

# Shrouded Attributes and Information Suppression: Evidence from the Field\*

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## Abstract

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; (2) increasing shipping charges boosts revenues particularly when these charges are hidden; and (3) the level and disclosure of the shipping charge have little effect on the number of bidders attracted to an auction.

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# 1 Introduction

Online stores often reveal shipping charges only after a consumer fills 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.<sup>1</sup> 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 on Yahoo’s auction platform to compare revenues for identical items while varying the level and disclosure of the shipping charge. We also compare revenues before and after a change on eBay’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 seller is better off disclosing; (2) increasing shipping charges boosts revenues particularly when shipping charges are shrouded; and (3) variation in the level and disclosure of the shipping charge has little effect on the number of bidders attracted to an auction.

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 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 (Ellison, 2005). Moreover, there is no incentive for firms to educate consumers about competitors’ shrouded add-ons (Gabaix and Laibson). Chetty *et al.* (2007) find that consumer demand falls when retailers post tax-inclusive prices (i.e. disclose a surcharge) for personal care products. They offer similar results for tax disclosure in alcohol prices. Ellison and Ellison (2004) find that shrouding add-ons is a profitable strategy for online computer memory firms. Ellison (2006) surveys various approaches to modeling bounded rationality and their implications for firm pricing. DellaVigna (2007) 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). The profitability of this strategy has been shown in field experiments (Hossain and Morgan, 2006),

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<sup>1</sup>Woodyard, C., “Hotels face lawsuits on surcharges for phones, energy,” USA TODAY, September 26, 2004.

while mixed results have been obtained in laboratory experiments (Morwitz *et al.*, 1998; Bertini and Wathieu, 2006). Smith and Brynjolfsson (2001) find that online book retailers do not benefit from price partitioning.

## 2 The Taiwan Field Experiments

To examine the effects of shrouding and shipping costs on auction revenues, we sold new iPod Shuffle and Nano players on Yahoo’s Taiwanese auction site. Our silver Shuffles came in both 512 MB and 1GB sizes, while our black and white Nanos came in both 1GB and 2GB sizes—a total of six different iPod models. The capacity, model, and color of each iPod was specified in the title and item description. The item description clearly stated the shipping charge and the shipping method. To vary shrouding, we included the shipping charge in the title of the listing for half of the auctions and omitted it for the other half. Figures 1 and 2 present screenshots (and accompanying English translations) for auctions where the shipping charge is disclosed and shrouded, respectively.

This choice of auction site and product allow us to easily vary shipping and shrouding while selling identical items. Unlike eBay, Yahoo did not automatically reveal shipping charges in search listings, an essential feature for examining shrouding using field experiments. Moreover, the market was thick and shipping charges varied widely—over 250 iPods were offered at the time of our experiments. Our Yahoo seller identity had a reasonable reputation rating. As a result, we could conduct auctions without drawing attention to ourselves as experimenters.

Our experiments varied three aspects of the auction—the opening price, the shipping charge, and shrouding. Our treatments were:

	Low Shipping TWD 30	High Shipping TWD180	
	High Opening Price TWD 750	Low Opening Price TWD 600	High Opening Price TWD 750
Disclosed	DA	DB	DC
Shrouded	SA	SB	SC

where “TWD” denotes the amount of the charge in New Taiwan Dollars. At the time of our experiments, the exchange rate was TWD 33 to \$1 US. In all of our treatments, the minimal payment a winning bidder would have to make, the opening price plus the shipping charge, is considerably below the retail price.<sup>2</sup> Thus, the reserve level (the opening price plus the shipping charge) of our auctions is not likely to be binding.

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<sup>2</sup>At the time of our experiments, the cheapest iPod we sold, the 512 MB Shuffle, had a retail price of TWD 2500.

To examine the effect of shrouding, we compare treatments  $Dx$  and  $Sx$ . To study the effects of raising the shipping charge while holding the reserve level constant, we compare treatments  $xA$  and  $xB$ . Comparing treatments  $xA$  and  $xC$  reveals the effect of raising the shipping charge while holding the opening price fixed. Comparing treatments  $xB$  and  $xC$  identifies the effect of raising the opening price while holding the shipping charge fixed. If bidders are attracted to an auction based on its full price including shipping, then there should be no treatment effects. However, if some bidders fail to account for shipping charges correctly, then variation in shrouding and the shipping charge should have an effect on revenues.

We auctioned all six iPod models under each treatment. Treatments DA, DB, and DC were conducted from March 13 to March 20, 2007 while treatments SA, SB, and SC were conducted from March 20 to March 27 of 2006. All of our items sold, and we received full payment. While 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).

