PEG Ratio: The Home Run?

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1. Introduction

Stock valuation is an art that has been studied by value investors for decades. Most investors are familiar with the PE (Price to Earning) ratio, which captures if a stock is overpriced or underpriced in relation to its earning. The PE ratio is a convenient heuristic that gives investors a quick buy/sell signal. However, it is not without its pitfalls. In particular, the PE ratio tends to be high when the projected growth of earning is high, which makes the ratio biased when used to assess high-growth stocks. This bias is a huge contrast to the backdrop of a lasting zeal for growth. "The value of growth was increasingly recognized in the 1950s and 1960s…by the early 1970s, the pendulum had swung to the other extreme, with investors seemingly interested *only* in growth…This myopia led them to pay what, in retrospect, were ridiculous prices for growth stocks." Comments Gary Smith (2016, p.121). With the zeal and influx of high-growth tech stocks into the market, investors call for a more objective heuristic to evaluate high-growth stocks.

Under this background, a new ratio, the PEG (Price/Earnings to Growth Rate) ratio, was developed by Mario Farina in 1969 and then popularized in Wall Street. By taking into consideration the growth factor, the PEG ratio is expected to give a more objective idea of the stocks' value. According to Peter Lynch (1989), one of the main popularizers of the PEG ratio, a fairly valued company will have a PEG value of 1. Fifty years after its introduction, the PEG ratio is still being widely used by Wall Street practitioners. A Forbes article credits PEG as a tool that "helps investors sniff out potential bargains, often indicated by a PEG below 1.0" (Murdock, 2008). Researchers also find that the PEG ratio carries the most explanatory weight to investment recommendations made by sell-side analysts (Bradshaw, 2002).

PEG's consistent popularity makes one wonder if it is going to be the home-run heuristic that can be solely relied upon for stock valuation. However, in contrast to the heat in Wall Street, the academic community has a more pessimist view towards the PEG ratio. For example, Clyde Stickney et al. comments in their 2007 book that PEG has little theoretical foundation. Furthermore, empirical studies by Peters (2001) and Schatzberg and Vora (2009) of the PEG ratio's effectiveness in rendering accurate stock valuation suggests that, while the existence of "PEG effect" (namely low PEG stocks tend to generate better long-run investment returns) can be verified, it has been dying over the years. A decade after the last empirical test of PEG effectiveness, the question remains for today's investors whether the PEG is still a rule-of-thumb ratio to be relied upon. The answer to this question is especially key considering the technological progress since 1970s and waves of technology stocks that have come into the market since. As tech stocks are typically expected to have high growth rates, the PEG ratio, if effective, will become a useful tool in tracking the latest technologies and how they affect the financial market.

This paper attempts to test the PEG's effectiveness in the 21st century. I use Schatzberg and Vora (2009)'s empirical model and update it with the latest stock return data from 2010 to 2020. I use a time-series and cross-section OLS regression model to test if low PEG ratios are always positively correlated to a high stock return. The result shows the correlation between the PEG ratio and stock returns is much weaker, but it also backs up the hypothesis that the PEG effect is dying overtime.

2. Theory

To understand the theoretical foundation of the PEG, I start with the theories behind the PE ratio. According to Smith (2016), stock valuation is a process of "comparing a stock's price to the present value of the anticipated cash the investor will receive." A common way to calculate the present value of the anticipated cash flow is through the dividend discount model, which calculate the present value of a stock's dividend as if it were held for perpetuity. The present value (P) is captured by the equation below, where R stands for the required rate of return of the investor, D_1 stands for the dividend one year from the present, D_2 stands for the dividend two years from the present, and so on.

$$P = \frac{D_1}{(1+R)^1} + \frac{D_2}{(1+R)^2} + \frac{D_2}{(1+R)^2} + \cdots$$

After simplifying the equation above and incorporating the constant growth assumption, the new equation looks like the one below, where g stands for the dividend growth rate:

$$P = \frac{D}{R-g}$$

Since most companies tend to keep a fixed payout ratio, which is the ratio of dividend to the company's earning, the growth rate g can often be used to indicate the growth rate of a company's earning as well. Under the dividend growth model, one can utilize the earning to price ratio (E/P), to give a rough estimate of a stock's return. Since if a company has a $10 earning per share by the year end and was sold for $100, it is as if the investor has made $10 return on his $100 investment. Under the same assumption, the inverse of the E/P ratio, which then becomes the PE ratio, can be used to indicate if a stock is cheap or expensive comparing to its return. Thus, under the dividend discount model, the equation for the PE ratio can be written as the following, where d stands for the dividend payout ratio:

$$\frac{P}{E} = \frac{D/E}{R-g} = \frac{d}{R-g}$$

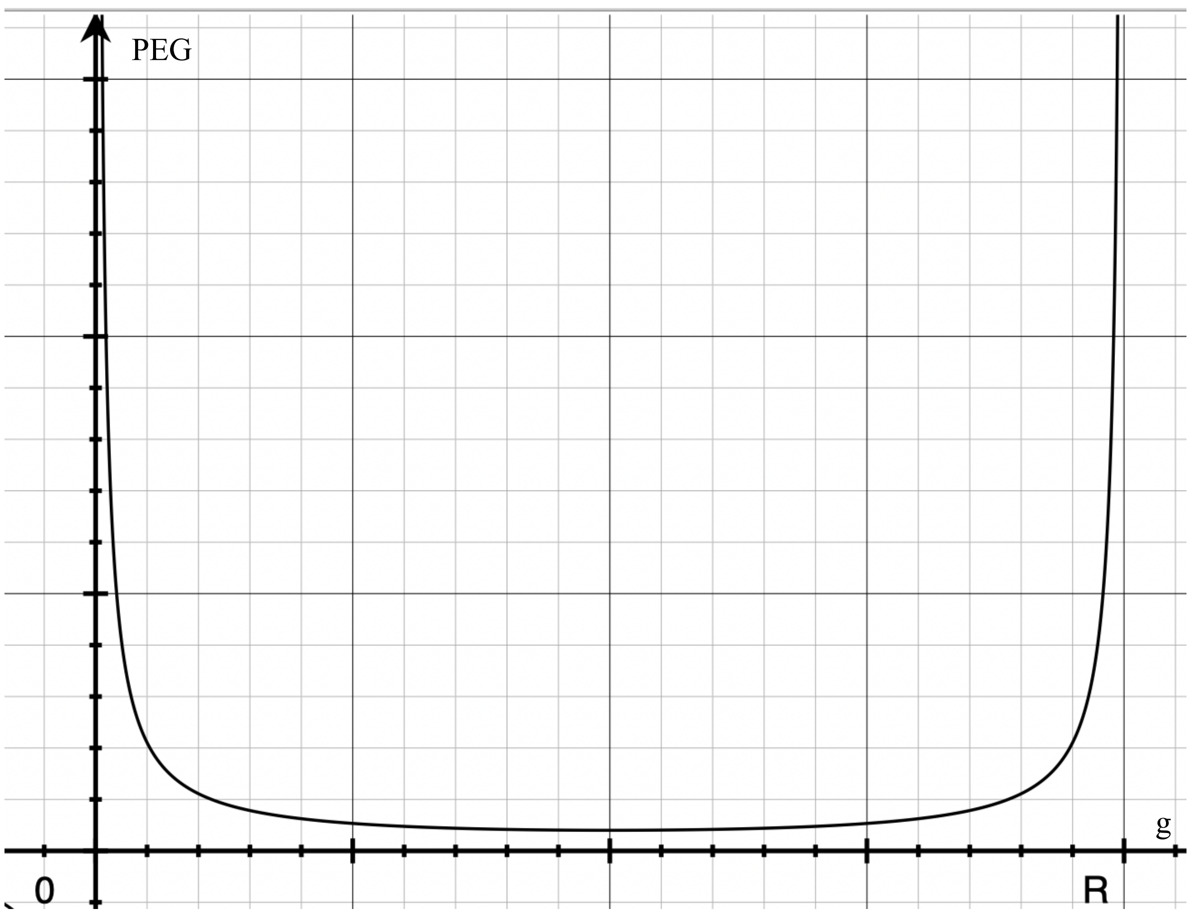
As the equation indicates, the PE ratio is positively correlated to the growth rate, which gives theoretical back-up to the popular critique that the PE ratio is biased against growth stocks.

Additionally, the PE ratio is sensitive to risk, since when the investors have high risk perceptions, they tend to have a higher required return. As we convert the PE ratio into the PEG ratio, a new equation can be drawn:

$$\frac{\frac{P}{E}}{g} = \frac{\frac{D/E}{R-g}}{g} = \frac{d}{(R-g)g}$$

The impact of growth on the PEG ratio is not explicit from the equation alone but can be more clearly demonstrated by plugging the equation into a graph, where g is the PEG ratio is the left-hand side variable and g is the right-hand side variable:

