



QF621 Quantitative Trading Strategy

Pairs Trading in the Context of Dual-Class System

Group Project Report

Arjun Sabari, Qu Ming, Shivani Jain, Wang Qinglin, Yan Haixiang

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Executive Summary

Class A and Class B shares of a same company are traded separately at Nasdaq. Due to the same underlying fundamentals, namely the overall company performance, and the mean-reverting quality, they are natural pairs in the pair trading strategy. This project first studies if this hypothesis is valid (the “*non-AGM*” *trading strategy* – strategy that employed in the times when no Annual General Meetings (AGM) is held), then explore further on whether the voting rights that are carried in Class A shares and exercised in company AGMs allow shareholders gain informational advantages over Class B shareholders. If so, it will create arbitrage opportunities that investors can actively trade on (the “*near-AGM*” *trading strategy* – strategy that is employed around the AGM days). Lastly, a portfolio with the selected pairs that exhibit high correlations but differ in size (measured by market capitalization), value (market value/book value ratio), and momentum (past winners and losers) characteristics is formed, so to figure out how these Fama-French value factors potentially affect the efficacy of the above mentioned trading strategy. With this finding, pairs selection process that maximizes ultimate portfolio returns and Sharpe Ratios is finalised.

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1. Background

1.1 *Dual-class Listing Arrangement, Development, and Controversy*

Companies sometimes issue various types of shares catering to various financing needs. A dual-class stock structure consists of two stocks, namely Class A and Class B, that are designed to be different in terms of voting rights or dividend payments. One class is issued to the public and the other may be issued to the founders, board of the company, or exclusive group of stakeholders, which would have more voting rights and hence also helps in holding the majority control of the company. This allows the Class A shareholders to control the majority of the voting power of the company while owning only a small percentage of the total equity, which allows companies to have easy access to public capital while maintaining control of the company efficiently. For the number of dual-class IPOs that take place in the US equity market, please refer to *Appendix 10.5 – Dual-class IPOs*.

While initially only a few exchanges and few companies issued dual-class stocks, that number has multiplied over the years with NYSE, NASDAQ, SGX, HKEX among others accepting this structure.

There is controversy around dual-class structures in stocks. One argument is that this allows a small group of people to hold control over the company while most of the capital comes from the public who have little to no say in it. As a consequence, there is an unequal distribution of risk, with the shareholders taking on the majority of the risk while the founders have a relatively minor amount of risk in accessing public capital. The supporters of this structure maintain that it allows the board or the founders to focus on the long term instead of short-term results, and they can avoid takeovers through their higher voting rights. Besides, Both Singapore and Hong Kong are keen to attract IPOs from companies in high-technology, innovative sectors, and founders of such firms have strong preferences for DCS structures. The quest for these IPOs became more urgent as global stock markets reached new highs, propelled by soaring prices of technology stocks (in particular, those listed on the US stock markets). (Aguilar, 2014)

Nonetheless, dual-listing shares reflect the same company fundamentals and thus are regarded as natural pairs in the classic pairs trading strategy. This report will explore on that hypothesis and expand our research with other pairs-related strategies.

1.2 *Past Research Literature*

Paul Schultz and Sophie Shive (2009) finds that prices of the two classes of shares could differ for rational reasons. The extra votes may have value or the market may value in the extra liquidity provided by one class. They find that significant abnormal returns are produced by the simple trading strategy of buying the cheaper class and shorting the more expensive class when the bid price of one exceeds the ask price of the other by a specified amount. The abnormal returns from exploiting these “price gaps” easily survive trading costs. The long sides of these positions earn abnormal returns by themselves, so price gaps provide profit opportunities even when there are severe restrictions on short selling.

The most common cause of the gaps is price pressure moving the active non-voting stock price out of line. After gaps arise, they find that purchases of cheap shares and sales of expensive ones become more likely to execute at quoted prices - evidence that investors are trying to trade quickly before prices change. They also find that trading volume changes in the expected ways when a gap exists. That is, sell volume becomes a larger part of total volume for expensive shares and buy volume becomes a larger part of total volume for the cheaper class. The changes in volume are particularly clear for the less active voting shares.

Besides, some other scholars find that given all else equal, voting shares may be more valuable if private benefits accrue to those who control the company through ownership of voting stock (see Lease, McConnell, and Mikkelsen (1983), Zingales (1995) and Nenova (2003)).

Differences in liquidity may also cause the two prices of dual class shares to diverge (see Smith and Amoako-Adu (1995) and Zingales (1995)). Shares with superior voting rights are typically less liquid. There are often fewer of them outstanding, and they are usually held for long periods of time by investors who wish to retain control of the company. Lower liquidity can explain why shares with superior voting rights sometimes sell for lower prices than shares with inferior votes. If price discrepancies are the result of differences in votes or liquidity, simple trading rules will not produce abnormal returns. Hence during the pair selection process, apart from deselecting the pairs with low correlation score, we also exclude the pairs that have generally significant liquidity disparity.

2. Economic Rationale

2.1 *Natural Pairs*

As both classes are from the same underlying company, they should demonstrate high correlation consistently. Besides, this means that the potential for severe deviations or spread widening are low and it protects us from high downside risks. Thus these classes will form a natural pair.

2.2 *Mean Reversion Characteristics*

When the two classes divert and the spread widens, creating a lower short-term correlation, traders will step in to take advantage of the arbitrage opportunity and go long on the underperforming class and short on the overperforming class. Besides, since both classes reflect the same underlying and based on the assumption of efficient market, price deviations should be temporary in nature, and will be wiped out by investors' arbitrage activities. As a result, stock prices will converge back over time. (Do, 2006)

2.3 *Less Trading Frequency and Overnight positions*

Switching between long and short position within a pair is done only when current spread deviates from historical average, which reduces the need to decide on an arbitrary trading frequency. Due to the high correlation score of the pairs we shortlisted (0.96 and above for the majority of the pairs), and based on the fact that such correlation is persistent throughout the observation periods, we take overnight positions when no position switching is required. This practice has been validated later in our research.

2.4 *Arbitrage Opportunity around AGM*

Shareholders who hold shares with more voting privileges tend to have more information about the company than the shareholders of the other class, which creates arbitrage opportunities. Such information tends to motivate these trades in the class with higher voting rights.

3. Assumptions

Although it is required by regulators that business insiders, including the business management, should disclose any arm-length transactions with their own stocks and refrain from trading on insider information before such information is publicly available, insider trading is assumed to be relevant in most companies because it is hard to detect whether trades done are done in innocence of inside knowledge. (Angel, James, McCabe, Douglas, 2018)

Shareholders who hold shares tend to have more information about the company, either direct or indirect. Such information tends to motivate them to trade in the market and impacts on share prices or trading volumes are generated before the Annual General Meeting (AGM) takes place. All issues discussed in the AGM are critical in nature, which is the reason that the trades placed around AGMs are regarded as the ones that carry most valuable information. (Nyqvist, Anette, 2015)

4. Data Preparation

4.1 Data Requirement

The trading universe was picked to be USA and Canada equity markets for ease of access to data, but these dual class stock structures can be found in many countries including Europe. Daily adjusted close prices, daily trading volume, and short interest rates on these pairs to initiate the pairs trading strategy are required. AGM dates for all the companies are to be included in our strategy as well.

4.2 Data Pre-Processing

- (1) Gathered list of all companies listed in the USA and Canada that have multiple classes of stocks from Capital IQ as well as Bloomberg terminal.
- (2) Eliminated companies that have only one regular stock and the other classes are ADR, Warrants, Rights or Units etc.
- (3) Eliminated companies whose two classes are not listed within the same country to avoid FX risks (further studies could include these as well).
- (4) As some companies have more than two classes of shares, correlations between all the classes of the same company were found and the ones with highest correlation and liquidity (reflected in trading volumes) are picked.
- (5) Downloaded all relevant data for each pair from WRDS and Bloomberg terminal. This also requires some level of manual work to clean all the data as some ticker names are misleading and not all Class A shares have more voting rights compared to its counterparty.
- (6) Rank all the pairs in terms of correlation and cointegration score and pick the ones with highest correlations. For correlation and cointegration score, please refer to *Appendix 10.1 – Correlation and Cointegration Evaluation*.¹ Besides, cointegration measures the long-term relationship between two or more variables, but this strategy focus on a time period of only 5 years, a stable long-term relationship between the classes are not expected in order for the strategy to be successful. Hence, for the pairs that have high correlation scores but low cointegration, we shortlisted them into our trading universe as well.

We also considered the distance method in pairs selection. The distance method is non-parametric in nature and does not assume the stock prices to follow certain models. Therefore it is not subject to the assumptions of established parametrized models or potential errors resulting from stock behavior's deviation from such models. However, it has a critical underlying assumption of a static price level distance between two stocks. This assumption renders the method vulnerable to price-level divergence, which could lead to sizeable losses to the investors, especially if a stop-loss method is not implemented. Another downsides of this non-parametric method is its lack of “forecasting ability regarding the convergence time or expected holding period”, as summarized by Binh Do (2006).

- (7) Mark the AGM dates and a 60-day window around the AGM.

The complete list of shortlisted pairs can be found in *Appendix 10.2 – Pairs Shortlisted*.

¹ Python commands used: statsmodels.tsa.stattools.coint and numpy.corrcoef

5. Implementation and Algorithm

5.1 Non-AGM Strategy

5.1.1 Description

Two approaches have been tested for the non-AGM strategy. For the long-only approach, Class A or B stock was bought if it is considered to be undervalued, namely, if the current ratio was found to be higher than the average of past 15-day average ratio. It has to be kept in mind that only one leg was longed at a time, as it is not possible to buy both the classes together. The ratio was calculated as Price of Class A/ Price of Class B.

