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RESEARCH ARTICLE

The market risk premium in Australia: Forward-looking evidence from the options market

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Abstract

This paper analyses forward-looking estimates of the expected market return in Australian. By utilising option prices, we compute a lower bound for the capital gain and dividend components of the expected return. Over a 17-year period, the average 1-month expected return lower bound is found to be 8.6% per annum, compared with an average realised return of 10.9% per annum. Our option-based estimates demonstrate significant predictive power beyond historical averages and enable direct measurement of the expected return term structure. This approach complements traditional measures of expected returns and offers valuable insights for practitioners, academics, and policymakers in Australia.

KEYWORDS

equity risk premium, lower bound, return predictability

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1 | INTRODUCTION

The market risk premium (MRP), defined as the expected return on the market in excess of the risk-free rate, is a critical input in a variety of financial applications. These include cost of capital estimates, asset valuation and portfolio construction. Throughout the years, numerous approaches have been proposed for estimating this important market variable. The current standard is the historical (static) approach which uses the average of past returns as a proxy for future expectations (Brailsford et al., 2008, 2012). This is underpinned by the assumption that positive and negative surprises in asset returns offset each other, rendering the realised return an unbiased estimator of the expected return. This assumption is, however, questionable and the method is not without its drawbacks. Historical returns are inherently retrospective (Elton, 1999; Merton, 1980) and the impact of survivorship bias can influence the magnitude of the expected premium (Jorion & Goetzmann, 1999).

Recent improvements in modelling approaches and the techniques oriented towards future expectations have resulted in more accurate and timely estimates of the equity risk premium. One such forward-looking approach is the implied cost of capital method (ICC) which is based on a theoretically derived valuation model that considers future growth opportunities (Lee et al., 2009; Li et al., 2013; Pástor et al., 2008). This has been applied in the Australian context by Paton et al. (2020). These estimates are, however, dependent on model choice and the quality of forecast data. Consequently, there is a genuine case for the introduction of forward-looking measures of the risk premium with minimal modelling assumptions. In this paper, we rely on recent advances in asset pricing theory (Chabi-Yo & Loudis, 2020; Martin, 2017) to determine the expected excess market return in Australia. The approach requires minimal assumptions and makes use of real-time data, resulting in timely and accurate predictions when judged against standards typically adopted in the return predictability literature (Welch & Goyal, 2008).

The implied risk premium approach is informed by the work of Martin (2017), which demonstrates that a lower bound to the equity premium can be computed from risk neutral moments derived from the return distribution of the market portfolio.[1] These moments can be computed from option prices, employing spanning relations outlined in Carr and Madan (2001), providing for a forward-looking estimate of the risk premium. To date, however, this research has not adequately considered the impact of the dividend yield on expected returns. Index option series, which are relied upon to provide these forward-looking estimates, do not account for the impact of dividend contributions. Previous studies have assumed that dividend income is known in advance, excluding this term from consideration.[2] In this study, we explicitly include dividends given their importance to the Australian market.

Under a traditional tax regime, as observed in the United States, firms may exhibit less preference for dividend distributions (Fama & French, 2001). Combined with the generally stable nature of dividends and their relatively small contribution to the overall risk premium, the dividend assumption utilised in Martin (2017) may be considered reasonable for the determination of an appropriate lower bound.[3] In Australia, however, the imputation tax system offers equity investors three sources of return: dividends, capital gains and franking (tax) credits (Gray & Hall, 2006). Imputation provides a clear preference for tax-based dividend clienteles (Henry, 2011), where the company decision to pay dividends is less dependent on profitability (Balachandran et al., 2019), leading to higher and more volatile dividends (Pattenden & Twite, 2008). Bregmann (2016) shows that the dividend payout ratio for Australian firms is approximately 67% between 2005 and 2015, which is significantly higher than for Europe (55%) and the US (48%). Moreover, while Lintner (1956) concludes that dividend payments are sticky, a view that is supported in subsequent literature, it is not entirely clear that dividends will continue to demonstrate this trait (DeAngelo et al., 2004). In this context, Guttman et al. (2010) demonstrate that firms that modify their dividend

[1]This approach is related to a growing literature which provides bounds on the risk premium including Schneider and Trojani (2019), Chabi-Yo and Loudis (2020), Kadan and Tang (2020), Foley, Li, et al. (2022) and Tetlock (2023).

[2]Martin (2017) additionally notes that if dividends are not known ahead of time then their variance would need to be accounted for. However, if dividends and prices are weakly positively correlated, then the variance of the price return is lower than the variance of the total return meaning that the lower bound, excluding dividends, still holds, and is in fact conservative.

[3]As a point of comparison, in 2023 the dividend yield on the S&P500 was 1.5%, and 4.1% on the S&P/ASX200.

payouts in a given year have only a 16% probability of maintaining a constant dividend in the subsequent year.

Given the importance of dividends to the Australian MRP, we employ the method developed by Aspris et al. (2024) to compute a lower bound to the future dividend yield from observed option prices. This approach draws heavily on the literature related to dividend strips (van Binsbergen et al., 2012) to extract an estimate of the future expected dividend yield, while the bound is established via general equilibrium asset pricing theory. We empirically examine these bounds using an Australian market setting and verify that our estimates form a valid lower bound to future dividend yields.

By combining the capital gain component, which we compute using the approaches of Martin (2017) and Chabi-Yo and Loudis (2020), with our estimated dividend component, we develop a forward-looking lower bound of the Australian market risk premium which can be computed in real time. Since the inferred dividend value derives from price movements on ex-dividend dates, our estimated value includes both the nominal dividend and all associated franking credits (the grossed-up dividend). Consequently, our estimate includes all three potential sources of returns identified by Gray and Hall (2006). Our average estimate of the total MRP (inclusive of franking credits) is between 8.34% and 8.64%, based on the methods of Martin (2017) and Chabi-Yo and Loudis (2020), respectively. This is above long-term historical estimates (excluding franking credits) of 6%–7% (Brailsford et al., 2008, 2012) and 6.1%–7.3% (Paton et al., 2020), but below the average annual realised return of 11% (5.1% capital gains, 4.6% dividend yield and 1.3% franking credits) earned over the corresponding forecast period.[4]

We find that the bounds (capital gains) obtained from option prices are relatively volatile, positively skewed and exhibit heavy tails. Specifically, the conditional expected excess market return implied by our lower bound measure is 3.3% p.a., with 3.0% volatility over the sample period to May 2020.[5] The MRP estimates display significant temporal variation which amplifies notably during periods of market turmoil, reaching in excess of 30% p.a. during the global financial crisis (GFC) and Covid-19 pandemic. Predictive regressions suggest that we cannot reject that the lower bound is approximately equal to the realised return on average (the bounds are tight) but standard errors of this test are large. Turning to the dividend component, we observe an average lower bound for the dividend yield of 5.3% p.a. with a standard deviation of 4.0%. At the one-year horizon, the dividend yield represents, on average, 61% of the total MRP in Australia. Interestingly, this proportion can soar to as much as 88% during periods of low market volatility. Similar to capital gains, forward-looking dividend yield lower bounds are positively skewed and leptokurtic. Predictive regressions indicate that the derived bounds for dividend yields are not tight and hence, unlike the capital gain estimates, represent a true lower bound to the future dividend yield. Notwithstanding, we find very large out-of-sample R^2 for our dividend yield lower bounds (49% at the 30-day horizon), suggesting that it provides significant forecasting ability over historical averages.[6]

We find that our option-implied MRP lower bounds are close to the average realised equity premium over the sample period. Importantly, this holds (bound is approximately tight)

[4]Gray and Hall (2006, 2008), Truong and Partington (2008) and Lally (2008) focus on the relevance of accounting for franking (tax) credits when measuring equity returns in a dividend imputation tax system. Following several different methods, the authors derive a relationship between the value of franking credits and the market risk premium. Gray and Hall (2006) conclude that since franking credits have value, they should be factored into the estimation of the market risk premium in Australia.

