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Title: Internet Auctions and Frictionless Commerce:
Evidence from the Retail Gift Card Market

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Abstract

This study investigates the pricing of retail gift cards on eBay. Our results indicate that substantially less price dispersion exists than previously documented in other online markets for consumer goods. As gift cards are homogenous goods with clearly defined value, this suggests that online price dispersion in other markets may be due to unobservable differences in product characteristics or the competitive nature of auction environments. Additionally, gift cards for the discount retailer Wal-Mart exhibit less price dispersion than other large retailers' gift cards, consistent with the perception that greater search by price-sensitive shoppers can lead to less friction in markets.

Keywords: auctions, e-commerce, gift cards, Internet, price dispersion

1. Introduction

While many predicted that the Internet would reduce search costs and lead to frictionless commerce, it has been documented that significant price dispersion remains and may even persist over time at retailers' websites (Xing, 2008; Brynjolfsson and Smith, 2000; Clay, et al. 2001). One question that has not been investigated is whether such price dispersion exists in Internet auctions. This is of particular importance, since auctions represent a unique and rapidly growing method of purchasing items online (Highfill and O'Brien, 2009). For example, in 2008 auction giant eBay.com received around 81 million unique visitors monthly (eBay Annual Report, 2008).

In this study, we examine auctions of a homogenous good on eBay: retail gift cards for Best Buy, Wal-Mart, and Home Depot. The auction market for gift cards provides an ideal setting for our study, since unobserved quality differences among the goods and/or sellers are trivial. Consumers have no uncertainty over the value of the item; gift cards are perfectly transferable and of identical materials and quality. Our dataset also contains information on seller characteristics such as seller reputation. We have the additional advantage that the data report transacted prices as opposed to posted prices (e.g., from a retailer's website or a price search engine). If consumers purchase only from a subset of the posted prices, then the full listing of prices may overstate the amount of price dispersion (Baye, et al. 2004).

We find substantially less price dispersion for gift cards than has previously been documented in other online markets, and our results are robust to a wide variety of measures. The daily range between the highest and lowest price (inclusive of shipping and handling fees) in our auctions is anywhere from 4 to 8% of the mean price, compared to ranges in the previous literature that are as large as 25 to 40% of the mean for non-auction online prices (Ellison and Ellison, 2005). Our results also indicate that gift cards for Wal-Mart

systematically exhibit less dispersion than do other retailers' gift cards, even after controlling for auction and seller characteristics. This is consistent with the perception that Wal-Mart shoppers are more price-sensitive and engage in greater search and also supports the theory that greater search leads to reduced levels of price dispersion.

This study investigates the question: Do Internet auctions for homogeneous goods exhibit price dispersion? Furthermore, if the relative quantity of goods sold in an auction setting increased, would prices converge to support the law of one price? Based on a study of homogeneous goods on eBay, our results suggest that online price dispersion is clearly related (negatively) to the homogeneity of the good being studied.

2. Previous Literature

Our study is related to previous research on price dispersion in online markets. Brynjolfsson and Smith (2000) collected data on prices for books and CDs at eight Internet retailers and found price ranges that are close to 30%; Baye, et al. (2004) examined prices on Shopper.com for computer and electronic parts and reported that the average differences between the two lowest prices that were listed were between 3.5% and 23%, depending on the number of firms that list prices. Ellison and Ellison (2005) collected price data from Pricewatch.com for small computer-parts retailers, and they found that the twelfth lowest price is approximately 10% above the lowest price. Xing (2008) examined price dispersion in offline and online markets and found no evidence of price convergence over time. According to Ellison and Ellison (2005), the sources of price dispersion can be due to product differentiation, search costs, or multiproduct competition and switching costs.[1] Though the exact reason for this is

[1] See Baye, Morgan, and Scholten (2006) for a thorough analysis of the prior literature on price dispersion in posted price markets.

still unclear, very little research exists that focuses on the level of price dispersion in an auction market setting, like that of eBay.[2]

It is important to mention that, in contrast to the posted price markets mentioned above, an environment like eBay allows buyers to participate in multiple auctions, either simultaneously or over time. Wolinsky (1988) considers whether this decentralized type of trading will result in a non-market clearing price and finds that under certain conditions (where there are a sufficient number of bidders relative to sellers and at least two buyers bid for each unit), the phenomenon of non-market-clearing-price disappears. Peters and Severinov (2006) articulate a bidding process for how buyers should optimally behave across competing auctions. They conclude that, as a result of buyers' focusing their bidding on auctions with the lowest standing bids, standing bids will increase gradually, and price dispersion will not occur. Anwar, McMillian, and Zheng (2006) empirically investigate "cross-bidding", and although not a focus of their study, they suggest that it may result in less price dispersion.

