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To what extent can a value-oriented investment strategy be profitable in microcap equities

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Introduction

In 2014, Martin Scorsese's film 'The Wolf of Wall Street' debuted in theatres worldwide. The movie follows Jordan Belfort, a now disgraced former stockbroker, and his exploits in America's finance industry in the 90's. While the movie is not the source of inspiration for this paper, the asset class that Belfort brokered and made his fortune on at that time is.

A microcap stock refers to a company with low, 'micro', capitalization, which means that the total value of its stock price is relatively low and usually in the $50 million to $300 million range (U.S. Securities and Exchange Commission , 2013). These firms are typically characterized by their highly illiquid trading nature, lack of sell-side analyst coverage, large bid-ask spreads, and general lack of publicly available financial information (Zaremba, 2015; The Brandes Institute, 2014; Rodríguez, 2015; Lavelle, 2018).

Despite the risky nature of investing in this asset class, The Brandes Institute (2014) demonstrates that selecting microcap stocks through a value investing approach can be a profitable investment, far from the speculative image portrayed by movies such as 'Wolf of Wall Street', 'Boiler Room', and academic literature pointing to poor performance. Lakonishok et al. (1994) define a value investing strategy as one focused on selecting stocks that display low prices relative to, for example, earnings, dividends, or book value of assets.

To the knowledge of the author, few studies have examined value investing in the microcap universe. Based on this, the following research question was established:

To what extent can a value-oriented investment strategy be profitable in microcap equities

The remainder of this paper will be divided into the following sections: theoretical framework, data and methodology, results and interpretation, conclusion, and a final evaluation on the drawbacks of the paper.

The theoretical framework cites prior available literature on similar topics. This is then followed by the data and methodology section where the variables investigated, data gathered, and method used to analyze the information collected is explained in detail. Within the results section, the results of two hypotheses derived from the aforementioned research question are presented and analyzed. The conclusions arrived at through these results are combined and elaborated on in the conclusions after which the final evaluation section highlights improvements and potential issues with the research.

Theoretical Framework

Previous literature relating to the performance of microcaps through a regional comparison is, to the knowledge of the author, difficult to locate. The general literature available on microcap stocks is similarly limited. The few studies that have been carried out in this asset class highlight the difficulties with examining prior research since these stocks have a reputation of being highly illiquid, speculative, and unreliable in terms of reporting financial statements, making them difficult to anlayse (The Brandes Institute, 2014; Rodríguez, 2015; Lavelle, 2018).

Rodríguez (2015) and Lavelle (2018) study the performance of microcap mutual funds relative to small, mid, and large cap funds, with both illustrating that despite total risk being higher, these funds underperform their peers. Another study compared the performance of microcap mutual fund managers to a microcap index, finding that only one third of these managers are able to outperform the bench mark on a risk adjusted basis (Ahmed, Beck, & Nanda, 2010).

Despite the negative stigma and evidence of relative underperformance of microcaps, there is also clear interest in the asset class. The Brandes Institute (2014) highlights that about 60% of of global public equities traded are microcaps with less than 50% of these having analyst coverage. The median age of non-US based microcaps to be 31 years with almost 60% of them generating positive annual free cash flow in the three years preceding the report, that microcaps have low correlations to other asset classes, and that there is a larger premium for value microcap stocks than for growth microcap stocks (The Brandes Institute, 2014).

Zaremba (2015) discovers that microcap equities in Central and Eastern European markets show signs of value and momentum effects as opposed to a size effect, corroborating the findings of The Brandes Institute. BMO Global Asset Management similarly demonstrates the potential for microcap firms, citing advantages similar to the above sources as well as suggesting that microcap managers may act as an alternative to highly illiquid private equity investments (The case for microcap investing , 2019).

A study on Canadian microcap companies found that these stocks offered both higher returns than the US, its developed counterpart, and offered lower correlations (Foerster, Fogler, & Sapp, 2014). Finally, a Blume & Kim (2014) found that institutional investors, such as hedge funds, gradually increased their holdings in small stocks while underweighting their large stock holdings.

The size effect, as first discussed by Banz (1981), has been a phenomenon most recognized in smaller stocks. Some studies have contested the dismissal of the size effect only residing in stocks of a smaller market capitalization, instead insisting that controlling for quality factors shows persistent size effects in even larger firms (Asness, Frazzini, Israel, Moskowitz, & Pedersen, 2018).

That value and momentum premiums may exist in microcaps, combined with the fact that value investing demonstrates higher returns than growth investing strategies (Chan & Lakonishok, 2004), should be of particular interest to market participants interested in diversification. As a result of the aforementioned findings, the following hypotheses are devised to answer the main research question.

H1: *At least one of the identified value investing metrics is more consistent in explaining microcap stock returns*

H2: *North American microcaps outperform Asian and European microcaps*

For hypothesis one, the expectation is that it may be possible to identify a common characteristic found in microcap stocks that may be correlated to relative outperformance. The experiment will analyze the frequency with which a financial ratio appears significant in explaining stock returns, which may provide support for fundamental analysis in microcap stocks.

Data and Methodology

The panel data collected for the regressions and performance analyses includes publicly listed microcap companies in the regions of North America, Europe, and Asia over the past forty fiscal quarters, which translates to 10 years of data. Data was collected for Price-to-Book, Price-to-Sales, Price-to-Cash Flow, Price-to-Earnings, Market Capitalization, and stock price as the dependent variable.