Figure 1: PEG Ratio vs. g

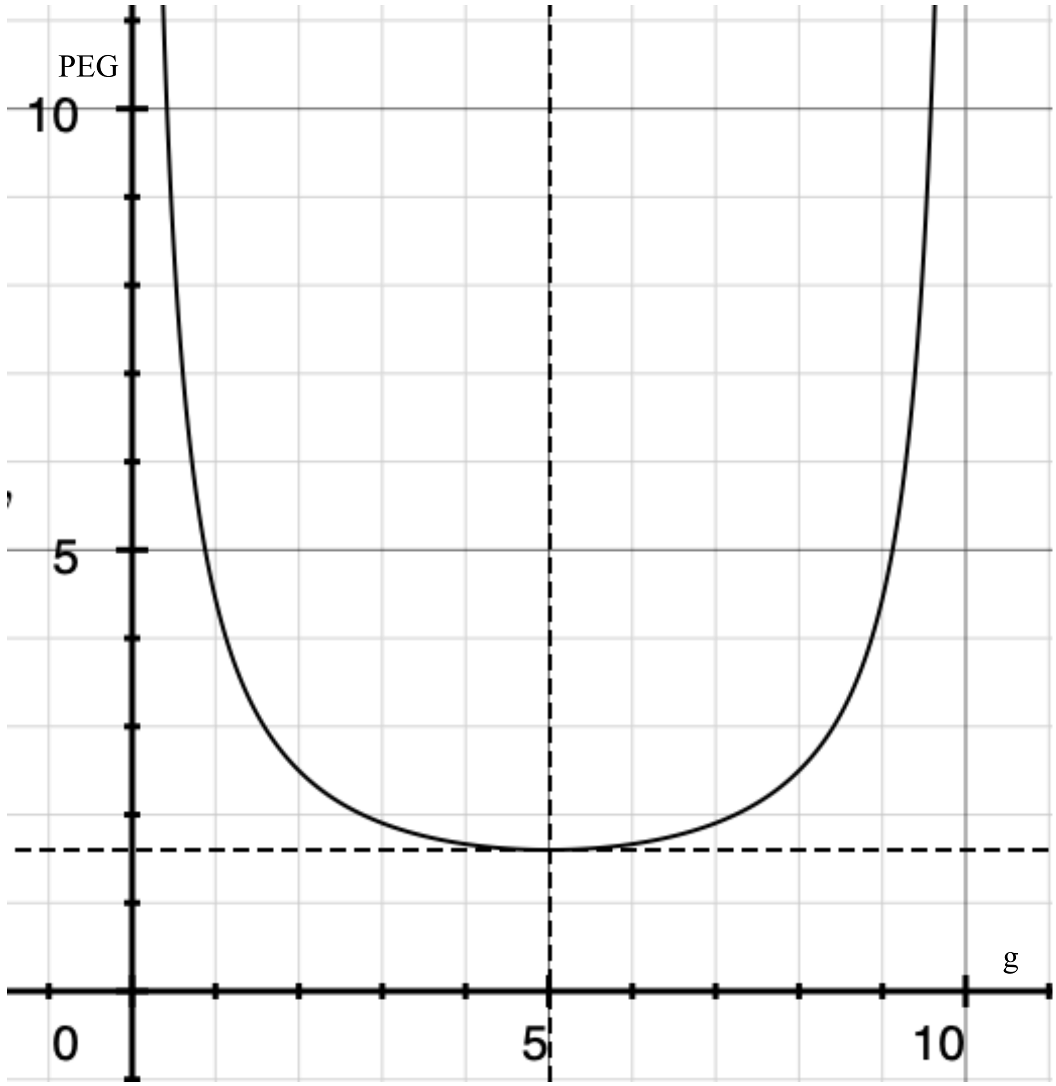


As the graph above shows, for any g in between 0 and R, the PEG ratio is almost a flatline except for values close to the two extremes, which means the PEG ratio is almost unaffected by g in this range. For g values closer to 0 and R, the PEG will rise to infinity, and this reflects the growth trap that investors may encounter. If an investor has an extremely small required return, any stock with positive return can be considered undervalued and thereby has an infinite PE value. If a stock has a growth rate greater than the investor's required return, its discounted present value would be infinite, meaning it will yield infinite return and have an infinitely large PE value. However, if an investor has a realistic required return, it is very unlikely for a stock to have a growth rate higher than the required return. This point is addressed by Smith (2016):

> The infinite intrinsic value for a stock whose dividend growth rate is as large or larger than shareholders' required return is the *growth-stock paradox*. The answer to the paradox is that investors should indeed be willing to pay an unlimited amount for a stock with a long-run growth rate that exceeds their required return, but that such a permanently high growth rate is not plausible…such rapid growth cannot be maintained forever. (p.123)