Given that it is possible to short stocks in the US market, long/short strategy was also tested. This requires to take into account the short borrowing cost and short availability at the time of trading. Long positions are entered on the underperformed leg if the current price ratio is found to be higher than the average of past 15-days average ratio and simultaneously short positions are taken on the other leg, in a bid to maintain market neutrality at each rebalancing point. Positions are switched if the trend reversed.

5.1.2 Short availability

Short availability gives the number of shares that are available in the market for shorting, as not all the shares in the market can be shorted. Short availability for each stock can be found in the *Appendix 10.3 – Short Availability*. When shorting a leg of the pair for the long/short strategy it is important to check if it's even possible to short the required amount of shares. Thus given a notional amount the number of shares required can be calculated. This will help to set a cap on the AUM that can be applied into this strategy. For most of the positions entered, the shorts are sufficient. As a result, such restraint on shorts does not affect our overall portfolio performance.

It is worth noticing that for the pairs that had insufficient data short availability and short rates, it is assumed that the shorts are sufficient, and the short borrowing rate is set at the prevailing rate of 0.3%.

Besides, the short availability is assumed to be constant for the entire back-testing period from 1 January 2019 to 31 December 2020.

5.1.3 Position switching parameter

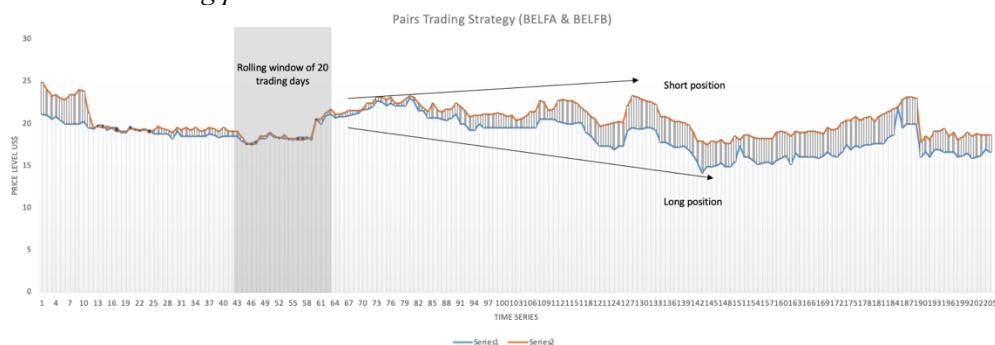


Figure 1. Pairs Trading Strategy

When the current price ratio deviates from the historical means, we will take positions and exploit the arbitrage opportunity. The default looking-back period is 15 trading days, which subjects to sensitivity analysis. See *Section 7 – Sensitivity Analysis and Strategy Robustness*.

5.1.4 Implementation costs and commissions

Execution costs include change-hand costs, short borrowing costs, market impacts and other transaction-related charges. Transaction costs are deducted for both approaches. Short borrowing cost is only applied in case of the long/short approach. Different stocks are

subject to different short availability and thus short borrowing costs. Commission for all the pairs is fixed at 2% p.a.

These costs have to be taken into account to calculate the net return.

5.1.5 *Indirect costs and market impacts*

For every position taken, it will generate a market impact that affects the bid-ask spread of each pair, which will in turn affect the ultimate portfolio performance. However, since the average position we take for each pair at a given point in time is 18.7, combining both long and short positions, we decided to ignore the market impact of position taking.

In this project, a bottom-up approach was taken to determine the positions we will take for a given period, i.e., first the minimum number of positions needed to be entered so as to maintain market neutrality at each rebalancing point is found, then these positions are benchmarked to the short availability we have for the stock in question. If shorts are insufficient, only enter into the number of short positions that are allowed.

In real trading settings, investors may choose to take the number of positions that are multiples to our default positions, so to reach the performance target set by various stakeholders. Depending on the pairs traded and short availability, the ultimate portfolio performance may be different from ours.

While market neutrality is intended for all the positions taken, the market beta at a point in time is not exactly 0. It is because only integer number of positions can be entered and beta fluctuates in overnight positions.

5.2 *Near-AGM Strategy*

5.2.1 *Description*

Determine market abnormal activities by (1) price volatility and (2) increase in trading volume over the 30 trading days window before the AGM. Decisions on our position is determined if there is a clear trend. Depending on the trend of the class with voting rights, and based on the assumption that the shareholders of the non-/less voting right class will follow the decisions made by shareholders of the class with voting rights, position is taken in the non-v/less voting right class if a clear trend (either upward or downward) is observed. If no clear trend is observed, no particular position will be made, the near-AGM strategy will remain inactive. The idea is to take advantage of this increase in trading volume or price volatility given a trend is clearly visible.

This strategy is implemented along with the non-AGM strategy. During the execution period, the non-AGM strategy comes to a pause and this strategy comes to effect if a clear trend is determined in the observation period.

5.2.2 *Pairs selection issues*

Out of the trading universe we have, 43 of the pairs are ETF in nature. Although such pairs have perfect correlation and cointegration throughout the back-testing period, the funds do not hold annual AGM, which poses a research limitation as they cannot be tested in the near-AGM strategy.

5.2.3 *Assumption on abnormal observation and execution window*

For 94% of the time, abnormal (deviate from year-average by 5%) either in pre-AGM trading volume or price volatility are observed. But only 57% of the time a clear upward or downward trend can be identified. An example of CENT pair near AGM trading volume can be seen here. Its observed that there is an increase in trading volume during 30 days before an AGM 2 or 3 times. This is what leads to the intuitive expectation of taking advantage of this increase in trading volume to get better results.

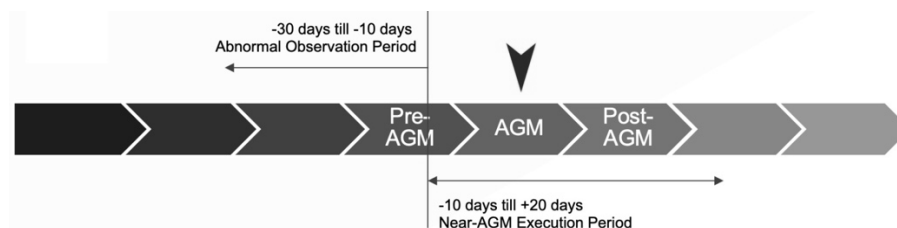


Figure 2. Near-AGM Observation and Execution Windows

AGM abnormal observation window starts 30 days and ends 10 days before the AGM dates. Overall near-AGM strategy execution window is 10 days before AGM and lasts until 20 days after AGM.

5.2.4 Abnormal detection criteria – Trading volume and price volatility

Abnormal observation refers to at least 5% deviate from normal average, this is subject to sensitivity analysis. See Section 7 – Sensitivity Analysis and Strategy Robustness.

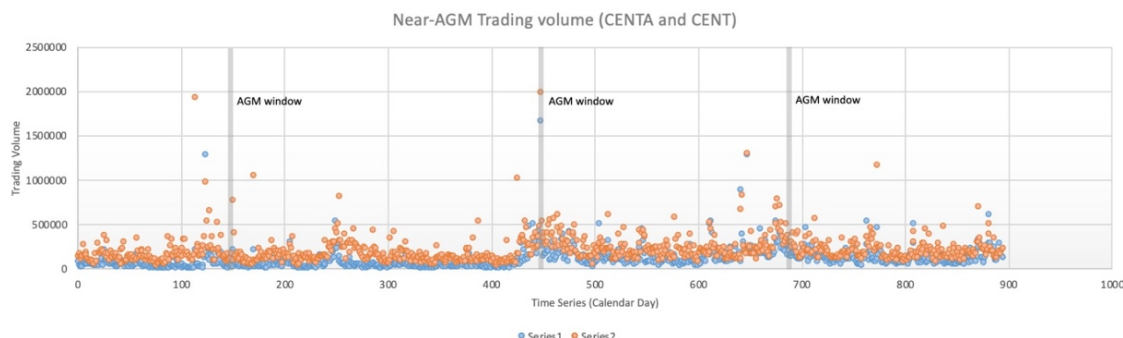


Figure 3. Abnormal Activities prior to AGM dates

Apart from AGM that contains valuable trading information investors can actively trade on, earnings announcements and major product releases etc. will have similar effect on stock prices. This project will only focus on the impact of insider trading that is manifested through exercise of voting rights prior to the AGM dates.

5.3 Portfolio Construction

After a thorough search through the US and Canadian market 132 pairs were recognised. a portfolio of 132 pairs will be constructed using spread-weighting scheme as well as equal-weighting scheme. For the companies that ceased to operate or one of the trading legs become delisted from the market in a certain year, we annualised their spreads and returns, so to achieve a fair comparison with other pairs. Such pairs will only be removed from the portfolio in the next rebalancing date For the companies that newly entered the market during a certain year, we will include them into the portfolio from the following rebalancing date onwards. Under both weighting schemes, portfolio is rebalanced annually.

5.3.1 Spread-weighting scheme

A pair will be selected on the basis of its current spread and how its current spread deviates from historical means. When the current spread is 1 or 2 standard deviations away from past 30-day historical spread means, we determine it to have high alpha generating capability and thus higher portfolio weights are assigned.

5.3.2 Equal-weighting scheme

Since all pairs shortlisted generate positive alphas, each pair in the portfolio will be assigned equal weights.

5.4 Fama-French Three Factors

The portfolio will also be tested for the impact of market, value and size factors. Data regarding these factors is taken from the Fama French official website and the portfolio returns (under spread-weighting scheme) are regressed on all three factors to arrive at a model that gives information about the effect of each factor.

