Navigating the Amazon: Pass-Through of Digital Service Tax *

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Abstract

Large digital firms pay little profit tax in many countries, prompting several countries to introduce digital services taxes on these firms to indirectly tax their profits. We study the incidence of digital service taxes using data on Amazon, the largest online retailer. We find that Amazon increased its fees by almost the exact amount of the digital service tax. Firms using Amazon as a platform have largely been able to pass these increased costs onto consumers. On average, the incidence of digital service taxes falls almost entirely on consumers, though there is significant heterogeneity among countries.

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1 Introduction

Firms in the digital economy are widely suspected of large-scale profit tax avoidance. In 2018, the European Commission estimated that businesses operating in the digital sphere faced an effective tax rate of merely 9.5%, a stark contrast to the average tax burden of 23.2% on traditional business models (European Commission, 2018). This disparity may arise because of the digital economy's heavy reliance on intangible assets (such as patents and algorithms), which facilitate shifting profit to low-tax countries.

In response to these challenges, numerous countries have implemented digital service taxes (DSTs). DSTs are levies on the revenues of digital firms, aiming to indirectly capture profits that have eluded traditional profit taxation. The rationale behind taxing revenue, which is inherently less mobile than profit, is to mitigate the ease with which profits in the digital economy can be transferred to jurisdictions with lower tax rates. This approach, however, introduces a new query: are these taxes ultimately transferred to other market participants, including consumers and smaller businesses reliant on these platforms?

Other revenue-based taxes, particularly the value-added tax (VAT), are known to be at least partially passed on to consumers (see, e.g., Benzarti and Carloni, 2019; Benzarti et al., 2020). However, the applicability of VAT findings to digital service taxes (DSTs) is not straightforward. The digital economy frequently operates through platform-based models, where other firms utilize platforms to reach consumers. Tax incidence in such two-sided markets may differ substantially from standard incidence results (see, e.g., Kind et al., 2010; D'Annunzio et al., 2020)

Who bears the burden of digital services taxes? We answer this question using data from Amazon, which is the largest online retailer (and, by revenue, the largest firm in the digital economy). We divide our study into two parts, aligned with the two sides of the market. First, we study the fees Amazon charges retailers who use its platform to reach consumers. Second, we study prices faced by consumers. In this way, we study the pass-through of DSTs from the point of application to the end consumer, covering two sides of the market platform. Thus, our study focuses on Amazon as a platform and not as a direct seller of goods and services.

In the first part of our paper, we use information on Fulfillment by Amazon (FBA) fees, i.e., the fees Amazon charges for storing, packing, and delivering goods.[1] We have fee information on France, Germany, Italy, Spain, and the United Kingdom. Except for Germany all of these countries introduced a DST during our sample period (December

[1]It is also possible to use Amazon as a pure platform and ship goods directly to consumers. However, information on the selling and referral fees due in this case are not publicly available.

2017 to February 2022). Using a two-way fixed effects (TWFE) model, we find that for every one percentage point increase in DST, we observe a 1.1% increase in the FBA fees. The confidence interval includes that the tax is exactly passed on. Using the Callaway and Sant'Anna (2021) estimator, we find significant heterogeneity among countries: In the UK, fees increased by more than the DST; in France and Spain it was exactly passed through; in Italy, fees did not increase after the introduction of the DST relative to the control group.

In the second part of our paper, we use data on prices listed on Amazon. We obtain these data from `https://keepa.com/`, an independent price tracking website. In this part of the study, we use a simple difference-in-difference analysis by comparing two prices for the same product. First, the price is not affected by the DST and forms our control group. [2] Second, the price charged by sellers using Amazon as a platform with the 'Fulfillment by Amazon' option. This price which is affected by the DST on the FBA fee, forms the treatment group.

We observe that the pass-through of the DST varies across the countries. In the UK, we observe a 3.3% increase in the treatment price in comparison to the control price. In France, we observe a 1.7% increase. In Spain, we observe a 1% increase. However, a back of the envelope calculation reveals that the pass-through of the tax in UK, France and Spain is approximately 369%, 135% and 85% respectively. In Italy, we observe an economically and statistically insignificant coefficient indicating no pass-through of the tax in Italy. This finding is in line with the findings of the first part where we see no effect of the DST on the FBA fees in Italy.

Our findings are relevant for policymakers who debate introducing or continuing DSTs. If the DST is largely passed onto local sellers and customers, it is not suitable as an indirect tax on firms in the digital economy.

We contribute to two strands of literature. First, we add to the literature studying the incidence of indirect taxes. Regarding VAT, papers have studied individual sectors such as Finnish hairdressers (Kosonen, 2015) or French car sales and housing repair services (Carbonnier, 2007), or used broad international panel datasets (Benedek et al., 2020). Results vary significantly between settings, showing partial or complete pass-through to consumers. There is also substantial heterogeneity at the firm level: Studying restaurants in Finland and Sweden, Harju et al. (2018) show that some restaurants passed a tax cut on completely, while others did not react at all. Papers studying temporary VAT cuts find asymmetric effects of tax cuts and increases (Benzarti et al., 2020; Fuest et al., 2024). We are the first to empirically explore the incidence of an

[2] Only the revenue from intermediary services (such as FBA fees) is subject to the DST in the countries we study, not the revenue from the sale of goods.

indirect tax in a two-sided market, studying pass-through on both sides of the platform.

We also contribute to the small empirical literature studying tax effects in the digital economy. Bibler et al. (2021) show that better enforcement of hotel taxes increased prices on Airbnb. Lassmann et al. (2020) show that (effective) corporate tax rate are passed onto ad prices using Facebook data. None of these papers has studied a tax specifically aimed at the sector, such as the DST.

The rest of the paper is structured as follows. Section 2 describes the DSTs in the countries we study and Amazon's fee structure. Section 3 presents the data and the empirical strategy. Section 4 describes the results and section 5 concludes.

2 Institutional Setting

2.1 Digital Service Taxes

Digital firms can often capture revenues from a country without attributing any profits to the country since a permanent establishment is not necessarily required to cater services to the people in a country. Thus, despite profiting from the demand and infrastructure in a country, digital firms do not necessarily pay profit taxes there. To address these issues, the OECD has come forward with the BEPS Pillar I proposal. Through the proposal, OECD is trying to address the taxing rights of countries in the new age economy consisting of digital firms which are also growing rapidly (UNCTAD, 2021). Due to the delays in implementing Pillar I, some countries have implemented DSTs. A Digital Services Tax (DST) is an ad valorem tax on the revenues generated from digital services provided.

As of 2024, thirty three countries have DSTs in place, four countries are in the public consultation phase of the law and a further five countries have an intention to implement DSTs (KPMG, 2024). Most DSTs only include revenues generated from advertisements under the tax net. In this study we consider the DSTs introduced by France, Italy, Spain and the United Kingdom. All of these DSTs include revenues generated from inter-mediation services, including shipping and logistics of goods, in addition to the revenues generated from advertisements.

France was the first country to introduce a DST. The French legislation was already in place by July 2019. However, the French government decided to postpone the collection of the DST since the EU was working on a directive to tax digital firms with a substantive presence in the EU. When the proposal failed France officially started collecting DST from December 2020. Table 1 presents the details of the DSTs in greater detail.

Table 1: **DST Summary Table**

Country	DST Date	DST Rate	GT	CT	DST Impl. Date
France	24/07/2019	3%	€750 mil	€25 mil	01/12/2020
UK	16/07/2020	2%	£500 mil	£25 mil	01/04/2020
Spain	10/07/2020	3%	€750 mil	€3 mil	16/01/2021
Italy	19/12/2019	3%	€750 mil	€5.5 mil	01/01/2020

Notes: The data is sourced from the latest report 'Taxation of the Digital Economy' of KPMG, dated 22^{nd} January 2024. The DST date represents the date of implementation in the legislature. 'GT' refers to the global threshold that qualifies a firm for DST in that jurisdiction. 'CT' refers to the country threshold, which indicates the amount of revenue that a firm has to make in that particular country for falling under the DST. The DST implementation date refers to the date when the country started collecting DSTs from firms.

Most countries implemented DSTs in such a way that it affects only very large digital firms. Each country has a global and a local revenue threshold for deciding whether the firm falls under the DST or not.

2.2 Amazon's Business Model and Fee Structure

Amazon is the largest e-commerce company in the world with a market capital of $1.95 trillion currently. As part of its e-commerce business, Amazon collects various intermediation fees from the sellers on their platform. The three major fees that Amazon charges sellers are the selling fee, the referral fee and the FBA fee. The selling fee and the referral fee are collected on all items sold by the sellers on Amazon. The FBA fee, however, only applies to those sellers who avail the fulfillment service by Amazon.

All the service fees that Amazon collects are subject to the Digital Service Taxes. We consider the FBA fee especially for this study because Amazon has a special fee structure for the FBA fee which it publishes from time to time which are available over the internet for public visibility. The historic fees data is only available for the EU countries and the United Kingdom. Therefore, we focus on these countries.

3 Data and Empirical Model

3.1 Pass-Through to Sellers on the Platform

To study how fees change in response to the DST, we hand-collected FBA rate cards that Amazon publishes for all marketplaces in the European Union. [3] Publication of the rate cards are non-periodical. We obtain the rate cards from December 2017onwards when Amazon published the first consolidated rate card for all EU countries.[4]

The rate cards contain fees for storage, packing and shipping. The rate cards also provide information on the calculation of the final FBA fee from the various fees. The fees for shipping depends on the weight of the item and the dimensions of the item post packaging. The weight of the item and the dimensions of the item determine whether the product is a 'Standard' product or an 'Oversize' product. The rate cards also contain fees for local shipment and cross-border shipment. We only consider the local shipment category, since the period of study includes the COVID pandemic and Brexit, which affected cross-border movement of goods.

We provide the methodology for calculating the FBA fees in Appendix A.1. The FBA fee provided in the rate cards is a pre-VAT fee and we use it as such. The rate cards contain the fees for Germany, France, Spain, Italy, the Netherlands, Sweden, Poland and the United Kingdom. However, the fees for the Netherlands, Sweden and Poland are available only since April 2020, and therefore, we do not include these marketplaces in the study. Data for the rest of the countries is available for the entire period of study.

We provide the descriptive statistics of the FBA fee from marketplaces in Table 2. In Panel A of Table 2, we observe that the fees in Germany are marginally lower than the fees for the other countries. In Panels B and C, we provide the descriptive statistics for the standard and oversize goods, respectively.

[3] Amazon refers to the country of operation as the 'marketplace' of operation. In the rest of this study, we use the terms 'country' and 'marketplace' interchangeably.