### Results

The effects of shrouding on revenue may be seen in Table 1 by comparing each item under treatment  $Dx$  with its pair under treatment  $Sx$ . For 11 of the auctions, shrouding the shipping charge yielded lower revenues than disclosing it. Shrouding produced higher revenues in three cases and identical revenues (to the disclosed treatment) in the remaining four cases. A Wilcoxon matched-pairs signed ranks test reveals a test statistic of 2.57, indicating that we can reject the null hypothesis of no treatment effect in favor of the two-sided alternative at the 1% level.<sup>3</sup> The average revenue increase from disclosure is TWD 130 with a (bootstrapped) standard error of approximately 50. Interestingly, most of the revenue improvements associated with disclosing the shipping charge occur when the charge is low—in five out of the six cases, disclosing raises revenues. When the shipping charge is high, disclosing the charge raises revenues in half of the cases.

Table 2 shows the number of bidders attracted to each auction. The shipping charge might raise revenues by attracting more bidders, yet there is little evidence that this occurred. Disclosing the shipping charge attracted more bidders in half of the cases and fewer in the other half. We cannot reject the null hypothesis that shrouding had no effect on the number of bidders at any reasonable significance level.

How does the level of the shipping charge affect revenues under the different shrouding treatments? When shipping charges are disclosed, raising the shipping charge while holding

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<sup>3</sup>While the reported test statistics use normal approximations, our results do not change when we use permutation tests to construct exact p-values.

the reserve level constant increases revenues in five out of six cases. When shipping charges are shrouded, raising the shipping charge increases revenues in all six cases. Comparing treatments DA and DB, the Wilcoxon test statistic is 1.8; we reject the null hypothesis at the 8% significance level. Comparing treatments SA and SB yields a Wilcoxon test statistic of 2.2, indicating a rejection of the null hypothesis at the 3% significance level.

One might speculate that, by simultaneously raising the shipping charge and lowering the opening price, more bidders are attracted to the “bargain” prices of the high shipping charge auctions. When shipping charges are disclosed, offering a higher shipping charge with the same reserve level attracts more bidders in only two out of the six cases. When shipping charges are shrouded, raising the shipping charge attracts more bidders in five out of the six cases. However, the Wilcoxon test statistics associated with these comparisons indicate that we cannot reject the null hypotheses ( $z = 0.315$  for DA and DB;  $z = 0.954$  for SA and SB).

Next, we compare the effects of raising the shipping charge while holding the opening price fixed. When shipping charges are disclosed, in four out of six cases raising the shipping charge yields higher revenues. Under shrouding, increasing the shipping charge improves revenue in five cases and yields the same revenue in the sixth case. Wilcoxon tests reveal that we can reject the null hypothesis of no treatment effect at the 11% significance level when shipping charges are disclosed ( $z = 1.57$  for DA and DC) and at the 4% level under shrouding ( $z = 2.11$  for SA and SC).

Since the opening price is the same under these treatments, there is little reason to suspect that increasing the shipping charge would attract more bidders. Indeed, it does not: Under disclosure, a higher shipping charge reduces the number of bidders in four out of six cases. Under shrouding, there is little systematic difference in the number of bidders—high shipping charges attract more bidders in three cases and fewer bidders in two cases. Wilcoxon tests indicate the absence of any treatment effect at all reasonable significance levels.

Finally, we study the effects of raising the opening price while holding the shipping charge fixed. As one might expect given that the reserve level is far below the market price of the items, there is no revenue effect associated with this treatment variation under both shrouding and disclosure. In one comparison (SB and SC), however, statistically significantly more bidders are attracted to the auction with the lower opening price ( $z = 1.89$ ).

### **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 shipping charges 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.<sup>4</sup> Finally, *suspicious* bidders are also unaware of the exact shipping charge, but assume that it will be high.<sup>5</sup>

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 since the actual shipping charge is lower than their expectations, while naive bidders lower their bids since the shipping charge is unexpectedly high. When the shipping charge is low, the net effect of disclosure is to increase seller revenues since 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 is larger than when the shipping charge is disclosed since a smaller fraction of bidders adjust their bids.

### 3 The eBay Natural Experiment

On October 28, 2004, eBay announced that it would soon change its 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.

