Price Parity Clauses and Product Prices:

Evidence from Amazon and eBay

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Abstract

Price parity clauses (PPCs) have been adopted by many digital platforms, raising antitrust concerns. We study how Amazon's removal of PPCs in March 2019 affects product prices on Amazon and eBay. We find that, after the removal, products in categories with greater differences in commission rates between Amazon and eBay experience greater price reduction on both. The price reduction on Amazon is greater for products sold directly by Amazon than for those sold by third parties. These results suggest that Amazon's removal of PPCs increases platform competition and reduces product prices.

Keywords: price parity clauses, Amazon, eBay, platform competition

1. Introduction

With the growing popularity of digital platforms, significant regulatory concerns have emerged, ranging from competitive price parity clauses (PPCs) (Baker and Scott Morton 2018) to consumer privacy (Koutroumpis et al. 2020) to the classification of platform participants as employees versus contractors (Hagiu and Wright 2019) to the enforcement of data portability (Parker et al. 2020).

This paper examines the use of PPCs by dominant platforms. These PPCs—also termed most favored nations (MFN) provisions—prevent third-party sellers or service providers from charging lower prices on alternative channels than on the focal platform.[1] For example, when Amazon adopted PPCs, the total price of an item listed by a seller on Amazon was required to be at or below the price at which the seller was offering that item on any other online sales channel. Such a policy draws attention from regulators because it could reduce competition, a possible violation of Section 2 of the Sherman Act.[2]

In the past few years, PPCs have been the subject of antitrust enforcement in multiple European countries. For example, the European Commission investigated the practice of Amazon in Europe, and ended its PPCs throughout the European Union in 2013.[3] In December 2018, Senator Richard Blumenthal recommended that the US Department of Justice and the Federal Trade Commission investigate whether the leading platforms violated antitrust rules by adopting PPCs. In March 2019, presidential candidate Elizabeth Warren proposed to break up tech giants Amazon, Facebook and Google, and suggested that Congress should pass a law banning large companies from operating

[1] There are two types of PPC: wide and narrow. Wide PPC prevents the provider from setting a lower price on all other platforms, including the provider's own website; narrow PPC prevents the provider from setting a lower price on its own website, while leaving prices on other platforms unrestricted. This paper focuses on wide PPC.

[2] See 15 U.S.C. §§ 1-2 (2012). Federal Trade Commission (FTC) enforcement actions would be brought under Section 5 of the FTC Act, applying Sherman Act principles. See 15 U.S.C. § 45 (2012).

[3] Jacob Kastrenakes (2013), "Amazon lifts EU restrictions barring merchants from setting lower prices elsewhere", *The Verge*, August 31, https://www.theverge.com/2013/8/30/4676520/amazon-removes-eu-rule-requiring-lowest-price-parity-online, accessed September 2020.

and owning participants on the same online platform.[4] Against this backdrop, Amazon decided to stop preventing third-party sellers from setting lower prices on other websites.[5]

In this paper, we investigate the impact of Amazon's removal of PPCs on product prices on Amazon and eBay. Amazon is a retailer itself and also operates a marketplace in which third-party sellers can sell their products directly to Amazon customers. Amazon charges third-party sellers a commission for each transaction. The commission rate—a percentage of the product price—varies across product categories.[6, 7] Many sellers sell their products on both Amazon and eBay, one of Amazon's biggest competitors. eBay charges lower commission rates in many product categories than Amazon[8] and has not imposed PPCs.

We collect data for products on Amazon and eBay from Keepa.com, a market research firm that tracks historical product prices on these websites, to examine how the removal of PPCs affects product prices on Amazon and eBay. The removal of PPCs presents an exogenous shock to third-party sellers on Amazon and eBay. In addition, while Amazon as a retailer may have anticipated the removal of PPCs, it has no incentive to change prices for products it sells before the official removal.

