (2023) show the effects of different legal liability regimes on the moderation of content in the net. Hua and Spier (2021) prove that holding firms liable for harm caused to consumers discourages dangerous companies from joining the platform in an setup with adverse selection, since two types of sellers coexist: safe and harmful ones, where the latter have lower production costs but cause harm to consumers more often. Platform liability is an instrument to give incentives to the platform to screen sellers who do not directly face all harm (if sellers are fully solvent, there is no need for platform liability). They show that when the harmful firms are marginal, platform liability does not increase efficiency. If they are inframarginal, less than full platform liability provides incentives to screen harmful sellers and delist them from the platform.

Yasui (2022) endogeneizes platform's choice of liability and finds that the imposition of platform liability has the unintended effect of reducing incentives to make products safer. In particular, if sellers attach importance to their own reputation, a third-party product liability rule may cause them to exert a lower effort, thus reducing total surplus. Our setting is different from it, since we simultaneously deal with moral hazard on the sellers' side, sanctioning decisions from consumers and the platform, and consider the effects of liability (with and without decoupling) on homogeneous sellers and heterogeneous sellers in terms of their reputational sensitivity.

Hua and Spier (2023), analyze a setting in which a platform provides network services to consumers from which harm may arise, and who can adopt precautions to reduce the probability of harm to consumers. The platform does not intermediate between sellers of products or services and consumers. Depending on the size of the network effects and the resulting price for consumers to join the platform, the paper provides conditions to compare the relative efficiency of various liability regimes: negligence, strict liability, and (when precaution is bilateral) strict liability with contributory negligence on the part of the consumer.

Zennyo (2023), in an independently developed paper close to ours, examines a setting in which sellers who produce goods that may cause harm to consumers interact with the latter through a platform, although sales may also take place offline (entailing the loss of network effects created by the platform). The sellers' investment on safety or quality is observable and sellers are directly liable towards consumers. This paper shows that the platform has never an incentive to voluntarily assume liability for third-party harm, although platform liability imposed by the lawmaker may enhance consumer surplus when the platform has not a large market power, competition among sellers is moderate, the harm from defective products is not large, and demand is less elastic. When some sellers are judgement-proof, platform liability only helps these sellers to the detriment of those who can pay damages to consumers. We depart from his analysis in several respects, especially in the role of consumers reputational sanctions, platform's disciplinary actions over sellers, and heterogeneity in how sellers may be affected by one or the other. The important drivers and policy implications are also different in our paper.

3 Model

We study sellers and consumers who interact through an intermediary platform. Our set-up builds on the framework of Karle et al. (2020) but departs from it along several directions. First, we consider a monopolistic platform and we allow for only one seller for

each product category. Second, sellers can make a safety investment to reduce the risk of accidents caused by the products. Third, we consider the legal liability of the platforms and sellers vis-à-vis the consumers of the products as a key factor.

Sellers. There is a unit mass of product categories, indexed by $k \in [0,1]$. Each product category is served by a single seller. Each seller privately and independently makes an investment to improve the quality of the product. The investment is binary, $e \in \{0,1\}$, and stochastically decreases the probability that the product will be defective. Specifically, the product will be defective with probability 1 if $e = 0$, whereas it will be defective with probability $1 - \eta \in (0,1)$ if $e = 1$. Accordingly, we will say that η captures the *productivity of the safety investment*. The investment costs $c > 0$. An active seller makes a profit π. In our basic setting, a seller cannot be sued for damages resulting from a faulty or non-conforming product they have sold. This may be because sellers have no assets to cover damage payments to consumers or because their location makes it impractical for consumers to sue for damages.[8]

Consumers. Each consumer is only interested in a product category and derives gross utility V from consuming a product in her preferred category and 0 otherwise. There is a unit mass of consumers per product category. A consumer learns her preferred product category only after visiting the platform. If the platform only lists a fraction $\alpha \in [0,1]$ of sellers, the consumer's gross expected utility is αV. If the product turns out to be defective (or harmful, we will use the two terms interchangeably[9]), a consumer incurs a loss $H > 0$. We assume that a consumer retains a fraction $1 - \gamma$ of the expected gains from trading with a seller through the platform. A consumer can sue the platform if the product bought is defective. Moreover, we assume that the consumer is able to commit to inflict a reputational punishment onto the platform[10] as a function of (i) whether the product bought is defective and (ii) whether there has been compensation for the harm resulting from the defect. The punishment suffered by the platform is $R \geq 0$ and costs the consumer τR, with $\tau \in [0,1)$. In practice, this may take the form of refraining from buying through the platform for some time or making some bad reviews that tarnish the platform's reputation. These punishments entail costs for the consumers, such as those arising from the need to find products through other channels or the time spent in writing

[8] Although arts. 30 and 32 of EU regulation 2022/2065 (DSA) set mandates for platforms to allow traceability of sellers, and means of redress, they do not include requirements that would prevent sellers from being judgement-proof or outside the realistic scope of consumers' lawsuits.

[9] Our notions do not intend to reflect specific categories in one or the other legal system. Thus, they should be understood broadly encompassing also instances of contractual non-conformity.

[10] In section 7.1 below we consider the scenario in which the reputational punishment by the consumer may both affect the platform and the seller.

reviews.[11]

Platform. The platform has a deep-pocket and is able to face damages sought by consumers. It charges a listing fee f to each seller, whereas it does not charge consumers. The platform can commit to punishing a seller if the product turns out to be defective. Let the punishment be $r \geq 0$ and the cost for the platform be ϕr with $\phi \in [0, 1)$. While we are agnostic about the actual type of punishment that is carried out, in practice there seem to be many tools available to the platform to discipline an underperforming seller, ranging from an outright ban from trading to reducing its visibility on the platform that will negatively affect its future sales.

Timing of the game. The sequence of events is as follows.

0. Consumers commit to a punishment R at unit cost τ for the event they suffer harm.
1. The platform offers each seller a contract consisting of (f, r).
2. Each seller decides whether to sell through the platform and, if so, each seller independently chooses whether to invest or not in safety.
3. Consumers learn their preferred product and make their purchasing decisions.
4. Uncertainty resolves; if the product purchased is defective, punishments are carried out and damages are paid according to the liability regime. Players derive payoffs.

Liability. In a perfectly functioning liability system, a liable platform pays fully-compensatory damages H. For now, we assume that the platform compensates the consumer for a fraction $\delta \in [0, 1]$ of the suffered harm of the consumers. This fraction may depend on the ability of courts to fully assess the harm suffered by consumers, the delay with which consumers are compensated, the uncertainty over judicial outcomes, and so on. It may also be interpreted as the legislator's choice variable as to the scope of the platform's liability. Bear in mind that $\delta = 0$ amounts to the case of no liability, whereas $\delta = 1$ is equivalent to the platform making consumers whole for the harm they suffer. Although we acknowledge that this constitutes a limitation, following previous literature (Hua and Spier, 2021; Zennyo, 2023), we assume away litigation and settlement costs associated with liability towards consumers.

[11] Bechwati and Morrin (2003) conceptualize and find supportive evidence for the consumers' desire for retaliation against a firm in the wake of a negative purchase experience. Extensive research in consumer psychology cited therein shows that dissatisfied consumers engage in negative word-of-mouth behavior and/or switch to alternative (suboptimal) providers.

Equilibrium concept and modeling assumptions. All parties are risk-neutral and have zero outside options. As the sellers' effort is private information, consumers will form a belief about the expected harm of the product on sale on the platform. We use Perfect Bayesian Equilibrium as equilibrium concept and, being rational, consumers will correctly anticipate the true amount of safety investment the sellers make on the equilibrium path. We assume that consumers are aware of the contract terms used by the platform.[12] Throughout we assume that $V - (1-\eta)H - c \geq 0$ and $\eta H - c > 0$, so that the sellers' safety investment is socially desirable.

3.1 Model discussion

Below, we discuss some of the key assumptions of the basic model.

Reputational sanctions. A key feature of our model is that both consumers and the platform can incur costs to punish other parties when a product turns out to be harmful/defective. As consumers' interaction with sellers is mediated, the platform is the natural starting point for consumers to punish. The platform, in turn, is able to punish sellers. These punishments are meant to capture, in a reduced form, how consumers and the platform can react to the occurrence of harm from a defective good: that is, their ability to take actions that affect the future (stream of) payoffs of other players in the game.

Consumers' commitment. As a shortcut, consumers can commit to imposing a sanction on the platform if they feel hurt by the interaction through the platform. Several competing mechanisms may justify this behavior. For instance, negative reciprocity according to which individuals are better off if they manage to punish those who have treated them unfairly even when this implies a cost.[13] Similarly, Hart and Moore (2008) argue that parties to a contract may feel aggrieved if they receive less than what they feel they are entitled to. The contract constitutes a natural reference point and, Hart and Moore argue, in the presence of multiple possible outcomes, the parties feel entitled to the best outcome the contract allows. Feelings of grievence may be partially offset by punishing the counterparty. In our environment, consumers may form the expectation that the good they have purchased should be free from defects. Should it turn out to be defective, consumers would retaliate (initially against the platform). Extensive empirical

[12] Art. 3 of the EU Regulation 2019/1150 contains transparency requirements for the terms used by the platforms vis-à-vis sellers.

