A PERFORMANCE EVALUATION ON EQUAL SECTOR STRATEGY

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Ruinan Lu
Bachelor of Economics,
Zhongnan University of Economics and Law, 2017

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Name: **Ruinan Lu**

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Supervisory Committee:

_____

Peter Klein
Senior Supervisor
Professor, Finance

Jijun Niu
Second Reader
Associate Professor, Finance

Date Approved: _____

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Abstract

In this paper, we extended the works done by Conconi, Demidow, Klein and Niu(2013), which examined the equal sector strategy. It was claimed that allocating assets equally into different sectors instead of allocating assets based on market cap weighting would generate more return and outperform the benchmark. We used several performance indicators, including excess return, Jensen's alpha, Sharpe ratio, Information ratio and Sortino ratio to see whether this strategy would generate alpha in different markets. We found that this allocating-asset-into-sectors-equally strategy was not effective in the US market and emerging markets, but this strategy has generated a statistically significant Jensen's alpha in EAFE market for the examined time period. Also, we found that by implementing the strategy in some circumstances, it is likely to make portfolio less volatile.

Keywords: Equal sector strategy; Performance evaluation;

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1: Introduction

Arguments about Capital Asset Pricing Model (CAPM) and Efficient market hypothesis have never ceased since the first days they were there. According to Fama(1965), active management could not consistently help fund managers to outperform the market, and thus investors should hold the market portfolio. Sturm(2010) found that with the help of Select Sector SPDRs, a portfolio constructed with equal sector strategy has outperformed its benchmark index S&P 500 Index (SPY) over the period January 1999–December 2007. And Conconi, Demidow, Klein and Niu(2013) extended the time period with the help of Sector ETFs and reached the conclusion that the outperformance does not hold and an equal sector portfolio cannot be expected to outperform the market portfolio. However, they also mentioned that an equal sector portfolio tends to be less volatile and thus may outperform market portfolio on a risk-adjusted basis.

Since then, the financial industry has taken several steps to implement and try to generate alpha with this strategy. For instance, the original claim from State Street Global Advisors (SSGA), which Conconi, Demidow, Klein and Niu(2013) mentioned, has become an ETF that incepted on 6th, July 2009 with the symbol of EQL. Furthermore, New York Stock Exchange (NYSE) launched a new index called NYSE Select Sector Equal Weight Index on 29th, Sept. 2017, of which EQL became a derivative. Apart from that, some other financial institutions, such as Bright Rock Capital Management LLC, have also released research papers and possible rationale about this strategy, claiming

that this strategy would help investors receive improved returns and reduce portfolio volatility.

Apart from of US market, foreign markets also have paid attention to this strategy. By the time of 2014, MSCI started releasing MSCI EAFE Equal Sector Weighted Index and MSCI Emerging Markets Equal Sector Weighted Index. Although MSCI documentations claim that these 2 indexes are only for performance comparison purpose, they are perfect underlying indexes to compare the difference in performance over the markets across the globe.

Intuitively speaking, the rationale of the strategy is very simple. Compared to a market-cap weighted benchmark index or underlying, equal sector strategy underloaded large market-cap sectors and overloaded small market-cap sectors. To make this strategy work, small sectors need to outperform large sectors. Therefore, examining the performance of each sector and comparing with each other would also help addressing the questions.

This article extends the research of Conconi, Demidow, Klein, and Niu(2013), and in our article we address the following questions:

Is there still statistically significant outperformance of an Equal Sector Strategy relative to the market portfolio transitory from 2009 till 2018? And how would this strategy perform in equity markets located in different geographical locations, such as EAFE markets and Emerging markets?

To answer these questions, we would examine the potentials of equal sector strategy outperforming market index by examining the performance of several investment

indexes. For US market, we would examine the performance of the exchange traded fund EQL, which is constructed with the equal sector method, against its benchmark index, S&P 500 Index. The time horizon that we examine starts from 31st, July 2009 and ends at 26th, Nov. 2018. For foreign markets, we examine the performance of the strategy in EAFE markets and emerging markets by evaluating the performance of MSCI EAFE Equal Sector Weighted Net Total Return RT Index and MSCI Emerging Markets Equal Sector Weighted Net Total Return RT Index and by comparing their performance with their benchmark, MSCI EAFE Index and MSCI Emerging Market Index, respectively. We would evaluate their performance over the time horizon from 30th Nov. 2014 to 30th Nov. 2018. Because MSCI released this index not long before 30th, Nov 2014, choosing this starting point would simplify calculation. All the data in this paper, unless otherwise specified, are extracted from Bloomberg Terminal.

2: Literature review

A considerable amount of literature has examined the effectiveness of this strategy, and the results and attributions vary. Banz(1981) and Reinganum(1981) discovered 'small firm effect', which provided a reasonable explanation of the strategy. The 'small firm effect' refers to the discovery that small NYSE firms have had significantly larger risk-adjusted returns than large NYSE firms between 1926 and 1975 on average. Sturm(2010) examined the performance of equal sector strategy during January 1999–December 2007 and found that 8 out of 9 sectors outperform S&P 500 Index with the exception of tech sector, which plays an important role and weighs heavily in the US stock market. Taking the Dot-com bubble in the beginning of 21st century into consideration, such performance should not be very surprising.

Conconi, Demidow, Klein and Niu(2013) examined the performance of this strategy against its benchmark with 4 performance indicators: excess return, Jensen's alpha, Treynor ratio, and difference in the Sharpe ratio. They extended the length of time period in Sturm(2010) to approximately 22 years, from September 1989 to December 2011. By examining the performance of a set of nine sector ETFs launched by State Street Global Advisors (SSGA), they reached the conclusion that the strategy cannot be expected to outperform the market portfolio as the outperformance does not hold given the extended time period. However, they also mentioned that equal sector portfolio tends to be less volatile and thus it may outperform market portfolio on a risk-adjusted basis.

