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e-Commerce Platforms and Self-preferencing

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e-Commerce Platforms and Self-preferencing

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Abstract

I survey the literature on eCommerce platforms with particular emphasis on the antitrust debate on self-preferencing by Amazon. The business model of hybrid marketplaces is based on monetization through commissions on third party sellers hosted on the platform and direct margins on own products. Recent theoretical and empirical work on endogenous marketplace structures has analyzed the welfare impact of the dual mode and of recommendation algorithms that have been associated with self-preferencing strategies. The trade offs are complex and one cannot easily conclude that Amazon entry is biased to expropriate third party sellers or that a ban on dual mode, self-preferencing or copycatting would benefit consumers.

Key words: eCommerce, Endogenous marketplace structures, Business models, Self-preferencing.

JEL Code: L1, L4.

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1 Introduction

This work reviews the literature on e-Commerce platforms such as Amazon and related antitrust issues. A common narrative in the public domain is that the dual role of Amazon, as a platform owner hosting third party sellers and a downstream player competing with them, creates inevitable conflicts of interests. In particular, it is part of the current accepted norm that Amazon squeezes rival third party sellers by setting commission fees too high so as to foreclose them, is engaged in self-preferencing with systematic recommendation of its own products, and reduces investment and entry of sellers by introducing products in spaces already occupied by them. While the public narrative focuses on size and power of Amazon, its business model and its commissions and strategies have been the focus of theoretical and empirical investigations, leading to mixed conclusions.[2]

Let us consider a main issue in the policy debate, self-preferencing. Although there is no unanimous definition of it, especially when it comes to understanding what the motivation and effect of such conduct may be, self-preferencing brings to mind manipulation, bias and consumer steering. This is not by chance, since the antitrust debate introduced this concept with reference to dominant ad-funded platforms which were systematically biasing search results to favor own vertical services. The ability of those platforms to monetize on sponsored ads (and not on organic ads and transactions) as long as customers are retained within their ecosystem was the reason why self-preferencing was profitable. And the potential foreclosure of third party services was the reason why it could harm consumers. Does this logic apply to e-Commerce platforms?

The economic literature has analyzed the implications of the business model of hybrid marketplaces, which is based on monetization of both own products through direct margins and third party products through commissions on revenues. Within this business model, the same notion of self-preferencing loses its original meaning. The systematic recommendation of own products to foreclose rivals conflicts with the decision of hosting third party sellers to collect commission revenues (especially for a platform that started as retailer and now collects most of its revenues from third parties). And when the recommendation of own products happens, it is far from obvious that it harms consumers. A basic logic would actually suggest that own products are introduced and recommended when they generate more profits through larger purchases and lower costs, and this normally benefits consumers. If there is an economically meaningful notion of self-preferencing, this should lie where steering consumers toward own products increases long run direct profits beyond losses in commission revenues, and at the same time reduces aggregate consumer welfare.

Recent theoretical works, however, suggest that the conditions for harmful entry and self-preferincing by a marketplace are rarely met (Jiang *et al.*, 2011; Hagiu and Wright, 2015; Etro, 2021a; Zennyo, 2022; Hervas-Drane and Shelegia, 2022; Dendorfer, 2023; Bisceglia and Tirole, 2023). For instance, when there

[2] An early discussion of the antitrust implications of differences in business models of platforms can be found in Caffarra (2019).

are competitive sellers for independent products, a marketplace has an incentive to introduce and recommend its own versions only when they increase also consumer welfare: this is an application of the One Monopoly Profit theorem to platforms.[3] This theorem breaks down after taking in consideration various market imperfections, but without generating a systematic bias in favour of the products by the marketplace. For instance, when sellers have market power and monetization through commissions generates some form of double marginalization, the introduction of private labels becomes profitable but also desirable for the customers, and harmful self-preferencing is even less likely (Jiang *et al.*, 2011; Etro, 2021a; Kang and Muir, 2021). Moreover, a main reason why a marketplace would introduce its products is not to manipulate customers to buy them, but to strengthen competition on the platform and reduce the prices of sellers while expanding customer purchases and commission revenues (Hagiu, Teh and Wright, 2022; Tremblay, 2022; Dendorfer, 2023). However, the existence of myopic consumers may allow the platform to bias product recommendations to favour own products and relax price competition (Hervas-Drane and Shelegia, 2022). Hagiu, Teh and Wright (2022) have emphasized another rationale for self-preferencing: when consumers learn about products through the marketplace and can then purchase them through outside channels, there is an additional incentive for the marketplace to favour its own products and hide those of third party sellers, reducing sales on the outside channel. On the empirical front, research by Zhu and Liu (2018) and Crawford *et al.* (2022) suggests that the main purpose for Amazon entry is to internalize platform-wide externalities and strenghten competition to attract more customers.

Online marketplaces offer a variety of differentiated products that are imperfectly substitutable for consumers (Anderson and Bedre-Defolie, 2022, 2023, Shopova, 2023a,b). This generates benefits from variety, but may also introduce an incentive to change conditions for sellers to divert demand toward own products. Then, new products by the marketplace exert an ambiguous impact on consumer welfare: positive by adding new varieties and eliminating double marginalization, and potentially negative by increasing fees and prices of third party products. Gutierrez (2021) has developed a structurally estimated model of Amazon, with the purpose of estimating the welfare impact of its dual role. His results suggest that simple policy interventions such as a ban of the dual model, turning Amazon into a pure marketplace or a pure retailer, can hardly create benefits for consumers. The reason is that they either degrade services that customers appreciate, such as shipping by Amazon, or reduce the vast selection of products available on Amazon, and they can also induce further increases in fees.

[3] Bisceglia and Tirole (2023) provide an explicit definition for this environment: "Aside from efficiency motives, a platform (the monopoly segment) has no incentive to foreclose a 3rd party app (an independent player in the competitive market): A rich ecosystem benefits consumers in two ways, product variety and enhanced competition, and allows the platform to raise its consumer price to extract the associated increase in consumer surplus." According to the authors self-preferencing materializes only for platforms with low commissions and zero-price constraints on products.

The main dynamic argument for harmful self-preferencing emerges through the impact on the entry of sellers, which affects consumers in the long run. By reducing the expected profits of the sellers, self-preferencing would lead some of them to exit and other potential sellers to reduce their investment. However, there is a more profitable way to monetize on sellers that have been hosted on the platform, which is to increase fees: when this happens, the platform could shift demand toward its own products, reduce the variety of third party products and increase their prices, creating consumer harm (Anderson and Bedre-Defolie, 2023). This is a powerful mechanism, but not the only one in action. When the platform introduces own products and reduces entry and sales of sellers, it also suffers a reduction of commission revenues. This creates an incentive to recover some of these revenues by reducing commissions to attract entry of sellers, which benefits consumers through lower prices and gains from variety (Etro, 2023a). In practice, either the raising rivals's cost effect or this extensive margin effect may dominate (as in Hervas-Drane and Shelegia, 2022) or they may simply balance each other (as in Zennyo, 2022).

Further implications have been emphasized in the literature. Zennyo (2022) and Hervas-Drane and Shelegia (2022) have argued that in the presence of myopic consumers the marketplace may bias recommendations toward its products, but would then reduce commissions to recover entry of sellers, and attract more customers from other sale channels. Lee and Musolff (2021) have developed a structurally estimated model of Amazon that takes into account free entry of sellers and have estimated the algorithm used by Amazon to assign the *Buy-Box* recommendation, assuming that a fraction of consumers are myopic and purchase only recommended products. On this basis, they have estimated the welfare impact of a ban on self-preferencing and found that it harms myopic consumers without sufficient compensation for the sophisticated ones through lower prices and additional entry.

Advertising and innovation on e-Commerce platforms are the focus of increasing attention. On one side, sponsored search ads are expanding on online marketplaces, but they crowd out commission revenues generated through organic search. This implies that the platforms regard ad fees and commission fees as substitute tools of monetization, and that there are limited gains from biased recommendations (Ciotti and Madio, 2022). On the other side, the use of third party sellers's data to introduce imitative products by marketplaces creates concerns for innovation, but the literature has suggested that a marketplace would naturally commit to limit the introduction of copycat products for the exact purpose of preserving the proper incentives of sellers to invest and create future products to be monetized through commission revenues (Etro, 2021a; Jeon and Rey, 2022b; Choi, Kim and Mukherjee, 2023). Building on these insights, the important work of Madsen and Vellodi (2024) has opened the debate on appropriate forms of data regulation to protect investments on e-Commerce platforms.

The framework described in this survey appears useful to analyze the complex interactions taking place on the Amazon marketplace, but does not allow one to draw unambiguous policy implications. Simple interventions, such as

a ban on dual mode, self-preferencing or copycatting, can hardly benefit consumers, because they either degrade services and product variety or induce higher prices or commissions. Further progress could arrive from the empirical research, which has started to explore self-preferencing issues (see Crawford *et al.*, 2022; Chen and Tsai, 2023; Farronato, Fradkin and MacKay, 2023).

