

SHROUDED ATTRIBUTES AND INFORMATION SUPPRESSION: EVIDENCE FROM THE FIELD*

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We use field and natural experiments in online auctions to study the revenue effect of varying the level and disclosure of shipping charges. Our main findings are (1) disclosure affects revenues—for low shipping charges, a seller is better off disclosing; and (2) increasing shipping charges boosts revenues when these charges are hidden. These results are not explained by changes in the number of bidders.

I. INTRODUCTION

Online stores often reveal shipping charges only after a consumer fills his or her “shopping cart.” Television offers for items “not sold in stores” disclose shipping and handling in small print with speedy voice-overs. Airlines increasingly use hidden fuel surcharges. Hidden mandatory telephone and energy fees in hotels have triggered class-action lawsuits.¹ Are these practices profitable? Firms will enjoy higher revenues if consumers naively underestimate “shrouded” charges. However, if hidden fees make consumers suspicious, demand may fall. If consumers fully anticipate the charges, shrouding will have no effect.

We conduct field experiments using leading online auction platforms in Taiwan and Ireland to compare revenues for identical items while varying both the amount and the disclosure level of the shipping charge. We also compare revenues before and after a change on eBay’s U.S. site that allowed users to display shipping charges in their search results. Our main findings are (1) shrouding affects revenues—for low shipping charges, a

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1. See Woodyard (2004) for examples.

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seller is better off disclosing; and (2) increasing shipping charges boosts revenues when shipping charges are shrouded. Changes in the number of bidders do not appear to drive these revenue differences.

Theoretical predictions on the profitability of shrouded pricing frequently depend on the rationality level of consumers. The literature makes a distinction between shrouded charges that are unavoidable (surcharges) and avoidable (add-ons). Shrouding a surcharge is not optimal when all consumers are fully rational and disclosure is costless (Milgrom 1981; Jovanovic 1982). However, shrouding may be optimal with boundedly rational consumers (Spiegler 2006). Add-ons may be shrouded in equilibrium when consumers are myopic (Gabaix and Laibson 2006; Miao 2006), lack self-control (DellaVigna and Malmendier 2004), or vary in their tastes for the add-on and advertising add-on prices is expensive (Ellison 2005). Moreover, there is no incentive for firms to educate consumers about competitors' shrouded add-ons (Gabaix and Laibson 2006). Empirical literature on price shrouding mostly suggests that shrouding raises profitability. Ellison and Ellison (2009) find that shrouding add-ons is a profitable strategy for online firms selling computer memory chips. Chetty, Loony, and Kroft (2009) find that consumer demand falls when retailers post tax-inclusive prices (i.e., disclose a surcharge) for personal care products using a field experiment. They offer similar results for tax disclosure in alcohol prices using historical data. Ellison (2006) surveys various approaches to modeling bounded rationality and their implications for firm pricing. DellaVigna (2009) provides an overview of bounded rationality models using field data.

Theory suggests that firms can exploit price partitioning (separating price into components) to affect consumer choice (Kahneman and Tversky 1984; Thaler 1985). Hossain and Morgan (2006) find evidence of this in field experiments on eBay's U.S. auction site. They find that, when shipping is shrouded, raising the shipping charge increases both revenues and the number of bidders attracted to an auction. In contrast, mixed results have been obtained in laboratory experiments (Morwitz, Greenleaf, and Johnson 1998; Bertini and Wathieu 2008). Smith and Brynjolfsson (2001) find that online book retailers do not benefit from price partitioning. Our paper complements these earlier works by studying the interaction between price partitioning and disclosure using both field and natural experiments.

II. FIELD EXPERIMENTS

We conducted field experiments, selling ten different types of iPods, to study the revenue effect of changing the amount and shrouding level of shipping charges. The auction title and item description specified the capacity, model, and color of each iPod. The item description clearly stated the shipping charge and method. We disclosed the shipping charge in the title of the listing for half of the auctions and shrouded (omitted) it from the title for the other half.

