Research Report

Towards a Better Understanding: Price-to-Earnings Ratios of High-Growth Firms

THE PRICE-TO-EARNINGS (P/E) RATIO IS ONE OF THE MOST IMPORTANT METRICS FOR VALUING FIRMS. UNFORTUNATELY, INTERPRETATIONS OF HIGH-GROWTH FIRMS' P/E RATIOS CAN BE CHALLENGING, BECAUSE THEY FREQUENTLY EXHIBIT EITHER EXTREMELY HIGH OR NEGATIVE VALUES. WE SHOW THAT THE USE OF CUSTOMER METRICS ALLOWS FOR BETTER INTERPRETING THESE P/E RATIOS, THAT IMPROVEMENTS IN CUSTOMER METRICS HAVE NON-INTUITIVE AND SURPRISING EFFECTS ON THE P/E RATIO, AND THAT OUR NEW MODEL BETTER PREDICTS FUTURE P/E RATIOS THAN EXISTING MODELS.

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Introduction

Fundamental comparative analyses of firms often use the price-to-earnings ratio as a key financial metric (Damodaran, 2006). This ratio focuses on the price, also known as market capitalization or equity value of the firm and on earnings. Thus, it describes how many units of a firm's earnings represent the firm's valuation. The primary purpose of the price-to-earnings ratio is to assess firms' different growth prospects: Whereas high price-to-earnings ratios are associated with strong earnings growth, low ratios imply lower growth prospects (Penman, 1996). The price-to-earnings ratio is used in various merger and acquisition (M&A) situations, initial public offerings (IPO), restructurings, and investment decisions (Rosenbaum and Pearl, 2009). Compared to discounted cash-flow models, comparative analyses with price-

to-earnings ratios are considered more relevant than intrinsic valuation analyses in many cases, since the price-to-earnings ratio is designed to reflect "current" valuation based on prevailing market conditions and sentiment.

Especially, comparative analyses of high-growth firms, such as start-ups, are very important because investments in them usually entail substantial risks. Unfortunately, interpretations of their price-to-earnings ratios can be challenging, because they frequently exhibit either extremely high or negative values (Gupta et al., 2004). With our current research, however, we show that linking customer metrics, such as the retention rate or acquisition costs, to the price-to-earnings ratio allows for interpreting these highly positive and even negative ratios. Specifically, linking customer metrics to

the price-to-earnings ratio provides answers to three important research questions:

- How do improvements in customer metrics affect the price-to-earnings ratio?
- How do price-to-earnings ratios of high-growth firms develop over time?
- Can customer metrics help to make better predictions of future price-to-earnings ratios?

Model

Our model describes price and earnings as functions of several customer metrics: the retention rate, acquisition costs, profit per customer, number of acquired customers, and the discount rate. The ratios of the respective functions for price and earnings then reveal the price-to-earnings ratio. Decomposing the resulting function leads to four multipliers: the margin multiplier (MM), the future multiplier (FM), the acquisition multiplier (AM), and the

leverage multiplier. The margin multiplier relates a customer's long-term value to a customer's short-term value. The future multiplier describes the relative importance of the value of the future customers. The acquisition multiplier captures the size of the acquisition costs for customers, and the leverage multiplier accounts for the firm's financial structure.

Impact of Customer Metrics on Price-to-Earnings Ratio

Our decomposed form of the price-to-earnings ratio allows for analyzing how improvements in customer metrics affect the four multipliers and the price-to-earnings ratio in total.

As we detail in Table 1, our analysis reveals some surprising effects. In particular, improvements in our model metrics – that is, any changes in our model metrics that lead to higher prices of the firm – do not have homogenous effects on the

Improvement in	Effect on	MM	FM	AM	P/E
Customer Metrics	Retention rate	▲		▲	▲
	Margin			▼	▼
	Acquisition costs			▼	▼
	Number of future customers		▲	▲	▲
	Discount rate	▲	▲	▲	▲

Table 1: Impact of Customer Metrics on Price-to-Earnings Ratio

magnitude of price-to-earnings ratios. For example, improving the retention rate increases the price-to-earnings ratio, but improvements to the acquisition costs lead to its decrease. Higher price-to-earnings ratios are associated with better growth prospects, so the conventional wisdom would predict increasing price-to-earnings ratios with improvements in both metrics.