[4] We use the rate cards till February 2022 for our study. We exclude the period after February 2022 from the study since the Russia-Ukraine war started in the end of February 2022. The war led to high inflation in most EU countries and therefore we expect the event to have an effect on the results.

Table 2: **Average FBA fee statistics**

Panel A: All products

	p25	p50	p75	Mean	SD	Observations
Germany	7.88	15.91	19.26	13.93	6.41	14280
Spain	7.87	16.98	21.09	15.19	7.68	14280
France	9.74	19.25	22.81	17.42	8.37	14280
Italy	9.79	19.25	22.36	16.58	7.46	14280
United Kingdom	6.59	13.75	16.89	12.18	6.24	14280

Panel B: Standard Size

	p25	p50	p75	Mean	SD	Observations
Germany	4.07	6.42	7.16	5.88	1.80	4080
Spain	3.96	6.24	7.21	5.90	1.83	4080
France	5.05	7.34	9.20	7.28	2.50	4080
Italy	4.61	7.03	8.94	6.97	2.35	4080
United Kingdom	3.01	4.67	5.92	4.49	1.73	4080

Panel C: Oversize

	p25	p50	p75	Mean	SD	Observations
Germany	15.45	17.73	19.95	17.16	4.45	10200
Spain	15.84	19.52	22.82	18.91	5.73	10200
France	18.25	21.42	24.52	21.48	6.16	10200
Italy	17.66	21.20	23.72	20.42	4.88	10200
United Kingdom	13.03	15.50	18.38	15.25	4.51	10200

Notes: FBA fees for goods of different weight and size. Fees for Spain, Italy and France are in €(Euro). Prices for the United Kingdom are in £(Great Britain Pound). p25, p50 and p75 are the price levels at the 25^{th} percentile, 50^{th} percentile and 75^{th} percentile. **Data Source**: Fulfilment by Amazon rate cards downloaded from `https://sell.amazon.co.uk/`.

In Figure A.1, we provide the graph depicting the movement of the average FBA fee over time in the marketplaces. In Panel A, we show the FBA fee movement for the consolidated data. In Panels B and C, we show the same for the standard and the oversize categories respectively.

To analyze the pass-through effects for every percentage point increase in the DSTs, we run the TWFE model by replacing the $Treat$ variable in equation 1 by the DST variable. The DST variable captures the tax rate in each country. The variable will have a value of 3 for Italy, Spain and France, 2 for the United Kingdom in the post-treatment period. Since Germany does not have a DST and serves as the sole control country, the DST in Germany is 0 for the period of study. The TWFE model in this case will be as follows:

$$lnFBAfee_{it} = \alpha + \beta_1.DST_{it} + \gamma_i + \theta_t + \epsilon_{it} \quad (1)$$

We also run the regression in equation 1 using a dummy variable as a treatment indicator. We do this to see the overall effect of the tax in order to compare it with the results generated by the modern staggered DiD estimators which use a binary treatment indicator.

Callaway and Sant'Anna (2021), Sun and Abraham (2021) and De Chaisemartin and d'Haultfoeuille (2024) point to the limitations of the TWFE model and provide more robust estimators in the event of staggered treatments. In the current setting, different marketplaces implement DSTs in different time periods. Therefore, the staggered implementation of DSTs across countries calls for analyzing the pass-through using the modern staggered differences-in-differences estimators. For this study we use the $CSDID$ estimator by Callaway and Sant'Anna (2021). We also replicate the results using the *did_multiplegt_dyn* estimator proposed by De Chaisemartin and d'Haultfoeuille (2024) as a robustness measure to ensure that more than one staggered differences-in-differences (DiD) estimator produce similar results.

We use the CSDID estimator since it allows the not-yet treated groups to serve as the control group. Callaway and Sant'Anna (2021) state in their study that using a not-yet treated control group is more intuitive when the total number of groups is few. Since we only have four treated and once control group we use the not-yet treated groups as our control. Equation 3 describes the regression model using the CSDID estimator.

$$lnFBAfee^{g,t} = \alpha_1^{g,t} + \alpha_2^{g,t}.G_g + \alpha_3^{g,t}.1\{T = t\} + \beta^{g,t}.(G_g * 1\{T = t\}) + \epsilon^{g,t} \quad (2)$$

In equation 2, $\beta^{g,t}$ is the coefficient of interest that calculates the average treatment effect,$ATT(g,t)$ of members of group g in time period t, i.e., the group-time average treatment effect. $ATT(g,t)$ lays no restrictions on treatment effect heterogeneity across group or across time and can allow us to analyze how average treatment effects vary across different dimensions in a unified manner (Callaway and Sant'Anna, 2021). G_g ia a binary variable that takes a value of 1 if the group G receives treatment for the first time in period g.

3.2 Pass-Through to Consumers

For the second part of the study, we use Amazon pricing data from Keepa (`https://keepa.com/`). Keepa is a pricing consultancy firm for sellers on Amazon. Keepa provides historical pricing data of the products sold on Amazon since 2011. Sellers can use these historical price information to track, analyze and price their products accordingly. The price history data is available for products in all five marketplaces

during the period of study. We use the Keepa database to capture two different price categories as well as the number of suppliers offering a product. The two price categories that we capture are :

1. **Amazon Price:** The Amazon price is the price at which Amazon sells the good when Amazon is one of the sellers of the product. The price does not include shipping costs but is inclusive of VAT. This price serves as the control for us to analyze pass-through of DSTs. When Amazon is the seller of the product, there is no inter-mediation service provided by Amazon and therefore DSTs do not apply to this price.

2. **FBA Price**: The FBA price is the lowest offered price of the product on the Amazon marketplace where Fulfilment by Amazon service is available. The price does not include shipping costs and is inclusive of VAT. This price is the treated price.

We also capture the number of sellers offering a product at any given time period. We use this to later analyze if the change in the number of suppliers on the platform affects the pass-through of the tax.

When a seller uses the FBA services from Amazon, every product that she sells through Amazon is subject to certain fees. The seller is subject to a referral fee, which is the fee charged for display of the product on the platform. The fee is charged to the seller on the sale of a product. The seller is subject to a selling fee, which is a fee that Amazon charges the seller for enabling the sale. Finally, the seller is subject to a FBA fee which is the fee charged by Amazon for providing warehousing and logistic services. All these fees are intermediation fees that are charged by Amazon to any seller who avails the FBA service and all these fees are subject to the DST.

Here, we try to explain the setting through an example. Let us consider a product that has a pre-VAT price of €100 in France. Let us assume that the product has a referral fee of 15%, i.e., €15.[5] The product has a selling fee of €0.90 and an FBA fee of €7. The total fee charged by Amazon to the seller for the sale and delivery of this product is the sum of the referral fee, selling fee and the FBA fee, which amounts to €22.90. Now with the introduction of a DST, the DST applies on the fee of €22.90. Since France has a DST of 3%, the amount of DST is €0.69.[6] With the inclusion of VAT (20% for France) the total effect of the DST will be €0.82. The price is not subject

[5]The referral fee is charged as a percentage of the product price and ranges normally between 7% and 15%, except for one category (Amazon accessories) where there is a referral price of 45%.

[6]3% of €22.90.

to any of the above mentioned fees when Amazon is the seller itself. Since there is no intermediation service provided and no fee charged the Amazon price is unaffected by the DST. Therefore, comparing the FBA price and the Amazon price of the product before and after introduction of a DST can help us to causally infer the pass-through of the DST.

Since all prices in the Keepa database are inclusive of VAT, it is hard to disentangle and neutralize the effect of VAT change on prices. So we no longer rely on cross-country comparisons as we did in the first part regarding FBA fees.[7] Since we capture two prices of the same products only within a country, the possibility of any event other than a DST affecting these two prices is highly unlikely.

For this analysis we filter the data to select those products for which both Amazon and FBA prices are recorded during the period of study. Data for the prices are not available for all weeks, so we ensure that the products selected have both prices for at least one week in the pre and post-treatment periods. This ensures that the products were not discontinued by the sellers (either those selling through FBA or Amazon itself) during the period of analysis. We have 136,729 products based on the selection criteria from a total population of 519,521 products or roughly 26.3% of the total products. We provide the summary statistics for this sample of 136,729 products in Table 3 based on the marketplace. The same sample is also used to generate the summary statistics for standard and oversize products shown in Tables A.3 and A.4 in the appendix.

We run the following DiD regression for each individual country to analyze the pass-through of the DST.

$$Price_{it} = \alpha + \beta_1 . FBA_{it} . Post\_DST_t + \gamma_i + \theta_t + \epsilon_{it}. \tag{3}$$

In the equation 3, $Price_{it}$ refers to the price of the product. In each country we randomly assign products to the treatment and the control groups. For the treatment group $Price_{it}$ is the FBA price and for the control group $Price_{it}$ is the Amazon price. i and t are indicators for the product and time. FBA is a binary variable which takes the value 1 when the price of a product is the FBA price and takes a value 0 when the price of the product is the Amazon price. $Post\_DST$ is a binary variable that takes a value of 1 for all post-treatment periods and a value of 0 for all pre treatment periods. γ and θ capture the cross-sectional and time fixed effects. ϵ captures the standard error clustered at the product time level.

In addition to the simple DiD regression we also perform an event study for each

[7] An additional problem with the cross-country comparison of consumer prices here is that Germany lowered its VAT in the second half of 2020.

individual country. We run the following regression for generating the event study.

$$Price_{it} = \sum_{k=-12}^{11} \alpha_k D_t^k * FBA_{it} + \gamma_i + \theta_t + \epsilon_{jt} \tag{4}$$

We run the DiD analysis and the event study using weekly aggregated price data. Since the data on prices is available only on a non-periodic basis, there is no possible way to run the analysis on a daily basis and therefore we aggregate the data on a weekly basis. Initially we run the analysis for a period of 24 weeks using 12 pre-treatment and 12 post treatment periods for each country.

4 Results

4.1 Pass-Through to Sellers on the Platform

We display the results of the tests for the pass-through of the tax to sellers from equation 1 and 2 in Table 4. In column (1) of Panel A where we observe the results for the consolidated data, we see a positive coefficient indicating a 1.1% increase in the fee for every 1% increase in the tax rate. This indicates a full pass-through of the tax. When we look at the standard and oversize categories separately, we observe coefficients indicating 0.8% and 1.4% increase in the fee for every 1% increase in the tax rate. These results indicate an 80% pass-through of the tax for the standard size goods and a 140% pass-through for the oversize category. In Panel B, where we test the same model using a binary treatment indicator, we observe a uniform coefficient of 3.5% on all columns indicating full pass-through of the DST on all categories.