Also, we should give consideration to the effect of other markets. According to the theory in Fama(1965), in an efficient market, active management should generate little and insignificant active return. The efficiency of different markets from different geographic locations varies, and therefore it would be interesting to examine the effectiveness of one strategy in different markets. Dyck, Lins, and Pomorski(2013) has found that active management in emerging equity markets outperforms passive strategies by more than 180 bps per year, even after adjusted for risk through a variety of mechanisms. In EAFE equities, active management also outperforms, but only by about 50 bps per year with the outperformance becoming insignificant with some risk corrections. Emerging markets and EAFE markets do not follow US equity market that closely but they demonstrate significant correlation to several economic factors in the US markets. For instance, Conover, Jensen, and Johnson(2002) found that the equity returns in developed markets during expansive U.S. monetary policy periods are significantly higher than they are during restrictive monetary conditions. Given the time period we

examine is a post financial crises environment, performance results from foreign markets would certainly enlighten us on the questions we intend to look into.

3: Replication from Conconi, Demidow, Klein and Niu(2013)

This article tends to extend the results of Conconi, Demidow, Klein and Niu(2013) by extending both time horizon and geographical locations with new investment underlying. For US market, we no longer need to construct portfolio with sector indexes. Instead, we only need to evaluate the performance of EQL, the ETF. However, to provide creditability to the research, it would be helpful to try to replicate the strategy within the same time period as of in Conconi, Demidow, Klein and Niu(2013).

According to its official homepage, EQL incepted on 6th, July 2009. To take convenience of data integration and return calculation, we chose the historical data starting on 1st, August 2009. For Conconi, Demidow, Klein and Niu(2013), their analysis covered the time period between 1989 to 2011, and a performance evaluation over the time period that the two analysis coincides may help us understand the performance of the strategy better.

We conduct the analysis in three steps, first is a hypothesis test on excess return, then a regression to get Jensen's alpha, and finally we calculate Sharpe ratio, Information ratio and Sortino ratio to analyze risk-adjusted return of the strategy. We conduct our analysis with monthly return data over the entire article unless otherwise specified because daily data contains too much noise, and the time period we examine is too short to generate sufficient data points on a quarterly basis.

Step 1:

A hypothesis test on the excess return of each equal sector strategy underlying against its benchmark underlying comes with a null hypothesis of

$$ER = r_{Equal\ Sector\ Underlying} - r_{Benchmark\ Underlying}$$

$$H_0: ER = 0 \qquad\qquad H_A: ER \neq 0$$

Step 2: The null hypothesis of Jensen's alpha is:

$$H_0: \alpha = 0 \qquad\qquad H_A: \alpha \neq 0$$

To test it, we do a regression of equal sector portfolio's monthly excess return to risk-free rate with the benchmark's excess return to risk-free rate, the regression is as follows:

$$r_{Equal\ Sector\ Underlying} - r_f = \alpha + \beta(r_{Benchmark} - r_f)$$

Step 3:

The formulas for the risk-adjusted return ratios are:

$$Sharpe\ ratio = \frac{r_p - r_f}{\sigma_p}$$

$$Information\ ratio = \frac{Annualised\ Excess\ Return}{Annualised\ Tracking\ Error}$$

$$Sortino\ ratio = \frac{r_p - r_T}{\sigma_D}$$

r_T is called minimum acceptable return, in this case, we use risk-free rate r_f for r_T, σ_D represents downside deviation, whose formula is $\sigma_D^2 = \sum_{i=1}^{n} \frac{\min[(r_i - r_T), 0]^2}{n}$.

To replicate the result from Conconi, Demidow, Klein and Niu(2013), we conduct an analysis to the performance of EQL and S&P 500 Index with the data that is within the coincided time horizon of 1st, Aug 2009 to 31st, Dec 2011.

The results of hypothesis test for excess return are exhibited in Table 1:

Table 1 Hypothesis test for EQL Excess Return (Aug. 2009 to Dec. 2011)

Mean	1.99E-04
SD	0.0055
df	28
tstat	0.1969
p-value	0.8454
95% Confidence Interval	[-0.0019,0.0023]

The results of Jensen's alpha regression are exhibited in Table 2:

Table 2 Jensen's alpha regression for EQL (Aug. 2009 to Dec.2011)

Estimated Coefficients:				
	Estimate	SE	tStat	pValue
(Intercept)	7.85E-04	8.84E-04	0.8877	0.3825
SP500_ret_monthly_minus_rf	0.9377	0.0186	50.4	3.02E-28
Number of observations: 29, Error degrees of freedom: 27				
Root Mean Squared Error: 0.0047				
R-squared: 0.989, Adjusted R-Squared 0.989				
F-statistic vs. constant model: 2.54e+03, p-value = 3.02e-28				

We can see that within this period the strategy did not generate significant excess return or Jensen's alpha.

The results of risk adjusted return are exhibited in Table 3:

Table 3 Risk-adjusted return for EQL (Aug. 2009 to Dec. 2011)

Period	2009/07/31-2011/12/31	
	EQL	S&P 500 Index
Average annual Return	0.1269	0.1206
Daily return SD	0.0123	0.0126
Annualized return SD (252 trading day)	0.1952	0.2000
Risk-Free Rate (Average yearly return of 1-Month Treasury Constant Maturity Rate)	7.38E-04	7.38E-04
Sharpe ratio	0.6462	0.5994
Annualized Tracking Error (Daily)	0.0055	N/A
Annualized Excess Return (Daily)	0.0025	N/A
Information ratio	0.4516	N/A
Monthly downward Risk	0.0235	0.0244
Sortino ratio	5.3669	4.9148

We can see that the strategy has a higher average annual return, Sharpe ratio and Sortino ratio than its benchmark during this period.

