Odd Lot Portfolio
Systematic Strategy

Executive Summary

Our odd lot strategy was inspired by alternative beta funds – quantitative strategies that reverse engineer popular hedge fund tactics and replicate them more cheaply. Instead of trying to recreate hedge fund strategies, we experimented with a common retail strategy to test if it could achieve scale (which might interest a smaller fund with capable IT infrastructure).

- **We focused exclusively on backtesting odd-lot tenders.** Since there is no academic literature on the frequency of odd-lot provisions, we looked at several potential macro indicators but refrained from any forward testing attempts. As with all investment research, past performance is not an indicator of future results.

- **Our strategy model relies heavily on assumptions.** While we made significant efforts to sensitize our data to various levers, successful implementation requires low latency. See the Modeling Adjustments slide.

Figure 1: **Strategy Details**

Description
- Invest in profitable US equity tender offers containing odd lot provisions and reinvest gains

Potential Opportunity
- Odd lot provision generally guarantees tendering of shares
- Tender offers are almost always priced at a premium
- Some brokers do not charge fees for tendering shares
- If creating and collapsing multiple lots can be done on a low latency frictionless basis, the strategy can scale exponentially

Odd Lot Portfolio Systematic Strategy									
Strategy	2010	2011	2012	2013	2014	2015	2016	2017	2018
Single Lot (Based on $50,000 account)									
Naïve Strategy									
Worst	3%	-8%	0%	-1%	1%	2%	-3%	-5%	0%
Average	5%	3%	4%	2%	5%	7%	4%	2%	16%
Best	8%	14%	9%	6%	8%	11%	10%	10%	32%
Conservative Strategy									
Worst	4%	2%	3%	1%	2%	4%	1%	1%	6%
Average	5%	2%	4%	2%	4%	5%	2%	2%	13%
Best	7%	2%	4%	3%	5%	7%	3%	2%	20%
Multi-Lot (Based on $100,000 account)									
Base Strategy									
Worst	28%	14%	12%	8%	7%	7%	4%	8%	2%
Average	41%	12%	11%	14%	13%	8%	6%	7%	3%
Best	48%	13%	6%	24%	10%	13%	5%	8%	3%

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Sources: CSSG Estimates, FT, SEC EDGAR

Odd Lot Provisions

We derived our quantitative backtest idea from a common retail trading strategy.

According to the Odd Lot Special Situations Newsletter: Occasionally, when a company is merging or offering a tender, it will add a provision for shareholders that hold 99 shares or less.

- Usually this provision states that odd lot holders will have their entire holding disposed of and not be prorated like other shareholders.

- This offer is normally at a premium to market price to encourage investors to sell. This is done to save on investor relation costs or to reduce the amount of shareholders so the company can go private (and save on SEC filing costs).

- Separately, companies undergoing reverse stock splits will cash out shareholders at a premium that would have otherwise been left with fractional shares.

By investing in companies that are undergoing tender offers with odd lot provisions or reverse stock splits, an investor deploying a small amount of capital can earn extremely attractive arbitrage returns. Additionally, certain brokerages (such as Interactive Brokers) do not charge any tender offer fees.

We decided to expand upon this strategy by taking a look at every single offer available on SEC EDGAR and testing the impact of owning multiple lots. By buying multiple lots of 99 shares each and tendering these lots separately, the returns in the overarching account should exponentially increase.
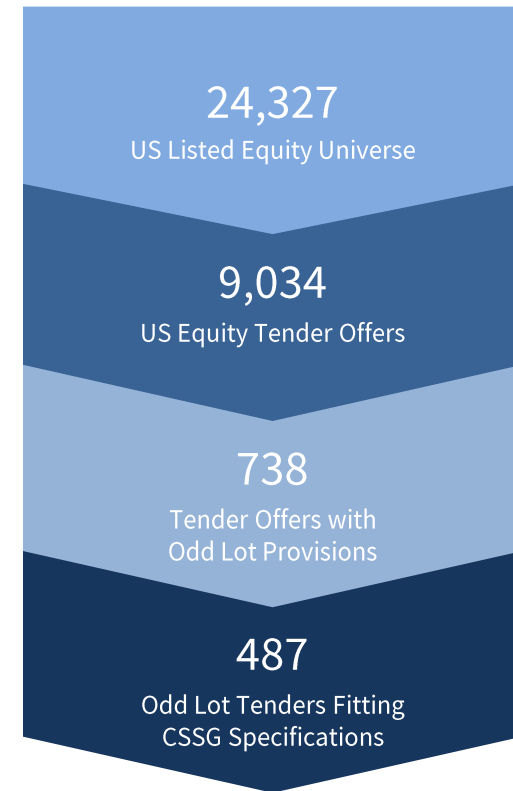
Figure 2: Illustrative Screening Process

24,327
US Listed Equity Universe

9,034
US Equity Tender Offers

738
Tender Offers with
Odd Lot Provisions

487
Odd Lot Tenders Fitting
CSSG Specifications

Figure 2 is an indicator of the historic supply of offers at each level of our screening process between 2000 and 2018.

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We found that there was no clear macro indicator for how often odd lot provisions occur in US equity tender offers.

