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Re-examination of the historical equity risk premium in Australia

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Abstract

In light of the ongoing debate over the value of the equity risk premium, its increasing use in the regulatory setting, and the impact of dividend imputation on the premium, this paper presents a timely new look at the historical equity risk premium in Australia, and provides an improved understanding of the historical record. We document concerns about data quality that become increasingly important the further back in time one looks. In particular, there are sufficient question marks over the quality of data prior to 1958 to warrant any estimates based thereon to be treated with caution. Accordingly, we present a new set of estimates of the historical equity risk premium corresponding to periods of increasing data quality but of decreasing sample size. Relative to bonds (bills), the equity premium has averaged 6.3 per cent (6.8 per cent) per annum over 1958–2005, which is a period of relatively good data quality. Together with other results in the paper, the findings reveal a historical estimate that is substantially less than widely cited historical studies would otherwise indicate. We reconcile prior evidence through documenting a dividend adjustment that has typically been overlooked. We also provide estimates that incorporate an adjustment for imputation credits.

Key words: Cost of capital; Equity risk premium; Capital asset pricing model; Valuation

JEL classification: G100, G110, G310

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1. Introduction

The value of the equity premium is one of the most fundamental yet debated matters in modern finance, in part because of its widespread use in a variety of applications including its critical role in valuations. The nature of these applications requires an unobservable *ex ante* estimate of the equity risk premium. The common approach to overcome this problem is to use *ex post* estimates obtained from historical data. For example, estimates from the USA lie in the range of 5–9 per cent and are often justified by reference to Ibbotson Associates who report a long-term estimate in the USA over 1926–2004 of 8.4 per cent per annum (p.a.).[1] In Australia, a similar range of 5–8 per cent p.a. has generally been used with common reference to Officer's (1989) estimate of 7.9 per cent p.a. based on data from 1882 to 1987.

The issue has received a great deal of recent attention partly because of the growing need for an estimate of the equity risk premium in regulatory pricing decisions. Regulators have acknowledged the difficulty in deriving the appropriate value. Nonetheless, the Australian Competition and Consumer Commission has been consistent in its adoption of 6 per cent as the value of the equity risk premium notwithstanding recognition that this decision is one that is subject to alternate views.[2]

More generally, there has been much debate over the nature of the equity risk premium in part stimulated by Mehra and Prescott (1985) who are unable to account for anywhere near the size of the historical premium by reference to economic models and reasonable risk aversion assumptions. In the present paper, we do not enter into this line of debate. Rather, we adopt the more pragmatic line as espoused by Siegel (1992), who points out that the evidence over almost 200 years is compelling that stocks beat bonds.

Furthermore, the literature has evolved to propose alternate ways of measuring the equity risk premium. Concerns over whether the *ex post* historical measures

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[1] The figure is typically referenced to the annual yearbook (Ibbotson Associates, *Stocks, Bonds, Bills and Inflation Yearbook*, Chicago, IL: Ibbotson Associates). Brealey *et al.* (2006, p. 154) state that: 'Brealey, Myers and Allen have no official position on the issue, but we believe that a range of 5–8% is reasonable for the risk premium in the United States'. However, views vary both across commentators and across time, as demonstrated by a similar statement just 6 years earlier in Brealey and Myers (2000, p. 160): 'Brealey and Myers have no official position on the exact market risk premium, but we believe that a range of 6–8.5% is reasonable for the risk premium in the United States. We are most comfortable with figures towards the upper end of the range.' Another commonly cited source is Copeland *et al.* (1995) who 'recommend using a 5–6% market risk premium for US companies' (p. 260).

[2] For example, see the Decisions in the cases of Queensland (Powerlink revenue cap of 2002), NSW and ACT (Energy Australia revenue cap of 2005), South Australia (ElectraNet revenue cap of 2002), Tasmania (Transend revenue cap of 2003), Victoria (VENCorp revenue cap of 2002 and SPI PowerNet revenue cap of 2002), MurrayLink revenue cap of 2003 and Directlink Interconnector of 2005.

represent *ex ante* expectations have led to implied models of the equity risk premium wherein the estimate is typically derived from inverting a pricing model, such as the dividend discount approach. Empirical applications have shown that these implied estimates of the equity risk premium are substantially lower than historical estimates (Fama and French, 2002; Vivian, 2005).