Table 4 made a comprehensive comparison with Conconi, Demidow, Klein and Niu(2013)

Table 4 Coincided time performance comparison

	Performance of EQL in coincided time period (2009/07/31-2011/12/31)	Conconi, Demidow, Klein and Niu(2013) entire period (1989-2011)
Annualized monthly excess return	0.63%	0.56%
Jensen's alpha	0.07%	1.04%
p-value for Jensen's alpha	0.3825	0.0800
Annualized SD(ESW)	19.52%	14.28%
Annualized SD (market portfolio)	20.00%	15.13%
Sharpe ratio (ESW)	0.6462	0.5330
Sharpe ratio (market portfolio)	0.5994	0.4660

Note: Period (1989-2011) data from Conconi, Demidow, Klein and Niu(2013)

From Table 4 we can see that even though the coincided time period is relatively short, the performance of EQL still matches the results in Conconi, Demidow, Klein and Niu(2013). The two time periods have similar annualized monthly excess return. The 2009-2011 period has larger volatility, but it can be explained by the fact that the market was recovering from the financial crises at that point, so it would not be surprising to have larger volatility for both the portfolio and the market. Most importantly, the comparison confirmed the conclusion of Conconi, Demidow, Klein and Niu(2013) that the portfolio has lower volatility and may outperform on risk-adjusted basis.

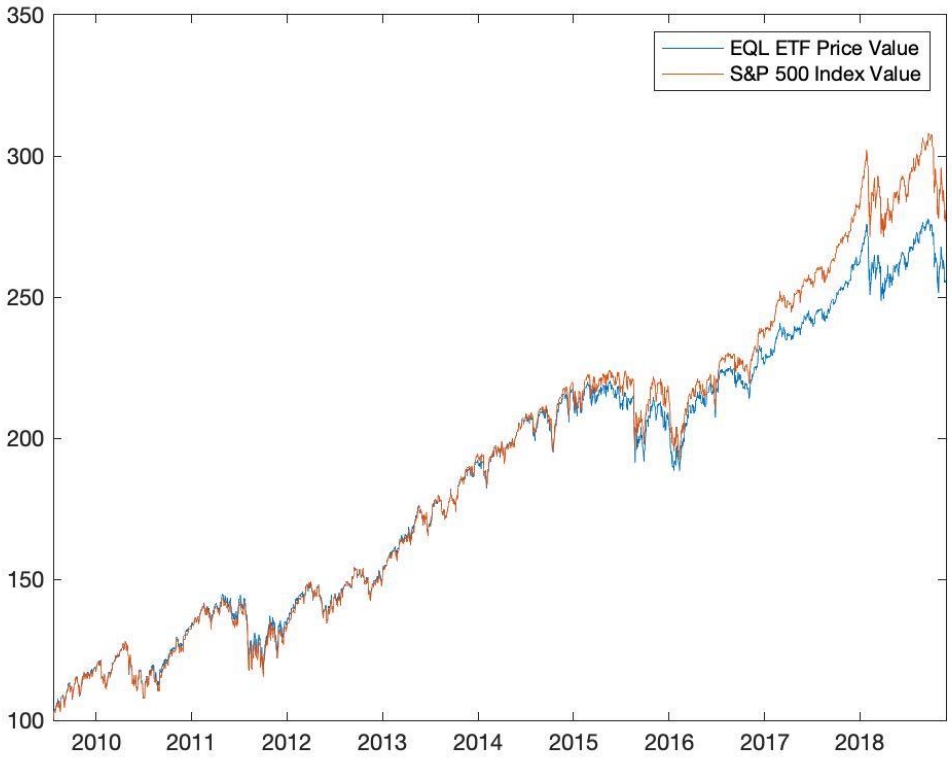
4: Hypothesis and tests from US market data

From the introduction on EQL's official website, we can find that this ETF charges investors a considerable amount of management fee, with a net expense ratio at 0.48% as of 31st, Mar. 2018. Therefore, the fairest way to evaluate the performance

would be to evaluate the price of EQL, which takes the management fee into account. The benchmark of this ETF is S&P 500 Index. Therefore, we evaluate the performance of EQL as the representative of the equal sector strategy portfolio in the US market.

Before we analyze the strategy's performance with statistical methods, we should first take a look at the moving trend of EQL's performance and S&P 500 Index's performance to get an intuitive impression. We assume investing 100 at the beginning of the time period, 1st, Aug. 2009. And the value of our investment moves as illustrated in Figure 1:

Figure 1 EQL and S&P 500 Value movement



We can see that EQL actually underperforms the S&P 500 by the end of the period we examine.

If we take a closer look at the graph above, we can discover the movement pattern that EQL actually followed S&P 500 Index very closely at the beginning of the time period. And then a deviation between the two investment underlying appeared in the middle of 2016, when S&P 500 Index started to outperform EQL. This gap between EQL and S&P 500 Index became increasingly larger in the remaining time. One possible explanation for this phenomenon is that IT sector weighs heavily in the US market, and an equal sector strategy underweights IT sector. By the middle of 2016, IT sector started to outperform other sectors and thus the market-cap weighted benchmark outperformed the equal sector strategy ETF.

And the result of the regression to calculate Jensen's alpha over this period is exhibited in Table 5:

Table 5 Jensen's alpha regression for EQL (July 2009 to Nov.2018)

Estimated Coefficients:				
	Estimate	SE	tStat	pValue
(Intercept)	-2.79E-04	5.09E-04	-0.5492	0.5840
SP500_ret_monthly_minus_rf	0.9272	0.0143	64.7340	2.08E-89
Number of observations: 112, Error degrees of freedom: 110				
Root Mean Squared Error: 0.0052				
R-squared: 0.974, Adjusted R-Squared 0.974				
F-statistic vs. constant model: 4.19E+03, p-value = 2.08E-89				

We can see that its Jensen's alpha in the US market is negative and insignificant.