[5]Using the method of Chabi-Yo and Loudis (2020), the time-series average (median) of the lower bound is lower at the annual horizon than it is at the monthly horizon where the data quality is best. The market for one-year options is less liquid with relatively fewer strikes traded.

[6]While our option-implied dividend yields are systematically lower than future realised dividend yields, they exhibit stronger covariance with future dividend yields than historical estimates, leading to improved predictive power.

during both normal and turbulent periods which provides market participants with a reasonable way of gauging the appropriate level of compensation for bearing market risk in a fast-moving market. We confirm the usefulness of our forecast through out-of-sample R^2 testing at various horizons. These values range from 0.9% to 2.9% (2.5%–8.75% excluding the GFC and the Covid-19 period) over the short term, with marginally weaker predictability observed at longer horizons. In relative terms, these out-of-sample values compare favourably to predictions in the literature, underscoring their potential utility in enhancing market timing trading strategies (Goyal et al., 2023; Welch & Goyal, 2008).

This paper makes several contributions to the academic literature. First, we employ a new method, developed in Aspris et al. (2024), to estimate expected dividend yields in a simple and economically intuitive framework. We compute a lower bound to the expected future dividend under the physical (real-world) probabilities, and therefore a lower bound on the dividend yield. The key advantage of this approach, over using realised dividend yields, is that these bounds are forward-looking. They represent the expected future dividends to be received over the life of the option from which they are derived. Interestingly, we find that our estimates are lower bounds but are not tight and therefore not approximately equal to future realised dividend yields. This finding suggests that investors demand a significant premium for bearing the uncertainty associated with dividend outcomes. Taking the lower bound derived from the capital and dividend component, we determine the expected stock return (capital and dividend) in a consistent and forward-looking manner. Second, we add to the growing literature on the time-varying term structure of expected returns (Bansal et al., 2021; Chabi-Yo & Loudis, 2020; Gormsen, 2021; Martin, 2017). We specifically examine the term structure of the capital gains and dividend components of the expected stock return and analyse changes during crisis periods. We find the term structure of expected returns in Australia to be upward sloping when markets are stable, but downward sloping during crisis periods. The term structure associated with the expected dividend yield is generally flatter during stable periods. Our results are consistent with a mean-reverting component in the structures of the risk premia, in line with Chabi-Yo and Loudis (2020) and Bansal et al. (2021). These results are also consistent with the theoretical model of Hasler and Marfè (2016), which shows that a downward-sloping term structure is obtained when investors anticipate a quick recovery following a disaster. Our findings collectively help to inform optimal asset allocations and portfolio performance of investors over their planning horizons.

Our final contribution is to the literature studying various approaches, techniques and models for estimating the MRP in Australia. Gray and Hall (2006) identify three potential sources of return for equity investors in a dividend imputation tax system. Focusing on capital gains and dividends, Brailsford et al. (2008) examine the All Ordinaries Index returns from 1958 to 2005 and conclude that, relative to bonds (bills), the MRP averaged 6.3% (6.5%) p.a. In a follow-up article, Brailsford et al. (2012) extend the analysis until 2010 to quantify the impact of the GFC. This extension underscores the drawbacks of using realised returns to estimate forward-looking and time-varying risk premia. The importance of valuing the third source of return (franking credits), typically overlooked in the estimation of the MRP, is highlighted by Gray and Hall (2006, 2008), Truong and Partington (2008) and Lally (2008). While there is little consensus on how this should be done in practice, the literature agrees that franking credits should be incorporated and that their presence increases the total return. We address this gap in the literature by providing a novel approach to integrate and simultaneously estimate all three sources of the risk premium from market data. Since price movements in the underlying correspond to the grossed-up dividend value, our forward-looking dividend yields include the imputation credit and thus avoid any assumptions about their underlying value to investors (Brailsford et al., 2008; Gray & Hall, 2006).

The remainder of the paper is organised as follows: Section 2 summarises the alternative techniques of estimating the MRP; Section 3 describes the theory for extracting the conditional equity premium with a focus on capital gains and dividends; Section 4 explains the empirical analysis and presents the results; and Section 5 concludes.

2 | ALTERNATIVE MRP ESTIMATION METHODS

The use of historical average excess market returns as a proxy for the Australian ex-ante MRP is a common practice for investors, as well as government regulators.[7] There are, however, several limitations to this approach that undermine its usefulness. First, international comparisons of the largest economies, including Australia and the US, show that excess returns in these countries are anomalies compared to most other markets (Jorion & Goetzmann, 1999). Second, high long-term historical stock returns are not necessarily indicative of high future stock returns (Fama & French, 2002; Welch, 2000). This view has been supported by Avdis and Wachter (2017), who argue that the generous risk compensation received since the postwar period may be due to unusually positive shocks to returns and thus not a reliable guide to what investors experience going forward.

While the academic literature generally supports the view that historical market performance exceeds the expected MRP, identifying any structural shifts driving the permanent change in the expected return is difficult (Constantinides, 2002). Several proposals have been put forward, including lower risk aversion (Welch, 2000), wider equity market participation, and lower costs of obtaining diversified equity portfolios (Heaton & Lucas, 1999; Siegel, 1999), and structural shifts during high-volatility periods (Mayfield, 2004). Lastly, in times of crises, a constant backward-looking historical MRP may not fully reflect the underlying economic conditions and mirror the dynamics of the risk spread on debt (Bishop et al., 2011). This can lead to a narrowing of the relative risk spread on debt and equity, when under such circumstances, one might expect the margin to remain the same or increase.

While surveys of academics (Welch, 2000; Welch & Goyal, 2008) and investment professionals (Fernandez et al., 2020; Graham & Harvey, 2015) overcome some of the limitations of the historical approach and capture future market expectations, they generally yield approximations that reflect historical estimates. Welch and Goyal (2008), for example, survey over 400 economics and finance professors and estimate the expected risk premium to be around 5%, whilst a survey of 21,000 financial professionals over 15 years by Graham and Harvey (2015) reports an average risk premium of 3.5%. Although these survey estimates may reasonably reflect forward-looking expectations of the risk premium, they are vulnerable to influences that affect their reliability and accuracy, including that they are expressions of subjective opinions and face an unknown selection bias (Duan & Zhang, 2014).

A distinct body of literature also explores the estimation of MRP through various valuation ratios (Campbell & Shiller, 1988; Fama & French, 1988, 2002; Rozeff, 1984). Assuming a sufficiently long estimation period and stationarity of all relevant stochastic processes, the rate of dividend growth approaches the rate of capital gain and is thus an unbiased estimate of the long-term expected equity return. Fama and French (2002) show that MRP estimates from the dividend and earnings growth models since the postwar period are lower than the average return, and that much of the high return on equity stems from unexpected capital gains. This suggests that the true MRP is likely below the realised premium throughout this period, consistent with other literature. However, the reliance of these models on infrequently reported dividend and accounting information and conservative accounting

[7]See, for example, 'Review of debt risk premium and market risk premium, independent pricing and regulatory tribunal', discussion paper, December 2012, https://www.ipart.nsw.gov.au/Home/Industries/Special-Reviews/Reviews/WACC/Review-of-method-for-determining-the-WACC; and 'Return on capital, inflation and financeability', *Frontier Economics*, March 2022, https://www.accc.gov.au.

assumptions places them at a relative disadvantage to approaches directly derived from asset prices in real time. They also largely ignore the value of franking credits in the MRP estimates.