In contrast, the focus of the present paper is not on exploring alternate estimates of the equity risk premium. Rather, given that historical estimates have traditionally been and continue to be used, the aim of the present paper is to take a fresh look at the historical equity risk premium and the data that underlie its estimate in Australia. We are concerned that if a historical estimate is to be used, as is typically the case, then that historical estimate should be the best available. Specifically, the study is motivated by two influences from the recent literature. First, the work of Dimson *et al*. (2002, 2003) discovered that prior estimates of the equity risk premium in the UK were subject to serious limitations mainly relating to concerns over data quality prior to 1955. In this vein, the purpose herein is to draw attention to certain features of the underlying data that we believe are important in interpreting estimates, which are based thereon, as 'good data is the key to understanding history' (Dimson *et al*., 2002, p. 4). Second, Officer's (1989) study is now almost 20 years old and much has happened since. Coincidentally, Officer's study ends at the time of the introduction of the dividend imputation tax system, and to the extent that this has impacted on equity risk premium observations, the present paper addresses this issue. More generally, following the sustained bull run in financial markets of the 1990s, there has been much debate over the past decade over whether the (*ex ante*) equity risk premium has altered and, hence, a 20 year update seems appropriate.

If the equity risk premium is stationary over time, then a naïve statistical approach would suggest the longer the estimation period the better. However, we conclude that residual concerns about data quality become increasingly important the further back into the past one looks. Accordingly, the present paper presents a new set of estimates of the historical equity risk premium in Australia, which correspond to various periods of increasing data quality but of decreasing sample size.

We find that estimates based on data before 1958 should be treated with caution because of concerns over data quality and the imprecision of the underlying series. Specifically, we document a problem with the equity series that concerns the way in which dividend yields have been incorporated. The equity series contains an adjustment factor in the periods prior to 1974 that seeks to mitigate against an inherent upward bias in the series. Therefore, the adjustment to the dividend yield series is a critical factor in understanding the series of equity returns over the first half of the sample period. Furthermore, we explore a series of issues associated with constructing both a long-term bill and bond series that limit the ability to derive 'market'-based estimates and introduce an artificial smoothing of these series. We conclude that the historical equity risk premium in Australia is significantly lower than previously reported estimates otherwise suggest.

2. Prior studies

The most widely cited historical estimates of the equity risk premium in Australia are sourced from Officer (1989) for the period 1882–1987 and Dimson *et al*. (2003) for the period 1900–2002.[3] A further study by Ball and Bowers (1986) covers the relatively short period from 1974 to 1985.

Officer's (1989) estimate is 7.9 per cent p.a., Dimson *et al*.'s (2003) estimate is 7.6 per cent p.a. and Ball and Bowers (1986) report a substantially lower figure of 5.6 per cent p.a. albeit based on a much shorter time period. The similarity of the Officer and Dimson *et al*. figures is not surprising as the data used in Dimson *et al*. (2002, 2003) are substantially drawn from that of Officer (1989). Specifically, the studies of both Officer (1989) and Dimson *et al*. (2003) make use of stock return data developed by Don Lamberton and bond return data sourced from the Reserve Bank of Australia (RBA).[4]

The equity series used in Officer (1989) and Dimson *et al*. (2002, 2003) includes the stock price index data constructed retrospectively by Lamberton for the period January 1875 to December 1957, which appears in full in Lamberton (1958) and the Sydney Stock Exchange Official Gazette (1958). This index consists of two series. First, there is a Commercial and Industrial price index that runs from January 1875 to June 1936 which is then followed by the All Ordinary Shares price index covering the period from July 1936 to December 1957.