Figure 3: Deal Count Time Series vs S&P and M&A

M&A Deals   Tender Offers   Odd Lot Offers   —S&P 500
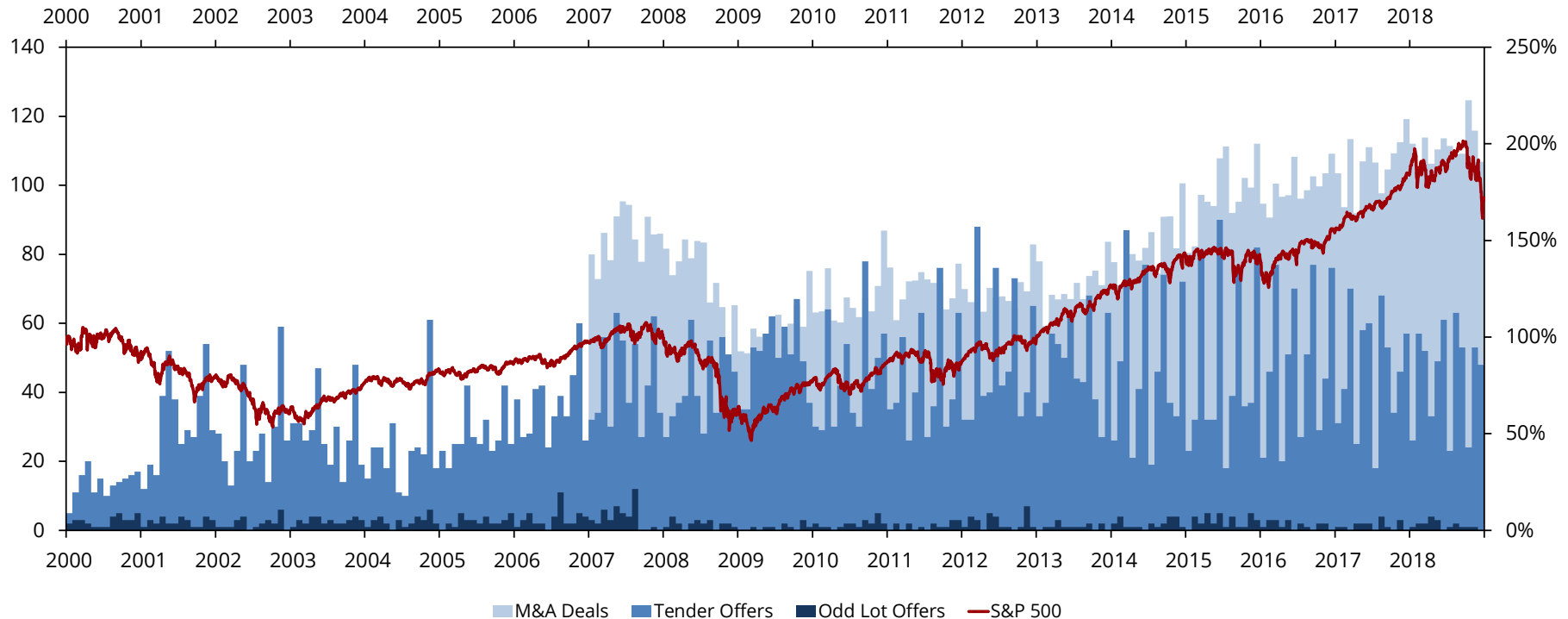
Bloomberg only provides monthly M&A deal time series of up to 12 years prior which is why the data begins in 2007. For the purposes of Figure 3, M&A data is normalized to 80 on the primary y axis, and S&P is charted on the secondary y axis as a percent return from 1/1/2000.

While there was no clear predictor for odd lot provisions, there appears to be a notable decrease in such tender offers after the 2008 financial crisis.

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We used Beautiful Soup 4, a Python library for pulling data out of HTML and XML files, to go through every corporation on SEC EDGAR.

Figure 4: **CSV Pulled Data and Sample Summary Term Sheet**

CIK	Central Index Key used by SEC to identify corporations and people
Date	Filing Date
URL	Filing URL
Error	*(see Assumptions and Errors)*
Exp Date	Tender expiration date
Trading Px	Last suitable trading price prior to the announcement of the tender offer; because the number implies a frictionless investment, we have sensitized this number appropriately
Px Date	The day that corresponds to the trading price
Tender Px	Tender price (left blank if Modified Dutch Auction)
Low	Low end price in a Modified Dutch Auction (left blank in a self tender)
High	High end price in a Modified Dutch Auction (left blank in a self tender)
Increment	Increment between low and high prices in a Modified Dutch Auction
Price Cap	Maximum amount being tendered (share cap blank in this case)
Share Cap	Maximum amount being tendered (price cap blank in this case)
Shares Out	Shares outstanding

ABBVIE INC.

Offer to Purchase for Cash

Up to $7,500,000,000 of its Common Stock
At a Purchase Price Not Less Than $99.00 Per Share
and Not More Than $114.00 Per Share

THE TENDER OFFER, THE PRORATION PERIOD AND WITHDRAWAL RIGHTS EXPIRE AT 12:00 MIDNIGHT, NEW YORK CITY TIME, AT THE END OF THE DAY ON MAY 29, 2018, UNLESS THE TENDER OFFER IS EXTENDED OR WITHDRAWN.

Upon the terms and subject to the conditions of this Offer to Purchase, including the provisions relating to "odd lot" priority…

We will purchase shares:

• First, from all stockholders of "odd lots" (persons who own fewer than 100 shares) who properly tender all of their shares at or below the Purchase Price and do not properly withdraw them prior to the Expiration Date

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We looked at all 13E-4 and SC TO-I forms. These filings represent tender offers made by the security issuer, otherwise known as self tender offers (as opposed to ones made by a third party in situations such as a hostile takeover).

