The Relationship Between Dividend Yield and Equity Market Value

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and
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Abstract

Campbell and Shiller (1998) observed a relationship between current dividend yield and the future value of the equity market. We replicated this analysis and extend it to include standard ECM analysis for the Australian equity market using equity market data for the period from 1882 to 2002. Consistent with Campbell and Shiller we observe a positive relationship between the currently observed dividend yield and future equity market value and the ECM analysis supports this result. Given the historically low dividend yields observed in recent times the estimated model suggests a fall in the Australian equity market over the next 10 years.

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1. Introduction

By the late 1990’s aggregate dividend yields in developed equity markets fell to the lowest levels in recorded history. This fall was particularly dramatic in the USA where dividend yields dropped to just above 2% pa. while in Australia dividend yields stood at about 3% pa. at the end of 2003. Does such a fundamental change in the equity market matter? Campbell and Shiller (1998) show that in the USA the equity market dividend yield has predictive power over the future level of the equity market, lower dividend yields predict lower equity market values in the future. We explore the relationship between dividend yield and future equity market value in an Australian context to assess the implications of this research for the Australian equity market.

A number of studies have investigated possible explanations for the decline in dividends over the 1990s. For example, Fama and French (2001) suggest that there were less firms paying dividends during this period due to the change in the composition of the market. They identify an increase in the level of small growth firms with low profitability and low dividend payout during the 1980s and 1990s in the USA equity markets. Another possible explanation for the fall in dividend yield could be linked to the decline in the level of equilibrium equity returns (Blanchard, 1993, Fama and French, 2002).

Campbell and Shiller, in a congressional testimony (1996) and a series of papers (1987, 1988a, 1988b, 1998), argue that low dividend/price ratios spell bad news for stock market investors. We re-evaluate the Campbell and Shiller argument and show that the linear short-term dynamics of dividend/price ratios and returns can

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1 Joint testimony before the Board of Governors of the Federal Reserve System, December 3, 1996.
account for most of the stylised features of return predictability in Australian equity market returns. While we confirm the main findings of the Campbell and Shiller’s analysis, we emphasise that the amount of uncertainty associated with this prediction is considerable. In the following section we describe the data used in the analysis, with analysis of the data provided in section 3 and provide a summary of the main results in section 4.

2. Data

Australian share market index data is used in this paper. Share market price index values, adjusted for capitalisation changes, and accumulation index values, adjusted for dividends and capitalisation changes, are obtained from the Australian Stock Exchange for the period from 1882 to 1999. A similar index was used in estimation of equity premia by Officer (1989) and in analysis of time changing volatility in Kearns and Pagan (1993).

The indices are constructed using three series, the Commercial and Industrial Index from 1875-1936, the Sydney All Ordinaries Index Calculated Retrospectively from 1937-1957, the Sydney All Ordinaries Index from 1958-1979 and finally the Australian Stock Exchange price index for the remainder of the study period, 1980-2002. While the share price index is used as a measure of the value of the market, the dividend series is extracted from the accumulation and price indices.

The indices do not include adjustment for share repurchases or takeover distributions though this bias should not be large for two reasons. First, there were no share repurchases permitted in Australia prior to the easing of legal restrictions in 1989 and little evidence of share repurchases prior to the further relaxation of the legislation in 1998 (Mitchell, Dharmawan and Clarke, 2001). Second, the impact of
takeover distributions should be fairly small because Australian takeover targets are
generally small relative to the acquiring firm and thus have a limited impact on the
value weighted indices used in this study.