Market capitalization refers to the total market value of a company's outstanding shares (Merriam Webster, n.d.). Price-to-Book, Price-to-Sales, Price-to-Cash Flow, and Price-to-Earnings are metrics that compare the price of a firm's stock to its book value of assets, total revenue generated, operating cash flow, and earnings per share, respectively. The formulas for the variables are outlined below

$$Market\ Capitalization = Share\ Price \times Number\ of\ shares\ outstanding \quad \textit{Eq. 1}$$

$$Price - to - Book = \frac{Market\ Price\ per\ Share}{Book\ Value\ per\ Share} \quad \textit{Eq. 2}$$

$$Price - to - Sales = \frac{Market\ Price\ per\ Share}{Sales\ per\ Share} \quad \textit{Eq. 3}$$

$$Price - to - Cash\ Flow = \frac{Market\ Price\ per\ Share}{Operating\ Cash\ Flow\ per\ Share} \quad \textit{Eq. 4}$$

$$Price - to - Earnings = \frac{Market\ Price\ per\ Share}{Earnings\ per\ Share} \quad \textit{Eq. 5}$$

The financial data was exported from the Thomson Reuters Eikon database. This was the sole source of financial information for this study due to the COVID-19 pandemic. This is further elaborated on in the discussion section.

The total number of companies collected for each region was as follows. 5766 companies were extracted from Asia, 1303 for North America, and 1454 for Europe. Filtering for companies with complete financial data at least for the past 3 years narrowed the number of companies under investigation. After filtering, the final number of companies in the dataset was 2002 in Asia, 474 in Europe, and 141 in North America.

For hypothesis one, companies in each region were ranked and sorted into deciles of market capitalization, which was the sole control variable for the regression. Banz (1981) found a prominent size effect in smaller firms in terms of stock performance and the portfolios were therefore created to isolate the effects of market capitalization such that the other variables could be analyzed.

Ten portfolios were compiled for each region, with the exception of North America which had nine. The first decile of microcap companies in this region did not have enough complete data to successfully return output in STATA, the regression software used. Thus, portfolios one and two were combined.

An ordinary least squares regression was used to regress the aforementioned financial metrics on the dependent variable, stock price. The regression takes the following form:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon \qquad \textit{Eq. 6}$$

Where:

y = Stock Price

x_1 = Price-to-Book

x_2 = Price-to-Sales

x_3 = Price-to-Cash Flow

x_4 = Price-to-Earnings

x_5 = ln(Market Capitalization)

β_0 = Constant

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Coefficients

The average market capitalization for portfolio one is $9.16 million, $7.13 million and $23.5 millions for Asia, Europe, and North America respectively. For portfolio ten, the averages are $261.20 million, $263.95 million, and $276.02 million.

Under hypothesis two, the portfolios were re-sorted based on the most significant financial metrics found in hypothesis one. Portfolio one represents the first decile of companies that report the lowest value for the ratio found to be significant. Conversely, portfolio ten, the tenth decile, contains the firms with the highest same ratio. The metric used to sort these portfolios is discussed in the next section.

$$Stock\ Return = \frac{Stock\ Price_{FQ0} - Stock\ Price_{FQ-39}}{Stock\ Price_{FQ-39}} \times 100 \qquad \textit{Eq. 6}$$

$$Equal\ Weighted\ Portfolio\ Return = \frac{\sum_1^n Stock\ Return}{n} \qquad \textit{Eq. 7}$$

$$Standard\ Deviation = \sqrt{\frac{\sum(x_i - \mu)^2}{n}} \qquad \textit{Eq. 8}$$

$$Portfolio\ Volatility = \frac{\sum_1^n Standard\ Deviation}{n} \times 100 \qquad \textit{Eq. 9}$$

$$Median = \frac{(y_{i,j,k,r,s,t,u} + 1)}{2} \qquad \textit{Eq. 10}$$

Where:

n = Number of firms

x_i = Firm stock price at the i^{th} fiscal quarter

μ = Average stock price of the firm

y_i = Number of observations for Price-to-Book

y_j = Number of observations for Price-to-Sales

y_k = Number of observations for Price-to-Cash Flow

y_r = Number of observations for Price-to-Earnings

y_s = Number of observations for Price-to-Market Capitalization

y_t = Number of observations for Stock Returns

y_u = Number of observations for Standard Deviation

In sorting the data for hypothesis two, companies with incomplete stock price data for the entire forty fiscal quarter period were removed. This led to an average number of firms in each region's portfolio being 156, 38, 12 for Asia, Europe, and North America respectively.

Returns for each company was determined and used to calculate the portfolio's average return on an equal weighted basis. The respective individual standard deviations were also calculated and averaged out to show volatility in each portfolio. The median values for returns and standard deviation was also found to demonstrate the skewness in returns as well as volatility. Mean values for the financial metrics of companies in every portfolio were found and are displayed in tables five, seven, and nine.

Results and Interpretation

Hypothesis One

Table 1: Regression output - Asia Portfolios

This table shows statistics for ten regressions of the sorted portfolios of Asian microcap stocks. In Portfolio 1, the largest market capitalization is $13.27 million. In Portfolio 10, the largest market capitalization is $300.09 million. Selected statistics are the variable coefficients, their t-statistics, and the level of significance. The bottom of the table distinguishes between which level of significance, 10%, 5%, or 1%, each coefficient is. The control variable is the natural log transformation of market capitalization.