Then, the set of forms was further filtered to only include tenders with odd lot provisions – which we accomplished by searching for the terms "odd lot", "odd-lot", and other similar permutations.
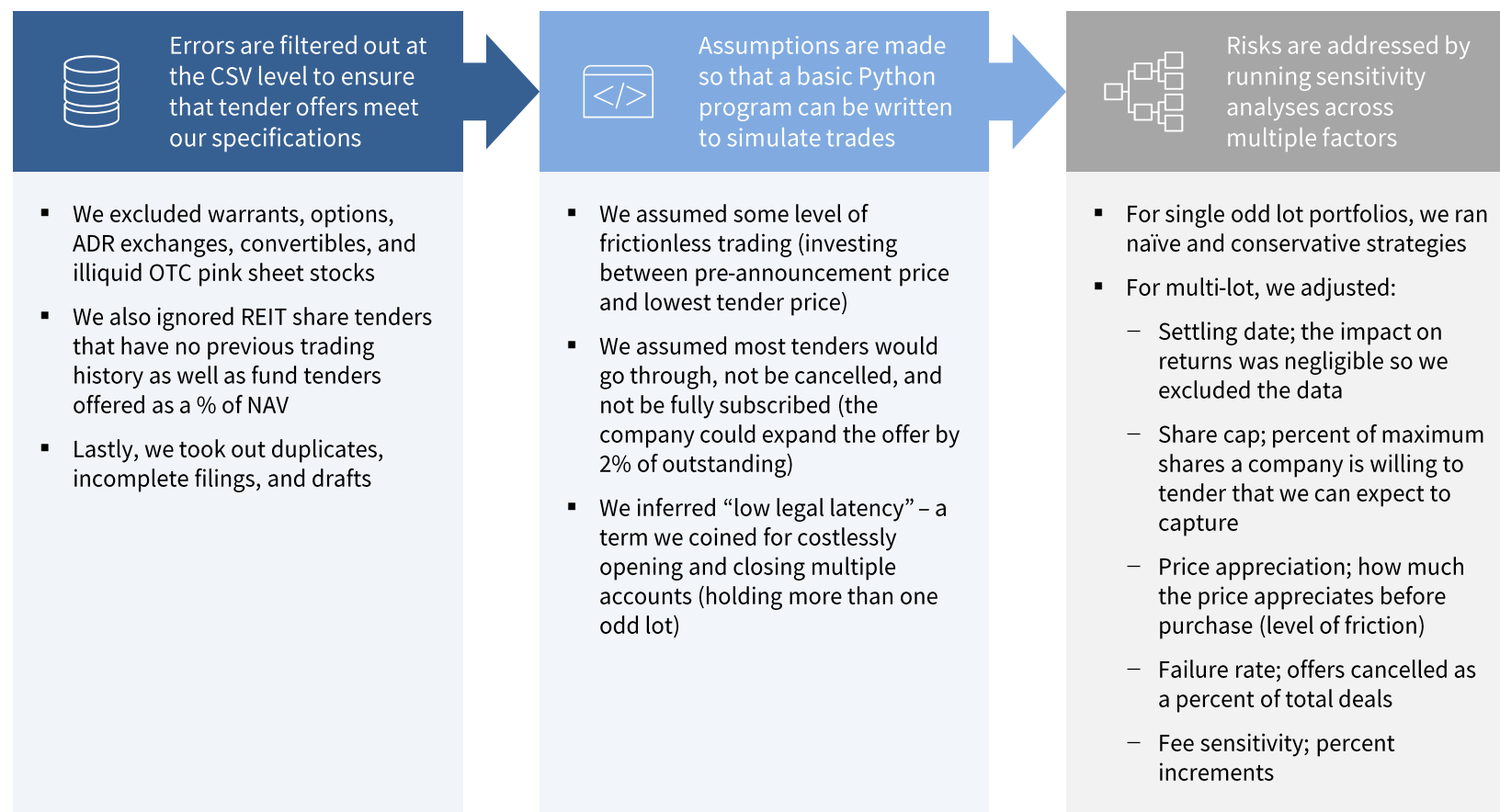
After taking in the CIK, filing date, and filing URL, we went through the Form of Offer to Purchase and then the Summary Term Sheet to find the information on the left side of Figure 3.

We ultimately went through 1,336 term sheets by hand.

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Program Adjustments

We wrote algorithms to account for a variety of different scenarios.

Figure 5: **Errors, Assumptions, and Risk Mitigation**

Errors are filtered out at the CSV level to ensure that tender offers meet our specifications	Assumptions are made so that a basic Python program can be written to simulate trades	Risks are addressed by running sensitivity analyses across multiple factors

- We excluded warrants, options, ADR exchanges, convertibles, and illiquid OTC pink sheet stocks

- We also ignored REIT share tenders that have no previous trading history as well as fund tenders offered as a % of NAV

- Lastly, we took out duplicates, incomplete filings, and drafts

- We assumed some level of frictionless trading (investing between pre-announcement price and lowest tender price)

- We assumed most tenders would go through, not be cancelled, and not be fully subscribed (the company could expand the offer by 2% of outstanding)

- We inferred "low legal latency" – a term we coined for costlessly opening and closing multiple accounts (holding more than one odd lot)

- For single odd lot portfolios, we ran naïve and conservative strategies

- For multi-lot, we adjusted:
  - Settling date; the impact on returns was negligible so we excluded the data
  - Share cap; percent of maximum shares a company is willing to tender that we can expect to capture
  - Price appreciation; how much the price appreciates before purchase (level of friction)
  - Failure rate; offers cancelled as a percent of total deals
  - Fee sensitivity; percent increments

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Single Lot Strategies

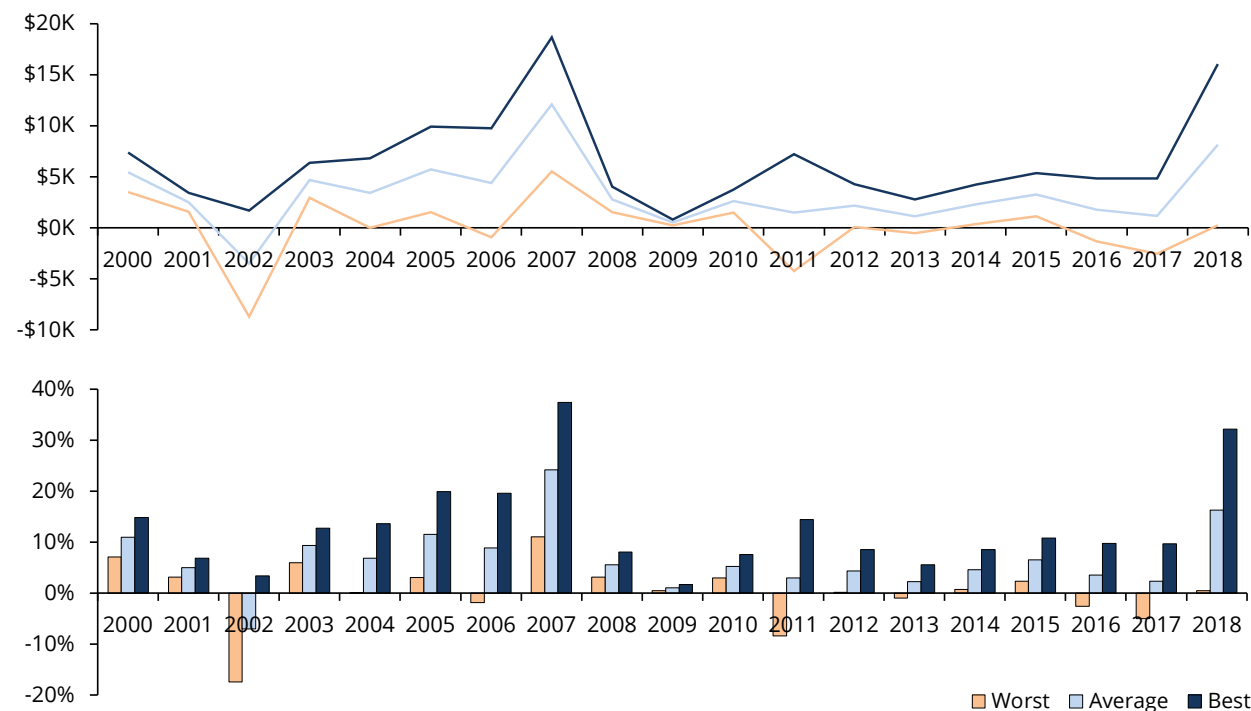Charon Special
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Naïve Strategy Returns

The naïve strategy consists of fully investing in every odd lot tender offer at 99 shares (the maximum odd lot amount).