We used two different auction sites for these experiments, selling 36 items on Yahoo Taiwan in 2006 and 40 items on eBay Ireland in 2008. Our seller identity on each site had a reasonable reputation rating. The choice of auction sites and products allows us to vary shipping and shrouding easily while selling identical items. iPod markets on these sites are thick, and exhibit considerable variation in shipping charges. Neither site automatically reveals shipping in search listings, an essential feature for examining shrouding.² This allowed us to control the disclosure level of shipping charges without drawing attention to ourselves.

II.A. Taiwan

We sold new 512 MB and 1 GB silver iPod Shuffles as well as 1 GB and 2 GB Nanos in both white and black—a total of six different iPod models. Our treatments were as follows:

	Opening price of TWD 750		Opening price of TWD 600
	Low shipping TWD 30	High shipping TWD 180	High shipping TWD 180
Disclosed	DL	DH	DR
Shrouded	SL	SH	SR

where “TWD” denotes new Taiwan dollars. At the time of our experiments, the exchange rate was TWD 33 to USD 1 or EUR 0.83. Prior to the start of the experiments, we collected field data and observed shipping charges ranging from TWD 50 to 250 with a median shipping charge of TWD 100. Thus, our low shipping charge is a “bargain” in this market, whereas our high shipping charge is at the 99th percentile of the market. We auctioned all six

2. In contrast, eBay U.S. automatically discloses shipping.

iPod models under each treatment. Treatments DL, DH, and DR were conducted from March 13 to March 20, 2006, whereas treatments SL, SH, and SR were conducted from March 20 to March 27, 2006. Although the auctions are separated by a week, Apple made no changes to the suggested retail price over this period, nor were there any price trends in online auctions for iPods worldwide (Glover and Raviv 2007). All auctions closed successfully. Figures I and II present screenshots (and accompanying English translations) for auctions where the shipping charge is disclosed and shrouded, respectively.

To examine the effect of shrouding, we compare treatments Dx to Sx . Comparing treatments xL to xH reveals the effect of raising the shipping charge while holding the opening price fixed. In comparing treatments xL to xH , there is a potential confound—the reserve price (minimum payment) of the auction also increases. This is unlikely to matter because the minimum payment is considerably below the retail price, and not likely to be binding.³ Nevertheless, the xR treatments (“R” is a mnemonic for reserve) disentangle shipping charges and reserve price. To study the effects of raising the shipping charge while holding the reserve constant, we compare treatments xL to xR . Comparing treatments xR to xH identifies the effect of raising the opening price with a fixed shipping charge.

II.B. Ireland

We sold new 1 GB second generation iPod Shuffles in four different colors: blue, green, pink, and silver. Because changing the reserve price had no effect in the Taiwan experiments, we simplified the design, omitting the xR treatments. Our treatments were as follows:

	Opening price of EUR 0.01	
	Low shipping EUR 11	High shipping EUR 14
Disclosed	DL	DH
Shrouded	SL	SH

At the time of our experiments, the exchange rate was EUR 0.77 to USD 1. We conducted eight auctions per week, with two items

3. The cheapest iPod we sold, the 512 MB Shuffle, had a retail price of TWD 2,500.



全新未拆封IPOD NANO 2G(白色)!!! 運費台幣30元!!!

賣方資料

賣方(評價) : [terp898 \(27\)](#)

正面評價百分比 : 93.55 %

付款方式

- 接受銀行或郵局轉帳

交貨方式

- (郵寄)賣方付運費
- 先付款再交貨

商品新舊

- 全新

[賣方的所有拍賣商品 \(0\)](#)

[賣方「關於我」 / 評價與意見](#)

[拍賣問與答 \(0\)](#)

拍賣檔案

目前出價 : **5,400 元**

得標者 : [cheery080808 \(2\)](#)

商品數量 : 1

出價次數 : 38 (出價紀錄)

起標價格 : 750 元

出價增額 : 100 元

所在地區 : 台北市

開始時間 : 2006-03-13 18:51

結束時間 : 2006-03-20 18:51

拍賣編號 : e12331412



容量 2GB

這是一部全新未拆封的IPOD NANO 2G(白色)。除郵寄外, 賣方不接受其他的運送方式。運費為台幣30元, 運費不可議價。買家請在拍賣完成10天內付款。賣方只接受銀行轉帳現金。您的 iPod 包含 90 天的電話技術支援和一年的有限保固。