3. Data

The data consist of the sale prices of gift cards for three retailers (Wal-Mart, Home Depot, and Best Buy) in the amounts of $50, $100, and $200. We collected data from completed transactions that occurred on eBay between October 2005 and April 2006. These companies were chosen because they represented the largest share of gift cards sold on eBay during that

[2] Gift cards can also be purchased directly from the retailer or other resale websites with posted (and non-negotiable) prices. We focus on the eBay environment to investigate whether the presence of multiple sellers can still lead to price dispersion as found in prior studies that examine multiple sellers with posted prices on a single website. Note that in eBay auctions, the sellers do not discount the cards themselves; the different prices arise from the different winning bids for these identical items.

time period; the retailers ranked by most gift cards sold to least were Home Depot, Wal-Mart, and Best Buy (Offenberg, 2007). The dollar amounts were chosen to allow for different levels of price dispersion at different price levels, as well as to avoid any unrelated issues such as analyzing gift cards in uneven values, like $34.56. As our primary interest is to investigate the extent of price dispersion, we restrict our sample to transactions that occur on days where at least two gifts cards were sold within a given category.[3] We define a "category" as a particular retailer and face value combination – e.g., Wal-Mart gift cards for $50. The retailers in our dataset have no maintenance fees or expiration dates for their gift cards. Our measures of price include the total price of the good, which is the item price plus any shipping or handling fees.

Table 1 gives summary statistics for the final sample. Gift cards are sold on average at 10% below their commodity value. We also collected information on whether the seller paid additional fees for extra promotion (*extra*), whether the auction ended early with the Buy-It-Now option, the length of the auction in days (*length*), the number of bids on the item (*bids)*, the seller's feedback and number of negative ratings, and whether any payment restrictions to PayPal were imposed.[4]

Nearly all transactions involve a buyer's paying less than the face value of the card. For all 1683 transactions in our sample, the item price (excluding shipping fees and transaction costs) did not exceed the face value of the card. For less than one percent of our sample (i.e., 0.04%, or 7 out of 1683 transactions), the full price of the card (i.e., item price plus any shipping fees or transaction costs) exceeded the face value.

[3] Our results are qualitatively similar whether we use a cutoff of two, three, or four items sold per day.

[4] For descriptive statistics and an in-depth analysis of how these different auction characteristics affect sale price, see Pate (2006).

4. Empirical Analysis

4.1 Overall Price Dispersion

To investigate the extent of price dispersion, we calculate four different measures for each category of gift cards on a given day: the standardized absolute deviation (which we define as the absolute difference between a gift card's payment price on a given day and the average price for its category on that same day, divided by that average price); the standardized range (i.e., the difference between the maximum and minimum price within a category on a given day, as a fraction of the mean price on that day); the standard deviation (for each day); and the coefficient of variation (for each day). Table 2 contains the average values of these dispersion measures across the different days of our sample and the average price across all gift cards within a category.

We find that our sample exhibits less price dispersion than has been previously reported in other online markets. Across the different categories, the average daily absolute deviation is anywhere from 1-3% of the mean price. The average daily range across the categories varies from 4 to 8% of the overall mean price. The average daily standard deviation and the average daily coefficient of variation across the categories vary from 2 to 4% of the overall mean price.

