Left-Digit Bias, Investor Attention and Trading Behavior

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Abstract

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We show left-digit bias in stock-selling behavior of individual investors. Left-digit bias is the tendency to focus on the leftmost digit of a number while partially ignoring other digits (Poltrock and Schwartz, 1984). Our contribution is to show that investors are disproportionately attentive to the leftmost digit in their trading choices, the salience of prices matters for investment choices (is this what we think is going on? This is similar to the rank effect finding of Hartzmark (2015), whereby either top-ranked or bottom-ranked stocks by return since purchase are those most likely to be sold. We contribute to the broader literature on left-digit bias, including Lacetera et al. (2012) and Shlain (2018). Our study contributes to our understanding of when and why investors sell stocks.

1 Data and Sample Selection

We use the Barclays data. We first do some basic data cleaning, with details shown in Table 3.

We then choose a sample for analysis. A key element in our analysis is to draw a price increasing sample and a price decreasing sample, because we will show that the probability of sale increases with a change in the left digit both from below and from above.

We define these samples as follows. First, using the example of price increasing, we identify the first day in each calendar quarter on which an investor made a login to their account. We then define the price increasing sample as the set of login days within the quarter for which the prices on subsequent login days were always above the price on the first day and the left-digit had changed within the quarter on at least one subsequent login-day. We define the price decreasing sample as the set of login days within the quarter for which the prices on subsequent login days were always below the price on the first day and the left-digit had changed within the quarter on at least one subsequent login-day. Our samples are based on quarters and individual \times login days during the quarter. Due to the immense size of the data, we further restrict to a 30% random sample.

The idea behind this sample restriction is that we need to focus on changes in left-digit that the investor actually saw. By restricting to changes in the left digit as seen by investors on login-days, we know that the investor saw the below-price and then subsequently the above-price (or vice versa).

We show later that results are unchanged when we modify the period that defines a sample to either a month or a year.

Summary statistics are shown in Table 4. Note, there are four units of left-digit in the data, pennies, tens of pennies, pounds and tens of pounds (there are only a few cases of hundreds of pounds). So, the left-digit changes of interest are pence to tens of pence, tens of pence to pounds, and pounds to tens of pounds (plus a few cases of tens of pounds to hundreds of pounds). Most stocks in the samples are prices in the range £1.10 to £10.10. A histogram of prices for all investor \times login days is shown in Figure A1.

2 Results

Our main result is shown in Figure 2. The figure stack all investor \times stock \times login days by the leftmost two digits. The figure plots in the left-side the probability of sale by leftmost digits, and in the right-side it plots the probability of sale by the leftmost two digits. For example, the left-side plot stacks up stocks which pass from 9 pence to 10 pence, 29 pence to 30 pence, 199 pence to 200 pence, and so on in every case in which the leftmost digit changes. These examples each enter the plot at X9 to Y0, where X and Y are integer units and Y = X + 1. The left-side plots show clear jumps in the probability of sale when the stock price crosses the leftmost digit; the right-side plots also show this phenomena, with the red bar denoting base 10 leftmost two digit prices. In Panel A there is a jump in probability of sale when the price crosses the left digit from below, e.g. 19 pence to 20 pence; in Panel B there is a jump when the price crosses the left digit from above, e.g. 20 pence to 19 pence. Note that in general the probability of sale is higher in the price increasing sample than in the price decreasing sample, consistent with the disposition effect. Figure 3 and Figure 4 show that the left-digit effect occurs in each of the pennies, pounds and tens of pounds samples.

We estimate the size of the left-digit effect in Table 5 and Table 6. The regression setup is a discontinuity regression which pools all of the observations from the sample (increasing or decreasing) and regresses the probability of sale against a dummy for the price being above the left-digit change, plus continuous controls for the leftmost two digits below and above the left-digit change. The coefficient in Column 2 implies that a stock that has crossed the left-digit from below is 50% more likely to be sold. The coefficient value is stable across specifications, including a rich specification in Column 5 that includes day, industry, account, and stock fixed effects. That specification therefore exploits within-investor, within-stock variation in the probability of sale, conditioning on day differences in the likelihood of sale. In the price-decreasing sample the coefficient estimate in Column 1 implies a 25% increase in probability of sale when the left-digit changes from above (note the coefficient are negative, reporting the effect of a change from below). Table A1 and Table A2 report regressions from the subsamples by pennies, pounds and tens of pounds.

2.1 Robustness

We test for a variety of robustness concerns

- Limit orders. The effect we see might in some cases be due to limit orders set at left-digit changes. However, while the strike price of the limit order would be at exactly the left-digit change, we see an elevated probability of sale across the range Y0 to Y5.
- Sample selection. We might be worried that our results are somehow due to sample selection. Therefore, we conduct a simulation analysis in which we assign sales randomly to investor × stock × days in each sample. Figure A2 shows that with randomly allocated sales we see no evidence of discontinuity in the probability of sale when the leftmost

- digit changes.
- Quarter time period. One might worry that this also somehow creates a selection effect.
 We therefore conduct the same analysis, with the same results, on samples where the time period is defined as a month in Figure A3 and as a year in Figure A4. See Table A3 for summary statistics and Table A4 and Table A5 for regression estimates.
- Sell-day sample. We see the same result in the sell-day sample in Figure A5, with again
 the same patterns in sub-samples by pennies, pounds and tens of pounds in Figure A6
 and Figure A7. See Table A6 and Table A7 for regression estimates, plus Table A8 and
 Table A9 for regression estimates using the sub-samples by pennies, pounds and tens of
 pounds.

2.2 Investor Characteristics

We use sample splits and test for differences in the left-digit effect by various investor characteristics

- Age: stronger among younger investors (Table 7).
- Gender: no differences (Table 8).
- Portfolio value: stronger among small portfolios (Table 9).
- Tenure: stronger among younger accounts (Table 10).
- Number of Stocks: stronger with fewer stocks (Table 11).

3 Possible Extensions

We should look at the robustness tests used by Hartzmark (2015) as some may be applicable here.

Can we say something about aggregate effects on investor behavior? The effect size in the regressions in very large, so maybe we see some aggregate effects? Other angles?

