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Active vs Passive Investing: An Empirical Study on the US Equity ETFs

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ABSTRACT

Modern Portfolio Theory (MPT), the fundamental investment theory is built on the assumption of the efficient market hypothesis, which is widely accepted by academic financial economists. It is believed that securities markets are extremely efficient, and any information that hits the market will be reflected in the securities' prices so beating the market is a daydream. If that's true, passive investment, for example investing in an index tracking fund would be the best bet for an investor. But on the other hand, ever since the securities markets emerged, investors never stopped trying to find ways to beat the markets, commonly called seeking alphas (excess returns over markets). The always coexistence of both passive funds and active funds makes the conclusion unclear. The objective of this research is to distinctly underscore when it comes to investments, whether to choose passive or active investment structures via an empirical study on active US Equity ETFs (exchange-traded funds). The daily excess returns of 33 active US equity active ETFs over 3 years have been analyzed via a single-factor linear regression model suggested by Capital Asset Pricing Model (CAPM) against the daily excess return of a popular index tracking ETF: SPY with the hypothesis that active ETFs generate alphas. The model has a great fit with over 90% R-square on average for all ETFs under study but rejects the hypothesis in 95%confidence level. In other words, active investments can't beat the market. This result may shed light on investment selection for the broad ordinary investors.

Introduction

For better or worse, life is full of choices to make. Sometimes it is hard to make choices. Investment decision is one of them, but unavoidable. There are so many asset classes, such as equities, fixed incomes, real estate, commodities, cryptos and on and on, which makes an ordinary person dazzled. Thanks to fund market which gives people the opportunity to expose themselves to almost any type of assets with limited capital. A fund pools money from many investors to invest in the assets the fund is set for so each investor can put a small amount of money but still expose to many assets to have benefit of diversification. Before exploring the fund options, an investor first needs to decide what type of funds to look at, active managed funds or passive managed funds. Active investing generally looks to beat the benchmark whereas passive investing aims to duplicate the index. Active funds charge much higher fees than passive funds. Does it worth to pay the extra fees? This research conducts an empirical study on active US Equity ETFs to address that question.

ETF is short for exchange-traded fund, a type of pooled investment security that operates much like a mutual fund. Like mutual funds, ETFs also track indexes, sectors, or other assets, but unlike mutual funds, ETF can be bought and sold on an exchange just like a stock. So, the benefit is obvious, it can be traded at any time during the day rather than wait till the end of the day otherwise. Also, the fees typically are lower than mutual funds with a similar purpose. Therefore, ETFs have gained more and more popularity since their inception. As ETFs are public traded on exchanges, their prices are more transparent and available for this research.

Modern Portfolio Theory (MPT), Asset Pricing Theory, especially Capital Asset Pricing Model (CAPM) and regression model are the central of this study, which will all be reviewed in the following section.

Literature Review

Modern Portfolio Theory (MPT)

The modern portfolio theory (MPT) was pioneered by Harry Markowitz (the Journal of Finance, 1952), who was later awarded a Nobel Prize for this work. MPT is a practical method for selecting investments in order to maximize their overall returns within an acceptable level of risk. This mathematical framework is used to build a portfolio of investments that maximize the amount of expected return for the collective given level of risk(Investopedia). MPT is under the assumption that market is efficient, so investor seeks higher return needs to take higher risk. A key component of the MPT theory is diversification.

Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAMP) describes the relationship between systematic risk, or the general peril of investing, and the expected return for assets, particular stocks. It is a finance model that establishes a linear relationship between the required return on an investment and risk. (Investopedia)
The model is formulated mathematically as follows:

$ER_i=R_f+\beta_i(ER_m-R_f)$
Where: ER_i: expected return of investment
R_f: risk-free rate
β_i:coefficient to market(beta risk)
(ER_m-R_f):market risk premium

As the model above exhibits the relationship between risk and return via the market or beta risk, hence termed single-factor model.

An important takeaway from CAPM is that an investor is only compensated for the market risk, which cannot be diversified away.