6. Performance Evaluation

6.1 Non-AGM Strategy (Pair Specific)

6.1.1 Long-only vs. Long/Short Positions

Returns for long only strategy are shown in blue and returns for the long/short strategy are shown in red in Figure 4. These returns are without execution costs

It can be observed that the returns from the long/short strategy are less volatile and thus have lower negative return whenever the return goes negative. This is also highlighted by the fact that the max drawdown for the long only strategy is 32.20% whereas the max drawdown for the long/short strategy is 7.34%.

When taking both long and short positions and maintaining market neutrality by allocating roughly same amounts to both, effectively the risk due to market volatility can be hedged. However, since overnight positions are taken, and as a result, some market risks pass through. This sample of Alphabet Inc. pair returns can be generalised to all the pairs.

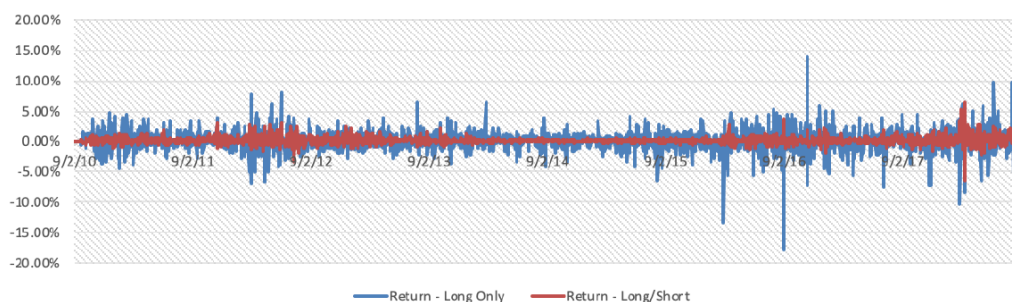


Figure 4. Long Only vs. Long/Short Position

6.1.2 Trading costs effect

Comparing the results after taking into account the execution costs, the below graph shows the net returns from the two strategies. For GOOG and GOOGL, the short borrowing cost is 0.3% per year. From Figure 4, it can be seen that it is better to go for the long/short strategy, as opposed to long-only, hence Figure 5 focuses on the long/short approach only. Both the cumulative returns without taking execution costs into account and cumulative net return of Alphabet Inc. pair are plotted. Cumulative return before deducting executions cost is 43.75% and it comes down to 39.63% after the execution costs are taken into account. Initially it can be seen they are almost the same but as the total number of trades increase over the 10 years the returns deviate and are nearly 4% apart after 10 years. This effect can be generalised to all other pairs in our portfolio.²

² Vidyamurthy (2004) tests on how different assumptions on transaction costs will lead to different portfolio performance, and how such effect lasts in longer period of time. (Appendix 10.4 – Assumptions on Transaction costs)

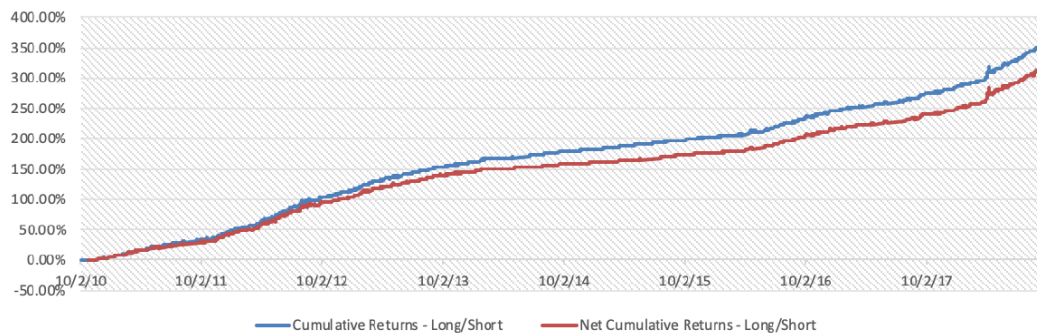


Figure 5. Transaction Cost Effect

6.2 Near-AGM Strategy (Pair Specific)

Continuing on the example of Alphabet Inc., the near-AGM strategy was implemented. The decision on execution was subject to observation of abnormal deviation in price volatility and trading volume 30 days prior to the AGM dates. As can be seen from the red arrows in Figure 6, the strategy was executed only twice out of the five AGMs held over a period of 4 years (usually the AGMs are an annual event but in the year 2017 two AGMs were held).

Blue line on the graph represents cumulative returns from the non-AGM strategy over the 4 years period used for this comparison. Red line represents the returns when the near-AGM strategy was implemented in its execution window if a clear trend was determined.

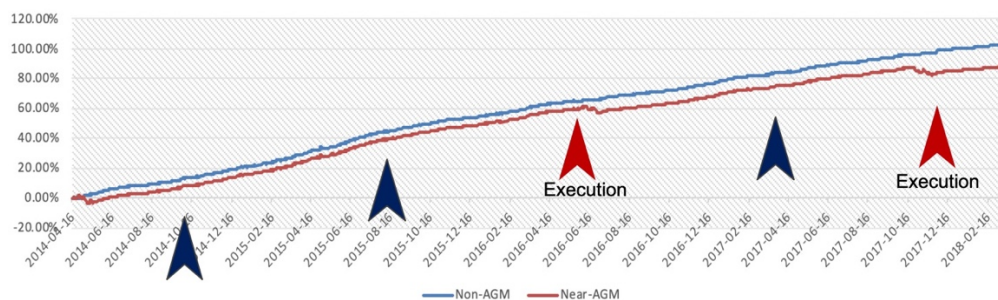


Figure 6. Near-AGM Performance

When applying the near-AGM strategy to all eligible pairs, the overall performance is obtained and compared to that of the non-AGM strategy.

Table 1 compares the performance metrics for non-AGM and near-AGM strategies for an equal weighted portfolio. Asserting further the finding that non-AGM strategy performs better than the near-AGM strategy. For the non-AGM strategy under long/short approach, the maximum drawdown is 11.03%. The annualised return is 21.47%, with a Sharpe ratio of 1.97, whereas the near-AGM strategy has a maximum drawdown of 12.67%, i.e. the maximum loss observed over the past 10 years period for near-AGM strategy is greater than that for non-AGM strategy. The annualised return is 15.29% , which is lower than the non-AGM strategy. Given these performance measures as expected, the Sharpe ratio of 1.35 is also lower than that of non-AGM strategy. In both strategies the short availability wasn't a problem.

	Non-AGM (Equal weighted)	Near-AGM (equal weighted)
<i>Annualised returns</i>	21.47%	15.29%
<i>Sharpe ratio</i>	1.97	1.35
<i>Max Drawdown</i>	11.03%	12.67%
<i>Beta</i>	0.014	-0.072

Table 1. Near-AGM vs. Non-AGM Performance

It is worth noticing that for this study a bottom-up approach was taken when deciding the daily AUM we hold, namely, the AUM is determined based on the long and short positions we took by the end of each trading day. Hence in such case it doesn't seem to be possible to breach the short availability. However, when taking a top-down approach where AUM is decided before entering into the strategy, it is advised to run a simulation and check for any shortage of short availability of any of the 132 pairs, and take positions only when shorts are sufficient. The top-down approach will inevitably lead to reduction in the expected returns, and further studies will explore further on how AUM limits will affect the portfolio performance in details.

6.3 Portfolio Construction

Although it seems that when current spread deviates away from the historical spread average, it will result in higher alpha and thus higher net returns, the results seem to align with the fact that usually an equally weighted portfolio outperforms a value-weighted portfolio, since equal-weighting subjects less to certain factor exposures and is able to counterpart volatilities experienced by some factors. Figure 7 shows the returns generated by the spread-weighted portfolio in blue, equal weighted portfolio in orange and the returns from S&P 500 in grey. Either way our strategy is outperforming the S&P 500 index. Equally weighted portfolio is further outperforming the spread-weighted portfolio. One of the reason for such outcome can be that the spread not returning to its historical mean at all or soon enough. Thus the fundamental idea behind spread-weighting is not being supported at least in some of the pairs we shortlisted.

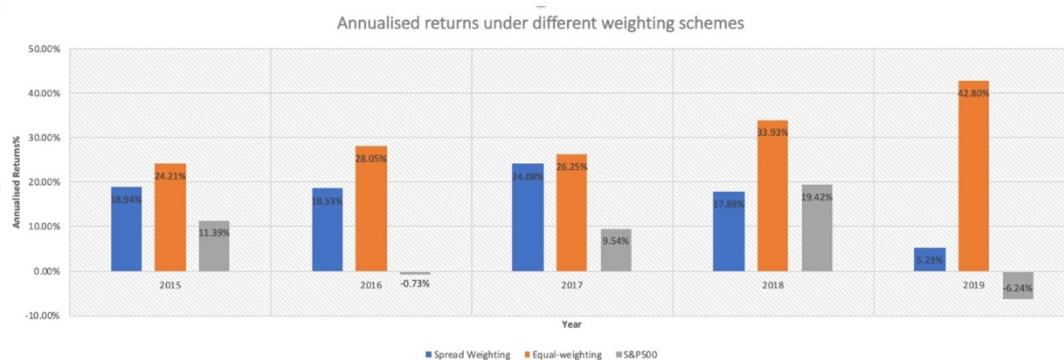


Figure 7. Weighting Schemes Performance

Table 1 shows the performance metrics of the two weighting schemes. It is observed that equal-weighting outperforms on the basis of all the metrics. A low beta suggests beta neutrality, which contributes to market neutrality. The outstanding Sharpe ratios (2.21 for equal-weighting scheme and 1.88 under spread-weighting) under both weighting schemes are in line with expectation, since the pairs shortlisted generally have low frequency of sudden spread deviation and thus low annualised volatility, while returns are sustainable in a longer period of time since we benefit from all market conditions as both long and short positions are entered.

