

Summary Research Findings on P/E, P/B, P/S ratio and its relationship with Market Capitalization

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Research Background and Objectives

Based on the valuation database of Valtech Valuation, common market multiples used in valuation include:

Market Multiples Selection (Business Valuation)

- ☐ EV/S (Enterprise Value-to-Sales)
- ☐ EV/EBITDA (Enterprise Value-to-EBITDA)
- ☐ EV/EBIT (Enterprise Value-to-EBIT)
- ☐ P/S (Price-to-Sales)
- ☐ P/E (Price-to-Earnings)
- ☐ P/B (Price-to-Book Value)
- ☐ Other

This research is to compare P/E, P/B and P/S ratio with its relationship to market capitalization

Objectives:

- ☐ Observe the relationship between the multiples and market capitalization
- ☐ Compare which multiples have a better fit with market capitalization
- ☐ Figure out a better ratio that can facilitate company valuation

Assumptions & Data

- Company data are based on API data of the HKEx's listed equities as of 26 October 2022
- The companies are listed companies listed in the Hong Kong Stock Exchange
- Only companies with all data fulfilled will be included in the sample

Ratio	Number of stock data (Sample size)
P/E Ratio	895
P/B Ratio	2,424
P/S Ratio	2,463

Research Methodology

Step 1: Normalize the market capitalization (MktCap) (Using $\frac{MktCap - Minimum\ MktCap}{Range\ of\ MktCap}$)

Step 2: Conduct a regression analysis between market capitalization and the ratio

Step 3: Plot a scatterplot of P/E or P/B or P/S ratio against market capitalization

Step 4: Rank the market capitalization in 10 decile groups

Step 5: Find the mean/median multiple in each of the 10 decile groups

Step 6: Chain up the results of the 10 decile groups to observe the relationship

Step 7: Observe whether a linear/exponential/quadratic equation can best-fit the relationship (determined by using R-squared)

Details of each correlation research

Refer to the slides “Relationship between Market Capitalization and PE Ratio” as an example

Relationship between
Market Capitalization and PE
Ratio

22-Nov-2022

Reasons for dividing the market capitalization into 10 decile groups

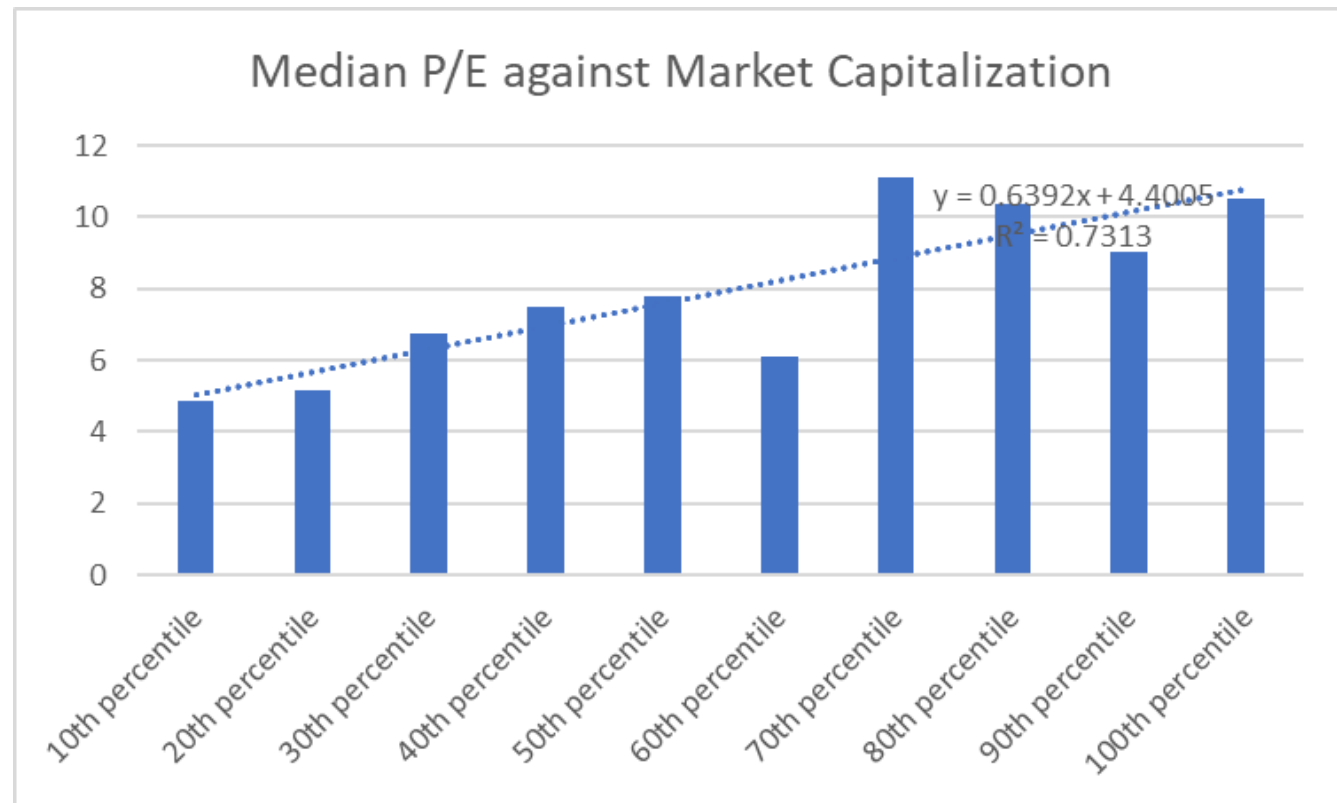
- Directly using linear regression might not be the best way to observe the relationship between market capitalization and the ratios since the RMSE (root mean square error) could be affected severely by extreme data
- It is advised to divide the market capitalization into 10 decile groups so that we can categorize the company into “Large” and “Small” companies with 10 divisions (Concept originated from Fama-French Three Factor Model: Analyzed the factors by dividing the stocks into large-cap stocks and low-cap stocks)
- Afterwards, by finding the mean and median ratio among each decile group, we can observe a general relationship between market capitalization (company size) and the ratios