[13] For theoretical models of reciprocity, see Rabin (1993), Dufwenberg and Kirchsteiger (2004), and Falk and Fischbacher (2006).

evidence has shown how rife negative reciprocity is (e.g., see Dohmen et al., 2009) and several experiments have shown that shortchanged economic agents are willing to incur costs to punish counter-parties, even when the latter are not ultimately responsible (at least fully) for the former's unpleasant outcome (e.g., see Bartling and Fischbacher, 2012 and Oexl and Grossman, 2013).

Consumers' bargaining power. The consumers' ability to obtain some positive gains from trading is necessary for them to carry out costly punishments. This assumption can be justified if consumers are heterogeneous as to the utility they obtain from the exchange and their true valuation is private information. This may be challenged in a world in which platforms may use AI to personalize prices intended to fully absorb consumers' surplus from the transaction. However, the extent to which this happens in practice is debatable (e.g., see Porat, 2022).

4 Analysis

We solve the model by backward induction. In stage 4, when joining a platform, a consumer expects to get:

$$U^E := (1-\gamma)\alpha[V - (1-\eta e^E)[(1-\delta)H + \tau R]].$$

In stage 3, a seller willing to join the platform decides on the safety investment:

$$\max_{e\in\{0,1\}} \quad -(1-\eta e)r - ce.$$

Keep in mind that the seller's investment choice, being unobservable to consumers, does not affect their expected utility from buying the good. It is immediate to see that a seller weakly prefers to invest if r is at least as high as the following critical value $\tilde{r} := \frac{c}{\eta}$.

Consider now stage 2 and suppose that the equilibrium where sellers are induced to invest, i.e., $e = 1$, is in place. The platform chooses the contract (f, r) to maximize:

$$f - (1-\eta)[\phi r + R + \delta H],$$

subject to the sellers' participation constraint:

$$\gamma[V - (1-\eta)[(1-\delta)H + \tau R]] - f - (1-\eta)r - c \geq 0,$$

and the sellers' incentive compatibility constraint:

$$r \geq \tilde{r}.$$

It can be shown that, when investment is induced (subscript 1 below),

$$\begin{aligned} r_1 =& \frac{c}{\eta}; \\ f_1(R) =& \gamma\Big[V - (1-\eta)[(1-\delta)H + \tau R]\Big] - (1-\eta)\frac{c}{\eta} - c. \end{aligned}$$

The platform's expected utility is:

$$\begin{aligned} \Pi_1(R) =& \gamma[V - (1-\eta)[(1-\delta)H + \tau R]] - (1-\eta)\frac{c}{\eta} - c \\ & - (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right), \end{aligned}$$

where the first line is the platform's revenue, and the second line represents the platform's expected loss from selling a potentially harmful good. The latter consists of the probability that an accident occurs multiplied by three terms: the platform's cost of sanctioning the under-performing seller, $\phi\frac{c}{\eta}$, the consumers' reputational punishment, R, and the damages payment to the consumer, δH. From this expression, we can infer that R cannot be too high or $\Pi_1(R)$ would be negative. In particular,

$$R \leq \bar{R} := \frac{\gamma V}{(1-\eta)(1+\gamma\tau)} - \frac{[\gamma(1-\delta)+\delta]H}{1+\gamma\tau} - \frac{[1+(1-\eta)\phi]c}{\eta(1-\eta)(1+\gamma\tau)}.$$

As for the equilibrium where sellers are not induced to invest, we distinguish between two main cases, depending on the value of V relative to H.

4.1 Relatively Low-value Goods

Suppose first that $V \in [(1-\eta)H + c, H)$. In this case, trade would optimally take place only when the sellers invest. Put differently, sellers' investment is indispensable for the market to exist. As a result, either the platform induces the sellers to invest or trade does not occur, i.e. $\Pi_0 = 0$. From inspecting $\Pi_1(R)$, it is immediate to see that consumers' sanctions would only diminish the platform's interest in inducing investment. Therefore, $R = 0$. In words, as transactions do not take place unless the goods are safe (though not necessarily accident-free), there is no need for consumers' reputational sanctions to induce the platform to punish those sellers whose goods are defective. What is the role of platform liability in this scenario? A higher degree of liability may undermine the

platform's incentive to motivate investment on the sellers' part. To see this, note that $\Pi_1 \geq 0$ if and only if:

$$V \geq \frac{(1-\eta)[\gamma(1-\delta)+\delta]H}{\gamma} + \frac{[1+(1-\eta)\phi]c}{\eta\gamma}. \tag{1}$$

The right-hand side is increasing in δ. Even if investment in safety is optimal, the platform does not enjoy all the surplus it generates, it has to allow a moral-hazard rent for sellers, because their investments are unobservable, and motivating the sellers entail socially-costly sanctions. Therefore, burdening the platform with liability may result in the latter deciding not to allow socially-beneficial transactions from taking place.

Yet, if a higher δ does not deter investment, it can be used to transfer surplus from the platform to consumers: provided that $e = 1$, consumers' expected utility is increasing in δ. This is especially relevant for a legislator who attaches a larger weight to consumers' welfare than to platform's profits. In that case, such a legislator would set δ to maximize expected consumer surplus subject to satisfying (1). We summarize these observations in the following proposition.

Proposition 1. *When $V \in [(1-\eta)H + c, H)$, a higher level of δ may prevent socially-desirable transactions. If the legislator values consumer surplus more than platform's profits, it would choose the highest feasible δ that does not deter trading.*

4.2 Relatively High-value Goods

Let us now suppose that (i) consumers are still willing to buy the good when they expect it to be defective with probability 1, which requires $V \geq (1-\delta)H$, and that (ii) the platform is willing to host goods that are defective with probability 1, which requires $V \geq (1-\delta)H + \frac{\delta}{\gamma}H$. It is immediate to see that the second constraint is always tighter. If $\delta = 1$, the condition is $\gamma V \geq H$. In fact, to guarantee that the platform wishes the sellers to invest and focus on the most interesting case, in the remainder of this section we will assume that $V \geq \bar{V} := \frac{H[1+(1-\eta)(1+\phi)]}{\gamma}$.

Consider the equilibrium where sellers are not induced to invest, i.e., $e = 0$. The platform chooses the contract (f, r) to maximize:

$$f - (\phi r + R + \delta H),$$

subject to the sellers' participation constraint:

$$\gamma[V - (1-\delta)H - \tau R)] - f - r \geq 0.$$

It follows that, when $e = 0$, the contract between the platform and sellers prescribes (subscript 0 below):

$$r_0 = 0;$$
$$f_0(R) = \gamma[V - (1-\delta)H - \tau R)].$$

The platform's expected utility is:

$$\Pi_0(R) = \gamma[V - (1-\delta)H - \tau R] - R - \delta H.$$

By comparing the platform's profits when investment is induced and when it is not, we find that $e = 1$ is induced whenever consumers' punishment is sufficiently severe, i.e., when:

$$R \geq \tilde{R} := \left[\frac{\eta + (1-\eta)(1+\phi)}{(1+\gamma\tau)\eta^2}\right] c - \frac{[\gamma(1-\delta)+\delta]H}{1+\gamma\tau}.$$

Two points are worth highlighting. First, a higher degree of platform's legal liability δ crowds out consumers' reputational sanctions since $\frac{\partial \tilde{R}}{\partial \delta} < 0$. Second, if H is sufficiently large as compared to c, consumers need not discipline the platform to induce $e = 1$. Specifically, this occurs if:

$$H \geq \tilde{H}_P := \frac{[\eta + (1-\eta)(1+\phi)]}{[\gamma(1-\delta)+\delta]\eta^2} c.$$

The next lemma immediately follows from the above observations.

Lemma 1. *Suppose that $V \geq \bar{V}$. If $H \geq \tilde{H}_P$, then $R = 0$, $f = \gamma[V - (1-\eta)(1-\delta)H] - (1-\eta)\frac{c}{\eta} - c$, $r = \frac{c}{\eta}$, and $e = 1$.*

Importantly, $\tilde{H}_P > 0$ even when $\delta = 0$: As the platform indirectly extracts surplus from consumers, it has an incentive to decrease the probability of harm, even if it does not have to pay damages to consumers. An attractive feature of platform liability is that it makes socially costly consumers' sanctions redundant. This may occur because the platform's incentive to induce sellers' investment is strengthened by the anticipation of legal liability towards consumers: $\frac{\partial \tilde{H}_P}{\partial \delta} < 0$.

If $H < \tilde{H}_P$, consumers must punish the platform if the product is harmful for otherwise sellers will not invest. In stage 1, consumers will choose R to maximize their expected utility. If $e = 1$, $R = \tilde{R}$, and[14]

$$U_1 = (1-\gamma)\Big[V - (1-\eta)[(1-\delta)H + \tau\tilde{R}]\Big]$$

[14]Below, we implicitly assume that $\tilde{R} \leq \bar{R}$, for otherwise the platform would not allow trading since it would incur a loss.