	Equal weighting	Spread weighting
<i>Annualised returns</i>	16.93%	31.05%
<i>Sharpe ratio</i>	2.21	1.88
<i>Max Drawdown</i>	7.96%	13.60%
<i>Beta</i>	0.027	0.043

Table 2. EW vs. SW Performance

6.4 Impact of MARKET, SIZE, and VALUE effects

While shortlisting eligible pairs, we noticed that larger corporations (defined as higher market capitalisation value) tend to have lower correlation scores. This leads to the hypothesis that size factor plays a role in deciding the strategy returns. In this section we regress the Fama-French 3 factors against the equal-weighted portfolio time-series returns in the back-testing period and strive to find any significant betas. The factor returns are downloaded from Fama-French's official publications (developed markets).

Variable 1, 2, and 3 corresponds to the MKT-RF, VALUE and SIZE factors. We noticed that the t-stat and p-value for MKT-RF and VALUE factors are low, indicating insignificant factor influence on the pairs returns. However, the t-stat for the SIZE factor is significant at a magnitude of 2.47, and its beta is valued at -0.8. Negative beta indicate that big market-cap companies tend to have higher returns as compared to small-cap companies.

Regression Statistics	
Multiple R	0.060923449
R Square	0.003711667
Adjusted R Square	0.001898035
Standard Error	5.035864645
Observations	1652

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	155.7002205	51.9000735	2.046538296	0.105450932
Residual	1648	41793.16913	25.35993272		
Total	1651	41948.86935			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1.10726094	0.124225633	8.913304895	1.28233E-18	0.863604224	1.350917656	0.863604224	1.350917656
X Variable 1	0.027021462	0.160101898	0.168776651	0.865993036	-0.287003123	0.341046048	-0.287003123	0.341046048
X Variable 2	0.098218076	0.355389538	0.276367382	0.782300561	-0.598844566	0.795280718	-0.598844566	0.795280718
X Variable 3	-0.804967969	0.325627954	-2.472048108	0.013534494	-1.443656107	-0.166279831	-1.443656107	-0.166279831

Table 3. Fama-French Regression Analysis

However, we only used 132 pairs in the regression analysis. To conclude more meaningful results, we need to have a larger trading universe. Fields of further studies will be address in *Section 8 – Limitations and Further Studies*.

7. Sensitivity Analysis and Strategy Robustness

This section talks about how change in parameters used in non- and near-AGM strategies will potentially affect the ultimate portfolio performance. Optimization of these factors requires extensive back-testing and it is often a trial-and-fail journey. Hence, instead of testing on all possible combination of parameters, the few that will either prove our hypotheses or potentially improve the ultimate portfolio performance were selected. These parameters include trading frequency, abnormal observation window, as well as trend intensity³.

³ The benchmark to decide whether there is clear trend to follow, either upward or downward.

7.1 Trading Frequency and Looking-back Period

In the vanilla non-AGM strategy discussed above, for each of the pair, long/short positions were only switched when the current price ratio ($t-1$) is above or below the past 15-day price ratio average ($t-16$ till $t-2$). As such, positions were inevitably held overnight when current trend continues. Theoretically, this means exposure to greater market volatility and vicious price manipulation before market opens. However, such concern is less grounded since unlike the classic pairs trading strategy, the pairs that are proved to be highly correlated (Class A and Class B shares) with correlation score of 0.96 and above are traded. Hence the probability of unexpected deviation or dramatic gap widening is minimised. This has been showcased in past studies as well. Following this, the average position holding period is 11.2 days for the vanilla non-AGM strategy.

7.1.1 Daily trading frequency

If trading frequency were to be switched to daily rebalancing and based on the assumption that commission rates and other related transaction charges remain constant at 2%, tremendous expenses will be incurred that will jeopardize our final returns, while the benefit of doing so is theoretically insignificant. As such, back-testing was not attempted on daily trading frequency.

7.1.2 Possibility of other trading frequencies

However, it is worth noticing that the position switching benchmark of 15-day price ratio average is arbitrary and thus can be further tuned. Longer looking-back periods will increase the chance of identifying true trend-switching points, and are less subject to extreme events and value fluctuation. Besides, longer looking-back periods will further extend the average position holding duration and thus less transaction costs.

	Trend identification	Avg. position holding duration	Transaction costs	Annualised returns (w/o transaction costs)
<i>Long looking-back periods</i>	More accurate	Longer	Lower	Lower. Less sensitive to profit opportunities
<i>Short looking-back periods</i>	Less accurate and subject to extreme and non-recurring events	Shorter	Higher	Higher. Able to identify profit opportunities more shrewdly

Table 4. Looking-back periods

As illustrated in the above table, longer looking-back periods are likely to have lower raw returns as well as transaction costs, while shorter looking-back periods indicate the opposite. However, to determine whether there is a monotonic relationship between returns (net of transaction costs) and looking-back period, rigorous back testing will be run. The hypothesis we have is that there might be a relationship between the two, but not significant enough to draw any universal conclusion as it subjects to portfolio composition. Due to the data constraint of this project, we reserve it to further studies.

7.2 Abnormal observation window

As discussed in the Performance Evaluation section, one plausible explanation for the consistent underperformance of near-AGM is that, by taking *either* long *or* short position instead of *both* long *and* short positions during the near-AGM execution window (10 days prior to the AGM till 20 days after the AGM), we are fully exposed to the market movement in that period. Since this period is also observed to be highly volatile as more investors are tempted to trade near the AGM dates, we are more likely to suffer if the daily returns for that period are

wiped out by higher volatility, resulting in unsatisfying cumulative returns or even negative returns. Besides, for quite significant amount of time, although we successfully identified the abnormal activities around the AGM dates, uniform opinions are not observed, making it hard to identify clear trends to follow.

To improve this situation, we propose to strengthen the process that we identify the near-AGM trends, and only execute near-AGM strategy when clear upward or downward trends are observed.

Borrowing the well-known idea of Post Earning Announcement Drift (Bernard and Thomas, 1989), we regard AGM publications to contain valuable information that investors can actively trade on, and investors', especially retail investors' behaviours are explainable by the proposition of underreaction, which causes momentum effect after the earning announcement, which can last 60 days or even longer in some cases. Besides, as discovered by Bernard and Thomas, investors start to take positions as early as 60 days before the actual earnings announcement date, potentially indicating relevant information leakage. Hence, instead of focusing on the "30 - 10" observation window⁴ to determine trends prior to the AGM dates, we extend the observation to "60 - 20" window prior to the AGM dates.

Specifically, we take the average price ratios from 60 days prior to AGM dates till 20 days prior to AGM dates, compare it to all-year price ratio average to determine whether the spread has widened or narrowed significant enough for us to identify clear trends. It is worth noticing that longer observation windows, namely 40 days, will subject less to extreme price ratios resulting from non-recurring events, as compared to 20 days as we implemented previously.



Figure 8. Trend Identification with Different Observation Windows

As illustrated in the above graph, when we switch the observation period from "30-10" to "60-20", we managed to observe fewer abnormal activities (out of 273 AGM dates, we observed 224 abnormal activities, down from 238 under "30-10" window), and significantly fewer trends (only 84 clear trends, identified which include both upward and downward trends, which makes 30.77% of the entire universe). This observation is in line with our hypothesis that longer observation window will average-out non-recurring extreme values and improve the ability of identifying true trends.

⁴ Observation of trends starts 30 days prior to the AGM dates, and form position 10 days prior to AGM dates

7.3 Trend Intensity

Apart from making improvement on observation windows, we experimented with trend intensity parameter as well. Using “60-20” observation window, we now only identify a true trend if the near-AGM price ratio is at least 1 standard deviation away from the historical price ratio mean. This process can be expressed as:

$$I_{trend} = \frac{\sum_{t-s}^t PR_i}{s} \geq \frac{\sum_{t-252}^t PR_i}{252} (1 + a * std)$$

where t is the end of abnormal observation window;

s represents the observation length;

PR is the price ratio between the two legs of a same pair;

std represent one standard deviation away from the historical mean of price ratios;

a is an integer.

This process follows an identity function that whenever the condition is fulfilled, we count 1.

As illustrated in the graph below, out of the universe of 273 AGM dates, the number of trends we can identify falls from 84 to 21.

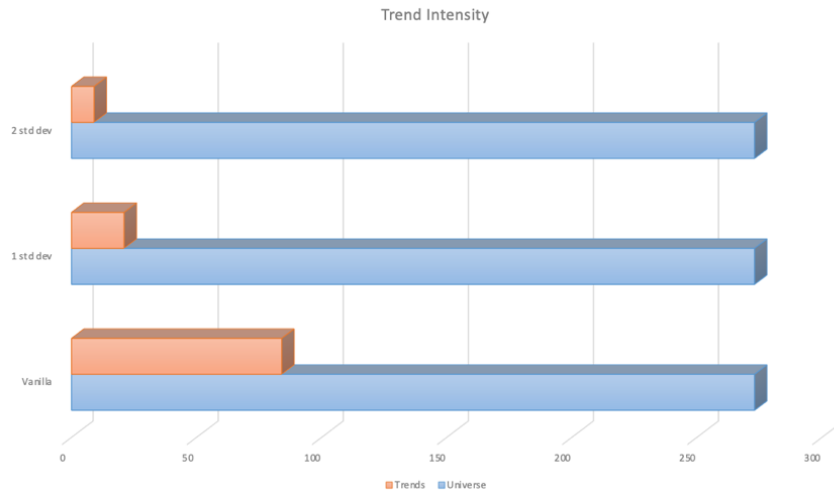


Figure 9. Trend Identification with Different Trend Intensity Assumption

Furthermore, we upscaled the trend intensity parameter to 2 standard deviations, while keeping observation window constant at “60-20”, we observed that only 9 out of 273 AGM dates in our universe have clear trends, either upward or downward. The identification rate is as low as 3.29%.