We obtained a dataset used in Tyan (2005) consisting of successful eBay auctions for gold and silver coins from September to December 2004. We also use data from field experiments reported in Hossain and Morgan (2006) consisting of successful eBay auctions of music CDs and Xbox games in November 2001 and March 2002. See the above cites for details on these data. 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. For the Tyan data, shrouded auctions are those ending prior to October 27, 2004, while disclosed auctions are those beginning after November 10, 2004.<sup>6</sup> Auctions between these dates are omitted. For the Hossain and Morgan data, all

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<sup>4</sup>Such behavior might arise if consumers anchor on the base price (Kahneman and Tversky, 1979).

<sup>5</sup>We are grateful to an anonymous referee for suggesting a model along these lines.

<sup>6</sup>Results are robust to variation in these cutoff dates.

auctions are shrouded.

Table 3 summarizes the revenue (including shipping), opening price, shipping charge, and number of unique bidders for the shrouded and disclosed auctions. Interestingly, average revenues are significantly 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.<sup>7</sup>

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

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

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 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 heteroskedasticity, we use robust estimation. Table 4 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 4 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 increase in shipping with an equal reduction in the opening price raises revenue. When shipping charges are disclosed, we cannot reject this hypothesis for iPods and gold coins, but can reject it for silver coins. 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 ( $\beta_3 + \beta_4 \times \text{average opening price} + \beta_5 \times \text{average shipping charge} = 0$ ;  $F_{(1,261)} = 4.48$  for gold coins and  $F_{(1,499)} = 50.58$  for silver coins).

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<sup>7</sup>T-tests of revenue differences between disclosed and shrouded auctions yield test statistics of 2.31 for gold coins and 8.65 for silver coins. T-tests of differences in the number of bidders yield test statistics of 0.64 and 0.63 for gold and silver coins, respectively.

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 5 presents 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.

### Discussion

The regression results are consistent with those of the Taiwan field experiments: (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 title of their listing?

An amendment to our model provides one possible "solution" to the puzzle. 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. Unlike when shipping charges are disclosed in the listing title, the eBay format change increases the attentiveness of suspicious bidders more than naive bidders. Since sellers benefit when suspicious bidders become aware of the exact shipping charge, the net effect on revenues is positive even when disclosure was previously unprofitable.

## 4 Conclusion

While 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, while 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 is not crucial to the success of partitioned pricing—a seller can increase revenues by raising its shipping charge and lowering its opening price by equal amounts, *even when both are disclosed*. This revenue effect is not attributable to changes in the number of bidders. Perhaps most surprising is the large revenue effect of raising shipping charges under shrouding. We find that a one dollar increase in shipping often raises average revenues by *more* than one dollar. This is hard to rationalize theoretically since, even if none of the bidders accounted for shipping, we would not expect to see such a large effect.



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**Table 1. Revenues Obtained in the Yahoo Field Experiments (in TWD)**

Item	Treatment					
	DA	DB	DC	SA	SB	SC
iPod shuffle 512m	2,190	2,210	2,160	1,860	1,980	2,180
iPod shuffle 1G	3,130	3,100	3,380	3,080	3,280	3,280
iPod nano 1G white	4,330	4,630	4,480	4,330	4,480	4,480
iPod nano 1G black	4,380	4,530	4,580	4,080	4,530	4,080
iPod nano 2G white	5,430	5,580	5,980	5,230	5,480	5,580
iPod nano 2G black	5,430	5,480	5,380	5,230	5,500	5,380
Opening Price	High	Low	High	High	Low	High
Shipping Charge	Low	High	High	Low	High	High
Shrouding	No	No	No	Yes	Yes	Yes

**Table 2. Number of Distinct Bidders in the Yahoo Field Experiments**

Item	Treatment					
	DA	DB	DC	SA	SB	SC
iPod shuffle 512m	15	9	8	4	7	6
iPod shuffle 1G	10	8	9	19	10	6
iPod nano 1G white	11	15	14	13	16	17
iPod nano 1G black	12	15	15	8	14	12
iPod nano 2G white	11	10	10	8	11	6
iPod nano 2G black	8	6	5	16	18	16
Opening Price	High	Low	High	High	Low	High
Shipping Charge	Low	High	High	Low	High	High
Shrouding	No	No	No	Yes	Yes	Yes