3 | THE THEORY OF THE FORWARD-LOOKING RISK PREMIUM

In this section, we outline the methods for extracting the conditional equity premium from the prices of actively traded options. Our approach is based on the work of Chabi-Yo and Loudis (2020) and Martin (2017), and uses option prices and economic theory to place ex-ante lower bounds on the risk premia of the market portfolio. In an ideal setting, we would observe options traded on total return indices (that include dividend income). Unfortunately, options on the main institutional and investable benchmark in Australia, the S&P/ASX200, are available only on the price index. Expected returns derived from these options will therefore only reflect expectations regarding the rate of capital gain. To capture the expected equity return, we develop a new method for computing a lower bound to the expected dividend yield. Central to our approach is the notion of a dividend strip, the value of which can be obtained from options on price indices. Section 3.1 outlines the current literature on estimating expected capital gain yields. Section 3.2 further outlines our approach to estimating expected dividend yields.

3.1 | Forward-looking capital gains

Martin (2017) demonstrates that, subject to a technical condition (the negative correlation condition [NCC]), one may obtain a lower bound to the MRP via the risk-neutral variance of the asset, which can be obtained from option prices. Chabi-Yo and Loudis (2020) extend Martin's (2017) work and develop a lower bound to the MRP that uses additional information contained in the return distribution's higher-order moments and that does not require the NCC assumption. We now briefly outline these two approaches for estimating option implied lower bounds to the MRP, though interested readers are directed to Martin (2017) and Chabi-Yo and Loudis (2020) for further details.

Define the return on the market portfolio from t to T as $R_{t,T}$, the gross risk-free rate as $R_{f:t,T}$, the stochastic discount factor (SDF) over the same period as $M_{t,T}$ and let $\mathbb{P}$ and $\mathbb{Q}$ denote the physical and risk-neutral measures respectively. Martin (2017) shows that if $\mathrm{Cov}_t^{\mathbb{P}}\left(M_{t,T}R_{t,T}, R_{t,T}\right) < 0$, the NCC, then a lower bound to the MRP may be obtained via

$$\mathbb{E}_t^{\mathbb{P}}\left(R_{t,T}\right) - R_{f:t,T} \geq \frac{1}{R_{f:t,T}}\mathrm{Var}_t^{\mathbb{Q}}\left(R_{t,T}\right). \quad (1)$$

Since the risk-neutral variance of returns ($\mathrm{Var}_t^{\mathbb{Q}}\left(R_{t,T}\right)$) can be directly computed from option prices, Equation (1) provides a simple method for computing a forward-looking estimate of the MRP. Martin (2017) finds that his bound is, on average, approximately equal to the future realised return and hence is approximately tight. Additionally, the author shows that the NCC is a natural consequence of mainstream asset pricing theories. However, it is difficult to get direct evidence that the NCC holds in practice.

Chabi-Yo and Loudis (2020) overcome the NCC assumption by developing a similar option-implied bound to the MRP that does not require this technical condition. Chabi-Yo and Loudis (2020) first identify a relationship between the physical expected return and the risk-neutral covariance between an asset's return and the inverted SDF

$$\mathbb{E}_t^{\mathbb{P}}\left(R_{t,T}\right) - R_{f:t,T} = \mathrm{Cov}_t^{\mathbb{Q}}\left(R_{t,T}, \frac{\mathbb{E}_t^{\mathbb{P}}\left(M_{t,T}\right)}{M_{t,T}}\right). \tag{2}$$

Equation (2) requires only the absence of arbitrage. Further assuming a single period economy populated by a representative agent endowed with a rational utility function, Chabi-Yo and Loudis (2020) demonstrate that the difference between physical ($\mathbb{P}$) and risk-neutral ($\mathbb{Q}$) moments may be expressed via an infinite series. Defining

$$\mathbb{M}_n^{\mathbb{P}} = \mathbb{E}_t^{\mathbb{P}}\left(\left(R_{t,T} - R_{f:t,T}\right)^n\right); \quad \mathbb{M}_n^{\mathbb{Q}} = \mathbb{E}_t^{\mathbb{Q}}\left(\left(R_{t,T} - R_{f:t,T}\right)^n\right),$$

these authors show that

$$\mathbb{M}_n^{\mathbb{P}} - \mathbb{M}_n^{\mathbb{Q}} = \frac{\sum_{k=1}^{\infty} \theta_k \left(\mathbb{M}_{n+k}^{\mathbb{Q}} - \mathbb{M}_n^{\mathbb{Q}}\mathbb{M}_k^{\mathbb{Q}}\right)}{1 + \sum_{k=1}^{\infty} \theta_k \mathbb{M}_k^{\mathbb{Q}}}, \tag{3}$$

where θ_k are linked to investors' risk preferences associated with the corresponding moment. Chabi-Yo and Loudis (2020) provide economic arguments to bound the values of θ_k. Making these assumptions, setting $n = 1$, and truncating the infinite sum in (3) to four terms provides the expression

$$\mathbb{E}_t^{\mathbb{P}}\left(R_{t,T}\right) - R_{f:t,T} \geq \frac{\frac{1}{R_{f:t,T}}\mathbb{M}_2^{\mathbb{Q}} - \frac{1}{R_{f:t,T}^2}\mathbb{M}_3^{\mathbb{Q}} + \frac{1}{R_{f:t,T}^3}\mathbb{M}_4^{\mathbb{Q}}}{1 - \frac{1}{R_{f:t,T}^2}\mathbb{M}_2^{\mathbb{Q}} + \frac{1}{R_{f:t,T}^3}\mathbb{M}_3^{\mathbb{Q}}}. \tag{4}$$

Equation (4) is the primary formula used in this study to compute the capital gain component of expected returns via the price of S&P/ASX200 index options, though we also compute and study bounds using Equation (1) to provide a robustness check on our results.[8] Chabi-Yo and Loudis (2020) also examine a version of Equation (4) which involves estimates of θ_k – the unrestricted bound. We elect to use the restricted lower bound specified in Equation (4) in this study for two reasons. First, it eliminates errors that could be introduced via the estimation procedure and Chabi-Yo and Loudis (2020) show that, in the US, the risk tolerance parameters are not statistically different from the values assumed to obtain Equation (4). They also empirically find that the restricted and unrestricted bounds are very similar. Second, it can be shown that Equation (1) is a special case of (4) where the expansion in (3) is truncated to a single term. This means that comparing the results obtained via Equations (1) and (4) provides an analysis of the role played by higher-order moments on the risk premium and hence acts as a robustness test of option-based estimates of the MRP. Values for $\mathbb{M}_n^{\mathbb{Q}}$ are obtained from observed option prices via the discretised versions of the spanning relations found in Carr and Madan (2001) and Bakshi et al. (2003).

3.2 | The theory of the forward-looking dividend yield

The S&P/ASX200 index, the asset underlying the options used in our study, is a price index and hence omits the contribution of dividends to investors' wealth. Dividend yields in Australia are, however, an important component of the MRP for at least two reasons: (i) these yields are high relative to other markets, and (ii) the imputation taxation system used in Australia increases the

[8]Equation (4) is referred to as the restricted lower bound in Chabi-Yo and Loudis (2020).

value of dividends through franking credits. We outline here a new approach to obtaining forward-looking estimates of future dividend income. Again, this information is drawn from option prices.