In this case, we calculate and examine EQL's risk-adjusted return against its benchmark, S&P 500 Index, and the result are demonstrated in Table 6:

Table 6 Risk-adjusted return for EQL (July 2009 to Nov. 2018)

Period	2009/07/31-2018/11/30	
	EQL	S&P 500 Index
Average annual return	0.1060	0.1171
Daily return SD	0.0089	0.0094
Annualized return SD (252 trading day)	0.1418	0.1487
Risk-Free Rate (Average yearly return of 1-Month Treasury Constant Maturity Rate)	0.0033	0.0033
Sharpe ratio	0.7239	0.7652
Annualized Tracking Error (Daily)	0.0057	N/A
Annualized Excess Return (Daily)	-0.0122	N/A
Information ratio	-2.1209	N/A
Monthly downward risk	0.0175	0.0185
Sortino ratio	5.8744	6.1503

EQL has a smaller Sharpe ratio and Sortino ratio, along with a negative Information ratio.

5: Test result from EAFE markets data

For the test on EAFE markets, we examine the performance of the strategy by analyzing the historical monthly data of MSCI EAFE Equal Sector Weighted Net Total Return RT Index against the historical data of its benchmark, MSCI EAFE Index.

EAFE markets refers to Europe, Australasia and Far East markets. By its definition, EAFE markets include developed markets around the world excluding US and Canada equity markets. Our data starts from 1st, Dec 2014 to Nov. 30th, 2018. For risk-

free interest rate in this analysis, we use US 1-Month Treasury Constant Maturity Rate as well.

Similarly, the start of our analysis is a value movement graph that assumes 100 of investment at the beginning of the time period to get an intuitive impression of the performance. The performance of equal sector strategy versus market-cap weighted index is demonstrated in Figure 2:

Figure 2 MSCI EAFE Equal Sector Index and MSCI EAFE Index

One good news for the strategy is that the EAFE markets equal sector index outperforms its market-cap weighted benchmark. Therefore, we can expect better performance from the strategy in EAFE markets.

For Jensen's alpha, the null hypothesis is:

$$H_0: \alpha = 0 \qquad\qquad H_A: \alpha \neq 0$$

To calculate MSCI EAFE Equal Sector Index's Jensen's alpha, we do a regression between MSCI EAFE Equal Sector Index's excess return and MSCI EAFE Index's excess return, the regression formula is as follows:

$$r_{EAFE\_EQUAL} - r_f = \alpha + \beta(r_{EAFE} - r_f)$$

And the results are exhibited in Table 7:

Table 7 Jensen's alpha regression for MSCI EAFE Equal Sector Index (July 2014 to Nov.2018)

Estimated Coefficients:				
	Estimate	SE	tStat	pValue
(Intercept)	0.0027	7.91E-04	3.3649	0.0016
eafe_ret_minus_rf	0.9619	0.0227	42.294	1.80E-38
Number of observations: 48, Error degrees of freedom: 46				
Root Mean Squared Error: 0.00548				
R-squared: 0.975, Adjusted R-Squared 0.974				
F-statistic vs. constant model: 1.79E+03, p-value = 1.8E-38				

We can see that the equal sector index's Jensen's alpha is above 0 and is statistically significant.

And then we examine the risk adjusted return of MSCI EAFE Equal Sector Index and MSCI EAFE Index. Similarly, we use Sharpe ratio, Information ratio, and Sortino ratio to evaluate MSCI EAFE Equal Sector Index's risk-adjusted return.

Table 8 Risk-adjusted return for MSCI EAFE Equal Sector Index (July 2014 to Nov.2018)

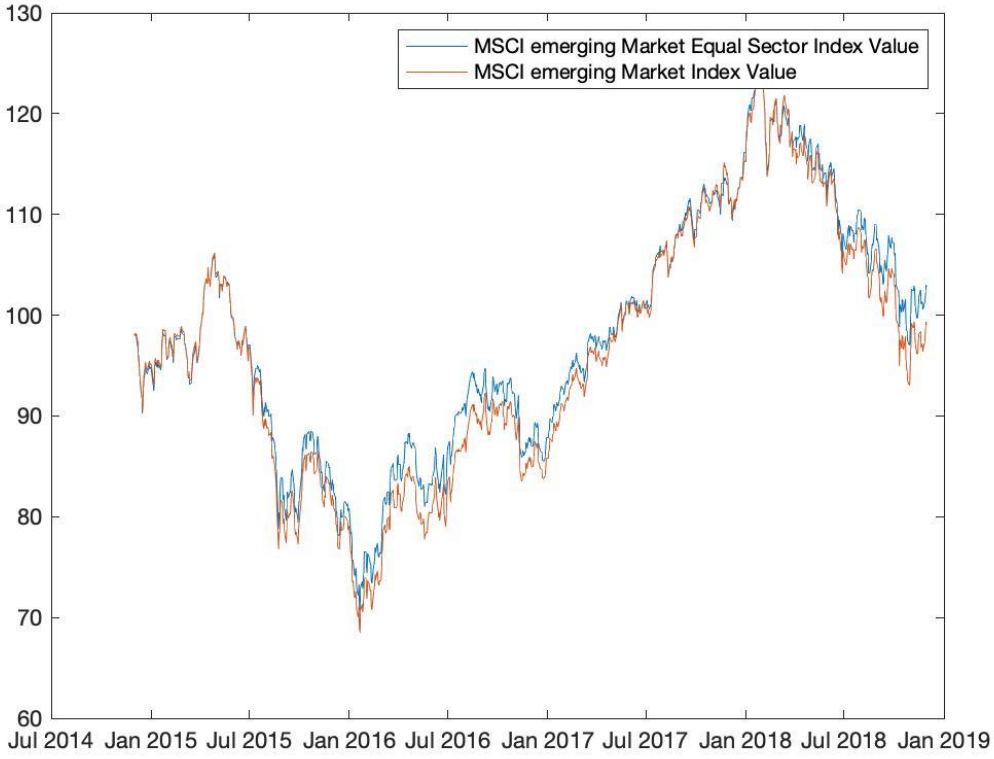
Period	2014/12/01-2018/11/30	
	MSCI EAFE Equal Sector Index	MSCI EAFE Index
Average annual return	0.0277	-0.0040
Daily return SD	0.0080	0.0080
Annualized return SD (252 trading day)	0.1267	0.1274
Risk-Free Rate (Average yearly return of 1-Month Treasury Constant Maturity Rate)	0.0070	0.0070
Sharpe ratio	0.1634	-0.0862
Annualized Tracking Error (Daily)	0.0056	N/A
Annualized Excess Return (Daily)	0.0316	N/A
Information ratio	5.6578	N/A
Monthly downward Risk	0.0198	0.0214
Sortino ratio	1.0465	-0.5118