We provide a summary of the dispersion results from previous studies of online markets in Table 3. In contrast, previous work on online prices for books and CDs find that the range is anywhere from 25 to 40% of the mean price, and the standard deviation is 10% of the mean price (Ellison and Ellison, 2005, Brynjolfsson and Smith, 2000). The results from Baye, et al (2004) suggest that for online computer products, the average range in prices is approximately 20-30% of the mean, while the coefficient of variation is 9.5%. In particular, they find that with only two firms that post prices, the gap between the two lowest prices is approximately 23% of the mean, and the gap falls to 3.5% for products with 17 firms that

post prices. In our dataset, with an average of seven sellers in each category daily, we find levels of dispersion within gift cards that are similar in magnitude to a market with 17 firms for online computer parts.

As a comparison of the data in Tables 2 and 3 indicates, we find lower levels of dispersion (in particular, the coefficient of variation) compared to prior studies. Using the statistics reported in Baye, et al. (2004), we were able to perform a two-sample t-test on the coefficient of variation from their sample and the measures calculated from each of our categories in Table 2. We can reject the null hypothesis at the 1% significance level that the means of these statistics are equal across the two samples.[5]

In an environment with an arguably homogeneous good – gift cards – we find significantly less price dispersion compared to other online markets. One possible explanation is that gift cards represent a truly homogeneous good where characteristics are identical and known to all buyers. Item condition and quality may vary for other goods in unobservable ways. Moreover, limited opportunity exists for sellers of gift cards on eBay to engage in search obfuscation and multiproduct competition, which can also be a source of price dispersion (Ellison and Ellison, 2005). Sellers post the individual items for sale on eBay and do not bundle the goods with other items. Finally, competition among bidders in an auction setting and the ability to cross-bid across auctions may lead to greater uniformity of prices.

4.2 Price Dispersion by Retailer

[5] While other studies do not report enough information in their tables to allow us to perform the t-test for comparison, we are able to perform a t-test using the information from all and multi-price listings reported in Table I in Baye, et al. (2004) across all product ranks.

Our results also suggest that price dispersion may vary by retailer. As shown in Table 2, under each category, Wal-Mart gift cards tend to exhibit less dispersion than do gift cards for the other two retailers. For instance, the average daily range of a $200 gift card for Wal-Mart is 4% of the mean daily price, while the average daily range is anywhere from 5-8% of the mean daily price for $200 gift cards for Best Buy and Home Depot.

As these differences may be due to auction or seller characteristics, we employ regression analysis on three different price dispersion measures to control for these factors and check for the robustness of this pattern. Table 4 reports the results of the OLS regressions.[6] In column (1), we consider the absolute deviation (normalized by the mean price) and employ the following regression:

$$\left| \frac{P_{ijt} - \overline{P}_{jt}}{\overline{P}_{jt}} \right| = X_{ijt}\beta + \varepsilon_{ijt} \qquad (1)$$

where i denotes a particular card sold on day t for a given retailer and face value j.[7] The independent variables X include controls for seller and listing-specific characteristics, such as seller rating, etc. We also include the number of other items that were sold that day in the same retailer-face value category to control for competition (Baye, et al. 2004) as well as a holiday dummy variable to control for seasonal effects. In columns (2) and (3), we regress the range (as a fraction of the mean price) and the coefficient of variation for each category of gift cards on seasonal controls (the holiday dummy variable) and the number of sellers in the market.[8]

[6] We use the Huber-White estimator (Huber, 1967; White, 1980).

[7] Our results are qualitatively similar when we run a Tobit regression to account for the lower bound of zero on the dependent variable, standardized absolute deviation. We obtain similar results when we include a dummy for whether the deviation was positive or negative and interactions of this dummy with the holiday dummy variable.

[8] The results using the standard deviation had similar signs for the coefficients, but were not precisely estimated.

Across the three different specifications in Table 3, we still find that Wal-Mart gift cards systematically exhibit less price dispersion even when controlling for seller and auction characteristics.[9] The negative coefficient on the Wal-Mart dummy variable indicates that Wal-Mart gift cards exhibit slightly less dispersion relative to Best Buy and Home Depot gift cards. On average, the price of a Wal-Mart gift card is 1% closer to its mean compared to the other two retailers. Given that the average daily absolute dispersion is 2-3% at other retailers, the Wal-Mart gift cards exhibit a 50% reduction in dispersion as measured by the absolute deviation. The daily price range (relative to the mean price) is 2% smaller for Wal-Mart gift cards compared to the other two retailers, and the daily coefficient of variation is approximately 1% smaller. Since the average daily range for other retailers is approximately 5-8%, this represents a 12-20% decrease in the range for Wal-Mart gift cards. Similarly, the average daily coefficient of variation is 3-4%, so this suggests a 25-33% decrease in the coefficient of variation for Wal-Mart gift cards.