We compute a lower bound to the future expected value of dividends through the price of dividend strips. Dividend strips are a relatively new asset class that represents a claim to dividend income over a finite period of time (see Brennan, 1998). van Binsbergen et al. (2012) study these assets and their implications for the term structure of equity markets, by constructing the price of dividend strips via put-call parity. Recall that

$$C_t - P_t = S_t - R^{-1}_{f:t,T}K - D_t,$$

where D_t is the present value of dividend income received between t and expiry, T, C_t and P_t are the price of European call and put options with strike K and expiry T. Applying the present value relation, we have that

$$D_t = \mathbb{E}^{\mathbb{P}}_t\left(M_{t,T}D_{t,T}\right) = -C_t + P_t + S_t - R^{-1}_{f:t,T}K.$$

The quantity required to compute forward-looking dividend yields is $\mathbb{E}^{\mathbb{P}}_t\left(D_{t,T}\right)$, the expected dividend income from t to T under the physical measure. However, without precise knowledge of the properties of $M_{t,T}$, we cannot recover this quantity exactly. However, we may write that

$$\begin{aligned}\mathbb{E}^{\mathbb{P}}_t\left(M_{t,T}D_{t,T}\right) &= \mathbb{E}^{\mathbb{P}}_t\left(M_{t,T}\right)\mathbb{E}^{\mathbb{P}}_t\left(D_{t,T}\right) + \mathrm{Cov}^{\mathbb{P}}_t\left(M_{t,T}, D_{t,T}\right)\\ &= R^{-1}_{f:t,T}\mathbb{E}^{\mathbb{P}}_t\left(D_{t,T}\right) + \mathrm{Cov}^{\mathbb{P}}_t\left(M_{t,T}, D_{t,T}\right),\end{aligned}$$

which implies

$$\mathbb{E}^{\mathbb{P}}_t\left(D_{t,T}\right) = R_{f:t,T}\left(\mathbb{E}^{\mathbb{P}}_t\left(M_{t,T}D_{t,T}\right) - \mathrm{Cov}^{\mathbb{P}}_t(M_{t,T}, D_{t,T})\right). \tag{5}$$

Hence, if $\mathrm{Cov}^{\mathbb{P}}_t\left(M_{t,T}, D_{t,T}\right) < 0$, then we may compute a lower bound to the expected future dividend via

$$\mathbb{E}^{\mathbb{P}}_t\left(D_{t,T}\right) < R_{f:t,T}\mathbb{E}^{\mathbb{P}}_t\left(M_{t,T}D_{t,T}\right) \tag{6}$$

$$= R_{f:t,T}\left(-C_t + P_t + S_t - R^{-1}_{f:t,T}K\right). \tag{7}$$

Aspris et al. (2024) show that the assumption that $\mathrm{Cov}^{\mathbb{P}}_t\left(M_{t,T}, D_{t,T}\right) < 0$ holds in several leading asset pricing models. This includes the classic Capital Asset Pricing Model (CAPM) of Lintner (1956) and Sharpe (1964), the consumption CAPM of Breeden (1979), the external habits model of Campbell and Cochrane (1999), and models of pure exchange economies employing Epstein and Zin (1989) preferences. We present a simple illustration of this result with time-separable utility. Consider a pure exchange economy such as that of Lucas (1978) where the aggregate dividend is fully consumed each period. This implies that the SDF is given by

$$M_{t,T} = \beta\frac{u'\left(D_{t,T}\right)}{u'\left(D_t\right)}, \tag{8}$$

where $\beta > 0$ is the representative agent's rate of time preference. Computing the t-conditional covariance between the SDF and the dividend,

$$\text{Cov}_t^{\mathbb{P}}\left(M_T, D_{t,T}\right) = \text{Cov}_t^{\mathbb{P}}\left(\beta \frac{u'\left(D_{t,T}\right)}{u'\left(D_t\right)}, D_{t,T}\right) \tag{9}$$

$$= \frac{\beta}{u'\left(D_t\right)} \text{Cov}_t^{\mathbb{P}}\left(u'\left(D_{t,T}\right), D_{t,T}\right). \tag{10}$$

Note that for a rational, risk-averse investor $u'(x) > 0$ and $u'(x)$ is monotonically decreasing in x as $u''(x) < 0$. This implies that as $D_{t,T}$ increases, $u'\left(D_{t,T}\right)$ decreases (and vice versa) and hence that $\text{Cov}_t^{\mathbb{P}}\left(u'\left(D_{t,T}\right), D_{t,T}\right) < 0$. Intuitively, because investors are assumed to be risk-averse and dividend income is perfectly correlated with their consumption, investors require a premium to compensate them for dividend uncertainty which could affect their future consumption. This premium is captured by the covariance term $\text{Cov}_t^{\mathbb{P}}\left(M_{t,T}, D_{t,T}\right)$. By omitting this term, we are underestimating the value of future dividends, which hence provides our lower bound. This simple example covers both the CAPM and Consumption Capital Asset Pricing Model (CCAPM) frameworks. We direct interested readers to Aspris et al. (2024) for details regarding more sophisticated settings.

4 | EMPIRICAL ANALYSIS

4.1 | Data

Our main data is option prices on the S&P/ASX200 index. Our data covers a 17-year period from January 2004 to May 2020. The data is procured from two sources: OptionMetrics IvyDB, which covers the first evaluation period from its earliest available date in January 2004 to September 2019; and Refinitiv Datastream, which covers the second evaluation period from 2019 to May 2020. We obtain options data elements including strike, expiration, call/put, best bid/ask prices, volume and open interest as well as underlying index values and risk-free rate (zero) curves. To compute realised dividend yields, we compute the difference between the returns of the accumulation and price versions of the S&P/ASX200 index. We note that since the price drop on the ex-dividend date reflects the total dividend value, including franking credits, computing the realised dividend yield this way naturally incorporates the value provided by franking credits. Daily values of the price and accumulation indices are obtained from Datastream.

To address possible liquidity and measurement concerns over our results, we filter our data in several ways. First, we eliminate all duplicate entries and those with non-standard settlements. We further only retain option entries that satisfy arbitrage-free conditions and have positive open interest.[9] All options with maturities <7 days are omitted to remove potentially confounding microstructure effects. We compute option prices as the midpoint of the bid and ask prices at the close to also negate the effect of bid-ask spread-induced bias on returns. We follow a similar approach to that of Patel et al. (2020) to minimise bid-ask noise. This provides us with a final sample size of 377,833 option-day observations. To compute integrals required for the computation of expected returns, we require a minimum of two put and two call prices.

Expected returns are calculated for a set of standardised maturities of {30, 60, 90, 180, 360} days using linear interpolation.[10] There are instances where we are required to extrapolate expected returns which we do using the nearest neighbour. We use the same interpolation and

[9]We also consider a more restrictive condition where we only use prices that have positive trade volume. While this eliminates a large number of observations, our results are consistent with those presented.

[10]Interpolation on the observed set of maturities to obtain standardised maturities is a common practice in the literature and is consistent with Martin (2017), Chabi-Yo and Loudis (2020) and Berkman and Malloch (2020).

extrapolation scheme for dividend yields but employ additional arbitrage-based filters. Since dividend strips at longer maturities nest those at shorter maturities, the price of dividend strips must be monotonically increasing in maturity. We eliminate all observations for dividend strips, and hence expected dividend yields, for any date that exhibits a non-increasing term structure. We also remove any negative-valued dividend strips. Since we have a strip price for each strike–maturity pair, we follow van Binsbergen et al. (2012) and use the median value across all strikes as our dividend strip price.[11]

4.2 | Preliminary analysis

4.2.1 | Descriptive statistics

Table 1 provides summary statistics of the lower bound of capital gains and dividends as well as realised returns across the five different forecast horizons. The term structure represents the expected returns held to maturity, spanning horizons from 30 to 360 days. Panel A presents the summary statistics for the lower bound of our capital gain estimates using the methods of Martin (2017) and Chabi-Yo and Loudis (2020). At the 30-day horizon, the (annualised) means of the Martin and Chabi-Yo and Loudis lower bound are 3.0%, and 3.3% with a standard deviation of 2.7% and 3.0%, respectively. The results across the different horizons are on average marginally higher based on Chabi-Yo and Loudis (2020) but the two methods are highly correlated. Back et al. (2022) shows that correlations in the US range from 99.8% at the 1-month horizon to 98.9% at the 12-month horizon. The outcomes are more dispersed at the 1-year horizon, ranging between 2.8% and 3.5% as Martin (2017) has a slightly downward-sloping term structure while the term structure for Chabi-Yo and Loudis (2020) is marginally upward-sloping. Berkman and Malloch (2020) find a similarly shaped term structure across 15 international markets. Using a similar sample period, Aspris et al. (2024) estimate the capital gain of the MRP in the US to be 4.8%. Being bounded by zero, the risk premium in Australia is positively skewed, which is most pronounced at shorter maturities. Similarly, the kurtosis at short maturities is much larger than at longer maturities suggesting that the 360-day MRP estimate is more stable with fewer jumps, in line with other markets.

