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The MAX effect: An exploration of risk and mispricing explanations ☆

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ABSTRACT

This paper studies the role that risk and mispricing play in the negative relation between extreme positive returns and future returns. We document a strong 'MAX effect' in Australian equities over 1991–2013 that is robust to risk adjustment, controlling for other influential stock characteristics and, importantly, manifests in a partition of the 500 largest stocks. While there is no evidence that MAX proxies for sensitivity to risk, the findings are highly consistent with a mispricing explanation. Adapting the recent methodological innovation of Stambaugh et al. (2015) to classify stocks by their degree of mispricing, we show that the MAX effect concentrates amongst the most-overpriced stocks but actually reverses amongst the most-underpriced stocks. Consistent with arbitrage asymmetry, the magnitude of the MAX effect amongst overpriced stocks exceeds that amongst underpriced stocks, leading to the overall negative relation that has been well documented.

1. Introduction

A recent study by Bali et al. (2011) suggests that extreme positive returns play a role in the cross-sectional pricing of US stocks. Measuring a stock's extreme return as the maximum daily return over the prior month (denoted MAX), Bali et al. (2011) document a pronounced negative relation between month t MAX and month $t+1$ stock returns. The MAX effect is statistically and economically significant, with a hedge portfolio taking long (short) positions in low (high) MAX stocks generating raw and risk-adjusted returns in excess of 1% per month. These findings are robust to controls for a number of other characteristics known to influence cross-sectional returns (e.g., size, book-to-market, medium-horizon momentum, short-term reversals, illiquidity and skewness). Bali et al. (2011) also document that the controversial negative relation between idiosyncratic volatility and stock returns first documented by Ang et al. (2006) is reversed after controlling for the MAX effect.

The reason why MAX predicts lower future returns is not well understood. Bali et al. (2011) note that their findings are consistent with investors having a preference for stocks with lottery-like features, whereby there is a small probability of an extreme positive payoff. Such preferences are readily observable in gambling markets, even when expected returns are low or negative. Further, there is evidence that gambling and lottery-like stocks attract very similar clienteles (Kumar, 2009). To the extent that investors believe that an extreme positive return in the recent past is likely to be repeated, low returns to high MAX stocks may reflect these lottery preferences.

Naturally, lottery characteristics are closely related to higher moments of the return distribution. A number of theoretical models motivate a preference for skewness in asset returns, with the resulting implication that various measures of skewness may be priced (e.g., co-skewness, total skewness, idiosyncratic skewness).[1] For example, the model of Mitton and Vorkink (2007) includes both traditional mean–variance optimisers and 'lotto investors' with a preference for skewness. In equilibrium, skewness-seeking investors hold underdiversified portfolios, total skewness is priced, and stocks with high idiosyncratic skewness generate negative alphas.

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[1] See Arditti (1967, 1971); Kraus and Litzenberger (1976); Simkowitz and Beedles (1978); Conine and Tamarkin (1981); Kane (1982); Harvey and Siddique (2000); Brunnermeier and Parker (2005); and Brunnermeier et al. (2007).

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Alternatively, assuming that investors have cumulative prospect theory utility functions as in Tversky and Kahneman (1992), Barberis and Huang (2008) show that low-probability extreme events are overweighted. When asset returns depart from normality, skewed securities are overpriced and generate negative excess returns, while idiosyncratic skewness is priced. To the extent that extreme positive returns are related to skewness, this may explain the observed MAX effect.

Following Bali et al. (2011), a number of studies have explored the MAX effect in settings outside the US. Using a series of multivariate regressions, Walkshäusl (2014) finds pervasive evidence of a negative relation between MAX and future returns for 11 European Monetary Union countries. Annaert et al. (2013) examine a pooled sample of nearly 8000 companies drawn from 13 European countries. Their univariate portfolio sorts detect little evidence of a MAX effect. However, after controlling for potential confounding influences using bivariate portfolio sorts and cross-sectional regressions, Annaert et al. (2013) verify the existence of a MAX effect. Curiously, Chee (2012) also finds no MAX effect using univariate portfolio sorts for the Japanese market, yet a distinct effect after controlling for firm characteristics with bivariate sorts.

Exploring an emerging stock market, Nartea et al. (2014) provide mixed out-of-sample evidence for South Korea. A MAX effect only manifests in equal-weighted portfolios, suggesting a small-firm premium may be present. Another notable feature of the South Korean evidence is that the negative relation between idiosyncratic volatility and future returns appears robust to controlling for MAX. More broadly, Cheon and Lee (2014) study 44 countries grouped into geographical regions and show that the core findings of Bali et al. (2011) generalise to many global markets. High MAX stocks generally underperform low MAX stocks, and the idiosyncratic volatility puzzle often vanishes after controlling for MAX.

