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Simple Review of Extrapolation Bias

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Abstract: Extrapolation bias is a popular topic recently in economics and finance. Many researchers have become interested in this bias because it can explain many anomalies that a rational model cannot. This paper is a simple review of extrapolation bias, including its definition and bias. After reviewing past research on extrapolation, this paper selects a comprehensible definition, and three applications that can represent the recent research on extrapolation: the investor behavior model, the bubble model, and the house price model from three different top papers. After the review, it can be concluded that extrapolation bias has a wide applied range especially, in the financial market and asset pricing, and can explain many financial anomalies.

Keywords: extrapolation, behavior finance, behavior economy

1. Introduction

It is hard for researchers to assess the bias's existence and extent in expectations, and those elements are at the cores of behavior finance because they play an important role in return predictability[1]. Fortunately, the predictability of behavior bias was confirmed by Greenwood and Shleifer[2]. They used the extrapolation bias to confirm that surveying traders' expectations for stock market future prices is reliable and direct.

In other words, individuals made a forecast depending too much on recent changes[3].

Recent extrapolation bias research and application focuses on asset pricing in many financial markets. Some researchers combine it with traditional models, and some have used it to answer the question about anomalies[4,5,6–8]. Some people mix it with preference [9]. But recent research mainly focuses on the application, and less research is concerned with operating principles.

This paper aims to provide a basic and limited review of extrapolation bias in finance. This review will provide a basic understanding of extrapolation bias and its applications. Also, the author's future research will focus on the extrapolation and volatility of the aggregate stock, so this paper will provide some ideas for future research.

2. Extrapolation Bias

Fuster et al said extrapolation bias is prevalent because it can explain some anomalies that traditional models (rational models) cannot solve in macroeconomy and microeconomy[3]. This is because the traditional models are based on the assumption that individuals are rational, which is impossible in the real world. This bias can reflect individuals' behaviors and it can help to make a model more

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accurate and work better in experiments. It always happens when people forecast their asset price depending on the recent growth rate of variables.

Greenwood & Greenwood say that the definition of extrapolation bias is that extrapolators would believe that future high returns would follow the recent high return[2]. In other words, individuals made a forecast depending too much on recent changes[3].

Barberis also agrees with Fuster's opinion, he confirms that extrapolation bias is one of the useful methods in behavioral finance and it can explain many stock market anomalies, for example, excess volatility, time-series predictability, momentum, long-run reversal, value premium, and bubbles[10]. And another feature of this bias is that it can apply to many asset classes in a natural way. This feature can also explain why extrapolation can explain many anomalies in different asset classes and not just in the stock market.

However, another bias, anchoring bias, is similar to extrapolation bias. The definition of anchoring bias is that people estimate the value close to the specific value they have considered[11]. It is obvious that they all anchor at a previous point. But for extrapolation bias, the previous reference point is recent changes instead of a specific number. To tell the difference between extrapolation and anchoring bias, researchers could make sure not to mix the definitions so that researchers could identify and use the bias correctly.

3. Application

This chapter reviews three applications of extrapolation in finance. There are investors, bubbles and volatility, and house pricing. This study focuses on investors, volatility and bubbles, and its main application of extrapolation is in those fields. Moreover, house pricing could expand the research perspective[10].

3.1. Investors Behavior Model

Barberis et al combined CAPM and extrapolative theory, developing a new model (X-CAPM model)[4]. It is a rare attempt in behavioral finance, and fewer researchers combine both theories. Their model contained traditional and behavior theories. The model they developed can be used to understand how rational and extrapolative traders interact. They use the model and find that the volatility in the stock market outweighs the rational expectation. This is because the extrapolations amplify the price as their expectation is based on past returns. Moreover, good price news also allows them to expect better future prices because the excess extrapolation contributes to extrapolators' holding excess extrapolation and their expectation that this stock will push the price higher. This means the price will be over-estimated and the future return will not be relatively low. Besides this finding, they also find that rational investors would not correct the overvalued price. This is because not only would they bear the risk, but rational investors are aware that the higher price is caused by extrapolation. In the short term, the extrapolators still have a demand for the stock, so the future price of the stock may still be higher. Therefore, rational buyers would be unwilling to sell the stock they hold.

They develop their new model through various procedures. Their experiment procedure first combines formal proposition and numerical analysis, followed by an examination of the model's price and performance. Also, their data is from Greenwood and Shleifer data source, which they use to measure the expectation of returns [2]. Overall, they conclude that their model measures are correct: even if rational traders exist in the market, extrapolators can generate the basic characteristics of bubbles—long-term and substantial overvaluation for an asset. Moreover, they found that their model is consistent with the fact that, when the price is relatively higher(lower) than dividends, its return would be lower(higher) subsequently. Moreover, when good news is launched, the stock price will be

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higher when rational traders only constitute the market. This mechanism contributes to excess volatility.

After they develop the model, they change the basic model parameters to make it more cautious. The model also considers the fact that the average expectation is an extrapolation if there are any extrapolators in the economy.

They drew empirical conclusions based on careful, rigorous examinations and assumptions. It has eight propositions in this implications section, and Barberis et al discovered that the model is consistent with empirical market facts: the interaction between extrapolators and rational investors.

Finally, they used the regression method and post-World War II American stock market data to test the mode's ability to predict the future. It can be found that it was consistent with the last chapter's conclusion.

Overall, the model has successfully captured many facts about value and return features, as well as a survey of the evidence. These results suggest that the model could fit better in the real market to some degree, compared with the traditional model.