Stahl (1996), among others (see Stahl for a summary of earlier models) demonstrates that price dispersion across stores can occur in equilibrium for a homogenous good when the population consists of some consumers who price search and others that do not. Consistent with his model, if Wal-Mart shoppers are more price sensitive and engage in more search, then we would expect less price dispersion for Wal-Mart cards compared to Best Buy and Home Depot cards.

5. Conclusion

Despite predictions of costless search and intensified price competition, previous studies have indicated that a substantial amount of price dispersion exists in the online market for books,

[9] Recall that we restrict our sample to transactions that occur on days when at least 2 items were sold in the same category. Our results are qualitatively similar whether we use a cutoff of 2, 3, or 4 items sold per day.

CDs, DVDs, and computer parts. In this study we consider whether this price dispersion persists in an auction setting of a homogeneous good – retail gift cards. We document substantially lower levels of price dispersion, and our results are robust to several different measures. Compared to online prices for books and CDs whose range (i.e., the difference between the maximum and minimum price) are often 25 to 40% of the mean price (Ellison and Ellison, 2005, Brynjolfsson and Smith, 2000), the price range for gift cards on any given day averages from 4 to 8% of the overall mean price across the different categories of cards.

In an environment with an arguably homogeneous good, our finding establishes a lower bound of online price dispersion for consumer goods in the literature. Our results suggest that the low levels of price dispersion may be due to the fact that gift cards represent a truly homogeneous good, as the characteristics of the good are identical and known to all buyers. Item condition and quality may vary for other goods in unobservable ways. In addition, limited opportunity exists for sellers of gift cards on eBay to engage in search obfuscation and multiproduct competition, since sellers post the individual items for sale on eBay and do not bundle the goods with other items. Auction markets may also provoke greater competitive behavior, and this, along with the ability to bid across multiple auctions, may reduce price dispersion.

We also find that price dispersion is systematically lower for gift cards from the discount retailer Wal-Mart relative to Home Depot and Best Buy. This result is consistent with search models that predict price dispersion as the result of two types of consumers – shoppers and non-shoppers. Consumers of discount retailers may be more price sensitive and engage in more intensive price search. This finding supports the theory that greater search leads to lower levels of price dispersion.

Our results suggest that when online price dispersion is quantified, product homogeneity and differences in characteristics play an important role in explaining the extent

of price dispersion. Seemingly identical items that are sold by multiple retailers may in fact be different goods based upon unobserved item quality and condition. The availability of cross-bidding and a competitive environment may also reduce the variance in prices across auctions. The small but persistent level of price dispersion that remains in auctions may be due to idiosyncratic differences between auctions, such as the bid increments that eBay mandates.

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References

Anwar, S., McMillian, R. & Zheng, M. (2006). Bidding behavior in competing auctions: Evidence from eBay. European Economic Review, 50, 307-322

Baye, M., Morgan, J. & Scholten, P. (2004). Price dispersion in the small and in the large: Evidence from an internet price comparison site. Journal of Industrial Economics, 52, 463-496

Baye, M., Morgan, J. & Scholten, P. (2006). Information, search and price dispersion. (In T. Hendershott, (Ed.), Handbook of Economics and Information Systems (pp. 323-371). Elsevier Press: Amsterdam.)