The rest of this survey is organized as follows. Section 2 sets up a general framework to analyze the business model of a hybrid marketplace and its entry decisions. Section 3 extends it to imperfect substitutability between products on the marketplace. Section 4 extends the same framework to endogenous entry of sellers. Section 5 studies sponsord ads and innovation. Section 6 concludes.

2 Marketplaces and self-preferencing

The economic analysis of a hybrid marketplace such as Amazon must take into account the crucial ingredients of a business model based on monetization from all the products available on the platform. The marketplace provides products that are differentiated by features, sellers, shipping services, prices and more for many product categories. Consumers benefit from more variety and lower prices compared to outside options and spread their purchases across various products. Third party sellers set their prices and can decide whether to adopt further services from the platform, such as shipping services. Finally, the platform sets commission rates on revenues of sellers and prices for its own products, and can adopt further strategies that affect matching between customers and products (i.e.: recommendations), advertising and more. These basic ingredients are common to most theoretical and empirical models recently advanced in the literature.

To frame the basic scenario, let us consider a product category with various products available on Amazon demanded in quantity q_j and produced at marginal cost of production and shipping c_j for each product j. We distiguish products sold by third party ($3P$) sellers on Amazon, and products directly sold by Amazon (A) and purchased at wholesale price w_j from producers that bear the effective marginal cost. Each third party seller of product i is subject to the payment of a commission at rate $\tau_i \in (0,1)$ and expects gross profits:[4]

$$\pi_i = [p_i(1-\tau_i) - c_i]\, q_i \tag{1}$$

The marketplace monetizes on the two respective sets of products according to:

$$\pi_A = \int_{i\in 3P} \tau_i p_i q_i di + \int_{j\in A} (p_j - w_j) q_j dj \tag{2}$$

In the simple case of a private label or in case of competitive wholesalers, Amazon bears the effective marginal cost of production $w_j = c_j$. However, when

[4] For a discussion on why e-Commerce platforms use percentage fees see Muthers and Wismer (2023).

Amazon acts as first party retailer for a producer with market power, the latter sets w_j to maximize profits $\pi_j = (w_j - c_j)q_j$.

In the rest of this section we use this basic framework to explore the decisions of the marketplace on entry with its own products and pricing under a variety of market conditions. We conclude by evaluating the available empirical evidence on Amazon entry.

2.1 One Monopoly Profit theorem and its limits

To gain basic insights on the incentives of the marketplace and their welfare consequences, we need to microfound the demand system to identify a measure of consumer welfare. We start from the simplest case where the marketplace provides a given variety of independent products. This allows us to determine conditions under which a version of the One Monopoly Profit (OMP) theorem for platforms holds, in the sense that a monopolistic marketplace has no incentives to introduce its products or steer consumers toward them unless this is also in the interest of consumers. We then relax the conditions for the OMP result and verify when a bias can emerge.

Let us consider a unit mass of consumers with quasilinear preferences, whose consumer welfare is expressed by:

$$V \equiv \int_j v(p_j)dj + H \tag{3}$$

This is the sum of the surplus functions generated by each product j supplied on the marketplace, decreasing and convex in the price p_j and an exogenous surplus from an outside option H, which will play a role later on. By Roy's identity, the demand of each product is $q_i = |v'(p_i)|$, which depends only on its own price. For instance, a power function $v(p) = p^{1-\theta}$ provides a isoelastic demand, an exponential function $v(p) = e^{\delta - \alpha p}$ provides a log-linear demand and a function $v(p) = (a-p)^2$ provides a linear demand. We could allow for heterogeneity in the surplus functions,[5] but under perfect fee discrimination product by product, we can ignore this and analyze each product independently.

Such a simple framework provides already a number of insights that are emphasized by Etro (2021a) and Anderson and Bedre-Defolie (2022). Let us start by considering the situation where there are competitive providers of a particular product. The competitive sellers supply the good on the marketplace at a price that, net of the commission rate, equates the marginal cost, namely $p(1-\tau) = c$. A marketplace simply sets the commission rate that maximizes revenues $\tau p\,|v'(p)|$ subject to the competitive price, trading off the benefits of higher revenues per unit sold and the costs of lower sales due to the commission

[5] Hervas-Drane and Shelegia (2022) assume a unit demand for prices up to a maximum willingness to pay drawn from a known distribution. Tremblay (2022) considers heterogeneous surplus functions to study imperfect fee discrimination. See also D'Amico, Flores-Fillon and Theilen (2023) for other applications.

rate. The solution satisfies a standard Ramsey rule for the commission rate:

$$\tau = \frac{1}{\varepsilon} \tag{4}$$

which is inversely related to the demand elasticity $\varepsilon(p) > 1$, which is the elasticity of $v'(p)$ with respect to the price and reflects the sensitivity of sales to changes of commission and price.

It should take a moment to realize that, when Amazon can supply the same good at the same marginal cost, it obtains the same profits through direct sales at a price that maximizes $(p-c)|v'(p)|$. In other words, Amazon should be perfectly indifferent between monetizing on commissions from competitive sellers or directly selling the same product. It takes another moment to realize that, more generally, Amazon would prefer to sell its product, or simply attract customers toward it, if and only if it bears a lower marginal cost, for instance due to more efficient shipping. But when this is the case, the product is also sold at a lower price by Amazon, so there is a perfect alignment between profit maximizing decisions and consumer welfare maximizing decisions on who should provide the product on the marketplace. In other words, when self-preferencing takes place in this environment, it is efficient self-preferencing.

Such a version of the OMP theorem does not apply to more realistic situations and market imperfections. A basic case emerges when sales by Amazon or sellers can attract customers with a different probability, for instance due to consumer loyalty reasons which may reward either the marketplace or the traditional sellers (Hagiu and Wright, 2015). The combination of different cost and demand conditions implies that commission revenues on third party sales and the direct profits on sales by Amazon are not anymore identical, and the OMP theorem breaks down. Nevertheless, it can be shown that for a wide family of surplus functions, including the three examples mentioned above, it is still the case that Amazon finds it profitable to directly sell the good, or simply direct customers to its own version, if and only if this also maximizes consumer welfare (Etro, 2021a). For more general cases, a misalignment may emerge in one or the other direction, but without a systematic promotion of own products rather than the products of the sellers. In other words, Amazon may either self-preference too little or too much compared to what customers would favor.

Other conditions that break down the OMP theorem involve market imperfections, namely market power of sellers (implying that entry by Amazon can strengthen competition), myopic consumers and imperfect monetization through commissions. We will examine them in order.

2.2 Market power of sellers

A relevant extension of the basic benchmark is the one to market power of the sellers, such that entry by Amazon can strengthen competition. The first insights on the choice of Amazon between relying on a monopolistic seller or directly providing the good are due to Jiang *et al.* (2011). Here we consider

a seller setting its price to maximize profits $(p(1-\tau)-c)\,|v'(p)|$ for a given commission rate according to a standard rule $p = p(\tau)$ that satisfies:

$$p = \frac{\varepsilon c}{(1-\tau)(\varepsilon - 1)} \tag{5}$$

where one can show that the shape of the demand elasticity ε governs the pass-through elasticity η, representing the elasticity of prices with respect to the marginal cost. The pass-through is important for Amazon because it determines how the sellers shift commissions on consumers through higher prices. Taking into account this rule, Amazon sets a commission rate to maximize $\tau p(\tau)\,|v'(p(\tau))|$, and the solution satisfies:

$$\tau = \frac{1}{1 + \eta(\varepsilon - 1)} \tag{6}$$

The novelty compared to (4) is that an increase of the pass-through induces Amazon to set a lower commission to limit the increase of the price for customers. In any case, the final price incorporates both the markup of the seller and the commission, and we are in front of a classic problem of double marginalization, where the price is inefficiently high, not only for consumers but also for the seller and the platform.[6]

Now, let us suppose that Amazon can actually provide the same product as the third party seller. Then, it could sell it at the usual profit maximizing price $\bar{p} = p(0)$, which avoids the double marginalization and necessarily leads to a larger profit for Amazon and a lower price for consumers (the OMP neutrality vanishes). As noticed by Hagiu, Teh and Wright (2022), entry by Amazon can generate the same efficiencies without the need to sell anything: as long as Amazon sets the commission rate (4) and prices its product at the profit-maximizing level $p(0)$, a Bertrand logic suggests that the price of the third party seller would be driven down to the same level in the attempt to serve some customers. In this perspective, a main effect of entry by Amazon is to strengthen competition on the platform. That's why Hagiu, Teh and Wright (2022, pp. 319-20) conclude that "a blanket ban on the dual mode (i.e., forcing platforms to choose the same mode for all products) is likely to do more harm than good, and even when considering a ban on the dual mode within a narrow product category... such a ban often benefits third-party sellers at the expense of consumer surplus or total welfare. The main reason for this is that in dual mode, the presence of the platform's products constrains the pricing of the third-party sellers on its marketplace, which benefits consumers." Nevertheless, Hagiu, Teh and Wright (2022) have also emphasized a separate rationale for self-preferencing, that is consistent with Amazon being focused on its own customers, but not with consumer welfare in general: when consumers learn about products