Hence, we decided to abort the near-AGM strategy at this stage as clear trends are not as easy to identify as we previously hypothesized. Even if we successfully identified such trends, it cannot be replicated to large scale as such observations are too rare to make significant impact to the overall portfolio we construct.

Causes of low identification rate include:

- (1) Information efficiency and low stock entry barrier. When Class A shareholders trade on insider information and reflected in the Class A share price movement, Class B shareholders respond quickly before any meaningful spread emerges. Or majority investors invest concurrently in Class A and Class B shares.
- (2) Insider trading are heavily regulated in the North American equity market since the big scandals in the early 2000s and systematic financial crisis.

8. Limitations and Further Research

8.1 Pairs Selection

Considering execution difficulties and potentially higher implementation costs involved, trading universe was narrowed to the US and Canada equity markets, including few OTC platforms. However, after filtering out inappropriate stocks, 132 pairs were left. This might pose data limitation issue when the Fama-French 3 factor regression is run. To conclude anything more meaningful, more data points are needed. Hence future studies could expand trading universe to European or other emerging markets.

Besides, in the pair selection process, it was assumed that stocks labelled as Class A are the ones with higher voting rights, unless otherwise stated. However, there might be cases where such assumption does not hold, which will result in trading the wrong leg in the near-AGM strategies.

It was also noticed that some legitimate pairs have quite bizarre ticker names that do not follow the standard XXX (Class B) vs. XXX/A (Class A), or XXX/B (Class B) vs. XXX (Class A) setting and labelled as XXX/L vs. XXX/B etc. Examples include MKC vs. MKC.V and TR vs. TROL.B.

8.2 Robustness in Different Markets under Different Insider Trading Practice (Near-AGM Strategy)

The reason that near-AGM strategy failed to identify sufficient genuine trends out of the trading universe may partially due to the heavy regulation on insider trading, or insiders trade in a way that is less obvious to observe with current measures. Hence, this strategy could be tested in other markets with different insider trading practice and relevant regulations, especially in emerging markets. See *Appendix 10.6 – Dual-class Practice by Country*.

8.3 Netting Effect on Portfolio Performance

Correlations between pairs were not considered, thus the netting effect among the pairs as a portfolio wasn't considered either. It is plausible that when implemented in real world, this netting effects will diversify certain extent of risk at a given point in time and thus enhance overall performance as a portfolio.

8.4 AUM Assumptions

Throughout this project, AUM limit isn't specified. The AUM held on a particular trading day follows a bottom-up approach – i.e. first benchmark to the short availability list and make sure it's possible to enter all the short positions intended to enter, in order to achieve market neutrality on each pair. Then based on these positions, calculate the current day AUM. It is worth noticing that such practice may encounter difficulties when implemented in the real market, which will be the focus of future studies.

9. Conclusion

In this project dual-listing stock pairs from the US and Canada equity market in period from 1 January 2014 to 31 December 2019 were shortlisted, a pair trading like non-AGM strategy was implemented on these pairs. Then the near-AGM strategy was implemented and possible explanations of why the strategy underperform non-AGM strategy consistently were explored. Following this, hypotheses of what actually causes such underperformance were tested and fields of future studies were provided. The main conclusions are (1) dual-listing stock pairs outperforms the S&P500 market consistently with minimised volatility and sustainable returns; (2) clear trends are hard to identify around the AGM dates. Abnormal activities are observed but investor opinions are too diverged for us to form robust trading strategies on. Furthermore, equally-weighted and spread-weighted portfolios were compared to decide on a weighting scheme. Following from Section 8, many branches of this study can be explored and worked on in further studies.

10. Appendix

10.1 Correlation and Cointegration Evaluation (partial)

Company	Correlation	Cointegration
Alphabet Inc.	0.999498347	Not Cointegrated
Amerant Bancorp Inc.	0.705626715	Not Cointegrated
Bel Fuse Inc.	0.928285928	Not Cointegrated
Biglari Holdings Inc.	0.999965121	Cointegrated
Brown Forman Corporation	0.9869397	Not Cointegrated
Central Garden & Pet Company	0.998402354	Cointegrated
Crawford & Company	0.930962479	Not Cointegrated
Discovery, Inc.	0.970842541	Cointegrated
Donegal Group, Inc.	0.547414909	Not Cointegrated
Embotelladora Andina S.A.	0.968736773	Not Cointegrated
Kelly Services, Inc.	0.721605984	Cointegrated
Liberty Broadband Corporation	0.99951204	Cointegrated
Liberty Global plc	0.991327807	Cointegrated
Liberty Media Corp	0.999108786	Cointegrated
Liberty Media Corporation	0.983816188	Not Cointegrated
LIBERTY MEDIA CORP 3	0.898920277	Cointegrated
Liberty TripAdvisor Holdings,	0.764272033	Cointegrated
Lions Gate Entertainment Corp	0.998923795	Cointegrated
Protective Insurance Corporat	0.887534202	Cointegrated
QAD Inc.	0.994515337	Cointegrated
Qurate Retail, Inc.	0.993193603	Cointegrated
Reading International Inc	0.879984256	Not Cointegrated
Royal Dutch Shell PLC	0.990016909	Not Cointegrated

Company	Correlation	Cointegration
Seneca Foods Corp.	0.930519348	Cointegrated
Under Armour, Inc.	0.993397865	Cointegrated
Urban One, Inc.	0.996862684	Cointegrated
Rush Enterprises, Inc.	0.990430875	Not Cointegrated
ViacomCBS Inc.	0.997703961	Not Cointegrated
Zillow Group, Inc.	0.997696069	Cointegrated
Greif, Inc.	0.99999302	Cointegrated
MOOG INC	0.99967824	Cointegrated
BIGLARI HOLDINGS INC	0.915508454	Not Cointegrated
BIO RAD LABORATORIES INC	0.999645065	Cointegrated
Clearway Energy, Inc.	0.993487087	Cointegrated
Constellation Brands Inc	0.999695384	Cointegrated
Federal Agricultural Mortgage C	0.983125049	Not Cointegrated
Fox Corporation	0.997875872	Not Cointegrated
Gray Television, Inc.	0.991206172	Not Cointegrated
Haverty Furniture Companies, In	0.997832534	Cointegrated
Heico Corporation	0.993100481	Cointegrated
Lennar Corporation	0.986882431	Not Cointegrated
Berkshire Hathaway Inc.	0.108828737	Not Cointegrated
NEWS CORP NEW	0.989174146	Not Cointegrated
LIBERTY GLOBAL	0.996641796	Cointegrated
MCCORMICK & CO INC	0.979390493	Cointegrated
WATSCO INC	0.999056922	Cointegrated

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10.2 Stocks Shortlisted

Symbol	Name
ADW.A	Andrew Peller Limited
ADW.B	Andrew Peller Limited
AGM	Federal Agricultural Mortgage Corporation
AGMA	Federal Agricultural Mortgage Corporation
AKO.A	Embotelladora Andina S.A.
AKO.B	Embotelladora Andina S.A.
AKT.A	AKITA Drilling Ltd.
AKT.B	AKITA Drilling Ltd.
AMTB	Amerant Bancorp Inc.
AMTB	Amerant Bancorp Inc.
APT	Aptiv PLC
APVP.F	Aptiv PLC
ARTNA	Artesian Resource
ARTNB	Artesian Resource
ATD.A	Alimentation Couche-Tard Inc.
ATD.B	Alimentation Couche-Tard Inc.
ATRO	Astronics Corporation
ATRO.B	Astronics Corporation
BASE	Evolve Global Materials & Mining Enhanced Yield Index ETF
BASE.B	Evolve Global Materials & Mining Enhanced Yield Index ETF
BATR.A	The Liberty Braves Group
BATR.B	The Liberty Braves Group
BBDA	Bombardier Inc.
BBDB	Bombardier Inc.
BBX	BBX Capital Corporation
BBXT.B	BBX Capital Corporation
BDX	Becton, Dickinson and Company
BDXB	Becton, Dickinson and Company
BELFA	Bel Fuse Inc.
BELFB	Bel Fuse Inc.
BFA	Brown Forman Corporation
BF.B	Brown Forman Corporation
BH	Biglari Holdings Inc.
BHA	Biglari Holdings Inc.
BIO	Bio-Rad Laboratories, Inc.
BIO.B	Bio-Rad Laboratories, Inc.
BRK.A	Berkshire Hathaway Inc.
BRK.B	Berkshire Hathaway Inc.
BURCA	Burnham Holdings, Inc.
BURCB	Burnham Holdings, Inc.
CALL	Evolve US Banks Enhanced Yield Fund
CALLB	Evolve US Banks Enhanced Yield Fund
CARS	Evolve Automobile Innovation Index Fund
CARS.B	Evolve Automobile Innovation Index Fund
CCLA	CCL Industries Inc.
CCLB	CCL Industries Inc.
OCOR	CI DoubleLine Core Plus Fixed Income US\$ Fund
OCORB	CI DoubleLine Core Plus Fixed Income US\$ Fund
FST.A	First Trust Canadian Capital Strength ETF
FUD	First Trust Value Line Dividend Index ETF
FUD.A	First Trust Value Line Dividend Index ETF
FWON.A	Formula One Group
FWONB	Formula One Group
GCG	Guardian Capital Group Limited
GCG.A	Guardian Capital Group Limited
GEF	Greif, Inc.
GEF.B	Greif, Inc.
GLIB.A	GCI Liberty, Inc.
GLIB.B	GCI Liberty, Inc.
GOOG	Alphabet Inc.
GOOGL	Alphabet Inc.
GTN	Gray Television, Inc.
GTN.A	Gray Television, Inc.
HBF	Harvest Brand Leaders Plus Income ETF
HBF.B	Harvest Brand Leaders Plus Income ETF
HEI	Helco Corporation
HEI.A	Helco Corporation
HHL	Harvest Healthcare Leaders Income ETF
HHL.B	Harvest Healthcare Leaders Income ETF
HNFS.A	Hanover Foods Corporation
HNFS.B	Hanover Foods Corporation
HTA	Harvest Tech Achievers Growth & Income ETF
HTA.B	Harvest Tech Achievers Growth & Income ETF
HVT	Haverty Furniture Companies, Inc.
HVT.A	Haverty Furniture Companies, Inc.
IQD	CI WisdomTree International Quality Dividend Growth Index ETF
IQD.B	CI WisdomTree International Quality Dividend Growth Index ETF
JAPN	CI WisdomTree Japan Equity Index ETF
JAPNB	CI WisdomTree Japan Equity Index ETF
JW.A	John Wiley & Sons, Inc.
JW.B	John Wiley & Sons, Inc.
KELYA	Kelly Services, Inc.
KELYB	Kelly Services, Inc.
KILO	Purpose Gold Bullion Fund
KILO.B	Purpose Gold Bullion Fund
KWG	KWG Resources Inc.
KWG.A	KWG Resources Inc.
LBROA	Liberty Broadband Corporation
LBROB	Liberty Broadband Corporation
LBTYA	Liberty Global plc
LBTYB	Liberty Global plc
LEN	Lennar Corporation
LEN.B	Lennar Corporation
LGF.A	Lions Gate Entertainment Corporation
LGF.B	Lions Gate Entertainment Corporation

