

1 Introduction

In recent years, the rise of commission-free trading platforms has profoundly reshaped retail investor behavior and sparked growing interest among scholars in behavioral finance. One of the most prominent examples is Robinhood, a mobile-first brokerage that gained widespread popularity for eliminating trading fees and offering a highly gamified user experience. The platform attracted a large number of retail investors, particularly young and inexperienced individuals.¹

An important development in the empirical literature was the release of Robintrack, an open-source dataset that tracks the number of Robinhood users holding individual stocks over time. This data, which was collected via Robinhood’s public API, provides a rare opportunity to directly observe the trading dynamics and portfolio shifts of real retail investors. The dataset can be downloaded from <https://robintrack.net/>.

Several recent studies, including [Fedyk, 2024] and [Welch, 2022]², have leveraged the Robintrack dataset to examine retail investor performance. Their findings suggest that Robinhood investors—contrary to popular belief—exhibited strong market timing and outperformed passive benchmarks. In particular, these papers report significant cumulative returns and positive alpha using standard factor models.

In this paper, we revisit these claims by constructing an alternative methodology for portfolio formation based on the same dataset. Specifically, we analyze whether the returns of Robinhood users’ favorite stocks exhibit stochastic dominance over benchmark indices. Our goal is to offer a more nuanced assessment of whether retail investors truly generate abnormal returns or whether previous results may be driven by sample selection or methodological choices.

2 Robinhood Dataset

2.1 Description of the Dataset

The dataset records the **number** of Robinhood users holding at least one share of 8,619 securities, with observations taken hourly. Following [Welch, 2022] and [Fedyk, 2024], we aggregate this data on a daily basis by selecting the last observation of each trading day.

¹According to Robinhood’s IPO filing, the typical user on the platform is 31 years old, with an average account balance of approximately \$3,500. Notably, around half of the platform’s users are investing for the first time.

²it must be noted that the former explicitly follows the method of the latter

The sample spans from February 5, 2018, to August 13, 2020, covering 818 days. Note that the dataset includes non-trading days and contains some missing observations.

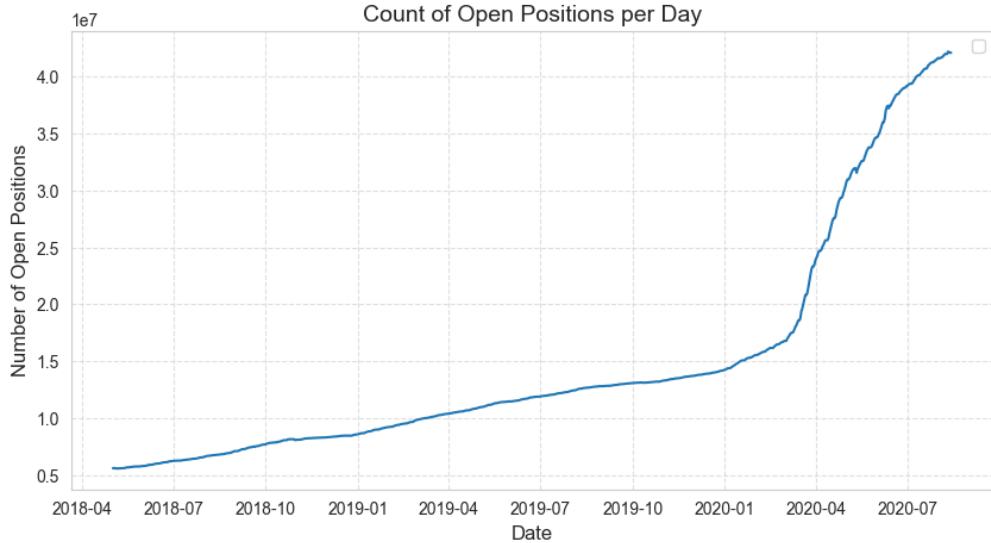
Since the dataset only provides the number of investors per security, we cannot track individual holdings, monetary amounts, or share quantities. Moreover, buy/sell flows are unobservable; however, we can approximate them using changes in the number of holders.

We merge this dataset with CRSP to obtain market-level information and later construct a benchmark index. The resulting dataframe contains 7,613 unique securities—substantially more than in [Fedyk, 2024] and [Welch, 2022], who restrict their analysis to U.S. common stocks only. Details of the data cleaning procedure are provided in Appendix B.

In terms of security types, common stocks represent 57.3% of the dataset, while ETFs and other funds account for 26.3% and 8.7%, respectively. Structured products, REITs, and ADRs constitute the remaining share. When classifying by market capitalization, stocks dominate with 83.1%, followed by ETFs (9.3%) and other funds (3.3%).