[6] When the marketplace can steer customers toward alternative offers, it can determine steering through the design of an algorithm or an auction. Bar-Isaac and Shelegia (2022) have analyzed the choice between them establishing an equivalence result for a single competitive retail market.

through the marketplace and can then purchase them through outside channels, there can be an incentive for the marketplace to favour its own products and hide those of third party sellers, reducing sales on the outside channel and creating consumer harm.[7]

An interesting mechanism design analysis by Kang and Muir (2022) has explored the impact of a hybrid platform setting non-linear commissions on independent producers with private information on costs: also in that case the hybrid platform benefits consumers by avoiding a form of double marginalization and by reducing final prices.[8]

A case we did not explore yet is the one where Amazon acts as a first party retailer. In this case it sets the final price to maximize profits for a given wholesale price. Taking into account the associated price rule, the producer sets the wholesale price to maximize its own profits, which generates another form of double marginalization. This makes it less convenient for Amazon to enter as a first party retailer and eventually to direct customers toward its products. The situation would be of course different if also the seller had to purchase from the producer, generating a triple marginalization (by producer, seller and marketplace). However, in all these cases entry by Amazon tends to be efficient when it takes place (Dendorfer, 2023) and even to materialize too rarely compared to what would be favoured by consumers (essentially because the platform appropriates only a part of the benefits emerging from entry). Asymmetric information between marketplace and sellers on demand conditions complicates the scenario. Jiang *et al.* (2011) have studied the impact of entry by a marketplace on sellers that have private information on the demand for the products. This may lead the sellers to hide high demand conditions by lowering sales with reduced service levels to avoid entry by Amazon: as a consequence the marketplace may commit not to enter and expand monetization through commissions on sellers, an issue on which we will return. An aspect that remains largely unexplored in the literature is bargaining between the marketplace and its big sellers, which may avoid double marginalization concerns but raise new concerns on buyer power.

2.3 Myopic buyers

It has been often argued that when consumers are myopic, inattentive or simply irrational, a platform may bias its product recommendations and divert sales from third party products increasing its profits and harming consumers (breaking down again the OMP theorem).

A variety of works (Lee and Musolff, 2021; Zennyo, 2022; Hervas-Drane and Shelegia, 2022) have introduced behavioral considerations assuming that

[7] Also Gautier, Madio and Shekhar (2021) have emphasized the pro-competitive role of hybrid platforms, but have also pointed out concerns for consumer welfare in case of digital services generating large network externalities. For related results on biased recommendations in a different framework see Peitz and Sobolev (2022).

[8] Kang and Muir (2022) also extend their framework to show that a hybrid marketplace may have an incentive to undermine upstream competition through killer acquisitions or exclusive dealing agreements.

only some customers evaluate all the alternative products available on the platform, and others are myopic and evaluate only the versions recommended by the platform. Let us consider two equivalent products offered by Amazon and a seller. Following Hervas-Drane and Shelegia (2022), let us assume that a fraction $\lambda \in (0,1)$ of consumers has a limited consideration set, restricted by the recommendation of the marketplace, for instance through the *BuyBox* (or what is now called the *Featured Offer*), while the remaining fraction $1-\lambda$ of consumers evaluates both options and purchases the cheapest one.

The seller is assumed to be a first mover in the price choice, and Amazon has the advantage of setting its price and recommending one of the two products after knowing the price of the seller. Then, the marketplace can recommend its own product and set the monopolistic price $\bar{p}$ for the myopic customers, while earning commissions on the third party product sold at price p to the attentive customers. The total profits are $\lambda(\bar{p}-c)\left|v'(\bar{p})\right| + (1-\lambda)\tau p\left|v'(p)\right|$ and, under some conditions, the seller simply sets the limit price at which Amazon cannot obtain larger profits $(p-c)\left|v'(p)\right|$ by selling to all the customers. The solution is particularly informative under the assumption of Hervas-Drane and Shelegia (2022) of a unit demand with maximum willingness to pay a for the product. Then the price of the marketplace is $\bar{p}=a$ and the limit price of the seller can be computed as:

$$p = \frac{\lambda a + (1-\lambda)c}{1-\tau(1-\lambda)}$$

This price is increasing in the commission τ because a higher fee relaxes competition, and it is increasing in the degree of consumer myopia λ because more inattentiveness allows the marketplace to focus on myopic customers rather than undercut the seller. It can be verified that the marketplace finds it profitable to introduce and recommend its product only when the commission rate is low enough (otherwise it prefers to monetize on third party sales).[9] The important insight of Hervas-Drane and Shelegia (2022) is that the platform has an incentive to systematically recommend its products to divert the demand of myopic customers toward them and relax price competition, which here creates benefits for sellers (as also found in works by De Corniere and Taylor, 2019, and Huang and Xie, 2022). As a consequence (ignoring the impact on entry), a ban on self-preferencing that forces the platform to recommend the cheapest products avoids this distortion and strenghtens competition with benefits for consumers.[10]

[9] As shown by Hervas-Drane and Shelegia (2022), the profits of the marketplace are above commission revenues on a monopolistic third party seller if $\tau < \frac{\lambda}{1-\lambda}$, which requires high myopia. Similar results would apply with a downward sloping demand and simultaneous pricing. I am thankful to Sandro Shelegia for helpful comments on this anaysis.

[10] This conclusion is based on the assumption of a low and given commission rate. If the platform can set the commission rate at the profit maximizing level (here $\tau = \frac{a-c}{a}$), any rationale for self-preferencing disappears because the platform can obtain the same margin on attentive and inattentive customers. The consequence, which will emerge again in other contexts, is that when the platform is engaged in profit maximizing strategies, simple policies such as a ban on self-preferencing may not create benefits for customers.

2.4 Imperfect fee discrimination

Administrative, informational and reputational costs of adapting commission rates product by product may force a marketplace to set a uniform commission rate for a wide product category. Since this is typically based on the average characteristics of the products (say demand elasticity and pass-through), it can be either too low or too high for some products, reducing the monetization through commissions on third party sales. For instance, the selection of a uniform commission rate $\tau_i = \tau$ for any i to maximize the expected profits (2) under pricing by heterogeneous sellers would amend the formula (6) replacing the elasticities at the denominator with a weighted average over all products. This "midpointing" suggests that the marketplace would have higher and possibly excessive incentives to introduce and promote some of its own products (breaking down the OMP neutrality). But, once again, things are more complex.

The first work that has analyzed the impact of imperfect fee discrimination for pure marketplaces is the one of Tremblay (2022). It considers a continuum of products with heterogeneous surplus functions, and shows that, under some conditions, a platform setting $N > 1$ uniform fees for each of N product categories decides to foreclose a set of low demand products and apply midpointing to the remaining product categories, setting the uniform fee at the profit maximizing level for the "average" product of each category (only when N increases indefinitely, the fees are essentially set product by product). In this environment, consumer welfare increases when N is reduced, that is when the ability of the marketplace to discriminate fees across products is restricted.

In a further extension, Tremblay (2022) analyzes the incentives of the marketplace to introduce own products in Cournot competition with those of a seller. Under perfect fee discrimination product by product, the marketplace would introduce and sell its own product alone whenever it has a cost advantage, and would enter to strengthen competition with the seller when this has a moderate cost advantage. In this last case, the marketplace would also reduce the commission rate on the seller since this produces less, and all of this creates benefits for customers through lower prices. What is most interesting is what happens under imperfect fee discrimination, with uniform fees set for each one of the N product categories. In this case, the platform enters only in the markets that produce high surplus within each product category and when it can offer cheap enough products. However, once again entry benefits consumers by strenghtening competition and inducing a reduction of the fees on the sellers, which expands sales.

As we have just seen above, in the presence of myopic customers and sub-optimal commission rates, the marketplace can have incentives to bias product recommendations and soften competition with sellers. Accordingly, the literature appears to make a case for harmful self-preferencing when three conditions jointly apply: market power of sellers, myopic buyers and sub-optimal fees.

2.5 Customer heterogeneity and subscription fees

The access to digital platforms, or at least to premium versions, is often subject to the payment of access fees. For instance, Amazon *Prime* gives access to a variety of special services, such as same-day or fast delivery and exclusive content or additional services (including streaming music, video, e-books, games and grocery shopping services). Customers that value more these services tend to subscribe. This and the associated monetization strengthen the incentives of the marketplace to provide more attractive offers and turn its business model into something closer to an access-funded two-sided platform (in the sense of Rochet and Tirole, 2003 and Armstrong, 2006). Also in this case, the public narrative associates *Prime* with a way to lock in customers, but some of the implications emphasized in the literature go in a different direction (Etro, 2021a,b; Teh, 2022; Padilla, Perkins and Piccolo, 2022; Shekhar *et al.*, 2022; Bisceglia and Tirole, 2023).