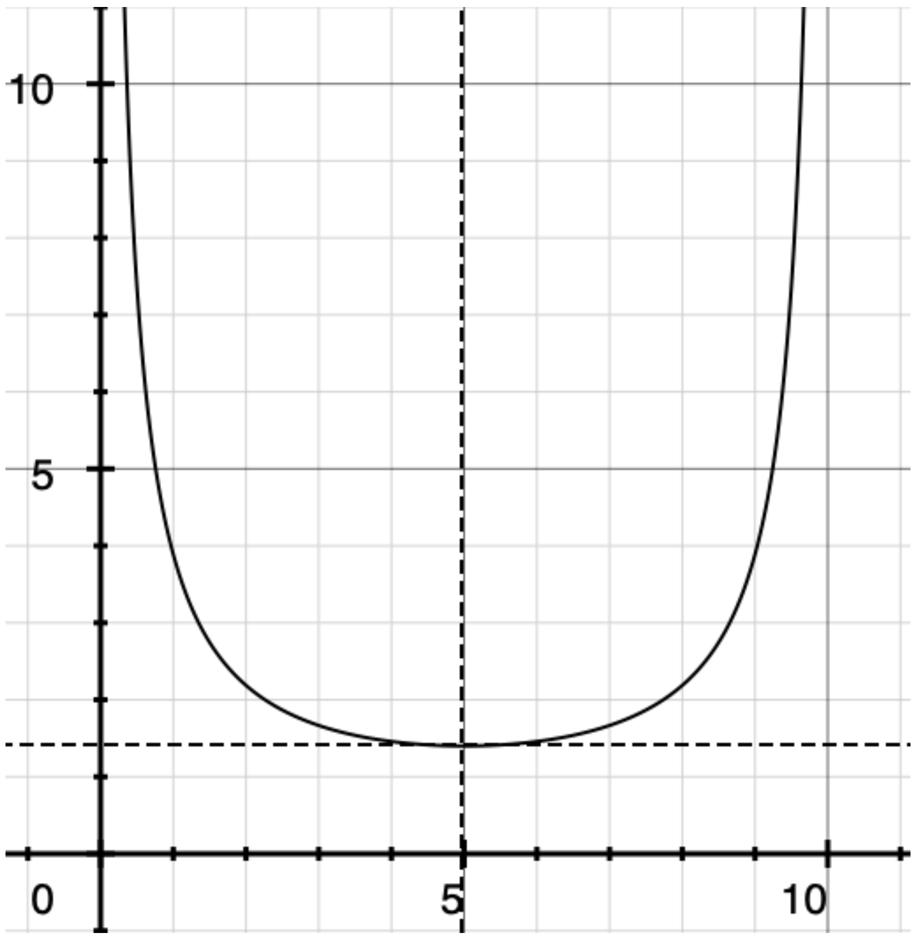
Thus, mathematically, the PEG ratio is a less biased ratio than PE to evaluate stocks, since it does not favor growth stocks as the PE ratio does, given that the growth is within a realistic range. According to the equation, the PEG ratio is also negatively correlated with required return, which means that a lower PEG often indicates a higher return. However, the assertion that a fairly valued stock should have a PEG close to one is not as strongly backed by the math underneath the equation. Assuming a dividend payout ratio of 35%, which is usually considered a strong payout ratio, and a required return of 7%, which aligns with the current market performance, I find that a stock's PEG, if fairly priced, should be around 3. See the graph below:

Figure 2: PEG Ratio vs. g (d=40, R=7)



However, if we plug in a more bullish required return, which is 12%, the average PEG should be around 1.5:

Figure 3: PE Ratio vs. g (d=35, R=12)



Thus, it seems like the number 1 is not a universal standard for a strong PEG ratio. A fairly priced stock can have a higher or lower PEG. One cannot easily make assumptions about the return of a randomly picked portfolio of stocks using the PEG ratio alone.

3. Literature Review

While various authors have studied implications of the PEG ratio through an academic lens, direct empirical studies on the return implications of the PEG ratio are first done by Peters (2001). He defines the PEG ratio as a stocks trailing EPS divided by its mean five-year long-term growth. He uses quarterly data from Jan. 1st, 1982, to June. 30th 1989. His study specifically focuses on growth stocks, by picking stocks with over 12% long term growth from the IBES data base. Additionally, he puts a liquidity bottom line at $50 million minimum in sales in his sample selection. His results show that after eliminating market factors, a dollar invested in the lowest PEG profile over the 30 quarters would yield $15.36, while the highest PEG profile would only $1.38. The lowest PEG portfolio outperformed the average growth stock in 26 of the 30 quarters and outperformed S&P 500 in 21 out of the 30 quarters. These results indicate that for growth stocks, low PEG ratio is directly correlated with high returns.

Despite being the first direct empirical study on the topic, the dramatic return difference Peters observed has caused scrutiny. R.C. Chan (1994) expresses his concern that no t-statistics was reported to back the significance of his study. Additionally, he points out that the sample period studied is too short, from 1982 to 1989. Moreover, the superior performance of low-PEG stocks mainly comes from the 1982 to 1986 subperiod, further undermining the significance of his study. Schwerts (2003)'s study suggests that Peters' results may not persist out of sample. He discovers that apparent mispricing of stock returns due to size, value, dividend-yield effects and so on tend to disappear after the initial release of the results. Thus, Peters' conclusion may not hold for future time periods, after adjusting for mispricing. Additionally, Peters uses some standards in selecting his samples that potentially undermines his unbiasedness. For example, he only picks stocks with over 12% long term growth over $50 liquidity, without explaining the incentive behind these two standards. This selection may be with the intention of yielding results that are favorable to his hypothesis.