FIGURE I

Screenshot for Disclosed Auction in Taiwan

Title: Brand new IPOD SHUFFLE 1G!!! Shipping Fee TWD30 <TWD 180>!!!
Item Description: This is a brand new IPOD SHUFFLE 1G. The seller delivers only via standard postage service. The shipping cost is TWD30 <TWD 180> and is not negotiable. The buyer needs to make the payment within 10 days of completion of the auction. The seller only accepts payment by bank transfer. Your iPod comes with 90 days of telephone technical support and 1 year of warranty.



全新未拆封IPOD NANO 2G(白色)!!!

賣方資料

賣方(評價): [terp898 \(27\)](#)

正面評價百分比: 93.55 %

付款方式

- 接受銀行或郵局轉帳

交貨方式

- (郵寄)買方付運費
- 先付款再交貨

商品新舊

- 全新

[賣方的所有拍賣商品 \(0\)](#)

[賣方「關於我」](#) / [評價與意見](#)

[拍賣問與答 \(2\)](#)

拍賣檔案

目前出價: **5,200 元**

剩餘時間: **已經結束(倒數計時器)**

得標者: **c711123.tw (57)**

商品數量: 1

出價次數: 33 (出價紀錄)

起標價格: 750 元

出價增額: 100 元

所在地區: 台北市

開始時間: 2006-03-20 21:22

結束時間: 2006-03-27 21:22

拍賣編號: d18146669



容量 2GB

這是一部全新未拆封的IPOD NANO 2G(白色). 除郵寄外, 賣方不接受其他的運送方式. 運費為台幣30元, 運費不可議價. 買家請在拍賣完成10天內付款. 賣方只接受銀行轉帳現金. 您的iPod 包含 90 天的電話技術支援和一年的有限保固.

FIGURE II

Screenshot for Shrouded Auction in Taiwan

Title: Brand new IPOD SHUFFLE 1G!!! Item Description: This is a brand new IPOD SHUFFLE 1G. The seller delivers only via standard postage service. The shipping cost is TWD30 <TWD 180> and is not negotiable. The buyer needs to make the payment within 10 days of completion of the auction. The seller only accepts payment by bank transfer. Your iPod comes with 90 days of telephone technical support and 1 year of warranty.



FIGURE III
Screenshot from Disclosed eBay Ireland Auction

in each treatment cell. In a given week, items of the same color differed only by shipping charge. The disclosure treatment for a color alternated each week. We ran the experiments over the five-week period from October 13, 2008, to November 18, 2008, and all auctions closed successfully. Prior to the start of the experiments, we collected field data and chose shipping charges coinciding with the 25th and 75th percentiles of the market. Figures III and IV

Winning bid: EUR 26.00

Ended: 28-Oct-08 19:00:00 GMT

Postage: To United Kingdom -- Check item description and payment instructions or contact seller for details

Post to: Ireland, United Kingdom

Item location: Cambridge, Cambridgeshire, Ireland

History: 25 bids

Winning bidder: [Redacted]

You can also: [Email to a friend](#)

Meet the seller
 Seller: [patricia2 \(1,105\)](#) (★)
 Feedback: 100 % Positive
 Member since 21-Sep-04 in United Kingdom
 • [See detailed feedback](#)
 • [Add to Favourite Sellers](#)
 • [View seller's other items](#)

Ask seller a question
[Email the seller](#)

Buy safely

1. Check the seller's reputation
 Score: 105 | 100% Positive
[See detailed feedback](#)
2. Check how you're protected

PayPal Choose PayPal for up to €200 buyer protection. [See terms & conditions](#)

PayPal Choose PayPal for up to €200 buyer protection. [See terms & conditions](#)

Description Seller assumes all responsibility for listing this item.

Item Specifics - MP3 & Digital Media Players

Storage Capacity:	1 GB	Display Capability:	--
Memory Type:	--	Compatible Memory:	--
Brand:	Apple iPod	PC Interface:	--
Model:	iPod Shuffle	Condition:	New
Additional Features:	--		

This is an auction for one NEW Pink iPod shuffle (1GB) in a SEALED-BOX.