Let us assume that customers pay a fixed fee P to access the marketplace and are heterogeneous in an outside option of value x drawn from a uniform distribution in the unit interval (under appropriate normalizations). Then, the marketplace attracts a fraction of consumers $\Pr(V-P>x)=V-P$, which is clearly increasing in the expected surplus per customer V net of the access fee. Under monopolistic competition, the prices set by the sellers remain given by (5), but the aggregate profits of the marketplace become $\Pi_A=(V-P)(P+\pi_A)$ where π_A are the profits per customer. Even in the absence of an access fee, the need to attract customers forces the marketplace to set lower prices and commissions compared to the baseline model, as well as to internalize platform-wide externalities that are instead ignored by sellers. When we introduce a positive access fee, this mechanism is strengthened and an increase of P induces the marketplace to reduce further prices and commissions with the additional purpose of expanding subscriptions and the associated monetization.[11] The alignment with the interest of consumers in the introduction of marketplaces's products remains as described earlier.

Ideally, a business model based on monetization through access fees would set them at the profit-maximizing level $P=\frac{V-\pi_A}{2}$, which increases in the expected surplus V to monetize on subscribers, but decreases in the profits π_A to attract more subscribers. This establishes a fundamental link between the platform and its customers, through which a larger surplus from sales is (in part) charged on customers through a higher access fee, but a larger revenue collected on the marketplace is (in part) redistributed to the customers through a lower access fee. This is exactly what happens for device-funded platforms such as the one of Apple, which monetizes on sales of smartphones taking into account revenues generated on the app store. An access funded platform obtains profits $\Pi_A=\frac{(V+\pi_A)^2}{4}$, which induce strategies finalized at maximizing the sum

[11] These results resonate well with those of the literature on membership fees for warehouses (such as Costco) that sell at prices close to the marginal cost for their members. For an important work comparing percentage and per unit commissions on platforms charging an access fee see Gaudin and White (2021).

of surplus and profits per customer. In practice, the platform acts as giving the same weight to consumer surplus and own profits, with the implicit purpose of investing in consumer loyalty. One can verify that this leads to a lower commission rate:

$$\tau = \frac{1-\eta}{1+\eta(\varepsilon-1)} \tag{7}$$

Actually, the commission is set at the level that maximizes expected consumer welfare, because the subscribers benefit from the commission revenues through reductions of the access fee: the interest of an access-funded platform and its customers are perfectly aligned (Etro, 2021b). In such a context a hybrid platform would keep introducing and promoting its own products taking into account the maximization of consumer welfare,[12] and a forced reduction of the commissions would harm consumers by inducing the platform to increase the access fee.

In practice, neither Amazon nor other eCommerce platforms impose exclusive access for their subscribers, and the same subscribers multihome by making purchases through other channels. Nevertheless, the broad message is that the need to attract customers to the marketplace and the presence of subscription-based services contribute to strengthen the incentives to internalize the interest of consumers introducing own products or determining access conditions for the sellers hosted on the platform.

2.6 Empirical evidence on Amazon entry

A prominent empirical work on Amazon entry is the one by Crawford *et al.* (2022), which is also the first to be based on proprietary data from Amazon. Its focus is on the record of every sale of any item from the product category Home & Kitchen on the Amazon marketplace in Germany between 2016 and 2021, with data on time, seller, final prices and alternative available offers. The authors measure predictors and effects of Amazon entry adopting respectively linear probability models and (staggered) difference-in-difference models. While the analysis is about a particular country and a representative sector, and the empirical setting presents challenges for estimating causal effects, the work offers unique results for the policy debate.

About half of the revenue from products in which Amazon is present comes from products that Amazon introduced before any other seller, which of course represents a type of entry that creates gains from variety for customers. Instead, when entry by Amazon occurs for a product already sold by another seller, Crawford *et al.* (2022) show that entry takes place mainly for products with high growth and low competition, as one would expect in a competitive environment and as applies also to the entry of other big sellers on the marketplace (defined as the top 100 merchants in the product category by in-sample revenue). Compared

[12] A similar point is made by Bisceglia and Tirole (2023) comparing a vertically integrated platform and a vertically disintegrated one subject to a zero price constraint on access prices for consumers. We should remark that the alignment can break down in the presence of hold up problems for platforms that do not monetize on commission revenues, as discussed by Padilla, Perkins and Piccolo (2022).

to these other big sellers, however, Amazon tends to introduce its own products more in case of low demand, even lower competition and low availability of the products. It should be remarked that these particular factors are observable to Amazon only through aggregated (across sellers) data. This suggests a rationale for Amazon entry that is related to increasing the overall attractivity of the platform rather than expropriating or foreclosing third party sellers.

The other contribution of Crawford *et al.* (2022) is to analyze the effects of Amazon entry. These effects can be summarized into a slight reduction of prices of the sellers and their product availability, with no relevant impact on revenues and sales of the active sellers or their number. Amazon enters with slightly lower prices than the pre-entry average sellers and earns a single digit percentage of sales on average. Putting together the results, Amazon entry appears to be mainly consistent with the need to cover increasing product demand with cheaper offers and to strengthen competition with third party sellers that have market power. However, the authors unveil also a reduced tendency of small innovative sellers (that have already introduced new products) to introduce additional products after the entry of either Amazon or another big seller. This tendency appears weaker after Amazon entry compared to the entry of other big sellers, and is intepreted by Crawford *et al.* (2022) in terms of "regression to the mean" in new product introduction rather than in causal terms.

Similar findings were also noticed by Zhu and Liu (2018) analyzing publicly accessible data on the Amazon marketplace for four product categories (Electronics & Computers; Home, Garden & Tools; Toys, Kids & Games; and Sports & Outdoors) in the U.S. between 2013 and 2014. The authors found that Amazon entry occurs in successful product spaces, discourages sellers from subsequent growth on the platform, and is associated with higher product demand and lower shipping costs. The big picture emerging from these empirical works is that of a marketplace that makes entry decisions internalizing platform-wide externalities and strenghtening competition.

3 Product variety on the marketplace

The benign effects of the introduction and promotion of products by Amazon that we emphasized until now could be reduced or overturned when a product category includes differentiated and imperfectly substitutable products by the platform and third party sellers rather than independent products (Anderson and Bedre-Defolie, 2022). We now introduce product differentiation in the analysis, which implies that the price of each product affects the demand of all the other goods in the same product category, with an interdependence that is taken into account in particular by Amazon in its choice on prices and commissions.

There are various ways of modeling imperfect substitutability. To nest a variety of standard models based on search mechanisms (Zennyo, 2022), representative agents (Etro, 2023a) and discrete choice frameworks (Anderson and Bedre-Defolie, 2023), we adopt the consumer welfare function $CS = \log V$,

which is increasing in the usual price aggregator (3) and assumed convex in the prices. The value of the aggregator remains a sufficient statistic for consumer welfare, but now the Roy's identity provides demand functions $q_i = |v'(p_i)|/V$, where the denominator is the price aggregator (3). This implies that a lower price of rival goods, or simply a wider variety of goods on the marketplace reduces the demand of each individual product, and increases consumer welfare.

To exemplify this setup, a specification that is useful for empirical purposes is based on the surplus function $v(p_i) = e^{\delta_i - \alpha p_i}$ for product i, which delivers:

$$q_i = \frac{\alpha e^{\delta_i - \alpha p_i}}{\int_j e^{\delta_j - \alpha p_j} dj + H} \tag{8}$$

This is analogous to what emerges in multinomial Logit models where consumers chose between alternatives with utilities subject to shocks. Here δ_i parametrizes the utility from the purchase of product i depending on its features, including observable ones potentially related to shipping days, customer feedback, fulfillment by Amazon or direct sale of a product by Amazon, and α parametrizes the consumer price sensitivity within the product category. Clearly, other surplus functions deliver demand systems with different properties.

3.1 Pure marketplaces

We start our theoretical analysis by considering pure marketplaces (as in case of eBay or travel agencies such as Booking or Expedia) that monetize only on third party sales of symmetric sellers, namely with the same cost c and surplus function $v(p)$ at price p. We assume that there is a mass n of products by sellers engaged in monopolistic competition, so that they ignore the impact of their price choices on the price aggregator. Then, the price rule of each seller remains given by (5).

The profits of the marketplace are now limited to the commission revenues $r(\tau)$ on the n sellers, and the commission rate τ is chosen to maximize aggregate profits per customer, which simplify to:

$$\pi_A = nr(\tau) \quad \text{with } r(\tau) \equiv \tau p(\tau) \frac{|v'(p(\tau))|}{V} \tag{9}$$

where the price aggregator $V = nv(p(\tau)) + H$ increases in the mass of products. The trade off is now enriched by substitutability between products since part of the demand reduction generated by a higher commission is shifted into a larger demand for the other products sold on the marketplace. The formula for the optimal commission rate can be derived as:

$$\tau = \frac{1}{1 + \eta(\varepsilon - 1 - \zeta) + \eta\zeta\frac{H}{V}} \tag{10}$$

which is inversely related to the value of the outside option H and increasing in the surplus elasticity $\zeta(p)$, representing the elasticity of $v(p)$ with respect to the

price.[13] Intuitively when the products purchased elsewhere generate high surplus or the products hosted on the marketplace generate high surplus compared to the revenue, it is convenient to set a lower fee. Moreover, since V increases with n, an increase in the number of traded products induces the marketplace to set a higher fee because losses of demand due to a higher commission are spread through a wider number of substitutes.