Based on Peters study and relative reviews, Schatzberg and Vora(2009) conduct an improved study of the return effects of the PEG ratio. There are a few major expansions they made in their study: First, instead of growth stocks alone, they extend their research targets to any stock that meets their specific data requirements. Second, they take into consideration the risk factors on stock returns by introducing three Fama-French risk variables. Third, they keep part of Peters' strategies in variable selection by using the IBES database and observables; however, instead of using trailing EPS, they use forecasted EPS when calculating their PEG ratios; instead of quarterly returns, they look at the 12-month holding period returns starting 7 months after the fiscal year ends, which factors in the lagged effect of PEG ratio on return. Fourth, they examine the separability of PEG effects on stock returns comparing to PE and growth effects alone. By looking at data from 1990 to 2003, they find a less significant but still negative correlation between PEG and stock return, even after factoring the risk variables.

In comparison to Peters (2001)'s study, Schatzberg and Vora(2009)'s study is of more significance. To start with, it reports the t-statistics. Second, it looks at a wider range of data, with a longer period of time. Third, they use forecast EPS instead of trailing EPS to make their study forward-looking. This is a more realistic approach, since the investors won't be able to know ahead the EPS number of the year as they make investment decisions. However, despite the effort of disclosing more details regarding their approach, Schatzberg and Vora(2009)'s work has some similar risks of p-hacking and biasedness as Peters (2001) did. For example, they choose to look at 12-month holding period returns starting 7 months after the fiscal year ends, without justifying the length 7 month. A more natural strategy would be looking at 6 months or 12 months after the fiscal year end. Additionally, they choose to study only stocks with positive EPS and return over the 13-year period, in order to have positive PEG numbers to study. However, this is an unrealistic strategy, since when investors are making decisions in real life, they cannot know ahead which stocks would have positive PEG numbers over the next few years. By restricting their samples to only stocks with positive PEG, they make a selection that is not random and may be biased. Thus, to yield a less biased result, I will revise these standards of choosing samples in my methodology.

4. Data and Methodology

Like Schatzberg and Vora's original study, this paper gets data for elements of PEG, including stock price, growth rate, and EPS for this paper come from the IBES summary database. The stock return data comes from the CRSP database. The risk variables are accessed at Dartmouth business school library.[1] Due to the restriction of computing capabilities, I only look at stocks in S&P 500. Schatzberg and Vora(2009) considered five standards for stock selection:

> (1) the forecast of one-year-ahead EPS and the subsequently reported EPS for the current year are both positive; (2) the five-year growth forecast of EPS is positive; (3) at least three analysts report; (4) stock return data for the 12-month period beginning seven months after the fiscal year-end are available from CRSP; and (5) the firm has a primary SIC code indicating other than the financial or utility sector. (p.11)

As mentioned in the last section, these standards of selection add to biasness. Instead, I use two new standards. The first is a standard for currency restriction, which is that the firm reports EPS data in U.S. dollar. This is because this paper primarily considers the U.S. stock market, and EPS and stock price reported in different currencies are not comparable among each other. The restriction on currency is a selection that investors can make in real-life investment scenarios as well, thus the practicality of the result would not be undermined. The other standard is that the observations must have positive earnings and price. This is to yield a positive PEG, since a negative PEG is not indicative of the stock's return. Additionally, for the return variable, instead of looking at 12-month holding period returns starting 7 months after the fiscal year ends, I

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[1] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

choose to look at 12-month holding period returns starting 12 months after the fiscal year ends, making the number more natural.

There are in total five variables used: stock return, PEG, SMB variable, HML variable, and MRP variable. For the return variable, while Peters and Schatzberg and Vora only use the actual return for regression, I conduct regression for both the actual return and excess return, to take into consideration that returns are affected by the economic conditions over the years. The actual return refers to the raw return for a 12-month holding period beginning 12 months after the fiscal year-end. The excess return refers to the actual return deducted by the value-weighted return provided by CRSP. There are two versions of PEG ratio, one is calculated by Peters' method, using the current year EPS (hybrid PEG); the other is calculated using Schatzberg and Vora's method, using the forecasted EPS of the next fiscal year (expectational PEG). Below is the equation used for calculation:

$$\mathrm{PE_t(hybrid)} = \frac{\mathrm{Price_t}}{\mathrm{EPS_t}}$$

$$\mathrm{PEG_t(hybrid)} = \frac{\mathrm{PE(hybrid)}}{\mathrm{g_t}}$$

$$\mathrm{PE_t(expectational)} = \frac{\mathrm{Price_t}}{\mathrm{EPS_{t+1}}}$$

$$\mathrm{PEG_t(expectational)} = \frac{\mathrm{PE(expectational)}}{\mathrm{g_t}}$$

