Global Education Stock Returns

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ABSTRACT: In this analysis, I selected 12 global stocks in the education sector across regions that have seen noticeable changes in talent and capital investment over the last few years. With a focus on China, I hope to gain new investing insight into the global educational sector through statistical tests. First, I analyzed the log-returns of each individual stock and then compared stocks by country to determine whether they had similar log-returns and observed their correlation.

Fall
2018

Data Set

The data set used consists of the daily closing stock prices of eight global education companies every trading day from Sept 2nd, 2016 to Sept 1st, 2018. I collected 503 data points for each stock and the daily closing stock prices were taken from Yahoo Finance. The stocks and the companies they represent in the data set are:

Chinese Educational Companies

- TAL Education (TAL, NYSE)
- New Oriental Edu. & Tech. (EDU, NYSE)

Brazilian Educational Companies

- Kroton Ed. ADR (KROTY, OTCMKTS)
- Estacio Participacoes (ESTC3.SA, SPSE)

American Educational Companies

- Adtalem Global Ed (ATGE, NYSE)
- Bright Horizons Family (BFAM, NYSE)

Indian Educational Companies

- CL Educate (CLEDUCATE, NSE)
- Career Point (CAREERP, NSE)

The companies listed above are chosen as a representative set among the industrialized (G8) and emerging (G5) nations across the New York Stock Exchange, Over-the-Counter Markets Group, South Pacific Stock Exchange & the National Stock Exchange of India. These companies specialize in all aspects of education from tutoring to higher education.

Project Goals

In this project, I chose to focus on the education sector as Chinese educational companies have seen a fairly steady rise over the last four years until recent regulatory changes prevented for-profit educational companies from raising equity-market funding.[1] This new legislation caused investors to divulge these investments over Q3/Q4 2018.

My goal in this analysis is two-fold: (1) to determine whether any region in this group of industrialized and emerging economies saw proportionate growth during the Chinese educational divesting period and (2) to conduct statistical tests that could lead to a more informed decision on which regional educational markets or even companies are attractive for investment and what time to invest.

To inform decision-making, I investigated a set of questions related to one stock and two-stock log-returns. For the one stock investigation, I first explored whether the log-returns were consistent with a random, normally distributed sample. Next, I reviewed the mean and variance of each stock's log-returns.

Finally, I evaluated how the stocks in a given region performed over time and if there were seasonality trends in the log-returns. For the two-stock investigation, I explored whether two stocks moved in similar yet opposing patterns around the time of the Chinese educational divesting period.

Analysis

Single Stock Analyses

Testing for Normal Distribution & Randomness

To see if the stock log-returns are consistent with a normally distributed random sample, I first performed the Runs test for Randomness and then plotted each company's log-returns over the last two years on a normal probability plot.

The results, seen in Table 1, show that the entire set of companies had p-values greater than 0.05, thus failing to reject the null hypothesis that each of the stock's log-returns are consistent with a random sample.

Table 1: Runs Test p-values to Determine Stock Log-Returns Randomness

	United States		China		India		Brazil	
Stock	ATGE	BFAM	TAL	EDU	CLEDUCATE	CAREERP	KROTY	ESTC3
p**-value**	0.4213	0.8582	0.0606	0.7887	0.2871	0.7186	0.1801	0.1078

Secondly, with the exception of one stock, each company's log-returns presented an approximately normal distribution, when visualized on a normal probability plot, with a reasonably linear pattern in the center of the data set and upper and lower tails variably departing from the fitted line. CLEDUCATE, the exception, appeared to have strong tails such that a greater proportion of the data set deviates from the fitted line than follows it.

Thus, from these two analyses, we can generally conclude that the companies' log-returns in this set are normally distributed random samples.

95% Confidence Interval for μ and σ^2

With the assumption of a normally distributed, random sample satisfied, I generated 95% confidence intervals for each company's log-returns' sample means, μ, and sample variances, σ^2 in Table 2. Since population mean and variance for this sample is unknown, I used the sample standard deviation and the t-distribution with 502 (n-1) degrees of freedom to calculate the sample mean and confidence interval for μ, and the sample variance and χ^2-distribution with the same degrees of freedom.

Table 2: 95% Confidence Interval for μ and σ^2

	Stock	**95% C.I. for Means** (μ)	**95% C.I. for Variance** (σ^2)
US	ATGE	(-0.000173,0.003145)	(0.000318,0.000408)
	BFAM	(0.000175,0.002037)	(0.000100,0.000128)
CH	TAL	(-0.000372,0.004503)	(0.000687,0.000880)
	EDU	(-0.000914,0.003392)	(0.000536,0.000686)
IN	CLEDUCATE	(-0.005705, -0.000528)	(0.000532,0.000715)
	CAREERP	(-0.002947,0.002064)	(0.000713,0.000916)
BR	KROTY	(-0.004063,0.001859)	(0.001013,0.001298)
	ESTC3	(-0.001916,0.003035)	(0.000708,0.000907)

The small 95% confidence intervals for μ and σ^2 indicate that the mean log-returns of the set of global education stocks is roughly 0, with upper and lower bounds not exceeding ±1 cent and minimal variability in any stock's log-returns.