However, as described in the previous section, different countries introduced DSTs at different time points and therefore, it is worth exploring the individual effects of each individual DST using the CSDID estimator(staggered differences-in-differences estimator of Callaway and Sant'Anna (2021). We present the results of the CSDID estimator in panel C. From panel C, we observe substantial differences in the effects across different countries. In column 1, we show the average effects for each individual country as well as an effect for all the countries taken together using the consolidated data. Here, we observe that post-DST introduction there is a 2.0% increase in the FBA fee on average. However, for Italy, we see a reduction of 1.8% in the FBA fee post DST indicating no pass-through of the tax onto sellers. In the UK, we observe a 3.4% increase suggesting a near 150% pass-through of the tax. In France and Spain, we observe an effect of 3.7% and 2.8% respectively indicating a greater than 100% pass-through in France and 90% pass-through of the tax in Spain.

Table 3: **Keepa Price Statistics**

Keepa price statistics(Pre Treatment)							**Keepa price statistics(Post Treatment)**						
Panel A: Average Amazon Price							**Panel A: Average Amazon Price**						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**	**Country**	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	13.18	20.74	36.45	34.18	42.06	218140	Spain	12.91	20.18	35.25	33.33	41.68	229619
France	13.32	20.77	36.15	33.73	41.12	277841	France	13.44	21.03	36.83	34.05	41.12	288278
Italy	13.39	20.99	37.08	34.64	42.87	320187	Italy	13.47	21.08	37.70	35.20	43.71	310601
United Kingdom	7.05	12.30	22.08	21.65	39.41	400987	United Kingdom	7.31	12.97	23.33	22.64	39.88	409860
Panel B: Average FBA Price							**Panel B: Average FBA Price**						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**	**Country**	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	13.88	21.63	37.99	35.33	44.69	93197	Spain	13.64	21.99	39.90	36.84	47.17	74684
France	13.66	22.05	39.14	36.56	47.35	73331	France	14.02	22.82	39.93	37.61	48.41	77225
Italy	13.69	21.21	36.25	33.77	40.64	204034	Italy	14.10	21.99	37.99	34.86	40.66	183037
United Kingdom	6.10	11.63	21.49	20.90	38.70	266254	United Kingdom	6.97	12.92	23.12	22.33	40.92	237398
Panel C: Average Supplier Count							**Panel C: Average Supplier Count**						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**	**Country**	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	5.00	9.00	15.00	11.77	10.72	288902	Spain	4.00	8.00	13.00	10.45	9.89	312462
France	5.00	9.00	14.00	11.18	9.68	391693	France	4.00	7.00	11.00	8.82	7.99	406644
Italy	7.00	11.00	20.00	16.09	15.52	463100	Italy	6.00	10.00	18.00	14.21	13.39	468306
United Kingdom	8.00	12.00	19.00	14.62	10.17	596568	United Kingdom	5.00	8.00	13.00	9.91	7.51	592362

Notes: All prices for Spain, Italy and France are in €(Euro). Prices for the United Kingdom are in £(Great Britain Pound). The number of sellers offering the products are in absolute numbers. p25, p50 and p75 are the price levels at the 25^{th} percentile, 50^{th} percentile and 75^{th} percentile.
Data Source: `https://keepa.com/`.

Table 4: **Results - Passthrough to Sellers**

Panel C: TWFE using DST rate

	(1)	(2)	(3)
VARIABLES	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)
DST	0.011***	0.008***	0.014***
	(0.002)	(0.002)	(0.002)
Observations	45,900	20,400	25,500
R-squared	0.992	0.986	0.981
Cross-section FE	YES	YES	YES
Time FE	YES	YES	YES
Size		Standard	Oversize

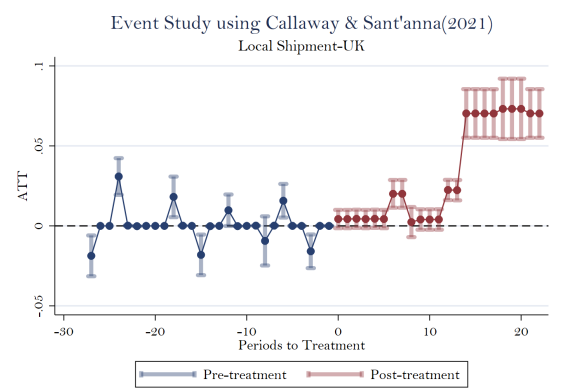
Panel A: Two-way fixed effects model

	(1)	(2)	(3)
VARIABLES	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)
Treat	0.035***	0.035***	0.035***
	(0.005)	(0.005)	(0.007)
Observations	45,900	20,400	25,500
R-squared	0.992	0.986	0.981
Cross-section FE	YES	YES	YES
Time FE	YES	YES	YES
Size		Standard	Oversize

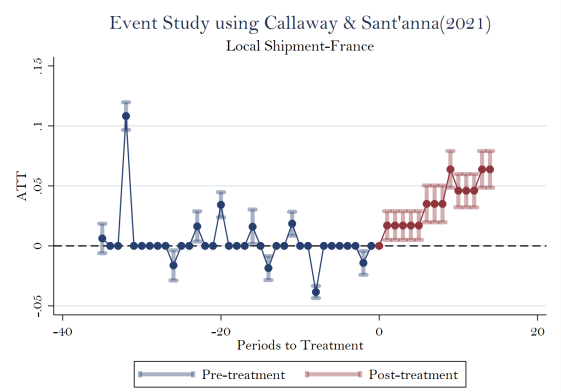
Panel B: Callaway-Sant'anna estimator

	(1)	(2)	(3)
VARIABLES	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)
GAverage	0.020***	0.023***	0.018**
	(0.004)	(0.004)	(0.004)
Italy	-0.018***	-0.012***	-0.023***
	(0.006)	(0.004)	(0.005)
UK	0.033***	0.052***	0.018***
	(0.004)	(0.007)	(0.004)
France	0.037***	0.030***	0.043***
	(0.006)	(0.004)	(0.007)
Spain	0.028***	0.023***	0.033***
	(0.006)	(0.004)	(0.007)
Observations	45,900	20,400	25,500
Cross-section FE	YES	YES	YES
Time FE	YES	YES	YES
Size		Standard	Oversize

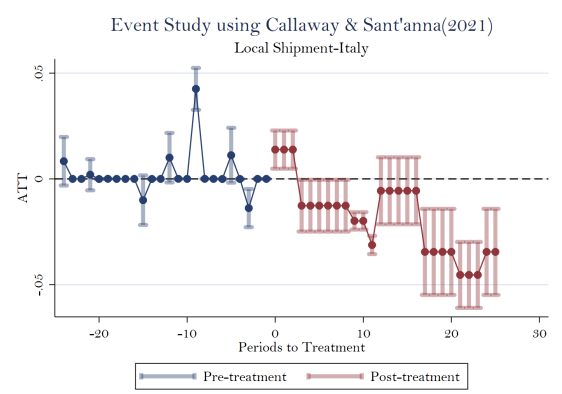
Notes: In Panel A and B, the standard errors are cluster robust at the country-time level. In Panel C, the standard errors are clustered at the cross-sectional level, as the Callaway-Sant'Anna allows only for clustering at a level nesting the cross-sectional identifier, and four clusters are too few. The dependent variable is the natural logarithm of the FBA fee which is the sum of the shipping fee, the storage fee, the labeling fee, the baggage fee and the taping fee. ***, **, * indicate significance at the 1%, 5%, 10% levels.



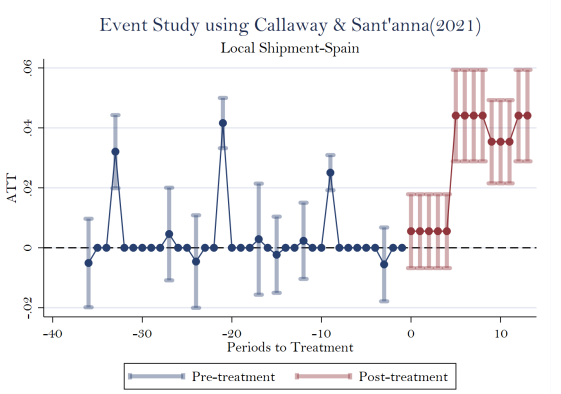
(a) United Kingdom



(b) France



(c) Italy



(d) Spain

Figure 1: **FBA Fee Movement - Individual Countries**

Notes: Subfigure (a) shows the event study for the United Kingdom. The FBA movement for France, Italy and Spain are shown in subfigures (b), (c) and (d) respectively. The standard errors are calculated at the cross-sectional identifier level. The figure displays the estimates of the coefficients along with the 95% confidence interval. An effect of 0.1 on the Y-axis indicates a 1% point pass-through of the tax. So if the DST rate in a country is 3%, then a 0.1 coefficient on the Y-axis indicates a 33.33% pass-through of the tax.

In columns (2) and (3), where we provide the results for standard and oversize categories respectively, we observe a marginally weaker effect for France and Spain in the standard size category and a relatively stronger effect in the oversize category than that observed in column (1). For Italy, we observe negative coefficients in each of the categories indicating no difference from the consolidated result of column (1). In the UK, we see high over-shifting (260%) in the standard size category with a coefficient indicating a 5.2% increase in the fee post DST. In the oversize category, we observe less than full pass-through (90%) with a coefficient indicating a 1.8% increase in the fee post-DST.[8]

In Figure 1, we show the event study results using the CSDID estimator for every

[8]The UK has a DST rate of only 2% where as all the other countries in the study have a DST rate of 3%.

individual country for the entire set of data. For the UK, France and Spain we observe a clear upward trend in the post treatment period. For each of the market places we observe that there is an occasional spike in the pre-treatment period. For Italy, there is no effect of the DST in comparison to the control group. However, there is no clear trend in the pre-treatment period.

4.1.1 Robustness Tests

From the initial results we observe that there is a considerable difference in the coefficients generated by the TWFE model and the CSDID estimator. The Bacon decomposition, developed by Goodman-Bacon (2021), explains the intuition behind the calculation of the weights that are used by the TWFE model in arriving at the estimate. Further details on the calculation of the weights using the Bacon decomposition and the decomposition table are provided in the appendix.

In Table A.7, we provide the comparison between the results using the *CSDID* and the *did_multiplegt_dyn* estimators. From the table, we show that the estimated effect by both the estimators is almost the same in all panels indicating robustness in the results.

In contrast to the initial TWFE model where we compare all treated countries against the control group, we run a TWFE analysis by comparing each of the treated countries individually against Germany. We present the results of the same in Table A.8 in the appendix. We also run a staggered DiD analysis by using the never treated group as the control group instead of the not-yet treated group. We present the results of the same in Table A.9 in the appendix. Here we observe the *CSDID* estimator produces results similar to that presented in panel (c) of Table 4 where as the TWFE estimator produces extremely high coefficients indicating the results to be more robust using the *CSDID* estimator.