If investment is not induced, $R = 0$:

$$U_0 = (1-\gamma)[V - (1-\delta)H].$$

Thus, if $H < \tilde{H}_P$, consumers punish the platform to induce investment when $U_1 \geq U_0$. This turns out to be the case when $H \in [\tilde{H}_C, \tilde{H}_P)$ where

$$\tilde{H}_C := \frac{(1-\eta)\tau[1+(1-\eta)\phi]}{\eta^2\{(\eta+\gamma\tau) - \delta[\eta(1+\gamma\tau) + \tau(1-\eta)(1-\gamma)]\}}c.$$

Notice that $\tilde{H}_C$ need not be smaller than $\tilde{H}_P$.

Lemma 2. *Suppose that $V \geq \bar{V}$. If $H < \tilde{H}_P$ there are two cases:*

1. *If $H < \min\{\tilde{H}_C, \tilde{H}_P\}$, then $R = 0$, $f = \gamma[V - (1-\delta)H]$, $r = 0$, and $e = 0$.*
2. *If $H \in [\tilde{H}_C, \tilde{H}_P)$, then $R = \tilde{R}$, $f = \gamma\{V - (1-\eta)[(1-\delta)H + \tau\tilde{R}]\} - (1-\eta)\frac{c}{\eta} - c$, $r = \frac{c}{\eta}$, and $e = 1$.*

When the platform is not subject to legal liability towards consumers for defective products purchased from sellers on the platform, i.e., $\delta = 0$, it always holds that $0 < \tilde{H}_C < \tilde{H}_P$.[15] Namely, there always exists a parameter region where consumers need and want to sanction the platform to induce the sellers' safety investment. When platform legal liability increases, that is, δ gets higher, consumers' benefit from purchasing a non-harmful good decreases, as they would get at least partially compensated by the platform.

As a consequence, higher platform liability weakens consumers' incentives to sanction the platform. Accordingly, $\frac{\partial \tilde{H}_C}{\partial \delta} > 0$. Although this implies a lower social loss due to savings in costly sanctions, an increase in the degree of platform liability increases the likelihood that the goods are harmful because it expands the parameter region in which $e = 0$. This represents the downside of platform liability. This unintended consequence must be taken into account in the design of legal liability of platforms.

In Figure 1 we graphically illustrate the two effects of imposing platform liability.[16] We do this by comparing two polar scenarios: no platform liability and full platform liability.

[15] To see this, let $\delta = 0$, then $\tilde{H}_P > \tilde{H}_C$ if

$$\begin{aligned} \frac{[\eta + (1-\eta)(1+\phi)]}{\gamma\eta^2}c > & \quad \frac{(1-\eta)\tau[1+(1-\eta)\phi]}{\eta^2(\eta+\gamma\tau)}c \\ \Leftrightarrow [\eta + (1-\eta)(1+\phi)](\eta+\gamma\tau) > & \quad (1-\eta)\tau[1+(1-\eta)\phi]\gamma \\ \Leftrightarrow (\eta+\gamma\tau) > & \quad (1-\eta)\gamma\tau \Leftrightarrow \quad \eta > -\gamma\tau\eta. \end{aligned}$$

[16] We assume that $H_C > H_P$ when $\delta = 1$. This is for instance the case if $\eta = 0.2$, $\gamma = 0.8$, $\phi = \tau = 0.2$, and $c = 1$.

On the one hand, the platform's incentive to induce sellers to invest derives less from consumers' outrage and punishment as these are replaced by the threat of legal liability: $\tilde{H}_P(\delta = 1) < \tilde{H}_P(\delta = 0)$. On the other hand, a higher level of liability faced by the platform discourages consumers to commit to punishments, given that their benefit from purchasing a non-defective good comparatively diminishes. In the case illustrated in the figure, $R = 0$ when $\delta = 1$.

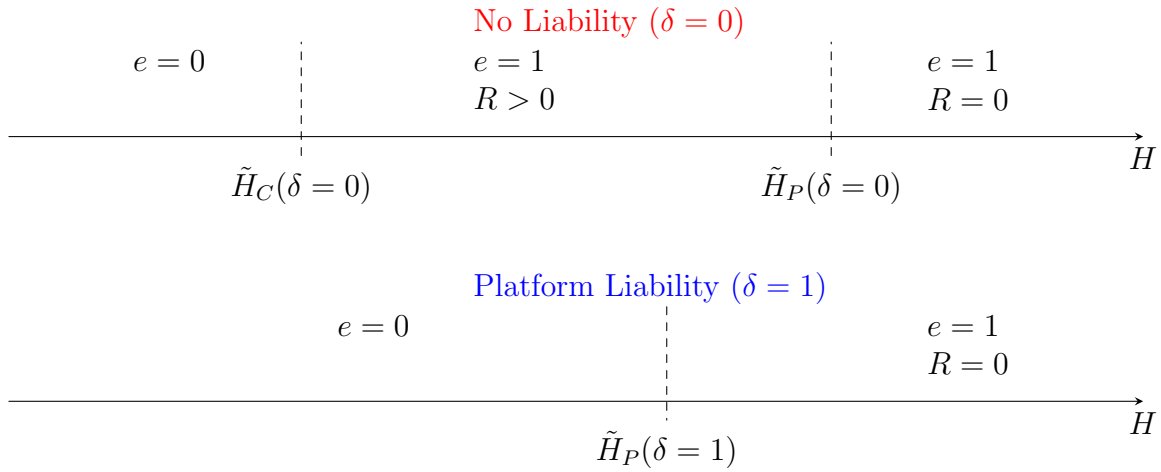

Figure 1: Equilibrium with and without Platform Liability.

As for social welfare, when $V \geq \bar{V}$,

$$SW = \begin{cases} V - H, & if H < \min\{\tilde{H}_C, \tilde{H}_P\}; \\ V - (1-\eta)\left[H + \tilde{R}(1+\tau) + \frac{c}{\eta}(1+\phi)\right] - c, & if H \in [\tilde{H}_C, \tilde{H}_P]; \\ V - (1-\eta)\left[H + \frac{c}{\eta}(1+\phi)\right] - c, & if H > \tilde{H}_P. \end{cases}$$

When V is sufficiently high, an increase in platform's liability has opposite effects. On the one hand, it reduces consumers' reputational sanctions. Intuitively, consumers' punishments are replaced by legal liability as the driver of the platform's decision to discipline unsafe sellers. As such punishments are costly, this is good in terms of welfare. On the other hand, an increase in platform liability may actually lower the safety of products: the region of parameters for which $e = 1$ may actually shrink. The latter is the most counterintuitive result and may imply that welfare declines when the degree of platform legal liability rises.

Proposition 2. *Let $V \geq \bar{V}$. An increase in platform legal liability δ may be welfare-decreasing.*

Proof. Suppose that at $\delta = \delta' \in [0,1)$, $H = \tilde{H}_C(\delta')$. Let δ increase to $\delta'' \in [0,1]$ so that $\tilde{H}_C(\delta') = H < \tilde{H}_C(\delta'')$. Assume that $\tilde{H}_C(\delta'') < \tilde{H}_P(\delta'')$. We now determine under what condition $SW(\delta'') < SW(\delta')$.

$$\begin{aligned}
&SW(\delta') > \quad SW(\delta'') \\
\Leftrightarrow &V - (1-\eta)\left[H + \tilde{R}(1+\tau) + \frac{c}{\eta}(1+\phi)\right] - c > \quad V - H \\
\Leftrightarrow &H > \frac{(1-\eta)\Big[(1+\tau)[\eta + (1-\eta)(1+\phi)] + (1+\gamma\tau)\eta(1+\phi)\Big] + \eta^2(1+\gamma\tau)}{\eta^2\Big[\eta(1+\gamma\tau) + (1-\eta)(1+\tau)[\gamma(1-\delta') + \delta']\Big]} c.
\end{aligned}$$

Note that, for a given H, the above inequality is more likely to hold for a higher δ'. Recalling that $\tilde{H}_C$ is increasing in δ, there exists a threshold value of δ, δ^T such that for any $\delta' \geq \delta^T$, an increase from δ' to δ'' is welfare decreasing. □

5 Platform liability with decoupling

One policy implication that derives from the previous section is that decoupling the payment received by the harmed consumers from that paid by the platform may be desirable.[17]. We now consider the case in which the platform is liable but there is decoupling. This means that the sum of the losses incurred by consumers and the liability of the platform is larger than H. In particular, we assume that consumers incur a loss of $(1-\delta)\Delta H$ with $\Delta \in [1, \frac{1}{(1-\delta)}]$. Notice that $\Delta = 1$ is the case in which liability is frictionless or not decoupled (albeit not necessarily fully compensatory, as we know). When $\Delta = \frac{1}{(1-\delta)}$, consumers suffer the harm in full and receive no damages compensation, but the platform faces a penalty δH. In this case, we denote the equilibrium values with the superscript PLD. This change in the liability regime mainly affects the expected utility of consumers from buying through the platform:

$$U^E = (1-\gamma)\alpha[V - (1 - \eta e^E)[(1-\delta)\Delta H + \tau R]]$$

Again, we solve this extension of the model by backward induction, mimicking the solution of the previous section. In particular, the safety investment problem of the seller has the same solution: the seller invests if r is at least as high as $\tilde{r}^{PLD} := \frac{c}{\eta}$.

Stage 2 in which the platform chooses the contract (f, r) with the seller, has the same structure as in the baseline analysis, but the participation constraint of the seller changes.