There are several features of the equity series that have implications for its use. First, although much care was exercised in the creation of this index to avoid a number of perceived pitfalls of earlier studies – Lamberton specifically notes that employing hindsight in sample selection commonly imparts an upward (survivorship) bias – the potential for some (upward) residual bias nevertheless remains. Second, the Commercial and Industrial price index from 1875 to 1936 does not include the financial sector and, therefore, is not strictly comparable to the All Ordinary Shares price index that followed from 1936 to 1957. Of note, Kearns and Pagan (1993) suggest this is the main discrepancy in the Lamberton set of price indices. Third, the Commercial and Industrial price index from 1875 to 1936 suffers from narrow coverage, with only 5 stocks included in the index in 1875, 12 in 1905 and 47 in 1935. Fourth, Australian government stock price controls were in operation from November 1941 to February 1947 and, hence, prices over this period cannot be taken as being fully

[3] Dimson *et al*. (2003) updates the earlier study of Dimson *et al*. (2002), in which the period covered is 1900–2000.

[4] However, Officer relies on a bond rate as the risk-free proxy whereas Dimson *et al*. (2003) make use of both a bond rate and a bill rate. We use 'bills' to refer to short-term (discount) government securities and 'bonds' to refer to long-term government securities. Dimson *et al*. (2002, p. 229) state that they use the treasury bill rate from 1929. They do not distinguish between treasury bills and treasury notes: an issue discussed later in the present paper.

market determined.[5] Finally, each of Lamberton's (1958) industry indices are value-weighted but in forming the All Ordinary Shares index and the All Ordinary Shares (excluding Financial) index, the relevant component industry indices have been weighted according to their aggregate amount of paid up capital.

Although it is difficult to draw a conclusion on the extent to which the above issues impact on the observed rates of return on the equity index relative to the unobserved 'true' rates of return, a consequent bias leading to an overstatement of equity performance up to the mid-1950s is probable.

3. Measurement issues

3.1. Our approach

The equity risk premium represents the rate of return on a well-diversified portfolio of risky assets in excess of the risk-free rate. But as Welch (2000, p. 502) notes: 'unfortunately there is neither a uniformly accepted precise definition nor agreement on how the equity premium should be computed'. The disagreement alluded to by Welch concerns a number of areas including: (i) the method of calculating single period returns (discrete verses continuous); (ii) the method of averaging returns over multiple periods (arithmetic mean, geometric mean or median); (iii) the appropriate proxy for the portfolio of risky assets; (iv) the appropriate benchmark for the risk-free rate (e.g. bills or bonds);[6] and (v) how the equity premium is defined relative to the risk-free rate (as a simple or geometric difference).

It is impractical to present the full set of estimates of the equity risk premium measured in every possible way. Instead, we follow accepted practice and use convention to make the various choices. We use discrete returns and report both the arithmetic and geometric means.[7] When past performance is being

[5] For further details see Brailsford and Easton (1991, p. 71). As a result, Lamberton (1958, p. 48) found 'it proved necessary to fill some gaps in the price records for the period when maximum prices were in force'.

[6] Dimson *et al*. (2002) suggest that 'only treasury bills can really be considered risk free' and only in nominal terms (p. 163) and we note further that this is true only for the life of the bill. They suggest further, '[using bonds] is harder to justify than for bills since long-term government bonds are risk free only in the sense that they normally offer a fixed income, and the likelihood of default is very small. In all other respects, they are appreciably riskier than bills since bond prices are sensitive both to changes in real interest rates and to inflationary expectations' (p. 169).

[7] From an investor's viewpoint, either way of calculating the realized return is satisfactory as it does not alter the observed end price which is ultimately what matters. However, to the extent that realized returns are used in decision-making and particularly used as an input to forming expected returns, the way in which returns are calculated does matter. In this regard, all returns must be constructed in a consistent manner.

considered, the geometric mean is of most interest, whereas for forward-looking decisions the arithmetic mean is the appropriate measure.[8] We use simple differencing between returns on a broad stock index and follow Dimson *et al*. (2003) and measure the equity premium relative to both bills and bonds.[9] Note that reconciliations and adjustments between the various methods of calculation can ensure consistency. However, the point is that clarity is required as to exactly on what basis the returns have been constructed.

