Suggested Solutions to Project 1 (FIN 3080)

Spring 2022 CUHKSZ

1. Please calculate the median static PE/PB ratio among all the stocks listed in the main board and SME board in each month from 2000 to now (latest data available in CSMAR). Plot the monthly time series. Repeat the calculation and plot for stocks listed in the Growth Enterprise Market (GEM) board. Please discuss your findings.

   Solution. The CSMAR database has a readily available table on daily PE and PB ratios for all Chinese listed firms in the *Stock Market Derivative Index* section. As many of your reports suggest, we may directly download these firm-level data, average daily ratios to obtain monthly ratios and then determine the median PB ratio at board level. Alternatively, we may manually collect monthly stock return data, merge them with quarterly-reported firm fundamentals and then derive static PE, PB ratios with the following formulas[1]:

   $$\begin{aligned} \text{PE} &= Price/Earnings\ per\ share = Market\ cap/Earnings, \\ \text{PB} &= Price/Book\ value\ per\ share = Market\ cap/Book\ value. \end{aligned} \tag{1.1}$$

   Monthly stock market trading data can be easily accessed through the *Stock Trading*table within the *China Stock Market Series* section. Restricting sample period to 2000 - 2020 yields 602,015 pieces of trading data covering stock code, date, closing price, trading volume, market capitalization, listing board and stock return. Then we may refer to the *Financial Statements* and *Income Statements* tables in the *China Listed Firms Research Series* section for quarterly firm fundamental data on stock code, date, net profit, total asset, total liabilities and etc. Since monthly stock prices are to be linked with latest quarterly reports, we shall pin down the quarter prior to the monthly date as the fiscal date for the trading data and then couple this date with stock code as joint keys to merge stock market data with firm fundamental data.

   Finally, by virtue of the merged data set, we may easily obtain the median PB and PE ratios for main and GEM board respectively. Figures 1 and 2 display the resulting time-series. It is clear that (i) the GEM and main boards share a similar time-series trend in both PE and PB ratios and (ii) the GEM board dominates the main board on both PE and PB ratios since its estabilshment till now.

[1] It is noteworthy that the numberators (price or market capitalization) of both ratios are usually provided by tables related to stock market performance and the frequency can be annual, monthly or even daily; the denominators are variables from firms' regular financial reports and the frequency is usually quarterly or annual. This is how 'static' kicks in. We link stock market data with the latest firm fundamental data and before the release of new reports, all numberators in the reporting phase share the same denominator - the denominator is much more 'static' compared with the numberator.

Remark. *Again there are many alternative ways to plot two figures and minor differences may arise from inconsistent chocies of raw data and data processing methods. All results are accepable as long as they are dervide from sensible procedures and the dominance of the GEM board over the main board can be observed. To replicate Figure 1 herein, one may first run q1_data_processing.do and then run q1_fig_plotting.R.*

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2. Pooling the monthly PB ratios from the main board, SME board and GEM together. Please study what factors can explain the firm's PB ratio.

Solution. The findings in the first question indeed yield with some hints. Recall that over the time GEM board firms on average have higher PB ratios than main board firms do. In light of in-class lectures, one significant difference between growth firms and others is that they have a higher profitability and a common proxy for profitability is *return on equity*. Also note that PB ratios for both GEM and main board firms fluctuate jointly over the time so that the general market condition is likely to affect PB ratio and we may use *beta* coefficient to gauge stocks' sensitivity to market risk. As a counterpart (or supplment) of *beta*, we may further take into consideration of *standard deviation of past stock returns*, a common proxy for firm idiosyncratic risks.

To justify whether the forementioned three factors really contribute to firm's PB ratio, we may perform the following firm-month regression (with the resulting data from question 1):

$$PB\ Ratio_{i,t} = \alpha + \beta ROE_{i,t-1} + \gamma Beta_{i,t} + \delta Return\ STD_{i,t} + Firm\ FE_i + Year\ FE_t + \epsilon_{i,t}, \quad (2.1)$$

in which $PB\ Ratio_{i,t}$ is firm i's PB ratio at month t; $ROE_{i,t-1}$ is firm i's return on equity available at month $t-1$; $Beta_{i,t}$ is firm i's beta coefficient at month t; $Return\ STD_{i,t}$ is the standard deviation of firm i's returns over past six months; $Firm\ FE_i$ and $Year\ FE_i$ denote firm and year fixed effects, respectively.[2] Then β, γ and δ capture the everage effects of *return on equity, beta* and *return volatility* on the PB ratio at firm-month level.