Single-Factor Regression Model

Proposed by Jensen, the single-factor model (1968) remains to date a prevalent methodology for quantifying managers' skill and fund performance via alpha estimation. The model takes a form as follows:

$E(Rp)-R_f=\alpha_p+\beta_i[E(R_{m)}-R_f]+\varepsilon_p$
Jensen's Alpha (Source: Jensen, 1968)
Where: $E(Rp)-R_f$: excess return of portfolio p
$E(R_{m)}-R_f$: excess return of the market
α_p: excess return portfolio yields from his superior skills if any
ε_p :error term, represents white noise

Data Collection

The study started from the broadest ETF world with 4354 funds and narrowed down to active US equity traded in NYSE and NASDAQ with 94 tickers. Those two stock exchanges are most active and efficient trading platforms, so

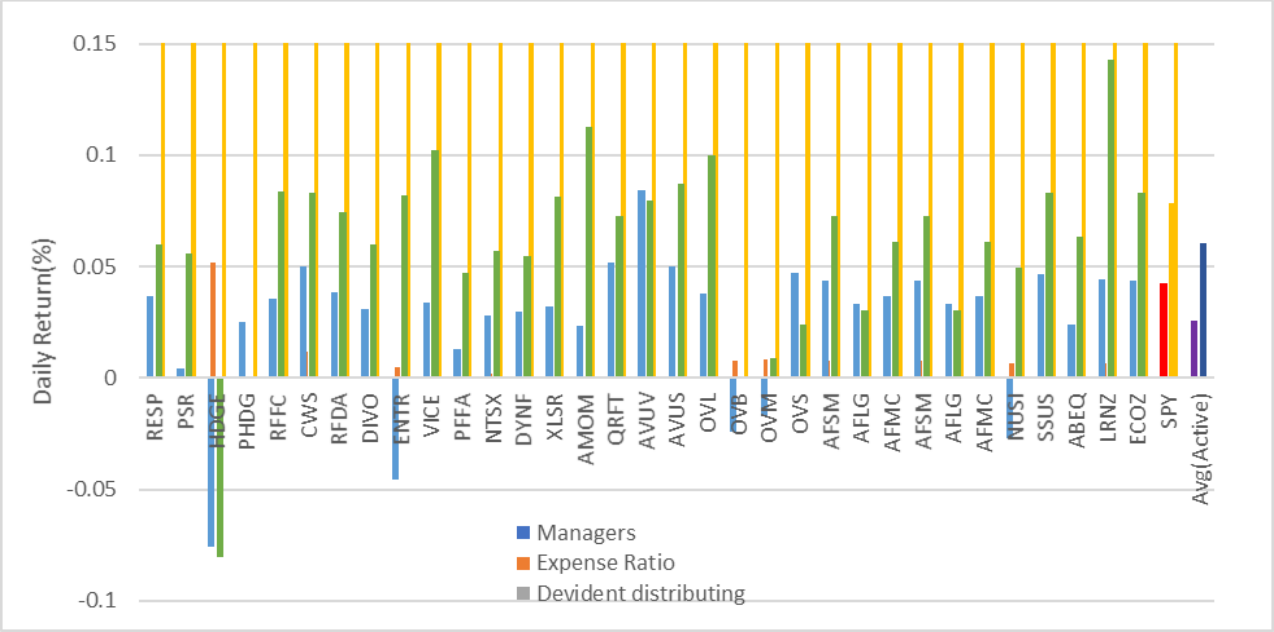
the prices are more meaningful. Further only ETFs with at least 3-year history to have relatively sufficient data points to analyze.

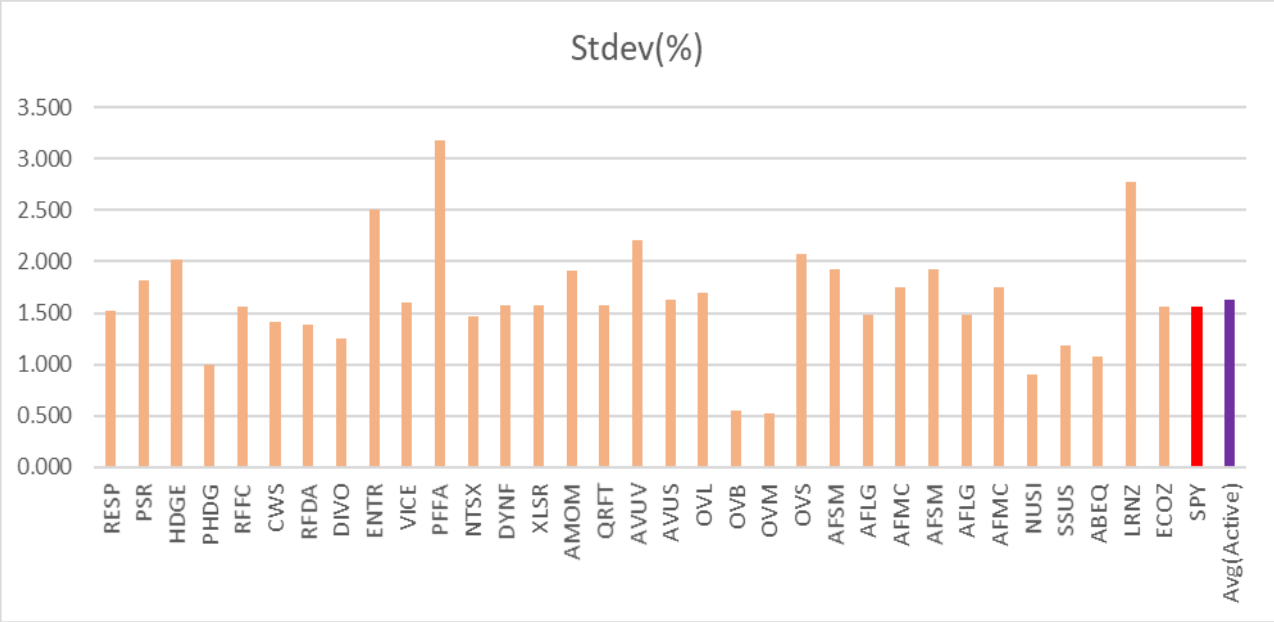
Total ETFs	Active ETFs	US	Equity	USD de-nominated	NYSE&NASDAQ Traded
4354	1680	669	523	461	94