A final point concerns the impact of inflation. The stock index and yields on bills and bonds are reported on a nominal basis. It is often assumed that the real and nominal equity risk premiums are identical because inflation has been accounted for in both the equity and bond rates of return. However, this is not true if the equity risk premium is defined as a simple difference between equity and bond discrete returns.[10] Hence, we report both the real and nominal equity risk premiums.

3.2. Data

3.2.1. Stock returns

The equity series is quarterly from December 1882 to December 2005. The price index is an aggregation of the following three series: (i) the Commercial and Industrial index from 1882 to 1936; (ii) the Sydney All Ordinary Shares price index from 1936 to 1979; and (iii) the Australian Stock Exchange (ASX) All Ordinaries price index from 1980 to 2005. The price index data up to

[8] '[The geometric mean] has intuitive appeal from an investment perspective. It corresponds to the annualized performance figures you see every day for mutual funds, for indexes and for pension plans . . . [it] measures the annualized rate of return that equates the initial investment to the final value of a portfolio. The geometric mean risk premium has a similar interpretation. It is the incremental reward from investing in equities in preference to government securities' (Dimson *et al*., 2002, p. 181). However, 'in practice, and perhaps because of its measurability, the historical risk premium is often treated as a proxy for the prospective risk premium' (Dimson *et al*., 2002, p. 163).

[9] There is also some debate concerning how best to measure returns on the risk-free proxy. Dimson *et al*. (2002, p. 35) suggest that long-term performance should be measured using total return (income and capital) because 'estimating bond returns simply from promised yields would frequently have overstated achieved returns since bond investors have often been disappointed and experienced capital losses' (p. 35). In contrast, Annin and Falaschetti (1998, p. 6–7) state that: 'the equity risk premium (ERP) is calculated by Ibbotson Associates using returns on the S&P 500 over the income return on the appropriate horizon Treasury security . . . Ibbotson uses the income return in calculating the ERP rather than the total return since it represents the *truly riskless* portion of the return'.

[10] The difference is due to the cross-product term in the Fisher relation. No difference arises if the equity risk premium is defined as a geometric difference (based on discrete returns) or as a simple difference (based on continuous returns).

December 1957 are the same as the Lamberton series described earlier. From January 1958, the Sydney Stock Exchange (SSE) began calculation of the Sydney All Ordinary Shares price index on a daily basis, initially adopting the same statistical structure as that designed by Lamberton.[11] Market value weighting was introduced from July 1960. In January 1980, this series was replaced by the ASX All Ordinaries price index and an accumulation index was calculated from July 1980.[12] A stock accumulation index for the period 1882–1979 was constructed retrospectively by the SSE in the mid-1980s based on the above (quarterly) price index data and three historical dividend yield series available at that time (i.e. the Lamberton/SSE yield series (for 1882–1979), the Melbourne Fifty Leaders weighted yield series (for 1965–1979) and the Statex yield series (for 1974–1979)).[13,14]

Of particular interest is the Lamberton/SSE yield series, constructed retrospectively by Lamberton for the period 1882–1955 and by the SSE for the period 1956–1961.[15] The key feature of the series is that it represents the simple (unweighted) average yield on dividend-paying shares only, with non-dividend paying shares excluded from the calculation. Therefore, the series is not strictly comparable to the corresponding stock price indices and contains two sources of bias. First, the unweighted yield will be different from the value-weighted yield and is biased towards high yielding small stocks. Second, as the series is

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[11] The Melbourne Stock Exchange calculated its own broad market index (the Melbourne All Ordinaries price index) on a daily basis, from 1963 with statistics commencing in January 1960. Although both the Sydney and Melbourne exchanges adopted the same basic method to calculate their indices, differences remained in parameters, such as structure, sample size and number of industry groups, such that the existence of two similar, but separate, indices for the one national share market created confusion both in Australia and overseas. This motivated the creation in 1980 of a single national index produced jointly by the stock exchanges of Sydney and Melbourne. From 1987, responsibility for the All Ordinaries index transferred to the newly created national ASX and more recently to S&P from April 2000.

[12] Australian Stock Exchange Journal (1980b). The Statex-Actuaries accumulation index was calculated, on a daily basis, by the SSE from March 1973 (Australian Stock Exchange Journal, 1973), with weekly values available back to March 1972. Ball and Bowers (1987) later identify that a peculiarity in the design of the index meant that it did not provide a true measure of daily total returns.