Inside the box, you'll find: one pink iPod shuffle with 1GB of internal memory, one set of white headphones, one USB docking station for charging the unit and transferring songs via iTunes. The iPod and dock are both PC and Mac-compatible. Apple's QuickStart guide is also included.

With this iPod shuffle you can:

- Store up to 240 songs
- Enjoy up to 12 hours of skip-free playback
- Also store data on the USB flash drive
- Charge the iPod via included USB docking station
- Play, pause, click forward, move back, and adjust the volume with an easy-to-use circular control pad
- Attach the iPod on your shirt, belt, pocket, or pack using the built-in clip

Shuffle the songs! Or play them straight through!

P&P charge for this item is EUR 11.00.

PLEASE NOTE: We ship only within Ireland and the United Kingdom.
 The P&P charge is non-negotiable and we do not combine shipping if you purchase multiple goods.
 Payments must be sent within 10 days of the end of the auction.
 Happy Bidding!

FIGURE IV
 Screenshot from Shrouded eBay Ireland Auction

present screenshots for auctions where the shipping charge is disclosed and shrouded, respectively.

II.C. Results

Table I summarizes the results by country for each treatment, whereas Table II presents formal statistical tests. By pooling the

TABLE I
SUMMARY STATISTICS FOR YAHOO AND EBAY FIELD EXPERIMENTS

		Opening price of TWD 750 or EUR 0.01		Opening price of TWD 600
		Low shipping TWD 30 or EUR 11	High shipping TWD 180 or EUR 14	High shipping TWD 180
Disclosed				
Taiwan	Revenue	92.92 (28.76)	96.92 (30.91)	95.31 (30.03)
	# of bidders	11.17 (2.32)	10.17 (3.76)	10.5 (3.7)
	# of observations	6	6	6
Ireland	Revenue	37.52 (5.63)	36.93 (5.65)	— (—)
	# of bidders	5.8 (1.3)	7.0 (1.9)	— (—)
	# of observations	10	10	—
Shrouded				
Taiwan	Revenue	88.89 (29.31)	93.26 (28.87)	94.27 (30.53)
	# of bidders	11.33 (5.6)	10.5 (5.2)	12.7 (4.1)
	# of observations	6	6	6
Ireland	Revenue	36.36 (4.85)	38.94 (3.15)	— (—)
	# of bidders	6.7 (2.26)	6.9 (1.6)	— (—)
	# of observations	10	10	—

Note: Values are means with standard deviations shown in parentheses. Revenue is denoted in euros. In March 2006, TWD 1 = EUR 0.025. Shipping charges are "shrouded" when they are not included in the title or search results. Shipping charges are "disclosed" when they appear in the title and search results.

data from the two countries, we can take advantage of a larger data set to estimate more precise effects. Three tests are reported, a standard *t*-test, a Wilcoxon signed-rank test, and a Fisher-Pitman exact permutation test. As the table shows, the statistical significance is similar across tests. Table II also presents permutation-based confidence intervals.⁴

The effects of shrouding on revenues may be seen by comparing each item under treatment D_x with its pair under

4. Permutation-based confidence intervals are only valid under the null hypothesis of exchangeability. Thus, we construct these only for treatment pairs where we cannot reject the null.