The total number of open positions on any given day is calculated as the sum of users holding at least one share across all securities—i.e., a row-wise sum across the dataset.

Market data for each security was retrieved from CRSP³ via WRDS. Out of the full universe, 8,099 securities were available in CRSP, as it includes only U.S.-listed assets.



The figure above shows the daily count of open positions on Robinhood from April 2018 to mid-2020. We observe a steady increase in user participation, with a sharp acceleration

³The Center for Research in Security Prices (CRSP), based at the University of Chicago, provides high-quality historical market data widely used in finance research and investment analysis.

beginning in early 2020. This surge coincides with the onset of the COVID-19 pandemic, likely driven by a combination of heightened market volatility, increased retail interest, and fiscal stimulus payments.

3 Building the Robinhood Portfolio

3.1 Methodology

3.1.1 Weights Methods

[Fedyk, 2024] and [Welch, 2022] use the same approach to build the performance of the Robinhood crowd (or "reference index"): they build daily weights and then apply the weights from the previous day to daily stock returns, directly building portfolio returns.

First, it is necessary to define how those weights are computed. They define two different types of weights, although they yield similar findings in their analysis.

The first method is the "dollar method", which assumes that every investor represents an equal dollar amount investment in the stock.

$$w_{i,t}^{\text{dollar}} = \frac{N_{i,t}}{\sum_j N_{j,t}} \quad (1)$$

where $w_{i,t}$ is the Robinhood portfolio weight of security i at time t and $N_{i,t}$ is the number of investors in security i at time t .

Alternatively, they define the "share method", where each Robinhood investor in a stock represents a one share investment in that stock.

$$w_{i,t}^{\text{share}} = \frac{N_{i,t} \cdot P_{i,t}}{\sum_j N_{j,t} \cdot P_{j,t}} \quad (2)$$

where $P_{j,t}$ is the price of stock j at time t .

3.1.2 Different Approaches to Compute Performance

As explained above, the biggest limitation of the Robintrack dataset is that it counts the number of users holding a certain security and doesn't provide any information on the amount invested in a particular security.

The other authors build the portfolio returns by multiplying weights by their daily re-

turns⁴, assuming that the weights, however computed, represent a certain share of wealth in a stock of the Robinhood crowd.

$$r_{RH,t} = \sum_{i=1}^N w_{i,t} \cdot r_{i,t} \quad (3)$$

On the other hand, I tried to compute the value of the Robinhood portfolio by doing a weighted sum of the prices of the securities in the dataset. Conceptually, this represents the portfolio of an investor who decides to allocate a certain number (or percentage) of shares to each security. I will call this the "Price" method, or simply my method.

We can therefore define the value of the Robinhood Portfolio as follows:

$$V_{RH,t} = \sum_{i=1}^N w_{i,t}^{\text{dollar}} \cdot P_{i,t} \quad (4)$$

Returns are then computed from the value of the overall portfolio as:

$$r_{RH,t} = \ln \left(\frac{V_{RH,t}}{V_{RH,t-1}} \right) \quad (5)$$

In this paper I prefer using log-returns where possible.

3.1.3 Capturing the Persistence of Investor Composition

Although both approaches ultimately yield a time series of Robinhood portfolio returns, there is a fundamental difference in what these return paths represent.

In the method used by [Fedyk, 2024] and [Welch, 2022], the portfolio is effectively rebalanced every day to reflect the current composition of investor popularity. Each day's return is computed based on that day's weights and the corresponding daily stock-level returns. This provides a valid snapshot of the average return generated by the stocks held on a given day.

However, this approach does not preserve the economic exposure that investors accumulate through time. A stock that was extremely popular for several days but declines in popularity just before a price spike will have minimal influence on the portfolio's return when that spike occurs. Only the weights at time $t - 1$ affect the return at time t ⁵, so the model captures immediate sentiment shifts but not the cumulative effects of holding positions over time.

⁴returns are computed directly by CRSP and are adjusted for dividends, e.g. if $P_0 = 10$ and $D_1 = 5$ and $P_1 = 5$ returns would be 0%

⁵Previous day's weights are taken to prevent look-ahead bias

In contrast, the methodology I propose (5) applies weights to stock prices and computes returns from changes in total portfolio value. This implies that a stock that was heavily weighted yesterday continues to influence portfolio performance today, even if its popularity has declined. The return reflects both the dynamics of price changes and the path dependency of investor composition.

As a result, my method embeds the effects of investor flows, popularity shifts, and concentration in the actual evolution of portfolio value. The cumulative performance is not a sequence of disconnected daily snapshots, but a reflection of how crowd behavior builds, persists, and unwinds over time.