Our identification strategy exploits varying treatment intensity as a result of the differences in Amazon and eBay commission rates across product categories. We also ensure that the

[4] Elizabeth Warren (2019), "Here's how we can break up Big Tech," Medium, March 9, https://medium.com/@teamwarren/heres-how-we-can-break-up-big-tech-9ad9e0da324c, accessed September 2020.
[5] David McCabe (2019), "Amazon to end price practice critics said could violate antitrust law," Axios, March 11, https://www.axios.com/amazon-price-practice-antitrust-elizabeth-warren-d802ba71-d376-4316-b9dc-cca4540959ac.html, accessed September 2020.
[6] See Amazon's commission rates for different categories at https://sellercentral.amazon.com/gp/help/external/200336920, accessed September 2020.
[7] For example, one company might sell an office chair at the final price of $100 on Amazon. An office chair is in the category of office products, which has a commission rate of 15%. Thus, this company needs to pay $15 to Amazon as commission, whereas Amazon itself selling the same chair does not need to pay commission.
[8] See eBay's commission rates for different categories at https://www.ebay.com/help/selling/fees-credits-invoices/selling-fees?id=4364, accessed September 2020.

commission rates on both sites stay the same for these product categories during the study period. When products have higher commission rates on Amazon than on eBay, then after Amazon removes its PPCs, third-party sellers would be more likely to reduce their prices on eBay because their marginal costs of selling on eBay are lower. We take advantage of this varying treatment intensity to apply a difference-in-differences (DID) approach to examine how Amazon's removal of PPCs affects product prices. This strategy allows us to control for common shocks to product prices during our study period.

Our analysis reveals that Amazon's removal of PPCs results in a greater price reduction on eBay for products that are subject to greater differences in commission rate between Amazon and eBay. The price of products on eBay decreases by 0.72 percent when the commission rate on Amazon is 1 percent higher than that on eBay. We also find that Amazon prices decrease by 0.63 percent when the commission rate on Amazon is 1 percent higher than that on eBay; this result is consistent with the two platforms being close competitors. The price reduction on Amazon is more pronounced when the products are sold directly by Amazon than by its third-party sellers, suggesting that Amazon is more responsive to price changes in the external environment.

This study contributes to the literature on PPCs. On the one hand, scholars point out that PPCs can benefit platforms, retailers, and customers. For platforms, theoretical studies have shown that PPCs can help resolve hold-up problems (e.g., Gans 2012, Ezrachi 2015) and prevent showrooming, a type of free-riding that undermines the platform's ability to operate (Baker and Scott Morton 2018, Wang and Wright 2020). For retailers, PPCs may streamline the way inventory is managed and price is determined across channels, since the retailer only needs to set one price for all intermediaries. For customers, PPCs reduce possible perceptions of unfairness. Many companies use dynamic pricing—setting the price based on individual-level information such as a

customer's browsing history and the time of booking—thereby raising concerns about whether the price being offered is fair. PPCs help maintain price transparency (Nicolau and Sharma 2019).

On the other hand, the increased price of the products or services can reduce consumer welfare and raise antitrust concerns. Edelman and Wright (2015) examine consumers' decisions to purchase either directly or through platforms and find that PPCs harm consumers by diverting them from direct channels. Boik and Corts (2016) explicitly consider the fee and price effects of platform PPCs in a theoretical model. They show that PPCs raise platform fees and retail prices and that they increase platform profits when aggregate demand is sufficiently inelastic. Johnson (2017) finds similar results but extends his model to consider differences between the agency and wholesale models. His finding shows that PPCs may harm consumers and reduce competition between platforms by reducing their incentives to lower prices. Baker and Chevalier (2012) and Scott Morton (2012) point out that antitrust enforcement against anticompetitive platform PPCs could have noticeable benefits for productivity and consumer welfare.