TABLE II
SUMMARY OF PAIRWISE TESTS OF REVENUE AND NUMBER OF BIDDERS FOR YAHOO AND EBAY FIELD EXPERIMENTS

	# of pairs of obs.	Mean differences (e.g., DL - SL)	<i>t</i> -test		Wilcoxon		Fisher-Pitman		Monte Carlo	
			<i>t</i> -test	<i>t</i> -stat	signed-rank test	<i>z</i> -stat	permutation test	<i>p</i> -value	permutation-based 90% confidence intervals	
Revenue										
DL vs. SL	10	2.763	2.578**		1.736*		.047		—	
DH vs. SH	10	1.422	0.807		0.410		.445		(-2.95, 2.95)	
DL vs. DH	16	-1.126	0.853		0.724		.409		(-2.16, 2.16)	
SL vs. SH	16	-3.254	3.043***		2.617***		.011		—	
DH vs. DR	6	-1.605	0.793		0.420		.500		(-3.09, 3.09)	
SH vs. SR	6	1.008	0.488		0.216		.750		(-3.25, 3.25)	
DL vs. DR	6	-2.389	2.200*		1.782*		.094		—	
SL vs. SR	6	-5.376	4.997***		2.201**		.031		—	
# of bidders										
DL vs. SL	10	-0.533	0.291		0.204		.805		(-2.93, 2.93)	
DH vs. SH	10	-0.271	0.148		0.307		.906		(-2.18, 2.18)	
DL vs. DH	16	-0.375	0.535		0.863		.666		(-1.13, 1.13)	
SL vs. SH	16	0.188	0.174		0.339		.921		(-1.69, 1.69)	
DH vs. DR	6	0.333	1.000		1.000		.625		(-0.66, 0.66)	
SH vs. SR	6	2.167	2.484**		1.897**		.094		—	
DL vs. DR	6	0.667	0.445		0.315		.750		(-2.33, 2.33)	
SL vs. SR	6	-1.333	0.623		0.954		.656		(-3.33, 3.33)	

Notes: "D" indicates disclosed, "S" indicates shrouded, "L" indicates low shipping fees, and "H" indicates high shipping fees. "R" indicates Taiwan auctions with a high shipping fee and low opening price, designed to have a reserve equal to the reserve in treatment. "L". Revenue is denoted in euros. In March 2006, TWD 1 = EUR 0.025. Permutation-based confidence intervals were constructed only when we failed to reject the null hypothesis of equality (200,000 replications).
*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

treatment Sx .⁵ Notice that, under low shipping, revenues declined with shrouding. Statistical tests indicate that this revenue difference is significant at the 5% level. Under high shipping, the effect is ambiguous—disclosure increased revenues in Taiwan but decreased them in Ireland. Formal statistical tests do not indicate a significant difference in revenues—confidence bounds suggest that revenue differences between shrouded and disclosed treatments under *high shipping* do not exceed EUR 2.95.

Disclosing a low shipping charge might raise revenues by attracting more bidders, yet there is little evidence of this. Disclosure increased the number of bidders in Taiwan but decreased the number in Ireland. Statistical tests suggest that revenue differences cannot be attributed to changes in the number of bidders. Similarly, disclosure has no significant effect on the number of bidders under high shipping.

How do shipping charges affect revenues under the different shrouding treatments? This may be seen by comparing each item under treatment xL with its pair under treatment xH . When shipping charges are disclosed, the revenue effect is ambiguous—more expensive shipping raises revenues increase in Taiwan but lowers them in Ireland. Once again, formal statistical tests fail to reject the hypothesis of no treatment effect—confidence bounds indicate that the effect is somewhere below EUR 2.16. In contrast, raising the shipping charge significantly increases revenues when it is shrouded—the winning bidder pays, on average, 5% more in Taiwan and 7% more in Ireland under high shipping. As Table II shows, this revenue difference is significant at about the 1% level.

Shipping charges have only modest effects on the number of bidders attracted to each auction. In Taiwan, higher shipping charges attract slightly fewer bidders. In Ireland, they attract slightly more. Statistical tests are consistent with this observation—we cannot reject the null hypothesis of no treatment effect at conventional levels under either disclosure or shrouding.

When the opening price is held fixed, raising the shipping charge increases the reserve level of the auction. Comparing treatments xH to xR isolates a pure reserve effect. Regardless of disclosure, there is no statistical difference between these treatments. In contrast, comparing treatments xL to xR isolates a pure

5. When multiple identical items were sold under the same treatment, we used mean revenue as the unit of observation leading to ten observations for ten different types of iPod.

shipping effect. Here we find that raising the shipping charge increases revenues, but the effect is more pronounced when shipping costs are shrouded.⁶ This revenue difference is significant at the 10% level under disclosure and the 5% level under shrouding. To summarize, changes in the reserve level do not appear to drive auction revenues.