The reason for these effects is that improvements in customer metrics do not necessarily yield higher growth rates of earnings, which might seem surprising. Improvements in customer metrics can yield higher and lower growth rates, because the respective metrics influence both price and earnings. If they affect (current) earnings more strongly than price (i.e., discounted future earnings), the result is a lower growth rate for future earnings.

On the one hand, improvements in margin and acquisition costs result in lower earnings growth rates, because improvements in these metrics increase the earnings of growth firms more strongly than the price, resulting in lower price-to-earnings ratios.

On the other hand, a higher retention rate, more customers expected for the future, and a lower discount rate, increase the price of a firm more strongly than its current earnings, resulting in higher price-to-earnings ratios.

In summary, "good news" (i.e., positive developments of metrics) does not necessarily lead

to increases in price-to-earnings ratios, nor does "bad news" (i.e., negative developments of metrics) necessarily lead to falling ratios.

Development over Time
We explore in more detail the kinds of developments that price-to-earnings ratios of newly founded, high-growth firms can take over time and propose a new non-linear model to capture various possible shapes that price-to-earnings ratios can take over time. The beauty of this model is that it just uses time as the independent variable and captures the jump of price-to-earnings ratios from very negative to very positive values.

The model is able to capture the five different shapes summarized in Figure 1. Because of their characteristic looks, we describe the shapes as single and double boomerang shaped, plateau shaped, inverse double boomerang shaped, and as steady state.

The double boomerang and the inverse double boomerang shape are characterized by phases of negative price-to-earnings ratios. Currently, negative price-to-earnings ratios are labeled "N/A" by convention and considered undefined, even though they can be calculated just as easily as positive price-to-earnings ratios. However, interpreting negative price-to-earnings ratios is both feasible and insightful.

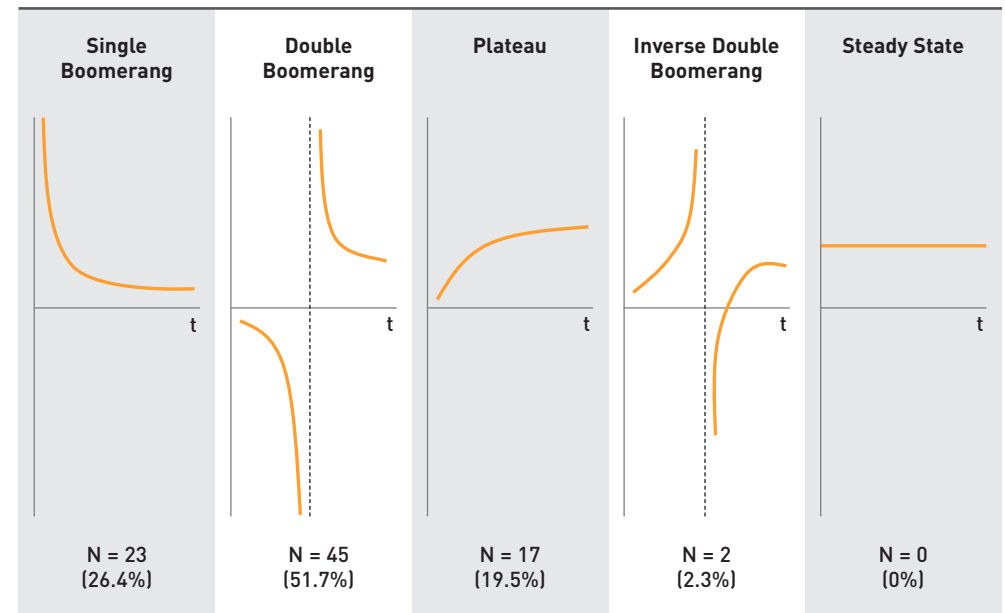For example, the double boomerang shape is characterized by a phase of negative price-to-