CDLB	CI DoubleLine Total Return Bond US\$ Fund
CDLB.B	CI DoubleLine Total Return Bond US\$ Fund
CENT	Central Garden & Pet Company
CENTA	Central Garden & Pet Company
CJT	Cargojet Inc.
CJT.A	Cargojet Inc.
CRD.A	Crawford & Company
CRD.B	Crawford & Company
CSOCA	Canso Select Opportunities Corporation
CSOC.B	Canso Select Opportunities Corporation
CSW.A	Corby Spirit and Wine Limited
CSW.B	Corby Spirit and Wine Limited
CTC	Canadian Tire Corporation, Limited
CTC.A	Canadian Tire Corporation, Limited
CWEN	Clearway Energy, Inc.
CWEN.A	Clearway Energy, Inc.
CYBR	Evolve Cyber Security Index Fund
CYBR.B	Evolve Cyber Security Index Fund
DGICA	Donagel Group, Inc.
DGICB	Donagel Group, Inc.
DGR	CI WisdomTree U.S. Quality Dividend Growth Index ETF
DGR.B	CI WisdomTree U.S. Quality Dividend Growth Index ETF
DII.A	Dorel Industries Inc.
DII.B	Dorel Industries Inc.
DISCA	Discovery, Inc.
DISCB	Discovery, Inc.
DMKB.A	Denmark Bancshares, Inc.
DMKB.B	Denmark Bancshares, Inc.
EBR	Centrais Electricas Brasileiras S.A.- Eletrobras
EBR.B	Centrais Electricas Brasileiras S.A.- Eletrobras
EHE	WisdomTree Europe Hedged Equity Index ETF
EHE.B	WisdomTree Europe Hedged Equity Index ETF
ETP	First Trust Global Risk Managed Income Index ETF
ETP.A	First Trust Global Risk Managed Income Index ETF
EUR	First Trust AlphaDEX European Dividend Index ETF
EUR.A	First Trust AlphaDEX European Dividend Index ETF
FCNCA	First Citizens BancShares, Inc.
FCNCB	First Citizens BancShares, Inc.
FHI	CI First Asset Health Care Giants Covered Call ETF
FHI.B	CI First Asset Health Care Giants Covered Call ETF
FLOT	Purpose Floating Rate Income Fund
FLOT.B	Purpose Floating Rate Income Fund
FOX	Fox Corporation
FOXA	Fox Corporation
FSL	First Trust Senior Loan ETF (CAD-Hedged)
FSL.A	First Trust Senior Loan ETF (CAD-Hedged)
FST	First Trust Canadian Capital Strength ETF
LGT.A	Logistec Corporation
LGT.B	Logistec Corporation
LIFE	Evolve Global Healthcare Enhanced Yield Fund
LIFE.B	Evolve Global Healthcare Enhanced Yield Fund
LILA	Liberty Latin America Ltd.
LILAB	Liberty Latin America Ltd.
LINS	Life Insurance Company
LINS.A	Life Insurance Company
LSXMA	Liberty Media Corporation
LSXMB	Liberty Media Corporation
LTRPA	Liberty TripAdvisor Holdings, Inc.
LTRPB	Liberty TripAdvisor Holdings, Inc.
MDP	Meredith Corporation
MDPE.B	Meredith Corporation
MINT	Manulife Multifactor Developed International Index ETF
MINT.B	Manulife Multifactor Developed International Index ETF
MKC	McCormick & Company, Incorporated
MKC.V	McCormick & Company, Incorporated
MOGA	Moog Inc.
MOG.B	Moog Inc.
MULC	Manulife Multifactor U.S. Large Cap Index ETF
MULC.B	Manulife Multifactor U.S. Large Cap Index ETF
MUMC	Manulife Multifactor U.S. Mid Cap Index ETF
MUMC.B	Manulife Multifactor U.S. Mid Cap Index ETF
MUSC	Manulife Multifactor U.S. Small Cap Index ETF
MUSC.B	Manulife Multifactor U.S. Small Cap Index ETF
NWS	News Corporation
NWSA	News Corporation
NXF	CI First Asset Energy Giants Covered Call ETF
NXF.B	CI First Asset Energy Giants Covered Call ETF
ORCA	Orca Exploration Group Inc.
ORC.B	Orca Exploration Group Inc.
PHE	Purpose Fund Corp. - Purpose Tactical Hedged Equity Fund
PHE.B	Purpose Fund Corp. - Purpose Tactical Hedged Equity Fund
PNC.A	Postmedia Network Canada Corp.
PNC.B	Postmedia Network Canada Corp.
PTVCA	Protective Insurance Corporation
PTVCB	Protective Insurance Corporation
PUD	Purpose Fund Corp. - Purpose US Dividend Fund
PUD.B	Purpose Fund Corp. - Purpose US Dividend Fund
PYF	Purpose Fund Corp. - Purpose Premium Yield Fund
PYF.B	Purpose Fund Corp. - Purpose Premium Yield Fund
QADA	QAD Inc.
QADB	QAD Inc.
QBR.A	Quebecor Inc.
QBR.B	Quebecor Inc.
QRTEA	Qurate Retail, Inc.

Excluded from Near-AGM Strategy
Excluded from strategy - data missing

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QRTEA	Qurate Retail, Inc.
QRTEB	Qurate Retail, Inc.
RAY.A	Stingray Group Inc.
RAY.B	Stingray Group Inc.
RCI.A	Rogers Communications Inc.
RCI.B	Rogers Communications Inc.
RDI	Reading International Inc
RDOB	Reading International Inc
RDS.A	Royal Dutch Shell PLC
RDS.B	Royal Dutch Shell PLC
RUSHA	Rush Enterprises, Inc.
RUSHB	Rush Enterprises, Inc.
RWE	CI First Asset MSCI Europe Low Risk Weighted ETF
RWE.B	CI First Asset MSCI Europe Low Risk Weighted ETF
RWU	CI First Asset MSCI USA Low Risk Weighted ETF
RWU.B	CI First Asset MSCI USA Low Risk Weighted ETF
RWW	CI First Asset MSCI World Low Risk Weighted ETF
RWW.B	CI First Asset MSCI World Low Risk Weighted ETF
RWX	CI First Asset MSCI International Low Risk Weighted ETF
RWX.B	CI First Asset MSCI International Low Risk Weighted ETF
SBT	Purpose Silver Bullion Fund
SBT.B	Purpose Silver Bullion Fund
SCX	The L.S. Starrett Company
SCXL.B	The L.S. Starrett Company
SDI	Standard Diversified Inc.
SDOI.B	Standard Diversified Inc.
SENEA	Seneca Foods Corp.
SENEB	Seneca Foods Corp.
SJRLA	Shaw Communications Inc.
SJRLB	Shaw Communications Inc.
STZ	Constellation Brands Inc
STZ.B	Constellation Brands Inc
TAP	Molson Coors Beverage Company
TAP.A	Molson Coors Beverage Company
TCLA	Transcontinental Inc.
TCLB	Transcontinental Inc.
TECK.A	Teck Resources Limited
TECK.B	Teck Resources Limited
TPX.A	Molson Coors Canada Inc.
TPX.B	Molson Coors Canada Inc.
TR	Tootsie Roll Industries, Inc.
TROLB	Tootsie Roll Industries, Inc.
TXF	CI First Asset Tech Giants Covered Call ETF
TXF.B	CI First Asset Tech Giants Covered Call ETF
UA	Under Armour, Inc.
UAA	Under Armour, Inc.
UBA	Urstadt Biddle Properties Inc.
UBP	Urstadt Biddle Properties Inc.
UONE	Urban One, Inc.
UONEK	Urban One, Inc.
URB	Urbana Corporation
URB.A	Urbana Corporation
UXM	CI First Asset Morningstar US Dividend Target 50 Index ETF
UXM.B	CI First Asset Morningstar US Dividend Target 50 Index ETF
VIAC	ViacomCBS Inc.
VIACA	ViacomCBS Inc.
VXM	CI First Asset Morningstar International Value Index ETF
VXM.B	CI First Asset Morningstar International Value Index ETF
WCM.A	Wilmington Capital Management Inc.
WCM.B	Wilmington Capital Management Inc.
WSO	Watsco, Inc.
WSO.B	Watsco, Inc.
WTBF.A	W.T.B. Financial Corporation
WTBF.B	W.T.B. Financial Corporation
XXM	CI First Asset Morningstar US Value Index ETF
XXM.B	CI First Asset Morningstar US Value Index ETF
YXM	CI First Asset Morningstar US Momentum Index ETF
YXM.B	CI First Asset Morningstar US Momentum Index ETF
Z	Zillow Group, Inc.
ZG	Zillow Group, Inc.
ZXM	CI First Asset Morningstar International Momentum Index ETF
ZXM.B	CI First Asset Morningstar International Momentum Index ETF