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
P/B										
Coeff.	0.05	0.51	0.89	0.03	0.07	0.85	1.09	(0.08)	(0.15)	(0.17)
t-stat	0.65	1.47	7.99	0.47	0.92	18.57	9.48	(1.60)	(1.60)	(1.69)
Sig.			***			***	***			*
P/S										
Coeff.	0.76	(0.49)	(0.46)	(0.23)	(0.30)	(0.53)	(0.38)	(0.01)	(0.03)	(0.01)
t-stat	4.33	(4.61)	(9.99)	(4.78)	(7.20)	(6.05)	(7.66)	(1.90)	(3.95)	(4.46)
Sig.	***	***	***	***	***	***	***	*	***	***
P/CF										
Coeff.	$(4.02) \times 10^{-4}$	$(2.72) \times 10^{-6}$	$(9.59) \times 10^{-4}$	$(2.60) \times 10^{-4}$	$(2.72) \times 10^{-4}$	$(8.25) \times 10^{-4}$	2.73×10^{-4}	$(1.70) \times 10^{-3}$	$(5.55) \times 10^{-3}$	$(2.49) \times 10^{-4}$
t-stat	(0.55)	(1.56)	(0.57)	(1.74)	(0.59)	(3.86)	5.67	(1.65)	(4.13)	(2.44)
Sig.				*		***	**	*	***	**
P/E										
Coeff.	$(5.96) \times 10^{-4}$	$(1.30) \times 10^{-5}$	3.02×10^{-4}	$(4.65) \times 10^{-4}$	$(4.84) \times 10^{-3}$	2.70×10^{-3}	1.34×10^{-3}	$(1.43) \times 10^{-5}$	$(4.15) \times 10^{-4}$	$(2.32) \times 10^{-3}$
t-stat	(4.64)	0.26	0.54	1.27	1.41	1.81*	3.15	3.39	(3.34)	(0.59)
Sig.	***					*	***	***	***	
ln Mkt. Cap										
Coeff.	(0.12)	3.08	4.79	4.38	3.73	5.46	(2.27)	7.09	17.76	3.14
t-stat	(0.34)	15.26	5.30	2.75	1.96	2.17	(0.86)	2.67	4.66*	0.84
Sig.		***	***	***						
Cons.										
Coeff.	0.90	(7.16)	(14.22)	(12.18)	(9.27)	(18.27)	18.24	(26.88)	(83.43)	(4.73)
t-stat	1.23	(9.83)	(3.97)	(1.81)	(1.09)	(1.55)	1.42	(1.99)	(4.14)	(0.22)
Sig.		***	***					**	***	

*** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 2: Regression output – Europe Portfolios

This table shows statistics for ten regressions of the sorted portfolios of European microcap stocks. In Portfolio 1, the largest market capitalization is $11.39 million. In Portfolio 10, the largest market capitalization is $300.03 million. Selected statistics are the variable coefficients, their t-statistics, and the level of significance. The bottom of the table distinguishes between which level of significance, 10%, 5%, or 1%, each coefficient is. The control variable in each regression is the natural log transformation of market capitalization.

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
P/B										
Coeff.	(0.19)	(0.02)	2.06	4.80	0.49	(2.67)	(0.59)	(2.49)	0.53	(0.11)
t-stat	(1.69)	(1.12)	1.72	1.50	0.22	(2.15)	(0.65)	(2.63)	0.95	(1.88)
Sig.	*		*			**		***		*
P/S										
Coeff.	0.67	(1.00)	(4.67)	(5.30)	(0.46)	1.87	(0.01)	1.20	(1.49)	0.77
t-stat	3.76	(1.91)	(4.82)	(4.11)	(0.45)	0.88	(0.01)	1.00	(3.30)	1.29
Sig.	***	*	***	***					***	
P/CF										
Coeff.	(0.03)	(0.01)	(0.03)	(0.11)	(0.07)	(0.06)	$(5.63) \times 10^{-3}$	(0.02)	(0.02)	(0.13)
t-stat	(1.83)	(1.02)	(1.30)	(3.05)	(1.62)	(4.51)	(1.75)	(1.17)	(3.31)	(0.85)
Sig.	*			***		***	*		***	**
P/E										
Coeff.	$(3.83) \times 10^{-4}$	0.05	0.82	0.02	0.01	$(2.37) \times 10^{-4}$	$(8.19) \times 10^{-3}$	$(6.00) \times 10^{-3}$	$(1.23) \times 10^{-3}$	(0.03)
t-stat	(3.92)	15.19	3.41	1.19	0.5	(0.06)	(2.46)	(2.14)	(0.17)	(2.53)
Sig.	***	***	***				**	**		**
ln Mkt. Cap										
Coeff.	0.64	13.00	95.52	(9.00)	55.82	(71.67)	33.09	27.48	(44.48)	(94.80)
t-stat	1.68	4.15	3.17	(0.17)	0.95	(1.12)	0.71	0.62	(0.83)	(1.56)
Sig.	*	***	***							
Cons.										
Coeff.	(0.07)	(32.66)	(350.31)	85.39	(195.88)	396.08	(117.98)	(87.83)	281.71	581.40
t-stat	(0.09)	(3.44)	(2.99)	0.39	(0.75)	1.32	(0.52)	(0.39)	0.99	1.71
Sig.	*	***	***							*

*** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 3: Regression output – North America Portfolios

Statistics for variable coefficients, t-statistics, and significance level for ten regressions of the sorted portfolios of North American microcap stocks are shown. Portfolio 1 and 2 are combined due to the former having incomplete data. The largest market capitalization for Portfolio 1 and 2 is $40.01 million. In Portfolio 10, the largest market capitalization is $299.61 million. The control variable is the natural log transformation of market capitalization.

Variables	**1 + 2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
P/B									
Coeff.	9.21×10^{-3}	0.40	1.00	0.07	1.40×10^{-3}	2.30×10^{-3}	2.52×10^{-3}	(0.01)	(0.02)
t-stat	2.33	2.04	2.49	1.09	0.16	0.19	0.14	(2.32)	(3.31)
Sig.	**	**	**					**	***
P/S									
Coeff.	(0.53)	(0.23)	0.24	(0.86)	(0.16)	(0.79)	(0.50)	(0.38)	0.23
t-stat	(7.17)	(1.06)	0.90	(4.03)	(0.95)	(5.22)	(3.65)	(6.58)	0.89
Sig.	***			***		***	***	***	
P/CF									
Coeff.	3.31×10^{-3}	$(4.77) \times 10^{-4}$	$(1.47) \times 10^{-3}$	0.07	2.95×10^{-3}	$(4.16) \times 10^{-4}$	0.01	0.03	0.05
t-stat	1.18	(0.15)	(0.25)	2.51	0.94	(0.73)	0.37	1.85	0.72
Sig.				**				*	
P/E									
Coeff.	$(2.05) \times 10^{-4}$	$(1.99) \times 10^{-4}$	1.70×10^{-3}	0.02	0.07	0.03	$(1.20) \times 10^{-3}$	$(3.40) \times 10^{-3}$	0.04
t-stat	(9.09)	(3.29)	2.22	1.70	1.87	1.99	(0.52)	(0.35)	1.16
Sig.	***	***	**	*	*	**			
ln Mkt. Cap									
Coeff.	1.71	3.69	1.77	(0.25)	(3.19)	18.45	22.90	12.00	16.82
t-stat	6.75	2.23	0.48	(0.04)	(0.52)	2.09	1.98	0.78	0.82
Sig.	***	**				**	**		
Cons.									
Coeff.	(2.70)	(10.92)	(3.59)	7.80	23.34	(81.92)	(106.72)	(50.05)	(77.92)
t-stat	(3.96)	(1.68)	(0.22)	0.27	0.78	(1.82)	(1.74)	(0.60)	(0.67)
Sig.	***	*				*	*		

*** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Analysis of Asia Portfolios

In the Asia portfolios, the regression results for each value-investing metric differs. Price-to-Book, Price-to-Sales, Price-to-Cash Flow, and Price-to-Earnings are at least significant at the 10% level four, ten, six, and five times respectively. Notably, Price-to-Sales is found to be significant at the 1% level nine out of the ten regressions. The remaining ratios displayed significance at the 1% level three, two, and four times for Price-to-Book, Price-to-Cash Flow, and Price-to-Earnings respectively.

In terms of the implied impact of these ratios on a microcap firm's stock price, the Price-to-Book coefficients are positive in seven out of the ten portfolios regressed. The coefficients of Price-to-Sales on the other hand are predominantly negative, with only portfolio one, the first regression, showing a positive relationship with a firm's stock price.

Price-to-Cash Flow and Price-to-Earnings also reveal mostly negative coefficients in nine and eight of the portfolios respectively. The latter two variables, despite the inverse relationships of their coefficients with the coefficients of a company's share price, are relatively small in magnitude. Price-to-Book and Price-to-Sales are, by comparison, show relatively larger effects.

The implication from these results could be that investors in Asian microcaps place more importance on a firm's ability to generate revenue or sales. Aside from the first portfolio, a primarily inverse relationship between Price-to-Sales and a microcap firm's share price can be translated into investors rewarding microcap firms that are able to increase their sales, as this leads to a larger Sales-per-Share ratio, thus leading to a negative change in Price-to-Sales (refer to Equation 3).

In portfolios three, six, and seven, the coefficient of Price-to-Book is shown to be significant and have a positive correlation to an Asian microcap firm's stock price. However, in portfolio ten, this relationship turns negative. Portfolio four, six, eight, nine, and ten for Price-to-Cash Flow display a negative effect in contrast to portfolio seven which shows a positive effect on stock price. This

is similar for Price-to-Earnings, where portfolios one, eight, and nine show inverse relationships while portfolios six and seven show the reverse.

These conflicting results infer that in some portfolios investors may reward firms with higher valuations despite, under the assumption of a constant number of shares outstanding, a reduction in book value, operating cash flows, and net income. While this interpretation seems paradoxical to valuation principles, isolating and examining the most significant coefficients reveals an alternative explanation.

The coefficient for Price-to-Book is simultaneously significant at the 1% level in all cases where it reports a positive relationship with share price. Price-to-Cash Flow is similarly significant at 1% in two cases, both of which show a negative effect on share price. Finally, Price-to-Earnings has a negative coefficient in three of the four portfolio regressions that show significance at 1%.

At a 1% level of significance, the probability that the coefficients are found due to chance or randomness is low. There is therefore strong evidence that changes in Price-to-Sales, and the accompanying negative multiplier in the coefficient, do have direct effects on an Asian microcap's share price. This is strengthened by the fact this variable is statistically significant in all portfolio regressions. The remaining variables show instances of high significance but are less consistent and are in some cases contradictory.

Analysis of Europe Portfolios

The portfolio regressions in the Europe portfolios are less relatively pronounced compared to the Asia portfolios. The number of instances of significance is visibly less, as shown in Table 2, with Price-to-Sales.

Despite this observation, Price-to-Book, Price-to-Sales, Price-to-Cashflow, and Price-to-Earnings each show significance at least at the 10% level five, five, six, and six times respectively. Of these instances, Price-to-Sales is strongly significant at the 1% level four times compared to Price-to-

Cashflow as well as Price-to-Earnings, which both show similar statistical significance three times each. Price-to-Book trails the other variables under investigation, showing only one instance of significance at the 1% level.

Regarding the sign and magnitude of coefficients, Price-to-Cash Flow and Price-to-Earnings both, again, show smaller effects, in absolute terms, on a company's stock price. The coefficient of Price-to-Cash Flow is consistently negative in every portfolio regression whereas Price-to-Earnings is positive in portfolio regressions two, three, four, and five. Price-to-Sales and Price-to-Book are similar in the number of times their respective coefficients are non-negative. For Price-to-Sales, these are portfolio regressions one, six, eight, ten and for Price-to-Book, portfolio regressions three, four, five, and nine.

Evaluating only the cases in which coefficients are significant, in four out of the five portfolio regressions found to have statistical significance, Price-to-Book shows an inverse relationship with only portfolio regression three showing a positive correlation. This trend is similar for the Price-to-Sales coefficient, which is found to be significant and inversely related to share price in four out of the five portfolio regressions.

Price-to-Earnings on the other hand has a computed coefficient is both significant and inverse in four out of six portfolio regressions. The coefficient of Price-to-Cash Flow shows a mainly negative correlation to stock price in all portfolio regressions where it is statistically significant.

Similar to the Asia portfolios, the mixed results of variables, Price-to-Cash Flow being the sole exception, leads to the following potential inference. Investors in European microcap equities seem to reward firms with higher stock prices when positive changes in book value per share, sales per share, operating cash flow per share, and earnings per share occur, except for a few instances. More emphasis seems to be placed on book value and sales as the relative changes in these metrics leads to larger changes in stock price relative to operating cash flows and earnings.

An examination of only the most significant coefficients shows Price-to-Book having a positive relationship with the dependent variable. Price-to-Sales demonstrates a negative correlation three out of the four cases where its coefficient is significant at 1%.