In the equations above, price refers to the average stock price for the fiscal year. EPS_t refers to the earnings per share for the current year, and EPS_{t+1} refers to the forecasted earnings per share of the following fiscal year. G refers to the average five-year growth rate forecasted by IBES. The three risk variables are defined by the Farma-French model. They are: (1) small minus big (SMB), which considers the market cap impact on risk; (2) high minus low (HML), which considers the book-to-value ratio impact on risk; the security's return less the risk-free rate of return (MRP), which considers the market impact on risk.

Below are the descriptive characteristics of the dataset. Table 1 reflects characteristics of the historical PEG method. There are 3,606 observations with meaningful PEG numbers. The table suggests that these stocks have a relatively high average PEG number and an exceedingly high standard deviation. This is due to huge outliers under the circumstances of low growth. The outliers occur almost randomly, without cyclical features or association with any particular firms. This indicates that they mostly come from incidental low growth for a firm in a particular time period. The regression results in the next section analyzes the impact of these outliers. Overall, the stocks selected performed strongly between 2010 and 2020, with an average annual return of 12%. This might be due to the fact that S&P 500 includes big corporates that are favorable investment choices, and that the stock market was booming in the given time period.

Table 1: Description of Variables-Historical PEG

Variable	Mean	Std. dev.	Min	Max
PEG	11.8662	277.1992	0.0018	16171.8300
Actual Return	0.1192	0.3630	-2.9841	4.6820
Excess Return	-0.0178	0.3547	-3.1983	4.4678
MRP	1.2028	0.9180	-0.4875	2.5725
SMB	0.0930	0. 5782	-0.5450	1.0933
HML	-0.4692	1.0969	-2.8750	1.6042

Table 2 reflects the characteristics of the expectational PEG method. Under this method, the problem of outliers still exists, yet the PEG ratio has lower mean and standard deviation. The forward-looking method renders more realistic PEG data than the historical one.

Table 2: Discription of Variables-Expected PEG

Variable	Mean	Std. dev.	Min	Max
PEG	7.5330	60.0535	0.0029	2626.6090
Actual Return	0.1260	0.3572	-2.9841	4.6820
Excess Return	-0.0083	0.3467	-3.1983	4.4678
MRP	1.1871	0.9138	-0.4875	2.5725
SMB	0.0744	0.5655	-0.5450	1.0933
HML	-0.4035	1.0448	-2.8750	1.6042

4. Methodology

The methodology of this paper is in line with Schatzberg and Vora's in their original study. I conduct a time-series and cross-section pooled OLS regression on variables described in the last section. I start with a simple regression where the return is the dependent variable, and the PEG ratio is the independent variable. Later, I add in additional dependent variables, which are SMB, HML, and MRP risk variables. I conduct different regressions for the historical EPS, expected EPS, actual return, and excess return, for the purpose of comparison.

5. Results

Actual Return

Table 3 demonstrates the regression results for actual return with historical and expectational PEGs.

Table 3: Regression Results - Actual Return

	Historical PEG		Expectational PEG	
Variables	Without Risk	With Risk	Without Risk	With Risk
PEG	-0.00001	-0.00001	-8.85e-07	-0.00003
	(0.59)	(0.48)	(0.99)	(0.79)
MRP		-0.05		0.05
		(0.00)		(0.00)
SMB		0.01		0.01
		(0.28)		(0.71)
HML		0.06		0.06
		(0.00)		(0.00)
R^2	0.0001	0.04	0.00	0.04
F	0.29	35.45	0.00	34.14

For the historical PEG method, according to the regression results, the simple regression without risk variables shows a very minor but negative correlation between the historical PEG ratio and stock return, with a coefficient of merely -0.00001. The simple regression only has a R-squared value of 0.0001, and the result is not statistically significant at a 5 percent level of significance. These results mean that the historical PEG ratio alone almost implies nothing about actual returns for stocks in S&P 500 stocks. The complex regression yields a similarly small coefficient for historical PEG ratio, which is -0.00002. Each of the risk variable has a stronger correlation with the actual return than the PEG ratio. The R-squared number is substantially improved after adding the risk variables, to 0.02040, and the regression results are significant at a 1% significance level, with the risk-free rate of return and higher-minus-low variables having more partial significance. These results mean that the risk factors should be added into consideration when considering PEG effects, since they carry substantial explanatory weight for return. However, the PEG effect using the historical PEG and actual return is much lower for S&P 500 stocks in the time period of 2010-2020.