4.2 Pass-Through to Consumers

In Table 5, we present the results of the DiD model described in equation 3. The results for UK are shown in columns (1)-(3). In column (1), where we present the results for the entire set of products, we observe a coefficient indicating a 3.3% increase in the difference between the FBA price and the Amazon price post-treatment. For the oversize products in column (3), we observe a coefficient indicating a 4.8% increase.

In France (columns (4)-(6)) we observe a coefficient indicating a 1.7% increase in the difference between the FBA price and the Amazon price post-treatment. However,

here as well, we observe a significantly higher pass-through on the oversize products with a coefficient indicating a 3.1% increase. In Italy (columns (7)-(9)), we observe an economically and statistically insignificant result indicating no pass-through of the tax in Italy. These results are in concurrence with the findings in the first part where we observed no pass-through of the tax by Amazon to the sellers. Since Amazon did not pass-through any of the tax onto the sellers, it is intuitive that the sellers also did not pass-through any tax onto the consumers.

In Spain (columns (10)-(12)), we observe a relatively weaker coefficient in comparison to France and the UK but we do observe a statistically significant coefficients. For the entire set of products in Spain, we observe a statistically significant coefficient of 1%. For the oversize category, we observe a relatively higher coefficient of 1.9% indicating higher pass-through of the tax in the oversize category.

We perform a back of the envelope calculation to determine the pass-through of the DST in this part. From this calculation, we observe that the pass-through of the DST in France is 135% for the overall product set. In the UK, we observe a pass-through of 369% and in Spain we see a pass-through of 85%. Therefore, we observe pass-through to be heterogeneous across countries. However, the results are in line with the first part of the study, where we observe the strongest pass-through effects in the UK followed by France and Spain. A detailed explanation of the calculation is provided in the appendix in A.3.

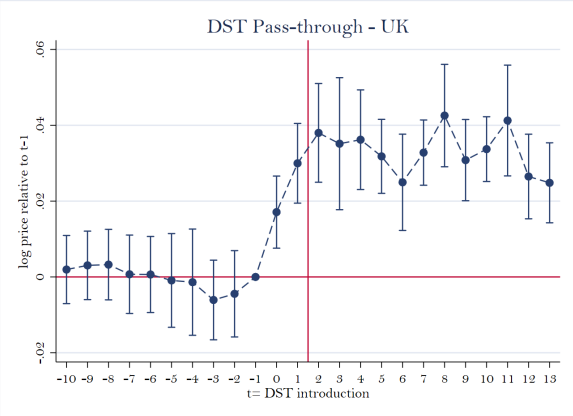
We present the results of the event study in equation 4 below for each country for the overall set of products.

From Figure 2, we see that the effect of the DST is clearly visible in UK, France and Spain but we do not see any effect in Italy. However we observe that in UK and France, we see clear anticipation effects from panel (a) and panel (b). In the UK, we observe that the treatment starts taking effect two weeks before the actual treatment date. This is mainly because the DST guide was published by the UK government on 19th March 2020. The DST treatment date was 1st April 2020 and we see the effect of the guide publication to have already started the effect of the DST. In France, we also see the effect starting to take place three weeks before the actual treatment date of 1st December 2020. However, in France the collection of the DST was significantly delayed from the original implementation date. News that France was going to start the collection of the DST from 1st December 2020 in November 2020 could have sparked the DST effect in France three weeks before the implementation date. In Spain, the event study presented uses the date of implementation of the DST into law i.e. 7th October 2020 as the treatment start date since we also observe clear anticipation effects in Spain and it looks like the effect had already started to kick in before the DST collection start

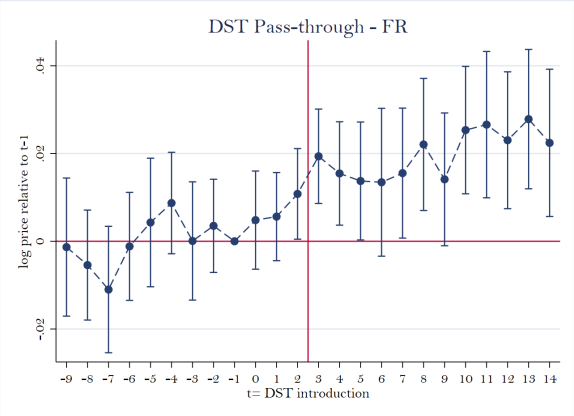
Table 5: **TWFE - Comparison of FBA price vs Amazon Price(24 weeks))**

	UK			**FR**			**IT**			**ES**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)
FBA x Post_Treat	0.032***	0.032***	0.047***	0.017***	0.016***	0.030***	0.001	0.001	0.001	0.010***	0.010***	0.019***
	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.006)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.007)
Observations	1,108,871	1,082,049	26,822	344,008	329,521	14,487	821,117	782,016	39,101	613,694	589,449	24,245
R-squared	0.974	0.973	0.984	0.977	0.975	0.985	0.977	0.974	0.986	0.979	0.977	0.984
Cross-Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Size		Standard	Oversize		Standard	Oversize		Standard	Oversize		Standard	Oversize

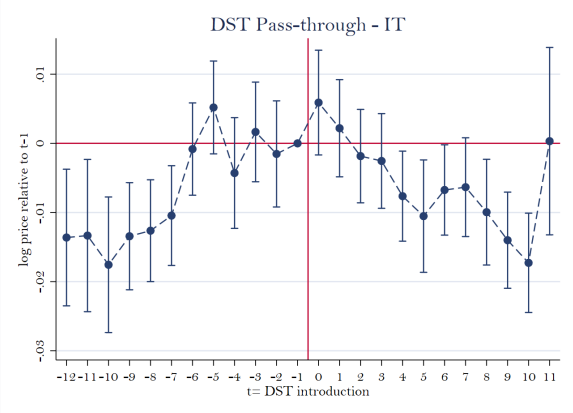
Notes: In all the columns the standard errors are cluster robust at the product time level. Product group is the group to which the product belongs such as books, cosmetics etc. The results are for a 24 week period with 12 pre and 12 post-treatment periods. The dependent variable is the log(price). For the treatment group the price is the average weekly FBA price where as for the control group the price is the average weekly amazon price. Standard errors are displayed in the parentheses. ***, **, * indicate significance at the 1%, 5%, 10% levels.



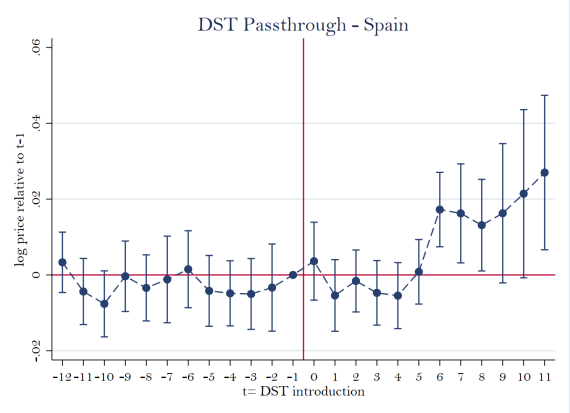
(a) UK



(b) France



(c) Italy



(d) Spain

Figure 2: **Event Study - 24 Weeks(FBA Price v/s Amazon Price)**

Notes: The subfigure(a) shows the results of the event study design for UK. Subfigures (b), (c) and (d) show the same for France, Italy and Spain respectively. The individual bars in each event study are indicative of the 95% confidence intervals.

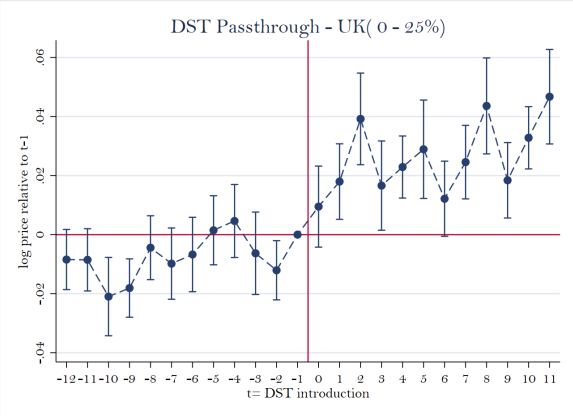
date of 16th January 2021.

4.2.1 Robustness & Heterogeneity Tests

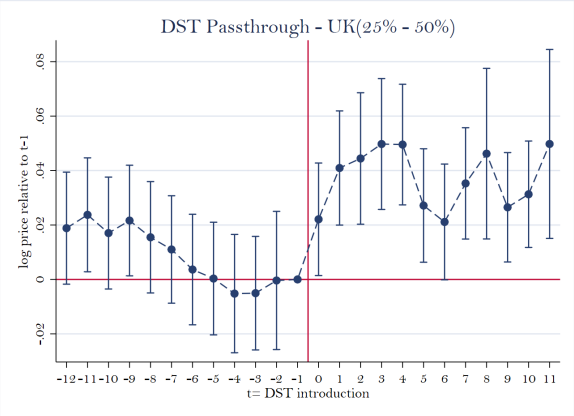
We run the DiD analysis for a period of 48 weeks with 24 pre and post-treatment periods for robustness. We present these results in Figure A.3. From the figure we observe that the results are similar to those observed for a shorter period.

Next, we explore heterogeneity based on the price of the products. For this, we run the event study analysis by splitting the data for each market place based on the price. We divide the products by quartiles and run the analysis for each quartile individually. This helps us in visualizing the pass-through on products belonging to different price levels. We present the results for the United Kingdom in Figure 3 to show the effects

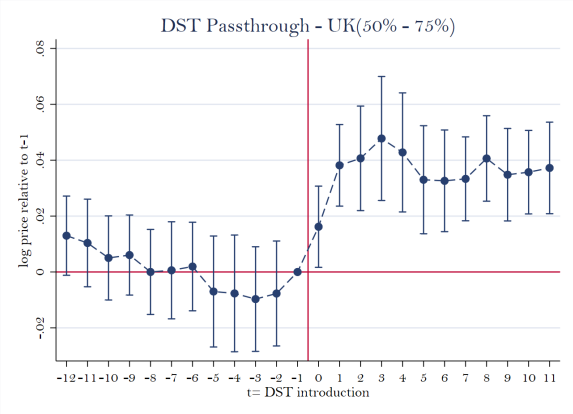
based on price quartiles. We find that the effects are strongest for higher priced goods.[9] For the other market places also, we observe similar effects across price quartiles except in Italy, where we do not observe any effect.