[13] Email correspondence from the ASX to the authors dated 11 April 2003 and 26 May 2004.

[14] The Melbourne Stock Exchange began calculation of a value-weighted average Melbourne Fifty Leaders yield series from November 1969, initially on a quarterly basis, with statistics retrospectively calculated back to March 1965 (Stock Exchange of Melbourne, 1969, p. xxi). The Statex weighted yield series is a value-weighted average of the yield on all companies listed on the SSE and was retrospectively calculated by the SSE back to January 1974 (Stock Exchange Research Pty Ltd, 1986, p. 101).

[15] From July 1961, the series was calculated by the SSE on a monthly basis.

based only on dividend-paying stocks, the yield is inevitably overstated as not all stocks pay dividends. This is also noted by Young *et al*. (1973 p. 2) who subsequently refer to the 'unsatisfactory features of the monthly figure of ordinary share yields which was being published'. Consequently, the SSE determined that the reported Lamberton/SSE yield series was prima facie not appropriate for the purposes of constructing an accumulation index and 'it was concluded that the real weighted dividend yield was probably overstated about a third on average and therefore the [Lamberton/SSE yield] series was reduced by 25% in the early years of the accumulation index where we didn't have any other dividend yields to guide us'.[16] Our investigations reveal that an adjustment factor of 0.75 was in fact used for the period 1882–1964. Precise details of the adjustment for the period 1965–1973 are not available but appear to involve a reduction in the order of one-third, whereas the Statex yield series appears to be have been used for the period 1974–1979.[17]

The adjustment to the dividend yield series is a critical factor in understanding the series of equity returns over the first half of the sample period. There is little doubt for the reasons discussed above that the reported Lamberton/SSE yield series is too high and, hence, any adjustment factor has a maximum value of one. The key question then follows as to how far the adjustment factor should be below the value of one. This is a very difficult question to answer directly as it would involve reconstructing the dividend series from source data over a long period of time. Nonetheless, there is other evidence that provides reasonable support when attempting to narrow the value of the adjustment factor.

First, we have the views of the stock exchange itself, whose staff carefully considered the issue and ultimately decided on an adjustment factor of 0.75. Second, in the USA, there have indeed been attempts to formulate dividend

[16] Email correspondence from the ASX to the authors dated 26 May 2004.

[17] Specifically, we take the quarterly long-term accumulation and long-term price indices and calculate the implied quarterly dividend yield (based on closing prices) for the period 1883–1979; that is, for each quarter, the return on the accumulation index is equal to the return on the price index plus the implied dividend return. We convert the implied dividend return (based on opening prices) to an implied dividend yield (based on closing prices) by multiplying by the ratio of the opening value of the price index to the closing value of the index. We then compare this to the Lamberton/SSE series (sourced from Lamberton, 1961; Australian Stock Exchange Journal, 1976, 1977, 1980a), the Statex series (sourced from Stock Exchange Research, 1986) and the Melbourne Fifty Leaders weighted series (sourced from Stock Exchange of Melbourne, 1980). We find that: (i) the ratio of the quarterly implied dividend yield to the quarterly Lamberton/SSE yield is 0.75 over the period 1883–1964; (ii) the ratio of the quarterly implied dividend yield to the quarterly Lamberton/SSE yield averaged 0.64 over the period 1965–1973; (iii) the ratio of the quarterly implied dividend yield to the quarterly Statex yield averaged 0.98 over the period 1974–1979; and (iv) the ratio of the monthly Statex yield to the monthly Lamberton/SSE yield averaged 0.76 over the period 1974–1979.