6: Test result from Emerging markets data

Similarly, for emerging markets, we examine the effectiveness of the strategy by looking into MSCI Emerging Markets Equal Sector Weighted Net Total Return RT Index's historical data against the historical data of its benchmark, MSCI Emerging Markets Index. According to MSCI documentation, emerging markets include Chinese, South Korean, Indian, Brazilian markets, and equity markets from many other countries as well. These countries are known as developing countries and their equity markets are generally believed to be less efficient than the equity markets of developed countries. Our data starts from 1st, Dec 2014 to 30th, Nov. 2018. And we continue to use US 1-Month Treasury Constant Maturity Rate as our risk-free rate.

Similarly, we start with an assumed 100 investment at the beginning of the time period. The performance of equal sector index versus market-cap weighted index is shown in Figure 3:

Figure 3 MSCI Emerging Markets Equal Sector Index and MSCI Emerging Markets Index



Different from the previous two comparisons, these two indexes do not seem to perform very differently.

For Jensen's alpha, the null hypothesis is:

$$H_0: \alpha = 0 \qquad\qquad H_A: \alpha \neq 0$$

To test MSCI Emerging Markets Equal Sector Index's Jensen's alpha, we conduct a regression to MSCI Emerging Markets Equal Sector Index's excess return and MSCI Emerging Markets Index's excess return, the regression formula is:

$$r_{EMERGING\_EQUAL} - r_f = \alpha + \beta(r_{EMERGING} - r_f)$$

And the result is shown in Table 9:

Table 9 Jensen's alpha regression for MSCI Emerging Markets Equal Sector Index (July 2014 to Nov.2018)

Estimated Coefficients:				
	Estimate	SE	tStat	pValue
(Intercept)	6.84E-04	7.34E-04	0.9315	0.3565
emerging_ret_monthly_minus_rf	0.9379	0.0163	57.671	1.49E-44
Number of observations: 48, Error degrees of freedom: 46				
Root Mean Squared Error: 0.0050				
R-squared: 0.987, Adjusted R-Squared 0.987				
F-statistic vs. constant model: 3.5E+03, p-value = 4.76E-45				

The same with US market, in emerging markets, equal sector index's Jensen's alpha is not significant enough to reject the null hypothesis.

We also examine the risk adjusted return of MSCI Emerging Equal Sector Index and the performance of MSCI Emerging Index, and the results are exhibited in Table 10:

Table 10 Risk-adjusted return for MSCI Emerging Markets Equal Sector Index (July 2014 to Nov.2018)

Risk-adjusted return		
Period	2014/12/01-2018/11/30	
	MSCI Emerging Markets Equal Sector Index	MSCI Emerging Markets Index
Average annual return	0.0067	-0.0024
Daily return SD	0.0088	0.0092
Annualized return SD (252 trading day)	0.1404	0.1463
Risk-Free Rate (Average yearly return of 1-Month Treasury Constant Maturity Rate)	0.0070	0.0070
Sharpe ratio	-0.0024	-0.0643
Annualized Tracking Error (Daily)	0.0058	N/A
Annualized Excess Return (Daily)	0.0080	N/A
Information ratio	1.3883	N/A
Monthly downward risk	0.0238	0.0256
Sortino ratio	-0.0144	-0.3671

It should be noted is that just like the previous MSCI example, equal sector index generated positive return while benchmark index ended up in negative return.

7: Empirical Results and Discussion

A hypothesis test on the excess return of each equal sector strategy underlying against its underlying comes with a null hypothesis of

$$ER = r_{Equal\ Sector\ Underlying} - r_{Benchmark\ Underlying}$$

$$H_0: ER = 0 \qquad H_A: ER \neq 0$$

And the result of the hypothesis result along with the results of other analysis are summarized in Table 11:

Table 11 Performance Summary

Market	US Market	EAFE Markets	Emerging Markets
Underlying vs Benchmark	EQL vs S&P 500 Index	MSCI EAFE Equal Sector Index vs MSCI EAFE Index	MSCI Emerging Markets Equal Sector Index vs MSCI Emerging Markets Index
Time period	2009/07/31-2011/12/31	2014/12/01-2018/11/30	2014/12/01-2018/11/30
Average Annualized ESW Portfolio Return	0.1060	0.0277	0.0067
Market Annualized Return	0.1171	-0.004	-0.0024
Average Monthly Excess return of ESW	-9.51E-04	0.0027	6.70E-04
Average Monthly Excess return p-value	0.0826	0.0018	0.4254
Jensen's alpha	-2.79E-04	0.0027	6.84E-04
Jensen's alpha p-value	0.5840	0.0016	0.3565
σ_p Annualized (ESW Portfolio)	0.1418	0.1267	0.1404
σ_M Annualized (Benchmark)	0.1487	0.1274	0.1463
β	0.9272	0.9619	0.9379
Risk Free Rate (Average annualized Return)	0.0033	0.0070	0.0070
Sharpe ratio (ESW portfolio)	0.7239	0.1634	-0.0024
Sharpe ratio (Market portfolio)	0.7652	-0.0862	-0.0643