Linear Regression of Log-returns Against Time

Next, I evaluated the linear regression of the log-returns versus time for each stock, as seen in Table 3. With R^2 values ranging from 0.00113 for ESTC3 to 0.005199 for TAL but all roughly 0 across all companies in the set, the results indicate the model does not explain the variation in the log-returns around the mean.

The residuals also cluster near 0, ranging from -0.05 to 0.05. This indicates that the there is no pattern to the log-returns that might be beneficial to an investor for future estimation of log-returns on this set of educational stocks.

Table 3: Linear Regression of Log-returns vs. Time

	Stock	$\widehat{\beta_0}$	$\widehat{\beta_1}$	R^2
US	ATGE	3.045e-03	-6.188e-06	0.002254
	BFAM	1.538e-04	3.778e-06	0.002669
CH	TAL	5.544e-03	-1.380e-05	0.005199
	EDU	3.957e-03	-1.079e-05	0.004068
IN	CLEDUCATE	-7.905e-04	-1.311e-05	0.002932
	CAREERP	1.735e-03	-8.776e-06	0.001957
BR	KROTY	2.372e-03	-1.379e-05	0.003515
	ESTC3	2.206e-03	-6.534e-06	0.00113

Two Stock Analyses

TAL Two Sample T-test and Linear Regression

To compare how Chinese educational stocks fair relative to other global educational stocks, I used a 95% confidence level and a two-sample t-test with unknown variance. For the purposes of comparison, I used the TAL stock as a comparison point against the seven other stocks.

From Table 4, you can see that the p-values are all > 0.05, which indicates that we fail to reject the null hypothesis that any of the stocks in the set had a statistically significant difference in log-returns as compared to one of China's largest education stocks, TAL. Repeating this exercise using EDU – the other Chinese educational stock – the p-value range stayed fairly consistent.

Table 4: TAL Two Sample t-Test and Linear Regression

	Stock	P-Value	Slope	R^2
US	ATGE	0.8794	0.295481	0.0377
	BFAM	0.5501	0.5746	0.0481
CH	EDU	0.4816	0.7130	0.4316
IN	CLEDUCATE	0.0077	0.1066	0.0171
	CAREERP	0.1495	--* (NA)	--* (NA)
BR	KROTY	0.1611	0.1643	0.0378
	ESTC3	0.5845	-0.0499	0.0018

To assess if there was no correlation in the returns, I used a linear regression model. The results showed that we can reject the null hypothesis that the log-returns of stocks within China vs. educational stocks outside of China are uncorrelated. This suggests there may be a correlation between these stocks.

Country-Stock Analyses

Looking at the histograms of each pair of stocks per country, the change in share price visually correlates strongly among companies within a region over the last two years. While the US appeared to be the only region with a consistently increasing trend in educational stock prices, China also saw similar trends up until July 2018, where the share prices of both TAL and EDU steadily declined until it started to level out around November 2018. The sampled pair of Brazil's educational stocks exhibited a peak in share price around September 2017, while India's sampled pair of educational stocks have been on the steady decline since 2016, when normalizing for CAREERP's anomalous trading event in September 2017.

When looking at the linear regression of the log-returns of pairs of stocks within each country, the p-values were miniscule across the board, most values falling within the range of 10^{-16} (Chinese educational stocks) to 10^{-14} (American educational stocks), enabling us to strongly reject the null hypothesis that the log-returns of educational stocks within a country significantly different. This suggests, though it does not prove, that there may be correlation seen among educational stocks within a country. Additionally, with the highest slope seen for EDU when evaluating relative to TAL, I would expect to see roughly similar log-returns across these two companies during the lookback period. That being said, the R^2 value for EDU and TAL is only 0.4316, which suggests the relationship may not be linear.

Currency Significance

It's important to note in this analysis that the stock with the highest share price is BFAM, an American company that specializes in early education, advisory services and child-care, with a share price $\$116$. For Brazil, India and China, while the trends are evaluated within the context of the country's currency, the share prices are not converted to a single currency within this analysis and instead kept within the local currencies.

Conclusion

From the tests, I first concluded that most of the log returns were normally distributed and consistent with a random sample. After this, I explored the 95% Confidence Interval for each of these stocks, which indicated both the sample mean and the variance hovered around 0.

The Linear Regression of Log-returns of the stocks yielded very small R^2 values and the residuals indicated no pattern in the log-returns that would be beneficial to an investor for future predictions. When evaluating the stocks relative to China's TAL in the two-stock analysis, I also failed to reject the null hypothesis that any of the stocks in the set had a statistically significant difference in log-returns.

Overall, the global education stocks selected here appear to suggest a correlation, especially within region, but no region appears to exhibit any uptick that correlates with the divesting period seen in China's educational sector in the third-quarter of this year.

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