**Figure 6:** **Naïve Annualized Absolute and Percent Returns**

- The naïve strategy, as expected, turned out to have a wide spread between worst and best possible outcomes.

- Negative returns in worst scenarios are purely attributed to lower-end Dutch auction prices being set below the market price. This is likely due to ECM bankers' anticipation of volatility in these situations.

- Worst case scenario mean and median edge out 0% by a slim margin.

- Decreasing the initial principal invested tends to increase the annualized percent return because the lot sizes are fixed at 99 shares.

	Worst	Average	Best
Mean	0%	7%	13%
Median	0%	5%	10%

Notes: Absolute returns are based on a $50,000 account size which is the minimum needed to invest in every odd lot offer.
Sources: CSSG Estimates, SEC EDGAR

Naïve Strategy Performance

The naïve strategy consists of fully investing in every odd lot tender offer at 99 shares (the maximum odd lot amount).

Figure 7: **Naïve Investment Growth Since 2000**
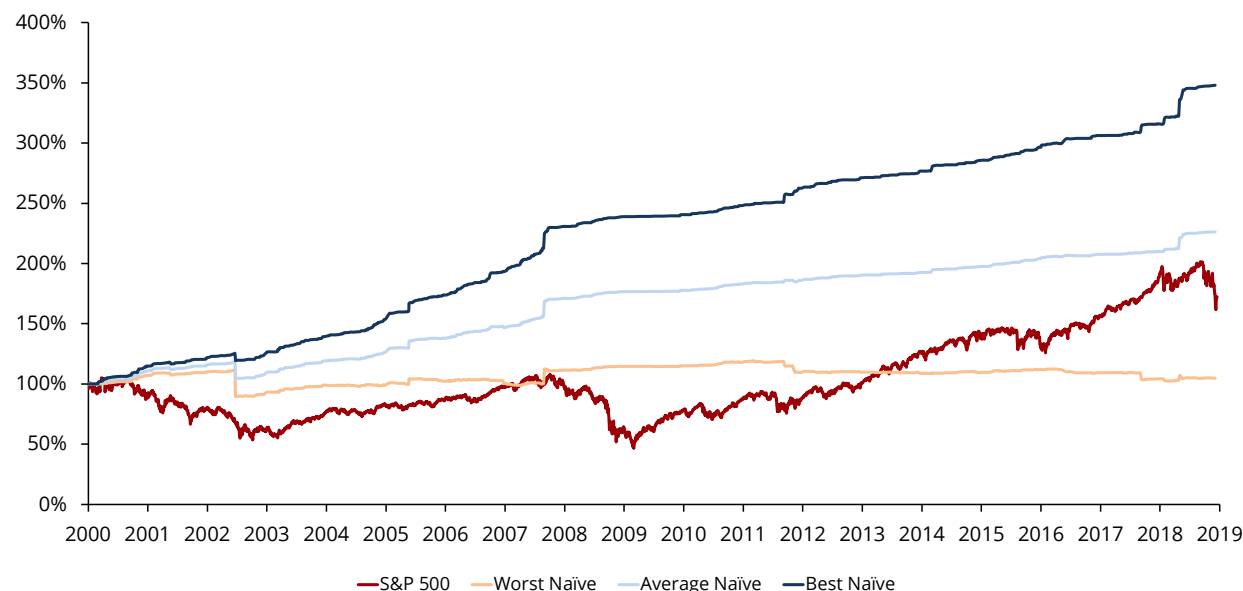
- The lack of volatility in the chart is not actually due to strategic success, but rather because there is no available data for delisted stocks except the pre-announcement price point we used.

- There should still be low volatility however since tender offer news tends to simply drive prices up.

- There were three particularly large drops / jumps in performance which were a result of outsized share prices listed below.

Company Name	Expiration	Auction Low	Auction High	Cap	Security
Granite Broadcasting Corporation	6/17/2002	590	670	45,000 Shares	12.75% Cumulative Exchangeable Preferred Stock
CME Group	8/29/2007	560		6,250,000 Shares	Class A Common Stock
White Mountains Insurance Group	5/7/2018	825	875	500,000 Shares	Common Shares

Notes: Absolute returns are based on a $50,000 account size which is the minimum needed to invest in every odd lot offer.
Sources: CSSG Estimates, SEC EDGAR, Yahoo Finance

Conservative Strategy Returns

The conservative strategy is to buy 99 shares in every odd lot offer where the tender or low-end auction price is greater than the trading price.