Empirical studies on PPCs are limited and many focus on the impact of the removal of PPCs on online travel agencies (OTAs) in Europe, where the National Competition Authorities and the European Union's enforcement institution brought cases against them. From 2015 to 2017, PPCs on Booking.com were eliminated in many European countries, including France, Italy, Sweden, and Germany. Hunold et al. (2018) show that hotels in Germany increased their sales channels and engagement with multiple OTAs when narrow PPCs were removed on Booking.com. They also find that price of the direct channel among hotel chains is more often strictly lower than the prices on all other visible online sales channels following the abolition of PPCs. De los Santos et al. (2020) study wholesale contracts and agency contracts under bargaining in the e-book sector and address that reinstitution of PPCs would raise the consumer prices by about three percent and non-

fiction books prices by up to nine percent through a counterfactual exercise. Ennis et al. (2020) study how switching from wide PPC to narrow PPC affects online price differential between OTAs and the direct channel. They find that the probability that the direct channel is cheaper than OTAs is increased significantly for mid-level and luxury hotels. Similarly, Mantovani et al. (2021) examine the removal of PPCs in France in 2015 for hotels listed on Booking.com and find a significant reduction in room prices in the short run, but a more limited effect in the medium run.

This paper provides empirical evidence beyond the OTA setting. In addition, the special structure of Amazon (being both a retailer and a platform provider) allows us to observe the responses of both Amazon itself and third-party sellers to Amazon's removal of PPCs. Our study also examines price changes on a competing platform. The prior empirical studies investigate price changes on OTAs after the removal or change of its PPCs in Europe, but do not look at the prices on competing platforms, where one would expect to see an immediate effect. Our study examines price reduction not only on Amazon (the indirect impact of eliminating PPCs) but also on eBay (the direct impact). Therefore, our findings can enrich our understanding of PPCs.

This paper adds to the growing literature on how regulation affects firms and consumers (e.g., Israeli 2018, Calzada and Gil 2019, Lu et al. 2019, Goldfarb et al. 2020). A subset of this work focuses on platform responses to regulation (e.g., Weyl 2010, Chen and Liu 2011). Scholars have examined many settings, such as platform firms changing their ad campaigns in response to privacy regulation (Goldfarb and Tucker 2011), changing e-book prices in response to vertical price restraints (De los Santos and Wildenbeest 2017), and changing prices and price dispersion in response to transparency regulation (Ater and Rigbi 2018).

Broadly, this paper relates to competition in platform markets (e.g., Caillaud and Jullien 2003, Rochet and Tirole 2003, Armstrong 2006, Economides and Katsamakas 2006, Armstrong and

Wright 2007, Karle et al. 2020). We find that the prices on Amazon and eBay are interrelated and that policy changes on Amazon affect prices on eBay. Moreover, in response to eBay's price change, Amazon itself—as well as its third-party sellers—adjust their own prices.

The rest of the paper proceeds as follows. Section 2 provides the background. Section 3 develops hypotheses. Section 4 describes the datasets and provides descriptive statistics. Section 5 presents the main empirical results and robustness checks. Section 6 concludes.

2. Background

Amazon, founded as an online retailer of books in 1994, quickly diversified into electronics, CDs, video games, home and kitchen, baby products, and many other product categories. Amazon Marketplace was launched in November 2000, allowing third-party sellers to sell directly to customers. Thus, Amazon is both a retailer and a platform provider: products on Amazon can be sold by Amazon and by its third-party sellers.

To help third-party sellers handle back-end operations, Amazon initiated the Fulfilled by Amazon service in 2006, whereby third parties pay for services but gain flexibility in their selling practices. The service provides storage, packaging, and shipping assistance, taking the burden off the sellers, and allows sellers to ship their merchandise to an Amazon Fulfillment Center, where it is warehoused until sold. When an order is placed, Amazon employees physically prepare, package, and ship the products.

eBay is another leading online marketplace and one of Amazon's major rivals. Many sellers choose to multi-home: they sell on both platforms. Unlike Amazon, eBay does not offer products itself; it is a pure marketplace connecting buyers and third-party sellers. At the time of this study, eBay does not offer fulfillment services.

3. Hypothesis Development

Since most products are charged lower commission rates on eBay than on Amazon, their selling costs are lower on eBay. When Amazon imposed PPCs, third-party sellers selling on both Amazon and eBay could not sell their products at lower prices on eBay even though they faced lower selling costs.[9] With the removal of PPCs on Amazon, third-party sellers no longer face price floors when setting their prices on eBay and are therefore likely to reduce the price on eBay. This price reduction is likely to be larger the larger the difference between Amazon and eBay commission rates.[10] Hence, we hypothesize:

Hypothesis 1a: The greater the difference in a product's Amazon and eBay commission rates, the greater its price reduction on eBay is likely to be after Amazon's removal of PPCs.