The dividend yield and nominal dividend amount are calculated as follows:

\[ dy_t = \frac{A_t}{A_{t-1}} - \frac{I_t}{I_{t-1}} \]

where \( dy_t \) = dividend yield for the period \( t-1 \) to \( t \),
\( A_t \) = accumulation index value at time \( t \),
\( I_t \) = price index value at time \( t \)

3. **Dividend/Price Ratios**

One critical assumption of our analysis and that of Campbell and Shiller (1998) is that
the dividend/price ratio forms a stationary time-series. Empirically, nominal dividend
yields (either real or nominal) are characterised by very high persistence. In monthly
Australian data, the first characteristic root of the autoregressive polynomial is close
to 0.99. Not surprisingly, standard ADF statistics with meaningful lag values do not
reject the null of a unit-root in monthly dividend yields or dividend-price ratios at
conventional significance levels.
On the other hand, the evolution of dividend yields over a long historical period (Figure 1) shows few signs of the explosive variance behaviour normally associated with unit-root processes. For example, taking as given the sample standard deviation of dividend yield changes of 0.22 and the beginning of the sample dividend yield of 6.83%; if the dividend yield series followed a simple random walk, the probability of observing a realisation staying between the historical bounds for dividend yields (2.49% to 10.29%) would be less than 0.01.

[Insert Figure 1 about here]

A similar picture emerges when the behaviour of the n-period ahead forecast variance is considered. Figure 2 plots the s-period ahead forecast variance normalized by the sample variance of dividend yield changes (Cochrane [1988], Lo and MacKinlay [1988]) against the forecast horizon s together with Monte-Carlo confidence intervals based on 10000 replications of a Gaussian random walk. We define the normalised forecast variance as follows:

\[
\hat{J}_T = \frac{1}{s^2(T - s - 1)} \sum_{t=s}^{T-1} (dy_{t+s} - dy_t)^2
\]  \hspace{1cm} (1)

[Insert Figure 2 about here]

If the process contains a unit root, this variance ratio should grow linearly with the forecast horizon. In contrast, if the process is stationary the variance ratio should converge to a finite number. While short term forecasts (up to 10 years) clearly show the effect of persistence, the behaviour of long term dividend yield forecasts indicate that this persistence appears to die out too quickly for a random walk process. While
empirically the issue of whether dividend yields are stationary or not is still unresolved (Campbell and Yogo, 2002), the field is leaning towards stationarity of the process.

If dividend yields were to revert to the historical average from the low level at the end of 2000 it could happen by either an increase in the dividend growth rate or through a period of flat stock prices. Dividend forecasts and historical experience (Campbell and Shiller [2001]) appear to favour the latter scenario, pointing to a period of low stock returns and a disappearing real equity premium.

3.1 Dividend yields, Capital Gains and Growth rates

Following Campbell and Shiller we examine the relationship between changes in dividend-price ratios and changes in the real value of equities and dividends that bring D/P ratio back in line with the historical average. Specifically, define

\[
\pi_t = \frac{d_t}{p_t}
\]

\[
i_t = (\pi_t - \hat{\mu}_\pi)(\pi_{t-1} - \hat{\mu}_\pi),
\]

\[
\tau_t = \{\tau : i_t > 0, t_0 < \tau < \tau_; i_{\tau_0} < 0\}.
\]

So that \(\tau_t\) is the index of the first observation following the return of dividend-price ratio \(\pi_t\) to the sample average. Denote \(r_{i,T} = \frac{p_T}{p_i} - 1\) and \(g_{i,T} = \frac{d_T}{d_i} - 1\), the price growth and dividend growth rate respectively and consider the following regressions:

\[
r_{i,\tau_t} = \alpha + \beta \pi_t + \sigma \varepsilon_t
\]
If the slope coefficient in the stock return regression $\beta$ is positive, while the coefficient in the dividend growth regression is insignificant then we can conclude that mean reversions in D/P ratios and dividend yields occur mostly through price adjustments. In this case, low current yield is bad news for stock market investors as it would indicate a period of low equity returns. This is the conclusion reached by Campbell and Shiller on the basis of their analysis of USA and international data. On the other hand, if the coefficient of dividend growth regressions is positive then dividend yields return to the mean through changes in dividends, in which case low yields forecast a period of high dividend growth.

Table 1 contains selected statistics for regressions based on yearly Australian data from 1882 to 2002.\textsuperscript{2} Regression estimates are not corrected for serial correlation due to overlapping data. Correcting for serial correlation does not change the estimated coefficients much but creates additional computational burden for simulations. Figure 3 shows the corresponding scatter plots.