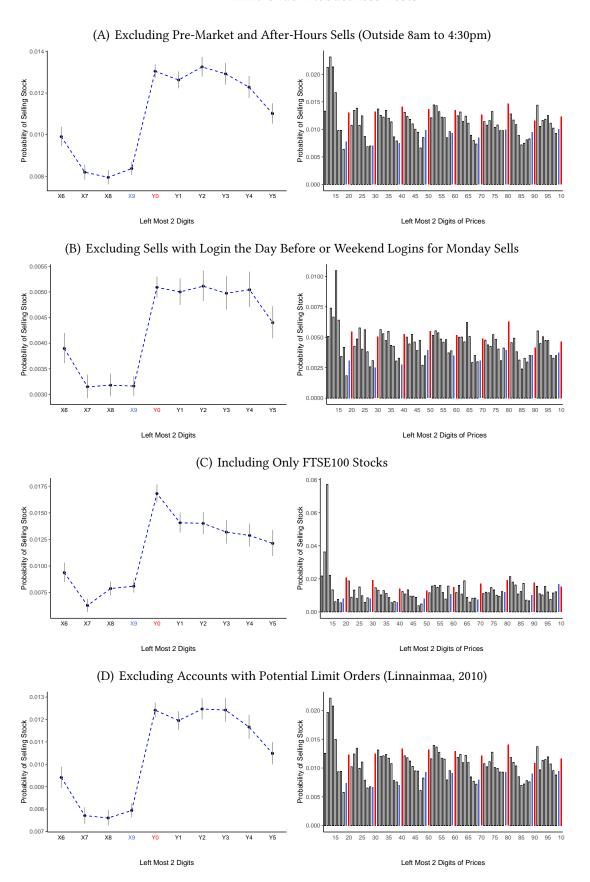
EQ:[but note that these analysis only work when we use login days. Using market days there is no pattern at all. So any aggregate analysis has to be restricted to login days.]

EQ: Effects on volume: New results looking at volume and left digits do not show consistent patterns. There are jumps in volume when the stock crosses a left digit. But there are many more other jumps that happen across the different prices' trajectories that obscure any estimation of the left digit effects. Note also that there is no an indicator of "sells" volume only—I imagine that this is because any sell of an stock tacitly implies also a purchase of that stock.

EQ: Additional exclusion to identify limit orders: Linnainmaa (2010) develops a method to detect limit orders in a data set. Note that for a limit order to be executed, the stock price has to move against the order. Individuals who are net buyers when the stock

price falls, and net sellers when the stock price rises, are likely limit-order traders. Market-order traders often trade in the opposite direction. By regressing a buy-versus-sell indicator (a dependent variable that takes the value of one when an investor sells a stock and the value of zero when an investor purchases a stock) against the daily return of an stock, for each investor, it is possible to detect investors using limit orders. The daily return coefficient is significantly positive for limit-order trades, but significantly negative for market-order trades (individuals who submit market orders often trade in the direction of the same-day return). We followed the same procedure and estimated return coefficients for each investor. To obtain reliable estimates, we included only investors with at least 10 trades, as in Linnainmaa (2010). Panel D excluded all investors with a positive and significant coefficient, 3,021 investors.

Figure 1: Leftmost Stock Price Digit and Probability of Sale,
Prices Increasing Sample
Limit Order Robustness Tests



Note: £Y in the X-axes is equivalent to £X + 1 (e.g., £X9 could include £0.19, £1.9, £19, etc., while £Y0 could include £0.20, £2.0, £20, etc.). Panels A, B and C show equal size θ ins of 1p, 10p and £1, respectively. Panel A drops 0.018% of sells, Panel B drops 61% of sells, Panel C drops 76% of sells, and Panel D drops 11% of sells.

Table 1: Price Increasing Sample Limit Order Robustness Tests

Panel (A): Excluding Pre-Market and After-Hours Sells (Outside 8am to 4:30pm)

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0042***	0.0052***	0.0047***	0.0052***	0.0059***		
, ,	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Stock Digits Y0 to Y5		-0.0003***	-0.0004***	-0.0005***	-0.0007***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		-0.0004***	-0.0002**	-0.0002**	-0.0001		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0085***	0.0080***	0.0081***				
	(0.0002)	(0.0002)	(0.0011)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	2,502,898	2,502,898	2,502,898	2,502,898	2,502,898		
R^2	0.0004	0.0004	0.0017	0.0654	0.0715		

Panel (B): Excluding Sells with Login the Day Before or Weekend Logins for Monday Sells

		Proba	bility of Sale	$e_{ijt} = 1$	
	(1)	(2)	(3)	(4)	(5)
Above Y0 = 1 (in Range Y0 to Y5)	0.0017***	0.0021***	0.0020***	0.0024***	0.0026***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits Y0 to Y5		-0.0001**	-0.0001***	-0.0002***	-0.0003***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Stock Digits X6 to X9		-0.0002***	-0.0002***	-0.0002***	-0.0001**
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	0.0033***	0.0031***	0.0011**		
	(0.0001)	(0.0001)	(0.0005)		
Day FE	NO	NO	YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Account FE	NO	NO	NO	YES	YES
Stock FE	NO	NO	NO	NO	YES
Observations	2,486,072	2,486,072	2,486,072	2,486,072	2,486,072
\mathbb{R}^2	0.0002	0.0002	0.0015	0.0589	0.0626

Note: Panels A, B and C show equal size bins of 1p, 10p and £1, respectively. Panel A drops 0.018% of sells, Panel B drops 61% of sells, Panel C drops 76% of sells, and Panel D drops 11% of sells.