Panel B shows our estimates of the lower bounds on the expected annualised dividend yield, inclusive of the franking credit. At 5.3%, the dividend lower bound exceeds the capital gain lower bound estimate and underscores the importance of dividends to the total MRP in Australia. For comparison, Aspris et al. (2024) find the dividend contributes only 2.2 percentage points to the US MRP. The dividend term structure, on average, is reasonably flat with no distinct slope, though it should be acknowledged that the accuracy of these estimates, particularly at the short maturities, can be affected by our interpolation/extrapolation scheme. In line with capital gain estimates, standard deviation, skewness and kurtosis are larger for short maturities, indicating that longer horizon estimates are more stable. We find this difference is more pronounced for dividends as they are clustered throughout the year. Annualising yields when the dividend stream is relatively low (high) produces correspondingly lower (higher) yields, leading to increased volatility.

Panels C and D report realised capital returns, and total returns (capital gains and dividend yields), respectively. Consistent with the capital gain and dividend estimates being a lower bound, the mean market excess return (total excess return) exceeds the lower bounds by approximately 340 bps (270 bps) over the sample period at the 30-day horizon. The difference

[11] Results are unaffected when using the mean instead of the median.

TABLE 1 Summary statistics of the lower bound on equity premium and realised returns.

Maturity	Mean	Std. dev.	Skew	Kurtosis	Min	P10	P25	P50	P75	P90	Max
Panel A: Capital gain – lower bound											
Bound: Chabi-Yo and Loudis (2020)											
30-day	3.34	3.04	3.38	21.56	0.50	1.20	1.56	2.29	3.91	6.72	37.60
60-day	3.30	2.76	3.57	25.54	0.50	1.29	1.65	2.36	3.91	6.45	37.60
90-day	3.35	2.73	3.34	24.12	0.50	1.29	1.65	2.36	3.91	6.45	37.60
180-day	3.43	2.46	2.15	11.09	0.50	1.37	1.77	2.50	4.28	6.87	27.10
360-day	3.45	2.40	1.90	8.00	0.50	1.37	1.82	2.59	4.32	6.79	20.50
Bound: Martin (2017)											
30-day	3.04	2.65	3.09	18.26	0.40	1.12	1.44	2.11	3.56	6.18	30.81
60-day	2.92	2.35	3.32	22.53	0.51	1.19	1.50	2.12	3.45	5.71	30.81
90-day	2.89	2.25	3.27	23.31	0.51	1.18	1.51	2.09	3.48	5.69	30.81
180-day	2.82	1.91	2.11	10.92	0.51	1.20	1.52	2.11	3.51	5.58	21.60
360-day	2.78	1.82	1.91	8.51	0.40	1.19	1.55	2.12	3.46	5.42	17.90
Panel B: Dividend yield – lower bound											
30-day	5.30	3.95	2.20	14.62	0.02	1.20	2.49	4.55	7.14	10.18	49.28
60-day	4.91	2.56	2.71	28.77	0.02	2.23	3.28	4.44	6.33	7.95	45.03
90-day	4.89	1.87	2.45	25.78	0.09	2.82	3.66	4.76	5.90	6.93	30.81
180-day	4.97	1.59	1.50	12.95	0.29	3.54	4.22	4.84	5.60	6.47	21.59
360-day	5.05	1.98	1.40	13.17	0.08	3.33	4.05	4.87	5.83	7.06	27.57
Panel C: Capital gain – realised											
30-day	6.40	15.47	2.56	17.45	−99.56	−43.32	−17.31	12.68	45.80	79.22	741.99
60-day	6.01	15.24	0.90	0.46	−93.30	−31.82	−10.05	10.71	31.18	52.41	280.67
90-day	5.69	15.25	0.33	2.37	−79.96	−27.46	−8.36	10.24	26.31	42.85	192.38
180-day	4.92	15.81	−0.16	1.30	−64.16	−23.76	−4.60	7.88	18.07	32.11	100.48
360-day	4.56	15.42	−0.62	0.68	−47.76	−13.41	−4.89	6.00	16.41	22.04	50.60

(Continues)

TABLE 1 (Continued)

Maturity	Mean	Std. dev.	Skew	Kurtosis	Min	P10	P25	P50	P75	P90	Max
Panel D: Capital gain + dividend yield – realised											
30-day	10.96	16.62	2.53	17.44	−99.50	−43.05	−16.27	15.76	53.19	90.13	766.47
60-day	10.48	16.15	0.90	4.50	−92.79	−30.30	−7.34	14.78	37.12	60.49	289.58
90-day	10.16	15.97	0.31	2.25	−78.80	−24.74	−5.03	14.53	31.99	49.15	194.28
180-day	9.41	16.44	−0.15	1.31	−62.17	−20.08	−0.42	12.41	22.95	37.28	109.98
360-day	9.06	16.13	−0.62	0.63	−45.25	−9.96	−0.74	10.62	21.43	27.34	56.88

Note: This table presents summary statistics for the lower bound and realised equity returns. Panel A shows the lower bound for Martin and Chabi-Yo and Loudis, which denotes computations using the Martin (2017) and Chabi-Yo and Loudis (2020) methods, respectively. Panel B presents the lower bound for dividends. Panel C presents the realised capital gain. Panel D shows the realised return, including dividends, where the market excess return is the S&P/ASX200 (accumulation return) in excess of the risk-free rate compounded over the indicated horizon. The results are annualised and reported in percent. The sample contains daily observations for the period January 2004–May 2020.

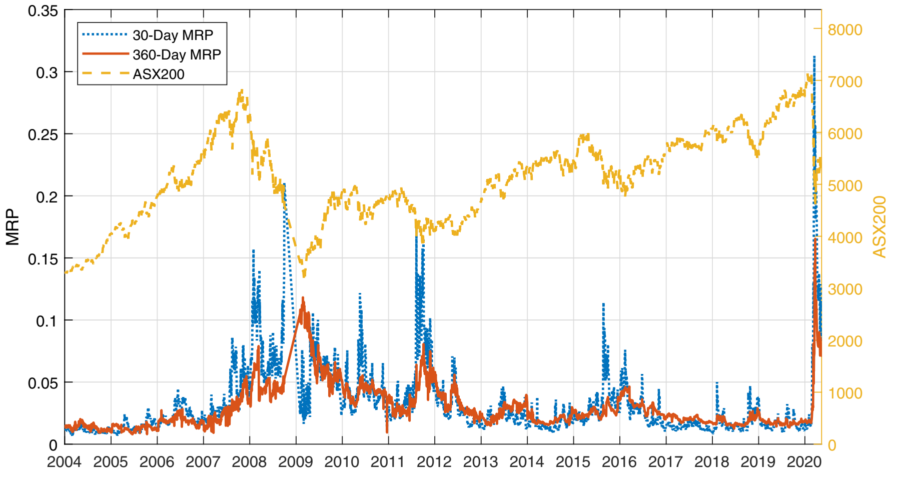

FIGURE 1 Time series of MRPs and the S&P/ASX200 index. This figure shows the annualised lower bounds of the Australian MRP computed over horizons of 30 and 360 days, together with the price levels of the S&P/ASX200 index. The lower bounds have been computed using the method of Chabi-Yo and Loudis (2020).

varies with the choice of model and horizon, but generally narrows with longer maturities. Realised yields are also more volatile than our estimates, more positively skewed and have higher kurtosis. The term structure in both panels is downward-sloping. Consistent with prior literature (see Back et al., 2022; Chabi-Yo & Loudis, 2020), the Chabi-Yo and Loudis bound is on average higher than the Martin bound, resulting in lower realised bound slackness (the difference between the excess return and the bound).