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10.3 Short Availability

Symbol	Name	Short Availability	Short Rates
ADW.A	Andrew Peller Limited	2497192	0.668
ADW.B	Andrew Peller Limited		
AGM	Federal Agricultural Mortgage Corporation	1542	2.437
AGM.A	Federal Agricultural Mortgage Corporation	1912079	0.3
AKO.A	Embotelladora Andina S.A.	6085	2.554
AKO.B	Embotelladora Andina S.A.	134921	1.007
AKT.A	AKITA Drilling Ltd.	1182905	0.4
AKT.B	AKITA Drilling Ltd.	373	0.3
AMTB	Amerant Bancorp Inc.	1685553	0.3
AMTB.B	Amerant Bancorp Inc.	4575	2.964
ARTNA	Artesian Resource	1031752	0.3
ARTN.B	Artesian Resource		
ATD.A	Alimentation Couche-Tard Inc.	123121276	0.3
ATD.B	Alimentation Couche-Tard Inc.	231903	0.55
ATRO	Astronics Corporation	5764428	0.3
ATRO.B	Astronics Corporation	217240	0.976
BATRLA	The Liberty Braves Group	3606618	0.3
BATRL.B	The Liberty Braves Group	21897195	0.3
BBD.A	Bombardier Inc.	14824047	0.3
BBD.B	Bombardier Inc.	1350	6.803
BBX	BBX Capital Corporation		
BBXT.B	BBX Capital Corporation	10486645	0.3
BELFA	Bel Fuse Inc.	268929	0.3
BELFB	Bel Fuse Inc.	2193765	0.3
BF.A	Brown Forman Corporation	1001479	0.3
BF.B	Brown Forman Corporation	25822924	0.3
BH	Biglari Holdings Inc.	196545	0.3
BHA	Biglari Holdings Inc.	17513	0.607
BIO	Bio-Rad Laboratories, Inc.	4827396	0.3
BIO.B	Bio-Rad Laboratories, Inc.		
BRK.A	Berkshire Hathaway Inc.	3623	0.3
BRK.B	Berkshire Hathaway Inc.	228903088	0.3
BURCA	Bumham Holdings, Inc.		
BURCB	Bumham Holdings, Inc.		
OCLA	CCL Industries Inc.		
OCLB	CCL Industries Inc.	12299383	0.3
CENT	Central Garden & Pet Company	3026315	0.49
CENTA	Central Garden & Pet Company	14207614	0.3
CRD.A	Crawford & Company	2914425	0.3
CRD.B	Crawford & Company	2168644	0.3
CSOC.A	Canso Select Opportunities Corporation		
CSOC.B	Canso Select Opportunities Corporation		
CSW.A	Corby Spirit and Wine Limited		
CSW.B	Corby Spirit and Wine Limited	1669963	0.3
CTC	Canadian Tire Corporation, Limited	6142995	0.3
CTCA	Canadian Tire Corporation, Limited		
CWEN	Clearway Energy, Inc.	5524559	0.3
CWEN.A	Clearway Energy, Inc.	13476848	0.3
DGICA	Donegal Group, Inc.	3248745	0.3
DGICB	Donegal Group, Inc.	206359	0.918
DII.A	Dorel Industries Inc.	5941157	0.3
DII.B	Dorel Industries Inc.		
DISCA	Discovery, Inc.	63987308	0.3
DISCB	Discovery, Inc.	8257691	0.3
DMKB.A	Denmark Bancshares, Inc.	25	4.121
DMKB.B	Denmark Bancshares, Inc.		
EBR	Centrais Electricas Brasileiras S.A.- Eletrobras	805280	3.533
EBR.B	Centrais Electricas Brasileiras S.A.- Eletrobras	1004383	2.074
FCNCA	First Citizens BancShares, Inc.	1286573	0.3
FCNCB	First Citizens BancShares, Inc.	1018093	0.3
FOX	Fox Corporation	60079656	0.3
FOXA	Fox Corporation	33766167	0.3
PWON.A	Formula One Group		
PWON.B	Formula One Group		
GOG	Guardian Capital Group Limited	382082	0.3
GCG.A	Guardian Capital Group Limited		
GEF	Greif, Inc.	7032844	0.3
GEF.B	Greif, Inc.		
GLIB.A	GCI Liberty, Inc.	17332435	0.3
GLIB.B	GCI Liberty, Inc.	320939	0.485
GOOG	Alphabet Inc.		
GOOGL	Alphabet Inc.	44288378	0.3
GTN	Gray Television, Inc.	21866998	0.3
GTN.A	Gray Television, Inc.	167887	0.3
HEI	Helco Corporation	11723170	0.3
HEI.A	Helco Corporation	5510815	0.3
HNFS.A	Hanover Foods Corporation		
HNFS.B	Hanover Foods Corporation	1500	2.394
HVT	Haverty Furniture Companies, Inc.		
HVT.A	Haverty Furniture Companies, Inc.	3095598	0.3
JW.A	John Wiley & Sons, Inc.		
JW.B	John Wiley & Sons, Inc.		
KELYA	Kelly Services, Inc.	3901	2.65
KELYB	Kelly Services, Inc.	9028075	0.3
KWG	KWG Resources Inc.		
KWG.A	KWG Resources Inc.		
LBROA	Liberty Broadband Corporation	3606618	0.3
LBROB	Liberty Broadband Corporation	21897195	0.3
LBTYA	Liberty Global plc	48185	0.914
LBTYB	Liberty Global plc	3068	4.75
LEN	Lennar Corporation	56315971	0.3
LEN.B	Lennar Corporation	1422173	0.3
LGF.A	Lions Gate Entertainment Corporation	26034	1.575
LGF.B	Lions Gate Entertainment Corporation	7668235	0.459
LGT.A	Logistec Corporation	5600	6.609
LGT.B	Logistec Corporation		
LILA	Liberty Latin America Ltd.	5815776	0.3
LILAB	Liberty Latin America Ltd.	17059219	0.3

UNS	Life Insurance Company	92	9.911
UNS.A	Life Insurance Company		
LSXMA	Liberty Media Corporation	55104	0.968
LSXMB	Liberty Media Corporation	11948625	0.3
LTRPA	Liberty TripAdvisor Holdings, Inc.	15217189	0.3
LTRPB	Liberty TripAdvisor Holdings, Inc.		
MDP	Meredith Corporation	3816728	0.3
MDPE.B	Meredith Corporation		
MKC	McCormick & Company, Incorporated	20729952	0.3
MKC.V	McCormick & Company, Incorporated	9998	0.634
MOGA	Moog Inc.	7240421	0.3
MOGB	Moog Inc.	25784	1.097
NWS	News Corporation	100477588	0.3
NWSA	News Corporation	14850593	0.3
ORCA	Orca Exploration Group Inc.	65833	1.882
ORCB	Orca Exploration Group Inc.		
PNC.A	Postmedia Network Canada Corp.		
PNC.B	Postmedia Network Canada Corp.		
PTVCA	Protective Insurance Corporation	7538	0.627
PTVCB	Protective Insurance Corporation	1951560	0.3
QADA	QAD Inc.	116963	0.777
QADB	QAD Inc.	1962682	0.3
QBR.A	Quebecor Inc	17731182	0.3
QBR.B	Quebecor Inc		
QRTEA	Qurate Retail, Inc.	8013	2.577
QRTEB	Qurate Retail, Inc.	60356220	0.3
RAY.A	Stingray Group Inc.	4315	0.3
RAY.B	Stingray Group Inc.		
RCI.A	Rogers Communications Inc.	53392526	0.3
RCI.B	Rogers Communications Inc.	5541964	0.3
RDI	Reading International Inc	2920024	0.3
RDI.B	Reading International Inc	38511	1.475
RDS.A	Royal Dutch Shell PLC	13047282	0.3
RDS.B	Royal Dutch Shell PLC	5555974	0.61
RUSHA	Rush Enterprises, Inc.	9825498	0.3
RUSHB	Rush Enterprises, Inc.	1440713	0.3
SCX	The L.S. Starrett Company	767331	0.898
SCXL.B	The L.S. Starrett Company		
SDI	Standard Diversified Inc.		
SDI.B	Standard Diversified Inc.	42273	1.29
SENEA	Seneca Foods Corp.	2030211	0.3
SENEB	Seneca Foods Corp.	93	9.911
SJRA	Shaw Communications Inc.	85749460	0.3
SJRB	Shaw Communications Inc.	3696	6.766
STZ	Constellation Brands Inc	25496989	0.3
STZ.B	Constellation Brands Inc	12400	1.091
TAP	Molson Coors Beverage Company	2985	0.3
TAP.A	Molson Coors Beverage Company	35017119	0.3
TCL.A	Transcontinental Inc.	6471698	0.3
TCL.B	Transcontinental Inc.		
TECK.A	Teck Resources Limited	56645741	0.3
TECK.B	Teck Resources Limited		
TPXA	Molson Coors Canada Inc.	2985	0.3
TPXB	Molson Coors Canada Inc.	35017119	0.3
TR	Tootsie Roll Industries, Inc.	1390446	0.986
TROL.B	Tootsie Roll Industries, Inc.		
UA	Under Armour, Inc.	24971336	0.3
UAA	Under Armour, Inc.	41927590	0.3
UBA	Ustadd Biddle Properties Inc.	148398	1.077
UBP	Ustadd Biddle Properties Inc.	181539	0.749
UONE	Urban One, Inc.	26433	0.3
UONEK	Urban One, Inc.	1137898	0.396
URB	Urbana Corporation		
URBA	Urbana Corporation		
VIAC	ViacomCBS Inc.	180094	0.3
VIACA	ViacomCBS Inc.	59355541	0.3
WCOM.A	Wilmington Capital Management Inc.	1320609	0.5
WCOM.B	Wilmington Capital Management Inc.		
WSO	Watsco, Inc.	12361	0.96
WSO.B	Watsco, Inc.	4537281	0.3
WTBFA	W.T.B. Financial Corporation	2429	1.437
WTBFB	W.T.B. Financial Corporation		
Z	Zillow Group, Inc.	10787509	0.3
ZG	Zillow Group, Inc.	6202658	0.3