II.D. Discussion

The main findings that emerge from the field experiments are (1) shrouding a low shipping charge is a money-losing strategy; (2) raising shipping charges increases revenue, particularly when they are shrouded; and (3) these revenue differences cannot be attributed to changes in the number of bidders. We sketch a model that can explain these findings. Suppose that the number of bidders is fixed. Some bidders are *attentive*—they are fully aware of the shipping charge. Others are *naive*—they are unaware of the exact shipping charge, but believe it to be extremely low.⁷ Finally, *suspicious* bidders are also unaware of the exact shipping charge, but assume that it will be high.⁸

With disclosure, a fraction of the naive and suspicious bidders become aware of the exact shipping charge and change their bids. Suspicious bidders raise their bids because the actual shipping charge is lower than their expectations, whereas naive bidders lower their bids because the shipping charge is unexpectedly high. When the shipping charge is low, the net effect of disclosure is to increase seller revenues, because the gains from suspicious bidders outweigh the losses from naive bidders. The reverse is true when the shipping charge is high. Thus, there is a shipping charge threshold below which disclosure is optimal and above which sellers prefer to shroud.

Increasing the shipping charge causes attentive bidders to reduce their bids on a one-for-one basis. Bids of naive and suspicious bidders, who are unaware of the exact shipping charge, do not respond to this change. The net effect is to improve seller revenues. When the shipping charge is shrouded, this improvement

6. The revenue difference between treatments SL and SR is consistent with the findings of Hossain and Morgan (2006), who also found that revenues increased with higher shipping charges, holding the reserve fixed. Unlike their findings, we do not see a treatment difference in the number of bidders.

7. Such behavior might arise if consumers anchored on the base price (Kahneman and Tversky 1979).

8. We are grateful to an anonymous referee for suggesting a model along these lines.

is larger than when the shipping charge is disclosed because a smaller fraction of bidders adjust their bids.

III. NATURAL EXPERIMENT

On October 28, 2004, eBay US announced a change in their search format—prospective bidders would now have the option of seeing the shipping charge for each auction on the results page. Prior to this, users had to read the body of each auction listing to learn the shipping charge. eBay also increased the visibility of shipping charges by displaying them on the bid confirmation screen. This action shifted the default from shrouding to disclosure of shipping charges.

We obtained a data set used in Tyán (2005), consisting of successful auctions for gold and silver coins conducted on eBay's U.S. site from September to December 2004. In this data set, we classify the shipping charges for each auction as either "shrouded" or "disclosed." Shipping charges are shrouded when they are not included in the title or search results and disclosed when they are included. Shrouded auctions are those ending prior to October 27, 2004, whereas disclosed auctions are those beginning after November 10, 2004.⁹ Auctions between these dates are omitted. Table III summarizes the revenue (including shipping), opening price, shipping charge, and number of unique bidders for the shrouded and disclosed auctions of gold and silver coins. Interestingly, average revenues are higher when the shipping charge is disclosed than when it is shrouded. The increase, however, cannot be attributed to differences in the number of bidders—shrouded auctions attract about the same number of bidders as do disclosed auctions.

We study changes in shrouding and shipping charges using the following regression:

$$(1) \quad \begin{aligned} \text{revenue} = & \beta_0 + \beta_1 \text{shipping} + \beta_2 \text{opening} + \beta_3 \text{disclosed} \\ & + \beta_4 \text{disclosed} \times \text{shipping} + \beta_5 \text{disclosed} \times \text{opening} \\ & + \gamma X + \varepsilon, \end{aligned}$$

where X is a matrix of control variables. For the field experiments, we include product fixed effects. For silver coins, we use a dummy for whether the coin was graded. For gold coins, we use dummies

9. Results are robust to variations in these cutoff dates.

TABLE III
SUMMARY STATISTICS FOR GOLD AND SILVER COIN AUCTIONS

	Gold coins	Silver coins
	Disclosed	
Revenue	67.45 (22.00)	45.72 (4.19)
Opening price	12.17 (21.81)	24.10 (16.16)
Shipping charge	4.55 (1.37)	5.08 (1.27)
# of bidders	6.15 (2.48)	4.53 (2.92)
# of observations	162	306
	Shrouded	
Revenue	62.12 (16.92)	42.49 (4.18)
Opening price	9.04 (17.02)	18.98 (15.98)
Shipping charge	4.81 (1.90)	4.95 (1.48)
# of bidders	6.34 (2.44)	4.37 (2.70)
# of observations	124	212