Ranked according to MktCap	Median P/E	Mean P/E	Median P/B	Mean P/B	Median P/S	Mean P/S
10th percentile	4.879	16.6243889	0.4495	1.840212	0.4221	2.889604
20th percentile	5.1429	33.5351427	0.51615	1.550756	0.525	1.940727
30th percentile	6.7297	20.2755169	0.57825	1.281693	0.7801	5.178479
40th percentile	7.48335	21.7947433	0.5241	2.502551	0.6467	1.925431
50th percentile	7.768	23.1428281	0.6297	2.394429	1.0114	24.82557
60th percentile	6.111	11.5868202	0.574	3.032269	0.9566	12.92262
70th percentile	11.1176	23.8646167	0.6992	2.0946	1.1966	28.69112
80th percentile	10.3721	37.6383	0.794	2.371185	1.4604	62.20658
90th percentile	9.0418	26.2040921	0.86755	2.137969	1.5561	13.96411
100th percentile	10.5137	58.1024289	0.9271	2.277996	1.9985	41.61742

Categorized data according to 10 decile groups | Ranked by market capitalization

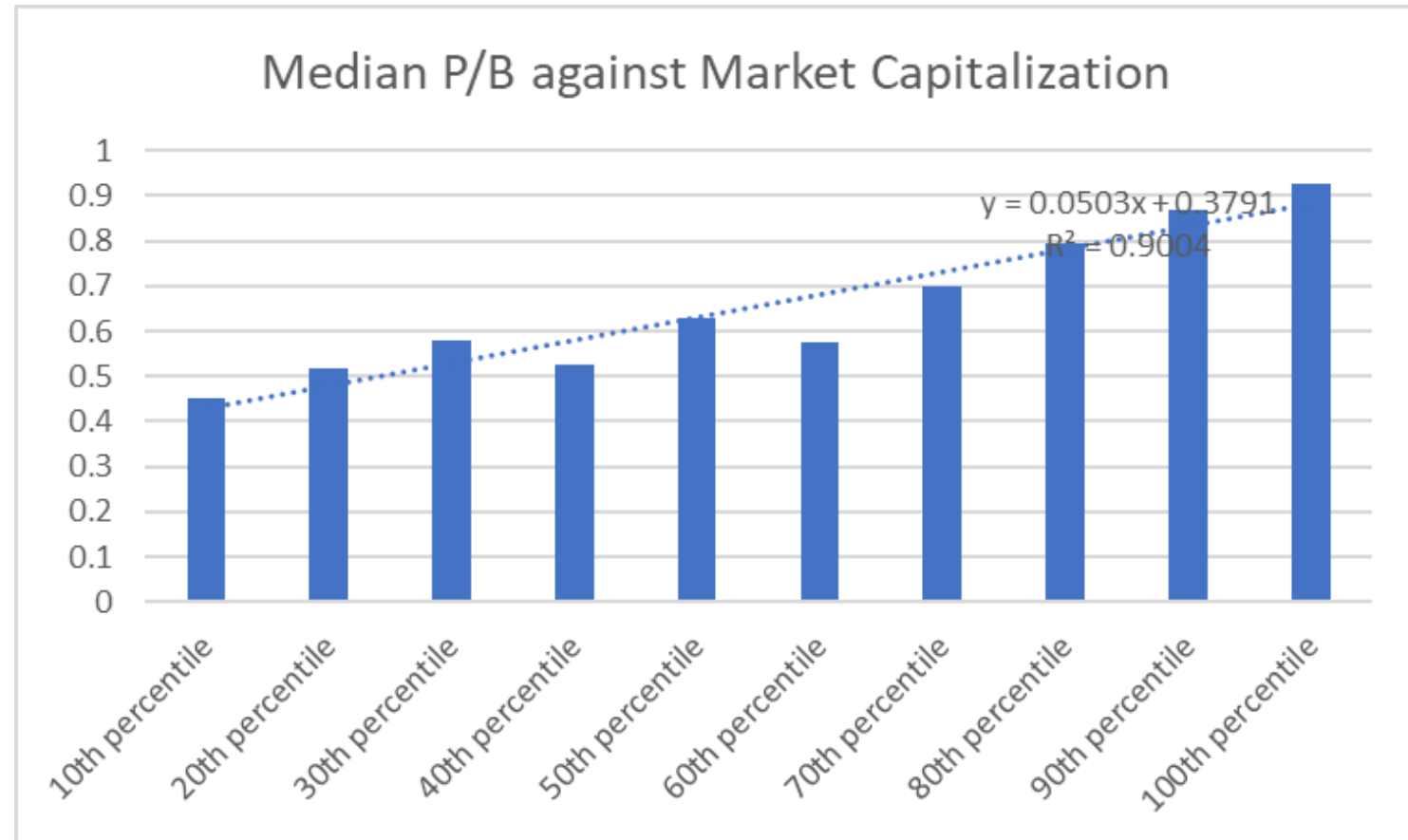
Median P/E Ratio against Market Capitalization in ten decile groups -SLR