Most products in our study have commission rates of 10 percent on eBay (see Table 1). The differences between Amazon's and eBay's commission rates are thus mainly determined by Amazon's rates. Therefore, Amazon's commission rates may also matter when analyzing the price change after it removes its PPCs. Products with higher commission rates on Amazon have greater selling cost reduction and thus the removal of PPCs should result in significantly lower prices on eBay. Therefore, we hypothesize:

Hypothesis 1b: The higher a product's commission rate on Amazon, the greater the price reduction

[9] To implement this policy, Amazon's software scans price on other websites looking for price parity violations, and Amazon will take automated action on sellers found to be in violation (e.g., making the product harder to find). Moreover, retailers choose to raise price on other websites rather than losing sales on Amazon, because they earn a large portion of their sales from Amazon. Source: https://www.bloomberg.com/news/articles/2019-08-05/amazon-is-squeezing-sellers-that-offer-better-prices-on-almart, accessed September 2020.

[10] We define the difference in commission rates between Amazon and eBay as $Commission\ Rate_{difference} = Commission\ Rate_{Amazon} - Commission\ Rate_{eBay}$.

on eBay is likely to be after Amazon's removal of PPCs.

Amazon is known to use algorithms to price products it sells directly (e.g., Chen and Wilson 2017). Its algorithms collect price information for the same product on many other websites. When sellers reduce their product prices on eBay or other sales channels, Amazon's algorithms are likely to detect the price changes and Amazon, as a retailer, is likely to reduce its own prices for those products. Following Hypotheses 1a and 1b, such a price reduction of a product sold by Amazon directly is likely to be greater for a product with a greater commission rate difference between Amazon and eBay or with a higher commission rate on Amazon.

Third-party sellers on Amazon also have incentives to reduce their prices to stay competitive. If they are single-homing on Amazon or if their products compete with Amazon's own offerings, they are willing to lower prices to avoid losing customers to eBay sellers or to Amazon itself. Overall, the prices of products sold both by Amazon itself and by its third-party sellers are likely to decrease on Amazon after the policy change. Hence, we hypothesize:

Hypothesis 2a: The greater the difference in a product's Amazon and eBay commission rates, the greater its price reduction on Amazon is likely to be after Amazon's removal of PPCs. Also, the higher a product's Amazon commission rate, the greater its price reduction on Amazon is likely to be after Amazon's removal of PPCs.

On the other hand, a third-party seller's incentive to lower prices might not be as strong as that of Amazon as a retailer. Because Amazon does not change its commission rates after the removal of its PPCs, the cost structure for selling on Amazon remains unchanged for third-party sellers. In other words, the commission rate for third-party sellers remain the same while Amazon itself continues to not pay commissions. Thus, the room for price decrease is smaller for third-party

sellers than for Amazon itself. Therefore, we hypothesize:

Hypothesis 2b: Amazon, as a retailer, will reduce its product prices more than its third-party sellers do after its removal of PPCs.

4. Data

We collect data from Keepa, which keeps track of the historical prices of products on Amazon and eBay. We exclude certain categories, such as e-books, videos, and music, as products in these categories are often exclusively offered by Amazon and thus the removal of PPCs has little impact on their prices. Ultimately, we randomly collect data in 17 product categories and ensure that commission rates for these product categories stayed the same during our study period on both Amazon and eBay.

For every product on Amazon, we collect (a) the Amazon Standard Identification Number (ASIN), unique to each product; (b) the category, which determines the commission rate; (c) the price history for Amazon as the seller if Amazon sells the product; (d) the price history for third-party sellers—specifically, the lowest price among all third-party sellers;[11] and (e) the price history on eBay for those products that are offered or matched on eBay in new condition.