The regression results of Equation (2.1) are summarized in Table 1. In univariate settings, all three factors show significant explanatory power on the PB ratio. When including all three factors in the regression, $Return\ STD$ loses its power while the significance of ROE and $Return\ STD$ sustains and is robust controlling for firm and year fixed effects and clustering standard errors at firm or firm-year levels. It is worth mentioning that the coefficient of ROE seems to be negligible but its economic magnitude is

[2] It is fine if you have not taken any econometric courses covering fixed effects or clustered standard errors. It suffices to take firm (year) fixed effects as a control for unobservable firm (temporal) characteristics and view standard error clustering as a refinement on statistical significance. Both items go beyond the scope of this course yet we still include them by intention to expose you to state-of-the-art econometric techniques; for a detailed discussion on fixed effects and standard errors, one may refer to Borenstein et al. (2010) and Abadie et al. (2017).

non-trivial. Note that the standard deviations of PB ratio and ROE in our sample are 0.45 and 295.42 so that a one standard deviaiton increase in ROE gives rise to a $0.00044 \times 295.42/0.45 = 0.29$ standard deviation increase in the PB ratio. These findings together highlight that ROE and $Beta$ are robust factors explaining the cross-firm heterogenity in PB ratio.

Remark. *There are many other factors that may potentially affect PB ratios and there are also many alternative emprical strategies to document the such effects. The methods above only serve as a benckmark and the results in Table 1 can be replicated with q2_regression_analysis.do. You will not be discredited for choosing different factors nor regression formulas and acutally most of you did a great job in determining sensible factors with solid justification. If you are interested in rigorous studies on PB/PE ratios, you may refer to Penman (1996) as a good starting point.*

□

3. Calculate the equal and circulated market value weighted monthly stock returns for all the stocks listed in the main board and SME board in each month from 2000 to now (latest data available in CSMAR). Plot their cumulative monthly return. Repeat the same practice for stocks listed in the Growth Enterprise Market (GEM). Please analyze these monthly stock market returns and discuss your findings.

   Solution. Thanks to the data processing in question 1 and 2, it suffices to accumulate returns for each listed firms and then aggregate by board. The resulting time-series are given by Figures 3 and 4. As is evident, (i) equal-weighted portfolios outperform value-weigthed portfolios in both boards, and (ii) the gap between two return series has significantly amplified since 2015. □

References

Abadie, Alberto et al. (2017). *When should you adjust standard errors for clustering?* Tech. rep. National Bureau of Economic Research.

Borenstein, Michael et al. (2010). "A basic introduction to fixed-effect and random-effects models for meta-analysis". In: *Research synthesis methods* 1.2, pp. 97–111.

Penman, Stephen H (1996). "The articulation of price-earnings ratios and market-to-book ratios and the evaluation of growth". In: *Journal of accounting research* 34.2, pp. 235–259.

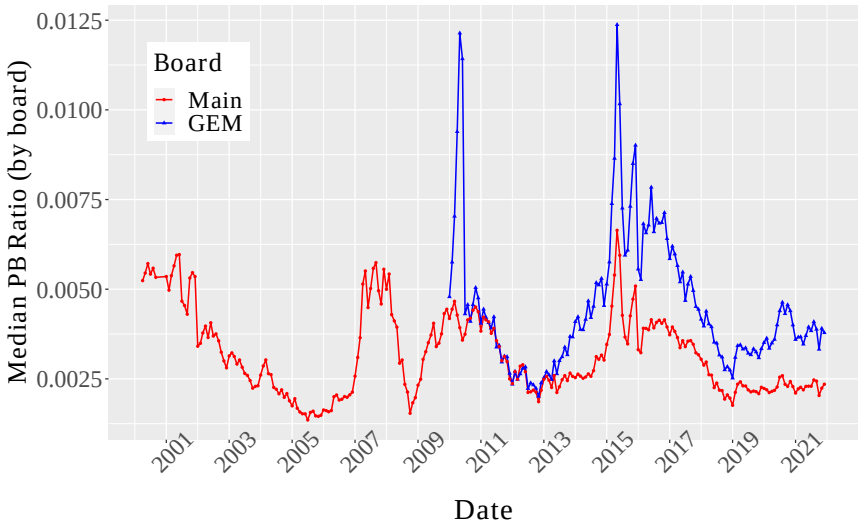

Figure 1: PB ratio by board (2000 - 2021)