[17] On decoupling liability see Polinsky and Che (1991).

In particular, when high effort is induced, $e = 1$ ($r \geq \tilde{r}^{PLD}$), the IC becomes:

$$\gamma[V - (1-\eta)[(1-\delta)\Delta H + \tau R]] - f - (1-\eta)r - c \geq 0,$$

and with the optimal contract, the platform's expected utility is:

$$\Pi_1^{PLD}(R) = \gamma[V - (1-\eta)[(1-\delta)\Delta H + \tau R]] - (1-\eta)\frac{c}{\eta} - c - (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right).$$

Similarly, when no effort is induced, the sellers' participation constraint becomes:[18]

$$\gamma[V - (1-\delta)\Delta H - \tau R] - f - r \geq 0.$$

and the platform's expected utility becomes:

$$\Pi_0^{PLD}(R) = \gamma[V - (1-\delta)\Delta H - \tau R] - R - \delta H.$$

By comparing the platform's profits when investment is induced and when it is not, we find that $e = 1$ is induced when

$$R \geq \tilde{R}^{PLD} := \left[\frac{\eta + (1-\eta)(1+\phi)}{(1+\gamma\tau)\eta^2}\right] c - \frac{[\gamma(1-\delta)\Delta + \delta]H}{1+\gamma\tau}.$$

$\tilde{R}^{PLD}$ is decreasing in Δ. By the same token, the cut-off H such that consumers need not discipline the platform is also decreasing in Δ:

$$H \geq \tilde{H}_P^{PLD} := \frac{[\eta + (1-\eta)(1+\phi)]}{[\gamma(1-\delta)\Delta + \delta]\eta^2} c.$$

When this condition does not hold, in stage 1, consumers choose $R = \tilde{R}^{PLD}$ to induce $e = 1$, which leads to

$$U_1^{PLD} = (1-\gamma)\{V - (1-\eta)[(1-\delta)\Delta H + \tau\tilde{R}^{PLD}]\}.$$

If investment is not induced, $R = 0$:

$$U_0^{PLD} = (1-\gamma)[V - (1-\delta)\Delta H].$$

Then, the cutoff $\tilde{H}_C^{PLD}$ for which consumers are indifferent between inducing effort or not,

[18] Let us assume, as in section 4.2 above, that (i) consumers are still willing to buy the good when they expect it to be defective with probability 1, which requires $V \geq (1-\delta)H$, and that (ii) the platform is willing to host goods that are defective with probability 1, which requires $V \geq (1-\delta)H + \frac{\delta}{\gamma}H$. The second constraint is tighter.

if investment is not induced, $R = 0$:

$$\tilde{H}_C^{PLD} := \frac{(1-\eta)\tau[1+(1-\eta)\phi]}{\eta^2\{(\eta+\gamma\tau)\Delta - \delta[\eta(1+\gamma\tau)\Delta + \tau(1-\eta)(1-\gamma\Delta)]\}}c.$$

This expression is difficult to interpret, but it could be decreasing in Δ (increasing the set of parameters for which high effort is induced) if δ is low. For particular values, the analysis is clearer. If $\Delta = \frac{1}{1+\delta}$ consumers incur all the loss H, and δH can be interpreted as a penalty imposed on the platform. In that case, the cut-off is decreasing in δ and then the set of parameters for which high effort is induced increases.

$$\tilde{H}_C^{PLD}(\Delta = \frac{1}{1+\delta}) = \frac{\tau(1-\eta)}{\eta(\gamma+\delta+1+\tau\delta)}\left[\frac{\eta+(1-\eta)(1+\phi)}{\eta^2}\right]c$$

The above result implies that decoupling the payment from the platform following the occurrence of harm weakens the diluting effects over sellers' safety investment associated with compensation to consumers and the reduced motivation for reputational sanctions.

6 Effectiveness of Platform's Sanctions upon Sellers

In this section, we allow the effectiveness of the platform's sanctions upon sellers to vary. In practice, there might be several reasons why this is the case. For one, some agents who are actually in charge of making the safety decisions may be harder to target because their true identity may even be unknown to the platform, if the goods are sold through a mere wholesaler. In addition, some sellers may care less about their reputation and long-term viability, trying to reap profits in the short term. In some occurrences, they might easily change their trade name and/or the location of their headquarters. To account for these possibilities, in this extension, we assume that the cost for the platform of sanctioning sellers is heterogeneous. The platform knows the sellers' type, but this is unobservable to consumers.

Specifically, we let ϕ be distributed according to a continuous distribution $G(\cdot)$, with density $g(\cdot)$ over the support $[0, \infty)$. This implies that it will be prohibitively costly for the platform to sanction some types of sellers. As sellers in this section may be motivated to invest only by the platform's sanction, these high-cost sellers will not invest in equilibrium. We now assume that there exists $\tilde{\phi} \in [0, \infty)$ such that a seller will not be induced to invest if $\phi > \tilde{\phi}$.Therefore, $G(\tilde{\phi}) \in [0, 1]$ will denote the fraction of participating sellers that invest in equilibrium and will be endogenously determined by the platform's contract.

In stage 4, when joining the platform as buyer, a consumer expects to get:

$$U^E := (1-\gamma)\alpha[V - (1-\eta G(\tilde{\phi}))[(1-\delta)H + \tau R]].$$

Note that the sellers will extract the same fraction of the consumers' expected surplus, regardless of their type. As in the baseline model, in stage 3, a seller willing to join the platform will invest only if $r \geq \tilde{r} := \frac{c}{\eta}$.

Consider now stage 2. The platform will offer three categories of contract. First, with all participating sellers who do invest, the platform's contract (f_1, r_1) will be $r_1 = \tilde{r}$ and

$$f_1 = \gamma\alpha\Big[V - (1-\eta G(\tilde{\phi}))[(1-\delta)H + \tau R]\Big] - \frac{c}{\eta}.$$

Second, with all participating sellers who do not invest, the platform's contract (f_0, r_0) will specify $r_0 = 0$ and

$$f_0 = \gamma\alpha\Big[V - (1-\eta G(\tilde{\phi}))[(1-\delta)H + \tau R]\Big].$$

Participating sellers who invest will face a lower contract fee but may incur sanctions if things go awry. For those sellers that the platform does not want to include, the platform will offer any contract that does not satisfy their participation constraint.

We now need to determine simultaneously the fraction of participating sellers (α) as well as which fraction of participating sellers will invest ($G(\tilde{\phi})$), or equivalently, the threshold value $\tilde{\phi}$ below which a participating seller will invest. The platform will choose α and $\tilde{\phi}$ to maximize its expected profit:

$$\begin{aligned}\max_{\alpha\in[0,1],\tilde{\phi}\in[0,\infty]} \quad & \alpha\int_0^{\tilde{\phi}}\left[f_1 - (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right)\right]g(\phi)d\phi \\ & +\alpha(1-G(\tilde{\phi}))[f_0 - (R+\delta H)],\end{aligned}$$

Consider the first-order derivative with respect to α:

$$2f_0 - \int_0^{\tilde{\phi}}\left[\frac{c}{\eta} + (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right)\right]g(\phi)d\phi - (1-G(\tilde{\phi}))(R+\delta H).$$

Note that the platform's profit may be convex in α, in which case $\alpha = 1$. This is always the case when $V \geq (1-\delta)H$.[19]

[19]To see why, note that the second-order derivative with respect to α yields:

$$V - (1-\eta G(\tilde{\phi}))[(1-\delta)H + \tau R].$$

If $G(\tilde{\phi}) = 0$, also $R = 0$ because consumers would anticipate that their sanctions are pointless. If

When the program is concave, α^* is determined by the first-order condition:

$$\alpha^*(\tilde{\phi}) = \frac{\int_0^{\tilde{\phi}} \left[\frac{c}{\eta} + (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right)\right] g(\tilde{\phi})d\phi + (1-G(\tilde{\phi}))(R+\delta H)}{2\gamma\Big[V - (1-\eta G(\tilde{\phi}))[(1-\delta)H + \tau R]\Big]}.$$

The program is always concave in $\tilde{\phi}$ and the first-order condition yields:

$$\tilde{\phi}^*(\alpha) = \frac{\eta^2}{(1-\eta)c}\Big[[\alpha\gamma(1-\delta)+\delta]H + (1+\alpha\gamma\tau)R\Big] - \frac{1}{1-\eta}.$$

If at the above value of $\tilde{\phi}$, the platform's profit is convex in α, then the solution $(\alpha, \tilde{\phi}) = (1, \tilde{\phi}^*(1))$.

Suppose that this is the case. Then, a quick inspection reveals that the fraction of investing sellers increases with δ, H, R, and γ, whereas it decreases with c. Intuitively, when the platform suffers more severe repercussions following an accident (i.e., higher liability or harsher consumers' sanctions, or lower consumers' willingness to buy the good on the platform), it is more inclined to ensure that sellers invest.