We focus on the prices of products three months before and three months after the month of Amazon's PPC removal (March 2019). We calculate the monthly average price—on Amazon and eBay—of every product in our sample. For products sold both directly by Amazon as a retailer and by its third-party sellers, we collect pricing data from both channels. To analyze the price

[11] If the product is sold by multiple third-party sellers, we take the lowest price among them, as we assume that consumers are likely to pay the lowest price for a given product. *Keepa* provides shipping costs for items fulfilled by third-party sellers only and for items sold on eBay. We include shipping costs when calculating the final prices of these products.

changes as a result of Amazon's removal of PPCs, we keep the product only if its price has been first tracked by *Keepa* before March 2019. As third-party sellers can use different IDs when selling on the two sites, we cannot match the sellers across the sites.

Table 1 provides a summary of products on the two sites in our dataset. Because not all Amazon products are offered on eBay or can be matched to an identical product in new condition on eBay, we have data for fewer products on eBay. The difference in the distribution of the products across categories is likely to capture both the multi-homing tendency of the sellers and the ease of matching. We also report the commission rates of the product categories on the two sites.[12] For most categories, eBay charges a lower commission rate. We observe more variation in the commission rates on Amazon than on eBay, which we leverage to identify the PPC effects.

5. Empirical Analysis

5.1 Analysis of Prices on eBay

We use the following DID model to analyze the price change on eBay:

$$log\ (price_{it}) = \beta_0 + \beta_1 Com\_Diff_i \times Post_t + \lambda_t + \theta_i + \varepsilon_{it}, \qquad (1)$$

where i identifies a unique product and t is the month. The dependent variable is the logarithm of the monthly average price of product i in month t on eBay. The variable Com_Diff_i is the commission rate difference between Amazon and eBay for product i.[13, 14] $Post_t$ is a dummy variable equal to 1 if the observation is collected after March 2019 and 0 otherwise.

[12] Zhu and Liu (2018) pointed out that Amazon appears to set commission rates strategically: The commission rates tend to be higher for product categories that are less competitive, in which margins for third-party sellers are higher.
[13] The commission rate for some categories is based on price, which might vary over time, so that a given product's commission rate can be different in different months. To avoid endogenous changes in commission rates, we fix Com_Diff_i using Com_Diff_i in March of the product i, regardless of variation in commission rates for some products caused by price change over the months of our analysis.
[14] When the commission rate difference is negative, we set it to zero because when a product's commission rate is higher on Amazon than on eBay, prices are not likely to affected by Amazon's removal of PPCs. The results are qualitatively the same if we use negative commission rate differences.

Table 1. Distribution of Products across Categories

	Amazon			eBay		
Category	Commission rate (%)	Frequency	% of all products	Commission rate (%)	Frequency	% of all products
Unlocked Cell Phones	8	2,547	0.50	10	35	0.23
Industrial & Scientific	12	1,345	0.26	10	555	3.72
Appliances	8/15[15]	1,987	0.39	10	39	0.26
Electronics	8/15[16]	75,965	14.92	10	2,565	17.18
Baby Products	15	12,662	2.49	10	189	1.27
Books	15	719	0.14	12	40	0.27
CDs & Vinyl	15	141	0.03	10	8	0.05
Clothing	15	18,436	3.62	10	35	0.23
Health Care	15	47,642	9.36	10	899	6.02
Home & Kitchen	15	59,624	11.71	10	2,438	16.33
Office Products	15	64,548	12.68	10	1,385	9.28
Patio, Lawn & Garden	15	6,789	1.33	10	22	0.15
Personal Care	15	40,942	8.04	10	1,152	7.72
Pet Supplies	15	46,467	9.13	10	1,358	9.10
Software	15	161	0.03	10	4	0.03
Sports	15	59,723	11.73	10	1,360	9.11
Tools & Home Improvement	15	25,434	5.00	10	951	6.37
Toys & Games	15	3,451	0.68	10	85	0.57
Video Games	15	40,516	7.96	10	1,806	12.10
Total		**509,099**	**100**		**14,926**	**100**

To control for possible seasonality that may affect all products, we include a month fixed effect λ_t, which absorbs the main effect of $Post_t$. θ_i is a product-level fixed effect and absorbs the main effect of Com_Diff_i. We cluster standard errors at the category level to account for autocorrelation in the data within categories and over time.