Figure 1 shows the monthly median PB ratio for firms listed on China's main board and GEM board. The blue line plots the monthly median PB ratio for the main board and the red line plots monthly median PB ratio for the GEM board. All data are sourced from CSMAR's *Stock Trading*, *Financial Statement*, and *Income Statement* tables.

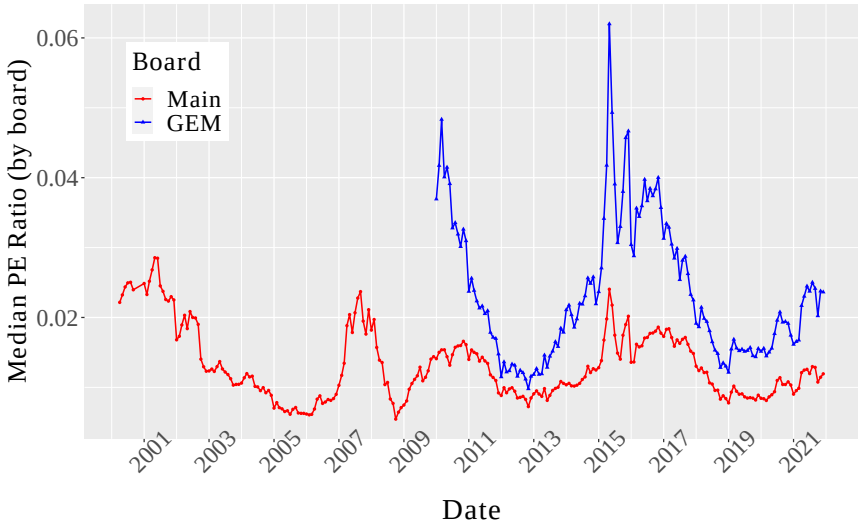

Figure 2: PB ratio by board (2000 - 2021)

Figure 2 shows the monthly median PE ratio for firms listed on China's main board and GEM board. The blue line plots the monthly median PE ration for the main board and the red line plots monthly median PE ratio for the GEM board. All data are sourced from CSMAR's *Stock Trading*, *Financial Statement*, and *Income Statement* tables.

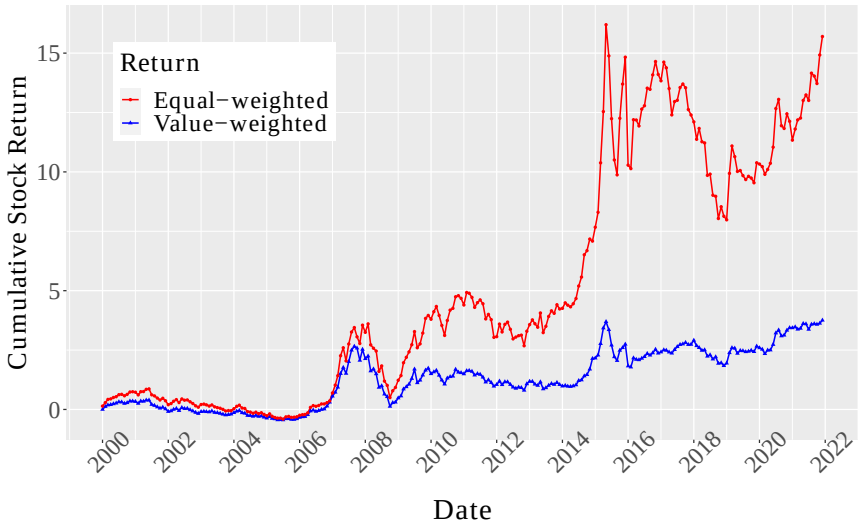

Figure 3: Main board monthly cumulative returns (2000 - 2021)

Figure 3 shows the monthly cumulative stock returns for China's main board. The blue line plots the equal-weighted return and the red line plots the value-weighted return. All data are sourced from CSMAR's *Stock Trading* table.