Similar results have been emphasized in the literature under strategic settings. For instance Huang and Zhang (2022) and Shopova (2023b) have analyzed the commission set by a pure marketplace with multiple differentiated sellers competing under a linear demand system *à la* Singh-Vives. Also in that case the commission rate is increasing in the number of sellers (as well as in the substitutability between products and in the intensity of demand). An additional mechanism is at work in that case, since more sellers (or sellers producing more substitutable goods) compete harder reducing markups and the marketplace recovers part of the lost margins through a higher commission. Ciotti and Madio (2022) have introduced myopic consumers that purchase only the products recommended by the marketplace to maximize its profits: in a vertical differentiation framework, they show that competition for prominence benefits consumers reducing the profits of the retailers (even without the use of ad auctions for prominence).

3.2 Static effects of the dual mode

Our next question is what happens when the marketplace introduces its own products. Assuming, for the time being, that Amazon introduces them without inducing exit of any sellers, we can identify a few separate effects whose net impact on consumer welfare is ambiguous.

More formally, imagine that Amazon introduces m products with cost c and surplus $v(\bar{p})$ at price $\bar{p}$ obtaining profits $\bar{\pi}$ on each product. Then the aggregate profits (9) are augmented as follows:

$$\pi_A = nr(\tau) + m\bar{\pi} \quad \text{with } \bar{\pi} \equiv \frac{(\bar{p} - c)\,|v'(\bar{p})|}{V} \tag{11}$$

where $V = nv(p(\tau)) + mv(\bar{p}) + H$ and we separated the commission revenues from n third party products and the direct profits on an exogenous set of m own products. Retaining monopolistic competition, the sellers always adopt the price rule (5), while Amazon tends to reduce the price of its new products due to a standard elimination of double marginalization effect, which is independent from the commission applied to third party sellers.[14] The provision of new cheaper varieties tends to expand market sales in the absence of changes in the commissions, which is consistent with the evidence found by Crawford *et*

[13] For instance, with power surplus functions for all products with a common demand elasticity $\theta > 1$, the commission satisfies $\tau = \frac{V}{V - H + \theta H}$.

[14] If Amazon was internalizing the strategic effect on the aggregator, its prices would be higher.

al. (2022) on cross-product effects of Amazon entry within a product category subject to a common and fixed commission rate.

However, after the introduction of its own products, Amazon can have an incentive to change the fees applied to the sellers. It can be verified that the new profit maximizing commission rate increases compared to (10). This is a standard raising rivals's cost effect which involves a worsening of the conditions for third party sellers to divert demand toward the products of the marketplace (and possibly causing more leakage to third-party sellers' direct channels in the sense of Hagiu, Teh and Wright, 2022). Similar effects can emerge as a consequence of annexation of downstream products and services (Athey and Scott Morton, 2021). Drawing conclusions on the welfare implications of a ban of the dual mode is complex, also because this would seemingly leave the platform having to choose between being a pure marketplace or being a reseller. We will soon examine the issue with a quantitative analysis.

3.3 Strategic interactions on the marketplace

Further results on the effects of the dual mode have been emphasized in a strategic setting. For instance, in case of a linear demand system with product differentiation and competition in prices between the marketplace and a big seller, an additional competition effect emerges: the introduction of the product by Amazon strengthens competition on the platform and reduces the prices of third party sellers. Moreover, this environment confirms earlier insights for which entry by Amazon is efficient when facing competitive sellers and can be even insufficient when the sellers have market power (Etro, 2021a; Dendorfer, 2023).[15]

The case of competition between the marketplace and multiple differentiated sellers has been analyzed under a linear demand system *à la* Singh-Vives. Shopova (2023b) has shown that the hybrid platform reduces the commissions on third party sellers and strengthens price competition with benefits for consumers from the introduction of its own products. Instead, Bisceglia and Padilla (2023) have explored the impact of price coordination between sellers, which has also attracted attention in the antitrust debate: the interesting result is that sellers's collusion forces the marketplace to reduce both its commission and the price of its own good (to divert demand toward it), which can force the sellers to reduce prices as well, with benefits for consumers when the products are highly substitutable.

Competition effects due to the introduction of products by a marketplace have been highlighted by Anderson and Bedre-Defolie (2022) in an example with horizontal differentiation between a product of the marketplace and one

[15] Lam and Liu (2023) have explored the role of informational advantages of the marketplace on market data in a related model of product differentiation with linear demand and competition in prices under uncertainty. As in Jiang *et al.* (2011), they unveil a channel through which data usage by the platform induces sellers to raise prices to hide demand conditions, which softens competition and can make the same sellers better off under high product substitutability. Similar effects of data sharing by hybrid marketplaces are emphasized by Magnani and Navarra (2023).

provided by a competitive fringe of sellers or a big seller. Shopova (2023a) has explored a vertical differentiation model showing that a marketplace has an incentive to introduce low quality private labels and once again reduce the commissions on high quality products by third party sellers because it internalizes their lower demand and the higher pass-through on their prices. In conclusion, in these strategic models the introduction of private labels does not generate raising rivals's cost effects and is actually beneficial for consumers.[16]

3.4 Structural estimation of Amazon and the dual mode

The general framework sketched until now can be brought to the data on Amazon for structural estimation, which allows one to evaluate the welfare impact of policy experiments in the spirit of seminal empirical works by Berry (1994), Crawford *et al.* (2018) and others. Such a step has been advanced by Gutierrez (2021), who has extended the framework to multiple product categories through a nested Logit model. Moreover, his framework allows sellers to supply multiple products, each one with profits as in (1), takes into account interbrand demand externalities and Bertrand competition, and incorporates uniform commission rates by product category and unit fees for shipping by Amazon through FBA (*Fulfilment By Amazon*). Finally, Gutierrez (2021) assumes that Amazon purchases its products from monopolistic wholesalers and extends the objective function from (2) to $\pi_A + \gamma^C CS + \gamma^S SS$ with positive weights γ^C on consumer surplus and γ^S on seller surplus $SS = \int_{i \in 3P} \pi_i di$ to take into account dynamic demand externalities related with investment in consumer loyalty.

The structural estimation of the model of Amazon is based on three steps: the first assigns products to nests, the second estimates demand parameters for each product category, such as α and δ_i in (8), taking the nests as given, and the last estimates the supply parameters taking the demand parameters as given. This recovers markups of Amazon, sellers and wholesalers as well as the weights γ^C and γ^S that rationalize effective product prices and commission rates while satisfying optimality conditions for all players.

Looking at averages across estimates for ten product subcategories, the large majority of sales are by third party sellers, mostly through FBA due to a significantly positive impact on demand of shipping by Amazon. The average demand elasticity is about 4, and the pass-through appears to be slightly incomplete. The model produces moderate markups and commissions due to a high weight given by Amazon to consumer surplus in its objective function ($\gamma^C = 1.04$ on average) compared to seller surplus ($\gamma^S = 0.39$): in other words, Amazon appears to be investing in consumer loyalty. The estimated markups are on average 34% for third party sellers against average commission rates around 22%, the markups of Amazon as a first party retailer are 37% on average and the whole-

[16] Moreover, building on Johnson (2017), Shopova (2023a) shows that a wholesale model (where the marketplace purchases from third party sellers and then sets the retail prices) leads to higher quality and lower prices for the private labels, with a further increase in consumer welfare. On strategies by hybrid marketplaces see also Belleflamme and Johnen (2023).

sale markups are around 30% in the product categories analyzed. Interestingly, shipping services are mostly provided by Amazon at low markup because the marketplace monetizes more efficiently through percentage rather than specific commissions.

On the basis of this estimated model, Gutierrez (2021) undertakes a few policy experiments. The first one turns Amazon into a pure marketplace monetizing only through the commissions on third party sellers, which stop relying on FBA, and on wholesalers, which start selling directly on the platform: the impact on consumer welfare tends to be negative, mainly driven by higher prices and commissions. Another experiment turns Amazon into a pure retailer, losing a long tail of third party products, with negative consequences for consumers in spite of some price reductions. Similar negative results on consumer welfare emerge from a structural separation of Amazon into independent companies acting respectively as a pure marketplace, a reseller and a logistics company. Another counterfactual is a ban on retailing preserving the FBA option for sellers, which (given the estimated objective function of Amazon) also generates a slight reduction in consumer welfare, mainly due to higher prices of sellers. Only the introduction of the *Prime* badge for sellers that meet the same standards as FBA through alternative shipping services can generate in the model a slight increase of consumer welfare by reducing average shipping fees and prices (in spite of increasing commission fees). For this reason, the literature would benefit from further explorations of the incentives to restrict sellers from using rival and more efficient fulfillment services.

4 Dynamic issues and entry of sellers

We now study the endogenous marketplace structure. This requires us to endogenize the entry of sellers on the marketplace, which is crucial to understand the strategies adopted by the marketplace taking into account the impact not only on the pricing of sellers, but also on their entry. This will allow us to evaluate the dynamic effects of the dual mode and self-preferencing, whose consequences on consumers may work through the impact on the entry and investment of sellers.