In stage 1, consumers choose R to maximize their expected utility:

$$(1-\gamma)[V - (1-\eta G(\tilde{\phi}^*(R)))[(1-\delta)H + \tau R]].$$

A higher R has two effects: its direct effect consists in increasing the sanctioning cost for consumers, whereas its indirect effect is related to the increase in the equilibrium number of firms who invest: $\frac{\partial\tilde{\phi}^*(R)}{\partial R} > 0$. The first-order condition yields:

$$\eta g(\tilde{\phi}(R))(1+\gamma\tau)\frac{\eta^2}{(1-\eta)c}[(1-\delta)H + \tau R] - (1-\eta G(\tilde{\phi}(R)))\tau = 0$$

R is the solution to this implicit function.[20] In the following lemma we show that a higher level of platform liability reduces consumers' sanctions.

Lemma 3. *Suppose $\alpha = 1$, an increase in δ has a negative impact on R^*.*

Proof. By applying the implicit function theorem, as the denominator corresponds to the

$V \geq (1-\delta)H$, the platform would find it profitable to extend market size as much as possible even when no seller invests.

[20] Note that for the second-order condition to be satisfied, $g(\tilde{\phi})$ must be sufficiently monotone decreasing. One implication is that $G(\cdot)$ will be log-concave - see Corollary 1 in Bagnoli and Bergstrom (2005).

SOC and is negative, the sign of $\frac{\partial R}{\partial \delta}$ coincides with the sign of the numerator, that is:

$$\frac{\partial R}{\partial \delta} = \eta g'(\tilde{\phi}) \frac{\partial \tilde{\phi}}{\partial \delta} \frac{\eta^2}{(1-\eta)c}(1+\gamma\tau)[(1-\delta)H + \tau R] - \frac{\eta^3}{(1-\eta)c} g(\tilde{\phi}) H(1-\tau+2\gamma\tau) < 0,$$

as $g'(\tilde{\phi}) < 0$ and $\frac{\partial \tilde{\phi}}{\partial \delta} > 0$. □

We now determine how the degree of platform liability affects social welfare, which is given by:

$$SW = V - \left(1 - \eta G(\tilde{\phi})\right)[H + R^*(1+\tau)] - \int_0^{\tilde{\phi}} \left((1-\eta)(1+\phi)\frac{c}{\eta} + c\right) g(\phi) d\phi.$$

Below, we report the first-order condition and we point out that there are opposing forces at play.

$$\frac{\partial SW}{\partial \delta} = \overbrace{\eta g(\tilde{\phi})[H + R^*(1+\tau)] \frac{\partial \tilde{\phi}}{\partial \delta}}^{>0} - \overbrace{\left(1 - \eta G(\tilde{\phi})\right) \frac{\partial R^*}{\partial \delta}(1+\tau)}^{>0}$$
$$- \underbrace{\left((1-\eta)(1+\tilde{\phi})\frac{c}{\eta} + c\right) g(\tilde{\phi}) \frac{\partial \tilde{\phi}}{\partial \delta}}_{<0}.$$

As a higher δ increases the equilibrium number of investing sellers, i.e., $\frac{\partial \tilde{\phi}}{\partial \delta} > 0$, it reduces harm and, consequently, consumers' sanctions. This is captured by the first term. Moreover, δ at least partially replaces costly consumers' sanctions as means to incentivize the platform to induce seller's investment, because $\frac{\partial R^*}{\partial \delta} < 0$. This is captured by the second term. Yet a higher proportion of sellers who invest is also socially costly, because of the investment cost and the platform's sanctions needed to induce the safety investment. If over the support of δ, the first two terms outweigh the last one, a benevolent legislator should opt for full platform liability. Otherwise, the optimal solution will be interior. The following corollary follows.

Corollary 1. *When $\alpha = 1$, welfare may not be monotonically increasing in δ over its $[0,1]$ support.*

Suppose now that the program is concave in α and let us assume that a unique solution exists, that is, there exists a unique admissible pair $(\alpha^*, \tilde{\phi}^*)$ such that $\alpha^* = \alpha^*(\tilde{\phi}^*)$ and, simultaneously, $\tilde{\phi}^* = \tilde{\phi}^*(\alpha^*)$.

We focus now on the system of two implicit equations in three parameters in a neighbor-

hood of $(\alpha^*, \tilde{\phi}^*)$:

$$\tilde{Z}_1(\alpha, \tilde{\phi}; R) = 0 \Leftrightarrow 2f_0 - \int_0^{\tilde{\phi}} \left[\frac{c}{\eta} + (1-\eta)\left(\phi\frac{c}{\eta} + R + \delta H\right)\right] g(\phi)d\phi - (1 - G(\tilde{\phi}))(R + \delta H) = 0.$$

$$\tilde{Z}_2(\alpha, \tilde{\phi}; R) = 0 \Leftrightarrow \eta H[\alpha\gamma(1-\delta) + \delta] + \eta R(1 + \alpha\gamma\tau) - \frac{c}{\eta}[1 + \tilde{\phi}(1-\eta)] = 0.$$

Assuming that the determinant of the Jacobian matrix is strictly positive, we can make use of the implicit function theorem to study the effect of changes in R on the equilibrium choices of α and $\tilde{\phi}$.

$$sign\left(\frac{\partial \alpha^*}{\partial R}\right) = -\begin{vmatrix} \frac{\partial Z_1}{\partial R} & \frac{\partial Z_1}{\partial \tilde{\phi}} \\ \frac{\partial Z_2}{\partial R} & \frac{\partial Z_2}{\partial \tilde{\phi}} \end{vmatrix} = -\frac{\partial Z_1}{\partial R}\frac{\partial Z_2}{\partial \tilde{\phi}} + \frac{\partial Z_1}{\partial \tilde{\phi}}\frac{\partial Z_2}{\partial R},$$

which is lower than 0 if $\frac{\partial Z_1}{\partial \tilde{\phi}} < 0$, as $\frac{\partial Z_1}{\partial R} < 0$, $\frac{\partial Z_2}{\partial \tilde{\phi}} < 0$, while $\frac{\partial Z_2}{\partial R} > 0$. Thus, we can conclude that if a higher fraction of sellers that invest decreases the fraction that participates, then an increase in the consumers' sanctions negatively affect sellers' participation.

$$sign\left(\frac{\partial \tilde{\phi}^*}{\partial R}\right) = -\begin{vmatrix} \frac{\partial Z_1}{\partial \alpha} & \frac{\partial Z_1}{\partial R} \\ \frac{\partial Z_2}{\partial \alpha} & \frac{\partial Z_2}{\partial R} \end{vmatrix} = -\frac{\partial Z_1}{\partial \alpha}\frac{\partial Z_2}{\partial R} + \frac{\partial Z_1}{\partial R}\frac{\partial Z_2}{\partial \alpha}.$$

The impact of R on $\tilde{\phi}$ is instead ambiguous because $\frac{\partial Z_1}{\partial \alpha} < 0, \frac{\partial Z_2}{\partial R} > 0, \frac{\partial Z_1}{\partial R} < 0, \frac{\partial Z_2}{\partial \alpha} > 0$. Hence, when $\alpha < 1$, more severe consumers' sanctions R do not necessarily increase the number of investing firms, because they might decrease the number of participating sellers.

We now proceed to study how δ affects the fraction of participating and investing sellers. For $\alpha < 1$, a higher δ may lead to a reduction in the number of participating sellers. Intuitively, the platform does not want to allow sellers who do not invest in the platform. This is more likely to occur if a higher fraction of investing sellers decreases the participation rate, i.e., if $\frac{\partial Z_1}{\partial \tilde{\phi}} < 0$. Keeping in mind that $\frac{\partial R}{\partial \delta} \leq 0$, with strict inequality if $R > 0$, with a slight abuse of notation we consider:

$$sign\left(\frac{\partial \alpha^*}{\partial \delta}\right) = -\begin{vmatrix} \frac{\partial Z_1}{\partial \delta} & \frac{\partial Z_1}{\partial \tilde{\phi}} \\ \frac{\partial Z_2}{\partial \delta} & \frac{\partial Z_2}{\partial \tilde{\phi}} \end{vmatrix} = -\frac{\partial Z_1}{\partial \delta}\frac{\partial Z_2}{\partial \tilde{\phi}} + \frac{\partial Z_1}{\partial \tilde{\phi}}\frac{\partial Z_2}{\partial \delta}.$$

If δ has a small impact on R, then α is decreasing in δ if $\frac{\partial Z_1}{\partial \tilde{\phi}} < 0$ because $\frac{\partial Z_1}{\partial \delta} < 0$, $\frac{\partial Z_2}{\partial \tilde{\phi}} < 0$, and $\frac{\partial Z_2}{\partial \delta} > 0$. Therefore, when the platform faces more severe legal liability, it decreases participation of sellers, unless liability does not simultaneously decrease consumers' sanctions to a significant extent. If R is highly responsive to a change in δ, the result may be the opposite, as $\frac{\partial Z_1}{\partial \delta} > 0$ and $\frac{\partial Z_2}{\partial \delta} < 0$. Hence, under the same assumption that $\frac{\partial Z_1}{\partial \tilde{\phi}} < 0$, a higher degree of platform liability may be conducive to more participation.