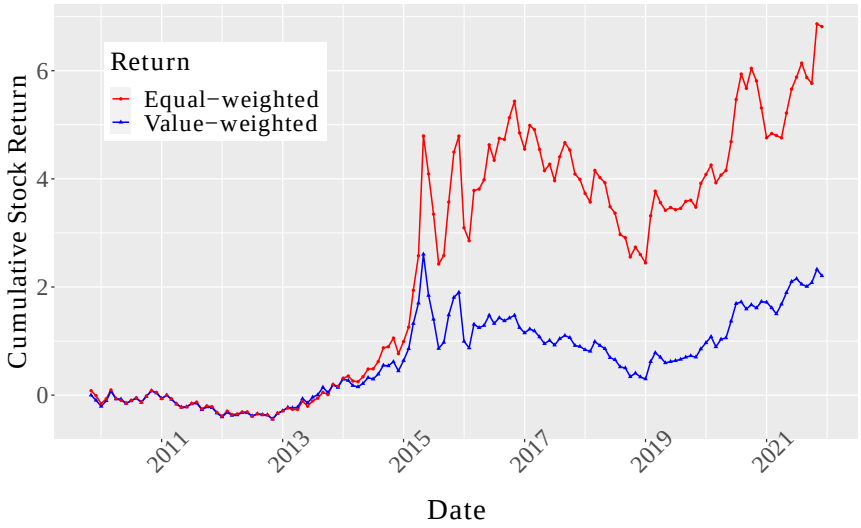

Figure 4: GEM board monthly cumulative returns (2010 - 2021)

Figure 4 shows the monthly cumulative stock returns for China's GEM board. The blue line plots the equal-weighted return and the red line plots the value-weighted return. All data are sourced from CSMAR's *Stock Trading* table.

Table 1: Explanatory factors for PB ratio

Table 1 summarizes the regression results of Equation (2.1), where monthly stock market data are sourced from CSMAR's *Stock Trading* table and quarterly fundamental data are collected from CSMAR's *Financial Statements* & *Income Statement* tables; samples are restricted to firms listed on China's main board and GEM board during 2000 to 2021. The dependent variable is PB ratio, which is given by the monthly closing price devided by latest reported book value of asset (net asset) per share. Key independent variables are defined as follows: ROE_{t-1} is the return on equity available at previous month; $Beta_t$ is the individual beta coefficient in month t; $Return\ STD_t$ is the standard deviation of stock returns in past six months. The coefficient of ROE is reported after multiplying with 100. Columns (1)-(3) report the results of univariate regressions; columns (4)-(7) include all three independent variables. Columns (5)-(7) control for firm and year fixed effects and columns (6)-(7) further cluster standard errors at firm level and firm-year level, respectively; t-statistics are in parentheses; $^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$.

Dependent Variable	PB Ratio						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ROE_{t-1}	0.036***			0.045***	0.044***	0.044***	0.044**
	(180.11)			(185.64)	(185.02)	(11.33)	(1.97)
$Beta_t$		0.005**		0.004*	0.007***	0.007	0.007*
		(2.49)		(1.84)	(2.61)	(1.62)	(1.73)
$Return\ STD_t$			0.010**	0.006	-0.004	-0.004	-0.004
			(2.03)	(0.88)	(-0.54)	(-0.46)	(-0.45)
Constant	0.004***	-0.003	0.003***	-0.002	-0.004	-0.004	-0.004
	(6.84)	(-1.06)	(2.84)	(-0.66)	(-1.24)	(-0.77)	(-0.74)
Firm FE	No	No	No	No	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes	Yes
Clustered SE	No	No	No	No	No	Firm	Firm-year
R^2	0.057	0.000	0.000	0.080	0.101	0.101	0.101
Observations	533,864	399,752	538,064	394,311	394,284	394,284	394,284