Column (1) of Table 2 shows that a 1-percent increase in the commission rate difference leads to a 0.721-percent price reduction on eBay. This supports Hypothesis 1a.

[15] 15% for the portion of the total sales price up to $300.00 and 8% for any portion of the total sales price greater than $300.00.

[16] 15% for the portion of the total sales price up to $100.00 and 8% for any portion of the total sales price greater than $100.00.

We further examine how the products' commission rates on Amazon affect price change on eBay. We use a similar model but replace the variable Com_Diff_i with Com_i, which measures the product's commission rate on Amazon.

As shown in Column (2) of Table 2, a 1-percent higher commission rate on Amazon leads to a 0.540-percent reduction in product prices on eBay due to Amazon's removal of PPCs. This supports Hypothesis 1b.

5.2 Analysis of Prices on Amazon

We then evaluate price changes for sellers on Amazon. In Column (3) of Table 2, we find that a 1-percent increase in commission rate difference leads to a 0.630-percent price reduction on Amazon.[17] Column (4) of Table 2 shows that a product with a 1-percent higher commission rate on Amazon has a 0.450-percent price drop on Amazon after the removal of PPCs. These results are consistent with Hypothesis 2a.

Because these products can be sold by Amazon (as a retailer) and/or by third-party sellers, we also analyze the impact of commission rate differences on the price changes separately. The results, as shown in Columns (1) and (3) of Table 3, indicate that a 1-percent higher commission rate difference between Amazon and eBay leads to 0.920-percent and 0.426-percent reductions in the average price of products sold by Amazon and by third-party sellers, respectively. Furthermore, Columns (2) and (4) of Table 3 present the empirical results based on Amazon's commission rate: a 1-percent higher commission rate on Amazon results in 0.694-percent and 0.305-percent decreases in the average price of products sold by Amazon and by third-party sellers, respectively.

[17] The price here is defined as the lowest price among that of Amazon itself as a retailer and those of all third-party sellers offering the product.

Table 2. Impact of Amazon's Removal of PPCs on Price on eBay and Amazon

	eBay		Amazon	
	(1)	(2)	(3)	(4)
Variable	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate
Commission rate difference × Post	-0.721*** (0.121)		-0.630*** (0.161)	
Amazon commission rate × Post		-0.540*** (0.087)		-0.450*** (0.114)
Product fixed effect	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes
Number of observations	90,633	90,633	3,032,247	3,032,247
R-squared	0.126	0.134	0.025	0.025

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level

To further examine the significance of the difference in price reduction between Amazon itself and its third-party sellers, we restrict to the products that are offered both by Amazon as a retailer and by a third-party seller. We adopt the following model:

$$log\left(price_{ijt}\right) = \beta_0 + \alpha Com\_Diff_i \times Post_t \times FirstParty_{ij} + \gamma_1 Com\_Diff_i \times Post_t +$$

$$\gamma_2 Post_t \times FirstParty_{ij} + \gamma_3 Com\_Diff_i \times FirstParty_{ij} + \delta FirstParty_{ij} + \lambda_t + \theta_i + \varepsilon_{ijt}, (2)$$

where j identifies the seller, $FirstParty_{ij}$ is a dummy variable equal to 1 if the seller of product i in month t is Amazon itself and 0 if it is a third-party seller, and α is the coefficient of interest. Com_Diff_i can also be replaced by Com_i for similar analysis.

Columns (5) and (6) of Table 3 reports the result. The significant coefficients and the differences in the magnitudes further support Hypothesis 2b.

