How Reference Points Determine the Prospect Theory Value of a Stock

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Abstract

Can the Prospect Theory Value of a Stock model be enhanced by incorporating reference point adjustment over time? Using an experiment, this paper generates an equation for the likely reference point for each month in the five year period required by the model based on key points from the share price path. The purchase and final price seen are found to be key determinants of the reference point. Market data testing is then undertaken to establish the predictive power of the result. Specifically, the Prospect Theory Value of a Stock Model (TK) variable is adjusted for the reference point, based on a combination of determinants established in the experiment. The adjusted TK measure outperforms the unadjusted version in cross-sectional US equity return analysis and performance analysis of decile sorted portfolios.

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Extended Abstract

In this paper, we undertake an experiment that collects reference points from participants on a month-by-month basis, which allows us to measure the amount of adaptation in participant reference points from one month to the next. We undertake regression analysis to establish the determinants of the reference point under this framework and then investigate how reference points generated from the experiment perform in the Prospect Theory Value of a Stock model developed by Barberis et al. (2016). We show that adjusting the TK variable in the model using these reference points improves its predictive power.

Our aim in the experiment is to measure the monthly reference points of an investor, over a 5-year investment horizon, as required for the Prospect Theory Value of a Stock model. This means that we measure the amount of movement in the reference point from one month to the next. Some prior research has been conducted that measures reference points over multiple periods of an investment. Heyman et al. (2004) is not a direct study of reference points but of satisfaction levels of participants. Nevertheless, this study does measure satisfaction levels at each stage of an investment, and they find a strong role for salient maximums and minimums. Arkes et al. (2008) and Arkes et al. (2010) look at reference points over 3 stages (time periods) and find partial adaptation between the reference points at each stage, with adaptation greater in gains than in losses. Gneezy (2005) measures the propensity to sell across a 10 stage (time period) investment and finds support for both the purchase and maximum prices acting as reference points.

A number of issues remain unsolved, from prior literature, which we aim to address in this paper. None of the multi-period studies above directly measure reference points except Arkes et al. (2008) and Arkes et al. (2010), but these papers only feature 3 investment periods. In our experiment, we will adopt the direct elicitation method used in Baucells et al. (2011), and apply this in a multi-stage way to capture reference points across 60 months.
Prior research on the role of reference points in investor preferences has focussed on the sell decision, the most notable development being the disposition effect outlined in Shefrin and Statman (1985). There has been some work, however, that could also be applied to investor preferences in general. A stream of the literature looks at the relationship between reference points and volume (trading) in the market. The first of these, Ferris et al. (1988), is motivated as a test of selling behaviour. The authors detect abnormal trading volume which is higher for winning stocks and lower for losing stocks, in line with that predicted by the disposition effect. A later paper from Huddart et al. (2009) measures abnormally high trading volume when stocks make a new 52-week high or low. The implication is that the 52-week high and low are key reference points for investors and the authors suggest that much of the abnormal volume is driven by the buying behaviour of small investors, as a stock making a new high attracts buyer attention and subsequent trading activity (Barber and Odean, 2008). This is in line with Duxbury and Yao (2017) who show that investors exhibit momentum behaviour when buying stocks and hence stocks making new highs are attractive to them.

Looking more broadly at investor preference, there is some coverage in the literature regarding how stock characteristics themselves (not specifically the reference point) might influence the decisions of an investor. Ang et al. (2006) show that stocks with high idiosyncratic volatility in the US market, within the context of the CAPM model, have low subsequent returns and vice versa. A later paper from them (Ang et al., 2009), extends the analysis to all major developed markets and finds a similar effect. Mispricing is also found in the case of stocks that have lottery type characteristics. Kumar (2009) finds that investors have a preference for lottery-type stocks, with skewed returns, that offer a small probability of extremely high returns. The increased demand for these types of stocks causes them to be overpriced, which leads to subsequent underperformance in the future. The effect is even stronger in non-market traded, over-the-counter stocks, which tends to have extremely high positive skew combined with negative future returns (Eraker and Ready, 2015).
The prior literature does not mention the role of reference points in the formation of investor preference in any detail. The lack of attention on the role of reference points is surprising, as the majority of anomalies discovered in markets (for a review see Subrahmanyam (2010)), could plausibly be explained by the preferences of investors. Equally, when reference points are addressed more specifically, in the case of selling behaviour, it has been usual to assume a static reference point, which is fixed on the purchase price. The purchase price is used as the reference point in Shefrin and Statman (1985)’s work, but is then largely continued through the literature, even when multi-period investments are considered.