4.2.2 | Time-series behaviour of the MRP

Figure 1 plots the 30-day and 360-day time series of the Chabi-Yo and Loudis (2020) lower bound, together with the S&P/ASX200 index level. The lower bound on the MRP exhibits higher levels of volatility corresponding to falls in the equity index. The volatility is more pronounced for the 30-day horizon, peaking at 37% during the GFC in 2008 and 31% through the Covid-19 pandemic in 2020.[12] The 360-day lower bound peaks at 17% during the Covid-19 pandemic. Outside of episodes of elevated volatility, the lower bounds across the different horizons tend to converge to historical ex-post levels of below 5%.

The dividend yield contributes 61% to the total MRP in Australia but the proportion can exceed 88% during calm market periods. This is significantly higher than the average of 27% documented in the US by Aspris et al. (2024). This behaviour is made clear in Figure 2, which plots the capital gain and total MRP (capital gain + dividend yield) at the end of each month.

4.2.3 | Market conditions and the MRP

To shed more light on the dynamics of the Australian MRP during different market phases, we differentiate between stable and crisis periods and present the summary statistics in Table 2. We define crises as periods covering the GFC (1 July 2007–31 December 2008) and the Covid-19

[12] We also observe a significant escalation in the lower bound during 2011 where the index fell by approximately 14.5% over the calendar year.

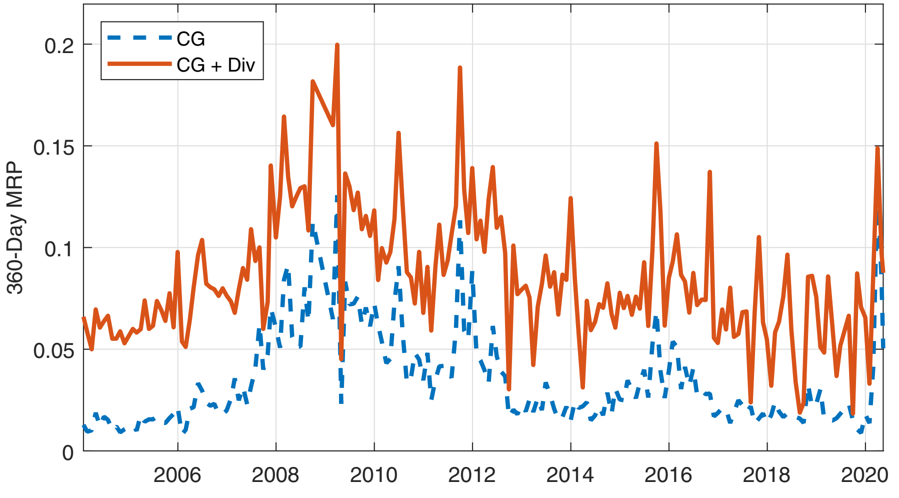

FIGURE 2 Capital gain and total MRP time-series. This figure presents the time-series behaviour of the capital gain component of the option-implied MRP and the total MRP (capital gain + dividend yield) at the 360-day horizon. The capital gain component is computed using the Chabi-Yo and Loudis (2020) method.

TABLE 2 Descriptive statistics of the MRP across a set of standardised maturities during stable market periods.

Bound	Maturity	Mean	Median	Std dev.	Skew	Kurt	Min	Max
Panel A: Stable market								
CY-Loudis	30-day	2.80	2.10	2.20	2.69	13.24	0.50	20.40
	60-day	2.90	2.20	2.00	2.31	10.45	0.50	17.00
	90-day	2.90	2.20	2.00	20.9	8.41	0.50	15.90
	180-day	3.10	2.30	2.10	1.86	6.71	0.50	15.20
	360-day	3.20	2.40	2.10	1.97	7.68	0.50	16.60
Martin	30-day	2.60	2.00	1.90	2.50	11.74	0.40	17.20
	60-day	2.50	2.00	1.60	2.09	8.69	0.50	13.40
	90-day	2.50	1.90	1.60	1.93	7.44	0.50	13.10
	180-day	2.50	2.00	1.60	1.73	6.10	0.50	11.10
	360-day	2.50	2.00	1.60	1.86	7.00	0.40	11.90
Panel B: Crisis period								
CY-Loudis	30-day	8.40	6.70	5.20	2.27	9.59	1.80	37.60
	60-day	7.90	6.40	4.90	2.60	11.53	2.00	37.60
	90-day	7.70	6.30	4.60	2.82	13.43	2.00	37.60
	180-day	6.80	6.20	3.20	2.66	13.83	2.00	27.10
	360-day	6.50	6.00	2.70	2.05	9.27	2.00	20.50
Martin	30-day	7.70	6.30	4.40	2.03	8.38	1.70	30.80
	60-day	7.00	5.90	4.00	2.39	10.31	1.90	30.80
	90-day	6.70	5.60	3.80	2.68	12.48	1.90	30.80
	180-day	5.80	5.30	2.50	2.46	12.21	1.90	21.60
	360-day	5.40	5.10	2.10	2.16	10.43	1.90	17.90

Note: This table shows the mean, median, standard deviation (Std Dev.), skewness, minimum (Min) and maximum (Max) values of the lower bound on the equity premium, computed using the methods of Martin (2017) and Chabi-Yo and Loudis (2020). Panel A presents these results for a stable market period that excludes crisis episodes. Panel B includes months surrounding the GFC and the Covid-19 pandemic events. Results are annualised and reported in percent.

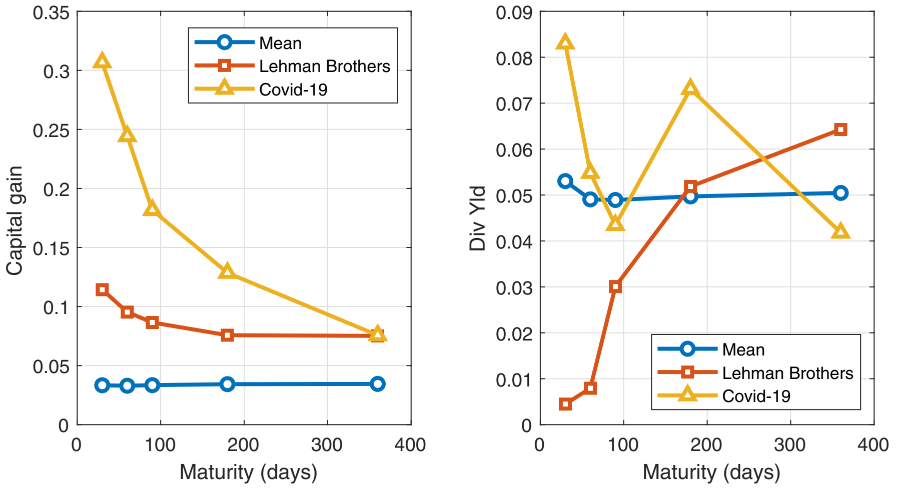

FIGURE 3 Lower bound term structures – implied term structure during crisis periods. This figure shows the term structure of the annualised capital gain and dividend yield implied by the lower bound during two recent crisis periods. These crisis periods are contrasted with the average result which reflects non-crisis periods.

pandemic (11 March 2020–31 May 2020).[13] Remaining dates in our sample are classified as a stable period. During the stable periods depicted in Panel A, our Martin (2017) and Chabi-Yo and Loudis (2020) bounds at the 30-day maturity average 2.6% and 2.8%, respectively, and are highly correlated, with less dispersion. This differential increases to 70 bps during crises, reflecting the inclusion of higher-order risk-neutral moments in the Chabi-Yo Loudis estimate. These results suggest that higher-order moments become an increasingly important component of risk, and hence the required expected rate of return, when markets become more unstable. The results in Table 2 also show evidence of a time-varying term structure of expected returns. Consistent across both methods, we observe an upward-sloping term structure during stable market conditions and a markedly pronounced downward-sloping term structure during crisis periods. These results are consistent with Chabi-Yo and Loudis (2020) and confirm that risk premia increase during crises and exhibit mean-reversion.