Recent literature is also beginning to investigate how MAX interacts with other determinants of US cross-sectional returns. Chen and Petkova (2012) document that stocks with high MAX tend to have high R&D expenditure, which suggests that MAX may signal an abundance of growth options and investment opportunities. Consistent with the intuition of behavioural explanations of the MAX effect, Han and Kumar (2013) document that stocks with lottery-like features are heavily traded by speculative retail investors with strong gambling propensity. Motivated by Kumar (2009), Baker and Wurgler (2006), and Fong and Toh (2014) show that investor sentiment and institutional ownership influence the strength of the MAX effect. The MAX effect only exists following states of high sentiment and is strongest amongst (although not entirely restricted to) stocks with low institutional ownership.

Frazzini and Pedersen (2014) document large abnormal returns from a 'betting against beta' strategy that takes long (short) positions in low (high) beta stocks. Bali et al. (2015), however, show that these returns do not survive after controlling for MAX. Of relevance to the current paper, the abnormal returns from the betting against beta strategy are completely captured by the Fama and French (1993) and Carhart (1997) four-factor model augmented with a factor capturing lottery demand.

The current paper makes a number of contributions to this emerging literature. As a starting point, we study the existence of a MAX effect in Australian equities over the period 1991–2013. The findings are unambiguous. Using a variety of methodological approaches, the negative relation between recent extreme returns and future returns is statistically and economically significant. A hedge portfolio that takes long positions in low MAX stocks and short positions in high MAX stocks generates significant returns, irrespective of whether stocks are equal or value weighted into portfolios. These returns survive risk adjustment using an assortment of risk models and, most importantly, also manifest in a subsample comprising the 500 largest stocks. Further, using double-sorted portfolios and Fama and MacBeth (1973) regressions, the MAX effect is robust to controlling for other stock characteristics known to influence cross-sectional returns.

The second contribution of the paper relates to the idiosyncratic volatility (IV) puzzle first documented by Ang et al. (2006). While MAX and IV are highly correlated, prior work documents that the MAX effect is not a simple manifestation of the IV effect. In fact, the direction of the IV effect reverses after controlling for recent extreme positive returns (Bali et al., 2011; Annaert et al., 2013). To date, there is little Australian evidence regarding the existence of an IV puzzle. As such, before exploring the interaction between MAX and IV, we undertake a thorough investigation of the IV-return relation. For value-weighted portfolio returns, univariate sorts suggest a negative IV-return relation. When we control for MAX, however, there is little remaining evidence of an IV puzzle. In contrast, the MAX effect is strongly robust to controlling for IV.

Given the strong evidence supporting the existence of a MAX effect, our third and most important contribution is to formally study whether it is attributable to risk or mispricing. We document a high degree of persistence across time in the MAX portfolios to which stocks are assigned. This lends credence to the notion that investors may utilise MAX as a signal of lottery-like characteristics. Consistent with lottery-seeking investors being cognisant of this persistence, the implications of a recent extreme positive return for future returns diminish slowly with the passage of time. However, while these findings are necessary for a risk-based explanation, there is little further evidence that MAX proxies for sensitivity to a priced risk factor. Using portfolio sorts and cross-sectional regressions, future returns are unrelated to stock-level sensitivities to a factor-mimicking portfolio constructed around MAX. Further, the lack of commonality in co-movement between returns to US and Australian MAX spread strategies suggests that these phenomenon are not explained by an underlying economic source of risk.

In the absence of an economic risk explanation, many studies of empirical regularities default to a mispricing conclusion. In this paper, we formally test whether the MAX effect is attributable to mispricing. Our approach draws on a recent methodological innovation by Stambaugh et al. (2015) who propose a proxy for mispricing that allows stocks to be classified according to their likely degree of under/over pricing. In the spirit of Stambaugh et al. (2015), we construct a mispricing index based on seven anomalies that are well-documented in the Australian equity market. The testing for mispricing involves an examination of portfolios double sorted on MAX and the mispricing index. Noting that idiosyncratic volatility is a common proxy for the level of arbitrage risk, the strong positive correlation between MAX and idiosyncratic volatility implies that the MAX effect (i.e., negative relation between MAX and future returns) is likely to concentrate in the overpriced partition. Conversely, amongst the underpriced partition, a reverse MAX effect (i.e., a *positive* relation between MAX and future returns) is predicted. The empirical findings are strikingly consistent with these predictions. Further, the magnitude of mispricing amongst overpriced stocks far exceeds that for underpriced stocks, consistent with Stambaugh et al. (2015) notion of 'arbitrage asymmetry'. Taken together, our empirical findings provide new insight into the cause of the MAX effect, with strong evidence that it results from mispricing rather than underlying economic risk.

The remainder of the paper is structured as follows. Section 2 discusses the sources of data utilised in the paper and describes the construction of key variables. Section 3.1 commences the empirical analysis by documenting the existence of the MAX effect in raw and risk-adjusted returns and examining whether it survives after controlling for numerous other characteristics known to be associated with cross-sectional returns. The robustness of these findings is subjected to sensitivity analysis in Section 3.2. Section 4 conducts a preliminary investigation into the existence