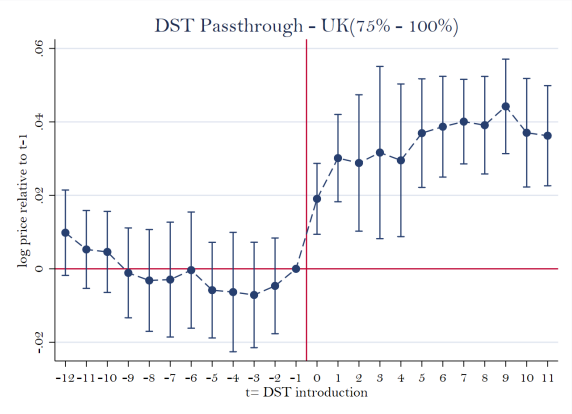
(a) 0 - 25% Quartile



(b) 25% - 50% Quartile



(c) 50% - 75% Quartile



(d) 75% - 100% Quartile

Figure 3: **Event Study - UK(Price Quartiles)**

Notes: The figure shows the results of the event study design for UK. Individual subfigures show the results for price quartiles. The quartiles are created using the FBA price as the reference. The individual bars in each event study are indicative of the 95% confidence intervals. .

We also analyze heterogeneity based on number of sellers for the products. We do this to see if product with lower number of sellers (low competition) behave differently to products with higher number of sellers (high competition). Similar to the previous test using price levels, we split the data by quartiles using the supplier count and generate the event study. From Figure A.4 in the appendix, we observe that the pass-through effects become stronger as the supplier count increases, indicating that pass-through is more in case of higher competition which is in line with classical incidence theory

[9]This can also be observed in Table 5 where we observe stronger effects of pass-through in the oversize category. Oversize goods generally have a higher price than standard goods and therefore the pass-through effects appear to be stronger in this category of goods.

which predicts full pass-through of ad valorem taxes in a fully competitive market.

Finally, we analyse the sensitivity of the FBA and Amazon prices to change in supplier levels by regressing the prices over the supplier count using a fixed effects model for each country separately. The results are in line with standard economic intuition. With an increase in the number of suppliers for a product, we observe that the price of the product (both FBA and Amazon price) reduces. However, we observe the fluctuation of the Amazon price is least in Italy indicating that Amazon as a seller is relatively inelastic to supplier entry/exit. This may partly explain the ineffectiveness of the DST in Italy.

5 Conclusion

When countries introduce taxes such as a DST, the idea is to make a firm operating mostly in the digital sphere pay a fair share for the business it does in that country. However, if the DSTs can be passed onto the consumers on either side of the market platform by the firm, then the country ends up taxing its own citizens and small firms, thereby not fulfilling the purpose of the tax.

We observe that DSTs are largely passed through by Amazon to sellers in all countries except Italy. In Italy, where we do not observe a pass-through of the tax, we observe that Amazon as a market participant is relatively inelastic to supplier entry/exit on the market indicating lower market power in Italy. We observe through the price quartile and supplier quartile tests that multi-sided market platforms still show effects similar to single sided markets on individual sides of the platform.

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Appendix

A.1 Calculation of FBA Fees

The Fulfilment by Amazon(FBA) is a service that Amazon offers to sellers on the platform. As part of the FBA service, Amazon stores products from sellers in its warehouses and then performs the packing and shipping of the products on receipt of an order. Amazon releases, on a non-periodical basis, the fee structure for the FBA service in all EU market places in the form of a rate card. Amazon has a defined fee structure individually for storage, packing and shipping of the products. The rate card displays the fee structure separately for storage, packing and shipping services. The storage fee is based on the volume of the product after packing the product according to the required shipping standards. The shipping fee for the products is based on the weight of the product and the dimensions of the packed product. The packing services, also called optional services, include labeling, bagging, bubble wrap, taping and opaque bagging. Below, we give a description of each of these fees in greater detail.

A.1.1 Storage Fee

The storage fee for all countries (Germany, France, Italy and Spain) except the United Kingdom are calculated on a cubic metres per month basis. In the UK, it is calculated on a cubic feet per month basis. For uniformity, we convert the value of the storage fee in the UK to cubic metres per month. Initially, Amazon distinguished between the products as media and non-media products. However, in the rate card released by Amazon in April 2020, Amazon changed the categorization from media and non-media to 'Clothing, Shoes and Bags' and other categories. In the rate card released in June 2021, Amazon introduced an additional category called 'Hazmat' which is an abbreviation for hazardous materials. For the sake of this study to maintain uniformity across all time periods, we maintain the categories media, non-media, 'Clothing, Shoes and Bags' and 'Hazmat' across all time periods. In the earlier periods the rates for 'Clothing, Shoes and Bags' and 'Hazmat' are the same as that of media and non-media products and start deviating from these categories from their respective dates of introduction. Amazon charges different storage fees depending on the time of the year. The storage fee from January-September and October-December are different. Starting from April 2020 Amazon also started to differentiate the storage fees on the size category of the product. The size categories will be explained in the next subsection.

A.1.2 Shipping Fee

The shipping fee is dependant only on the size of the product. There are two size categories namely, standard size products and oversize products. A product is classified as oversize if it weighs 12kg or more. A product can also be classified as oversize if the packaging of the product is 45cm or more on its longest side, 34cm or more on its median side and 26cm or more on its shortest side irrespective of the weight of the product. Each of the size categories is further divided into subcategories based on the style of packaging of the product. In the standard size category there are four subcategories namely 'small envelope', 'standard envelope', 'large envelope' and 'standard parcel'. The oversize category has three subcategories namely 'small oversize', 'standard oversize' and 'large oversize'. In the table below, we show the maximum weights and packaging dimensions for each of these categories.

A.1.3 Optional Fee

Amazon provides multiple optional services as part of the FBA program. The various optional service are removal, disposal, labeling, bagging, bubble wrap, taping and opaque bagging. Amazon has a fee for each of these optional services that it provides. All fees are measured on a per unit basis. For the calculation of the FBA fee we only consider labeling, bagging and taping fee. We do not consider removal and disposal fee since they only apply when Amazon disposes a product from the warehouse and in which case there is no shipment of the product. We also do not consider bubble wrap and opaque bagging since these are only performed in a few cases. Initially the optional fee were the same for all size categories. However in April 2020, Amazon adopted a system that charged a fee based on whether the product was a standard size product or an oversize product. In June 2021, it restructured the system to charge the optional fee based on the kind of packaging i.e., whether it is an envelope, a parcel or an oversize product.

A.1.4 FBA Fee & Cross-sectional Identifier

The FBA fee is a sum of the storage fee, the shipment fee and the optional services fee. The shipment fee is the fee as given in the rate cards for a given weight, size and packaging type. The storage fee is calculated as the rate per volume multiplied by the maximum volume of the packaging type. So for example, say if the storage fee per cubic metre per month is €20 and the packaging type is small envelope which has a maximum volume of 20x15x1cm. Then the storage fee for this product is recorded as

Table A.1: **FBA Rate Card - Size Chart**

		Maximum Weight(including packaging)	Maximum Dimensions
Standard	**Small Envelope**	0.1kg	20x15x1cm
	Standard Envelope	0.5kg	33x23x2.5cm
	Large Envelope	0.1kg	33x23x5cm
	Standard Parcel	11.999kg	45x34x26cm
Oversize	**Small Oversize**	2kg	61x46x46cm
	Standard Oversize	30kg	120x60x60cm
	Large Oversize	30kg	>120x60x60cm

Notes: For each of the sizes the given weights and dimensions are the maximum weight and the maximum dimensions of the product once it is packed. There could be products which weigh less than the maximum weight and can still be part of the category. Also in the rate cards, there are multiple weight categories within each packaging category which are described in the rate cards in a more detail way.
Data Source: Fulfilment by Amazon rate cards downloaded from `https://sell.amazon.co.uk/`.

20x(0.2x0.15x0.01). Since the volume is in cubic metre we convert all the dimensions into metre from centimetre. In the optional services, as mentioned before we only consider the bagging, labeling and taping fee. Therefore, the FBA fee is calculated as follows:

$$\text{FBA Fee} = \text{Shipping Fee} + \text{Storage Fee} + \text{Bagging fee} + \text{Taping fee} + \text{Labeling fee} \quad \text{(A.1)}$$

For example, let us consider a standard size product which weighs between 3kg and 4kg and is a standard size product in France. The shipping fee for the product from the rate card is €5.18. The product has to be shipped as a standard parcel and the maximum dimensions of the standard parcel are 45x34x26cm. The storage fee per cubic metre is €20. Therefore the storage fee for the purpose of the FBA fee calculation is 20x(0.45x0.34x0.26) which is €0.8. The bagging, labeling and taping fee are €0.45, €0.15 and €0.20 respectively. So using equation A.1 the FBA fee for this category of products is 5.18+0.8+0.45+0.15+0.20 = €6.78.

While manually converting the data from the rate cards into excel format for further execution, three different shipment types were created since the rate cards contain the shipping fee for local shipping, cross-border shipping and PanEU shipping. Therefore, three different shipment types were included in the data. Since in cross-border and PanEU shipping a country for shipping the product and a country for receiving the product are required, we included a ship from and a ship to country in the data. However, due to the COVID pandemic and Brexit in the period of study, we do not consider the cross-border and PanEU shipment categories for the study. However, the data still has these fields and for the local shipment category, the ship from and the ship to country remain the same. The cross-sectional identifier is therefore a combination of the ship from country, the shipment type, the product type(media, non-media etc.), the size(standard/oversize), the package type(envelope, parcel etc.), the max weight of the product and the ship to country.

A.2 Keepa.com Data

Keepa.com is a pricing consultancy website that helps sellers on Amazon price their products competitively. Keepa scrapes pricing data of products from the Amazon website on a non-periodic basis. The data for some products are scraped more frequently than for other products. Also, the data for a product is scraped sometimes on consecutive days and for some products only once in a week or once in a month. So the data for all products is not scraped at the same interval. Also, there is no defined frequency

when the data is scraped for any given product. Keepa makes this data available to sellers and others on a subscription basis.

A.2.1 Data download

We first downloaded the set of products that would help in the analysis. For that we consider products that were tracked at least since January 2019 and that have the FBA price(described in Section 3) tracked during the period of study. We use January 2019 as the cut-off date because we wanted to have data on all products that were tracked at least from 12 month before the introduction of the first DST. We download the set of products using a python code and the Keepa API provided for this purpose. We perform this exercise for each market place individually.

Once the set of products is downloaded, we then feed this list of products through another python code and using the Keepa API download data for each product since January 2011. We download the following data from Keepa for every single product for this study:

1. **ASIN**: This is the unique identifier for each product across a marketplace. No two products in the same marketplace can have the same ASIN.