Conceptually, this distinction is important when studying behavioral dynamics. Retail investor behavior—particularly on platforms like Robinhood—is driven not only by cross-sectional preferences at a point in time but also by persistent patterns of attention, sentiment, and herding. A portfolio that evolves with these behavioral shifts provides a more realistic measure of the actual wealth path experienced by retail investors, rather than an idealized, continually rebalanced index.

In this sense, computing returns from the portfolio value offers a more structurally consistent and behaviorally meaningful representation of the Robinhood crowd’s investment trajectory.

4 Comparing Returns and Risk measures

The biggest difference do not appear when using different kinds of weights ("dollar" or "share" method) but rather when building the portfolio from prices or returns. Moreover, Fedyk and Welch build their portfolio only using common american stocks (share code 10 or 11). In my final analysis I look at all types of securities but significant differences emerge even when using the same sample. Additionally, by recreating their method employed by the other authors we can analyse its return when dealing with all kinds of securities. In section 4.2 I compare returns using only common stocks or the full sample of securities, in the other sections of this paper I will use the full sample unless explicitly stated.

As the other authors have claimed in their papers, the Portfolio built directly from returns had a significantly higher cumulative return compared to the market and positive alpha.

I will proceed to analyse in more detail the distribution of returns of different Robinhood portfolios, showing that my method depicts a far less rosy picture of the "Robinhood strategy".

Moreover, [Fedyk, 2024] has analysed extensively the differences between the portfolio

obtained using the share method and the dollar method. We'll focus on the dollar method since it is the same approach I use to compute weights.

4.1 Constructing Moving Averages

I begin by computing daily log returns as $r = \ln\left(\frac{P_1}{P_0}\right)$, knowing that for small x , $\ln(1+x) \approx x$. Defining log returns allows us to simply compute moving averages, showing the profitability of the Robinhood portfolio at different time frames. Conceptually, the value of an n -day moving average on a given date T represents the return an investor would have earned by initiating the position at the open of day $T - n$ and holding it continuously up to close of day T . More rigorously, for a given horizon of n days:

$$r_n = \sum_{t=T-n+1}^T r_t \approx \ln\left(\prod_{t=T-n+1}^T (1 + R_t)\right) \quad (6)$$

where r_t are daily log returns and R_t are daily percentage returns.

4.2 Retail Performance Under Different Samples

4.2.1 Rolling Returns Across Investment Horizons

Common Stocks Only At short horizons (5–30 days), the two Robinhood portfolios (Fedyk and Mine) display highly similar dynamics, with both closely tracking market indices and exhibiting bursts of volatility during periods of market stress, particularly around the onset of the COVID-19 crash. This suggests that in the very short term, retail investors tend to move in tandem with broader market trends, with limited divergence in return profiles across methodologies. However, at the 120-day horizon, both Robinhood portfolios outperform the S&P 500 and a World ETF⁶.

This finding is consistent with the idea that many retail investors, especially on Robinhood, engaged in "buy-the-dip" behavior during the COVID-19 crash. Their increased exposure to beaten-down or speculative stocks during the downturn appears to have been rewarded in the subsequent rebound. Importantly, this also coincides with a period of explosive growth for the platform itself, which may have amplified attention and capital inflows into popular names.

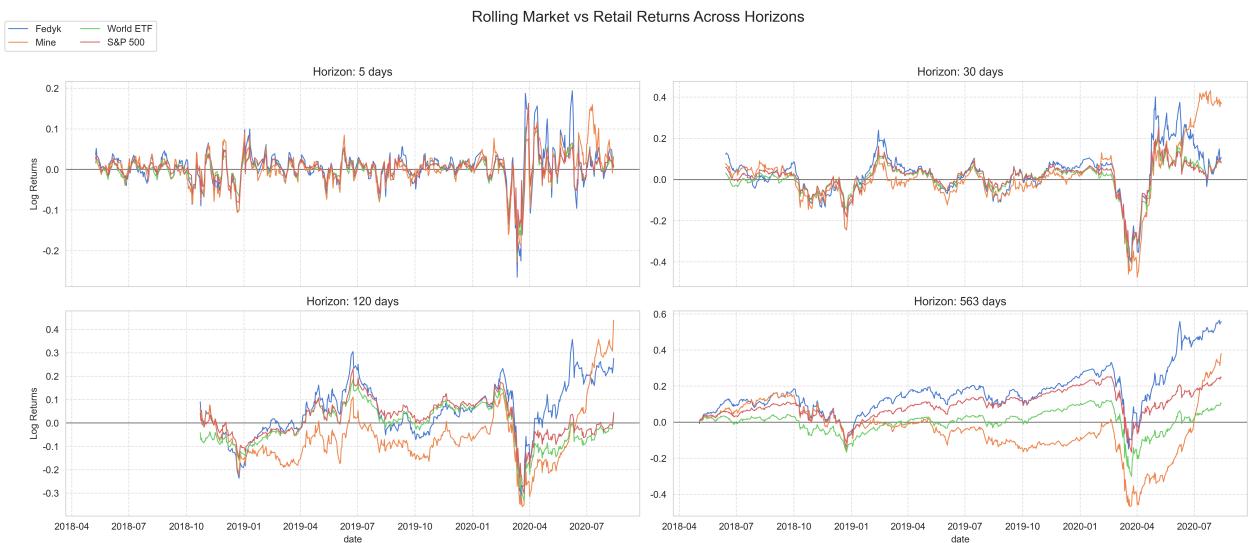
Nonetheless, this post-crash outperformance comes after a prolonged period of clear underperformance. Prior to March 2020, both Robinhood portfolios consistently lag behind the