Brynjolfsson, E. & Smith, M. (2000). Frictionless commerce? A comparison of internet and conventional retailers. Management Science, 46, 563-585

Clay, K., Krishnan, R. & Wolff, E. (2001). Prices and price dispersion on the web: Evidence from the online book industry. Journal of Industrial Economics, 49, 521-540

Ellison, G. & Ellison, S. (2005). Lessons about markets from the internet. Journal of Economic Perspectives, 19, 139-158

Highfill, J. & O'Brien, K. (2009). The determinants of sales on eBay: The case of baseball cards. Applied Economics Letters, 16, 1421-1424

Huber, P. J. (1967). The behavior of maximum likelihood estimates under nonstandard conditions. Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability (pp. 221-233). (Berkeley: University of California Press)

Nelson, R., Cohen, R. & Rasmussen, F. (2007). An analysis of pricing strategy and price dispersion on the internet. Eastern Economic Journal, 33, 95-110

Offenberg, J. (2007). Markets: Gift cards. Journal of Economic Perspectives, 21, 227-238

Pan, X., Ratchford, B. & Shankar, V. (2002). Can price dispersion in online markets be explained by differences in e-tailer service quality? Journal of the Academy of Marketing Science, 30, 433-445

Pate, J. (2006). Seller reputation as a determinant of price in online auctions: Theory and evidence from gift card sales. Retrieved March 23, 2010 from Loyola Marymount University Web site: http://myweb.lmu.edu/jpate/research.html

Peters, M. & Severinov, S. (2006). Internet auctions with many traders. Journal of Economic Theory, 130, 220-245

Stahl, D. (1996). Oligopolistic pricing with heterogeneous consumer search. International Journal of Industrial Organization, 14, 243-268

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica, 48, 817–830

Wolinsky, A. (1988). Dynamic markets with competitive bidding. Review of Economic Studies, 55, 71-84

Xing, X. (2008). Does price converge on the internet? Evidence from the online DVD market. Applied Economics Letters, 15, 11-14

Table 1. Summary statistics

Variable	Number of observations	Mean	Standard Deviation
Payment price			
Face value $50	605	45.23	2.40
Face value $100	847	90.22	4.45
Face value $200	231	181.18	9.88
Best Buy	1683	0.49	0.50
Home Depot	1683	0.43	0.50
Wal-Mart	1683	0.08	0.27
Face value $50	1683	0.36	0.48
Face value $100	1683	0.50	0.50
Face value $200	1683	0.14	0.34
Extra promotions	1683	0.43	0.56
Buy It Now	1683	0.36	0.48
Length of auction (in months)	1683	0.09	0.07
Number of bids (in 000s)	1683	0.008	0.007
Seller feedback (in 000s)	1683	0.34	0.82
Negative ratings (in 000s)	1683	0.002	0.004
Payment restrictions	1683	0.63	0.48
Number of items sold on same day	1683	6.16	4.25

Note: All reported prices are inclusive of shipping and handling costs.

Table 2. Measures of Average Dispersion and Price

	price	standardized absolute deviation	standardized range	standard deviation	coefficient of variation
Best Buy $50	45.05	0.02	0.08	1.67	0.04
	(2.15)	(0.03)	(0.08)	(1.75)	(0.05)
Best Buy $100	89.63	0.03	0.07	3.04	0.03
	(4.37)	(0.03)	(0.06)	(2.20)	(0.03)
Best Buy $200	178.29	0.02	0.06	6.12	0.04
	(11.68)	(0.03)	(0.06)	(5.24)	(0.03)
Home Depot $50	45.51	0.03	0.08	2.08	0.05
	(2.83)	(0.04)	(0.09)	(2.05)	(0.05)
Home Depot $100	90.34	0.03	0.08	3.18	0.04
	(4.35)	(0.03)	(0.06)	(2.36)	(0.03)
Home Depot $200	182.78	0.02	0.05	5.42	0.03
	(7.01)	(0.02)	(0.05)	(5.70)	(0.03)
Wal-Mart $50	46.83	0.01	0.04	1.23	0.03
	(4.31)	(0.02)	(0.04)	(1.33)	(0.03)
Wal-Mart $100	92.51	0.01	0.05	3.07	0.03
	(5.15)	(0.02)	(0.04)	(2.98)	(0.03)
Wal-Mart $150	185.99	0.01	0.04	4.60	0.02
	(6.28)	(0.01)	(0.03)	(3.87)	(0.02)

Note: All reported prices are inclusive of shipping and handling costs. Averages are reported with standard deviations in parentheses. The standardized absolute deviation is defined as the absolute difference between a gift card's payment price and the average price on a given day; this measure is divided by the average price for its category (i.e., retailer and face value) on that same day. The standardized range is the difference between the maximum and minimum price within a category on a given day, and it is reported as a fraction of the mean price within a category on that same day. The standard deviation and coefficient of variation are also calculated for each category on a given day.