Information ratio (IR)	-2.1209	5.6578	1.3883
σ_D (ESW) (Monthly Downward Risk)	0.0175	0.0198	0.0238
σ_D (Market) (Monthly Downward Risk)	0.0185	0.0214	0.0256
Sortino ratio (ESW Portfolio)	5.8744	1.0465	-0.0144
Sortino ratio (Market Portfolio)	6.1503	-0.5118	-0.3671
Number of observations	112	48	48

We can see EQL's excess return could not reject the null hypothesis that its mean equals 0 under 95% confidence interval, indicating that it is very close to 0. Thus, we can conclude that this strategy did not generate excess return over the period in US market. This also applies to emerging markets, whose excess return is very small, and the p-value indicates that it cannot reject the null hypothesis either, which also suggesting equal sector strategy cannot outperform its market-cap weighted benchmark. However, we see a different pattern in EAFE markets. With the p-value of excess return equals 0.0017, rejecting the null hypothesis, we can conclude that for EAFE markets, an equal sector index could generate statistically significant positive excess return within the examined time period.

For Jensen's alpha, we can see that even though all three regressions are significant overall, in US market and emerging markets Jensen's alpha, the intercepts of the two regressions, are both insignificant. For US market its Jensen's alpha is even

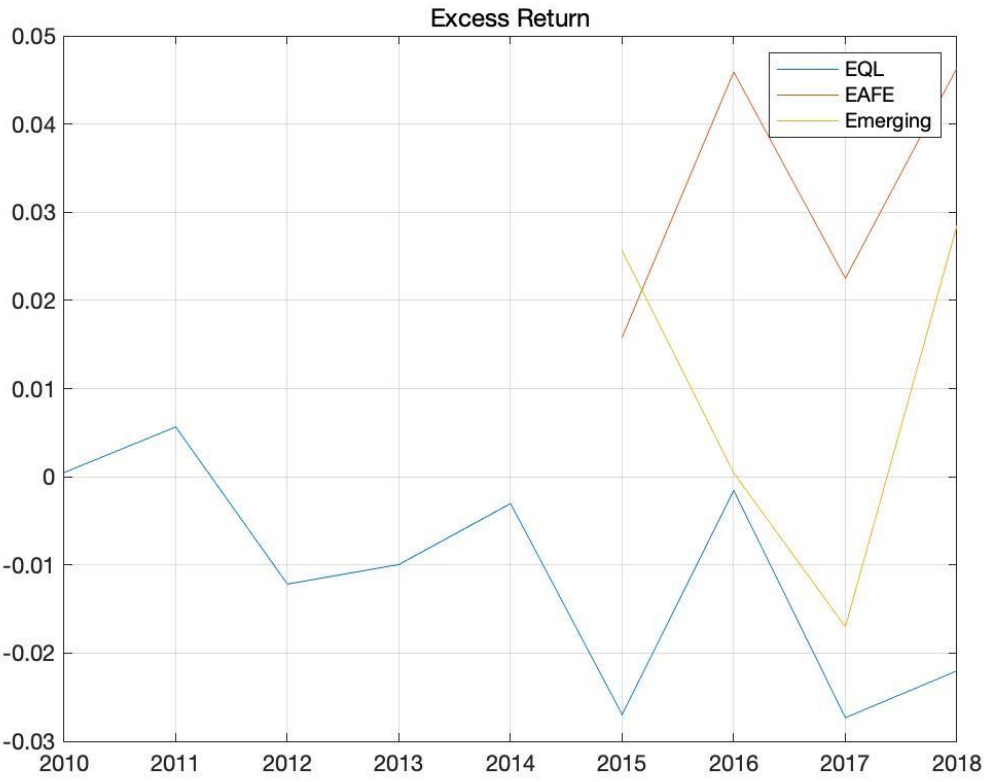
negative, indicating the strategy didn't generate alpha after taking into account of management fee, which is already included in EQL's price return. For EAFE markets, even though its Jensen's alpha is as small as 0.27%, it has a high level of significance.

As for risk-adjusted returns, we can clearly see the difference in performance between EQL and S&P 500 Index in the US market. S&P 500 Index not only outperformed EQL, but also has a larger Sharpe ratio. For average annual return, S&P 500 Index outperforms EQL by 1.11%. Even after taking the management fee into account, a net expense ratio of 0.48% as reported on EQL's homepage, EQL still approximately underperforms S&P 500 Index by 0.63%.

Also, both Sharpe ratio and Sortino ratio of the two foreign markets, the two indicators of risk and downside risk respectively, have demonstrated different patterns in different markets. The ratios of the US market have suggested that S&P 500 Index generates significantly higher return per unit of downside risk. For the circumstance in EAFE markets and emerging markets, the bad news is that they even underperformed the risk-free rate in the US and as a result we can see a negative market Sharpe ratio and Sortino ratio. However, the indexes constructed with equal sector strategy have larger Sharpe ratios and Sortino ratios, indicating a larger return (a smaller loss) for per unit of risk/downside risk. One thing we should note here is that in EAFE markets, equal sector strategy has generated positive Sharpe ratio and Sortino ratio while the market-cap weighted index has generated negative Sharpe ratio and Sortino ratio. That is, the EAFE equal sector strategy index outperformed US risk-free rate but EAFE markets index did not.

From Figure 4, we can see the movement trend of excess return in different markets in the time period we analyzed. For EAFE markets, the excess return is above 0. For emerging markets, we can see that 2016 and 2017 are two bad years for the strategy, but excess return for 2018 has rebounded. For US market, with longer data, we can see that the strategy has not been effective since 2010, indicating a more significant 'not effective' for the strategy.