Ranked according to MktCap	Median P/E
10th percentile	4.879
20th percentile	5.1429
30th percentile	6.7297
40th percentile	7.48335
50th percentile	7.768
60th percentile	6.111
70th percentile	11.1176
80th percentile	10.3721
90th percentile	9.0418
100th percentile	10.5137



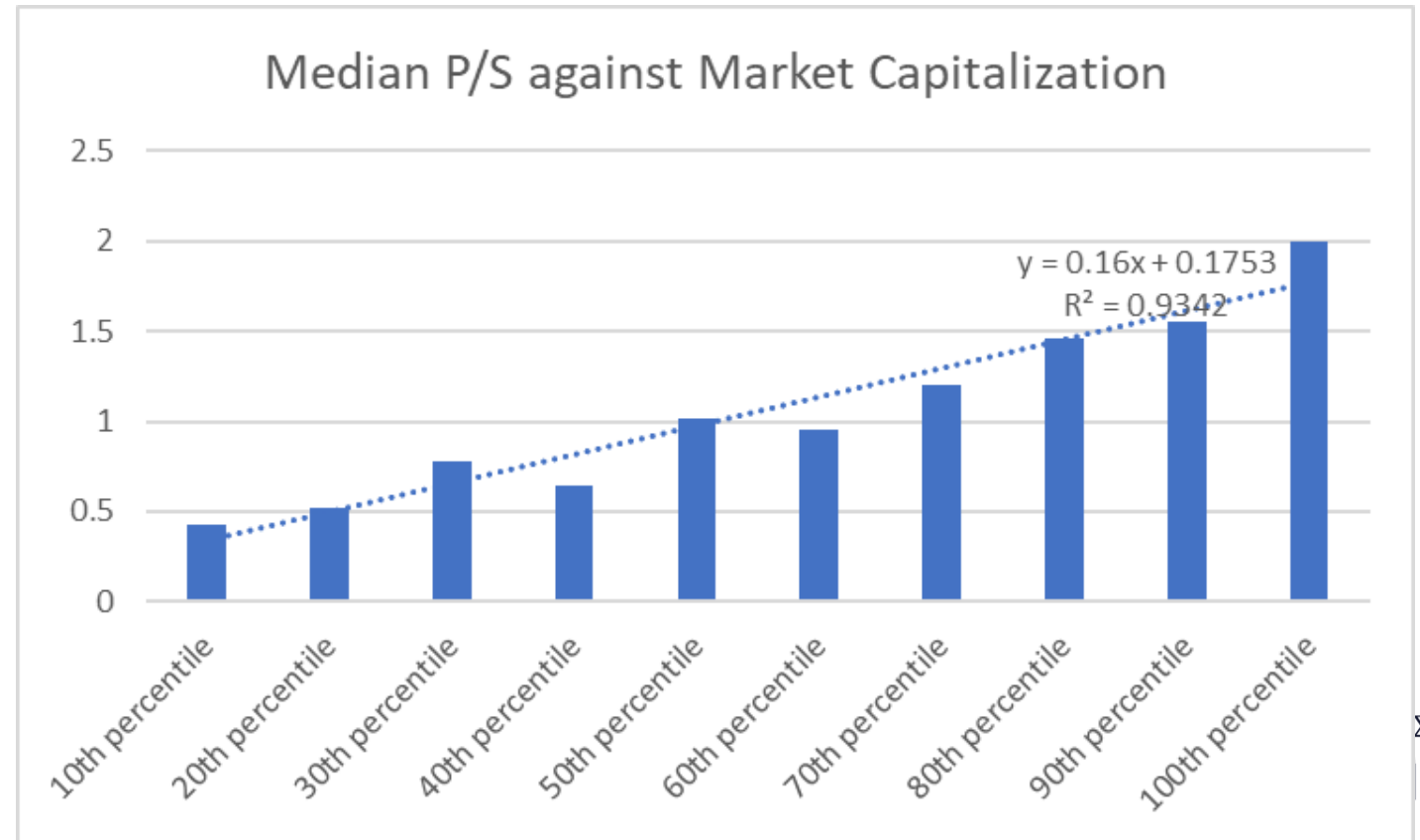
Median P/B Ratio against Market Capitalization in ten decile groups - SLR