Consider now the effect of platform liability on the fraction of investing sellers:

$$sign\left(\frac{\partial\tilde{\phi}^*}{\partial\delta}\right) = -\begin{vmatrix} \frac{\partial Z_1}{\partial\alpha} & \frac{\partial Z_1}{\partial\delta} \\ \frac{\partial Z_2}{\partial\alpha} & \frac{\partial Z_2}{\partial\tilde{\delta}} \end{vmatrix} = -\frac{\partial Z_1}{\partial\alpha}\frac{\partial Z_2}{\partial\delta} + \frac{\partial Z_1}{\partial\delta}\frac{\partial Z_2}{\partial\alpha}.$$

Irrespective of whether δ has a sizable impact on R, the relationship between δ and $\tilde{\phi}$ is ambiguous because $\frac{\partial Z_1}{\partial\alpha} < 0$ and $\frac{\partial Z_2}{\partial\alpha} > 0$.

To conclude, a higher degree of platform liability has an ambiguous effect on the fraction of investing sellers and may or may not decrease the fraction of participating sellers, depending on the extent of the substitution existing between consumers' sanctions and liability.

7 Sellers' heterogeneity and legal liability

7.1 Sellers with reputational penalties and platform liability

In this section, we consider that reputational penalties triggered by consumers may affect both the platform and the seller according to a sharing parameter β. The platform faces legal liability of δH (and consumers bear the remaining cost of harm $(1-\delta)H$). As in the main analysis, we solve by backward induction and we denote the equilibrium values of this setting with the superscript SRL. On the consumer side nothing changes, and in stage 4, when joining a platform a consumer expects to get

$$U^E := (1-\gamma)\alpha[V - (1-\eta e^E)((1-\delta)H + \tau R)].$$

In stage 3, a seller willing to join the platform decides on the safety investment:

$$\max_{e\in\{0,1\}} \quad -(1-\eta e)(r + (1-\beta)R) - ce.$$

Similarly to the main case, a seller weakly prefers to invest if r is at least as high as the following critical value, $\tilde{r}^{SRNL} = \max\{\frac{c}{\eta} - (1-\beta)R, 0\}$. When the seller bears some reputational sanctions, the required platform penalty for inducing effort is reduced. Moreover, if $R > \frac{c}{\eta(1-\beta)}$, then the seller has incentives to provide high effort without any platform penalty. We focus on the case in which $R \leq \frac{c}{\eta(1-\beta)}$. Notice that as the reputational penalty R is costly, R higher than $\frac{c}{\eta(1-\beta)}$ is never optimal.

Consider now stage 2 and suppose that we are in the equilibrium where sellers are induced

to invest, i.e., $e = 1$. The platform chooses the contract (f, r) to maximize:

$$f - (1 - \eta)(\phi r + \beta R + \delta H),$$

subject to the sellers' participation constraint:

$$\gamma[V - (1 - \eta)((1 - \delta)H + \tau R)] - f - (1 - \eta)(r + (1 - \beta)R) - c \geq 0,$$

and the sellers' incentive compatibility constraint:

$$r \geq \tilde{r}^{SRL}.$$

It can be shown that, when investment is induced (subscript 1 below),

$$\begin{aligned} r_1^{NL}(R) =& \frac{c}{\eta}; \\ f_1^{NL}(R) =& \gamma[V - (1 - \eta)(1 - \delta)(H + \tau R)] - (1 - \eta)\frac{c}{\eta} - c. \end{aligned}$$

The platform's expected utility is:

$$\begin{aligned} \Pi_1^{SRL}(R) &= \gamma[V - (1 - \eta)((1 - \delta)H + \tau R)] - (1 - \eta)\frac{c}{\eta} - c - (1 - \eta)\left(\phi(\frac{c}{\eta} - (1 - \beta)R) + \beta R + \delta H\right) \\ &= \gamma[V - (1 - \eta)((1 - \delta)H + \tau R)] - (1 - \eta)(1 + \phi)\frac{c}{\eta} - c - (1 - \eta)((\beta - (1 - \beta)\phi)R + \delta H) \end{aligned}$$

Platform profits are decreasing in δ, $\frac{\partial \Pi_1^{SRL}(R)}{\partial \delta} = (\gamma - 1)(1 - \eta)H < 0$, since higher δ increases consumers surplus but the platform can appropriate only a fraction γ, and this cannot offset the cost of increased liability. Platform profits are also decreasing in β, $\frac{\partial \Pi_1^{SRL}(R)}{\partial \beta} = -(1 - \eta)(1 + \phi)R < 0$. Bear in mind that the platform internalizes the impact of the consumer reputational sanction faced by the seller, since the latter has to be compensated by the platform for all its costs. However, the lower the reputational sanction falling upon the seller, the more incentives for safety effort need to be generated by the platform through another costly sanctioning mechanism. Thus, it gives rise to a sort of "double marginalization" scenario leading to lower platform profits.

As in the baseline setting, we now analyze the equilibrium where sellers are not induced to invest, i.e., $e = 0$. The platform chooses the contract (f, r) to maximize:

$$f - (\phi r + \beta R + \delta H),$$

subject to the sellers' participation constraint:[21]

$$\gamma[V - ((1-\delta)H + \tau R)] - f - r - (1-\beta)R \geq 0.$$

It follows that, when $e = 0$, the contract between the platform and the seller prescribes (subscript 0 below):

$$\begin{aligned} r_0^{SRNL}(R) =& 0; \\ f_0^{NL}(R) =& \gamma[V - ((1-\delta)H + \tau R)] - (1-\beta)R \end{aligned}$$

The platform's expected profits when high effort is not induced is equivalent to the baseline model:

$$\Pi_0^{SRL}(R) = \gamma[V - ((1-\delta)H + \tau R)] - R - \delta H.$$

Then, $\Pi_0^{SRL}(R)$ does not depend on β, and it is decreasing in δ, $\frac{\partial \Pi_0^{SRL}(R)}{\partial \delta} = (\gamma - 1)H < 0$.

The incentives to induce effort by the platform are captured by the difference between profits with and without effort, $\Pi_1^{SRL} - \Pi_0^{SRL}$, and this difference is decreasing in β. Then, the platform's profit function on (e, β) is submodular, which implies that inducing effort from the seller is relatively more atractive the lower is β (the higher the fraction of consumers' sanctions that fall upon sellers).

We formalize this by comparing the platform's profits when safety investment is induced and when it is not. We find that $e = 1$ is induced when $\Pi_1^{SRL} > \Pi_0^{SRL}$, that is

$$\gamma[V - (1-\eta)((1-\delta)H + \tau R)] - (1-\eta)(1+\phi)\frac{c}{\eta} - c - (1-\eta)((\beta - (1-\beta)\phi)R + \delta H) > \gamma[V - ((1 -$$

$$(1 + \gamma\eta\tau - (1-\eta)(\beta(1+\phi) - \phi))R > [\eta + (1-\eta)$$

This inequality implies that it is optimal to induce effort by the platform if the consumer reputational sanction is large enough.

$$R \geq \tilde{R}^{SRL} := \left[\frac{\eta + (1-\eta)(1+\phi)}{(1 + \gamma\eta\tau - (1-\eta)(\beta(1+\phi) - \phi))}\right]\frac{c}{\eta} - \frac{\eta(\gamma(1-\delta) + \delta)H}{(1 + \gamma\eta\tau - (1-\eta)(\beta(1+\phi) - \phi))}.$$

$\tilde{R}^{SRL}$lower than zero, means that consumers do not need to discipline the platform. This happens if $H \geq H_P^{SRL} = \frac{[\eta + (1-\eta)(1+\phi)]}{(\gamma(1-\delta)+\delta)\eta^2}c$. In line with the baseline model, H_P^{SRL}, is decreasing in δ, since the platform has more incentives to induce effort as a consequence of facing

[21] Let us suppose for now that the consumers are still willing to buy the good when they expect it to be defective with probability 1, which requires $V \geq H$.

legal liability.

If $H < H_P^{SRL}$, $\tilde{R}^{SRL}$ is increasing in β since the denominator is decreasing in β. However, it is less sensitive to changes in β ($\frac{\partial^2 \tilde{R}^{SRL}}{\partial\beta\partial\delta} < 0$), the higher is the platform exposure to liability, δ.