Figure 8: **Conservative Annualized Absolute and Percent Returns**
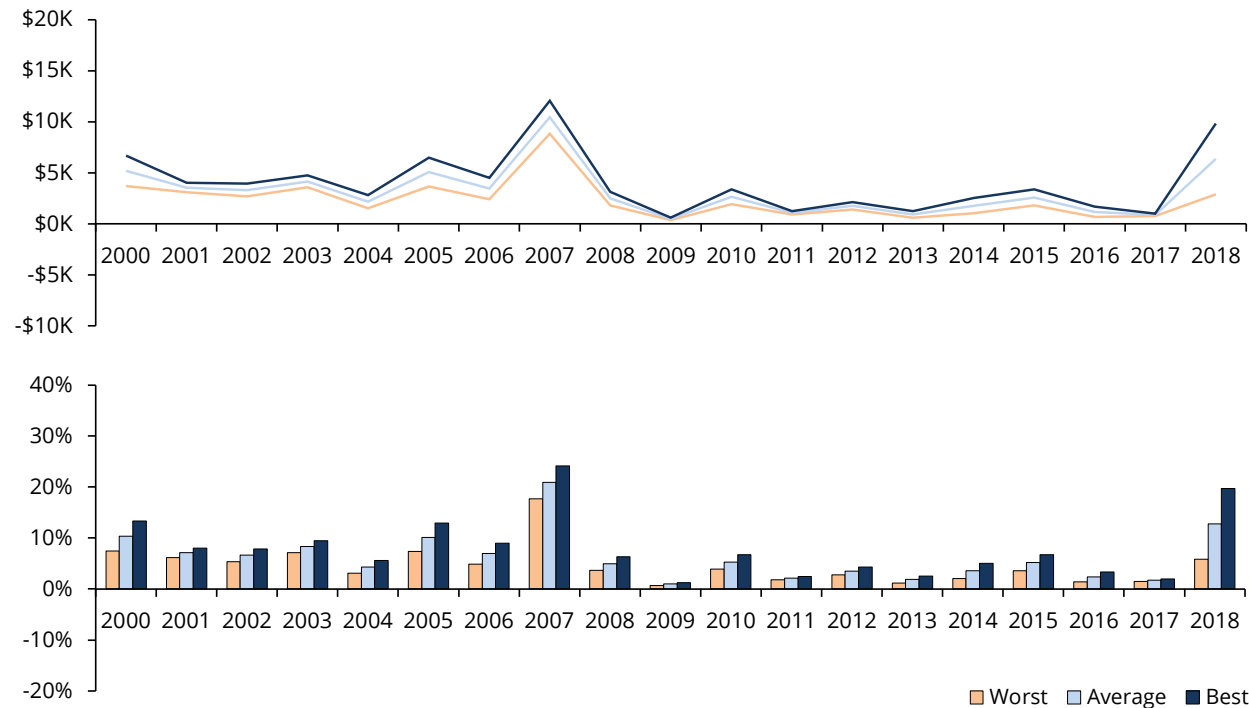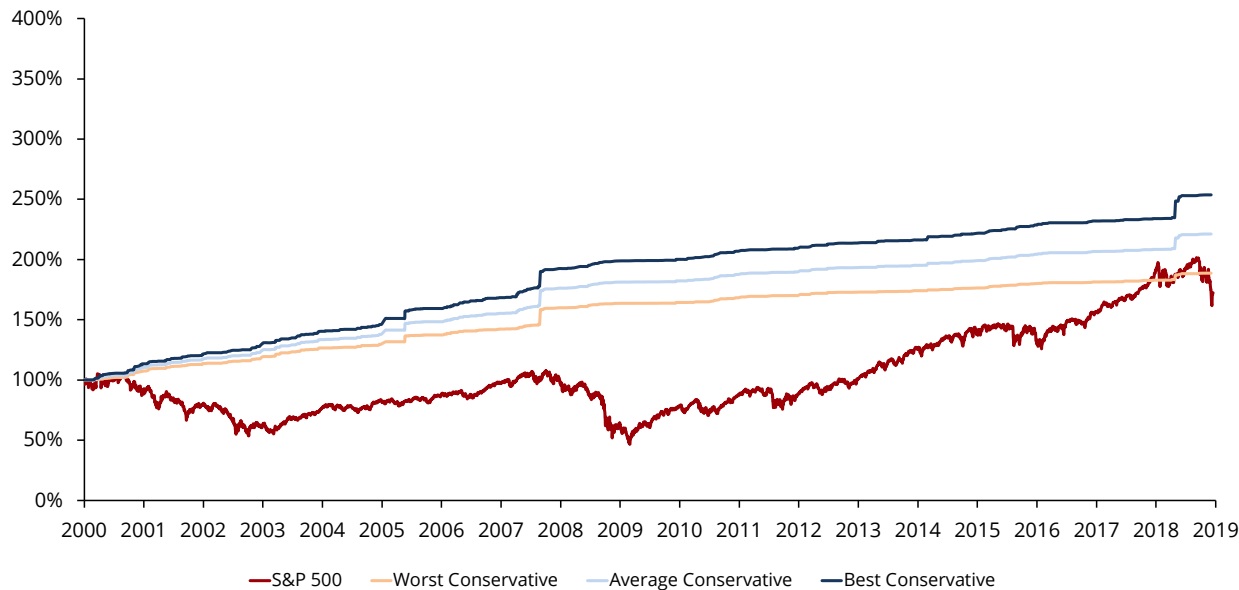

- Compared to the naïve strategy, the conservative strategy's spread collapses.

- The reduced dispersion indicates that, for Dutch auction deals in which the lower-end price goes below the trading price, the range extends higher by an equal amount.

- While there are no outsized upside opportunities, the worst case scenario is safely and consistently positive.

- Decreasing the initial principal invested tends to increase the annualized percent return because the lot sizes are fixed at 99 shares.

	Worst	Average	Best
Mean	5%	6%	8%
Median	4%	5%	7%

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Notes: Absolute returns are based on a $50,000 account size which is the minimum needed to invest in every odd lot offer.
Sources: CSSG Estimates, SEC EDGAR

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Conservative Strategy Performance

The conservative strategy is to buy 99 shares in every odd lot offer where the tender or low-end auction price is greater than the trading price.

Figure 9: **Conservative Investment Growth Since 2000**

- The conservative average adjusts one major drop included in the naïve.

- Like the naïve strategy, low volatility is from a lack of pricing data (although the returns are mathematically correct).

- There were two particularly large jumps in performance which were a result of outsized share prices listed below.

Company Name	Expiration	Auction Low	Auction High	Cap	Security
CME Group	8/29/2007	560		6,250,000 Shares	Class A Common Stock
White Mountains Insurance Group	5/7/2018	825	875	500,000 Shares	Common Shares

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Multi-Lot Strategy

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Multi-Lot Base Performance

The multi-lot base strategy is to buy ~5% of every odd lot offer in 99 share lots.