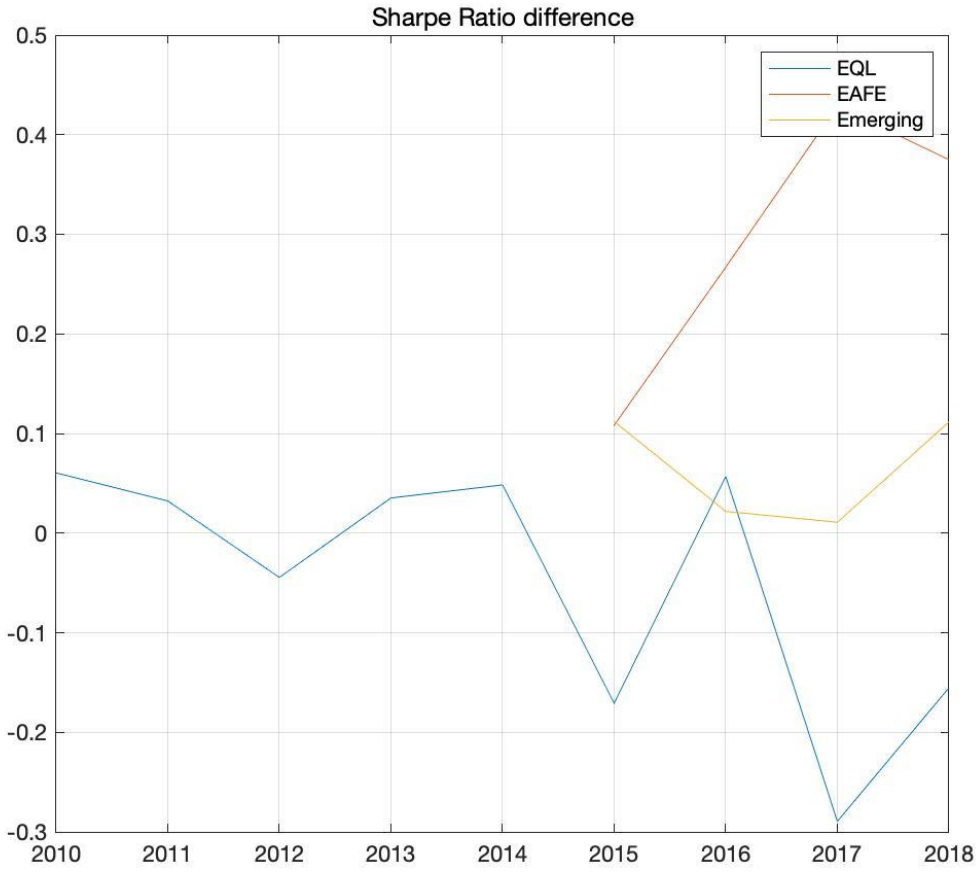
Figure 4 Excess Return for three underlying



From the pattern of Sharpe ratio over the years demonstrated in Figure 5, we can see the effectiveness of the strategy in detail. For US market, we find that for the years that excess return is below 0, like 2013, 2014 and 2016, the Sharpe ratio for the strategy

is actually higher than its benchmark, supporting the conclusion of Conconi, Demidow, Klein and Niu(2013) that the equal sector strategy portfolio may be less volatile than the market portfolio. However, we should not overlook the fact that the equal sector strategy portfolio significantly underperformed market portfolio in 2015, when IT sector start to generate significant return as we tried to explain in Section 4, indicating the strategy's inability to catch up the market when large sectors outperform.