Following similar arguments than in the baseline model, we compare the utility of the consumers when they induce high effort, $e = 1$, $R = \tilde{R}^{SRL}$,

$$U_1^{SRL} = (1-\gamma)[V - (1-\eta)((1-\delta)H + \tau\tilde{R}^{SRL})].$$

and when they do not, $R = 0$:

$$U_0^{SRL} = (1-\gamma)(V - (1-\delta)H).$$

Thus, consumers impose reputational punishment with an eye on inducing safety investments when $H \in [H_C^{SRL}, H_P^{SRL})$ where

$$H_C^{SRL} := \frac{(1-\eta)\tau\tilde{R}^{SRL}}{(1-\delta)\eta}.$$

H_C^{SRL} is implicitly defined, since $\tilde{R}^{SRNL}$ also depends on H_C^{SRL}. In fact, we can rewrite the previous equation as follows

$$F(H_C^{SRL}, \beta, \delta) = \frac{(1-\eta)\tau\tilde{R}^{SRL}}{(1-\delta)\eta} - H_C^{SRL} = 0$$

Then, by using the total derivative, we can conclude that $\frac{dH_C^{SRL}}{d\beta} = -\frac{\frac{\partial F}{\partial \tilde{R}^{SRL}}}{\frac{\partial F}{\partial H_C^{SRL}}}$ As $\frac{\partial F}{\partial H_C^{SRL}} < 0$, and $\tilde{R}^{SRL}$(and F) is increasing in β, then $\frac{dH_C^{SRL}}{d\beta} = -\frac{\frac{\partial F}{\partial \tilde{R}^{SRL}}}{\frac{\partial F}{\partial H_C^{SRL}}} > 0$. As H_C^{SRL} is increasing in β and H_P^{SRL} is independent of β, then we can conclude that the set of parameters for which high effort is induced is decreasing in β. However, the comparative statics with respect to δ are less clear cut. Notice that given $F(H_C^{SRL}, \beta, \delta) = \frac{(1-\eta)\tau\tilde{R}^{SRL}}{(1-\delta)\eta} - H_C^{SRL}$,the sign of $\frac{\partial F}{\partial \delta}$ depends on the values of the parameters, since $\tilde{R}^{SRL}$ is decreasing in δ because more platform liability allows to induce effort with lower reputational sanctions. But the denominator is also decreasing in δ, as consumers have lower incentives to induce effort since they receive higher compensation from the platform. Therefore, the sign of $\frac{dH_C^{SRL}}{d\delta}$ is inconclusive. This is in contrast with the baseline model ($\beta = 1$) in which these two effects are also present, but the denominator effect is stronger. In this more complex setting whether or not one effect is stronger than the other depends on the values of the

parameters.

Until now, we have considered that firms are homogenous regarding β and that there is always possibility of trade between consumers and platforms/sellers. However, it is perhaps more realistic to consider that the utility of the consumer may eventually be negative and the platform may prefer not to offer a product to consumers. Also, the platform may face heterogenous sellers in terms of their β. In such a case, for a given $H \in [H_C^{SRL}, H_P^{SRL})$ (otherwise the parameter β is irrelevant). it may be possible that $\Pi_1^{SRL}(\delta, 0) > 0$, and $\Pi_1^{SRL}(\delta, 1) < 0$. If this is the situation, there exists a cut-off $\overline{\beta}(\delta)$ such that if $\beta < \overline{\beta}(\delta)$ the product would be supplied in the platform, but not otherwise.

How would the level of legal liability of the platform (δ) influence this result? Since inducing the platform to motivate the seller to invest in safety through legal liability instead of through consumers' reputational sanctions makes platform's profits less responsive to β, legal liability would make the selection of sellers active in the platform on the basis of β less appealing for the platform. On the one hand, it may reduce the overall profitability from the products. Moreover, it expands the region of H for which the platform's actions are independent of β. On the other hand, it reduces the relative cost difference of inducing effort from sellers with a lower β (more exposed to the reputational penalty from consumers) compared with those who are less sensitive to the consumers' reputational sanctions.

In sum, when reputational sanctions imposed by consumers may affect both the platform and the seller, legal liability on the platform reduces the importance of restricting access to the platform to sellers who are not impacted in a meaningful way by the punishments that consumers set in the wake of a negative event with a product bought on the platform. However, this effect may be offset by the fact that increasing liability may reduce the profits of the platform.

In fact, if we are in the interior of the interval, and $\Pi_1^{SRL}(\delta, \overline{\beta}(\delta)) = 0$, we can compute how locally the cut-off $\overline{\beta}(\delta)$, and the products listed by the platform depend on δ. In particular, $\frac{d\overline{\beta}(\delta)}{d\delta} = -\frac{\frac{\partial \Pi_1^{SRL}}{\partial \delta}}{\frac{\partial \Pi_1^{SRL}}{\partial \beta}}$, as $\frac{\partial \Pi_1^{SRL}}{\partial \beta} < 0$, the sign of $\frac{d\overline{\beta}(\delta)}{d\delta}$ depends on the sign of $\frac{\partial \Pi_1^{SRL}}{\partial \delta}$. Calculating this derivative we obtain

$$\frac{\partial \Pi_1^{SRL}}{\partial \delta} = -(1-\eta)[(1-\gamma)H + (\gamma\tau + \beta - (1-\beta)\phi)\frac{\partial \tilde{R}^{SRL}}{\partial \delta}]$$

As $\frac{\partial \tilde{R}^{SRL}}{\partial \delta} < 0$, a sufficient condition for the range of sellers active in the platform to go down when platform liability increases is that $\gamma\tau + \beta - (1-\beta)\phi$ is negative. Otherwise, we can obtain the opposite result for some parameter values, induced by the fact that platform liability reduces the required reputational sanction and, consequently, the comparative

advantage of firms with low β.

7.2 Sellers with heterogeneous liability exposure.

Now we will turn to a different source of heterogeneity across sellers. We refer to the ability to face compensation to consumers in case an accident involving the products they sell through the platform causes harm to consumers. This is something that has been considered in previous contributions (Hua and Spier, 2021; Zennyo, 2023).

Let's imagine in our setting (where sellers initially faced no direct liability vis-à-vis consumers) with platform liability δH, where $\delta \in [0, 1)$ that sellers can also be liable, so that in case an accident affecting a given seller's product takes place, the platform faces an expected effective payment to consumers of $\lambda\delta$H (where $\lambda \in [0, 1]$), and the seller who sold the product faces $(1 - \lambda)\delta$H.

When the seller can cover the entire payment legally mandated to the consumer (so that, effectively, $\lambda = 0$), there seems to be little room for having legal liabilities for third-party products being imposed upon the platform. This may make sense only when having the platform initially fronting claims from and payments to consumers saves administrative costs. An example may be found in settings where H is typically low, the loss to the consumer occurs shortly after the delivery of the product, and the platform is in possession of funds belonging to the seller (e.g. the purchase price from that or from other transactions) that can be used to compensate consumers. This would explain why return and reimbursement policies typically offered by intermediary platforms are generous and easily allow consumers to get their money back if they promptly claim that something is wrong with the product bought through the platform.

There are numerous factors, however, leading to sellers in the platform not being easily targeted by a direct claim from the consumer or a contribution claim from the platform who has initially compensated the consumer: sellers may be hard to trace, foreign-located, or lack the assets to pay compensation, especially if the harm affects a large number of consumers buying the same product.

If sellers are heterogeneous in the effective λ that they are likely to imply for the platform under a meaningful legal regime of platform liability (that is, when δ is significantly larger than 0), the platform would be in a situation broadly comparable to the one we analyzed in the previous sub-section: the platform may prefer -because the relative costs to induce effort from the seller are lower, provided that effort can be induced- to allow access to the platform only to those sellers who would imply a lower effective λ for the platform.

This may be the case either because the seller may be directly sued by the consumer or, more probably, because the platform is able to use the possibility of "passing-on" the compensation paid to consumers to induce effort from the seller[22]. The intuition behind this result is similar to the one we observed previously in this section, and namely the kind of "double marginalization" in providing incentives for safety to sellers (now, with costly internal sanctions by the platform relative to the "passing on" of liability, and not the costly internal sanctions relative to the also costly consumer reputational sanctions).

One could think that the legal liability regime may mandate a fixed level of platform liability that cannot be passed on to sellers ($\lambda = \bar{\lambda}$) through contribution actions or similar mechanisms. Similarly to what we noticed earlier in this section, this may make platforms less concerned with the characteristics of sellers conducive to a certain effective level of λ. However, under such a regime, in order to provide incentives to sellers the platform would need to resort to the costly internal platform sanctions, that may be less cost-effective than relying on contribution actions against sellers or other similar schemes.

8 Exploring some policy dimensions and implications

When confronted with the emergence and expansion of phenomena that do not find explicit solutions in the current legal framework, it is not surprising that the initial reaction of courts and legal commentators across legal systems tends to be a re-interpretation of the doctrines and notions that seem to stand closer to the developments deserving attention. Sometimes, this process implies stretching the previous concepts and principles well beyond the boundaries of the consensus that prevailed prior to the new factual scenarios. Very often, this occurs as a result of arguments and reasons grounded on "similarities" in factors or dimensions that would apparently lend support to such extension. Analogy lies at the core of the mechanisms through which the law evolves and covers new terrain.

In connection with liability of online platforms acting (at least formally) as intermediaries in transactions over goods and services between consumers and sellers (both professional traders and non-professional offerors of certain products and services) US courts and commentators have struggled with the application of the concept of "seller" or "distributor" to e-commerce platforms. On several legal grounds, and not only in pure liability in contract or concerning the scope of product warranties, such notions are key to determine the liability consequences of the operations of the online platform.

In Europe, due to the stricter separation -and the differential specific scope of the relevant

[22]This can eventually take place ex ante through mechanisms such as the requirement to show reliable liability insurance or to post bonds to cover potential liabilities that the platform may face vis-à-vis consumers as a result of products sold over the platform by a seller.

legal provisions- between the realms of liability for breach of contract, liability for non-conformity of traded goods, and liability for harm to life and limb, the debate has appeared more fragmented than in the US. In EU Directive 2019/771, on the sale of consumer goods, the European rules do not treat online platforms acting as intermediaries in third party transactions as traders or sellers, and thus do not directly subject them to the consequences of non-conformity in the goods delivered to the consumer, albeit national legal systems in the EU are granted regulatory leeway to assimilate, totally or partially, online platforms to sellers in the strict sense.