Table 2: Price Increasing Sample Limit Order Robustness Tests

Panel (C): Including Only FTSE100 Stocks

	$Probability \ of \ Sale_{ijt} = 1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	0.0066***	0.0083***	0.0081***	0.0090***	0.0092***	
	(0.0003)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	
Stock Digits Y0 to Y5	(,	-0.0009***	-0.0009***	-0.0008***	-0.0009***	
8		(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Stock Digits X6 to X9		-0.0000	-0.0000	-0.0004**	-0.0004**	
C		(0.0002)	(0.0002)	(0.0002)	(0.0002)	
Constant	0.0078***	0.0078***	0.0251***	,	,	
	(0.0003)	(0.0003)	(0.0018)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	579,637	579,637	579,637	579,637	579,637	
R^2	0.0009	0.0011	0.0023	0.0994	0.1000	
Panel (D): Excluding Acco	ounts with P	otential Limi	t Orders (Lin	nainmaa, 20	10)	
		Proba	bility of Sal	$e_{ijt} = 1$		
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	0.0040***	0.0049***	0.0045***	0.0050***	0.0056***	
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	
Stock Digits Y0 to Y5		-0.0003***	-0.0004***	-0.0005***	-0.0007***	
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Stock Digits X6 to X9		-0.0004***	-0.0002**	-0.0002**	-0.0002*	
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Constant	0.0081***	0.0076***	0.0072***			
	(0.0002)	(0.0002)	(0.0010)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	2,346,934	2,346,934	2,346,934	2,346,934	2,346,934	
\mathbb{R}^2	0.0004	0.0004	0.0016	0.0678	0.0736	

Note: Panels A, B and C show equal size bins of 1p, 10p and £1, respectively. Panel A drops 0.018% of sells, Panel B drops 61% of sells, Panel C drops 76% of sells, and Panel D drops 11% of sells.

Figure 2: Leftmost Stock Price Digit and Probability of Sale, Quarterly Sample

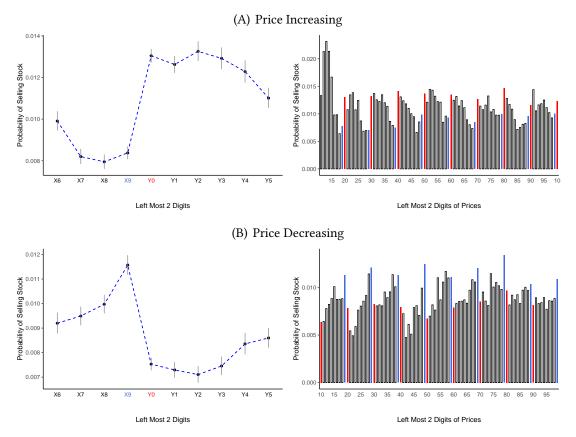
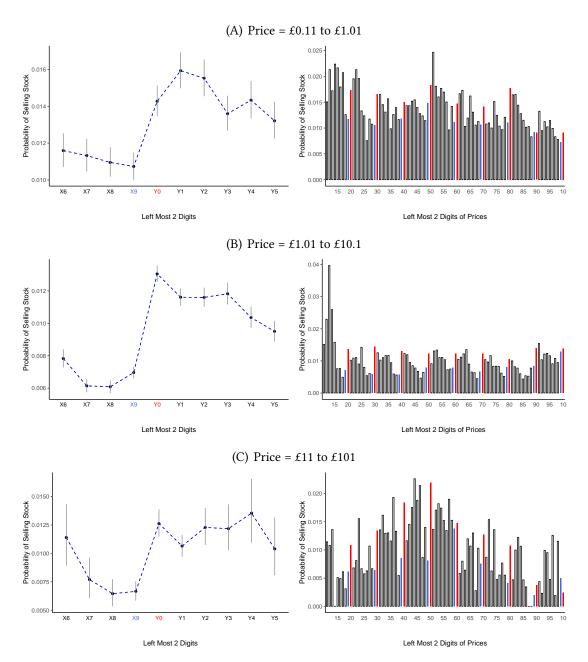
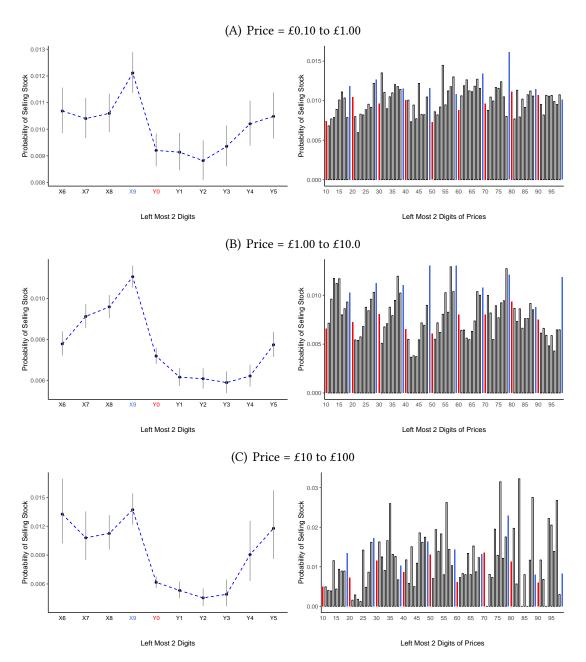


Figure 3: Leftmost Stock Price Digit and Probability of Sale Prices Increasing Sample by Price Range



Note: £Y in the X-axes is equivalent to £X + 1 (e.g., £X9 could include £0.19, £1.9, £1.9, £1.9, etc., while £Y0 could include £0.20, £2.0, £20, etc.). Panels A, B and C show equal size bins of 1p, 10p and £1, respectively. Panel A corresponds to 25% of the observations in the prices increasing sample; Panel B, to 55%; and Panel C, to 8%.

Figure 4: Leftmost Stock Price Digit and Probability of Sale Prices Decreasing Sample by Price Range



Note: £Y in the X-axes is equivalent to £X + 1 (e.g., £X9 could include £0.19, £1.9, £19, etc., while £Y0 could include £0.20, £2.0, £20, etc.). Panels A, B and C show equal size bins of 1p, 10p and £1, respectively. Panel A corresponds to 27% of the observations in the prices decreasing sample; Panel B, to 43%; and Panel C, to 7%.

Table 3: Sample Selection

	Accounts	Login-Days	Transaction-Days	Sell-Days
Unrestricted Sample	45919	67734059	1228755	493041
Drop due to:				
Inactive Accounts	14370	7932474	46982	19562
Unmatched Prices	306	13009351	129314	49012
At Least Two Stocks in Portfolio	3062	720291	76539	32652
Missing Demographic Data	1137	1793831	37427	16400
Starting Position Days	23	367341	331557	25479
Baseline sample	27021	43910771	606936	349936

 $\it Note:$ The unrestricted sample contains 155,300 accounts. We use a 30% random sample of accounts. The table detail the steps in sample selection.