For the expectational PEG method, the simple regression showcases an even weaker negative correlation than historical PEG, with smaller R-squared. This indicates that the PEG effect is even weaker after taking into consideration the lagged effect, and that the lag time of 7 months was likely picked to yield a result favorable for the authors' hypothesis. After adding in the risk factors, like the historical method, the coefficient for PEG was improved to -0.00003, and yet still indicate a very weak correlation. Like the historical PEG approach, risk factors still have more statistical significance than the PEG ratio. The regression results still indicate a very small correlation between the PEG ratio and stock return after switching to the expectational PEG method.

Excess Return

Table 4 demonstrates the regression results for excess return with historical and expectational PEGs.

Table 4: Regression Results - Excess Return

	Historical PEG		Expectational PEG	
Variables	Without Risk	With Risk	Without Risk	With Risk
PEG	-0.00002	-0.00002	-9.69e-06	-0.00003
	(0.35)	(0.32)	(0.92)	(0.78)
MRP		-0.02		-0.01
		(0.02)		(0.11)
SMB		-0.02		-0.03
		(0.08)		(0.02)
HML		0.05		0.05
		(0.00)		(0.00)
R^2	0.0003	0.03	0.00	0.03
F	0.89	28.64	0.01	28.51

Using excess return, the coefficient for the simple regression is increased to -0.00002, with a higher R squared of 0.0002, indicating a slightly improved statistical significance. The coefficient for the complex regression is -0.00002, with a 0.03280 R squared number and similarly more significance than the actual return approach. However, the risk factors still carry the most explanatory weight in the regression results.

Like the historical PEG approach, both the correlation and statistical significance are improved for the expectational PEG approach. These improvements indicate that excess return is a better measurement of stocks' performance compared to actual return when used to assess the PEG effect. However, the conclusions from the actual return approach remain unchanged. The PEG ratio alone is not enough to draw conclusions about a set of randomly picked stocks. These findings are consistent with what the theories imply. A fairly priced company can have a low or high PEG ration, and it is hard to find a rule of thumb PEG ratio number that guarantees a good investment choice. Moreover, different typical payout ratio and required return of various industries makes cross-industry comparison of PEG harder, thus the low R squared.

In comparison to the coefficients Schatzberg and Vora (2009) arrive at, which are -0.004 (0.04 R squared) for historical PEG and -0.021 (0.04 R squared) for expectational PEG, the results from the 2010-2020 period, with excess returns, shows a much weaker correlation between the PEG ratio and return and much lower statistical significance. This contrast is understandable, since this paper attempts to remove some of the p-hacking tactics observed in previous empirical studies. The weak PEG effect echoes findings in the theory section, which indicate that the absolute value of PEG alone cannot single-handedly determine the value of a randomly selected portfolio of stocks. Additionally, Schatzberg and Vora (2009) are correct in adding in the risk factors since they do carry some explanatory weight to the returns. As mentioned earlier, there are huge outliers in the sample, and they are reflected in the regression results. As the Figure 4 and 5 below show, when removing outliers and restrict observations to those with PEG lower than 20, the coefficient and R-squared are improved but still lower what Schatzberg and Vora (2009) find. This suggests that the dying-off effect of PEG ratio is not due to the outliers for a large part. However, as mentioned earlier, most outliers are results of incidental factors. Thus, it would be hard for investors to predict irregularities in PEG numbers, especially when the firm's financials or market is in a fluctuating situation. As a result, the PEG ratio still has its value even today, but it's not the home run that should singlehandedly determine the value of a stock.

Figure 4: Correlation of Return and Historical PEG Ratio (PEG<20)