**Table 3: Summary Statistics for all Auctions**

	CDs & Games	iPods	Gold Coins	Silver Coins
Currency	US\$	TWD	US\$	US\$
<b>Shrouded Shipping Charge</b>				
Mean				
Revenue	25.534 (14.373)	4113.333 (1245.103)	62.116 (16.918)	42.487 (4.182)
Opening Price	2.950 (2.270)	700.000 (72.761)	9.039 (17.019)	18.981 (15.979)
Shipping Charge	2.943 (2.225)	130.000 (72.761)	4.805 (1.902)	4.945 (1.480)
Number of Unique Bidders	6.662 (2.985)	11.500 (4.805)	6.339 (2.439)	4.373 (2.698)
# of observations	74	18	124	212
<b>Disclosed Shipping Charge</b>				
Mean				
Revenue		4243.333 (1256.761)	67.453 (22.002)	45.722 (4.190)
Opening Price		700.000 (72.761)	12.168 (21.811)	24.104 (16.164)
Shipping Charge		130.000 (72.761)	4.553 (1.369)	5.078 (1.268)
Number of Unique Bidders		10.611 (3.165)	6.148 (2.483)	4.529 (2.923)
# of observations		18	162	306

**Note:** The values in parentheses are standard deviations. 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 or search results. For the coin data, shrouded auctions are those ending prior to October 27, 2004, while disclosed auctions are those beginning after November 10, 2004. Auctions between these dates are omitted. For the CDs and games data, all auctions are shrouded.

**Table 4: Results from Regressions of Total Auction Revenue**

**Dependent variable:** Revenue (i.e. final price + shipping charge)

	CDs & Games	iPods	Gold Coins	Silver Coins
<b>Coefficient Estimates</b>				
$\beta_1$ Shipping Charge	0.720 *** (0.208)	1.600 *** (0.398)	2.031 *** (0.569)	0.888 *** (0.178)
$\beta_2$ Opening Price	0.248 * (0.128)	-0.300 (0.515)	0.013 (0.046)	0.079 *** (0.015)
$\beta_3$ Disclosed		-400.000 (603.961)	4.053 (4.941)	4.261 *** (1.392)
$\beta_4$ Disclosed x Shipping Charge		-0.889 (0.572)	-0.359 (1.218)	-0.290 (0.253)
$\beta_5$ Disclosed x Opening Price		0.778 (0.779)	0.048 (0.075)	-0.013 (0.021)
<b>F-tests</b>				
$\beta_3 = \beta_4 = \beta_5 = 0$		4.84 *** (3,25)	2.1 * (3,261)	18.47 *** (3,499)
$\beta_1 = \beta_2$	9.74 *** (1,52)	5.79 ** (1,25)	11.95 *** (1,261)	20.45 *** (1,499)
$\beta_1 + \beta_4 = \beta_2 + \beta_5$		0.08 (1,25)	2.15 (1,261)	8.45 *** (1,499)
<b># of observations</b>	74	36	286	518

**Note:** \*, \*\* and \*\*\* represent statistical significance at the 10, 5 and 1 percent levels, respectively. The values in parentheses are robust standard errors. For experimental data, "Revealed"=1 when the shipping charge was listed in the item title. For field data, "Revealed"=1 when the auction occurred after November 10, 2004. Column 1 includes only undisclosed shipping charge observations.

**Table 5: Results for Regressions on Bidder Count**

**Dependent variable:** Number of Unique Bidders

	CDs & Games	iPods	Gold Coins	Silver Coins
<b>Coefficient Estimates</b>				
$\beta_1$ Shipping	0.157 (0.106)	0.002 (0.011)	0.124 (0.078)	-0.089 (0.089)
$\beta_2$ Opening Price	-0.078 (0.096)	-0.008 (0.009)	-0.077 *** (0.005)	-0.132 *** (0.007)
$\beta_3$ Disclosed				0.969 (0.756)
$\beta_4$ Disclosed x Shipping				0.066 (0.132)
$\beta_5$ Disclosed x Opening Price				-0.019 ** (0.010)
<b>F-tests</b>				
$\beta_3 = \beta_4 = \beta_5 = 0$		0.52 (3,25) d.f.	0.44 (3,261)	12.2 *** (3,499)
$\beta_1 = \beta_2$	7.09 ** (1,52) d.f.	0.41 (1,28)	6.44 ** (1,264)	0.23 (1,499)
$\beta_1 + \beta_4 = \beta_2 + \beta_5$				1.83 (1,499) d.f.
<b># of observations</b>	74	36	286	518

**Note:** \*, \*\* and \*\*\* represent statistical significance at the 10, 5 and 1 percent levels, respectively. The values in parentheses are robust standard errors. For experimental data, "Revealed"=1 when the shipping charge was listed in the item title. For field data, "Revealed"=1 when the auction occurred after November 10, 2004. Column 1 includes only undisclosed shipping charge observations.