⁶I've used Vanguard's VOO for the S&P500 and Vanguard's VT as a World Equity ETF

benchmark indices, with my method in particular reflecting substantial drawdowns and poor stock selection.

What differentiates the two methods most clearly is the strength of the post-COVID recovery. While Fedyk’s method shows a relatively steady climb, my price-based approach rebounds even more sharply after March 2020. This reflects the fact that, under my methodology, investor positions are not rebalanced away from prior favorites. As a result, stocks that surged after the crash contributed disproportionately to the portfolio’s recovery.

In sum, the 120-day results provide two key insights: first, that retail traders on Robinhood did benefit from post-crisis market dynamics, and second, that the magnitude and nature of this benefit depends heavily on the modeling approach, particularly when capturing persistence in portfolio composition.



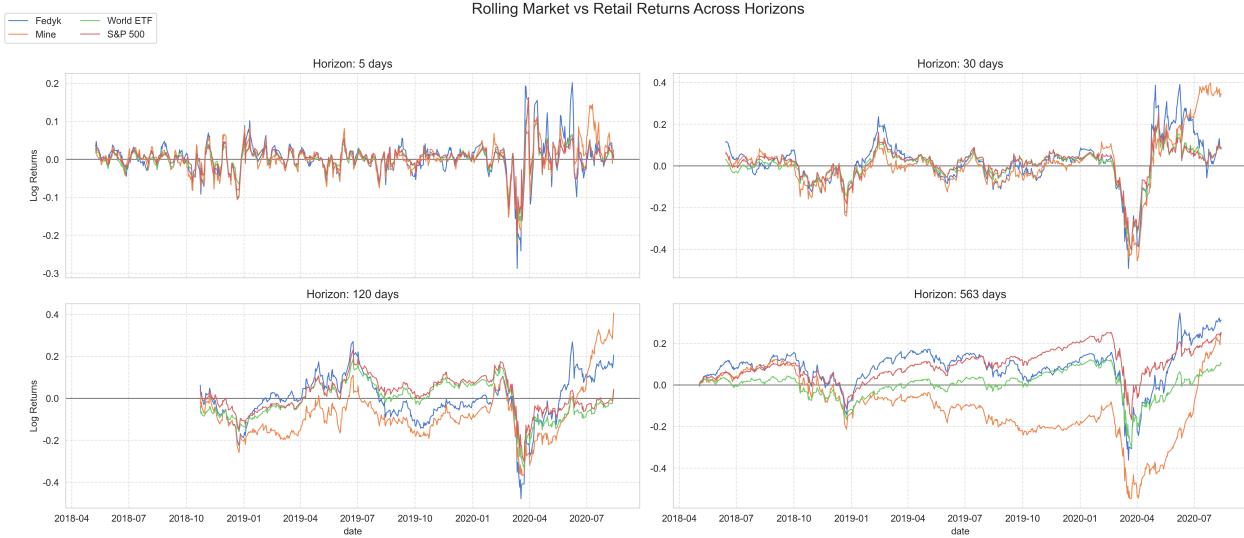
Full Universe of Securities We now extend the analysis to all securities in the dataset, including ETFs, REITs, and structured products.

Expanding the sample, we still observe that short-term movements (5–30 days) remain closely correlated across all portfolios, with limited divergence in returns or volatility between methods.

However, the performance gap widens at longer horizons. In contrast to the stock-only case, where both Robinhood portfolios outperform after the crash, here the drawdowns, particularly in the price-based portfolio, are deeper and more persistent.

Low performance spans the entire pre-COVID period: my portfolio underperforms continuously throughout 2019, while Fedyk’s stays closer to the benchmarks but still lags in absolute terms.

At the 563-day horizon, both Robinhood portfolios end below the S&P 500 and the World ETF. My portfolio, while showing a stronger post-crash rebound, barely catches up to the S&P 500 by the end of the sample, and only due to its heavier exposure to post-crash winners. Fedyk's method performs slightly better but remains clearly below the benchmark, reversing the apparent outperformance seen in the stock-only sample.