Figure 10: **Multi-Lot Investment Growth Since 2000**
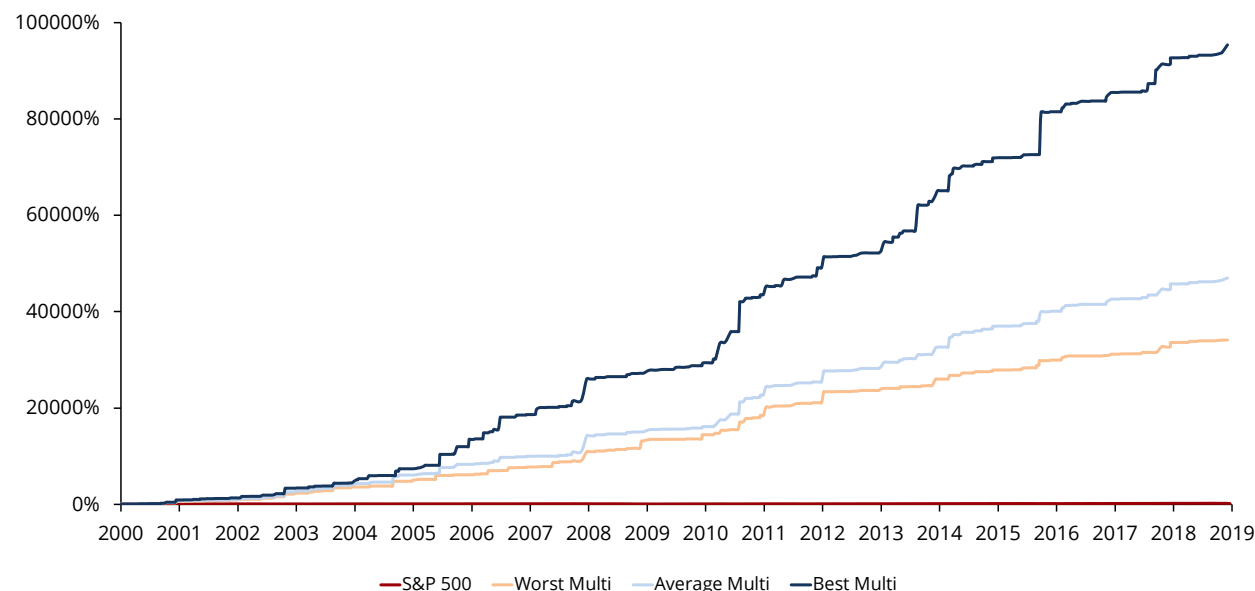
- The outsized returns render the S&P literally flat.

- Because it is less than likely a fund would be able to purchase 5% of a tender offer share amount, we sensitized numerous factors in the following slides.

- The largest six deals by percentage return are listed below. They correspond with the vertical jumps in the best multi-lot scenario.

Company Name	Expiration	Auction Low	Auction High	Cap	Security
IKON Office Solutions	12/19/2007	13	15	$295,000,000	Common Shares
MDS	3/29/2010	8.1	9.3	55,555,555 Shares	Common Shares
Fidelity Nat. Information Services	8/3/2010	29	31	$2,500,000,000	Common Shares
Halliburton	8/22/2013	42.5	48.5	$3,300,000,000	Common Shares
Outerwall	3/7/2014	66.82	76.32	$350,000,000	Common Shares
H&R Block	10/2/2015	32.25	37	$1,500,000,000	Common Shares

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Notes: Absolute returns are based on a $100,000 account size.
Sources: CSSG Estimates, SEC EDGAR, Yahoo Finance

Share Cap

Our base case assumes that we would be able purchase up to 5% of the tender amount in 99 share lots; we tested other offer percent limits.

Figure 11: **Share Cap Sensitivity Chart**
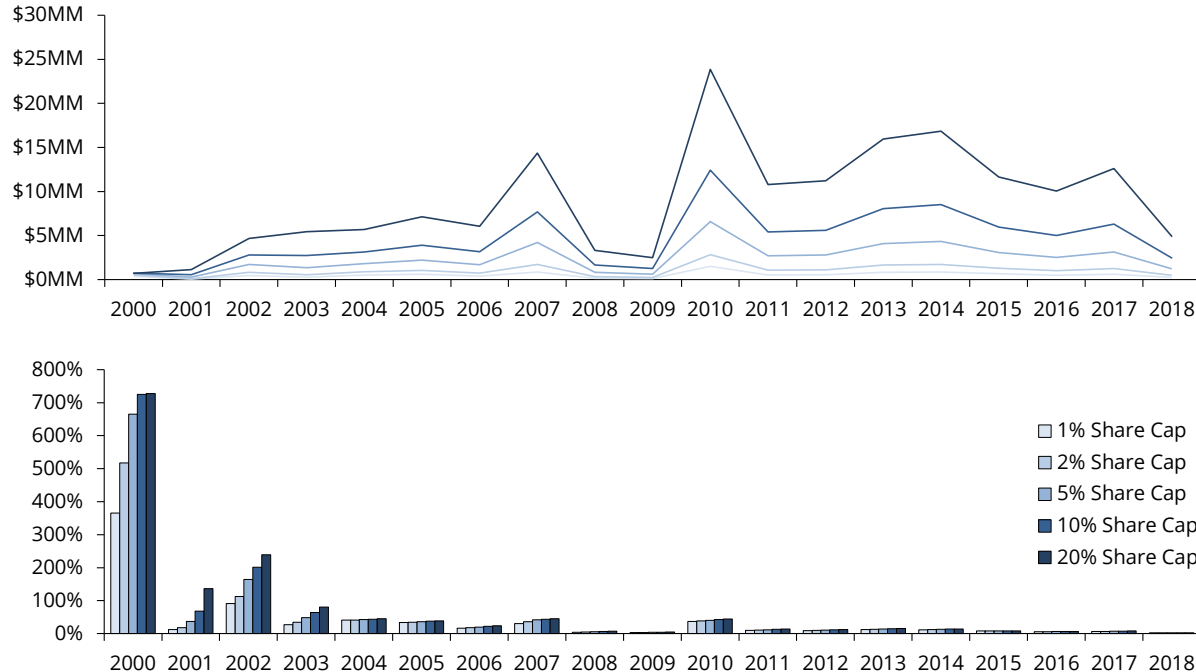
- The share cap program simulates buying up to the % share cap as the principal amount allows, starting at $100,000.

- As expected, purchasing a greater percent of the tender offers increases the absolute return by a fairly constant multiple.

- From the annualized returns, it appears that the share cap returns taper off between 10 and 20%.

- In addition, the largest percent returns come from the early 2000s.

- We chose to set the caps at a lower end (1%, 2%, etc.) because purchasing smaller amounts was more reasonable than larger.

	1% Cap	2% Cap	5% Cap	10% Cap	20% Cap
Mean	38%	49%	62%	71%	78%
Median	12%	13%	14%	15%	16%

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Notes:　Absolute returns are based on a $100,000 account size.
Sources:　CSSG Estimates, SEC EDGAR

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Price Appreciation

Since the prices we used were pre-announcement, we modeled performance as market prices approached the offer amount in percentages.