The model of Barberis et al. (2016) acts as a link between the work on investor preference for volatility/skewness and reference points. In their model, investors evaluate monthly returns in relation to a reference point and then evaluate subsequent gains or losses using Prospect Theory rules. High volatility in the form of past gains are favoured by investors but high volatility caused by large losses are undesirable due to investor loss aversion.

Prior studies also do not consider the role of lagged reference points within the context of a multi-period investment, which is a possible extension of the Barberis et al. (2016) model. If investors form a reference point on a month-by-month basis then they may use the previous reference point as an anchor for next month. Köszegi and Rabin (2006) construct a model where the reference point is a function of lagged probabilistic beliefs about prior outcomes and then apply the model to consumer and worker decisions. We aim to investigate if lagged reference points play a role in the determination of future reference points.

In total, 25 price charts are used in our experiment to ensure adequate variation in chart characteristics, although individual participants only see 1 price chart, and are asked to provide 60 reference points across a single chart. Our results show that the purchase and the final price seen are key salient prices which determine the reference point. There is also a role for the maximum, although this is smaller than that discovered in other studies such as Riley et al. (2017). We argue that the final price
plays a greater role in reference point formation when participants are asked for the reference point on a monthly basis, as their attention is shifted to the recent movement in the chart and they use the last reference point provided as an anchor. Therefore, the strength of the maximum as a reference point may depend on how frequently the investor updates their reference point.

To examine the use of prior reference points as anchors, we consider the impact of lagged reference points on the determination of the current month’s reference point and show that a 1-month lagged reference point is a powerful predictor. The 2-month lag is also significant, but it does not add greatly to the explanatory power of the models. Our results demonstrate the importance of the lagged reference point, as suggested by the model of Kőszegi and Rabin (2006).

In the market data testing section, we describe the Prospect Theory Value of a Stock model and show how the static reference point assumption can be changed to develop alternative Prospect Theory values for stocks. In the model, potential investors assess the desirability of a stock based on its past 5-year history, as a set of 60 separate months. Each month has its own reference point, which is taken to be the return of the benchmark over the month in the conventional calculation. The Prospect Theory value of each of the 60 months is then summed together to form the overall Prospect Theory value of the stock (TK).

We create 5 new versions of the Barberis et al. (2016) variable, using the purchase, maximum, minimum, 52-week maximum and 52-week minimum as reference points, as well as two composite variables that are formed from a combination of the above points. The weights for the composite variables are taken from the coefficients from regressions in the experiment, which was designed to measure sequential reference point formation.

Then we perform regression analysis using the original TK variable and alternative TK variables and show that the alternative variables, based on composite reference points
(TK_Com1 & TK_Com2), retain significance at the 5% level, even when the original TK variable is added into the regression. The explanatory power of the original TK variable is removed, however, and it becomes insignificant. The result suggests that the investor’s reference point is formed from salient points in the prior price path.

In the remainder of the paper, we test different mechanisms by which the reference point may be formed and thereby look to improve the predictive power of the Barberis et al. (2016) model still further. Firstly, we look at the case of an investor who forms only a single reference point at the end of the chart (as in Riley et al. (2017)) and then applies this reference point across months (we do this purely for comparative purposes as Barberis et al. (2016) suggests investors form a new reference point every month). The change in the reference point, from the initial purchase price, is adjusted in either a linear fashion or exponential fashion across the months. We find that the linear adjustment model works best, although it is no more predictive than the TK_Com1 and TK_Com2 variables discussed earlier. Secondly, we look at the case of an investor who uses the lagged reference point to form the reference point in the current month. In the experimental data, we discovered that last month’s reference point is a strong predictor of the current month reference point and this insight is confirmed in our subsequent regression analysis. We find that versions of the Barberis et al. (2016) model that incorporate lagged reference points are predictive of future returns, although no more so than the TK composite variables.

In summary, our results show that reference points do change after the stock is purchased and affect the investor preferences of investors, and we show for the first time how these reference points are determined by salient points in the prior price path within a multi-period setting. Subsequently, our adjusted TK variables have greater explanatory power in predicting future returns than the conventional TK variable.
References