Table 4: Summary Stats, Quarterly Sample

Panel (A): Baseline Sample

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Price on Login Days £	43,910,771	7.946	26.271	0.000	1.153	3.050	7.642	15,051.630
Price on Sell Days £	3,348,713	7.152	25.799	0.000	0.831	2.645	6.680	3,589.000
Price of Stocks Sold £	349,936	7.322	29.887	0.000	0.856	2.689	6.717	2,057.301

Panel (B): Price Increasing Sample

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
All Stocks	2,502,903	6.437	23.513	0.000	0.739	2.992	6.175	3,600.000
Stocks with Prices Between £0.11 to £1.01	616,769	0.599	0.256	0.110	0.382	0.628	0.811	1.010
Stocks with Prices Between £1.1 to £10.1	1,370,707	4.890	2.310	1.100	2.954	4.570	6.600	10.100
Stocks with Prices Between £11 to £101	192,406	35.681	22.229	11.000	19.720	29.780	48.040	100.995

Panel (C): Price Decreasing Sample

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
All Stocks	2,528,282	4.263	20.405	0.000	0.165	1.025	4.513	3,284.000
Stocks with Prices Between £0.10 to £1.0	688,845	0.511	0.270	0.100	0.275	0.485	0.750	1.000
Stocks with Prices Between £1 to £10	1,096,158	4.517	2.508	1.000	2.366	4.135	6.231	10.000
Stocks with Prices Between £10 to £100	180,327	25.818	18.967	10.000	10.940	20.900	30.370	99.990

Table 5: Probability of Sale and Left Digit, Price Increasing Sample

		Proba	bility of Sale	$e_{ijt} = 1$	
	(1)	(2)	(3)	(4)	(5)
Above Y0 = 1 (in Range Y0 to Y5)	0.0042***	0.0052***	0.0047***	0.0052***	0.0058***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Stock Digits Y0 to Y5		-0.0003***	-0.0004***	-0.0005***	-0.0007***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits X6 to X9		-0.0004***	-0.0002**	-0.0002**	-0.0001
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	0.0085***	0.0080***	0.0081***		
	(0.0002)	(0.0002)	(0.0011)		
Day FE	NO	NO	YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Account FE	NO	NO	NO	YES	YES
Stock FE	NO	NO	NO	NO	YES
Observations	2,502,903	2,502,903	2,502,903	2,502,903	2,502,903
\mathbb{R}^2	0.0004	0.0004	0.0017	0.0654	0.0715

Table 6: Probability of Sale and Left Digit, Price Decreasing Sample

		Probal	bility of Sale	$e_{ijt} = 1$	
	(1)	(2)	(3)	(4)	(5)
Above Y0 = 1 (in Range Y0 to Y5)	-0.0025***	-0.0040***	-0.0043***	-0.0039***	-0.0039***
Stock Digits Y0 to Y5	(0.0002)	(0.0002) 0.0002***	(0.0002) 0.0002***	(0.0002) $0.0004***$	(0.0003) $0.0004***$
Stock Digits X6 to X9		(0.0000) 0.0008***	(0.0000) 0.0008***	(0.0000) 0.0005***	(0.0001) 0.0006***
<u> </u>		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	0.0102*** (0.0003)	0.0112*** (0.0003)	0.0154*** (0.0017)		
Day FE	NO	NO	YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Account FE	NO	NO	NO	YES	YES
Stock FE	NO	NO	NO	NO	YES
Observations	2,528,282	2,528,282	2,528,282	2,528,282	2,528,282
\mathbb{R}^2	0.0002	0.0002	0.0004	0.0678	0.0737

Table 7: Probability of Sale and Left Digit, Splitting by Median Age

	Prices Increa	asing Sample	Prices Decre	asing Sample
	Below Median	Above Median	Below Median	Above Median
Above Y0 = 1 (in Range Y0 to Y5)	0.0071***	0.0045***	-0.0037***	-0.0042***
	(0.0004)	(0.0003)	(0.0003)	(0.0004)
Stock Digits Y0 to Y5	-0.0009***	-0.0006***	0.0004***	0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits X6 to X9	-0.0003**	-0.0000	0.0007***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Day FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Account FE	YES	YES	YES	YES
Stock FE	YES	YES	YES	YES
Observations	1,346,559	1,156,344	1,391,135	1,137,147
\mathbb{R}^2	0.0850	0.0520	0.0890	0.0544

Table 8: Probability of Sale and Left Digit, Splitting by Gender

	Prices Incre	asing Sample	Prices Decre	easing Sample
	Female	Male	Female	Male
Above Y0 = 1 (in Range Y0 to Y5)	0.0056***	0.0059***	-0.0040***	-0.0039***
	(0.0005)	(0.0003)	(0.0006)	(0.0003)
Stock Digits Y0 to Y5	-0.0006***	-0.0008***	0.0004***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits X6 to X9	-0.0003	-0.0001	0.0007***	0.0005***
	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Day FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Account FE	YES	YES	YES	YES
Stock FE	YES	YES	YES	YES
Observations	429,057	2,073,846	401,271	2,127,011
\mathbb{R}^2	0.0731	0.0730	0.0774	0.0749

Table 9: Probability of Sale and Left Digit, Splitting by Portfolio Value

	Prices Increa	asing Sample	Prices Decre	asing Sample
	Below Median	Above Median	Below Median	Above Median
Above Y0 = 1 (in Range Y0 to Y5)	0.0083***	0.0032***	-0.0046***	-0.0031***
	(0.0004)	(0.0003)	(0.0004)	(0.0004)
Stock Digits Y0 to Y5	-0.0010***	-0.0004***	0.0004***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits X6 to X9	-0.0002*	-0.0001	0.0008***	0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Day FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Account FE	YES	YES	YES	YES
Stock FE	YES	YES	YES	YES
Observations	1,355,866	1,147,037	1,408,129	1,120,153
\mathbb{R}^2	0.0987	0.0465	0.1054	0.0457

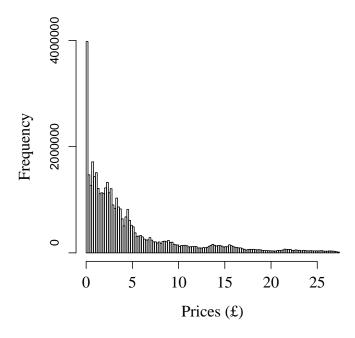
Table 10: Probability of Sale and Left Digit, Splitting by Account Tenure