Ranked according to MktCap	Median P/B
10th percentile	0.4495
20th percentile	0.51615
30th percentile	0.57825
40th percentile	0.5241
50th percentile	0.6297
60th percentile	0.574
70th percentile	0.6992
80th percentile	0.794
90th percentile	0.86755
100th percentile	0.9271



Median P/S Ratio against Market Capitalization in ten decile groups -SLR

10th percentile	0.4221
20th percentile	0.525
30th percentile	0.7801
40th percentile	0.6467
50th percentile	1.0114
60th percentile	0.9566
70th percentile	1.1966
80th percentile	1.4604
90th percentile	1.5561
100th percentile	1.9985



R-Square Comparison Result -SLR

R-squared	Mean	Median
P/E	0.3151	0.7313
P/B	0.2255	0.9004
P/S	0.5207	0.9342

Using **linearity**

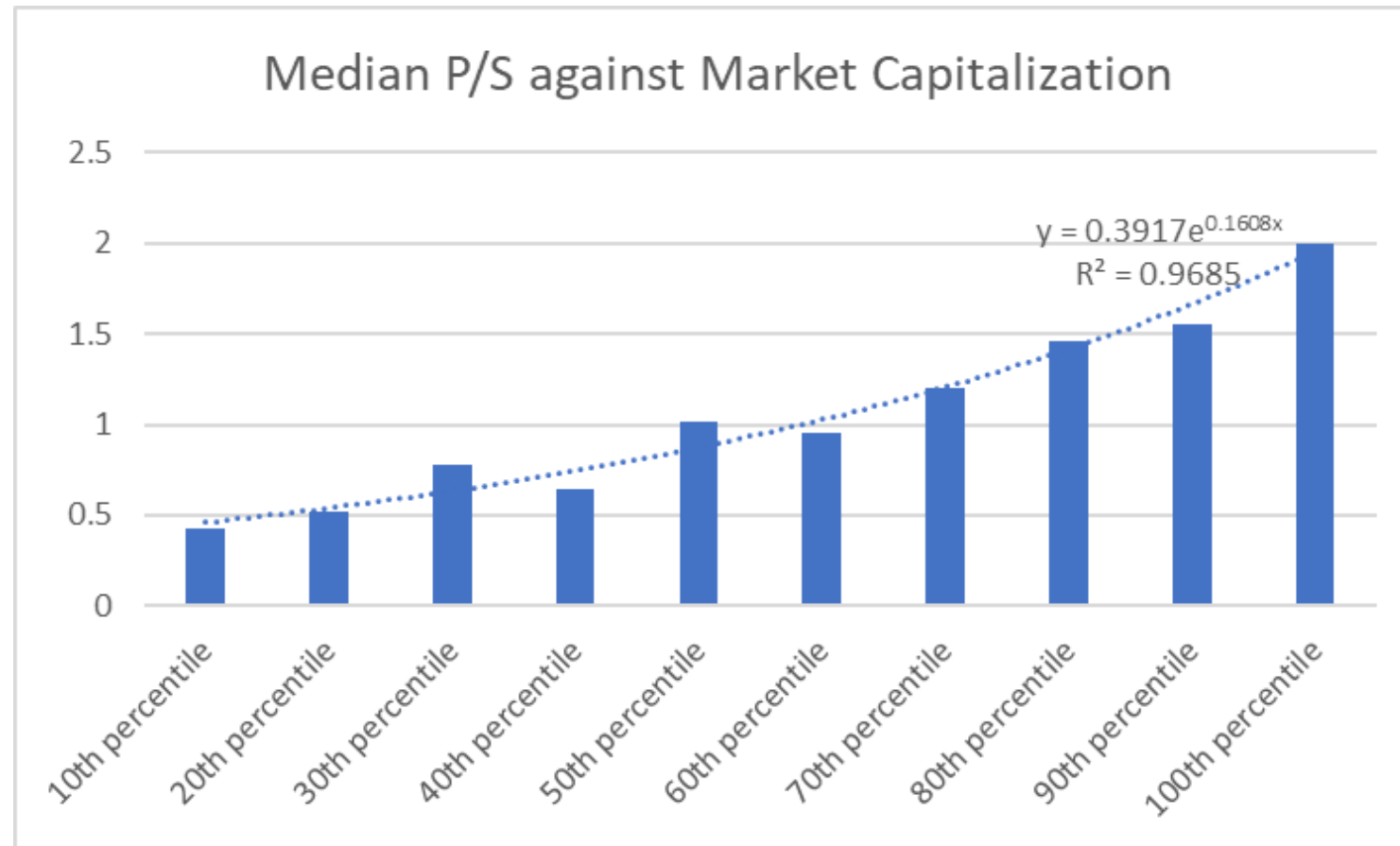
Best fit line (ranked by R-squared):