*Raw data: Pensions& Investments (https://www.pionline.com)
Yahoo Finance(https://finance.yahoo.com/)

Below are some tables and charts to organize the data collection.

#	Ticker	Name	Managers	Expense Ratio	Devident distributing	Inception
1	RESP	WisdomTree U.S. ESG Fund	WisdomTree	0.28%	Distribution	2/23/2007
2	PSR	Invesco Active U.S. Real Estate Fund	Invesco	0.35%	Distribution	11/21/2008
3	HDGE	AdvisorShares Ranger Equity Bear ETF	AdvisorShares	5.20%	Distribution	1/27/2011
4	PHDG	Invesco S&P 500 Downside Hedged ETF	Invesco	0.41%	Distribution	12/6/2012
5	RFFC	RiverFront Dynamic US Flex-Cap ETF	ALPS	0.52%	Distribution	6/28/2016
6	CWS	AdvisorShares Focused Equity ETF	AdvisorShares	1.19%	Distribution	9/21/2016
7	RFDA	RiverFront Dynamic US Dividend Advantage ETF	ALPS	0.52%	Distribution	9/28/2016
8	DIVO	Amplify CWP Enhanced Dividend Income ETF	Amplify ETFs	0.55%	Distribution	12/15/2016
9	ENTR	ERShares Entrepreneur ETF	EnterpreneurShares	0.49%	Distribution	11/8/2017
10	VICE	AdvisorShares Vice ETF	AdvisorShares	0.99%	Distribution	12/13/2017
11	PFFA	Virtus InfraCap U.S. Preferred Stock ETF	Virtus Investment Partners	1.21%	Distribution	5/16/2018
12	NTSX	WisdomTree U.S. Efficient Core Fund	Wisdom Tree	0.20%	Distribution	8/2/2018
13	DYNF	BlackRock U.S. Equity Factor Rotation ETF	iShares	0.30%	Distribution	3/21/2019
14	XLSR	SPDR SSGA U.S. Sector Rotation ETF	SPDR	0.70%	Distribution	4/3/2019
15	AMOM	QRAFT AI-Enhanced U.S. Large Cap Momentum ETF	Qraft AI ETFs	0.75%	Distribution	5/21/2019
16	QRFT	QRAFT AI-Enhanced U.S. Large Cap ETF	Qraft AI ETFs	0.75%	Distribution	5/21/2019
17	AVUV	Avantis U.S. Small Cap Value ETF	American Century Investments	0.25%	Distribution	9/26/2019
18	AVUS	Avantis U.S. Equity ETF	American Century Investments	0.15%	Distribution	9/26/2019
19	OVL	Overlay Shares Large Cap Equity ETF	Overlay Shares	0.80%	Distribution	10/1/2019
20	OVB	Overlay Shares Core Bond ETF	Overlay Shares	0.80%	Distribution	10/1/2019
21	OVM	Overlay Shares Municipal Bond ETF	Overlay Shares	0.84%	Distribution	10/1/2019
22	OVS	Overlay Shares Small Cap Equity ETF	Overlay Shares	0.83%	Distribution	10/1/2019
23	AFSM	First Trust Active Factor Small Cap ETF	First Trust	0.75%	Distribution	12/3/2019
24	AFLG	First Trust Active Factor Large Cap ETF	First Trust	0.55%	Distribution	12/3/2019
25	AFMC	First Trust Active Factor Mid Cap ETF	First Trust	0.65%	Distribution	12/3/2019
26	AFSM	First Trust Active Factor Small Cap ETF	First Trust	0.75%	Distribution	12/4/2019
27	AFLG	First Trust Active Factor Large Cap ETF	First Trust	0.55%	Distribution	12/4/2019
28	AFMC	First Trust Active Factor Mid Cap ETF	First Trust	0.65%	Distribution	12/4/2019
29	NUSI	Nationwide Nasdaq-100 Risk-Managed Income ETF	Nationwide	0.68%	Distribution	12/20/2019
30	SSUS	Day Hagan/Ned Davis Research Smart Sector ETF	Day Hagan Asset Management	0.81%	Distribution	12/20/2019
31	ABEQ	Absolute Select Value ETF	Absolute Investment Advisors	1.51%	Distribution	1/22/2020
32	LRNZ	TrueShares Technology, AI and Deep Learning ETF	TrueShares	0.68%	Distribution	3/2/2020
33	ECOZ	TrueShares ESG Active Opportunities ETF	TrueShares	0.58%	Capitalization	3/2/2020
34	SPY	SPDR S&P 500 ETF Trust	SPDR	0.09%	Distribution	1/29/1993
	Avg(Active)			**0.80%**		