The Price-to-Cash Flow coefficients are illustrated to have a mostly inverse correlation to a firm's stock price at the 1% level. Finally, Price-to-Earnings shows only one coefficient that is both significant at 1% and negative. The remaining two coefficients that are similarly as significant are positive.

An inconclusive inference may be that investors overall reward European microcaps with higher share prices for decreases in book value per share, increases in sales per share, increases in operating cash flow, and a reduction in net income. A final analysis containing all 29 regressions may shed more light on the significance of each variable.

Analysis of North America portfolios

Publicly listed microcaps in North America dataset add to the consistency seen in the Price-to-Sales financial ratio. The metric's coefficient is statistically significant at the 1% level in five of the ten portfolio regressions. These instances happen to also be the number of times Price-to-Sales demonstrated significance at least at 10%.

Price-to-Book, Price-to-Cash Flow, and Price-to-Earnings each exhibit coefficients that are at least significant at the 10% level five, two, and seven times respectively. Of these, Price-to-Cash Flow does not report any coefficients significant at 1%. By comparison, Price-to-Book and Price-to-Earnings each show strong evidence at 1% one and two times, respectively.

Assessing the sign of each coefficient, Price-to-Sales is negative in all but portfolio regressions four and ten. The coefficient for Price-to-Book is negative in only portfolios nine and ten. Price-to-Cash Flow shows a similar trend, with only regressions three, four, and seven showing negative coefficients. Price-to-Earnings overall has a negative effect in relation to stock price four of the

nine portfolio regressions. In terms of coefficient magnitude, Price-to-Cash Flow and Price-to-Earnings once again lag behind Price-to-Sales, which subsequently trails Price-to-Book.

An initial judgement may be made that investors in North American microcap equities seem to place importance on Price-to-Book, Price-to-Sales, Price-to-Cash Flow, and Price-to-Earnings in that order. This leads to an inspection into the more significant coefficients.

The total number of coefficients that are at least significant is eighteen. Of these, Price-to-Book, Price-to-Sales, Price-to-Cash Flow, and Price-to-Earnings account for five, five, two, and six cases, respectively. In terms of the most significant variable coefficients, Price-to-Sales, as aforementioned, is significant five of the seven instances with Price-to-Earnings tallies the remaining two.

Both Price-to-Sales and Price-to-Earnings metrics report negative coefficients in each of the occurrences. Using these variables as the sole focus of the following adjusted interpretation, investors in North American microcap stocks may put more focus on the ability of these companies to increase sales, as it has the larger effect on stock price. Increasing the bottom line also seems to reflect positively on stock price.

A final, region-agnostic evaluation will take into account all analyses compiled so far.

Hypothesis One Addressed

A thorough analysis by region shows a few key trends in the regressions. The Price-to-Sales coefficient is significant at least at the 10% level in twenty of the twenty-nine portfolio regressions. The coefficient for Price-to-Earnings counts seventeen instances of significance at least at 10%. Both Price-to-Book and Price-to-Cash Flow both display fourteen cases in which their coefficients are significant at 10%.

Price-to-Book and Price-to-Sales demonstrate larger absolute effects on a microcap firm's stock price compared to Price-to-Cash Flow and Price-to-Earnings. As mentioned earlier, the 1% level of significance shows strong evidence for a coefficient's effect on the dependent variable. Price-to-Sales demonstrates this in eighteen portfolio regressions. Price-to-Earnings exhibits this in nine out of the twenty-nine portfolio regressions and Price-to-Book as well as Price-to-Book both count five instances where their coefficients are highly significant.

Price-to-Sales distinguishes itself as the primary proxy, at least for the past 10 years, for determining stock price performance. While the remaining metrics show relatively less consistency in providing evidence for their effects on stock price, due to reasons that will be discussed in the evaluation section, hypothesis one arguably cannot be refuted. There are clearly variables that can be considered as having a significant effect on a microcap firm's share value.

The final inference that can be made when considering these results as a whole is as follows. Price-to-Sales shows an inverse relationship with stock price in sixteen of the eighteen instances where it is significant at 1%.

Price-to-Earnings shows a similar trend in six of its eight portfolio regressions that are significant at 1%. For Price-to-Cash Flow, the correlation is also mainly negative in each of its portfolio regressions that have 1% level of significance. Price-to-Book counts only two of its five highly significant coefficients as negative.

With the exception of Price-to-Book, investors in the microcap asset class seem to place relatively more importance on Price-to-Sales followed by Price-to-Earnings and Price-to-Cash Flow. An increase in sales, operating cash flow, and profitability, intuitively, lead to upwards pressure in the stock price. Price-to-Sales consistently shows significance in the majority of portfolio regressions.

Still, there are potential reasons that will be outlined in the evaluation as to why this may be the case. Despite this, the intuition behind growth in sales in these relatively smaller, lesser known companies, leading to higher valuations shows investor optimism in the long-term growth of some of these companies.

Hypothesis Two

Using the results of the first hypothesis as a starting point, each portfolio is re-sorted using Price-to-Sales to sort deciles. A secondary sort was carried out on Price-to-Earnings as this was the second most consistent variable in the portfolio regressions.The risk free rate used for this hypothesis is the 10-year US treasury bill of 3.85% which was sourced from the U.S. Department of the Treasury (U.S. Department of the Treasury, n.d.). The absolute returns found below are not in excess of the risk-free rate.

What is immediately observable in Tables 5, 7, and 9 is the median and average Price-to-Sales are in most cases identical. This is simply the result of the sorting criteria.

Table 4a: Performance of Asia Portfolios

Average and median values are illustrated for absolute returns ex-risk-free rate, standard deviation, and Sharpe ratios. The risk-free rate of a 10-year Treasury bill is provided for comparison. Stocks are sorted firstly on Price-to-Sales followed by Price-to-Earnings. Portfolio 1 contains microcaps with an average Price-to-Sales ratio of 0.05 and a Price-to-Earnings ratio of 0.30. Portfolio 10 contains microcaps with an average Price-to-Sales ratio of 0.95 and a Price-to-Earnings ratio of 0.74.