	Prices Increa	asing Sample	Prices Decreasing Sample		
	Below Median	Above Median	Below Median	Above Median	
Above Y0 = 1 (in Range Y0 to Y5)	0.0069***	0.0048***	-0.0045***	-0.0034***	
	(0.0004)	(0.0003)	(0.0003)	(0.0004)	
Stock Digits Y0 to Y5	-0.0009***	-0.0006***	0.0005***	0.0003***	
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Stock Digits X6 to X9	-0.0002	-0.0001	0.0006***	0.0005***	
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Day FE	YES	YES	YES	YES	
Industry FE	YES	YES	YES	YES	
Account FE	YES	YES	YES	YES	
Stock FE	YES	YES	YES	YES	
Observations	1,235,268	1,267,635	1,280,279	1,248,003	
\mathbb{R}^2	0.0823	0.0607	0.0822	0.0670	

Table 11: Probability of Sale and Left Digit, Splitting by Number of Stocks

	Prices Increa	asing Sample	Prices Decre	asing Sample
	Below Median	Above Median	Below Median	Above Median
Above $Y0 = 1$ (in Range $Y0$ to $Y5$)	0.0084***	0.0028***	-0.0044***	-0.0034***
, ,	(0.0003)	(0.0003)	(0.0004)	(0.0003)
Stock Digits Y0 to Y5	-0.0011***	-0.0003***	0.0004***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Digits X6 to X9	-0.0002*	-0.0001	0.0008***	0.0002*
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Day FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Account FE	YES	YES	YES	YES
Stock FE	YES	YES	YES	YES
Observations	1,420,565	1,082,338	1,343,898	1,184,384
\mathbb{R}^2	0.0893	0.0336	0.0946	0.0372

Figure A1: Histogram of Stock Prices



Note: Figure shows the histogram of prices on login days. Outliers above the 95 percentile are excluded.

Figure A2: Sample Selection and Simulation Exercise

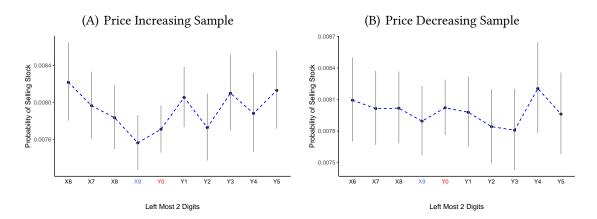


Figure A3: Leftmost Stock Price Digit and Probability of Sale, Monthly Sample

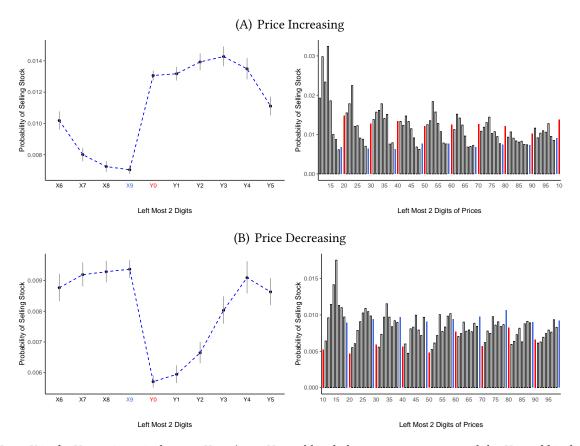


Figure A4: Leftmost Stock Price Digit and Probability of Sale, Annual Sample

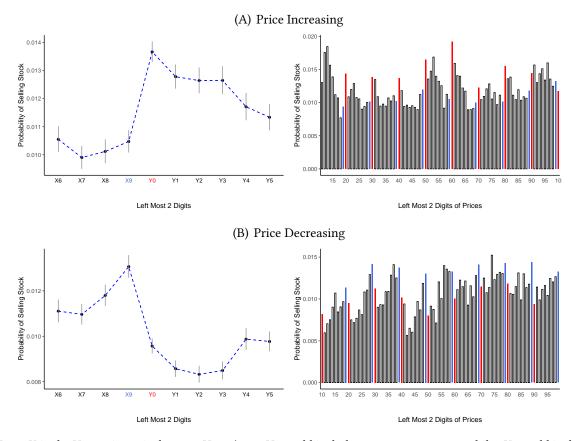


Figure A5: Leftmost Stock Price Digit and Probability of Sale, Sell Days

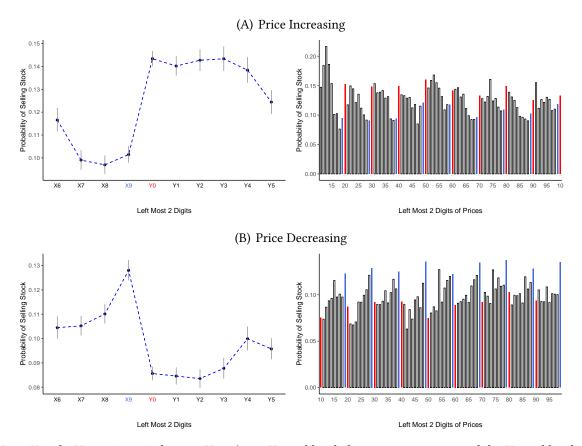
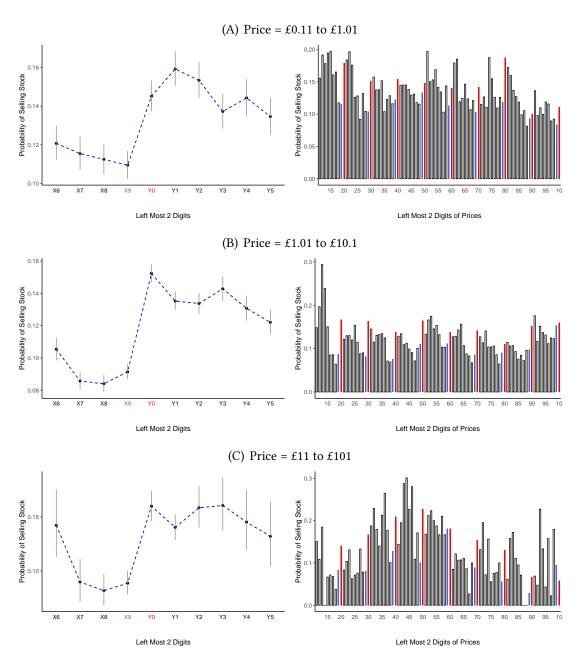
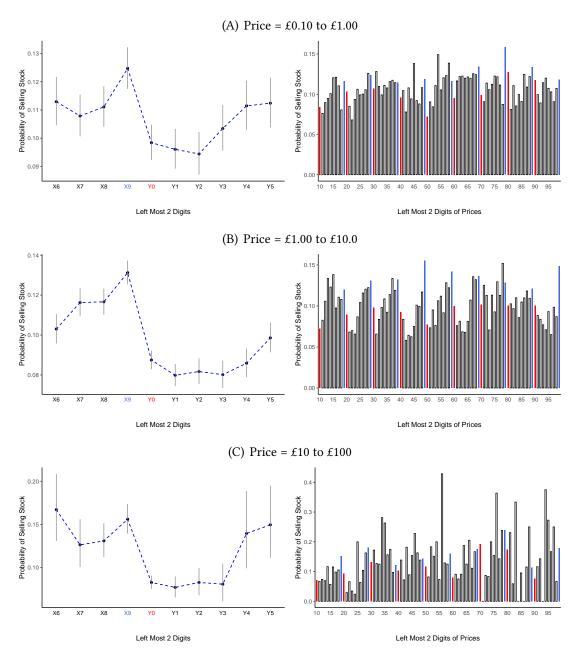