Data missing

10.4 Assumptions on Transaction Costs

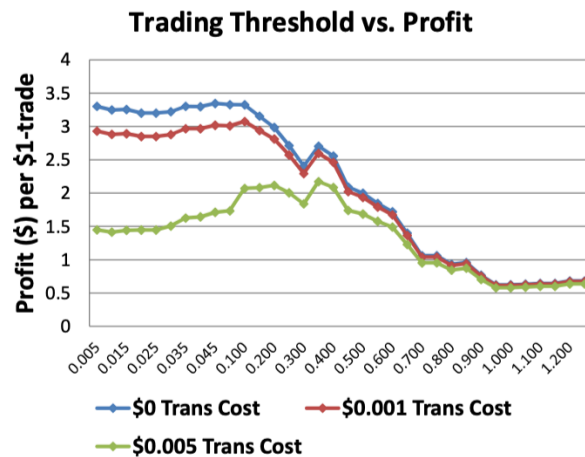


Figure 6. Profit (y-axis) as a function of trading thresholds (units: standard deviation)
Stock selection: Coca-Cola and Pepsi

When transaction cost is zero, it seems that the investor could have made the most profit by choosing a very small trading threshold in this case. However, with a transaction cost of \$0.005, or 0.5%, setting minimal trading threshold is not economical. The three scenarios converge as trading threshold goes up.

10.5 Dual-class IPOs

Exhibit 7: US IPO Data Since 1980

Year	Tech IPOs			Non-tech IPOs		
	Dual-class	Total	%	Dual-class	Total	%
1980	0	22	0.0%	1	49	2.0%
1981	2	73	2.7%	4	120	3.3%
1982	0	42	0.0%	0	35	0.0%
1983	3	173	1.7%	3	278	1.1%
1984	2	50	4.0%	5	121	4.1%
1985	1	36	2.8%	6	149	4.0%
1986	3	77	3.9%	21	316	6.6%
1987	1	58	1.7%	23	227	10.1%
1988	3	28	10.7%	6	77	7.8%
1989	1	35	2.9%	6	81	7.4%
1990	0	31	0.0%	7	79	8.9%
1991	7	70	10.0%	16	216	7.4%
1992	2	113	1.8%	16	299	5.4%
1993	3	126	2.4%	30	383	7.8%
1994	8	116	6.9%	25	286	8.7%
1995	8	204	3.9%	22	257	8.6%
1996	16	274	5.8%	46	403	11.4%
1997	10	173	5.8%	41	301	13.6%
1998	9	113	8.0%	21	168	12.5%
1999	22	370	5.9%	19	106	17.9%

Year	Tech IPOs			Non-tech IPOs		
	Dual-class	Total	%	Dual-class	Total	%
2000	19	260	7.3%	7	120	5.8%
2001	2	23	8.7%	5	56	8.9%
2002	2	20	10.0%	12	46	26.1%
2003	3	18	16.7%	5	45	11.1%
2004	3	61	4.9%	10	112	8.9%
2005	9	45	20.0%	13	114	11.4%
2006	1	48	2.1%	10	109	9.2%
2007	4	75	5.3%	14	84	16.7%
2008	0	6	0.0%	3	15	20.0%
2009	2	14	14.3%	3	27	11.1%
2010	2	33	6.1%	7	58	12.1%
2011	5	36	13.9%	9	45	20.0%
2012	5	39	12.8%	11	54	20.4%
2013	5	43	11.6%	23	114	20.2%
2014	6	53	11.3%	18	153	11.8%
2015	13	36	38.9%	8	79	10.1%
2016	5	21	23.8%	5	53	9.4%
2017	13	30	43.3%	17	78	21.8%
1980-2017	200	3,046	6.6%	498	5,314	9.4%

Source: Ritter (2018)

Exhibit 8: Number and Percentage of US Dual-Class IPOs Compared with Total Number of Listed IPOs

Year	Number of US dual class IPOs	Number of US listed IPOs	Percentage of dual class IPOs
2010	20	170	12%
2011	20	146	14%
2012	18	145	12%
2013	39	229	17%
2014	36	292	12%
2015	27	174	16%
2016	17	111	15%
9M2017	20	112	18%

Source: Huston (2017)¹⁹

10.6 Dual-class Practice by Country

Typically the superior voting shares are primarily held by founders and other insiders to achieve control of a firm. This allows insiders to operate without the interference from outside shareholders, who may be less well-informed or more short-term oriented than insiders.

This table summarizes whether a country's Company Law allows issuing multiple classes of shares. It is based on Table 3.3 of OECD Corporate Governance Factbook 2017.

Table A.1 (continued)

		Limited voting rights	No voting shares	Multiple voting rights
MSCI Emerging Countries:	Brazil	Allowed	Allowed (up to 1/2 of total shares; must have preferential rights to dividends)	Not allowed
	Chile	Allowed	Allowed	
	China	Allowed	Allowed (must have preferential rights to dividends)	Not allowed
	Colombia)	Allowed	Allowed (up to 1/2 of total shares; must have preferential rights to dividends)	Not allowed
	Czech Republic	Allowed	Allowed	Allowed
	Egypt	... Info N/A ...		
	Greece	Allowed	Allowed	
	Hungary	Allowed		Allowed
	India	Not allowed (listing rules)	Not allowed (listing rules)	Not allowed (listing rules)
	Indonesia	Not allowed	Allowed	Not allowed
	Malaysia	... Info N/A ...		
	Mexico	Allowed (up to 1/4 of total shares)	Allowed (up to 1/4 of total shares)	Not allowed
	Peru	... Info N/A ...		
	Philippines	... Info N/A ...		
	Poland	Allowed	Allowed	
	Qatar	... Info N/A ...		
	Russia	Allowed	Allowed (up to 1/4 of total shares; must have preferential rights to dividends)	
	South Africa	Allowed	Allowed	Allowed
	South Korea	Allowed (up to 1/4 of total shares)	Allowed (up to 1/4 of total shares; must have preferential rights to dividends)	Not allowed
	Taiwan	... Info N/A ...		
	Thailand	... Info N/A ...		
	Turkey	Allowed (need authorization)	Allowed	Allowed
		Limited voting rights	No voting shares	Multiple voting rights
MSCI Developed Countries:	Australia	Allowed (listing rules)	Not allowed	Not allowed
	Austria	Allowed	Allowed	
	Belgium	Allowed	Allowed (up to 1/3 of total shares)	
	Canada	Allowed		
	Denmark	Allowed	Allowed	Allowed
	Finland	Allowed	Allowed	Allowed
	France	Allowed (up to 1/2 of total shares)	Allowed (up to 1/4 of total shares)	Allowed (Loi Florange, 2x voting on shares with >2 years holding)
	Germany	Allowed	Allowed (up to 1/2 of total shares; must have preferential rights to dividends)	Not allowed
	Hong Kong	Allowed (but listing rules impose "one-share-one-vote")	Allowed	Not allowed
	Ireland	Allowed	Allowed	Allowed
	Israel	Not allowed (preference shares allowed under certain conditions)		Not allowed
	Italy	Allowed (up to 1/2 of total shares)	Allowed (up to 1/2 of total shares)	Allowed (loyalty shares, 2x voting on shares with >2 years holding)
	Japan	Allowed (up to 1/2 of total shares)	Allowed (up to 1/2 of total shares)	Not allowed
	Netherlands	Allowed	Not allowed	
	New Zealand	Allowed	Allowed	Allowed
	Norway	Allowed (code prescribes "one-share one-vote")		Allowed
	Portugal	Allowed	Allowed (up to 1/2 of total shares)	Not allowed
	Singapore	Not allowed (listed companies)	Not allowed (listed companies)	Not allowed (listed companies)
	Spain	Allowed	Allowed (up to 1/2 of total shares; must have preferential rights to dividends)	Not allowed
	Sweden	Allowed	Not allowed	Allowed (up to 1/10 of total shares)
	Switzerland	Allowed	Allowed (must have preferential rights to dividends)	Allowed
	United Kingdom	Allowed	Allowed	Allowed
	United States	Allowed	Allowed	Allowed

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