A detailed description of the distributions can be found in table 2.

4.2.2 Distribuional insights

Common Stocks Only The distribution of returns across horizons provides further evidence on the differences between the Robinhood portfolios and the benchmarks.

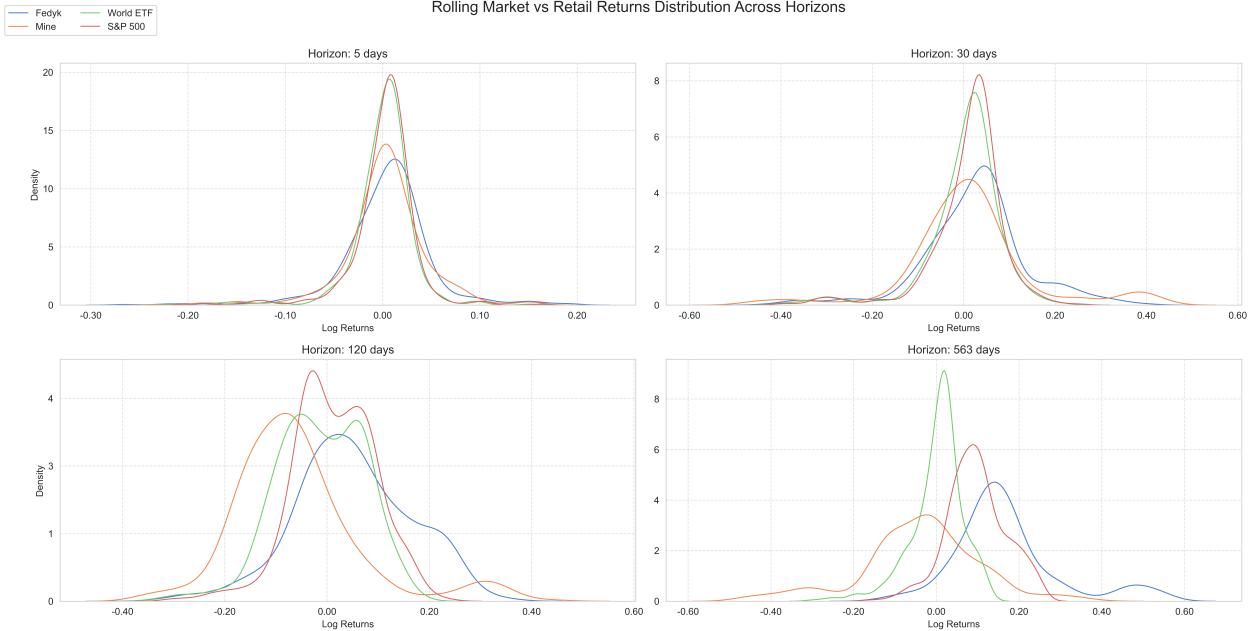
At short horizons (5–30 days), all portfolios are tightly centered around zero, with relatively similar dispersion. Both Robinhood portfolios display slightly higher volatility than the S&P 500 and the World ETF, with standard deviations of approximately 0.045 for five-day returns, compared to about 0.03 for the benchmarks. However, mean returns remain close to zero for all portfolios, and short-term behavior shows limited divergence across methods.

At the 120-day horizon, differences become more evident. While Fedyk's portfolio maintains a positive mean log return of approximately 0.05, my price-based portfolio exhibits a negative mean return of about -0.06. The median is also much worse, at about -0.14 versus -0.02. This shift is reflected in the distribution shapes, with my portfolio showing a wider left tail and greater dispersion relative to both Fedyk's method and the benchmarks.

At the 563-day horizon, the gap further widens. The price-based portfolio remains centered around negative returns, with a mean log return of approximately -0.04, while the

rebalanced portfolio achieves a positive mean return of 0.17. In contrast, the S&P 500 maintains a strong positive outcome, with a mean log return close to 0.1.

Despite the strong rebound observed after the COVID-19 crash, the cumulative performance of the price-based portfolio remains significantly weaker, often with higher standard deviation.