Note: Values are means with standard deviations shown in parentheses. Shipping charges are “shrouded” when they are not included in the title or search results. Shipping charges are “disclosed” when they appear in the title and search results. Data from silver and gold coin auctions were provided by Tyan (2005). For the coin data, shrouded auctions are those ending prior to October 27, 2004, whereas disclosed auctions are those beginning after November 10, 2004. Auctions between these dates are omitted.

for each grade interacted with dummies for the grading organization. We also control for whether the coin was listed as a “proof” or “brilliant uncirculated.” Controls for photographs, acceptance of Paypal or credit cards, and the decile of the sellers’ feedback rating are used for all coin auctions. To account for heteroscedasticity, we use robust estimation. Table IV presents the results of this analysis.

If shrouding matters, then we should reject the hypothesis that the coefficients associated with disclosure are all equal to zero ($\beta_3 = \beta_4 = \beta_5 = 0$). Table IV reports that this is the case in all instances.

What happens when a seller increases the shipping charge but leaves the reserve level unchanged? If all bidders were attentive, this would have no effect on revenues (under shrouding $\beta_1 = \beta_2$; under disclosure $\beta_1 + \beta_4 = \beta_2 + \beta_5$). When shipping charges are shrouded, we reject this hypothesis—a one-dollar

TABLE IV
REGRESSIONS OF TOTAL AUCTION REVENUE FOR IPOD AND COIN AUCTIONS

	iPods (EUR)	Gold coins (USD)	Silver coins (USD)
Coefficient estimates			
β_1 shipping charge	1.130*** (0.320)	2.031*** (0.569)	0.888*** (0.178)
β_2 opening price	-0.101 (0.378)	0.013 (0.046)	0.079*** (0.015)
β_3 disclosed	6.991 (8.634)	4.053 (4.941)	4.261*** (1.392)
β_4 disclosed \times shipping charge	-0.470** (0.266)	-0.359 (1.218)	-0.290 (0.253)
β_5 disclosed \times opening price	-0.140 (0.446)	0.048 (0.075)	-0.013 (0.021)
<i>F</i> -tests			
$\beta_3 = \beta_4 = \beta_5 = 0$	4.17*** d.f. (3, 61)	2.1* (3, 261)	18.47*** (3, 499)
$\beta_1 = \beta_2$	4.48** d.f. (1, 61)	11.95*** (1, 261)	20.45*** (1, 499)
$\beta_1 + \beta_4 = \beta_2 + \beta_5$	2.20 d.f. (1, 61)	2.15 (1, 261)	8.45*** (1, 499)
# of observations	76	286	518

Note: The values in parentheses are robust standard errors. For experimental data, "disclosed" = 1 when the shipping charge was listed in the item title. For field data, "disclosed" = 1 when the auction occurred after November 10, 2004. iPod regressions include item-specific fixed effects. Coin regressions include controls for condition, grade, seller reputation, and other auction characteristics.

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

increase in shipping with an equal reduction in the opening price raises revenue. When shipping charges are disclosed, we can reject the null hypothesis for silver coins, but not for other items. In all cases, increasing shipping by a dollar while holding the reserve level constant has a smaller revenue effect when the shipping charge is disclosed than when it is shrouded.

An average seller benefited from the increased disclosure of shipping charges due to eBay's format change. Formally, we reject the hypothesis that an average seller earned the same revenue under shrouding and disclosure ($\beta_3 + \beta_4 \times$ average opening price + $\beta_5 \times$ average shipping charge = 0; $F_{(1,261)} = 4.48$ for gold coins and $F_{(1,499)} = 50.58$ for silver coins).