1st: P/S Median

2nd: P/B Median

3rd: P/E Median

The best-fit R-square: P/S Median using exponential curve



R-Square Comparison Result

Best-fit		
R-squared	Mean	Median
P/E	0.5802 (Quad)	0.7313 (Linear)
P/B	0.3943 (Quad)	0.9451 (Quad)
P/S	0.5207 (Linear)	0.9685 (Expo)

Choosing the best-fit among:

Quad: Quadratic curve

Linear: Linear line

Expo: Exponential curve

Log: Log curve

Pow: Power curve

Best fit (ranked by R-squared):

1st: P/S Median

2nd: P/B Median

3rd: P/E Median

Limitations of the Research

- **Lack of Comprehensiveness**

- Some earnings data are not disclosed by some companies, which lead to the lower sample size of when doing regression of the P/E ratio

- **Limitations caused by outliers**

- For examples, very high market capitalization
- Some particular data have extreme results (It also explains why the median measure could be a more accurate prediction than the mean measure)

Conclusion

Median multiple is a better fit than the mean multiple when fitting the relationship

P/S ratio has the most relationship with market capitalization among P/S, P/B, P/E multiple

Verification of Research Result using updated data set

05/01/2023

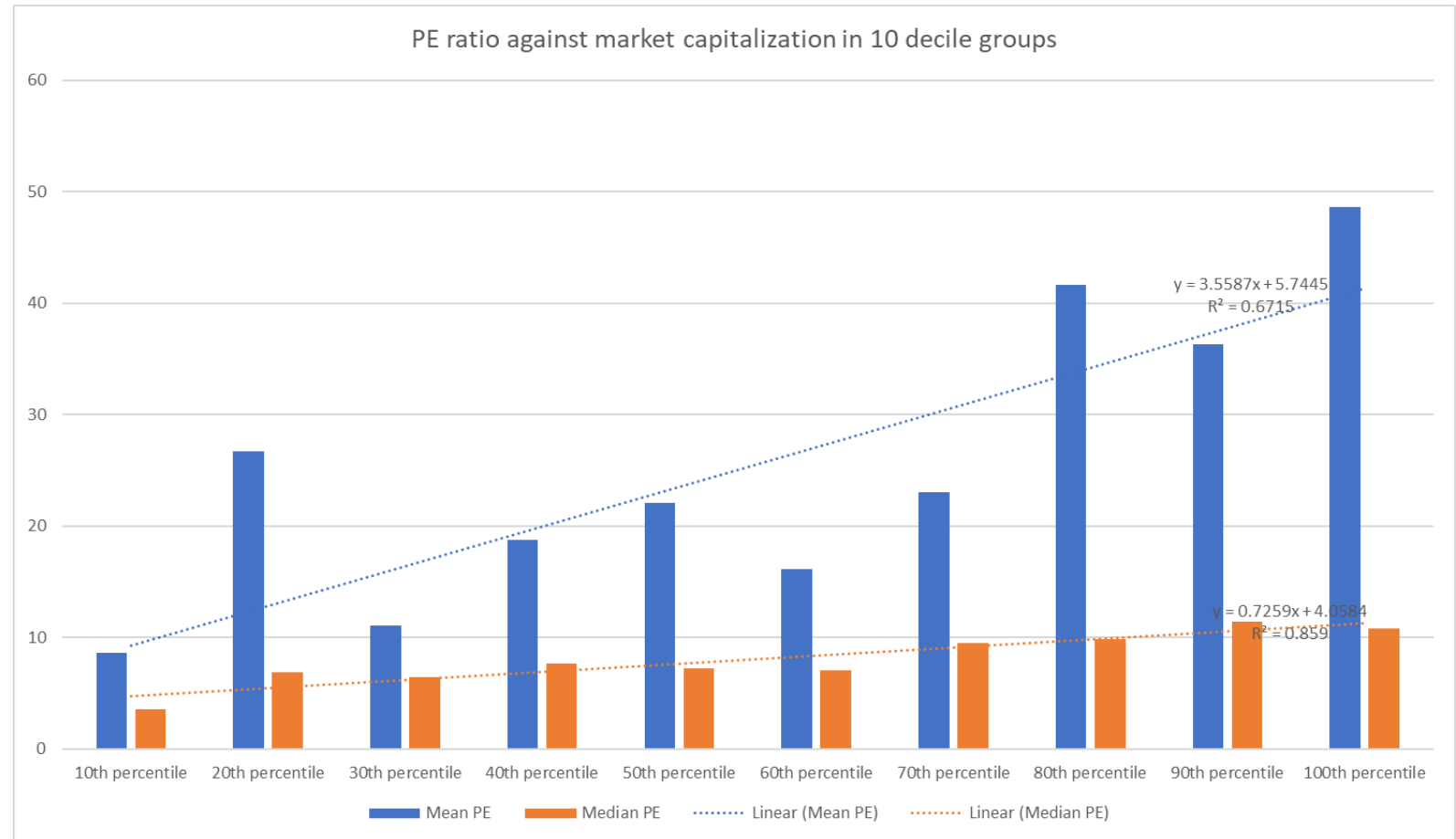
	Median PE	Mean PE	Median PB	Mean PB	Median PS	Mean PS
10th percentile	3.5357	8.635367	0.4901	1.6976916	0.4225	2.7281633
20th percentile	6.8591	26.672142	0.46565	1.5397988	0.6394	3.8712876
30th percentile	6.4852	11.113141	0.62065	1.6512194	0.85525	5.0511657
40th percentile	7.6875	18.794456	0.5207	3.4436996	0.7511	4.2462275
50th percentile	7.27485	22.114994	0.68595	2.2887149	0.9552	60.192948
60th percentile	7.0182	16.126539	0.56545	4.4420246	1.06915	7.5501214
70th percentile	9.52735	23.086601	0.7594	2.5162053	1.235	32.130651
80th percentile	9.875	41.678801	0.9358	2.2789315	1.7407	73.573686
90th percentile	11.41075	36.337485	1.0586	2.2925802	1.98935	52.559597
100th percentile	10.83635	48.614694	1.1241	3.2743474	2.3136	8.2728101

Background

To verify the research results, we use the same regression analysis method but using another set of data as at 31 December 2022