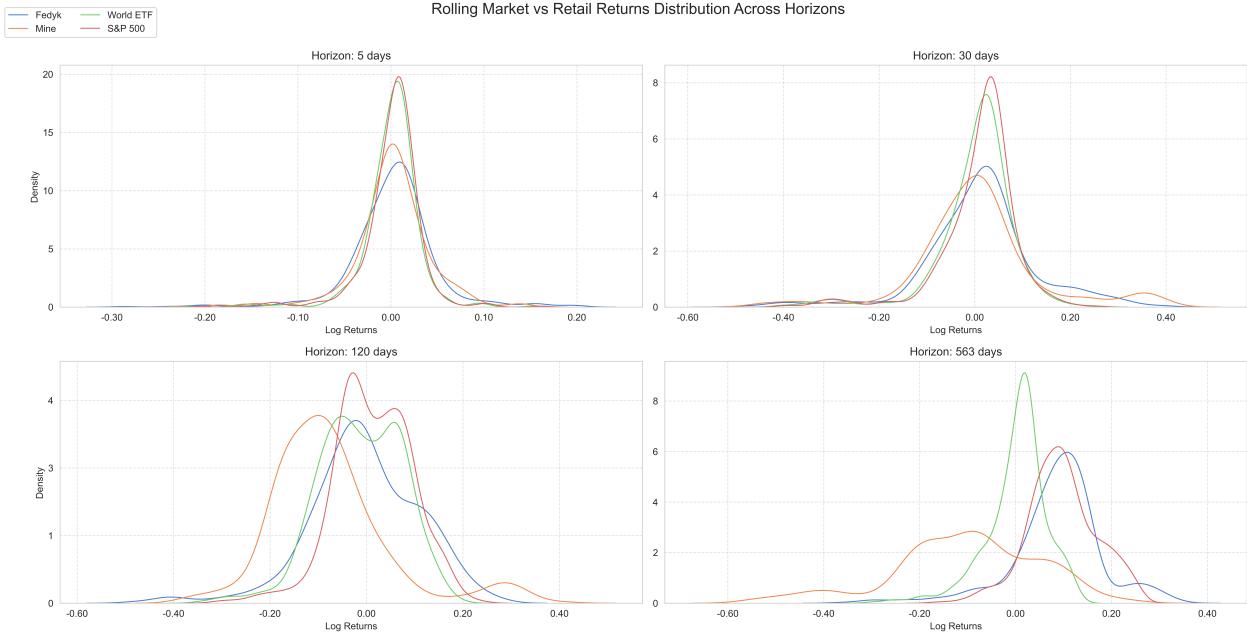
A detailed description of the distributions can be found in table 1.

Full Universe of Securities Expanding the analysis to include all types of securities slightly alters the distributional patterns compared to the stock-only case.

At short horizons (5–30 days), return distributions remain centered around zero and maintain a similar dispersion across all portfolios. Standard deviations are comparable to the stock-only case, around 0.02 for both Robinhood portfolios at the daily level and 0.04 for five-day returns. Mean returns are very close to zero, confirming that short-term dynamics are largely unaffected by the broader sample.

At the 120-day horizon, however, differences become more evident. Both Robinhood portfolios exhibit flatter distributions with thicker left tails compared to the benchmarks. In particular, my price-based portfolio records a negative mean log return of approximately -0.07, while Fedyk's method also turns slightly negative at around -0.004, unlike in the stock-only case where it remained positive. The S&P 500 maintains a positive mean return over the same horizon, reinforcing the relative weakness of retail portfolios when more asset types are included.

At the cumulative horizon, the gap becomes substantial. My portfolio shows a strongly left-skewed distribution with a mean log return of approximately -0.10. Fedyk's portfolio, although positive at around 0.087, remains below the S&P 500, which achieves a mean return close to 0.1. The World ETF again displays lower returns, in line with its broader exposure to international markets.



Descriptive statistics supporting these findings are reported in Table 2.

4.3 Analysis of Short-Term Market Movements and the Impact of COVID

Comparing the daily returns for the whole period available we can already observe distinct behavior in terms of returns and distributions for the market and Robinhood indeces. To test whether there are statistically significant differences between the mean daily returns of the Robinhood portfolios, the S&P 500 and the world ETF, I conduct an ANOVA test. The null hypothesis is that all portfolios have equal mean daily returns.

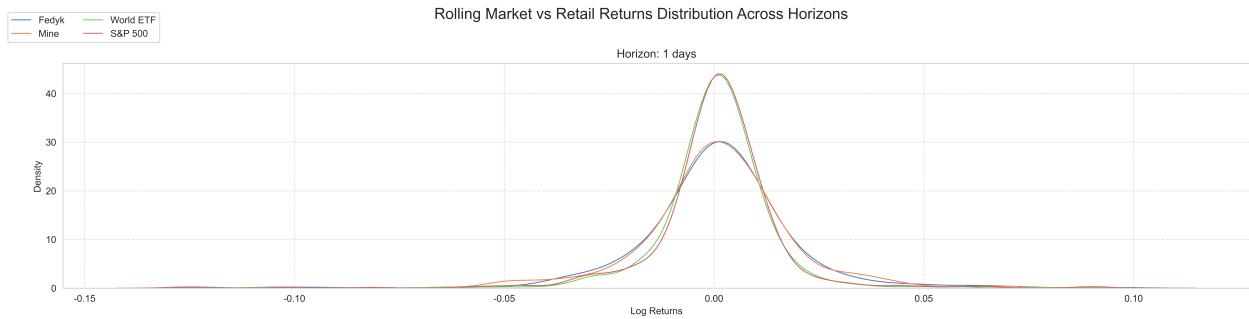
Mean daily returns are very close, and the results of the ANOVA test indicate that the null results cannot be rejected at the conventional significance levels ($p\text{-value} = 0.9273$). This suggests that, at the daily frequency, the mean returns of the Robinhood portfolios and the benchmarks are not statistically different.