	Returns		**Std. Deviation**		**Sharpe**	**Risk Free Rate**
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
1	24%	5%	339%	212%	0.06	3.85%
2	45%	13%	355%	217%	0.12	3.85%
3	55%	23%	268%	201%	0.19	3.85%
4	78%	40%	265%	170%	0.28	3.85%
5	79%	36%	274%	160%	0.27	3.85%

Table 4b: Performance of Asia Portfolios

	Returns		Std. Deviation		Sharpe	Risk Free Rate
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
6	79%	45%	337%	146%	0.22	3.85%
7	150%	56%	231%	148%	0.63	3.85%
8	137%	71%	349%	80%	0.38	3.85%
9	142%	67%	406%	93%	0.34	3.85%
10	194%	96%	359%	52%	0.53	3.85%

Table 5a: Characteristics of Asia Portfolios

The properties of each portfolio are displayed below. Average and median values are provided to demonstrate the skewness of microcap financial data. Although it is not controlled for, microcaps with larger market capitalizations seem to perform better on both a risk adjusted basis and in absolute returns.

Portfolio Characteristics

	P/B		P/S		P/CF		P/E		Mkt. Cap.	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
1	0.47	0.41	0.14	0.14	5.37	3.16	15.40	7.04	116.75	94.62
2	0.59	0.49	0.26	0.26	14.84	4.35	18.54	8.42	116.47	94.68
3	0.76	0.66	0.37	0.37	10.41	5.32	17.96	9.70	128.97	101.55
4	0.83	0.67	0.50	0.50	7.16	5.76	13.76	9.09	135.87	115.31
5	0.99	0.85	0.64	0.64	9.22	6.93	19.58	11.20	136.03	120.14

Table 5b: Characteristics of Asia Portfolios

Portfolio Characteristics

	P/B		P/S		P/CF		P/E		Mkt. Cap.	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
6	1.16	0.98	0.82	0.81	14.51	8.25	16.63	11.69	130.70	111.96
7	1.35	1.06	1.05	1.04	15.98	9.61	17.90	13.44	138.38	119.39
8	1.62	1.42	1.39	1.37	140.96	9.24	18.85	13.87	139.46	124.65
9	1.92	1.70	2.12	2.12	15.65	11.72	19.28	15.80	143.05	135.58
10	2.73	2.02	5.70	3.66	24.10	14.69	30.72	17.83	149.89	148.34

Table 6a: Performance of Europe Portfolios

Average and median values are illustrated for absolute returns ex-risk-free rate, standard deviation, and Sharpe ratios below. The risk-free rate of a 10-year Treasury bill, sourced from the U.S Department of the Treasury is also provided for comparison. Stocks are arranged into portfolios through a two layered ranking system of Price-to-Sales followed by Price-to-Earnings. Portfolio 1 contains microcaps with an average Price-to-Sales ratio of 0.05 and a Price-to-Earnings ratio of 0.30. Portfolio 10 contains microcaps with an average Price-to-Sales ratio of 0.95 and a Price-to-Earnings ratio of 0.74.

Performance Measures

	Returns		**Std. Deviation**		**Sharpe**	**Risk Free Rate**
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
1	-6%	-32%	1072%	294%	-0.01	3.85%
2	16%	-16%	1569%	439%	0.01	3.85%
3	21%	5%	723%	292%	0.02	3.85%
4	114%	70%	1906%	554%	0.06	3.85%
5	114%	41%	2769%	287%	0.04	3.85%

Table 6b: Performance of Europe Portfolios

Performance Measures

	Returns		**Std. Deviation**		**Sharpe**	**Risk Free Rate**
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
6	176%	40%	1592%	456%	0.11	3.85%
7	170%	76%	1675%	530%	0.10	3.85%
8	188%	106%	1324%	191%	0.14	3.85%
9	182%	110%	2113%	500%	0.08	3.85%
10	310%	182%	1114%	288%	0.27	3.85%

Table 7a: Characteristics of Europe Portfolios

The properties of each portfolio are displayed below. Average and median values are provided to demonstrate the skewness of microcap financial data. Although it is not controlled for, microcaps with larger market capitalizations seem to perform better on both a risk adjusted basis and in absolute returns.

	Portfolio Characteristics									
	P/B		**P/S**		**P/CF**		**P/E**		**Mkt. Cap.**	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
1	0.66	0.52	0.13	0.12	2.59	1.95	11.82	8.10	130.51	106.55
2	0.81	0.74	0.26	0.26	4.17	3.76	49.74	8.88	117.00	111.44
3	0.94	0.82	0.36	0.35	6.12	5.11	17.67	10.95	128.05	96.32
4	1.27	1.20	0.48	0.48	5.86	5.52	34.28	12.35	139.86	116.26
5	1.46	1.34	0.64	0.64	11.01	7.33	35.02	13.93	143.12	131.47

Table 7b: Characteristics of Europe Portfolios

	Portfolio Characteristics									
	P/B		**P/S**		**P/CF**		**P/E**		**Mkt. Cap.**	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
6	1.74	1.46	0.83	0.82	9.56	6.46	15.43	11.49	150.60	133.48
7	1.94	1.39	1.11	1.10	10.64	8.65	14.05	13.07	148.90	132.99
8	2.17	1.69	1.57	1.65	11.28	9.60	44.39	15.38	150.37	156.32
9	2.93	2.32	2.51	2.48	18.99	11.67	23.03	18.00	129.98	108.97
10	3.03	2.35	6.46	5.38	17.71	12.48	27.30	18.97	168.51	159.18

Table 8a: Performance of North America Portfolios

Average and median values are illustrated for absolute returns ex-risk-free rate, standard deviation, and Sharpe ratios below. The risk-free rate of a 10-year Treasury bill, sourced from the U.S Department of the Treasury is also provided for comparison. Stocks are arranged into portfolios through a two layered ranking system of Price-to-Sales followed by Price-to-Earnings. Portfolio 1 contains microcaps with an average Price-to-Sales ratio of 0.05 and a Price-to-Earnings ratio of 0.30. Portfolio 10 contains microcaps with an average Price-to-Sales ratio of 0.95 and a Price-to-Earnings ratio of 0.74.