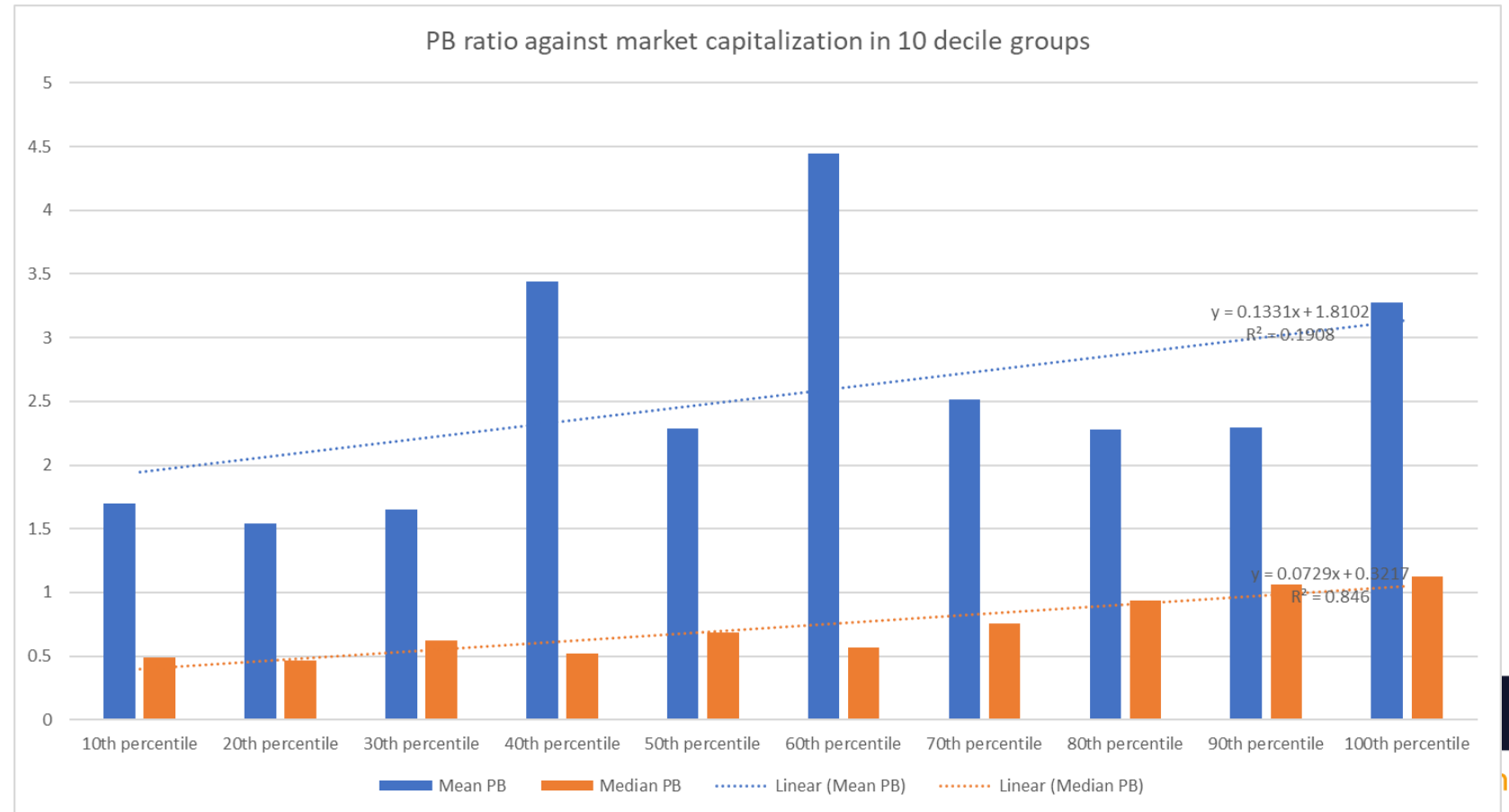
Mean and Median P/E ratio against Market Capitalization - SLR

	Mean PE	Median PE
10th percentile	8.635367	3.5357
20th percentile	26.67214	6.8591
30th percentile	11.11314	6.4852
40th percentile	18.79446	7.6875
50th percentile	22.11499	7.27485
60th percentile	16.12654	7.0182
70th percentile	23.0866	9.52735
80th percentile	41.6788	9.875
90th percentile	36.33749	11.41075
100th percentile	48.61469	10.83635