Figure A6: Leftmost Stock Price Digit and Probability of Sale, Sell Days Prices Increasing Sample by Price Range



Note: £Y in the X-axes is equivalent to £X + 1 (e.g., £X9 could include £0.19, £1.9, £19, etc., while £Y0 could include £0.20, £2.0, £20, etc.). Panels A, B and C show equal size bins of 1p, 10p and £1, respectively.

Figure A7: Leftmost Stock Price Digit and Probability of Sale, Sell Days Prices Decreasing Sample by Price Range



Note: £Y in the X-axes is equivalent to £X + 1 (e.g., £X9 could include £0.19, £1.9, £19, etc., while £Y0 could include £0.20, £2.0, £20, etc.). Panels A, B and C show equal size bins of 1p, 10p and £1, respectively.

Table A1: Price Increasing Subsamples with Equal Prices Bins

Panel	(A): Price	= £0.11	to £1.01
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	Probability of $Sale_{ijt} = 1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0034***	0.0045***	0.0041***	0.0044***	0.0043***		
	(0.0003)	(0.0005)	(0.0005)	(0.0005)	(0.0005)		
Stock Digits Y0 to Y5		-0.0003**	-0.0003***	-0.0004***	-0.0005***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		-0.0003	-0.0001	-0.0003	-0.0003		
		(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Constant	0.0111***	0.0107***	0.0216***				
	(0.0004)	(0.0004)	(0.0043)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	616,769	616,769	616,769	616,769	616,769		
R^2	0.0002	0.0002	0.0014	0.0988	0.1076		

Panel (B): Price = £1.01 to £10.1

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0049*** (0.0002)	0.0063*** (0.0003)	0.0061*** (0.0003)	0.0061*** (0.0003)	0.0064*** (0.0003)		
Stock Digits Y0 to Y5	(0.0002)	-0.0006***	-0.0007***	-0.0006***	-0.0007***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		-0.0001	-0.0001	-0.0001	-0.0001		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0067***	0.0065***	0.0164***				
	(0.0002)	(0.0002)	(0.0041)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	1,370,707	1,370,707	1,370,707	1,370,707	1,370,707		
R ²	0.0006	0.0007	0.0020	0.0716	0.0751		

Panel (C): Price = £11 to £101

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0046***	0.0055***	0.0057***	0.0073***	0.0080***		
, ,	(0.0005)	(0.0006)	(0.0006)	(0.0007)	(0.0008)		
Stock Digits Y0 to Y5		-0.0000	-0.0001	0.0002	0.0002		
		(0.0002)	(0.0002)	(0.0003)	(0.0003)		
Stock Digits X6 to X9		-0.0011***	-0.0014***	-0.0012***	-0.0012***		
		(0.0004)	(0.0004)	(0.0004)	(0.0004)		
Constant	0.0072***	0.0063***	-0.0017**				
	(0.0004)	(0.0005)	(0.0008)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	192,406	192,406	192,406	192,406	192,406		
\mathbb{R}^2	0.0005	0.0005 28	0.0028	0.1330	0.1391		

Table A2: Price Decreasing Subsamples with Equal Prices Bins

Panel	(A): Ì	Price	= £0.10	to £1.00
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	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0034***	0.0045***	0.0041***	0.0044***	0.0043***		
· · · · · ·	(0.0003)	(0.0005)	(0.0005)	(0.0005)	(0.0005)		
Stock Digits Y0 to Y5		-0.0003**	-0.0003***	-0.0004***	-0.0005***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		-0.0003	-0.0001	-0.0003	-0.0003		
		(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Constant	0.0111***	0.0107***	0.0216***				
	(0.0004)	(0.0004)	(0.0043)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	616,769	616,769	616,769	616,769	616,769		
R^2	0.0002	0.0002	0.0014	0.0988	0.1076		

Panel (B): Price = £1.00 to £10.0

	Probability of $Sale_{ijt} = 1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	-0.0030***	-0.0043***	-0.0046***	-0.0046***	-0.0043***		
Stock Digits Y0 to Y5	(0.0002)	(0.0003) -0.0000	(0.0003) 0.0000	(0.0003) $0.0004***$	(0.0004) 0.0003***		
Stock Digits X6 to X9		(0.0001) 0.0010***	(0.0001) 0.0010***	(0.0001) 0.0005***	(0.0001) 0.0006***		
C	0.000/***	(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0096*** (0.0003)	0.0109*** (0.0004)	0.0234* (0.0135)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	1,096,158	1,096,158	1,096,158	1,096,158	1,096,158		
R ²	0.0003	0.0004	0.0008	0.0843	0.0905		

Panel (C): Price = £10 to £100

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	-0.0066***	-0.0075***	-0.0068***	-0.0060***	-0.0051***		
	(0.0007)	(0.0009)	(0.0009)	(0.0009)	(0.0011)		
Stock Digits Y0 to Y5		0.0003	0.0005**	0.0006***	0.0003		
		(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Stock Digits X6 to X9		0.0006	0.0010*	0.0001	0.0005		
		(0.0005)	(0.0005)	(0.0005)	(0.0006)		
Constant	0.0125***	0.0131***	0.0062***				
	(0.0007)	(0.0009)	(0.0011)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	180,327	180,327	180,327	180,327	180,327		
\mathbb{R}^2	0.0011	0.0011 29	0.0034	0.1437	0.1511		