In Figure 3 we focus on the crises and plot the term structure implied by our lower bound for capital gains and dividend yield separately. We single out the bankruptcy of Lehman Brothers (15 September 2008) and the declaration of the Covid-19 pandemic (12 March 2020) as two key dates to explore the dynamics of the MRP in more detail. Our results show a monotonically downward-sloping term structure observed during periods of market stress. We find that heightened uncertainty is associated with higher near-term risk premia and steeper term structure slope, implying that investors expect risk premia to fall in the future and converge to a long-term risk premium as part of a mean-reverting process. These findings further align with standard equilibrium asset pricing expectations (Campbell & Cochrane, 1999). As with the term structure of equity risk premia, the term structure associated with dividends also exhibits cyclical variation and is downward-sloping on average, consistent with Bansal et al. (2021).

Additionally, we observe that the slope of the capital gain term structure is steeper during the Covid-19 pandemic compared to the GFC. This is consistent with the model of Hasler and Marfè (2016) which shows that downward-sloping term structures emerge from the market's expectation of a recovery. In this model, bad (good) times are depicted by high (low) disaster

[13]The start and end dates for the GFC are the same as those used by the Reserve Bank of Australia to define the GFC. Following Foley, Kwan, et al. (2022) and Berkman and Malloch (2023), we mark the beginning of the pandemic as the date when the WHO declared a global pandemic.

intensity. In bad times, short-term risk premiums embody this disaster risk. However, with the expectation of an economic recovery in the longer term, the intensity of the disaster is expected to revert to its long-run average, thereby mitigating risk at these extended horizons. Hence, the compensation for this risk in the longer term is reduced, which leads to a downward-sloping term structure of equity risk premiums. Comparing the GFC with the Covid-19 pandemic, we observe a steeper capital gain term structure during the pandemic suggesting a higher level of disaster intensity. However, when examining the term structure of dividend yields, we observe that short-term yields fall sharply during the GFC but not during the pandemic. These results suggest that high short-term capital gains during the pandemic were primarily the result of an escalation in the price of risk. Evidence of this risk can also be observed in the abnormally large discounts on frequent capital raises documented by Aspris et al. (2023). In contrast, the GFC period is characterised by an expectation of a decline in free cash flows to investors in the short term. Despite the similar magnitude of falls in the S&P/ASX200 exhibited during these two crises, the information gleaned from this approach reveals that not all disasters are created equal.

4.3 | Assessing tightness of the lower bound

4.3.1 | Risk premium

We now test if our option-implied lower bounds are approximately equal to future realised returns on average, that is whether the bounds are approximately tight. To this end, we perform forecasting regressions of the market excess return on their bounds. Specifically, we estimate

$$R_{t,T} - R_{f:t,T} = \alpha + \beta LB_{t,T} + \epsilon_t, \tag{11}$$

where LB is the lower bound for each standardised maturity $T \in \{30,60,90,180,360\}$. We test if α is statistically different from 0 and β is statistically different from 1.

Since our observations at each day t involve overlapping periods, the residuals will suffer from autocorrelation, which may bias our standard errors. We address this issue by computing Newey and West (1987) heteroscedasticity and autocorrelation-corrected standard errors using a Bartlett kernel. We also run two versions of our regression, one which includes all observations from January 2004 to May 2020 and a second regression which excludes the GFC and the Covid-19 pandemic periods outlined in Section 4.2. Results are reported in Table 3.

Panel A of Table 3 shows that we are unable to reject the null that $\alpha = 0$ at all horizons over the sample period. Similarly, we cannot reject the null that $\beta = 1$ at any of the horizons. We cannot, therefore, rule out the possibility that the bound is approximately tight, supporting its use as a direct proxy of the MRP. Whilst these inferences about tightness are consistent with earlier literature, Back et al. (2022) caution that the bounds obtained are often too low compared to realised excess return, making them valid as lower bounds but not good predictors of future market returns. We concede that the standard errors involved in Panel A of Table 3 are large, which may make the previous results less compelling because we cannot reject that the bounds are slack. To address concerns that these results might be driven by certain market episodes associated with increased volatility, we reassess the informativeness of the bound by removing the crises (the GFC and the Covid-19 pandemic). Our results in Panel B of Table 3, show that when excluding the period covering these crises, the predictive ability of the risk premium lower bound at 30-day horizons substantially increases, with $\hat{\beta}$ being very close to, and not statistically different from, 1. However, predictability at longer horizons is generally weaker. For instance, when excluding the GFC period, we can reject the hypothesis that $\beta = 1$

TABLE 3 Tightness of lower bounds – predictive regressions.

	30-day	60-day	90-day	180-day	360-day
Panel A: All observations					
Bound: Chabi-Yo and Loudis (2020)					
α	−0.002	−0.005	−0.007	−0.007	0.007
SE (α)	0.004	0.008	0.011	0.024	0.046
β	1.451	1.826	1.666	0.979	0.211
SE (β)	0.981	1.033	1.036	1.062	0.876
R^2_{OOS}	0.010	0.026	0.034	0.030	0.012
Bound: Martin (2017)					
α	−0.002	−0.005	−0.007	−0.003	0.011
SE (α)	0.004	0.008	0.012	0.025	0.048
β	1.628	2.042	1.970	0.972	0.179
SE (β)	1.220	1.342	1.475	1.491	1.361
R^2_{OOS}	0.009	0.023	0.030	0.021	0.011
Panel B: Excluding crisis periods					
Bound: Chabi-Yo and Loudis (2020)					
α	−0.002	−0.005	−0.008	−0.012	0.006
SE (α)	0.003	0.007	0.009	0.020	0.038
β	2.248*	2.606**	2.512**	1.935	0.824
SE (β)	0.747	0.772	0.695	0.960	0.747
R^2_{OOS}	0.025	0.063	0.093	0.121	0.067
Bound: Martin (2017)					
α	−0.002	−0.006	−0.009	−0.013	0.002
SE (α)	0.003	0.007	0.010	0.021	0.041
β	2.761*	3.166**	3.222**	2.550	1.261
SE (β)	0.925	0.959	1.012	1.338	1.150
R^2_{OOS}	0.026	0.062	0.094	0.114	0.068

Note: This table reports test statistics of the predictive regression outlined in Equation (11) where lower bounds are computed using the method of Martin (2017) and Chabi-Yo and Loudis (2020). Standard errors are computed using the Newey and West (1987) method. Estimates for α that are statistically different from 0 and β that are statistically different from 1 at the 10%, 5% and 1% levels are indicated with *, ** and ***, respectively.

at 30, 90 and 180 days. These results suggest that the risk premium lower bound is approximately tight unconditionally, but may underestimate the true MRP during periods of heightened volatility.