Figure 5 Difference in Sharpe ratio for three underlying



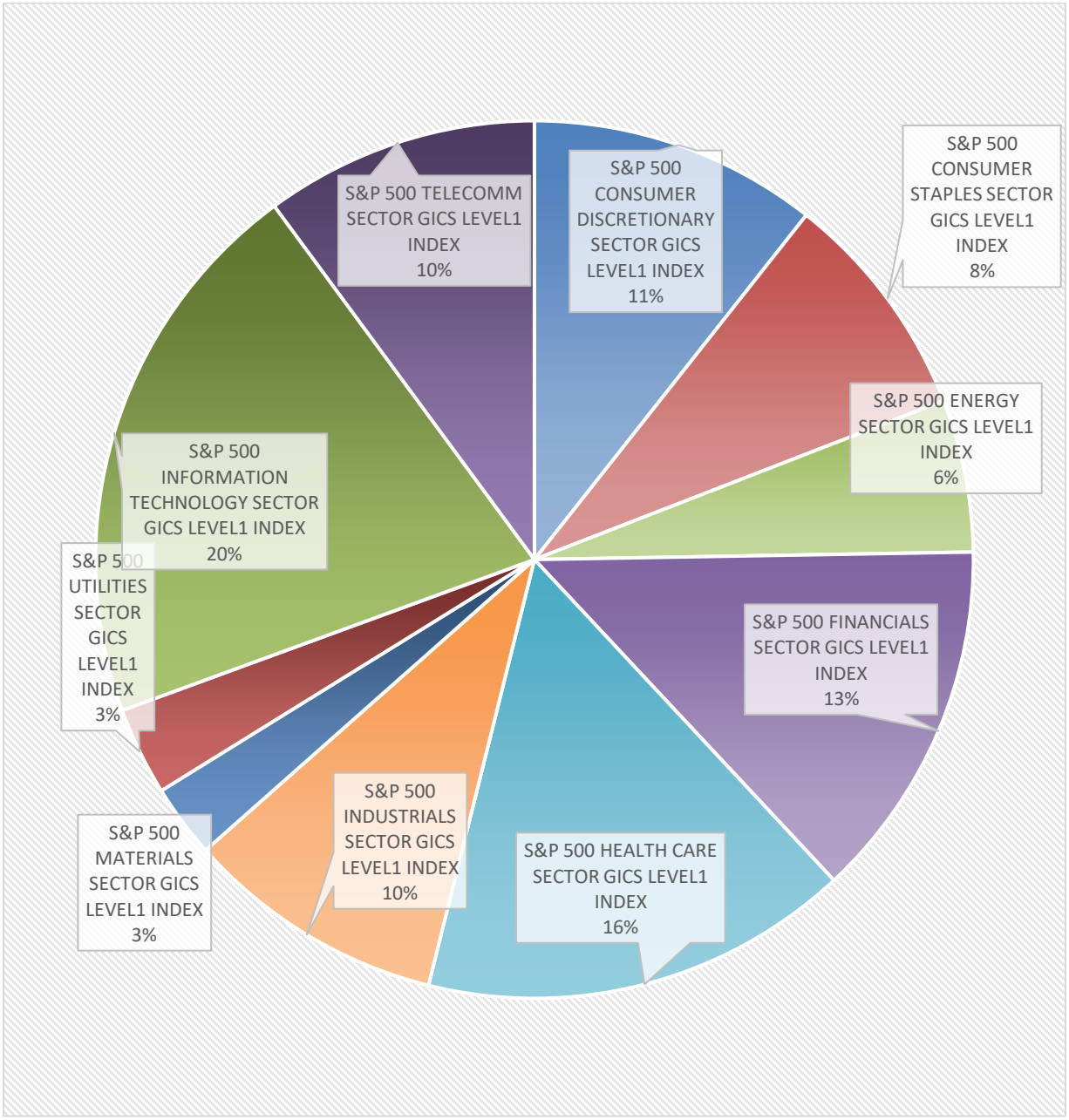
8: Possible Explanation

The results of statistical tests have provided us several insights regarding the effectiveness of this equal sector strategy. First of all, in US market and emerging markets, the strategy does not generate significant excess return or Jensen's alpha against its benchmark index for the given time period we examine. But for EAFE markets that is not the case. In EAFE markets, this equal sector strategy has provided investors statistically significant excess return and Jensen's alpha. As for risk-adjusted return, we found that for both EAFE markets and emerging markets, both the Sharpe ratio and the Sortino ratio of the equal sector indexes are higher than that of their benchmark index. For US market, the Sharpe ratio and Sortino Ratio of S&P 500 Index is greater than that of EQL, indicating the strategy could not protect investors from downside risk than market-cap weighted indexes in the US market. Another finding is that for both EAFE markets and emerging markets, the average annual return of equal sector index could still remain positive while their benchmark generates negative average annual return.

It would not take much effort to think of the connection between the idea of equal sector strategy to equal stock weighted strategy, whose effectiveness is constructed upon small firm effect. The foundation of the small firm effect relies on the phenomenon that small market-cap stocks could outperform large market-cap stocks. Similarly, it is natural to formulate that this strategy would work well if small market-cap sectors could outperform large market-cap sectors. Therefore, a test on such an effect would certainly help us unveil the possible mechanism of this strategy. The following is the market-cap of different sectors within S&P 500 Index, and the largest several sectors are IT, health care, and financials, taking 19.90%, 15.38%, 12.94% of the total market cap of US

market respectively. For an equal weighted ETF like EQL, each sector in S&P 500 Index should take approximately 10% of total portfolio, while in a market-cap weighted index these three sectors are relatively overweighed.

Figure 6 Sector weight in S&P 500 Index as of 2018



To test the potential 'small cap sector effect', we need to see the return and risk adjusted return of each sector. Suppose we bought 100 for each of the 10 S&P 500 Sector Indexes by 1st, Aug 2009 (that is, an equal sector approach), then we can see the distribution of our profit. If the largest three sectors generate a proportion smaller than 30%, then we can conclude that there is 'small sector effect' in the time period. The return of our investment is demonstrated by sector in Table 12:

Table 12 Performance decomposition by sector in S&P 500 Index.

Sector	Total Return	Annualized Return	Daily SD	Annualized SD	Sharpe ratio	100 investment end up as
Consumer discretionary	313.02%	16.44%	0.0103	0.1638	0.9833	413.02
Consumer staples	121.74%	8.92%	0.0073	0.1159	0.7410	221.74
Energy	22.60%	2.21%	0.0133	0.2118	0.0886	122.60
Financials	151.33%	10.40%	0.0131	0.2083	0.4832	251.33
Health care	222.58%	13.39%	0.0092	0.1461	0.8938	322.58
Industrials	181.94%	11.77%	0.0108	0.1718	0.6654	281.94
Materials	92.58%	7.29%	0.0123	0.1949	0.3567	192.58
Utilities sector	86.78%	6.94%	0.0089	0.1406	0.4695	186.78
Information technology	265.20%	14.91%	0.0110	0.1749	0.8338	365.20
Telecomm	34.13%	3.20%	0.0097	0.1542	0.1859	134.13

We can see that the best performing sectors are IT, Health Care, Consumer Discretionary, Industrials and Financials. Our initial investment sums up as 1000, and this initial investment totals 2491.89 at the end of the time period. The three largest

sector, IT, Health Care, and Financials generates 43% of the total profit, larger than the threshold of 30%.

9: Conclusion

Since December 1998, when State Street Global Advisors (SSGA) launched the Select Sector SPDRs and claimed that "Equal Sector Strategy" consistently outperforms the S&P 500 in history, the investment community has been developing products and technics to explore the potential of the strategy. For US market, ALPS launched EQL based on the strategy. Outside of US, MSCI released MSCI EAFE Market Equal Sector Index and MSCI Emerging Markets Equal Sector Index to provide performance data on the strategy. This paper has tested the effectiveness of the equal sector strategy between 2009 to 2018 for US market and 2014 to 2018 for EAFE markets and emerging markets. We found some very interesting results.

First of all, the strategy did not significantly outperform benchmark index in US market and emerging markets but generated statistically significant alpha in EAFE markets.

Secondly, our analysis has provided further evidence to the conclusion of Conconi, Demidow, Klein and Niu(2013) that the equal sector strategy may be less volatile than market-cap weighted benchmark in US market and may outperform the market portfolio on risk-adjusted basis.

We examined the performance of US market sector indexes and found that with an equal sector strategy, we underloaded the winning sectors of the time period and thus

could not provide better return. However, the details of how this strategy would affect performance at other markets, especially EAFE markets, remain an interesting topic.

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