*The study period: 3/2/2020 to 3/17/2023 (Approx. 3 years), on average, the fees for active ETFs are almost 9 times that of passive ETF SPY tracking S&P 500.

The table below shows the descriptive statistics for daily returns for active ETFs and passive ETF tracking S&P 500 to represent the daily market return. At a quick glance, active ETFS have lower returns and higher risks on an aggregated level.

#	Ticker	Mean	Median	Stdev	Min	Max	Obs.
1	RESP	0.037	0.060	1.521	-9.539	8.800	767
2	PSR	0.004	0.056	1.814	-17.156	8.641	767
3	HDGE	-0.076	-0.080	2.018	-11.962	11.773	767
4	PHDG	0.025	0.000	1.000	-7.355	11.505	767
5	RFFC	0.035	0.083	1.556	-11.686	8.021	767
6	CWS	0.050	0.083	1.412	-6.976	7.710	767
7	RFDA	0.039	0.074	1.391	-9.153	8.254	767
8	DIVO	0.031	0.060	1.254	-9.759	9.160	767
9	ENTR	-0.045	0.082	2.506	-35.347	8.138	767
10	VICE	0.034	0.102	1.596	-8.571	8.292	767
11	PFFA	0.013	0.047	3.173	-40.348	51.650	767
12	NTSX	0.028	0.057	1.462	-11.985	7.835	767
13	DYNF	0.030	0.055	1.580	-11.504	9.312	767
14	XLSR	0.032	0.081	1.569	-12.678	9.519	767
15	AMOM	0.023	0.113	1.911	-19.395	7.861	767
16	QRFT	0.052	0.073	1.579	-9.943	8.269	767
17	AVUV	0.084	0.079	2.212	-12.690	10.266	767
18	AVUS	0.050	0.087	1.635	-11.742	9.431	767
19	OVL	0.038	0.100	1.690	-11.460	8.362	767
20	OVB	-0.024	0.000	0.545	-3.774	2.851	767
21	OVM	-0.017	0.009	0.520	-5.550	4.537	767
22	OVS	0.047	0.024	2.075	-12.245	9.811	767
23	AFSM	0.044	0.073	1.929	-12.781	9.617	767
24	AFLG	0.033	0.030	1.474	-11.117	8.891	767
25	AFMC	0.037	0.061	1.749	-12.071	9.947	767
26	AFSM	0.044	0.073	1.929	-12.781	9.617	767
27	AFLG	0.033	0.030	1.474	-11.117	8.891	767
28	AFMC	0.037	0.061	1.749	-12.071	9.947	767
29	NUSI	-0.027	0.050	0.898	-4.750	4.529	767
30	SSUS	0.047	0.083	1.191	-6.507	5.110	767
31	ABEQ	0.024	0.063	1.072	-7.682	7.691	767
32	LRNZ	0.044	0.143	2.768	-11.933	11.726	767
33	ECOZ	0.043	0.083	1.564	-9.410	7.223	767
34	SPY	0.043	0.079	1.560	-10.942	9.060	767
	Avg(Active)	**0.026**	**0.060**	**1.631**	**-12.213**	**9.794**	**767**