[Insert Table 1 and Figure 3 about here]

Figure 3 and the coefficients reported in Table 1 confirm the Campbell and Shiller findings. It appears that most adjustments to the mean D/P ratio happen through price changes (Panel A) rather than through changes in dividend payments. Panel B of Figure 3, and the regression estimates reported in Table 1, show that there

\begin{equation}
g_{t-\tau} = \gamma + \delta \pi_t + \sigma \nu_t.
\end{equation}
is no apparent relationship between current D/P ratios and subsequent dividend growth.

3.2 Forecast Accuracy and Horizon

Dividend yields, earnings/prices ratios and interest rates have a well-documented ability to forecast stock returns over medium to long-term horizon. Table 1 reports the results of forecast regressions using log dividend-price ratios as a predictor for log price changes and dividend growth. Define the n-period return as

\[ r_{t,t+h} = \ln \left( \frac{P_{t+h}}{P_t} \right) \]

and the corresponding h-period dividend growth rate

\[ g_{t,t+h} = \ln \left( \frac{d_{t+h}}{d_t} \right) \]

and consider the following regressions of \( r_{t,t+h} \) and \( g_{t,t+h} \) on the dividend/price ratio:

\[ r_{t,t+h} = \alpha_h + \beta_h \ln \pi_t + \varepsilon_{t,h} \quad (3) \]

\[ g_{t,t+h} = \gamma_h + \delta_h \ln \pi_t + \nu_{t,h} \quad (4) \]

Regression R square statistics are reported for these models in Table 2. The R square statistics are generally comparable with those reported by Campbell and Shiller (1989) for the USA. While current dividend yield exhibits little explanatory power over dividend growth rate at any horizon dividend yield exhibits considerable explanatory power over returns and thus the value of equity market in the future. In the short-term, return explanatory power of these regressions is quite low though it steadily rises to reach about 35% for the 20 year forecast period. Thus both the size of the forecastable component in return and the pattern are similar to that reported in
the USA. The main difference between the results reported here and those reported in the USA is that in the USA data R Square values level out faster; after about 10 years.3

3.3 Error-Correction Model for Returns and Dividend/Price Ratios

This analysis is designed to see if a simple bi-variate ECM that captures short-term linear dynamics of log price changes and log dividend changes can replicate the patterns of predictability reported in the previous sections. The statistical aspects of model selection can be found elsewhere (Heaney, 2003). The model we select is a second order ECM for log $p_i$ and log $d_i$ with the lag length of two selected to remove serial correlation from the residuals. We also assume that log prices and dividends are cointegrated so that the dividend/price ratio is stationary (see Heaney, 2003). Table 3 details coefficient estimates and selected statistics.

3.4 Price and Dividend Simulations

Slope coefficients and corresponding R-squared statistics were simulated from the regression of changes in equity values and dividends (calculated up to the next D/P ratio mean cross-over point) on the current D/P ratio. Further, R-squared

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3 Campbell and Shiller (1989) report that smoothed earnings/price ratios are even more successful at forecasting stock returns in the USA, but these data are not available to us over the full sample period.
statistics were simulated from the regression of total return and dividend growth (calculated for horizons from 1 to 20 years) on dividend-price ratio.

The results of the simulations of crossover regressions based on 10000 simulated ECM realisations are reported in table 4. It is further assumed that innovations are Gaussian. Figure 4 plots R-squared of regressions of log total returns and dividend growth on dividend-price ratios as a function of the regression horizon.