Performance Measures

	Returns		**Std. Deviation**		**Sharpe**	**Risk Free Rate**
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
1 + 2	-5%	-47%	685%	430%	-0.01	3.85%
3	38%	-20%	518%	576%	0.07	3.85%
4	91%	59%	719%	620%	0.12	3.85%
5	56%	33%	453%	403%	0.12	3.85%

Table 8b: Performance of North America Portfolios

Performance Measures

	Returns		**Std. Deviation**		**Sharpe**	**Risk Free Rate**
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**		
6	187%	46%	657%	434%	0.28	3.85%
7	105%	56%	485%	387%	0.21	3.85%
8	236%	85%	460%	492%	0.51	3.85%
9	186%	49%	833%	305%	0.22	3.85%
10	45%	3%	400%	268%	0.10	3.85%

Table 9a: Characteristics of North America Portfolios

The properties of each portfolio are displayed below. Average and median values are provided to demonstrate the skewness of microcap financial data. Although it is not controlled for, microcaps with larger market capitalizations seem to perform better on both a risk adjusted basis and in absolute returns.

	Portfolio Characteristics									
	P/B		**P/S**		**P/CF**		**P/E**		**Mkt. Cap.**	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
1 + 2	0.35	0.52	0.15	0.16	3.12	2.37	7.69	6.21	138.45	131.87
3	0.69	0.69	0.30	0.30	6.04	4.92	16.16	10.30	172.44	184.80
4	0.77	0.73	0.37	0.37	6.42	5.65	28.69	10.46	184.46	178.49
5	1.24	1.03	0.45	0.44	4.52	4.08	10.23	9.24	115.88	121.69

Table 10b: Characteristics of North America Portfolios

	Portfolio Characteristics									
	P/B		**P/S**		**P/CF**		**P/E**		**Mkt. Cap.**	
Portfolios	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**	**Avg.**	**Median**
6	1.01	0.93	0.58	0.56	9.11	6.62	12.86	11.19	200.02	228.53
7	1.63	1.35	0.93	0.94	12.52	7.39	19.68	14.45	195.48	193.26
8	1.87	1.19	1.42	1.35	9.13	7.18	14.30	9.23	142.02	153.30
9	12.29	1.85	2.98	2.91	14.82	12.76	19.36	13.86	153.77	134.92
10	27.63	2.24	8.36	5.54	17.64	9.67	24.97	13.12	151.97	138.53

Analysis of Asia Microcap Performance

The performance of Asian microcap equities exhibits an increasing average and median absolute returns trend. This is not always followed by increases in volatility, as shown by the corresponding Sharpe ratios.

The relationship between absolute returns and Price-to-Sales seems linear. In reference to hypothesis one, investors seemed to place more consistent weight on the sales of microcaps, irrespective of region. The above results seem to both strengthen and extend this assumption. That is, Asian microcap firms with larger Price-to-Sales ratios tend to outperform, in absolute terms, those with lower ratios.

Another ratio that tends demonstrates a similar linear relationship to stock price performance is Price-to-Book. However, since Market Capitalization also shows a similar correlation to stock price performance, it could simply be driven by a higher stock price. Price-to-Cash Flow and Price-to-Earnings do not illustrate any clear relationships with the direction of stock price performance.

Analysis of European Microcap Performance

Similar to Asia, European microcap stocks show increasing average and median returns as Price-to-Sales values increase. Volatility in these shares, however, is much higher in comparison to Asian microcap equities as illustrated by the standard deviation values in Table 6. The corresponding Sharpe ratios are thus also relatively lower than those found in Table 4.

Price-to-Sales shows a positive correlation to returns, as does Price-to-Book. However, the latter does not show as strong a linear relationship to Market Capitalization as it does in the Asia portfolios. This may imply that investors in European microcaps place importance on the book value of assets of the firm, contesting the analysis from hypothesis one. Price-to-Earnings and Price-to-Cash Flow once again are not consistent in their respective changes as stock returns increase.

Analysis of North American Microcap Performance

North American microcap stock performance illustrate similar trends found in Asian and European microcap firms. Notably, volatility seems to be lower on average for both mean and median values in comparison to the Europe portfolios.

The similarities extend to the correlation between Price-to-Sales, Price-to-Book, and share price performance. Increases in both variables are shown to positively affect returns. Additionally, similar to the Europe portfolios, Price-to-Book does not seem to exhibit a strong correlation to Market Capitalization. Finally, Price-to-Earnings and Price-to-Cash Flow do not show any consistent relationship with stock returns.

Dissimilar to European microcaps are the Sharpe ratios of their North American counterparts, which tend to be higher on average and thereby reflecting the lower relative standard deviation.

Hypothesis Two Addressed

A comparison of the performance of microcaps regionally reveals that Asian microcaps demonstrate superior risk adjusted returns. Portfolio seven shows a Sharpe ratio of 0.63, the highest of any of the twenty-nine portfolios. In terms of absolute returns, European microcaps perform better, returning 310% in portfolio ten over the forty fiscal quarter period.

However, Europe portfolios are shown to be much more volatile compared to Asia portfolios, thus reflecting poorly in their low Sharpe ratios. The Asia portfolios illustrate far lower standard deviations while still indicating substantial returns on investment. North America portfolios are somewhere in between with average Sharpe ratios higher than Europe in all but one portfolio and volatility that remains higher on average than the Asia portfolios.

Thus, a relatively more risk averse investor may choose to invest in Asian microcap companies to benefit from the comparatively lower volatility. If a larger equity risk premium, which is defined as the additional return in excess of the risk free rate (Pechter, 2020), is sought, then European microcaps would fare better in spite of larger standard deviations. North American microcaps, on average, do not demonstrate any clear benefits in terms of returns, both absolute and risk adjusted, as well as volatility.