In turn, EU product liability law does not hinge upon the notion of seller or supplier -or only on a subsidiary basis- but upon that of manufacturer of the product resulting in harm. Only with thin factual and legal support it seems possible to stretch the notion of manufacturer to online intermediary platforms, so the efforts in this area have focused on the introduction of changes into the current EU legal framework, as we already mentioned in the introduction. Thus, in Europe the interpretive efforts concerning existing rules (that is, beyond the moves to modify the existing legal regime) and doctrines have mainly been directed towards the factors that could lend support to finding online platforms liable vis-à-vis consumers on several grounds or principles that could make feasible to speak of a contractual relationship between the consumer and the online platform comprising the goods and services transacted within the platform.

Beyond the implementation of the provisions and doctrines in force in various areas of the law, we believe that the debate should bring to the foreground the rationales for online platform liability underlying third-party transactions, as well as their impact on the contours and design of such liability regimes. We find a number of different strands in the policy reflections behind the proposals to expand the current liability framework to online intermediary platforms.

One is linked to a notion with a long pedigree (Calabresi (1970)) in the economic analysis of tort liability: the cheapest cost avoider. Sharkey (2020, 2022), argues that in the world of e-commerce mediated by online platforms, the operators of the latter are the cheapest cost avoiders with respect to the defects and unsafe features of the consumer goods transacted in the platform. In the physical marketplaces, sellers can exercise a positive role on the safety of products through a combination of channels and influences: ongoing relationships with manufacturers, indemnification actions from the ultimately responsible agents, decisions over what to place and not to place in the market, loss-spreading through price increases over their entire consumer base. The same is true of online marketplaces, who are the new "essential players" exercising control over what is transacted inside the platform. This is even reinforced in the face of relevant platform's functions in certain areas: providing packaging, storage and shipment of goods sold by

third party sellers who interact with consumers on the platform.

In a related fashion, Van Loo (2020) argues that those who control a certain network environment should be considered as the "principal" or controlling party with respect to the negative effects on consumers arising from all interactions inside the network. This brings the rationale for making online platforms liabile close to the traditional doctrines of respondeat superior and vicarious liability. Online platform operators occupy a key position in the governance of the interactions mediated through the platform. They are thus in the best position to police, monitor and punish behavior taking place within the platform.[23]

In the European debate, the ELI model rules (European Law Institute (2019)) emphasize the notion of the platform's predominant influence over the seller, and whether consumers can reasonably rely on such influence. Affirming the existence of a predominant influence involves, according to the model rules, an inductive judgement based upon a number of factors: the seller exclusively contracts with consumers through the platform; there is uncertainty at the time of contract formation as to the true identity of the seller, control of the payments to sellers by the platform; marketing and price-setting is controlled by the platform, etc. As to the reasonable reliance by consumers on the existence of such predominant influence, this seems to be close to the consumers' expectations principle, although here linked to the degree of involvement and influence that the platform exercises over the sale of the product or service, and not to the safety of the product as such.

With our model we intend to highlight a number of factors that we believe are relevant to understand the role that platform liability may play to improve the functioning of online markets. In this sense, obviously, we are interested in the incentives that a liability regime may create for the parties to undertake actions when there is a risk of malfunction of goods exchanged on the platform. To be sure, a number of contributions have explicitly looked into the incentives that liability may generate to platform operators in order to monitor, screen, and reduce harm from goods, services, and content that rely on the platform for their hosting and exchange: Buiten et al. (2020), Jeon et al. (2021), and Hua and Spier (2021).

Our model, however, does not only look at the incentives for the platform to engage in monitoring or screening actions to increase detection, exclusion, and sanctioning of misbehavior by the agents who offer goods, services, and content on the platform. We think that one needs to look at the behavior of the three parties: sellers who trade on the platform, the platform operator, and consumers. Platform liability is likely to affect the

[23]It is also argued that there are efficiency gains in relying on large businesses (such as sizable and even dominant providers of online platform services) to regulate behavior of a multitude of unconnected sellers, when the alternative is the direct regulation by the government: Van Loo (2020).

behavior of all three of them, taking into account the parameters that define how sellers interact with consumers and how the online platform operator sets the rules for sellers to be able to offer their goods and services through the platform. Moreover, we believe that how consumers' sanctions, platform internal penalties for harmful outcomes, and legal liability operate in conjunction lies at the core of the matter. In this respect, given the sheer size and heterogeneity of goods exchanged in platforms, we do not think that *ex ante* screening or monitoring of sellers' effort by platforms is a realistic goal that can be positively and meaningfully pursued through platform liability.

We also consider that among the circumstances that condition the way in which the three players interact in the online platform contracting game, the efficiency of organizing the complaints from consumers, and eventually providing compensation for the latter, as a result of interactions in the platform is particularly relevant. For many transactions that take place on a platform, channelling the interactions after an adverse event related to a good or service materializes through the platform is typically more efficient. It both saves administrative costs and fits the expectations of consumers who transact through the platform with third parties[24]. In such a setting the imposition of legal liability for product malfunction to the online platform may be particularly appealing.

In fact, one can empirically observe that online platforms "voluntarily" (i.e., when not legally required or beyond what is legally requested) take over the fronting of complaints vis-à-vis consumers when the stakes are not too high: lack of delivery of goods or services -even when the online platform is not involved in shipment-, non-conformity of the goods or services with what the consumer expected, and regrets about having bought a certain item, through liberal return policies with no or very little questions asked, providing indemnity for minor instances of harm from the use of the products. This is especially the case for complaints arising shortly after delivery of the goods, since the platform would be using the proceeds from the transaction (that, simply deducting the platform's fee, belong to the seller) to provide redress.

What are the effects of increased (from this voluntarily assumed level up to the level of complete and full) liability of the online platform for consumer harm?. Our paper points out that the consequences are not straightforward. Some dilution of incentives of sellers may take place for low levels of consumer harm when consumers are compensated by platforms. Formal legal liability, however, allows consumers to reduce costly reputational sanctions over platforms and sellers. Also, when the effectiveness of disciplinary measures by the platform over sellers is heterogeneous across sellers, platform liability may positively affect the equilibrium safety investments and the participaton rate of sellers in the

[24]To be sure, this may not necessarily be the case, and a fraction of consumers may prefer to deal directly with the seller.

platform. Similarly, online platform liability also affects how platform operators select sellers who may be more or less affected by consumers' reputational sanctions when these fall both upon the platform and sellers. Depending on parameter values, one may end up with a less selective outcome in terms of sellers active on the platf.

We do not deny that other approaches are feasible to obtain a comprehensive picture of online platform liability. But we think that focusing (as legal provisions, courts, and commentators sometimes do) on other settings and factors may not necessarily lead us to a better understanding of the issues involved in online platform liability. For instance, consumer reliance on predominant influence, or whether sellers are perceived as being agents of the online platform may be relevant for other dimensions of the problem (consumer fraud online, how online transactions should be framed for adequate consumer choice) but perhaps less so for the general liability problem of online platforms for harm ensuing from third party transactions.

9 Conclusions

Intermediaries have accompanied economic exchange for centuries. In our current world, online platforms are perhaps more ubiquitous and influential on economic transactions than their predecessors in the offline environment. We very often buy groceries, appliances, books, entertainment, transportation, travel, leisure, food, financial products, and many other goods and services through them. Our daily lives crucially depend on the availability and functioning of online platforms.

Not surprisingly then, their emergence and expansion have posed serious problems for several areas of law and public policy, from antitrust to data protection, from IP to consumer contracting. Legislatures, courts, and commentators struggle to capture the features of online platforms and their influence on the performance and consequences of the main principles and solutions in different legal fields. Platforms provide a natural stress test for a large portion of our legal and policy consensus.

One of the topics widely debated with respect to online platforms and their intermediary role is that of liability for transactions made by (independent, that is, not controlled by the platform) sellers and buyers that go wrong, generating negative consequences for buyers (personal harm or economic loss). Legal discussions and economic contributions have flourished with the goal of providing a better understanding and solution. In this paper we offer a theoretical model intended to shed light on this matter. Our distinctive feature lies on the tripartite active interaction between the 3 players: platform, seller, and consumers. Consumers react to product mishaps, platforms are able to discipline sellers

as to their safety level through measures taken inside the seller/platform contract, and sellers may invest in safety to reduce the expected harm from their products.

In such a setting, imposing legal liability on the platform for third party products will have a number of positive effects: substitute costly reputational sanctions by consumers, improve safety when sellers are heterogeneous on how sensitive they are on internal platform sanctions, and the possibility, under certain conditions, of expanding the range of sellers selected by the platform when the latter are diverse in how they are reached by platform's internal penalties and consumers' reputational sanctions. The counterproductive effect is linked with the decrease in safety that may follow the reduction in reputational punishments for low levels of consumer harm.

Naturally, there are many complications that would enrich the setting and the analysis: competition among platforms, platforms that compete with sellers with their own products, litigation and settlement costs, just to name a few. We believe, however, that the paper may illuminate some of the current legal and policy debates in Europe and the US, and we hope to provide more specific policy suggestions concerning contract, tort, and regulatory remedies in future research.

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