[Insert Table 4 and Figure 4 about here]

For crossover regressions, results of simulations of a simple model are also reported for comparison. The simple model assumes that the dividend-price ratio follows a simple AR(1) process with Gaussian white noise errors and stock returns are Gaussian white noise:

\[
\begin{align*}
\pi_t &= -0.294 + 0.896 \rho \pi_{t-1} + 0.121 \nu_t \\
r_t &= 0.021 + 0.161 \omega_t \\

\nu_t &\sim N(0,1), E(\nu_t \nu_{t-j}) = 0 \forall j > 0 \\
\omega_t &\sim N(0,1), E(\omega_t \omega_{t-j}) = 0 \forall j > 0 \\
E(\nu_t \omega_{t-j}) &= 0, \forall j
\end{align*}
\]

Table 4 shows very clearly that the simple ECM replicates salient features of cross-over regressions very well, both in the amount of predictable variation in the returns and the sensitivity of returns to current D/P ratios. In contrast, the simple model has problems explaining the positive slope of the relationship between changes in prices to the crossover point and the D/P ratios evident in the Panel A of Figure 3. The estimated slope coefficient for the regression is just inside the simulated 90%
confidence interval. Importantly, the simple model cannot explain the amount or predictable variation in equity returns to crossover point.

The simple model cannot explain long-horizon predictability reported in Table 2 by construction. As illustrated in Panel A of Figure 4, the ECM can reproduce the pattern of rising R-squared observed for the return regression (3). The only obvious problem with the ECM is that it seems to overestimate the amount of dividend growth predictability (Panel B, Figure 4). However, the simulated R-squared of dividend growth regression (4) are still fairly small and lie well within 90% confidence intervals implied by the ECM.

3.5 Return Forecasts and Forecast Intervals

The analysis of the previous section leads to a conclusion that forecasts of declining equity values reported in Campbell and Shiller can be based equally well on the ECM dynamics. The benefit of the ECM analysis is that it allows placing confidence intervals around the point forecasts that have been the focus of the literature. Figure 5 shows ECM forecasts of changes in equity values for up to 20 years ahead together with 90% forecast intervals, constructed on the assumption that innovations are Gaussian.

[Insert Figure 5 about here]

The immediate forecast for equities is indeed rather bleak. The mean prediction is for a decade of declining equity values. Importantly, the median forecast reveals that the downside risk of holding equities continues to be considerable for up to 25
years, which is close to the time that the dividend yields would be expected to remain below the historical average.

4.0 Conclusions

Consistent with Campbell and Shiller (1998) we also find that the equity market dividend yield has predictive power over the future level of the equity market using share market data from 1882 to 2002. Further, while the composition of the USA equity market may have changed over the 1990s the use of value weighted indices and the small number of large firms that account for much of the Australian equity market value market suggest that changing composition is not driving the recent fall in Australian equity market dividend yield. We cannot rule out the argument that a decline in equilibrium returns is driving this fall in dividend yield and this ties in with the recent arguments suggesting lower the equity market risk premia in the future (Blanchard, 1993 and Fama and french, 2002).

Given data drawn from the period from 1882 to 2002 our findings for the Australian equity market are generally consistent with the USA equity market evidence. We find that dividend yield has some predictive power over future equity market value and the current low equity market dividend yield suggests that there may be a tendency for the equity market to fall in value over the next decade.
References


Table 1
Estimated regression coefficients

\[ r_{t,\tau_i} = -1.22 + 21.89\pi_t + 0.33\varepsilon_t, R^2 = 45\% \]

\[ g_{t,\tau_i} = 0.12 + 0.19\pi_t + 0.28\nu_t, R^2 = 0.00 \]
Table 2.
Dividend growth and stock return regressions using dividend/price ratio