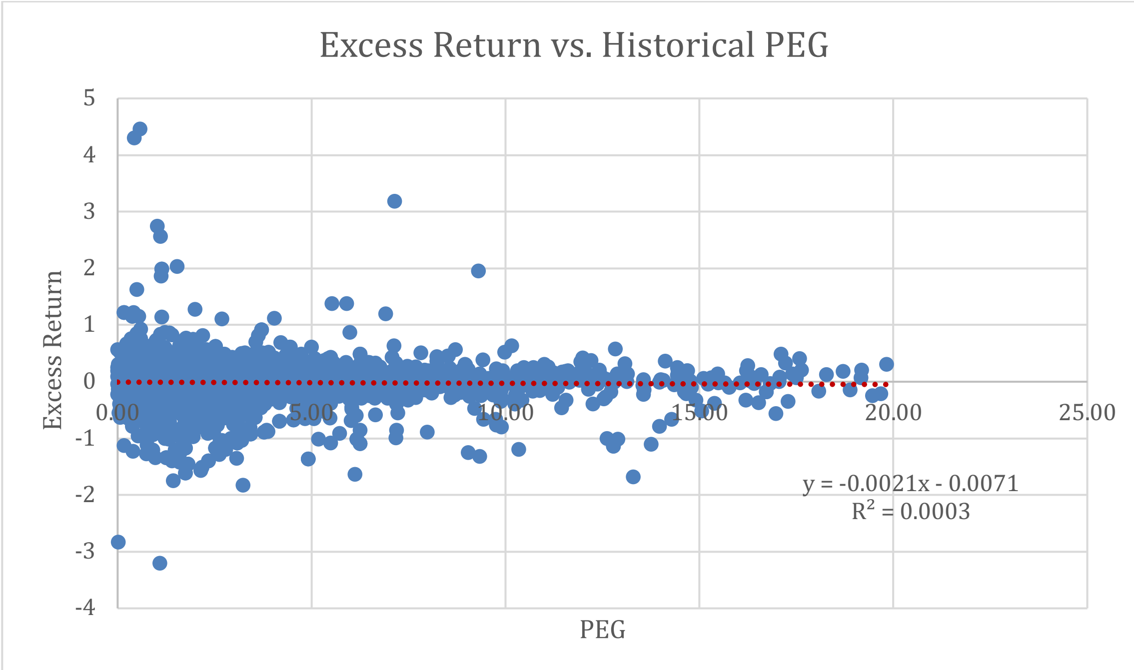
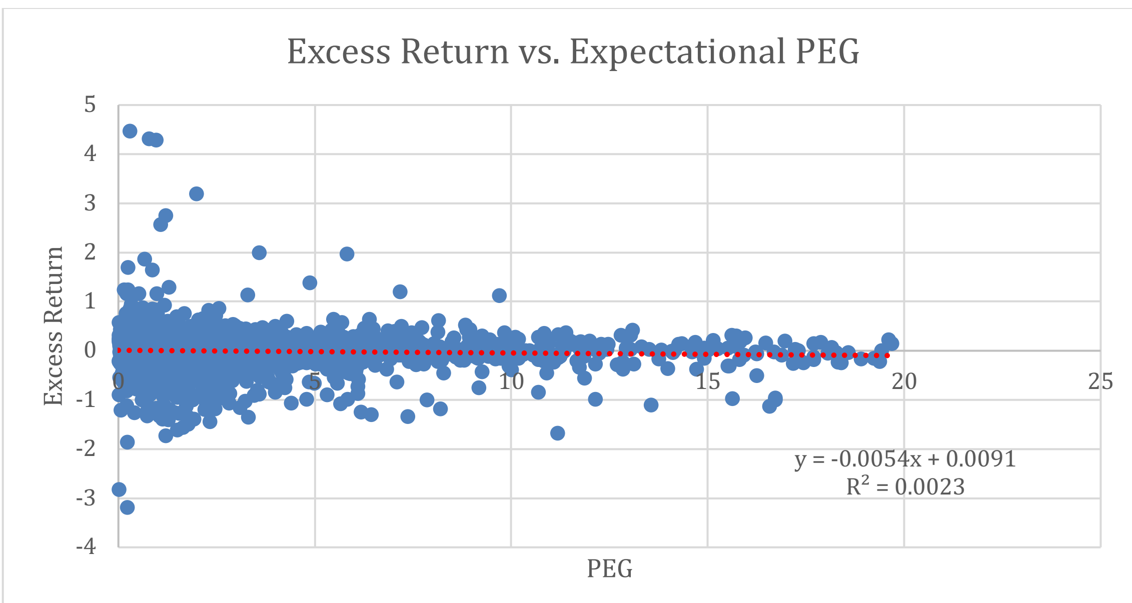


Figure 5: Correlation of Return and Expectational PEG (PEG<20)



6. Conclusion

To summarize, the results of the pooled OLS regressions confirm the hypothesis proposed in this paper. The PEG ratio continues to have a very weak forecasting value for today's market, unbiased by growth. However, the PEG effect is much weaker today than what previous researchers found, especially after removing the p-hacking tactics. The huge difference in payout ratio and required return across industries and unpreventable outliers further weaken the significance of PEG effect across industries. For future research, a potential topic to look at the PEG effect in specific industries, and see if a stronger correlation with returns can be found. While Schatzberg and Vora (2009)'s approach in adding in Farma-French risk factors enhances the statistical significance of the results, their assumption about the lagged effect of PEG ratio needs to be testified, since the lagged effect seems less significant than they suggested after a 12-month period. Future research can also look at ways of proving the lagged effect and underpinning the exact length it takes for the lagged effect to show. Moreover, both the theory and empirical results showcase that the PEG equals 1 mark seems arbitrary. The PEG ratio is more practical when used for comparison instead of an absolute mark. Overall, the PEG ratio has its reference value; however, it is far from a magical homerun ratio that can be used universally.

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