**Figure 12:** **Price Appreciation Sensitivity Chart**
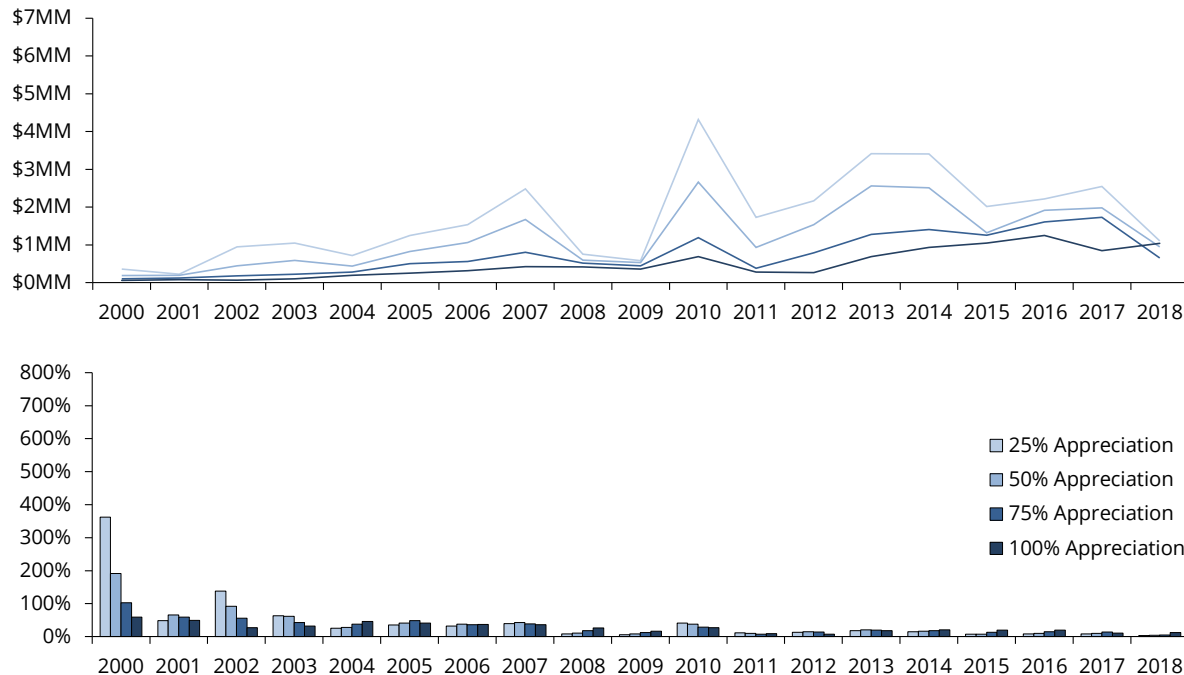
- As the market prices approach the lower end of the tender offer prices, the returns are decreased.

- At maximum price appreciation, there are still positive gains because we used the lower end of the auction price for the full appreciation amount.

- We used larger appreciation increments (25%) since it was likely that investing would be not frictionless.

- Due to the flatter nature of the 100% appreciation, it is interesting to note that the median and mean seem to have inverse relationships.

	25% App.	50% App.	75% App.	100% App.
Mean	47%	37%	40%	27%
Median	18%	21%	31%	26%

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Notes: Absolute returns are based on a $100,000 account size.
Sources: CSSG Estimates, SEC EDGAR

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SEC filings do not indicate failed or cancelled tender offers so we ran simulations to see returns when percentages of offers returned nothing.

**Figure 13:** **Failure Rate Sensitivity Chart**
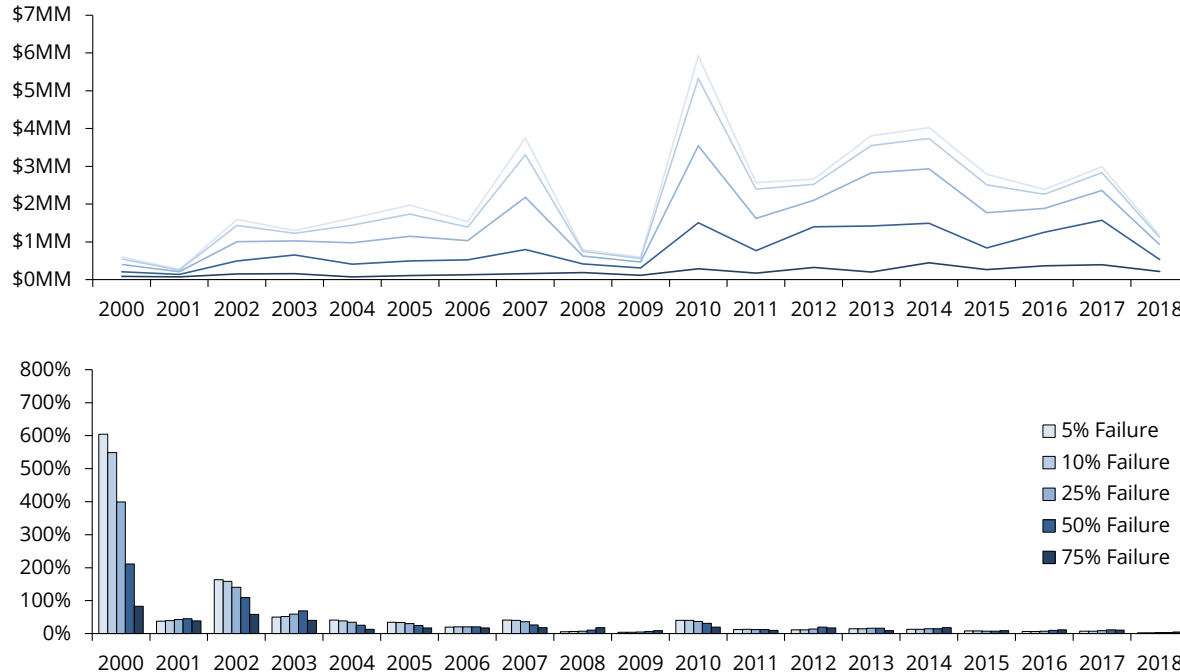
- Higher failure rate mutes returns; this was fairly standard and in line with expectations.

- The multi-lot condition seems to offset the high degree of failures. At 75% failure, the average returns are still 22%.

	5% Fail.	10% Fail.	25% Fail.	50% Fail.	75% Fail.
Mean	59%	56%	47%	36%	22%
Median	15%	15%	16%	20%	17%

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Notes: Absolute returns are based on a $100,000 account size.
Sources: CSSG Estimates, SEC EDGAR

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Broker Fee

Occasionally brokers charge a percentage of returns or a fixed fee for handling share tendering; we tested a range of percentages.