Table 3. Measures of Price Dispersion from Previous Studies of Online Markets

Study	Data Period	Product Category	Dispersion Measure
Baye, et al. (2004)	2000-2001	consumer electronics	coefficient of variation: 0.09
		consumer electronics	range: 24%
Brynjolfsson and Smith (2000)	1998-1999	books	price range: 33%
		CDs	price range: 25%
Clay, et al. (2001)	1999-2000	books	standard deviation as % of average price: 12.9% - 27.7%
		books	range: 31.9% - 65.2%
Pan, et al. (2002)	2000	books	coefficient of variation: 1.5
		CDs	coefficient of variation: 0.20
		DVDs	coefficient of variation: 0.64
		computer desktop	coefficient of variation: 0.89
		computer laptop	coefficient of variation: 0.27
		PDA	coefficient of variation: 0.66
		software	coefficient of variation: 2.27
		electronics	coefficient of variation: 1.07
Nelson, et al. (2007)	2000	watches	coefficient of variation: 0.12
		copiers	coefficient of variation: 0.18
		games	coefficient of variation: 0.10
		hardcover books	coefficient of variation: 0.19
		paperback books	coefficient of variation: 0.16
		CDs	coefficient of variation: 0.12
		portable audio equipment	coefficient of variation: 0.13
		home audio equipment	coefficient of variation: 0.13
		PDAs	coefficient of variation: 0.13
		computers/monitors	coefficient of variation: 0.07
		cameras	coefficient of variation: 0.09
		computer printers/scanners	coefficient of variation: 0.10
		computer accessories	coefficient of variation: 0.12

Notes: The price range is the difference between the maximum and minimum price within a category; when available, they are reported as a percentage of the mean price. For Pan et al (2002), the coefficient of variation is calculated from the mean and standard deviation reported in Table 1. For Baye, et al. (2004), the statistics are reported for all listings among all product ranks in their dataset; the range was divided by the mean over the whole sample as reported in Table I.

Table 4. OLS Regressions Explaining Measures of Price Dispersion

	(1) Standardized absolute deviation	(2) Standardized range	(3) Coefficient of variation
Best Buy	-0.003	-0.003	-0.003
	(0.002)	(0.007)	(0.004)
Wal-Mart	-0.011**	-0.018*	-0.008+
	(0.002)	(0.008)	(0.005)
face value $100	0.000	-0.008	-0.005
	(0.002)	(0.008)	(0.004)
face value $200	-0.005*	-0.015+	-0.008
	(0.002)	(0.009)	(0.005)
number of items	-0.000	0.006**	-0.000
	(0.000)	(0.001)	(0.001)
holiday	0.001	0.007	0.003
	(0.002)	(0.007)	(0.004)
extra	-0.001		
	(0.001)		
Buy It Now	0.007**		
	(0.002)		
length of auction (in months)	-0.010		
	(0.012)		
number of bids (in 000s)	0.114		
	(0.123)		
seller feedback (in 000s)	-0.003**		
	(0.001)		
negative ratings (in 000s)	0.463+		
	(0.268)		
payment restrictions	-0.001		
	(0.002)		
Observations	1683	406	406
R-squared	0.03	0.12	0.02

Notes: Robust standard errors in parentheses.
+ significant at 10%; * significant at 5%; ** significant at 1%
All reported prices are inclusive of shipping and handling costs. The omitted retailer is Home Depot, and the omitted face value is $50. The standardized absolute deviation is defined as the absolute difference between a gift card's payment price and the average price on a given day; this measure is divided by the average price for its category (i.e., retailer and face value) on that same day. The standardized range is the difference between the maximum and minimum price within a category on a given day, and it is reported as a fraction of the mean price within a category for that same day. Note that the absolute deviation is calculated for each gift card in our sample. The range and coefficient of variation are calculated for each day in our sample.