Nonetheless, a striking similarity between the market indeces and between the Robinhood portfolios appears when looking at the plot below. The distributions differ in their higher

moments, with Robinhood portfolios

In terms of standard deviation, RH shows more volatility in both horizons. The 1-day standard deviation for RH is 0.018809, compared to the market's 0.01547, and for the 5-day returns, RH's standard deviation is 0.041909, while the market's is 0.031198. Therefore, RH consistently exhibits higher returns and higher volatility over both timeframes compared to the market. Detailed distribution are in table 3.

Here below the plots of the time series, while the returns are in table (2):



Appendix A Tables

Table 1: Descriptive Statistics for Daily and Rolling Returns

Note: Returns accounting only for investments in Stocks.

	count	mean	std	min	25%	50%	75%	max
Fedyk daily return	563	0.000990	0.019894	-0.135995	-0.005807	0.001516	0.009167	0.105441
Mine daily return	563	0.000677	0.019209	-0.125590	-0.006681	0.001363	0.009784	0.071628
VT daily return	563	0.000185	0.015106	-0.123763	-0.004592	0.000886	0.005933	0.087470
VOO daily return	563	0.000443	0.015820	-0.124870	-0.003893	0.000976	0.006653	0.091087
Fedyk 5 return	559	0.004866	0.046404	-0.265341	-0.015031	0.007872	0.025282	0.193965
Mine 5 return	559	0.002979	0.043110	-0.226991	-0.013770	0.003621	0.021740	0.159707
VT 5 return	559	0.000824	0.030805	-0.214262	-0.011045	0.003956	0.014927	0.151788
VOO 5 return	559	0.002111	0.031063	-0.204425	-0.009442	0.005716	0.016506	0.162820
Fedyk 30 return	534	0.025268	0.114955	-0.431533	-0.032448	0.035874	0.072017	0.401292
Mine 30 return	534	0.012159	0.140314	-0.474366	-0.051104	0.009054	0.054639	0.431367
VT 30 return	534	0.002735	0.081324	-0.406688	-0.024941	0.017664	0.041113	0.224464
VOO 30 return	534	0.009843	0.079924	-0.401950	-0.015450	0.027341	0.046977	0.252864
Fedyk 120 return	444	0.050804	0.114293	-0.330870	-0.021276	0.046242	0.130711	0.357556
Mine 120 return	444	-0.059004	0.127178	-0.358205	-0.139490	-0.074974	-0.015135	0.439583
VT 120 return	444	-0.012628	0.085645	-0.333294	-0.070621	-0.012804	0.059034	0.186378
VOO 120 return	444	0.013786	0.079450	-0.302877	-0.037033	0.011899	0.073431	0.231377
Fedyk 563 return	563	0.168894	0.129435	-0.148334	0.100301	0.146221	0.199060	0.565657
Mine 563 return	563	-0.038567	0.143947	-0.468443	-0.114762	-0.027966	0.041386	0.380918
VT 563 return	563	0.002293	0.063753	-0.300675	-0.023998	0.014837	0.032750	0.122378
VOO 563 return	563	0.096803	0.071714	-0.166225	0.054575	0.093080	0.136742	0.253868

Table 2: Descriptive Statistics for Daily and Rolling Returns

Note: Returns accounting for investments in all types of securities. ETF returns are identical to table 1.