2. **Domain**: This is a unique number that is given for each marketplace. The domain is 2 for the United Kingdom, 3 for Germany, 4 for France, 8 for Italy and 9 for Spain. A combination of the ASIN and the domain is the cross-sectional identifier in the second phase of the analysis.

3. **Product Group**: This group classifies the product into different groups. Examples of the product group are books, cosmetics, baby products etc,.

4. **Package Height**: This variable captures the height of the packed product in millimetres.

5. **Package Length**: This variable captures the length of the packed product in millimetres.

6. **Package Width**: This variable captures the width of the packed product in millimetres.

7. **Package Weight**: This variable captures the weight of the packed product in grams.

8. **Item Weight**: This variable captures the weight of the unpacked product in millimetres.

9. **Product Category**: This variable assigns a specific numeric value to every product group. Sometimes the product category might differ for products within the same product group. However, for the purpose of the study we only consider the product group and ignore the product category.

10. **Product Type**: The product type captures whether the product is a digital product or a non-digital product. For the sake of this study since we only consider products that can be physically shipped, all products have a value of 0 for the product type.

11. **Time**: We capture the exact time of the data capture by Keepa in this variable. The time variable is downloaded with precision to the second of capture. For each different price mentioned in Section 3 we capture the time of capture of that price.

A.2.2 Data Cleaning

The time variable for each price category is in a string format. We destring the time variable and extract the day, month and the year from the time variable and remove the rest. We then average each of the price variables on a weekly basis. Amazon is a large market place with many sellers and the probability of discounts at any given time can be too high or too low. However, when we average the price over a week we remove any such extreme changes in price. Also, due to the non-periodic recording of the prices for a product, it would be very hard to build the panel data with individual observations.

After averaging the prices for every week, we drop the months before December 2017 and the months after February 2022 just as in the first phase. Since the two most important prices that have to be compared are the Amazon price and the FBA price, we ensure that each product has at least one observation in the pre-treatment and one observation in the post-treatment period. We filter the products based on this criteria and drop all products that are only tracked in the pre-treatment or post-treatment period based on the marketplace.

A.3 Pass-through calculation(Pass-through to consumers)

For calculating the pass-through, we use the descriptive statistics presented in Table 2, 3 and the regression results presented in Table 5. We show the calculation for France for the entire set of products. Calculation for subsets of the sample based on size follows the same logic. All prices in this section are in € (Euro).

Table A.2: **Price table for pass-through calculation**

Pre-Treatment		
	Price	**ln(Price)**
Amazon	33.73	3.518
FBA	36.56	3.599
Post-Treatment		
	Price	**ln(Price)**
Amazon	34.05	3.528
FBA(Pred.)	37.56	3.626

In Table A.2, the FBA price in the pre-treatment period and the Amazon price in the pre and post-treatment periods is taken from Table 3. Using this data and the coefficient in column (4) of Table 5 we calculate the post-treatment average FBA price using the DiD method.

$$(ln(FP)_{Post} - ln(AP)_{Post}) - (ln(FP)_{Pre} - ln(AP)_{Pre}) = \beta \tag{A.2}$$

In equation A.2, FP refers to the FBA price and AP refers to the Amazon price. Substituting the values of Amazon price from both periods, the FBA price from the pre-treatment period from Table A.2 and a value of 0.017 for β from column (4) of Table 5, we get a predicted FBA price of 37.56.

In the absence of a DST, the difference between the two terms on the left hand side of equation A.2 shall be zero, since we have parallel trends in the pre-treatment period. So, in the absence of the effect of the DST, the FBA price in the post-treatment period would have been 36.93. Therefore, the effect of the DST on the FBA price is $37.56 - 36.93 = 0.63$. However, this price includes a VAT of 20% (standard VAT Rate in France), which will have to be deducted from the effect. Therefore, the actual effect of the DST excluding VAT is 0.52.

To effectively calculate the pass-through we shall calculate the fees that is charged on a product with an FBA price of 36.93. Since DST applies on a product before VAT, we

have to first deduct VAT from the product price. The price of the product excluding VAT is 30.78. On this price there are three fees which apply for the calculation of the DST, the referral fee, selling fee and the FBA fee. The average referral fee for products is 15% of the price. So, referral fee on the product is 4.62. Selling fee per item in France is 0.90. Since a majority (more than 95%) of the products are standard size products, we take the average FBA fee for standard size products from Table 2, 7.28. The total fee on a product worth 36.93 is $4.62 + 0.90 + 7.28 = 12.8$. Since the DST applies on this fee charged by Amazon to the seller, the total DST is 3% of the fee, equalling 0.38. Therefore, the pass-through in this case can be calculated as follows:

$$Pass - through = (0.52/0.38) * 100 = 135\% \tag{A.3}$$

A.4 Additional Tables & Figures

We display the results of the Bacon decomposition produced using the *bacondecomp* estimator in Table A.5. From the table we observe in every panel two groups, one that estimates the consolidated effect of the early treated v/s late treated and late treated v/s early treated(also called Timing_group). The second group calculates the effect of the treated groups v/s the never treated group. Here, we observe that the effects of the Timing_group are very small in panel A and C. However, the weight allocated to these effects is nearly 44%. The TWFE coefficient observed in Table 4 is calculated through the following equation:

$$\beta = \sum_{i=1}^{n} Beta_i.TotalWeight_i \tag{A.4}$$

The Bacon decomposition provides us with a detailed breakup of how groups receiving treatment at different time points in a sample respond against other treatment groups, the never treated group and the always treated group. The decomposition method evaluates every set of 2x2 DiD in the sample by calculating the effect from the 2x2 DiD and also assigning a weight to the same.

In Table A.6, we provide the breakdown for the results shown in Table A.5 and in Figure A.2 we plot the various coefficients and their weights as shown in Table A.6.

Table A.3: **Keepa Price Statistics - Standard Size**

Keepa price statistics(Pre Treatment)						
Panel A: Average Amazon Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	12.94	20.01	34.44	31.69	35.27	206927
France	13.04	20.04	34.18	31.08	33.75	265354
Italy	13.04	20.15	34.72	31.53	34.58	303808
United Kingdom	6.99	11.99	21.14	20.33	34.56	389129
Panel B: Average FBA Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	13.56	20.92	35.69	32.36	34.91	88951
France	13.31	21.29	36.00	32.98	36.27	70005
Italy	13.36	20.44	34.13	30.89	32.38	194934
United Kingdom	5.99	11.28	20.49	19.69	35.08	259719
Panel C: Average Supplier Count						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	5.00	9.00	15.00	11.81	10.69	272539
France	5.00	9.00	14.00	11.21	9.64	372817
Italy	7.00	11.00	20.00	16.02	15.30	440469
United Kingdom	8.00	12.00	19.00	14.65	10.15	580070

Keepa price statistics(Post Treatment)						
Panel A: Average Amazon Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	12.67	19.67	33.41	30.90	34.65	217498
France	13.15	20.27	34.90	31.39	33.75	275197
Italy	13.15	20.29	35.08	32.11	35.28	295398
United Kingdom	7.15	12.59	22.30	21.31	35.00	397918
Panel B: Average FBA Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	13.29	21.15	37.06	33.39	36.67	70778
France	13.81	21.90	36.99	33.51	36.25	73472
Italy	13.89	21.19	35.56	31.99	32.96	175058
United Kingdom	6.88	12.52	22.19	21.02	37.24	231671
Panel C: Average Supplier Count						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	4.00	8.00	13.00	10.50	9.90	294711
France	4.00	7.00	11.00	8.88	8.01	387122
Italy	6.00	10.00	18.00	14.17	13.26	445437
United Kingdom	5.00	8.00	13.00	9.94	7.48	575577

Notes: All prices for Spain, Italy and France are in €(Euro). Prices for the United Kingdom are in £(Great Britain Pound). The number of sellers offering the products are in absolute numbers. p25, p50 and p75 are the price levels at the 25^{th} percentile, 50^{th} percentile and 75^{th} percentile.
Data Source: `https://keepa.com/`.

Table A.4: **Keepa Price Statistics - Oversize**

Keepa price statistics(Pre Treatment)						
Panel A: Average Amazon Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	35.78	57.4	114.23	98.63	109.77	5956
France	35.81	58.55	115.86	99.69	109.28	5321
Italy	35.80	60.45	113.04	96.04	100.84	12403
United Kingdom	24.57	39.76	75.00	74.35	113.63	8383
Panel B: Average FBA Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	38.44	65.86	128.8	109.26	123.36	2887
France	42.49	72.29	134.00	117.27	126.31	2479
Italy	42.89	74.45	135.33	110.82	113.71	8395
United Kingdom	25.86	42.99	78.36	75.22	104.6	5472
Panel C: Average Supplier Count						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	5.00	8.00	17.00	13.06	13.04	8026
France	5.00	9.00	16.00	13.23	13.34	8072
Italy	6.00	11.00	23.00	19.07	21.35	16012
United Kingdom	6.00	11.00	19.00	14.69	12.12	10777

Keepa price statistics(Post Treatment)						
Panel A: Average Amazon Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	35.1	56.73	111.14	97.19	110.13	6202
France	37.05	59.29	115.61	97.4	102.49	5598
Italy	36.01	61.61	115.49	98.62	104.19	11621
United Kingdom	24.99	41.34	75.63	74.67	112.95	8590
Panel B: Average FBA Price						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	41.07	73.96	135.65	116.77	127.66	2413
France	44.89	83.75	158.04	128.27	126.59	2488
Italy	39.00	67.40	116.43	99.44	99.60	7030
United Kingdom	28.00	47.46	88.99	81.71	107.33	4829
Panel C: Average Supplier Count						
Country	**p25**	**p50**	**p75**	**Mean**	**SD**	**Observations**
Spain	4.00	7.00	14.00	11.10	11.15	8461
France	3.00	7.00	12.00	9.24	9.14	8152
Italy	5.00	10.00	20.00	16.05	17.12	16170
United Kingdom	4.00	7.00	13.00	9.83	9.07	11150

Notes: All prices for Spain, Italy and France are in €(Euro). Prices for the United Kingdom are in £(Great Britain Pound). The number of sellers offering the products are in absolute numbers. p25, p50 and p75 are the price levels at the 25^{th} percentile, 50^{th} percentile and 75^{th} percentile.
Data Source: `https://keepa.com/`.