Are differences in the number of bidders driving the revenue effects? To examine this, we change the dependent variable in equation (1) to the number of unique bidders. Table V presents

TABLE V
REGRESSIONS OF TOTAL NUMBER OF BIDDERS FOR IPOD AND COIN AUCTIONS

	iPods	Gold coins	Silver coins
Coefficient estimates			
β_1 shipping charge	0.244 (0.394)	0.124 (0.078)	-0.089 (0.089)
β_2 opening price	-0.228 (0.350)	-0.077*** (0.005)	-0.132*** (0.007)
β_3 disclosed			0.969 (0.756)
β_4 disclosed \times shipping charge			0.066 (0.132)
β_5 disclosed \times opening price			-0.019** (0.010)
<i>F</i> -tests			
$\beta_3 = \beta_4 = \beta_5 = 0$	0.51 d.f. (3, 61)	0.44 (3, 261)	12.2*** (3, 499)
$\beta_1 = \beta_2$	0.44 d.f. (1, 61)	6.44 (1, 264)	0.23 (1, 499)
$\beta_1 + \beta_4 = \beta_2 + \beta_5$			1.83 (1, 499)
# of observations	76	286	518

Note: The values in parentheses are robust standard errors. For experimental data, "disclosed" = 1 when the shipping charge was listed in the item title. For field data, "disclosed" = 1 when the auction occurred after November 10, 2004. iPod regressions include item-specific fixed effects. Coin regressions include controls for condition, grade, seller reputation, and other auction characteristics.

*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

the results of this analysis. We only observe a shrouding effect on the number of bidders for silver coins. For all other data, we cannot reject the hypothesis that the disclosure coefficients are all equal to zero ($\beta_3 = \beta_4 = \beta_5 = 0$). Moreover, in every instance, shipping charge coefficients are statistically indistinguishable from zero. There is little evidence that changes in the number of bidders are responsible for the observed revenue differences. Instead, revenue differences are likely a result of differences in the bids being placed.

The regression results complement those of the field experiment: (1) shrouding affects revenues; (2) raising the shipping charge increases revenues, and the effect is stronger under shrouding; and (3) these differences are not attributable to changes in the number of bidders. The finding that disclosure on eBay increased average seller revenues, however, presents a

puzzle. If disclosure were profitable, then why didn't more sellers disclose their shipping charges in the titles of their listings?

Prior to the institutional change on eBay, an individual seller would not benefit by switching from shrouding to disclosing a high shipping charge. Revenues would fall if more naive bidders than suspicious ones became aware of the shipping charge, because newly aware naives would then lower their bids. In contrast, disclosure is profitable for sellers offering low shipping charges. A marketwide change is likely to have different effects on awareness. In particular, suppose that suspicious bidders are more technologically sophisticated than naive bidders and hence more likely to adjust their user preferences to make shipping visible following the changes to eBay's site. Now, if a seller discloses a high shipping charge, newly aware suspicious bidders will raise their bids (so long as the charge is below their expectations), and revenues will increase. Similarly, sellers offering a low shipping charge will also benefit from disclosure. As a result, overall seller revenues can increase with such a change even when disclosure was previously unprofitable (for high-shipping charge sellers).

IV. CONCLUSIONS

Although sellers often shroud their shipping charges in online auctions, our findings suggest that the profitability of this strategy depends on the size of the charge. In field experiments, we find that shrouding a low shipping charge actually reduces seller revenues, whereas shrouding a high shipping charge does not improve revenues relative to disclosure. Using field data from eBay, we find that an institutional change toward transparency may raise revenues for the average seller. Shrouding and partitioned pricing are complements—a seller can increase revenues by raising its shipping charge when shrouded, but not under disclosure. These revenue effects are not attributable to changes in the number of bidders. Perhaps most surprising is the large revenue effect of raising shipping charges under shrouding. Indeed, for all products, the estimated effect of raising the shipping charge (β_1 in Table IV) is statistically indistinguishable from 1 at the 5% level.¹⁰

10. For gold coins, the coefficient is more than one. Formally, we can reject the null hypothesis that $\beta_1 = 1$ at the 7% level.

That is, at the current level of shipping fees, a dollar marginal increase in shipping fees passes directly through to seller revenues.

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