Table 3. Impact of Amazon's Removal of PPCs on Amazon's Price

	Amazon as retailer		Third-party sellers		Amazon as retailer and third-party sellers difference	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate
Commission rate difference × Post × First party					-0.508**	
					(0.231)	
Amazon commission rate × Post × First party						-0.350*
						(0.182)
Commission rate difference × Post	-0.920***		-0.426***		-0.391**	
	(0.260)		(0.135)		(0.156)	
Amazon commission rate × Post		-0.694***		-0.305***		-0.299***
		(0.165)		(0.095)		(0.096)
Product fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	558,192	558,192	2,851,177	2,851,177	835,191	835,191
R-squared	0.005	0.006	0.015	0.015	0.002	0.003

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

5.3 Robustness Checks

We first test the parallel trends assumption underlying the DID analysis. We conduct a leads-and-lags analysis that allows us to incorporate the continuous nature of the treatment before the policy change. Specifically, we adopt the model as follows:

$$log\ (price_{it})\ = \beta_0 + \sum_{\tau=-3}^{3} \beta_\tau Com\_Diff_i \times Post_{t+\tau} + \lambda_t + \theta_i + \varepsilon_{it}. \quad (3)$$

As shown in Table 4, we do not find significant differences in trends before Amazon's removal of PPCs. The coefficients of the interaction terms are in general significant and the magnitudes for Amazon are larger than those for eBay, as expected.

Table 4. Leads-and-Lags Analysis

	(1) eBay	(2) Amazon
Commission rate difference × Post (t-2)	0.031	0.006
	(0.130)	(0.068)
Commission rate difference × Post (t-1)	0.019	0.051
	(0.115)	(0.065)
Commission rate difference × Post (t)	-0.247*	-0.224*
	(0.150)	(0.125)
Commission rate difference × Post (t+1)	-0.350***	-0.293***
	(0.094)	(0.100)
Commission rate difference × Post (t+2)	-0.214**	-0.201*
	(0.100)	(0.105)
Commission rate difference × Post (t+3)	-0.233*	-0.200**
	(0.125)	(0.093)
Product fixed effect	Yes	Yes
Month fixed effect	Yes	Yes
Number of observations	90,633	3,032,247
R-squared	0.136	0.027

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

We conduct two analyses to ensure that our results are not driven by alternative explanations. First, one might be worried that the sudden price reduction on eBay and Amazon is caused by seasonality; that is, that it takes place every March. To check this possibility, we apply the same model to data from the same months in 2018. The results, reported in Tables 5 and 6, show no significant changes in March 2018.[18]

Second, it is possible that Amazon's and eBay's price changes after March 2019 in the United States are driven by unobservable factors. For example, the labor cost of producing some products in countries like Vietnam, China, and India might have declined around this time. Such supply-side shocks are likely to have affected Amazon's businesses in other countries. We collect data on

[18] Because some products offered in 2018 were no longer offered by sellers or tracked by Keepa during and after 2019, and some products were offered starting in 2019, we have different numbers of products in 2018 and 2019.

products sold on Amazon in the United Kingdom and Canada. We choose these two countries because their market structures and economic conditions are similar to those of the United States. In addition, they did not experience policy changes during our study period.[19] The results, presented in Table 7, show no significant effect.[20, 21]

These two placebo tests boost our confidence that the observed empirical patterns are caused by Amazon's removal of PPCs.

Table 5. Price on eBay and Amazon in 2018

	eBay		Amazon	
	(1)	(2)	(3)	(4)
Variable	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate
Commission rate difference × Post	-0.003		0.072	
	(0.147)		(0.067)	
Amazon commission rate × Post		-0.001		0.070
		(0.148)		(0.078)
Product fixed effect	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes
Number of observations	89,850	89,850	2,507,387	2,507,387
R-squared	0.0002	0.0002	0.000	0.000

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

[19] For example, the price of Amazon's Prime service rose in Japan in April 2019.
[20] Data limitations prevent our study from examining price change on eBay in the United Kingdom and Canada.
[21] Products may have different ASINs across countries, so I can only match products based on categories.