3.2. Bubbles Model

Application two is an extension of application one's research. Because extrapolators always overestimate the price and cause many abnormal phenomena, particularly bubbles, which are exacerbated by volatility.

Barberis et al investigated bubbles by extrapolation [12]. Based on extrapolation bias, they developed a new bubble model to address which types of news would generate the largest bubbles, whether bubbles would still exist if good news ended, and the relationship between bubbles and high trading volume. In their model, the extrapolators would put weight on the "growth signal" and the 'value signal' representing 'greed' and 'fear' signal respectively. Those two weightings are in conflict: 'greed' encourages investors to buy, and 'fear' makes them sell when the price increases sharply and an asset is overvalued. Moreover, their model also reflects how extrapolators balance their conflict of signals: the assumption of extrapolators slightly switches the relative weight of two signals—this is called "wavering." After analyzing the data and basing it on the assumptions they made, they realized that extrapolators would exist in the three stages of bubbles: beginning, peak, and burst. In the beginning, extrapolators buy more assets from rational traders and push asset prices higher. Then, in the second stage, because of the overvalued asset, rational traders exit the market. When the good news vanished, extrapolators were not as enthusiastic as before. Because there were fewer traders and less enthusiasm, the bobbles collapsed. Then, in the last stage, the rational traders would buy the stock from the extrapolators. Moreover, they also find that the small degree of wavering generates intense trading volume in the bubble period, compared with how it generates normal volume in general conditions. Their research has clearly explained the creation and bursting of bubbles.

The research process is that they considered the related elements of bubbles—the model of bubbles, asset prices in bubbles, and trading volume of bubbles. They also consider one special bubbles, negative bubbles, and empirical examine: comparing with other bubbles models, and stock evidence from many big bubble periods.

In the second part 'model of bubbles', they have developed a new model containing risk-free and risky assets; extrapolators, and rational traders; how the conflict signals interact with each other. And, the proposition here is that market cleaning is already in place. The third part, asset price in bubbles, illustrates the beginning, peak, and collapse of bubbles, and the shift of 'wavering' with the formulas. The fourth part trading volume illustrates one of the characteristics of bubbles, with proposition 3 depending on the previous chapter: extrapolators and their wavering. The following section, with a formula, discusses the special situation of a bubble, a negative bubble after the peak collapse.

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To make sure their model works better than the previous one, the authors used an observational study to compare the previous two bubble models and to present empirical evidence containing the use of their model characteristics.

Their model can totally successfully illustrate bubbles, but it still has some drawbacks. For example, they do not solve the fundamental psychological problems of extrapolators.

3.3. House Price Model

Glaeser and Nathanson conduct research on house prices using an extrapolative model, building on the work of X-CAPM and other relative extrapolation studies[5]. Based on the previous research and empirical evidence, they find the traditional house price model does not contain three important elements: momentum in one year period, mean reversion in a five-year period, and excess longer-term volatility of fundamentals. Therefore, they developed a new house price model that contains those three elements.

In the housing market, it is reasonable for buyers to review the past price to forecast the price. It is the demand for the houses that determines the price. Because of the relationship between price and demand, buyers can analyze the price to measure the demand for a house. But this analysis has some problems. It is hard to do this because it depends on an unintuitive formula to link past prices to future demand. However, those buyers are regarded as extrapolators or naive traders. Because when traders find that the past price has had an increasing trend of around 5% per year, they would believe that this trend represents the potential growth rate of fundamentals. In this situation, they do not regard the actual demand and the change in belief about the fundamentals. Therefore, it may bring a positive shock that brings momentum to the price and pushes the price higher. In a boom, they overvalue the demand, and in a bust, they underestimate the demand.

When they use the model to analyze the situation, they find that reasonable parameters can improve the model's ability to predict momentum, mean regression, and volatility. But there are some interesting facts that when buyers approach the truth about demand and are aware the news is extremely good or bad, the characteristics of bubbles will disappear.

How do they do the research? They put the extrapolators inferences into a house price model. When traders observe their own demand, they observe it not directly from market demand but rather from the market price. Their experiment can be divided into three parts: a determination model of house price, autocorrelation naïve house price changes, and the dynamics of price changes. They use data from metropolitan area income and rents, and many parameters are drawn from previous research.

The first part discusses the fundamentals of house prices, homebuyer information, demand inference, and price change forecasts. These elements are the basic content of housing prices.

The second part contains the time series properties and the autoregressive structure of the extrapolator prices. Those elements quantify the extrapolators characteristics.

The last experimental part demonstrates how to choose parameters, simulation methodology, price autocorrelations, belief dynamics, expected price change volatility, predictions of parameters, and forecast accuracy. In this section, researchers analyze data using regression, cumulative autocorrelations, and any other method available. Those elements help correct the model. The parameter has been divided into two parts. One is from demand for housing in the city, and the other is from individual housing transactions.

Overall, the model accurately measured the three key components of the house price.

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4. Conclusion

The research topic of this paper is a simple review of recent developments in extrapolation bias although this topic has been less thoroughly researched in more related papers. It has reviewed the definition of extrapolation bias and its three applications. Moreover, the author has found that the recent research on extrapolation has connections to the traditionally rational model, and applies to asset prices in many different markets not only the stock market. But there is less research talking about how the mechanism of extrapolation works in depth. Therefore, future research may focus on the mechanism of extrapolation and some of its related and derived topics

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