Methods

Jensen's single-factor model proposed was applied to this study. The independent variable is the daily excess return of the market and dependent variables are the daily excess returns of 33 active US equity ETFs. 3-month T-bill was used as risk-free rate. The model is formulated as follow:

$$E(Rp_i)-R_f=\alpha p_i+\beta_i[E(R_m)-R_f]+\varepsilon p_i$$

Where Rp_i: daily return of ETF i

$E(Rp_i)-R_f$: daily excess return of ETF i

Rm: daily return of SPY

$E(R_m)$-R_f: daily excess return of SPY, which represents daily market return

R_f: 3-month T-bill, represents daily free rate

β_i the coefficient of market excess return for ETFi

αp_i: alpha generated by the fund manager of EFT i

εp_i: error term of EFT i

The hypothesis for this test is αp_i is significantly greater than zero, ie portfolio manager of ETFi generated alpha with his superior skills. Obviously, this analysis is a quantitative analysis, which is appropriate for this empirical study as the aim of this study is to find if alpha is significantly greater than zero over time.

Analysis/Results

The regression is conducted on each individual ETF level. Below is the regression output for the daily excess return of RESP vs daily excess return of SPY. The linear relationship shows very strong with 0.97 R-square. Significance F of almost zero and the p value of almost 0.7 further suggest the very strong linear relationship, which could be clearly illustrated in the line fit plot and residual scatter plot. All other funds have very similar results which will be shown in the appendix.