We also compute out-of-sample performance tests of market forecasts via the out-of-sample R^2 (R^2_{OOS}) of Campbell and Thompson (2008) given by

$$R^2_{OOS} = 1 - \frac{\sum_{j=t}^{T} \varepsilon_j^2}{\sum_{j=t}^{T} \nu_j^2}, \tag{12}$$

where ε_t are the residuals from predictive regression (11) and $\nu_t = R_{t\to T} - R_{f,t\to T} - \overline{R}$, where $\overline{R}$ is the historical average excess return. We use the longest available series to compute $\overline{R}$ with data becoming available from January 1992. Our out of sample R^2 values are reported in Table 3 and range from approximately 1% to 3%, with the highest values at the 90-day horizon. All estimates of R^2_{OOS} are positive, which implies that our lower bound estimates provide predictive power above that provided by our benchmark, the historical mean. We find that R^2_{OOS} increases significantly when omitting crisis periods (the GFC and the Covid-19 pandemic) with values as high as 8.80% at the 90-day horizon.

To illustrate the economic significance of the predictive power of our option-based estimate above that provided by the historical mean, we follow the analysis outlined in Campbell and Thompson (2008) who consider the difference in performance between a mean–variance investor who uses the average return and one who has access to a variable that helps predict returns. These authors show that the performance difference between these two investors is determined by the Sharpe ratio of the asset, the out-of-sample R^2 and the investors' risk aversion. Specifically, the performance difference between these two investors, each with risk aversion γ, is given by

$$\left(\frac{1}{\gamma}\right)\left(\frac{R^2_{OOS}}{1-R^2_{OOS}}\right)(1+S^2),$$

where S is the Sharpe ratio of the asset and the relative difference in performance is given by

$$\left(\frac{R^2_{OOS}}{1-R^2_{OOS}}\right)\left(\frac{1+S^2}{S^2}\right).$$

Over our sample period between 2004 and 2020, the annualised Sharpe ratio of the ASX200 index was approximately 32.8%. This suggests that with an R^2_{OOS} of 3%, a mean–variance investor could improve his/her annual return by a factor of 31.8%. Establishing absolute performance benefits requires that we specify a risk aversion. For $\gamma = 1$, this corresponds to an additional return of about 3.4% per year and about 1.2% when $\gamma = 3$. While not an exhaustive treatment of the problem, this analysis nonetheless suggests that the option-based MRP established in this paper provides significant benefits to investors.

4.3.2 | Dividend yields

Similar to our analysis of whether option-implied capital gains provide an estimate of the realised capital gain, we now test if dividend yields implied from options provide an unbiased estimate of future realised dividend yields. Our analysis uses the predictive regression

$$\frac{D_{t,T}}{S_t} = \alpha + \beta R_{f:t,T}\frac{\mathbb{E}^{\mathbb{Q}}_t\left(D_{t,T}\right)}{S_t} + \epsilon_t, \tag{13}$$

where $D_{t,T}$ is the dividend earned from t to T and S_t is the level of the S&P/ASX200 price index. We estimate Equation (13) at the same set of standardised horizons as used in the study of capital gains with results presented in Table 4. The slope coefficients in regression (13) are statistically different from 1, suggesting that our estimates are indeed lower bounds and are not tight. This finding concurs with the proposition that investors demand a premium for bearing the uncertainty associated with dividend outcomes. All slope coefficients are also significantly different from 0 at the 1% level suggesting that, despite being a lower bound, they nonetheless have the ability to help predict dividends at all tested horizons. Predictability is strongest at the shortest horizons and weakest at the longest. This is driven by the relatively high variability in dividends at short horizons compared to longer horizons. Because the realised 360-day dividend yield is stable, our predictive regressions capture this via the intercept term that is almost equal to the average 360-day yield. Out-of-sample R^2 values are very high, especially at short horizons. This is because dividends are not paid at a constant rate throughout the year. This means that, over short horizons,

TABLE 4 Tightness of lower bounds – predictive regressions (dividends).

Parameter	Maturity 30-days	60-days	90-days	180-days	360-days
$\hat{\alpha}$	0.007	0.014**	0.020***	0.039***	0.042***
SE ($\hat{\alpha}$)	0.005	0.004	0.003	0.002	0.001
$\hat{\beta}$	0.688***	0.594***	0.465***	0.102***	0.056***
SE ($\hat{\beta}$)	0.106	0.094	0.051	0.028	0.020
R^2_{OOS}	0.487	0.484	0.402	0.243	0.124

Note: This table reports test statistics of the predictive regression outlined in Equation (13). Standard errors are computed using the Newey and West (1987) method. Estimates for α that are statistically different from 0 and β that are statistically different from 1 at the 10%, 5% and 1% levels are indicated with *, ** and ***, respectively.

the annualised dividend yield fluctuates. Using a historical estimate for the dividend yield misses these periodic fluctuations, whereas our option-based estimates capture this feature resulting in much higher R^2_{OOS}. However, even at the annual horizon, we still find that our option-implied estimates provide better predictions of future dividend yields than historical averages.

5 | CONCLUSION

The equity market risk premium (MRP) – the compensation that investors require for holding risky securities over the risk-free asset – is a fundamental, yet unobserved, quantity in finance that underpins many important financial decisions. This paper represents the first comprehensive empirical study of the MRP that is implied by the prices of options on the stock market in Australia. Accurate estimates of the equity premium can affect levels of firm investment (Baker et al., 2003), rates of personal consumption (Di Maggio et al., 2020) and, where it can be derived on a timely basis, allows for high-frequency market timing strategies to be considered (Martin, 2017) and stock price fluctuations to be understood (Tetlock, 2023). We rely on recent advances in asset pricing theory (Chabi-Yo & Loudis, 2020; Martin, 2017), which require minimal assumptions and utilise real-time options data to obtain lower-bound estimates on the equity risk premium. This includes an assessment of the lower bound to the future dividend yield observed from option prices which provides for a comprehensive evaluation of the Australian MRP. Since this method is theoretically motivated, and based directly on asset prices, it serves as a useful signal for expected returns on the market.

We estimate that the total risk premium (inclusive of franking credits) is between 8.34% and 8.64% but can exceed 30% during crises, based on the methods of Martin (2017) and Chabi-Yo and Loudis (2020), respectively. This is above long-term historical and ICC estimates (excluding franking credits) of 6%–7% (Brailsford et al., 2008, 2012; Paton et al., 2020), but below the average annual realised return of 11% (5.1% capital gains, 4.6% dividend yield and 1.3% franking credits) earned over the corresponding forecast period. We also show that the MRP consistently peaks in periods of stress, when volatility is highest. The estimates at different horizons also tend to converge when the markets are calm, but diverge during crises. Predictive regressions show that, while we cannot reject that the option-implied lower bounds are approximately tight, the standard errors associated with this test are large so these results should be interpreted with caution. Nonetheless, we find that option-implied MRPs provide predictive power over historical means, which suggests option markets contain relevant and forward-looking information. The development of these option-based bounds for forecasting returns are an important contribution that will be of use to practitioners, academics and policymakers.

These forecasts of the equity premium, as implied by the prices of stock market options, provide a promising avenue for enhancing asset allocation and risk management strategies. A limitation of option-implied estimates of the market risk premium, however, is that they represent lower bounds. As this field continues to develop, there is a potential for new approaches to further refine the risk premium estimates provided in this paper. One promising avenue is the early work of Tetlock (2023). We leave an investigation of this to future research.

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DATA AVAILABILITY STATEMENT

Data is sourced from OptionMetrics and Reuters Refinitiv – these are proprietary databases which are duly noted. They are available to any subscribing academic, but are not open access.

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