Table 6. Price of Different Types of Seller on Amazon in 2018

	Amazon as retailer		Third-party sellers	
	(1)	(2)	(3)	(4)
Variable	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate
Commission rate difference × Post	0.059		-0.099	
	(0.200)		(0.080)	
Amazon commission rate × Post		0.092		-0.073
		(0.643)		(0.064)
Product fixed effect	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes
Number of observations	554,947	554,947	1,999,600	1,999,600
R-squared	0.0004	0.0004	0.000	0.000

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Table 7. Price on Amazon in the United Kingdom and Canada in 2019

	United Kingdom		Canada	
	(1)	(2)	(1)	(2)
Variable	Commission rate difference	Amazon commission rate	Commission rate difference	Amazon commission rate
Commission rate difference × Post	0.066		0.049	
	(0.250)		(0.081)	
Amazon commission rate × Post		0.083		0.017
		(0.217)		(0.064)
Product fixed effect	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes
Number of observations	148,990	148,990	481,970	481,970
R-squared	0.0001	0.0002	0.0002	0.0003

Notes: Dependent variable: Logarithm of (price +1) ×100.
Standard errors in parentheses, clustered at category level.
*** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

6. Discussion and Conclusion

The rapid growth of digital platforms has created antitrust concerns in many countries; PPCs, in particular, have attracted growing attention from policymakers. Our large-scale empirical study explores the impact of Amazon's removal of PPCs on the prices of products that are subject to differential commission rates on competing platforms. The DID analysis shows that, as a result of Amazon's removal of PPCs, the product with a greater commission rate difference between Amazon and eBay experiences a larger price drop on both. Furthermore, the product with a higher commission rate on Amazon experiences a greater price reduction on both platforms. We also find that Amazon as a retailer is more responsive to the policy change than its third-party sellers are.

Our findings imply that platform PPCs reduce platform competition and are thus a potential antitrust concern. Similar forms of platform PPCs are being widely adopted in other settings. For example, in April 2020, a group of New Yorkers sued dominant food delivery platforms like GrubHub, DoorDash, and Uber Eats, accusing them of forcing restaurant owners to sign contracts which include clauses that require prices for customers receiving delivery through platforms to be no higher than prices for dine-in customers.[22] Outside the United States, hotel platforms Yanolya in South Korea and Rakuten in Japan have also implemented PPCs, which drew attention from their countries' competition authorities.[23]

This paper also offers managerial implications for platform firms. It shows that when platforms can no longer impose PPCs, due to government regulation or the threat of regulation, they may lose customers to their rivals. As a result, these platforms could consider lowering commission

[22] Ethan Baron (2020), "DoorDash, Uber Eats, Grubhub, and Postmates make restaurant meals cost more: lawsuit," *Mercury News*, April 14, https://www.mercurynews.com/2020/04/14/doordash-uber-eats-grubhub-and-postmates-make-restaurant-meals-cost-more-lawsuit/, accessed September 2020.

[23] James Panichi (2019), "Booking.com, Expedia's Asian woes may thrust parity-clauses back onto global stage," mlex, April 20, https://mlexmarketinsight.com/insights-center/editors-picks/area-of-expertise/antitrust/booking-com-expedias-asian-woes-may-thrust-parity-clauses-back-onto-global-stage, accessed September 2020.

rates to stay competitive. They may also (a) consider alternative revenue streams such as advertising to reduce revenue loss or (b) introduce new features to retain customers.

This paper has a few limitations. First, it examines price change over a relatively short period. Some third-party sellers might not have become aware of the policy change or have fully understood its implications and thus not have taken any action. European Competition Network (2017) report that 47-percent of the hotels do not realize the change or removal of PPCs on Booking.com and Expedia, according to the electronic survey across the ten participating Member States. The effect of the removal of PPCs may therefore become more pronounced in the longer term.

Second, data limitations prevent us from examining price change on other channels, such as third-party sellers' own websites. One would expect similar price reductions there.

Third, this study focuses on price responses, but one might expect that Amazon's removal of PPCs has other impacts. For example, it may induce new e-commerce platforms to enter the market to compete with Amazon and eBay if they can leverage multi-homing and low prices to generate demand. Future work can examine the entry of new e-commerce platforms and investigate the change in online market structures.

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