	count	mean	std	min	25%	50%	75%	max
Fedyk daily returns	563	0.000555	0.020000	-0.125369	-0.006658	0.000754	0.008755	0.097995
Mine daily returns	563	0.000450	0.018710	-0.126475	-0.006472	0.000606	0.009044	0.072808
VT daily return	563	0.000185	0.015106	-0.123763	-0.004592	0.000886	0.005933	0.087470
VOO daily return	563	0.000443	0.015820	-0.124870	-0.003893	0.000976	0.006653	0.091087
Fedyk 5 return	559	0.002684	0.047496	-0.287100	-0.017592	0.005106	0.022556	0.201768
Mine 5 return	559	0.001891	0.041707	-0.224346	-0.015152	0.002165	0.020423	0.145245
VT 5 return	559	0.000824	0.030805	-0.214262	-0.011045	0.003956	0.014927	0.151788
VOO 5 return	559	0.002111	0.031063	-0.204425	-0.009442	0.005716	0.016506	0.162820
Fedyk 30 return	534	0.012231	0.118341	-0.491574	-0.044795	0.018809	0.055543	0.391200
Mine 30 return	534	0.005924	0.134409	-0.456420	-0.056865	0.006054	0.044482	0.399350
VT 30 return	534	0.002735	0.081324	-0.406688	-0.024941	0.017664	0.041113	0.224464
VOO 30 return	534	0.009843	0.079924	-0.401950	-0.015450	0.027341	0.046977	0.252864
Fedyk 120 return	444	-0.004432	0.114878	-0.478685	-0.062876	-0.010586	0.076930	0.271451
Mine 120 return	444	-0.076568	0.124668	-0.368195	-0.159984	-0.095393	-0.037126	0.406700
VT 120 return	444	-0.012628	0.085645	-0.333294	-0.070621	-0.012804	0.059034	0.186378
VOO 120 return	444	0.013786	0.079450	-0.302877	-0.037033	0.011899	0.073431	0.231377
Fedyk 563 return	563	0.086945	0.096844	-0.361597	0.050499	0.096675	0.134919	0.345822
Mine 563 return	563	-0.103880	0.152561	-0.547158	-0.193259	-0.096858	0.008830	0.253266
VT 563 return	563	0.002293	0.063753	-0.300675	-0.023998	0.014837	0.032750	0.122378
VOO 563 return	563	0.096803	0.071714	-0.166225	0.054575	0.093080	0.136742	0.253868

Table 3: Descriptive Statistics for 1-Day and 5-Day Returns, Covering the Whole Period

Note: Positive returns indicate the percentage of days in which the log returns were greater than zero.

	count	mean	std	min	25%	50%	75%	max	positive returns
rh portfolio 1 return	564	0.000719	0.018809	-0.132368	-0.006164	0.001141	0.009484	0.072851	0.553191
mc 1 return	564	0.000396	0.015470	-0.125496	-0.003944	0.001012	0.006481	0.086673	0.558511
VOO 1 return	564	0.000438	0.015806	-0.124870	-0.003874	0.000942	0.006632	0.091087	0.563830
VT 1 return	564	0.000184	0.015092	-0.123763	-0.004568	0.000842	0.005926	0.087470	0.547872
rh portfolio 5 return	560	0.003281	0.041909	-0.224427	-0.012379	0.004643	0.022098	0.153755	0.598214
mc 5 return	560	0.001913	0.031198	-0.207508	-0.008632	0.004961	0.016300	0.151511	0.630357
VOO 5 return	560	0.002128	0.031036	-0.204425	-0.009442	0.005838	0.016494	0.162820	0.635714
VT 5 return	560	0.000839	0.030779	-0.214262	-0.011044	0.003977	0.014911	0.151788	0.583929

Table 4: Descriptive Statistics for 1-Day and 5-Day Returns, up to February 3rd 2020

Note: Positive returns indicate the percentage of days in which the log returns were greater than zero.

	count	mean	std	min	25%	50%	75%	max	positive returns
rh portfolio 1 return	430	0.000115	0.013490	-0.050597	-0.005461	0.000809	0.007377	0.068808	0.537209
mc 1 return	430	0.000419	0.008745	-0.032113	-0.003126	0.000804	0.005285	0.045916	0.553488
VOO 1 return	430	0.000485	0.008928	-0.032828	-0.003066	0.000757	0.005096	0.049350	0.558140
VT 1 return	430	0.000198	0.008361	-0.031068	-0.003794	0.000716	0.004853	0.036545	0.546512
rh portfolio 5 return	426	0.000259	0.026549	-0.105948	-0.013623	0.002922	0.014899	0.088194	0.570423
mc 5 return	426	0.002091	0.019395	-0.075729	-0.008188	0.004110	0.014121	0.063052	0.624413
VOO 5 return	426	0.002442	0.019790	-0.081061	-0.008308	0.004981	0.014449	0.067072	0.636150
VT 5 return	426	0.001031	0.018612	-0.066412	-0.010824	0.002804	0.013208	0.060003	0.565728

Appendix B Handling Missing Data

The original Robinhood dataset contains missing values for 3,331 securities, primarily in the earlier periods. This means that these securities don't have information for a certain date.

To ensure consistency we adopt a similar method as [Fedyk, 2024]. Their Robinhood portfolio is constructed using the available securities on a daily basis, hence securities with missing values are simply not taken into account for the day. Moreover we drop all securities that they have defined as problematic in the appendix.

Since our CRSP dataset is also a bit different from the one they use, we drop entirely securities that have more than one entry per day.

References

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