What can be noted from the data is the differences between the average and median values for both returns and standard deviation. Each region's portfolios show that median values tend to be lower than average returns, implying that the data for these returns is skewed to the right, also meaning they are positively skewed, and therefore not a traditional normal distribution.

In a 2019 working title paper, Stein (2019) finds that low values for skewness have a negative relationship with stock returns. However, he simultaneously provides evidence for a positive relationship with stock returns when skewness values are high, irrespective of whether they are positive or negative (Stein, 2019). This might infer a relationship between returns in microcap stocks in Asia and the skewness of the data.

The implications of this information are as follows. The non-normal distribution of data found in each portfolio suggests that there may be a lower probability of randomly selecting a microcap that will outperform its peers. While this interpretation may seem limiting in nature, it provides stock picking investment practitioners the opportunity to earn substantial returns in an asset class that has very little, if at all, coverage (The Brandes Institute, 2014) and is otherwise ignored.

As illustrated by all the above portfolios, increasing Price-to-Sales, and to some extent Price-to-Book, ratios are associated with increasing returns over the same ten-year period. That better performing microcap companies have this commonality demonstrates two things. One is that there is evidence for links between fundamental financial information and stock returns, which contests the idea that microcap stocks are mostly speculative gambling as an asset class (Nofsinger & Varma, 2014).

The second inference is that it is possible to be profitable in the long run. While the corresponding volatility is high, there seems to be evidence for profitability in microcaps, a view that has been contradicted by previous studies citing sub-par microcap mutual fund performance (Rodríguez, 2015; Lavelle, 2018).

Conclusion

The overall results of this research show evidence that there are value investing financial ratios that can indicate potential performance of microcap stocks. A subsequent evaluation of microcap performance by region shows that microcaps in Asia outperform Europe and North America in terms of risk adjusted returns. European microcaps meanwhile demonstrate superior absolute returns.

Hypothesis one sought to determine which financial ratios, out of Price-to-Book, Price-to-Sales, Price-to-Cash Flow, and Price-to-Earnings, may help predict returns. Price-to-Sales was discovered to be the most consistent and significant metric, followed by Price-to-Earnings. In the majority of regressions, the coefficient of Price-to-Sales exhibited an inverse relationship to stock price changes, implying a positive change in stock price as a result of increasing sales.

Hypothesis two used the results of hypothesis one to re-sort portfolios and assess subsequent microcap performance over the past decade. The results illustrated increasing average and median returns as Price-to-Sales increased. Price-to-Book also displayed a similar trend but since Market Capitalization also mimicked these movements, it is possible that the increasing Price-to-Book ratios was simply the result of increasing share price value rather than book value of assets.

Not only were the majority of portfolios profitable over the ten-year period profitable, the data for these returns followed a distribution that skewed to the right, implying that the probability of selecting relatively more profitable microcap investments was low than under a traditional normal distribution.

As a result, it could be possible for professional investors to take advantage of this information by, for example, selecting a concentrated portfolio of high-quality microcap stocks. Given the expansive universe of this asset class, it may prove challenging but certainly possible. Investments in Asian microcaps appear to be relatively safer when adjusted for volatility.

Ultimately, both hypotheses were constructed in order to address the main research question, which is to what extent can a value-oriented investment strategy be profitable in microcap equities? Combining the results gathered from hypothesis one and two, there is evidence suggesting that investing in microcap firms could be profitable using Price-to-Sales, Price-to-Book, and, to some extent Price-to-Book, as screening ratios.

However, there are numerous limitations that may have inhibited the accuracy of the results, and therefore the conclusions drawn from both hypotheses. These are discussed below in the final section.

Discussion

The first limitation is clear very early on. The number of datapoints derived from the number of firms in each region was not equal. Financial information gathered in Asia was more than double that of Europe and North America combined.

The relative lack of data may be a reason why the regression analyses for Asia showed consistent and significance in the Price-to-Sales variable. Additionally, due to the nature of microcaps, there were several instances where financial data going back the full ten-year period was incomplete. This is perhaps most distinguishable in the North America portfolios where portfolios one and two required combining due to the former containing insufficient data to run a STATA regression.

The effects of the coronavirus pandemic meant that physical access and assistance with university resources was limited to the remote Thomson Reuters Eikon database. Future research of a similar topic may be improved by extracting information from two or more databases.

A lack of data for Europe and North America may have also impacted the output of hypothesis two, where returns and volatility tended to be more extreme than in the Asia portfolios. An increasing Price-to-Sales ratio for Asian microcaps was more likely to lead to a positive change in stock returns, a trend not as strong or consistent as microcaps in the Europe and North American portfolios. The possibility also exists that the skewness of the data may have been affected or been the result of insufficient data, at least in the cases of European and North American microcaps. The conclusion of the effects of skewness in microcap returns may thus need further investigation.

Additional areas for improvement include the appropriateness of the variables studied. Each ratio studied was simply a proxy for the underlying financial data such as revenues, book value

of assets, operating cash flow, and profitability. Future research could substitute these proxy ratios for financial statement data instead to test whether the conclusions and implications of this paper hold.

Other aspects to consider include changing the ratios studied. Returns metrics for example were not explicitly focused on in this research. However, studying the effects of Returns on Invested Capital or Return on Assets could shed some more light on the efficiency of capital allocation by management of microcap companies and, as a result, whether stock prices react.

One critical metric that was not accounted nor controlled for in this paper was the corresponding number of shares outstanding in each fiscal quarter. An increase or decrease in the number of shares available to investors could affect the values of any of the financial ratios studied, despite no changes in revenue, book value of assets, operating cash flow, and earnings. Similar future studies should consider controlling for this variable.

Finally, other improvements could be analyzing the comparative performance of microcap companies in different sectors or industries. Furthermore, a comparison of microcap performance and a particular index or other asset class was not covered. A more rounded judgement on whether microcaps are a worthwhile investment given alternative options may be more valuable to the reader.

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