Table A3: Summary Stats for Annual and Monthly Samples

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Monthly Increasing Sample	2,224,458	5.646	26.950	0.000	0.561	2.735	6.060	3,600.000
Monthly Decreasing Sample	2,644,657	4.822	24.815	0.000	0.205	1.008	5.083	3,453.000
Annual Increasing Sample	2,351,131	8.338	24.526	0.000	1.073	3.672	7.350	3,600.000
Annual Decreasing Sample	2,172,299	4.084	21.423	0.000	0.155	1.077	4.256	2,062.035

Table A4: Price Increasing Samples, Monthly and Annual Samples

Panel (A): Monthly Sample

	Probability of $Sale_{ijt} = 1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0055***	0.0066***	0.0061***	0.0064***	0.0070***		
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Stock Digits Y0 to Y5		-0.0001	-0.0002***	-0.0005***	-0.0008***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		-0.0009***	-0.0005***	-0.0002*	-0.0001		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0077***	0.0068***	0.0106***				
	(0.0002)	(0.0002)	(0.0019)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	2,224,458	2,224,458	2,224,458	2,224,458	2,224,458		
\mathbb{R}^2	0.0007	0.0007	0.0017	0.0625	0.0692		

Panel (B): Annual Sample

	Probability of $Sale_{ijt} = 1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0024***	0.0033***	0.0030***	0.0038***	0.0044***		
	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)		
Stock Digits Y0 to Y5		-0.0004***	-0.0005***	-0.0005***	-0.0007***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		0.0000	0.0001	-0.0001	-0.0001		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0103***	0.0103***	0.0079***				
	(0.0002)	(0.0003)	(0.0011)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	2,351,131	2,351,131	2,351,131	2,351,131	2,351,131		
\mathbb{R}^2	0.0001	0.0001	0.0026	0.0753	0.0819		

Table A5: Price Decreasing Samples, Monthly and Annual Samples

Panel (A): Monthly Sample

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	-0.0025***	-0.0038***	-0.0041***	-0.0041***	-0.0043***		
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)		
Stock Digits Y0 to Y5		0.0007***	0.0007***	0.0007***	0.0006***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Stock Digits X6 to X9		0.0002*	0.0003***	0.0002**	0.0004***		
		(0.0001)	(0.0001)	(0.0001)	(0.0001)		
Constant	0.0092***	0.0094***	0.0149***				
	(0.0003)	(0.0003)	(0.0015)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	2,644,657	2,644,657	2,644,657	2,644,657	2,644,657		
\mathbb{R}^2	0.0002	0.0003	0.0006	0.0577	0.0625		

Panel ((B):	Annual	Sample

	$Probability\ of\ Sale_{ijt}=1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	-0.0027***	-0.0038***	-0.0041***	-0.0031***	-0.0029***	
, ,	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	
Stock Digits Y0 to Y5		0.0001	0.0000	0.0003***	0.0003***	
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Stock Digits X6 to X9		0.0007***	0.0008***	0.0004***	0.0004***	
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	
Constant	0.0118***	0.0128***	0.0157***			
	(0.0003)	(0.0004)	(0.0016)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	2,172,299	2,172,299	2,172,299	2,172,299	2,172,299	
\mathbb{R}^2	0.0002	0.0002	0.0005	0.0806	0.0870	

Table A6: Probability of Sale and Left Digit, Price Increasing Sample, Sell Days

		Proba	bility of Sal	$e_{ijt} = 1$	
	(1)	(2)	(3)	(4)	(5)
Above Y0 = 1 (in Range Y0 to Y5)	0.0375*** (0.0023)	0.0469***	0.0439*** (0.0030)	0.0383***	0.0423*** (0.0030)
Stock Digits Y0 to Y5	(0.0023)	-0.0025***	-0.0031***	-0.0031***	-0.0049***
		(0.0006)	(0.0006)	(0.0006)	(0.0006)
Stock Digits X6 to X9		-0.0038***	-0.0023**	-0.0018*	-0.0014
0 1 1	0.1005***	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Constant	0.1025*** (0.0041)	0.0977*** (0.0042)	0.0965*** (0.0120)		
Day FE	(0.0041) NO	(0.0042) NO	(0.0120) YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Account FE	NO	NO	NO	YES	YES
Stock FE	NO	NO	NO	NO	YES
Observations	218,875	218,875	218,875	218,875	218,875
\mathbb{R}^2	0.0030	0.0032	0.0109	0.2457	0.2764

Table A7: Probability of Sale and Left Digit, Price Decreasing Sample, Sell Days

	$Probability\ of\ Sale_{ijt}=1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	-0.0246***	-0.0403***	-0.0424***	-0.0326***	-0.0319***	
Stock Digits Y0 to Y5	(0.0017)	(0.0026) 0.0025***	(0.0026) 0.0025***	(0.0026) 0.0033***	(0.0027) 0.0037***	
Stock Digits X6 to X9		(0.0006) 0.0080***	(0.0006) 0.0084***	(0.0005) 0.0043***	(0.0006) 0.0039***	
Comptont	0.1129***	(0.0011) 0.1237***	(0.0011) 0.1466***	(0.0010)	(0.0010)	
Constant	(0.0034)	(0.0039)	(0.0123)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	222,138	222,138	222,138	222,138	222,138	
\mathbb{R}^2	0.0016	0.0021	0.0034	0.2228	0.2511	

Table A8: Price Increasing Subsamples with Equal Prices Bins, Sell Days

Panel (A): Price = £0.11 to £1.01

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	0.0323***	0.0438***	0.0402***	0.0237***	0.0204***		
	(0.0035)	(0.0049)	(0.0049)	(0.0049)	(0.0049)		
Stock Digits Y0 to Y5		-0.0029**	-0.0028**	-0.0021*	-0.0023**		
		(0.0013)	(0.0013)	(0.0012)	(0.0012)		
Stock Digits X6 to X9		-0.0036*	-0.0019	-0.0015	-0.0017		
		(0.0019)	(0.0019)	(0.0020)	(0.0021)		
Constant	0.1139***	0.1090***	0.2047***				
	(0.0062)	(0.0068)	(0.0330)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	60,807	60,807	60,807	60,807	60,807		
\mathbb{R}^2	0.0022	0.0024	0.0154	0.3453	0.3763		