<table>
<thead>
<tr>
<th>Forecast Horizon</th>
<th>Return Regression $R^2$</th>
<th>Dividend Growth Regression $R^2$</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.045</td>
<td>0.002</td>
</tr>
<tr>
<td>2</td>
<td>0.059</td>
<td>0.019</td>
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<tr>
<td>3</td>
<td>0.091</td>
<td>0.019</td>
</tr>
<tr>
<td>4</td>
<td>0.133</td>
<td>0.013</td>
</tr>
<tr>
<td>5</td>
<td>0.171</td>
<td>0.009</td>
</tr>
<tr>
<td>6</td>
<td>0.193</td>
<td>0.005</td>
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<tr>
<td>7</td>
<td>0.210</td>
<td>0.003</td>
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<tr>
<td>8</td>
<td>0.243</td>
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<tr>
<td>9</td>
<td>0.300</td>
<td>0.002</td>
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<tr>
<td>10</td>
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<tr>
<td>12</td>
<td>0.319</td>
<td>0.008</td>
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<tr>
<td>13</td>
<td>0.294</td>
<td>0.007</td>
</tr>
<tr>
<td>14</td>
<td>0.292</td>
<td>0.012</td>
</tr>
<tr>
<td>15</td>
<td>0.284</td>
<td>0.007</td>
</tr>
<tr>
<td>16</td>
<td>0.290</td>
<td>0.004</td>
</tr>
<tr>
<td>17</td>
<td>0.302</td>
<td>0.005</td>
</tr>
<tr>
<td>18</td>
<td>0.319</td>
<td>0.008</td>
</tr>
<tr>
<td>19</td>
<td>0.354</td>
<td>0.020</td>
</tr>
<tr>
<td>20</td>
<td>0.346</td>
<td>0.019</td>
</tr>
</tbody>
</table>
Table 3.
Error-Correction Model (numbers in parenthesis are asymptotic t-statistics)

<table>
<thead>
<tr>
<th></th>
<th>$\Delta d_i$</th>
<th>$\Delta p_i$</th>
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<tr>
<td>$x_{t-1}$</td>
<td>-0.016</td>
<td>0.088</td>
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<tr>
<td></td>
<td>(-0.310)</td>
<td>(1.386)</td>
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<tr>
<td>$\Delta d_{t-1}$</td>
<td>0.168</td>
<td>0.127</td>
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<td></td>
<td>(1.330)</td>
<td>(0.818)</td>
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<td>$\Delta d_{t-2}$</td>
<td>-0.204</td>
<td>-0.320</td>
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<tr>
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<td>(-1.654)</td>
<td>(-2.112)</td>
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<td>$\Delta p_{t-1}$</td>
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<td>-0.010</td>
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<td></td>
<td>(-2.323)</td>
<td>(-0.077)</td>
</tr>
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<td>$\Delta p_{t-2}$</td>
<td>0.270</td>
<td>0.106</td>
</tr>
<tr>
<td></td>
<td>(2.515)</td>
<td>(0.803)</td>
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<tr>
<td>$c$</td>
<td>0.012</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>(0.979)</td>
<td>(1.305)</td>
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Cointegrating Relationship
\[ \xi_t = 2.781 + d_t - p_t \]

$R^2$ 0.106 0.072

LM Serial Correlation Test

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<th>Lag</th>
<th>LM</th>
<th>Prob ($X^2(4)$)</th>
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<td>5</td>
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<td>0.847</td>
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<tr>
<td>10</td>
<td>7.207</td>
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Table 4.  
ECM Simulations and Data Features  
(numbers in brackets are 90% intervals)

<table>
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<th>ECM</th>
<th>Simple (AR,White Noise) Model</th>
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<td></td>
<td>Median</td>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>Price Change</td>
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<td></td>
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<tr>
<td>$\beta$</td>
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<td>15.399</td>
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<tr>
<td>$R^2$</td>
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<td>0.356</td>
<td>0.348</td>
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<tr>
<td></td>
<td>[ 0.011, 0.691 ]</td>
<td>[ 0.001, 0.334 ]</td>
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<tr>
<td>Dividend Growth</td>
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<td>-5.785</td>
<td>-4.323</td>
</tr>
<tr>
<td></td>
<td>[ -24.607, 7.809 ]</td>
<td>[ -79.978, -1.287 ]</td>
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</table>
Figure 1. Yearly dividend/price ratios

Figure 2. S-period ahead forecast variance divided by sample variance (J-Stat).
Figure 3. Dividend and price growth from the current year to the year when dividend/price ratio returns to the mean value.
Figure 4. R-squared for Stock Return (Panel A) and Dividend Growth regression forecasts using dividend/price ratio. The figures include the mean regression R-squared implied by the ECM representation and 90% confidence intervals.
Figure 5. ECM returns forecasts and confidence intervals