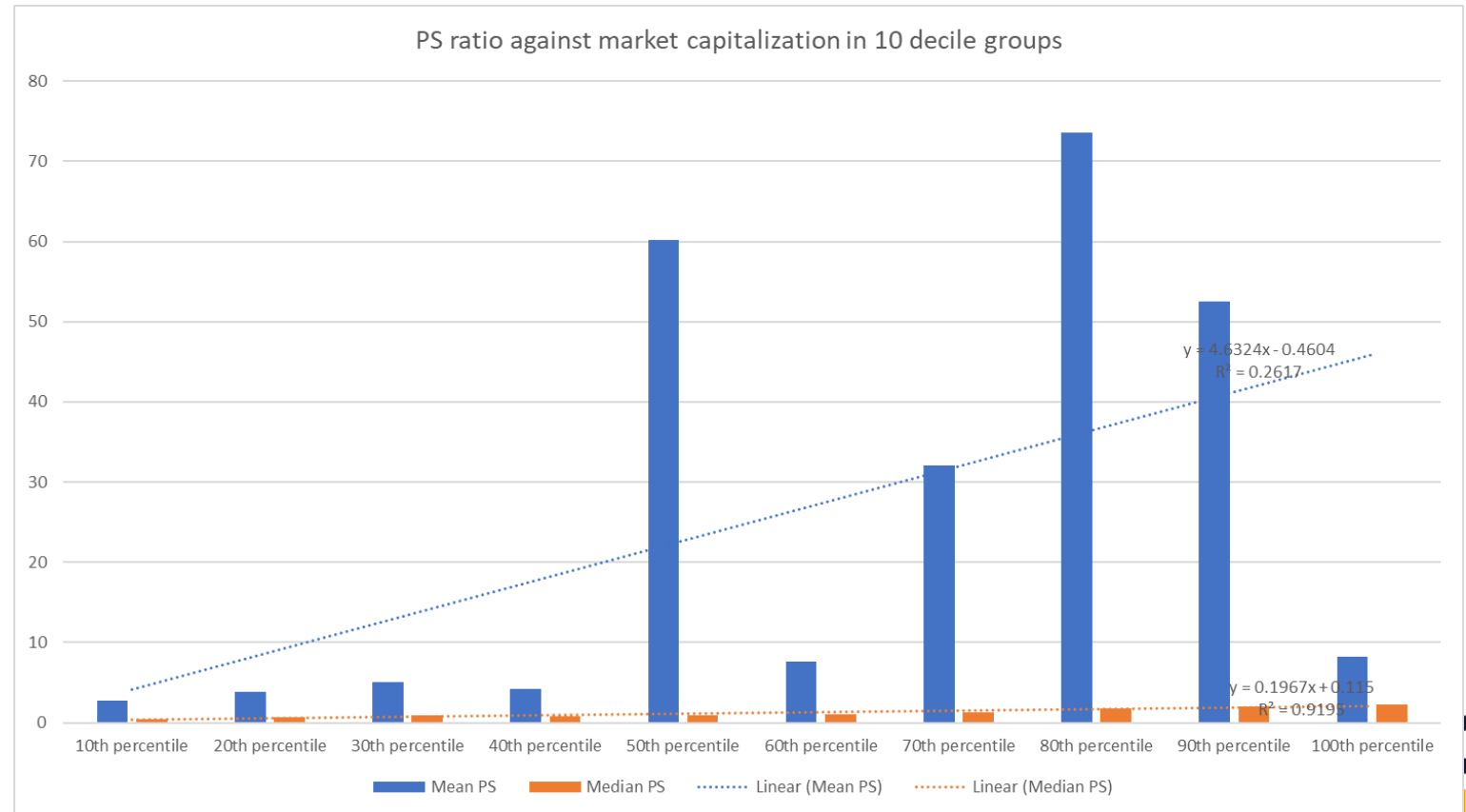
Mean and Median P/B ratio against Market Capitalization - SLR

	Mean PB	Median PB
10th percentile	1.697692	0.4901
20th percentile	1.539799	0.46565
30th percentile	1.651219	0.62065
40th percentile	3.4437	0.5207
50th percentile	2.288715	0.68595
60th percentile	4.442025	0.56545
70th percentile	2.516205	0.7594
80th percentile	2.278931	0.9358
90th percentile	2.29258	1.0586
100th percentile	3.274347	1.1241



Mean and Median P/S ratio against Market Capitalization - SLR

	Mean PS	Median PS
10th percentile	2.728163	0.4225
20th percentile	3.871288	0.6394
30th percentile	5.051166	0.85525
40th percentile	4.246228	0.7511
50th percentile	60.19295	0.9552
60th percentile	7.550121	1.06915
70th percentile	32.13065	1.235
80th percentile	73.57369	1.7407
90th percentile	52.5596	1.98935
100th percentile	8.27281	2.3136



R-square Comparison Result from the best fit line - SLR

R-squared	Mean	Median
P/E	0.6715	0.8590
P/B	0.1908	0.8460
P/S	0.2617	0.9195

For the median measures, the R-squared fit is above 0.8, this shows that there is a **strong correlation and linear relationship** between P/E, P/B, P/S ratio and the market capitalization, with **P/S ratio having the largest correlation**

R-Square Comparison Result

Best-fit		
R-squared	Mean	Median
P/E	0.7643 (Quad)	0.8613 (Power)
P/B	0.3155 (Quad)	0.9255 (Quad)
P/S	0.3495 (Quad)	0.9766 (Expo)

Choosing the best-fit among:

Quad: Quadratic curve

Linear: Linear line

Expo: Exponential curve

Log: Log curve

Power: Power curve

Best fit (ranked by R-squared):

1st: P/S Median

2nd: P/B Median

3rd: P/E Median

Summary

The results of the 31 December 2022 data is consistent with the result at 26 October 2022 that:

Median multiple is a better fit than the mean multiple when fitting the relationship

P/S ratio has the most relationship with market capitalization among P/S, P/B, P/E multiple

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