Panel (B): Price = £1.01 to £10.1

	$Probability\ of\ Sale_{ijt}=1$				
	(1)	(2)	(3)	(4)	(5)
Above Y0 = 1 (in Range Y0 to Y5)	0.0478***	0.0605***	0.0587***	0.0459***	0.0478***
Stock Digits Y0 to Y5	(0.0030)	(0.0042) -0.0047***	(0.0042)	(0.0039) -0.0035***	(0.0039) -0.0048***
Stock Digits X6 to X9		(0.0009) -0.0029**	(0.0010) -0.0020	(0.0009) -0.0015	(0.0009) -0.0009
Constant	0.0905***	(0.0014) 0.0870***	(0.0014) 0.1290***	(0.0013)	(0.0014)
	(0.0039)	(0.0041)	(0.0305)		
Day FE	NO	NO	YES	YES	YES
Industry FE	NO	NO	YES	YES	YES
Account FE	NO	NO	NO	YES	YES
Stock FE	NO	NO	NO	NO	YES
Observations	108,807	108,807	108,807	108,807	108,807
\mathbb{R}^2	0.0053	0.0057	0.0135	0.3002	0.3192

Panel (C): Price = £11 to £101

	$Probability \ of \ Sale_{ijt} = 1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	0.0586***	0.0710***	0.0681***	0.0490***	0.0508***	
, ,	(0.0064)	(0.0080)	(0.0080)	(0.0092)	(0.0100)	
Stock Digits Y0 to Y5		-0.0022	-0.0027	0.0042	0.0048	
-		(0.0029)	(0.0028)	(0.0032)	(0.0033)	
Stock Digits X6 to X9		-0.0107**	-0.0123***	-0.0077	-0.0060	
		(0.0043)	(0.0043)	(0.0049)	(0.0051)	
Constant	0.0918***	0.0828***	-0.0072			
	(0.0052)	(0.0060)	(0.0126)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	15,031	15,031	15,031	15,031	15,031	
R^2	0.0071	0.0075 35	0.0277	0.4586	0.4800	

Table A9: Price Decreasing Subsamples with Equal Prices Bins, Sell Days

Panel (A): Price = £0.10 to £1.00

	$Probability \ of \ Sale_{ijt} = 1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	0.0323***	0.0438***	0.0402***	0.0237***	0.0204***	
	(0.0035)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	
Stock Digits Y0 to Y5		-0.0029**	-0.0028**	-0.0021*	-0.0023**	
		(0.0013)	(0.0013)	(0.0012)	(0.0012)	
Stock Digits X6 to X9		-0.0036*	-0.0019	-0.0015	-0.0017	
		(0.0019)	(0.0019)	(0.0020)	(0.0021)	
Constant	0.1139***	0.1090***	0.2047***			
	(0.0062)	(0.0068)	(0.0330)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	60,807	60,807	60,807	60,807	60,807	
\mathbb{R}^2	0.0022	0.0024	0.0154	0.3453	0.3763	

Panel (B): Price = £1.00 to £10.0

·	$Probability\ of\ Sale_{ijt}=1$					
	(1)	(2)	(3)	(4)	(5)	
Above Y0 = 1 (in Range Y0 to Y5)	-0.0335***	-0.0470***	-0.0503***	-0.0388***	-0.0346***	
	(0.0026)	(0.0039)	(0.0039)	(0.0039)	(0.0042)	
Stock Digits Y0 to Y5		0.0014	0.0015	0.0032***	0.0022**	
		(0.0009)	(0.0009)	(0.0009)	(0.0010)	
Stock Digits X6 to X9		0.0086***	0.0088***	0.0027*	0.0033**	
		(0.0017)	(0.0016)	(0.0016)	(0.0016)	
Constant	0.1190***	0.1298***	0.2497**			
	(0.0037)	(0.0046)	(0.1241)			
Day FE	NO	NO	YES	YES	YES	
Industry FE	NO	NO	YES	YES	YES	
Account FE	NO	NO	NO	YES	YES	
Stock FE	NO	NO	NO	NO	YES	
Observations	86,156	86,156	86,156	86,156	86,156	
\mathbb{R}^2	0.0031	0.0035	0.0066	0.2877	0.3117	

Panel (C): Price = £10 to £100

	$Probability\ of\ Sale_{ijt}=1$						
	(1)	(2)	(3)	(4)	(5)		
Above Y0 = 1 (in Range Y0 to Y5)	-0.0600***	-0.0706***	-0.0620***	-0.0434***	-0.0345***		
	(0.0076)	(0.0092)	(0.0092)	(0.0107)	(0.0129)		
Stock Digits Y0 to Y5		0.0077***	0.0085***	0.0057*	0.0014		
		(0.0028)	(0.0028)	(0.0032)	(0.0037)		
Stock Digits X6 to X9		0.0036	0.0053	-0.0062	-0.0033		
		(0.0059)	(0.0060)	(0.0065)	(0.0068)		
Constant	0.1450***	0.1482***	0.0698***				
	(0.0077)	(0.0090)	(0.0167)				
Day FE	NO	NO	YES	YES	YES		
Industry FE	NO	NO	YES	YES	YES		
Account FE	NO	NO	NO	YES	YES		
Stock FE	NO	NO	NO	NO	YES		
Observations	13,233	13,233	13,233	13,233	13,233		
\mathbb{R}^2	0.0082	0.0090 36	0.0254	0.4376	0.4672		

References

- Hartzmark, S. M. (2015). The Worst, the Best, Ignoring All the Rest: The Rank Effect and Trading Behavior. *Review of Financial Studies 28*, 1024–1059.
- Lacetera, N., D. G. Pope, and J. R. Sydnor (2012). Heuristic thinking and limited attention in the car market. *American Economic Review 102*(5), 2206–36.
- Poltrock, S. E. and D. R. Schwartz (1984). Comparative judgments of multidigit numbers. *Journal of Experimental Psychology: Learning, Memory, and Cognition 10*(1), 32.
- Shlain, A. S. (2018). More than a penny's worth: Left-digit bias and firm pricing. *manuscript, University of California, Berkeley*.