series over roughly comparable time periods. These studies consistently suggest that the average US dividend yield over the period was around 5 per cent p.a. (notwithstanding differences in their construction). For instance, Schwert (1990) reports an estimate of 5.16 per cent p.a. over 1871–1938; Wilson and Jones (1987) report a similar figure of 5.21 per cent p.a. for 1871–1925; whereas Barclay (1987) reports the dividend yield on the mid-quintile over 1900–1910 to be 4.82 per cent p.a. In comparison, the Lamberton/SSE yield series averaged 6.74 per cent p.a. over 1883–1957. To the extent that the US observations are relevant to the Australian market, this would imply an adjustment factor of around 0.75 (i.e. 5/6.74 per cent). Third, Grossman (2002) estimates both an unweighted and weighted dividend yield for the UK stock market over 1872–1913. The weighted yield is 3.48 per cent p.a., which can be compared to the unweighted yield estimated by Grossman of 5.46 per cent p.a. for the same market. From these two figures we can estimate an adjustment factor for the UK market, which points to a value of 0.64. Fourth, we have collected from the Sydney Stock Exchange Gazette, dividend yields together with the end of month stock price and number of issued shares for February 1966 (the first month of decimal currency) for all stocks listed on the SSE. Based on 590 dividend paying stocks, we estimate the simple (unweighted) average dividend yield for the month at 5.96 per cent p.a., which compares to the 5.97 per cent p.a. (based on 580 stocks) reported by the SSE. That is, we have a high degree of confidence that the dividend data that we have collected are highly correlated with those data used originally in the construction of the unweighted dividend yield series. From there, as we have collected data concerning price and the number of issued shares, we estimate the weighted dividend yield across all (908) stocks for February 1966 at 3.97 per cent, which implies an adjustment factor of 0.67 (i.e. 3.97 per cent/5.96 per cent).[18] On the basis of the above, it appears that an adjustment factor somewhere in the range of 0.65–0.75 would be defensible. We cannot be more specific, but note that there is no strong evidence to suggest that we should diverge from the currently used adjustment factor. Nonetheless, what this issue reveals is that these data and the equity premium obtained thereof should be treated with caution.

The equity return series is then obtained by taking the December values of the long-term stock price index each year to form our Historical Stock Price Index Series from 1883 to 2005. Each data point in the index series represents the average value of the index in December of that year. From 1882 to 1957, the index value for each year is based on the arithmetic average of the high and low individual stock prices during December of that year. From 1958, the yearly index value is the arithmetic average of the daily closing index values during the

[18] Furthermore, although not available for February 1966, the value of the weighted average Melbourne Fifty Leaders yield series for March 1966 is 4.02 per cent (Stock Exchange of Melbourne, 1980, p. 61).

corresponding December.[19] Similarly, we form our Historical Stock Accumulation Index Series for each calendar year from 1883 to 2005. Our estimates of the historical equity risk premium in Australia are then based on this return series because it has, for the later part of the sample period, reflected the benchmark equity index for the Australian market.

3.2.2. Bond returns

According to Butlin (1977, p. 52), 'the domestic bond market was very small in the early twentieth century; most loans were raised in London. This casts some doubts on the generality of [such yields] for a good deal of the early period.' Moreover, as noted by Ball and Bowers (1986), the absence of a liquid secondary market for bonds over much of the 1900s in Australia raises doubts over the nature of reported yields. Noting this caveat, our Historical Bond Return Series is spliced together from a number of sources.[20]

For the period 1883–1913, we use the redemption yield on New South Wales securities trading on the London capital market on the last day of December of each year, as shown in Hall (1963). Data for the period 1914–1973 are sourced from Butlin (1977). All observations are at or near the end of December of each year. The series for 1914–1925 represents the yield on Commonwealth and State government securities trading on the SSE and maturing in 4 or more years, derived from material contained in the RBA's archives. For 1926–1958, the data were sourced from the RBA's Research Department. In particular, the series for 1926–1940 is the average redemption yield on a fully taxed security maturing in 10 or more years. For 1941–1947 the series is the theoretical redemption yield on a fully taxed security maturing in 12 years. For 1948–1958 the series is the theoretical yield on government securities maturing in 10 or more years subject to current tax. For 1959–1973 the data were sourced from the RBA Statistical Bulletin and represent the theoretical yield on 10 year rebatable bonds. For the period 1974–2005, we use the yield on 10 year non-rebatable treasury bonds as at the end of December of each year. For 1974–1975, data are sourced from the RBA Statistical Bulletin. For 1976–2005, data are sourced from the RBA Occasional Paper no. 10.[21]

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[19] For consistency with the older data, we have continued to use, post-1980, the December average rather than the value of the index at the end of December of each year.