Table A.5: **Bacon Decomposition Results - Passthrough to sellers**

Panel A: All products		
	Beta	**TotalWeight**
Timing_groups	0.008	0.437
Never_v_timing	0.056	0.563
Panel B: Standard Size		
	Beta	**TotalWeight**
Timing_groups	0.018	0.437
Never_v_timing	0.048	0.563
Panel C: Oversize		
	Beta	**TotalWeight**
Timing_groups	0.001	0.437
Never_v_timing	0.062	0.563

Notes: Beta is the effect of each individual group and the total weight is the weight allocated by the *Bacon Decomposition* method developed by Goodman-Bacon (2021). The Timing_groups captures the consolidated effect of all the Early_treated v/s Late_treated and Late_treated v/s Early_treated effects. The Never_v_timing captures the effect of the treated group against the never treated group.

Table A.6: **Bacon decomposition - Total effects sample**

Bacon Decomposition - All products		
	Beta	**TotalWeight**
Early_v_Late	.034	.018
Late_v_Early	.066	.017
Early_v_Late	.005	.066
Late_v_Early	.039	.040
Early_v_Late	.002	.054
Late_v_Early	-.0199	.029
Early_v_Late	.002	.072
Late_v_Early	.055	.040
Early_v_Late	-.0175	.060
Late_v_Early	-.020	.030
Early_v_Late	-.015	.009
Late_v_Early	.001	.0031
Never_v_timing	.056	.563

Notes: Beta is the effect of each individual group and the total weight is the weight allocated by the *Bacon Decomposition* method developed by Goodman-Bacon (2021). The Never_v_timing captures the effect of the treated group against the never treated group.

Table A.7: **Comparison of Staggered DiD estimators(13 post-treatment periods)**

Panel A: All Products												
	Callaway/Sant'anna						**de Chaisemartin/d'Hauptfouille**					
Variable	**Coefficient**	**SE**	**z**	**P>|z|**	**[95% conf. interval]**		**Coefficient**	**SE**	**t**	**P>|t|**	**[95% conf. interval]**	
ln(FBA fee)	0.014***	0.003	4.82	0	0.009	0.020	0.014***	0.003	4.92	0	0.009	0.020
Panel B: Standard Size Products												
	Callaway/Sant'anna						**de Chaisemartin/d'Hauptfouille**					
Variable	**Coefficient**	**SE**	**z**	**P>|z|**	**[95% conf. interval]**		**Coefficient**	**SE**	**t**	**P>|t|**	**[95% conf. interval]**	
ln(FBA fee)	0.016***	0.003	6.33	0	0.011	0.021	0.015***	0.002	6.55	0	0.011	0.020
Panel C: Oversize products												
	Callaway/Sant'anna						**de Chaisemartin/d'Hauptfouille**					
Variable	**Coefficient**	**SE**	**z**	**P>|z|**	**[95% conf. interval]**		**Coefficient**	**SE**	**t**	**P>|t|**	**[95% conf. interval]**	
ln(FBA fee)	0.013***	0.003	4.29	0	0.007	0.019	0.013***	0.003	4.48	0	0.007	0.019

Notes: In all the panels the standard errors are cluster robust at the cross-sectional level for both the estimators. The Callaway/Sant'anna estimates are generated using the *CSDID* estimator. The estimates for the de Chaisemartin/d'Hauptfouille are generated using the *did_multiplegt_dyn* estimator. ***, **, * indicate significance at the 1%, 5%, 10% levels.

Table A.8: **TWFE Pass-through to Sellers - Individual countries against Germany**

	UK			**FR**			**IT**			**ES**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)
Treat x Post	0.064***	0.086***	0.046***	0.049***	0.039***	0.058***	0.042***	0.030***	0.052***	0.065***	0.031***	0.093***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.007)	(0.009)	(0.005)	(0.004)	(0.007)
Observations	18,360	8,160	10,200	18,360	8,160	10,200	18,360	8,160	10,200	18,360	8,160	10,200
R-squared	0.991	0.988	0.985	0.991	0.983	0.979	0.992	0.986	0.980	0.994	0.987	0.984
Cross-Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Size		Standard	Oversize		Standard	Oversize		Standard	Oversize		Standard	Oversize

Notes: In all panels, the standard errors are cluster robust at the country-time level. The dependent variable is the natural logarithm of the FBA fee which is the sum of the shipping fee, the storage fee, the labeling fee, the baggage fee and the taping fee. ***, **, * indicate significance at the 1%, 5%, 10% levels.

Table A.9: **CSDID Results(Never Treated) - Passthrough to Sellers**

	(1)	(2)	(3)
VARIABLES	ln(FBA fee)	ln(FBA fee)	ln(FBA fee)
GAverage	0.020***	0.022***	0.020**
	(0.004)	(0.004)	(0.004)
Italy	-0.016**	-0.014***	-0.018***
	(0.007)	(0.005)	(0.005)
UK	0.033***	0.049***	0.020***
	(0.004)	(0.007)	(0.004)
France	0.037***	0.030***	0.043***
	(0.006)	(0.004)	(0.007)
Spain	0.028***	0.023***	0.033***
	(0.006)	(0.004)	(0.007)
Observations	45,900	20,400	25,500
Cross-section FE	YES	YES	YES
Time FE	YES	YES	YES
Size		Standard	Oversize

Notes: The standard errors are clustered at the cross-sectional level, as the Callaway-Sant'Anna allows only for clustering at a level nesting the cross-sectional identifier, and four clusters are too few. The dependent variable is the natural logarithm of the FBA fee which is the sum of the shipping fee, the storage fee, the labeling fee, the baggage fee and the taping fee. ***, **, * indicate significance at the 1%, 5%, 10% levels.

Table A.10: **TWFE - Comparison of FBA price vs Amazon Price(48 weeks)**

	UK			**FR**			**IT**			**ES**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)	log(price)
Treat x Post	0.020***	0.020***	0.040***	0.028***	0.027***	0.043***	0.013***	0.013***	0.015***	0.015***	0.015***	0.020***
	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.006)
Observations	1,367,785	1,330,418	37,367	735,786	705,615	30,171	974,082	930,219	43,863	630,230	602,611	27,619
R-squared	0.968	0.966	0.979	0.970	0.967	0.981	0.969	0.965	0.980	0.972	0.969	0.979
Cross-Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Size		Standard	Oversize		Standard	Oversize		Standard	Oversize		Standard	Oversize

Notes: In all the columns the standard errors are cluster robust at the product time level. Product group is the group to which the product belongs such as books, cosmetics etc. The results are for a 48 week period with 24 pre and 24 post-treatment periods. The dependent variable is the log(price). For the treatment group the price is the average weekly FBA price where as for the control group the price is the average weekly amazon price. Standard errors are displayed in the parentheses. ***, **, * indicate significance at the 1%, 5%, 10% levels.

Table A.11: **FBA Price Movement by Supplier Count**

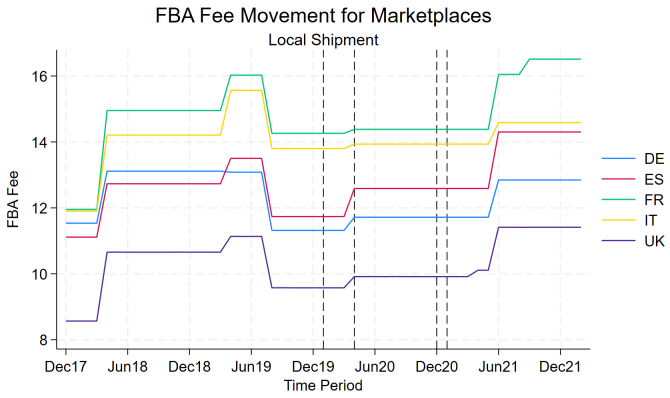
VARIABLES	(1) log(FBA Price)	(2) log(FBA Price)	(3) log(FBA Price)	(4) log(FBA Price)
Supplier_Count	-0.011***	-0.010***	-0.005***	-0.008***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	805,573	289,083	568,699	221,410
R-squared	0.969	0.973	0.968	0.976
Cross-section FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Country	UK	France	Italy	Spain

Notes: This is a standard fixed effects model tracing the effect on FBA price movement by change in number of suppliers for a product. In all the columns the standard errors are cluster robust at the product time level. Product group is the group to which the product belongs such as books, cosmetics etc. The results are for a 24 week period. The dependent variable is the log(FBA price). Standard errors are displayed in the parentheses. ***, **, * indicate significance at the 1%, 5%, 10% levels.

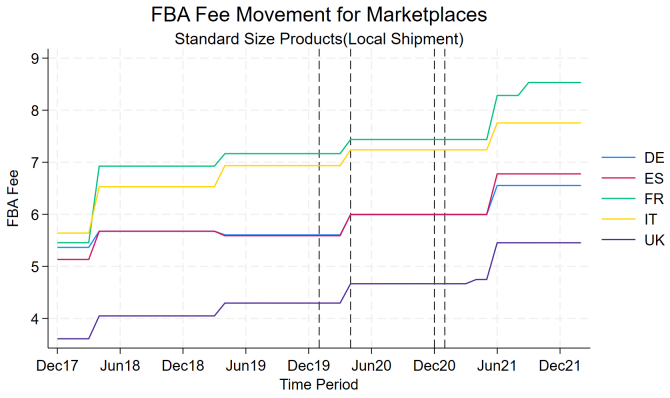
Table A.12: **Amazon Price Movement by Supplier Count**

VARIABLES	(1) log(Amz Price)	(2) log(Amz Price)	(3) log(Amz Price)	(4) log(Amz Price)
Supplier_Count	-0.005***	-0.006***	-0.002***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,360,281	779,168	935,231	619,863
R-squared	0.973	0.972	0.974	0.975
Cross-section FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Country	UK	France	Italy	Spain

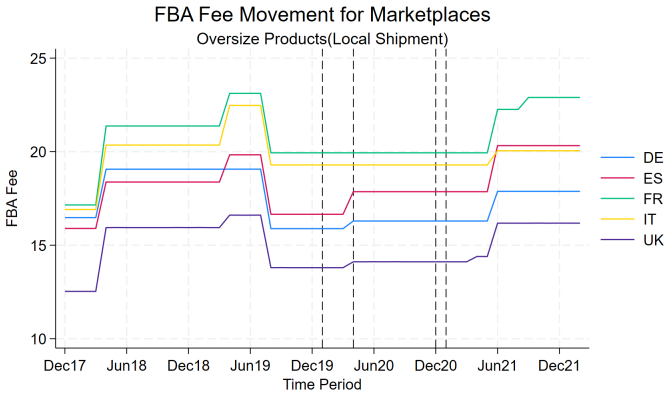
Notes: This is a standard fixed effects model tracing the effect on Amazon price movement by change in number of suppliers for a product. In all the columns the standard errors are cluster robust at the product time level. Product group is the group to which the product belongs such as books, cosmetics etc. The results are for a 24 week period. The dependent variable is the log(Amazon price). Standard errors are displayed in the parentheses. ***, **, * indicate significance at the 1%, 5%, 10% levels.