4.1 Pure marketplaces

It is useful to start our theoretical analysis from a pure marketplace, and for this purpose we adopt the microfoundation of Section 3 and our assumption of symmetric sellers engaged in monopolistic competition with free entry. The endogenous number of products on the marketplace n should be such that the profits of a marginal seller (1) barely cover a fixed cost of entry f, and a new entrant ends up with negative profits. Each seller sets the prices according to the usual rule (5) expecting gross profits:

$$\pi(\tau) = [p(\tau)(1-\tau) - c] \frac{|v'(p(\tau))|}{V}$$

Since the price aggregator increases with the number of sellers, equating these profits to the entry cost f pins down the equilibrium number of sellers or, equivalently, the value of the aggregator. In particular, under free entry, the aggregator becomes:

$$V(\tau) = \frac{[p(\tau)(1-\tau) - c] \left| v'(p(\tau)) \right|}{f} \tag{12}$$

which is a decreasing function of the commission τ for the simple reason that a higher fee reduces profitability and leaves space for fewer sellers.

Given this, the commission rate is chosen by the marketplace to maximize (9) under the additional constraint that the endogenous number of sellers is $n = (V(\tau) - H) / v(p(\tau))$ where the aggregator is given by (12). The equilibrium commission must take into account its impact on the variety of products that are endogenously supplied on the marketplace and their contribution to generate commission revenues. The solution can be obtained as:[17]

$$\tau = \frac{1}{1 + \eta(\varepsilon - 1 - \zeta) + \frac{\varepsilon H}{V - H}} \tag{13}$$

where the last term at the denominator reflects the impact of the commission on entry. Internalizing this impact, the marketplace tends to set lower commissions to attract entry.[18]

Such a framework has been used for further explorations that are relevant for the design of marketplaces. For instance, Zennyo (2023) introduces defective products by sellers and investments to reduce their frequency to study the liability design. An unregulated platform would impose full liability on sellers enhancing their investments and reducing entry. However, a minimum standard of platform liability can benefit consumers attracting more sellers with lower investments, but can also harm consumers forcing an increase of the commission which instead reduces entry.[19]

4.2 Dynamic effects of the dual mode

The next question is what happens when the marketplace introduces its own products turning into a hybrid marketplace such as Amazon. A key theoretical result in this context has been noticed by Anderson and Bedre-Defolie (2023)

[17] For instance, with power surplus functions for all products with a common demand elasticity $\theta > 1$, the commission satisfies $\tau = \frac{V-H}{V-H+\theta H}$.

[18] We have already seen that when a marketplace sets a profit maximizing access fee for customers, it is then induced to return part of the commission revenues to consumers through a lower access fee. Such a link applies also in the case of endogenous entry of sellers for competing platforms (Jeon and Rey, 2022a; Etro, 2023b; Bisceglia and Tirole, 2023).

[19] For related discussions on the incentives of platforms to control the activity of sellers see Lefouili and Madio (2022) and Jeon, Lefouili and Madio (2022). Most of the empirical analysis on the relation between Amazon and sellers is focused on algorithms, but it would be interesting to explore changes in the user interface (Lam, 2021) and related investments, such as those aimed at removing fake reviews.

relying on principles of aggregative models with free entry. For a given commission rate, the introduction of products by the marketplace does not affect the pricing of the sellers (5), and as long as there is entry of some of them, it does not even affect the equilibrium value of the aggregator (12). The same pricing of the products by the marketplace can affect the number of third party sellers by leaving more or less space for entry, but it does not affect the equilibrium value of the aggregator for a given commission rate, and therefore the equilibrium welfare. In other words, if the commissions of Amazon are not changed, welfare is entirely neutral with respect to the introduction of new products by the marketplace even if this leads to exit of some third party sellers: the benefits of the former and the costs of the latter compensate each other exactly.

The only channel through which consumers are affected by the introduction of new products by Amazon is through changes in the commission rate and their consequences on third party products. If Amazon increases the commission while introducing its products, all prices would be increased and the number of products would be reduced, so that consumers would be necessarily worse off. Anderson and Bedre-Defolie (2022, 2023) have emphasized that this may well be the case, and that it is actually the case in a Logit model, due to the dominance of a raising rivals's cost effect: after introducing its own products, the marketplace diverts customers toward them through a higher commission. However, if Amazon reduces its commission rate while introducing own products, all prices would be reduced and variety would be promoted with benefits for consumers. There can be an incentive to do so due to an extensive margin effect: after introducing its own products, the marketplace tries to recover entry of sellers and the associated commission revenues by reducing the commission rates. Etro (2023a) has emphasized that this mechanism may be dominant.

Formally, if the marketplace introduces m products with surplus $v(\bar{p})$ at price $\bar{p}$, the endogenous number of third party sellers has to take into account the surplus of the products by the marketplace. Then, the problem of the marketplace is to select its own prices $\bar{p}$ and the commission rate τ to maximize (11) under the constraint that the number of third party sellers is now $n = [V(\tau) - H - mv(\bar{p})]/v(p(\tau))$ and the aggregator is always given by (12). The prices set by the marketplace differ from those of the sellers because of a) an elimination of double marginalization, which pushes toward lower prices and b) a lower opportunity cost of diverting demand to third party sellers (since they raise commission revenues), which pushes toward higher prices. None of this, however, affects consumer welfare for a given commission. It is only the change in the commission rate that affects welfare, reducing it to shift demand toward own products or increasing it when the commission is reduced to recover entry of sellers. Either case can emerge depending on the properties of the demand system, but the empirical prediction is simple: consumer harm (benefit) requires a positive (negative) correlation between changes in market shares of products by the marketplace and commission rates on rival sellers. This is a powerful insight which awaits for empirical examination.

We should emphasize that the spirit of these results goes through also in a strategic setting with Bertrand competition between sellers and when Amazon

has no leadership in setting prices of its own products. Moreover, similar results have been derived also in different frameworks. In an important work, Hervas-Drane and Shelegia (2022) have developed a model where a marketplace hosts free entry of heterogeneous third party sellers softening competition through control of the storefront, by learning about products and mitigating its capacity constraints. Also in such a model with myopic consumers (as in Section 2.3), the introduction of products by the marketplace affects the trade-off in setting commission rates and can reduce them to recover entry of sellers. The welfare impact of a ban of the dual mode is typically negative because it induces an increase of commissions that increases prices and reduces variety.[20]

The insights of this analysis extend also to the case of endogenous entry of buyers in the presence of alternative sale channels and rival platforms. However, this can give rise to additional issues. Hagiu, Teh and Wright (2022) have stressed how self-preferencing can cause leakage to third-party sellers' direct channels.[21] Ronayne and Taylor (2022) have instead emphasized the emergence of multiple equilibria: some where a marketplace sets low commissions to attract price-sensitive shoppers and others where it sets higher commissions to attract inattentive consumers. In this environment a strengthening of competition within sale channels may be associated with softening competition between alternative sale channels.

4.3 Self-preferencing and entry

Major concerns about self-preferencing are related with a reduction in the profits and investments of the sellers,[22] therefore it is important to examine its role in an environment where the entry of sellers is endogenous. As we have seen in Section 2.3, self-preferencing has been formalized considering myopic consumers whose choice is biased by product recommendations. Let us consider this possibility within the Logit model. In the absence of recommendations, with sophisticated consumers evaluating all the alternative products, the demand (8) applies to each product i. Now assume that a fraction $\lambda \in (0,1)$ of consumers is myopic and has a limited consideration set, restricted by the recommendations offered by the marketplace, while a fraction $1-\lambda$ of consumers evaluates all the options. Then, we can express the demand of product i as follows:

$$q_i = (1-\lambda)\frac{\alpha e^{\delta_i - \alpha p_i}}{\int_j e^{\delta_j - \alpha p_j} dj + H} + \lambda r_i \frac{\alpha e^{\delta_i - \alpha p_i}}{\int_{j \in R} e^{\delta_j - \alpha p_j} dj + H} \tag{14}$$

where r_i represents the probability that the product i is recommended and R the consideration set of the myopic customers.

[20] Kirpalani and Philippon (2020) have argued that information disclosure by consumers improves the gains from match quality through recommendations, but may also increase the market power of a monopolistic marketplace toward third party sellers reducing their entry, once again with ambiguous welfare implications.

[21] Sato (2022) has extended the same model to show that a marketplace may also harm consumers by overinvesting in joint-purchase benefits and increase commissions on sellers.

[22] For a policy perspective on self-preferencing see Peitz (2022) and for a review of the theoretical literature see Kittaka, Sato and Zennyo (2023).