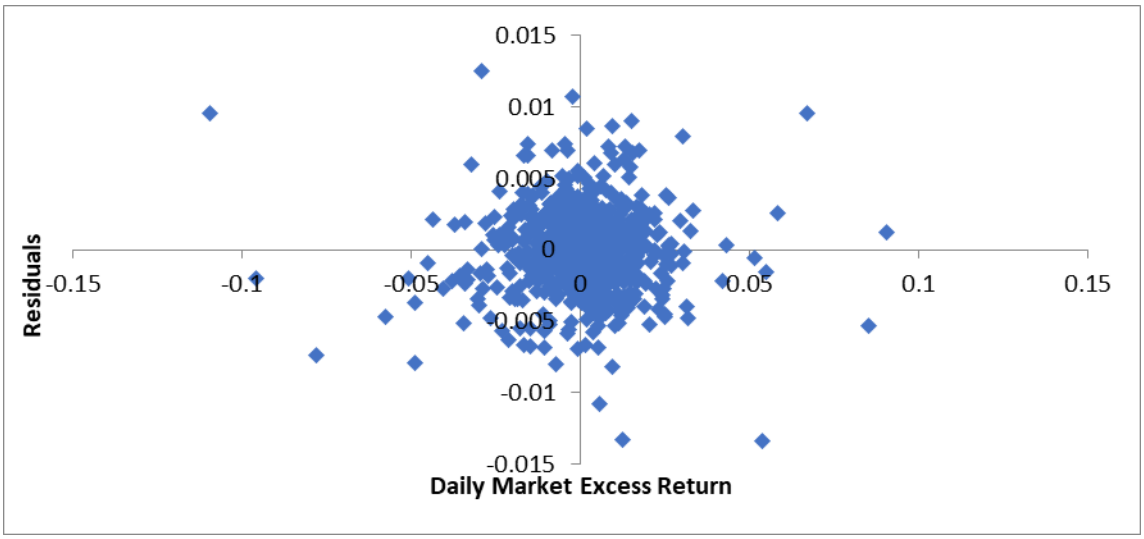
SUMMARY OUTPUT

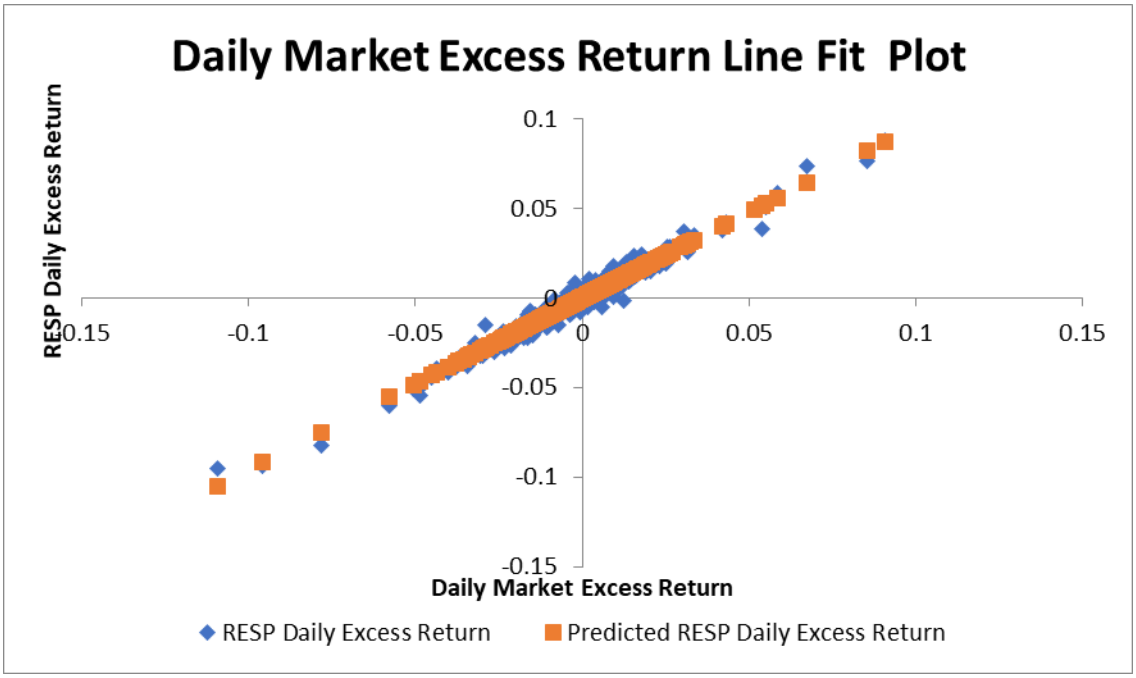
Regression Statistics	
Multiple R	0.982840643
R Square	0.965975729
Adjusted R Square	0.965931311
Standard Error	0.002819976
Observations	768

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.17294061	0.17294061	21747.34053	0
Residual	766	0.006091435	7.95226E-06		
Total	767	0.179032045			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-3.96206E-05	0.0001018	-0.38920107	0.697235582	-0.000239461	0.000160219	-0.000239461	0.000160219
Daily Market Excess Return	0.958350288	0.006498621	147.4697953	0	0.945593068	0.971107509	0.945593068	0.971107509





Discussion

Single-factor is a linear model which might miss some nonlinear relationship between dependent variables and independent variable, likewise, single-factor only captures one factor, ie, market excess return, there might be other factor(s) which can further extract additional information. But with an avegage of over 90% R-square, most of the ETFs performances have been explained by market performance, so no further granularity is necessary.

Secondly, as the study only used current tradable ETFs due to the data availability, the result might have survivorship bias, fortunately the bias should be upwards, which won't contradict from our conclusion as the regression results rejected the hypothesis of alphas were significantly greater than zeros, in other words, the active ETFs did not beat the market even with survival biased data. By adding dead ETFs, the results should be more significant presumably funds delisted from exchanges generally performed worse than funds alive on average.

Conclusion

When it comes to investment, the coexistence of active managed and passive tracking funds triggers a puzzle for investors. Generally speaking, scholars in academics believe in efficient markets and passive investing, which financial practitioners advocate active investing. This study applies Jensen's single-factor pricing model with the most recent price data of 33 active US equity ETFs and the popular index-tracking fund of SPY (tracking S&P 500 index) as a proxy of market. 3-year daily price data is applied. The model has a great fit of over 90% R-square on average. The model rejects the hypothesis that active managed ETFs overperformed the market in the past 3 years with close to zero F value and high p value under 5% confidence level . According to the study result, passive investment won.

But on the other hand, it is surprising to see the phenomenon that regardless many empirical studies have proven active investing could not overperform market on a consistent basis, many investors simply ignore the material facts demonstrated by rigorous and robust model and still pay very high fees for worse returns than market generated by active fund managers. My thought is when it comes to investments, there are many people are speculating and gambling. They are not satisfied with the "boring" average market returns and looking for significant excess returns which could only happen at very low probabilities. Further investigation into the causes is helpful to learn.

This analysis is only conducted on US equity markets due to time constraint and availability of the raw data. If more time and access to data permit, it would be valuable to apply this study to other geographical areas and asset classes.

If we accept these results, a natural extension for this study which is rarely seen in literature is to attribute the failure of active fund management. What's gone wrong? What're the pitfalls in their investment decision.

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