Figure 1: Shapes and Frequencies of Price-to-Earnings Ratios over Time

earnings ratios, followed by a phase of positive price-to-earnings ratios. Knowledge of the double boomerang shape leads to the conclusion that firms with slightly negative price-to-earnings ratios are still early in their lifecycle, compared to firms with highly negative price-to-earnings ratios. Hence, when comparing high-growth firms according to their price-to-earnings ratios, it is important to consider their respective development stages. Furthermore, the steep slope of the curve suggests that large differences in the magnitude of high-growth firm's price-to-earnings ratios do not necessarily make a statement about their dissimilarity.

Figure 1 also summarizes the results of the empirical study by displaying the distribution of the development of the price-to-earnings ratios of NASDAQ 100 firms immediately after their IPO across the five shapes. The IPO is the earliest point in time at which we can observe both firms' prices and earnings. Also, it is common for firms to go public when they are still relatively young and in their growth phase.

Almost 80% of all firms can be assigned to either the single or the double boomerang shape. Almost two-thirds of them exhibit a double boomerang shape. This result illustrates that including negative price-to-earnings ratio in the analysis is

essential. The analysis shows that firms with extremely negative and extremely positive price-to-earnings ratios are likely to be similar, more so than, for example, firms with slightly negative and very negative price-to-earnings ratios.

Predictions of Price-to-Earnings Ratios

Traditional models that predict future price-to-earnings ratios rely on historical or forecasted earnings growth rates and risk proxies as independent variables (e.g., Zarowin, 1990; Cho, 1994). Our new model just uses time as an independent variable. Thus, it does not require collecting additional data to predict future price-to-earnings ratios. Despite the use of fewer variables, our model allows for better predictions than traditional models, as Table 2 illustrates. Again, the analyses were conducted with data of the NASDAQ 100 firms.

Table 2 shows that our new model predicts future price-to-earnings ratios more precisely, i.e., with smaller forecast errors, than any tra-

ditional model. The hit rates of our new model versus traditional models are between 55% and 65%. This result means that our model beats each of the traditional models in the majority of cases.

Interestingly, the model using the historical long-term growth rate as independent variable produces the best results among the traditional models. This result is surprising, since price-to-earnings ratios reflect the market's expectations about firms' future growth prospects. Therefore, we expected models using analysts' forecasts of earnings growth rates to perform better than models using historical growth rates.

Conclusion

The price-to-earnings ratio is a key metric underlying comparative fundamental analysis. Despite the importance of any such fundamental analysis of high-growth firms, the interpretation of price-to-earnings ratios is challeng-

ing, because high-growth firms frequently exhibit either extremely high positive or negative values.

We find that changes in customer metrics have non-intuitive effects on price-to-earnings ratios of high-growth firms. The underlying rationale is that improvements in customer metrics do not necessarily yield higher growth rates of earnings because changes in customer metrics can affect earnings more strongly than firms' prices. Thus, the interpretation of price-to-earnings ratios is not as simple as it often might appear.

Furthermore, our research shows that customer metrics allow for interpreting very high and even negative price-to-earnings ratios. We find that the single and the double boomerang shape represent typical developments of high-growth firms' price-to-earnings ratios over time. Knowledge of these shapes allows for making inferences about a firm's development stage and correctly comparing high-growth firms according to their price-to-earnings ratios.

Finally, we derive a new model that beats traditional models when it comes to predicting a firm's future price-to-earnings ratios. We show that our model is more precise in predicting these future price-to-earnings ratios than any of the traditional models that use historical or forecasted earnings growth rates and risk proxies as independent variables.

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Traditional Models		Hit Rate New Model
Historical Earnings Growth	short-term (1 Year)	63.64%
	long-term (3 Years)	54.55%
Forecasted Earnings Growth	short-term (1 Year)	65.28%
	long-term (5 Years)	62.30%

Table 2: Hit Rates of New Model versus Traditional Models