This framework can be detailed in different ways. Zennyo (2022) defines a fair search engine for the marketplace as one with $\lambda = 0$ where all consumers can evaluate all the options they search for, and a biased search engine one with $\lambda = 1$ where the product by Amazon is always in the consideration set of consumers while the other products belong to it with a probability lower than one. This is a case where self-preferencing materializes in the systematic recommendation of the product of Amazon with customers chosing between this and a restricted number of alternative offers. The purpose of Zennyo (2022) is to evaluate the impact of self-preferencing in a benchmark model of a marketplace whose dual mode is neutral on consumer welfare in the absence of recommendation bias. For a given commission rate, the marketplace gains from diverting customers to its products through self-preferencing, and reduces the expected profitability of third party sellers and therefore their entry. However, these intuitive results are only a part of the story. As a consequence of lower entry and lower commission revenues, the marketplace has an incentive to reduce the commission rate to attract more sellers, which in turn reduces prices and attracts more purchases. It is again the extensive margin effect at work, suggesting that there are no solid reasons to conjecture that self-preferencing is necessarily associated with consumer harm.[23]

The empirical work of Lee and Musolff (2021) estimates λ as the fraction of myopic consumers who evaluate only one recommended offer, namely the one in the *BuyBox* (and compare it with the option of purchasing outside the marketplace). The probability of being in the *BuyBox* r_i depends on price and characteristics of each product according to the algorithm of Amazon: while this is not known, it can be estimated through a sort of reverse engeneering based on the available data. A fair algorithm would assign the *BuyBox* to the product that maximizes the welfare of consumers independently from the identity of the seller, while self-preferencing would materialize when the algorithm systematically gives Amazon's products a higher probability to be in the *BuyBox* compared to equivalent products by third party sellers.[24] The price elasticity of the recommendation algorithm estimated by Lee and Musolff (2021) is quite high, suggesting that only low prices assign the *BuyBox*. Also shipping is important: an additional delivery day penalizes the chances to obtain the *BuyBox* as much as a 9% higher price. Most important for our purposes, products by

[23] These results resonate well also with findings by Hervas-Drane and Shelegia (2022). Similar results emerge for different reasons in the work of Zou and Zhou (2022) which explores the unintended consequences of a ban on self-preferencing on hybrid marketplaces characterized by pre-search price observability and personalized search rankings. In the short run, such a form of search neutrality can weaken price competition for contestable consumers, namely those that explore the characteristics of cheaper offers. In the long run, the ban on self-preferencing can also incentivize the platform to increase its commission rate to deter or limit entry of sellers.

[24] It should be clarified that this empirical approach tends to support the existence of self-preferencing when the available data are incomplete or of low quality and Amazon's products are preferred by consumers for reasons that cannot be quantified in the econometric investigation. An ideal approach should evaluate the same objective function at the basis of Amazon's algorithm, which is not publicly known. A more pragmatic empirical approach may compare consumer behavior with and without recommendations.

Amazon have a higher probability to obtain the *BuyBox*, with a gap equivalent to another 9% difference in the price. Raval (2023) has implemented a similar analysis with data from hundreds of thousands of products and multiple countries, but without data on delivery speed, which makes it hard to distinguish between a bias due to self-preferencing or better delivery speed.[25]

A related work by Chen and Tsai (2023) finds evidence of self-preferencing in recommendations by Amazon for *frequently-bought-together* products. These should be organic and non-sponsored recommendations depending on the preferences of consumers and not on the identity of the sellers, but the authors find that Amazon receives more recommendations than third party sellers for the same product. Moreover, exploiting within-product variation generated by Amazon stockouts, they show that, when out of stock, Amazon reduces by 8% the probability of recommending identical products sold by other sellers, while there are not significant changes when the sellers are out of stock. Chen and Tsai (2023) argue also that the recommendation bias emerges when profitable for Amazon and may negatively affect consumer welfare. However, a comprehensive evaluation of welfare effects requires a structural analysis of the equilibrium consequences of self-preferencing on pricing, sales and profits.

4.4 Structural estimation of Amazon with self-preferencing

Lee and Musolff (2021) have estimated a model of the Amazon marketplace with free entry of sellers. While building on the empirical literature on industrial organization models with free entry (see for instance Berry and Waldfogel, 1999, and Dutta, 2011), the authors face a complex theoretical and computational problem. They consider multiple product categories through a Logit framework and allow heterogeneous sellers to offer one product under differentiated Bertrand competition with free entry within each product category. Before entry, each firm draws the marginal cost of production from a lognormal distribution with parameters to be estimated. A fixed entry cost is also drawn from a lognormal distribution with parameters to be estimated. After entry, competition takes place under complete information between active firms that set prices to maximize profits (1) where the demand is given by (14) with estimated values for the fraction of myopic customers λ, price sensitivity α, product parameters δ_i and recommendation probabilities r_i. Each firm decides whether to enter after drawing its own marginal cost and knowing the fixed cost of entry, but without knowing the costs of the other firms.

The structural estimation is founded on estimates of demand parameters through maximum simulated likelihood, and supply parameters through the simulated method of moments. This recovers prices and numbers of sellers by product category as well as the fraction of myopic consumers λ. A conservative demand estimate provides $\lambda = 0.26$, suggesting that at least a quarter of the

[25] See also the recent works of Hunold, Laitenberger and Thébaudin (2022) for evidence of biased recommendations depending on prices in competing marketplaces and Farronato, Fradkin and MacKay (2023) for evidence of preferential ranking in search for Amazon branded products.

customers make purchases only through the *BuyBox* option, while the majority of customers evaluate all the options. The overall demand elasticity is about 4, in line with Gutierrez (2021), but it is the recommendation algorithm that appears to increase the demand elasticity and therefore price competition. Remarkably, the estimation implies that the demand is higher for products by Amazon, which suggests that the bias toward those products in the estimated algorithm may be simply due to quality differences that are not observable in the data.

On this basis, Lee and Musolff (2021) estimate the welfare impact of a ban on self-preferencing which materializes into a change of the estimated recommendation algorithm to eliminate higher chances of winning the *BuyBox* for products by Amazon. Taking a static perspective that neglects both changes in prices and in the number of third party sellers, the ban on self-preferencing harms consumers, in particular by reducing the utility of unsophisticated customers who favour Amazon's products. Taking into account price changes while retaining exogenous the number of third party sellers (as in Gutierrez, 2021), the ban induces a slight reduction in prices making sophisticated customers better off, but increases the losses for myopic customers (whose options deteriorate on average), reducing consumer welfare overall. Once endogenous entry is taken into account in the long run analysis, the ban exerts a modest positive impact on entry of sellers in the marketplace, but the negative impact on consumer welfare is confirmed also in this case.

Overall, the results of Lee and Musolff (2021) suggest that, even taking into account the impact of self-preferencing on entry, there are no reasons to conclude that a ban on self-preferencing would improve consumer welfare. One aspect that is neglected in the analysis is the endogenous change in prices of the products of Amazon, but the authors notice that the ban would benefit consumers only if it would induce a 7.8% reduction of the prices of Amazon (which is an order of magnitude larger than the estimated price reduction of the sellers). Another major aspect that is neglected in the analysis is the endogenous change in commission rates (or other fees): to the extent that a ban on self-preferencing could induce an increase in commission rates (or other fees on sellers), its social cost could be higher, as already suggested by theoretical results of Zennyo (2022) and Hervas-Drane and Shelegia (2022). Further investigations could explicitly incorporate these aspects.

5 Advertising and innovation

Our focus until now has been on entry by the marketplace and the sellers with differentiated products. In this section, we focus on two sources of differentiation that have attracted recent attention, namely advertising by sellers for product discovery and investment by sellers in new products.

5.1 Sponsored ads

E-Commerce platforms are rapidly expanding sponsored ads for sellers, raising a completely new set of issues compared to ad-funded platforms that do not monetize on transactions.[26] First, the retailers that pay for ads on a marketplace bear additional costs that are shifted in part on the prices of their products: this affects competition and also the variety of goods provided on the marketplace (Motta and Penta, 2022). Second, the platform offers sponsored ads that displace organic ads for other sellers and the associated commission revenues, and therefore needs to take into account this tension. In particular, to the extent that sponsored ads are mainly driven by profit incentives of the sellers rather than by relevance for the buyers, they can generate a limited incremental contribution to total sales, diverting demand and commission revenues from products that would have been purchased otherwise. As a consequence, the platform has to take into account the opportunity cost of the advertising activity in terms of lost commission revenues (Ciotti and Madio, 2022; Bar-Isaac and Shelegia, 2022). Finally, when the marketplace monetizes both on third party sales and its own direct sales, the dual mode could create further conflicts of interest and generate raising rivals' costs and self-preferencing strategies through biased recommendations (Long and Amaldoss, 2022).

The role of sponsored ads can be easily formalized in an extension of the model of Section 4 with ads and ad fees. Let us assume that the ad intensity a of a seller generates a surplus $z(a)v(p)$ augmented with a concave scale function determining the frequency of "clicks" that lead to a purchase, and the total percentage commission is augmented by $\tau_a a$, that is an ad fee τ_a on the advertising intensity. This implies that the ads of each seller provide revenues to the platform, but crowd out sales and commission revenues by other sellers, generating an opportunity cost of ads for the platform.

Under monopolistic competition each seller sets the price as in (5) and the ad intensity according to a Dorfman-Steiner condition, implying:

$$p = \frac{(\varepsilon + \sigma)c}{(1-\tau)(\varepsilon - 1)} \quad \text{and} \quad a = \frac{\sigma(1-\tau)}{(\sigma + \varepsilon)\tau_a}$$

where $\sigma(a)$ is the elasticity of demand to advertising. Accordingly, both prices and ad intensity increase with the effectiveness of the ad technology, and under regularity conditions an increase of the commission fee increases prices and reduces ads, while a higher ad fee reduces ads, but has an ambiguous impact on prices depending on the shape of $\sigma(a)$. Under free entry the aggregator $V(\tau_c, \tau_a)$ becomes a decreasing function of both fees, but is still independent from the introduction, pricing and advertising of the products by the marketplace.