(a) All products



(b) Standard



(c) Oversize

Figure A.1: **FBA Fee Movement**

Notes: Panel (a) shows the movement of the FBA fee over time for the entire product set. Here by all products we mean including standard size and oversize goods. In Panel (b), we show the FBA fee movement over time for only standard size goods and in Panel (c) for the oversize goods. Fees for all countries except the UK are in Euro. The fee for the UK is in Pound. We use the FBA fee on the Y-axis and the time period on the X-axis. The four DSTs are marked with the black dotted lines in the subfigures. The DSTs in chronological order are Italy (Jan 2020), the UK (April 2020), France (Dec 2020) and Spain (Jan 2021).
Data Source: Fulfilment by Amazon rate cards downloaded from `https://sell.amazon.co.uk/`.

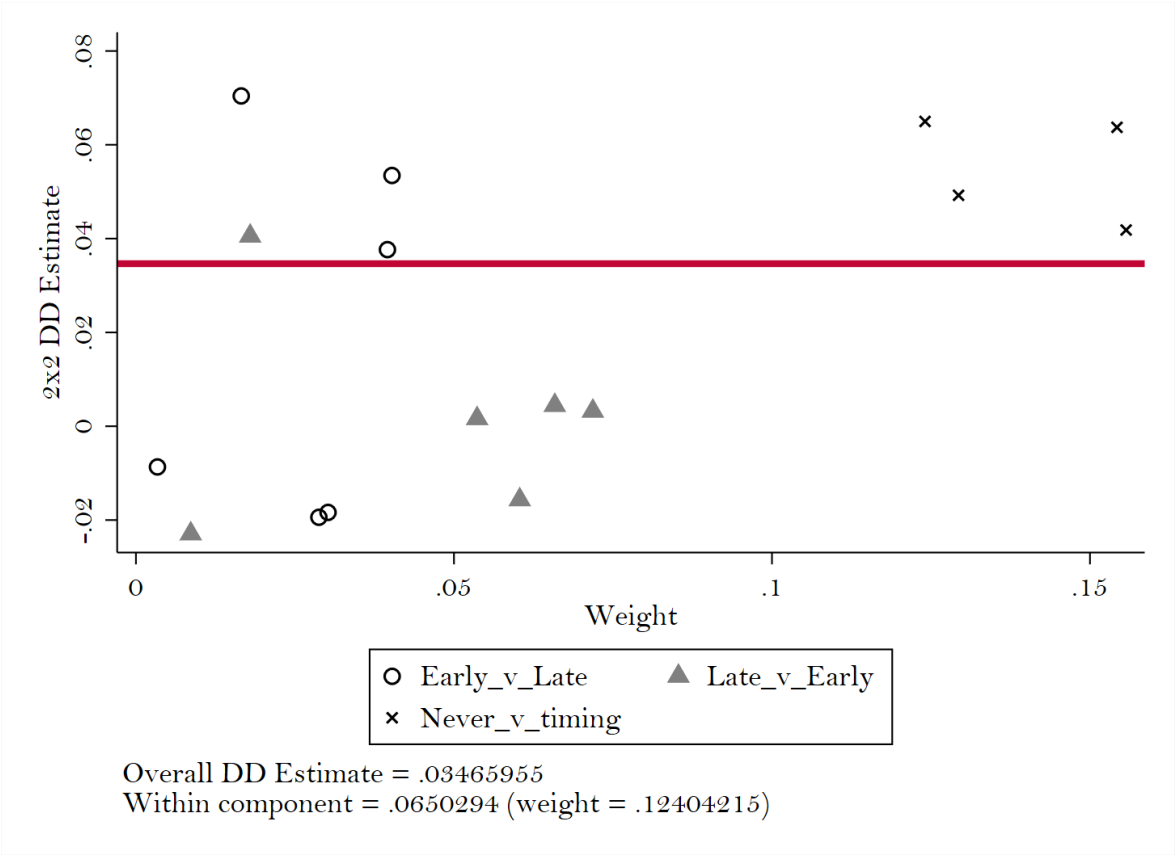
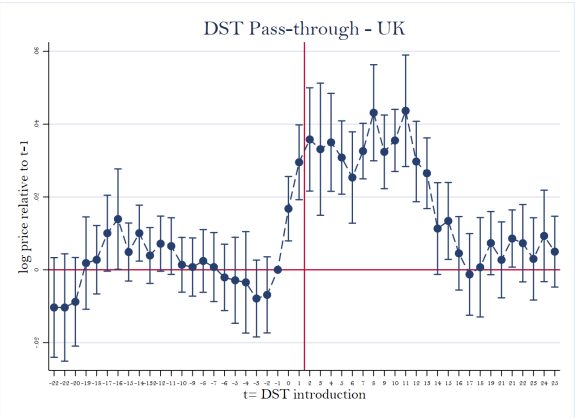
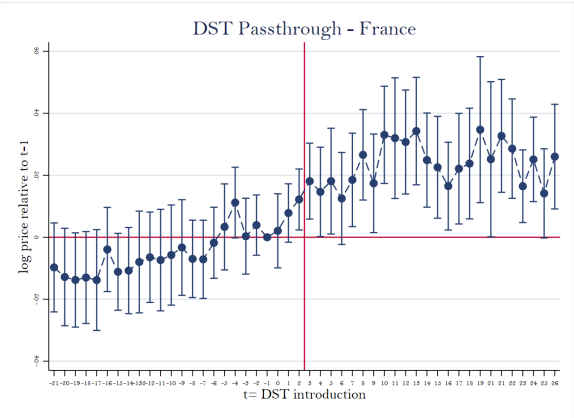


Figure A.2: Bacon Decomposition

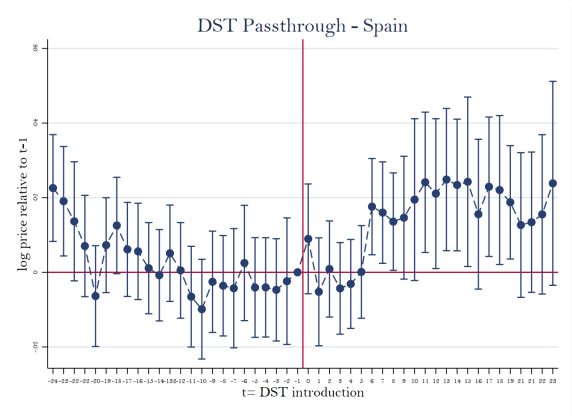
Notes: The red line in the figure shows the average coefficient from the TWFE model. The coefficients for each group are plotted on the Y-Axis and the weights assigned to each of these groups by the estimator are plotted on the X-Axis.



(a) UK



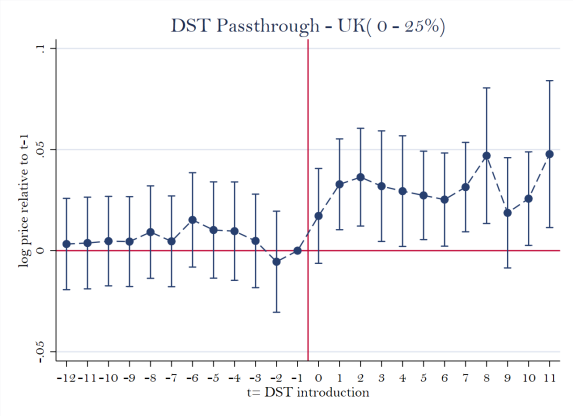
(b) France



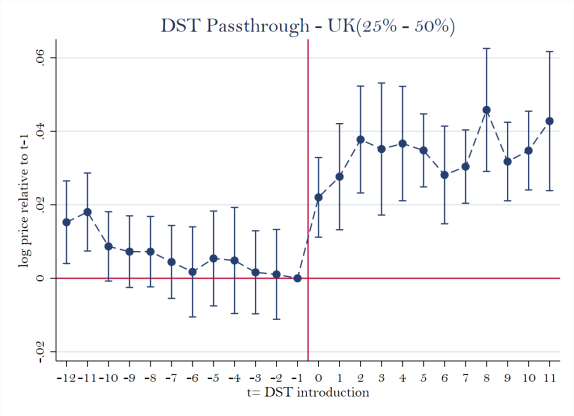
(c) Spain

Figure A.3: **Event Study - 48 Weeks(FBA Price v/s Amazon Price)**

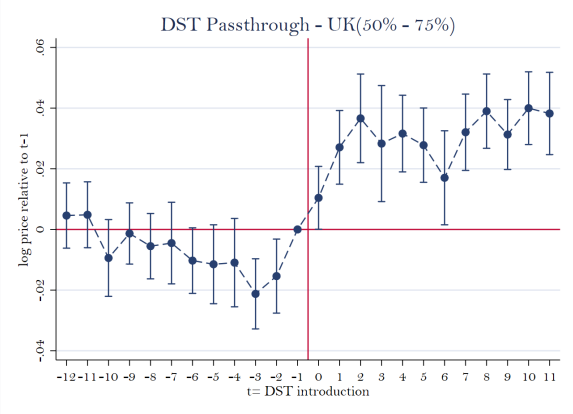
Notes: The figure presents the event study designs for UK, France and Spain taking anticipation effects into consideration. The individual bars in each event study are indicative of the 95% confidence intervals.



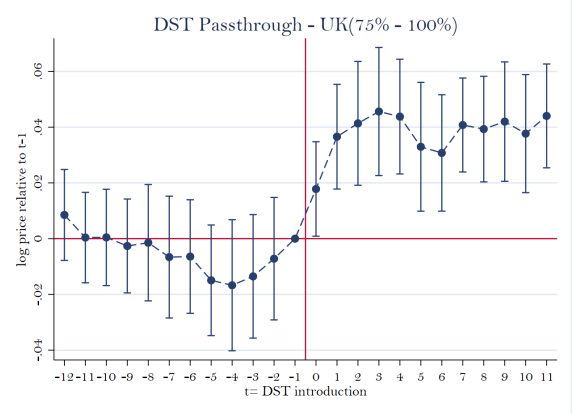
(a) 0 - 25% Quartile



(b) 25% - 50% Quartile



(c) 50% - 75% Quartile



(d) 75% - 100% Quartile

Figure A.4: **Event Study - UK(Supplier count Quartiles)**

Notes: The figure shows the results of the event study design for UK. Individual subfigures show the results for supplier count quartiles. The quartiles are created using the supplier count as the reference. The individual bars in each event study are indicative of the 95% confidence intervals. .