Figure 14: **Broker Fee Sensitivity Chart**
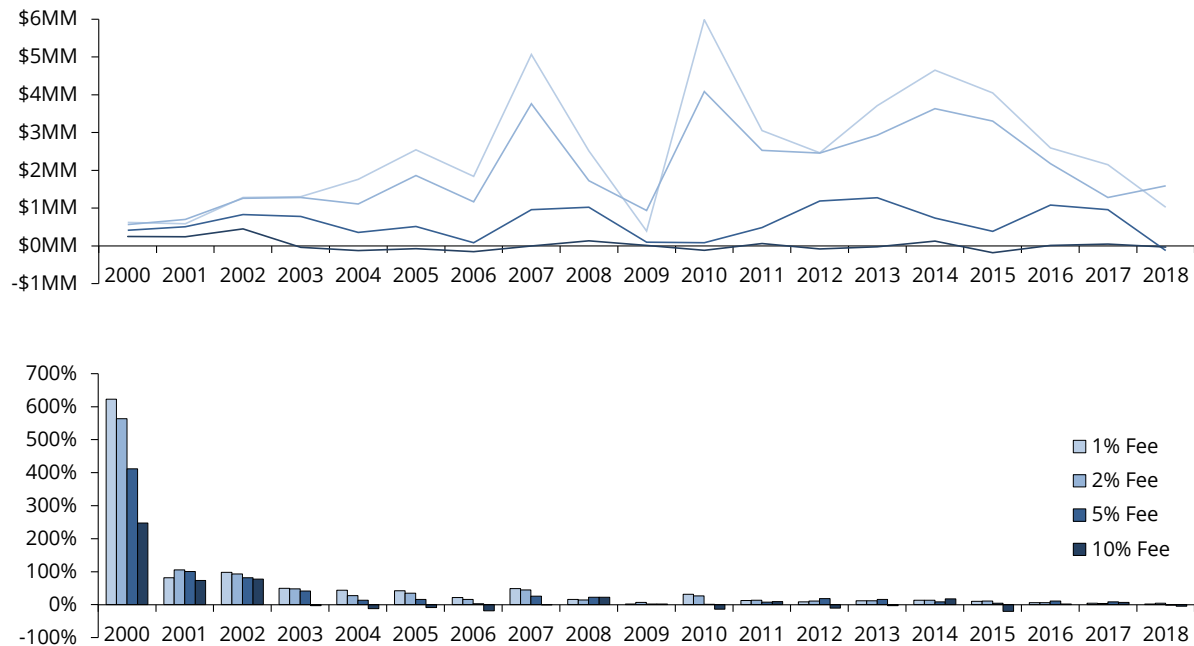
- The base case assumes no fees while the sensitivity analysis ranges from 1% to 10%.

- The 10% fee returns negative ROI because the program runs as follows:

  1. The algorithm checks to see whether we are currently invested, if not then we invest in any offer as long as the average returns positive.

  2. Every time a new stock is available, it compares it to current portfolio.

  3. If the new stock has a predicted ROI that is better than the current one plus our fee rate, we sell the old stocks.

  4. If the fee is greater than the incremental ROI, then the algorithm does not buy.

- The algorithm does not check the initial purchase with fee (initial ROI – fee > 0) resulting in negative returns. While this is arguably undesirable behavior, it still provides a decent proxy for fees.

	1% Fee	2% Fee	5% Fee	10% Fee
Mean	59%	56%	42%	19%
Median	16%	14%	13%	0%

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Notes: Absolute returns are based on a $100,000 account size.
Sources: CSSG Estimates, SEC EDGAR

Next Steps

Running these strategies on a large scale would probably affect how tender offers are structured, but below are some potential next steps.

Further Data Collection

Properly calculating volatility and performance metrics (Sharpe, Sortino) would require a higher amount of data to work with. This includes:

- Historical data for delisted securities which would allow for correlation matrices and other comparisons

- More time series data for regressions, since M&A activity and S&P 500 did not correlate with odd lot occurrences

- Qualitative conversations with equity capital markets professionals who structure tender offers

- Information on odd lot provisions in tender offers for other asset classes since equity odd lot offer supply is limited

More Rigorous Modeling

Our lightweight calculations could be enhanced with the following analyses:

- Adjusting principal for inflation; this would give us a more accurate view of returns and money required to invest

- Discounting to present value; like a DCF, this might contribute a better forecast of capital appreciation

- Penalty sensitization; our fee sensitivity numbers assume no losses and exit at original market price

- Tax calculation; portfolio returns should be netted against capital gains taxes

Portfolio Calculations

As important as backtesting is, understanding how an odd lot portfolio should be practically structured would be critical to executing trades. Potential frameworks include:

- Regular retail portfolio; margin trading account

- Special purpose vehicle; collateralized structured product

- Fund; mutual fund, hedge fund structure

- Index; ETFs, liquid alts

| Explore Data Sets | Modify Assumptions | Set Up Systematic Structure | Make Optimal Returns |

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Appendix

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Date	News	
02/18/2016	FT	[Threats to Hedge Fund Managers' Secret Sauce](#)

Title	Source	
Bloomberg	Bloomberg Terminal	Link not available
Odd Lot Special Situations	Odd Lot SS Newsletter	http://oddlotspecialsituations.com/
SEC EDGAR	SEC	https://www.sec.gov/edgar/searchedgar/companysearch.html
Yahoo Finance	Yahoo	https://finance.yahoo.com/

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Charon Special Situations Group (CSSG or Charon SSG) is an independent investment research firm focused on covering quantitative and event-driven strategies for institutional investors. Comprised of undergraduate students from the Georgia Institute of Technology, our team works to produce the highest quality investment research and share our publications with financial professionals in Atlanta and New York.

Hyunjae (Brian) Lee, Investment Analyst
Brian is an incoming Global Markets Summer Analyst in RBC Capital Markets' FICC Origination division with previous experiences in leveraged finance and credit research at SunTrust Robinson Humphrey. Brian currently works in private wealth management at Morgan Stanley and studies computer science and finance at the Georgia Institute of Technology.

Anthony D'Achille, Quantitative Analyst
Anthony is an incoming software engineering intern at HubSpot. He currently works in Home Depot's Supply Chain team on leveraging statistical methods and machine learning for load forecasting and has previous experience in full-stack web development. Anthony studies computer science at the Georgia Institute of Technology.

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