A pure marketplace is now incentivized to set lower commission rates because it monetizes also on ads,[27] and is going to expand sponsored advertising revenues to the point of equating the marginal profitability of the two monetization tools.

[26] On the role of ad auctions on online platforms see the classic works of Roth and Ockenfels (2002) and Bajari and Hortaçsu (2004).

[27] For instance, with power surplus functions, it can be shown that the commission fee

However, our earlier results for hybrid marketplaces hold: for given fees, the introduction of own products remains neutral on welfare, and, when the fees adjust, the welfare impact is ambiguous. This suggests that there is no solid ground to conclude that expanding ad revenues for Amazon should be associated with raising rivals' cost strategies that would harm consumers through higher prices and less variety. Nevertheless, further empirical work on sponsored ads on marketplaces is needed, and structural models as those examined before should incorporate advertising.

5.2 Copycatting and insider imitation

Part of the concerns about Amazon entry has been about the introduction of imitative products, typically private labels similar to existing products by third party sellers, that may undermine their investment incentives and harm consumers in the long run (a classic "hold up" problem). However, a common point emerging from the literature is that a marketplace should commit to limit the same introduction of such "copycat" products for the exact purpose of preserving the proper incentives of sellers to invest and introduce products to be monetized through commission revenues in the future (Jiang *et al.*, 2012; Etro, 2021a; Hagiu, Teh and Wright, 2022).[28]

The role of copycatting can be easily formalized in a two-stage version of the basic model of Section 2, where the marketplace moves first and sellers move next. We denote with ρ the probability of an innovation that generates expected profits $\pi(\tau)$ for a representative seller and commission revenues $r(\tau)$ for the marketplace, and with β the probability of imitation which delivers profits $\bar{\pi}$ to the marketplace and none to the seller. We naturally assume $\pi'(\tau) < 0$ and $r'(\tau) > 0$.

The probability of innovation ρ is generated by the seller at a quadratic cost, therefore, given β, a perspective seller sets the probability of innovation to solve the problem:

$$\max_{\rho} \rho(1-\beta)\pi(\tau) - \frac{\rho^2}{2}$$

where the first term represents expected profits (materializing if the innovation occurs, with probability ρ, and is not imitated, with probability $1-\beta$) and the second term represents the investment costs (to obtain a probability of innovation ρ). This implies a rate of innovation $\rho(\beta,\tau) = (1-\beta)\pi(\tau)$ which is assumed in the unit interval (under an appropriate normalization). This rate of innovation decreases in the copycat frequency β and in the commission τ. Expecting this, the marketplace commits to a probability of imitation β that maximizes:

$$\pi_A(\beta,\tau) = \rho(\beta,\tau)[(1-\beta)r(\tau) + \beta\bar{\pi}] \tag{15}$$

becomes $\tau = \frac{V-H-(\theta+\sigma)H\sigma/\theta}{V-H+(\theta+\sigma)H}$, which is decreasing in the ad fee τ_a and in the effectiveness of the ad technology measured by σ.

[28] On the related issue of mandated data sharing in hybrid marketplaces see Navarra, Pino and Sandrini (2023).

where, as long as the innovation occurs, with probability $\rho(\beta, \tau)$, the commission revenues $r(\tau)$ materialize if the third party product is not imitated, and the copycat profits $\bar{\pi}$ if it is imitated. Then, an interior solution for the optimal imitation policy satisfies the rule:

$$\beta(\tau) = \frac{1}{1 + \frac{\bar{\pi}}{\bar{\pi} - 2r(\tau)}} \tag{16}$$

which is low when the commission revenues are high and the imitation profits are low. In particular, it is easy to verify that imitation occurs only if the copycat profits are high enough, only for a minority of innovations, and less frequently when the commission rate is higher ($\beta'(\tau) < 0$). The extent of the copycat activity has been formalized in terms of the frequency of imitation (Etro, 2021a; Choi, Kim and Mukherjee, 2023), the time after which the marketplace chooses to imitate (Madsen and Vellodi, 2024) or a cap on the profitability of imitated sellers (Jeon and Rey, 2022b). In either case, an intermediate level of imitation is socially desirable to balance the static gains from lower prices of copycat products and the dynamic gains from more innovation for the platform.

This framework provides further implications when the profit functions are endogenized. Etro (2021a) has emphasized that the equilibrium level of copycat activity can be sustainable (without commitment) in a long run perspective, and may be also too low from a social point of view because the marketplace does not fully internalize the static benefits from its low price products, while it better internalizes the dynamic costs of reduced investment by sellers.

The important work of Madsen and Vellodi (2024) has augmented this kind of analysis with a profit shifting parameter drawn from a known distribution for each innovation and a fixed cost of imitation. The shift parameter reflects proprietary information of the seller on the state of demand, but in the absence of data regulation it is known by both the seller and the marketplace after the product is introduced. The concern about "insider imitation" is that Amazon has been using such third-party seller's proprietary data to imitate products with high enough demand, reducing innovation. The authors show that this is the case under *laissez faire*, and examine the impact of data regulation on innovation. By restricting the access of the marketplace to proprietary data (and therefore the ability to imitate conditional on them), this regulation reduces not only the average profits of imitation, but also the marginal profits, implying an ambiguous impact. A total ban on data usage induces the marketplace to select a constant probability of imitation, and the impact on innovation depends on the thickness of the right tail of the demand of new products: the thick right tail of experimental product categories (with good chances of high demand) implies that the ban stimulates innovation, but the opposite happens for incremental product categories with a thin tail. Madsen and Vellodi (2024) show that more complex forms of data regulation would be more effective in stimulating innovation, and they include sufficiently long data patents and policies that allow the marketplace to access immediately data on highly successful products and never data for the other products. In their words, "consumer surplus is in general not monotone in innovation, and an outright ban on imitation overshoots

the regulator's first best innovation rate. When surplus gains from competition are sufficiently important, this overshooting is severe and data regulations can achieve higher levels of consumer surplus than can a ban on imitation. This comparison becomes even starker if a dual-mode ban prevents the platform from competing in established product categories for which innovation is not a concern, or from establishing new product categories on its own."

Ongoing work by Jeon and Rey (2022b) emphasizes the two-sided aspect of the problem endogenizing the participation of both sellers and buyers on the marketplace: in our terms this means that consumer participation and profits increase in the innovation rate, and the other way around. As long as the marketplace does not monetize directly on access fees on customers (which happens endogenously when buyers' participation is sufficiently elastic), the authors show that it is convenient to use both a commission on revenues and a cap on profitability to balance the incentives of the sellers to invest and join the platform and of buyers to join the platform and purchase from it. The policy implication is that a ban on copycatting may harm consumers, not only by preserving higher prices from third-party sellers, but also by reducing the number of sellers present on the platform (since preventing the platform from achieving the right balance between sellers' and buyers' incentives results into reduced participation on both sides).

Choi, Kim and Mukherjee (2023) make a further step by endogenizing the commission rate in a related model. They emphasize an additional argument through which a ban on copycatting harms consumers: such a ban forces the marketplace to react by increasing the commission rate, which increases prices of third-party sellers and disincentivizes their investments. The point can be easily made in our simple framework. The optimal commission rate maximizes $\pi_A(\beta, \tau)$, with first order condition:

$$r'(\tau) = \frac{|\pi'(\tau)|}{\pi(\tau)} \left(r(\tau) + \frac{\beta}{1-\beta} \bar{\pi} \right)$$

The left hand side represents the marginal revenues from increasing the commission rate on the sales of each successfull innovator, and the right hand side is the marginal cost due to the reduction in sellers's profits, which translates into a lower rate of innovation. The higher is the copycat rate the higher is the loss of profits due to lost innovations, and therefore the marketplace sets a lower commission to incentivize entry. The consequence is that a ban on copycatting (forcing $\beta = 0$) induces higher commissions amplifying consumer harm.

These findings appear consistent with the evidence by Zhu and Liu (2018) and Crawford *et al.* (2022) that Amazon entry may reduce the investments of some innovative sellers, but is mostly aimed at internalizing platform-wide externalities and strenghtening competition to attract more customers. However, more empirical work on the dynamic impact of marketplace's strategies is highly needed.

6 Conclusion

We have reviewed the economic literature on hybrid marketplaces with particular emphasis on the antitrust debate. Building mainly on theoretical contributions and structurally estimated models, we have analyzed the welfare impact of the dual mode of Amazon and of self-preferencing strategies. While the public narrative has focused its attention on size and power of Amazon, the economic literature has analyzed its complex business model leading to conclusions that do not seem to be in line with the prevailing pubic view: the trade offs are complex and one cannot easily conclude that Amazon entry is biased to expropriate third party sellers or that a ban on the dual mode, self-preferencing or copycatting would automatically benefit consumers.

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