[20] We note that at any given time the (nominal) yield on a bond is a measure of its *ex ante* or promised (nominal) return. This yield will be realized *ex post* only if the bond is held to maturity and if all interim cash flows are immediately reinvested on receipt at an interest rate equal to the promised yield.

[21] Data for the period 1976 to September 1993 appear in McMillan and Martin (1993). The RBA subsequently updates these data on a quarterly basis. Data from October 1993 are available from the RBA website.

3.2.3. Bill returns

From 1914/1915, the Commonwealth government has been authorized to issue Treasury bills as security for short-term borrowings and overdraft facilities from trading banks and in particular, from the central bank – the Commonwealth Bank prior to 1959 and thereafter the RBA (Mathews and Jay, 1972, p. 92). Importantly, Treasury bills have never been a marketable security and, therefore, the prevailing discount rate at any point in time was not necessarily representative of the actual borrowing rate at that time.[22] The Commonwealth government first issued 3 month marketable short-term government securities (seasonal securities) in November 1959 followed by Treasury notes in July 1962. A consequence of this history is that reported 'yields' in the early half of the 1900s are likely to be less volatile than their true unobservable market counterparts.

Similar to the bond series, our Historical Bill Return Series is also spliced together from a number of sources. For the early period we use the midpoint of the 3 month deposit and discount rates offered by Australian trading banks at the end of December of each year. Butlin *et al*. (1971) note two limitations with these data. First, the series is based on Melbourne rather than Australia-wide data. Second, there is a break in the series for the 3 month deposit rate between 1895 and 1919; however, according to Butlin *et al*. (1971), this does not necessarily imply that no rates were quoted but rather that nothing was recorded in the underlying sources that they accessed. As there is very little variation in the 3 month discount rate over the period 1895–1919, we fill the gap in the series with the midpoint of the 3 month deposit rates that were observed in 1894 and 1920. Over the period 1937–1959, we take the only available data that exist on 'short'-term (marketable) government securities being the theoretical yield on 2 year rebatable bonds, sourced from the RBA Statistical Bulletin. We note that from 1942 to 1952, maximum rates of interest over a wide field were fixed by the Commonwealth Bank under the National Security (Economic Organization) Regulations. Therefore, the series is likely to be artificially smoothed. For 1959–1975, yield data on 3 month seasonal securities/Treasury notes are sourced from the RBA Bulletin. For 1976–2001, the data are sourced from the RBA Occasional Paper no. 10. Since December 2002, the Commonwealth government has temporarily suspended issues of Treasury notes; hence, for 2002–2005, we use the yield on 90 day Bank Accepted Bills as shown in the RBA Occasional Paper no. 10. We note that these yields will contain some small default premium, but this will be negligible especially when averaged over our sample period.

[22] For example, for the period 1945–1986, the discount rate on treasury bills was fixed at 1 per cent, except for the 3 year period from May 1949 to July 1952, during which time it was 0.25 per cent lower. See Commonwealth Bank of Australia (1954, p. 18), Hill (1985, p. 311) and Reserve Bank of Australia (1993).

From December 1959, we construct a bill index to reflect the return on a rolling investment in 3 month seasonal securities/treasury notes, assuming reinvestment on a quarterly basis. The choice of a rolling investment is consistent with the assumption of quarterly reinvestment of dividends that underlies the stock accumulation index. Using the December values of the bill index we calculate a series of annual returns, which might be interpreted as the geometric average of the opening quarterly bill yields over each calendar year.

3.2.4. Inflation

We follow Boudoukh and Richardson (1993), Dimson *et al*. (2003), Ball and Bowers (1987) and, for the majority of his sample period, Officer (1989) and measure inflation by the return on a consumer price index (CPI). We construct our CPI by linking index data from three sources. For the period 1882–1901, we use the 'W6' series from McLean (1999), which is based on prices at December year end. For 1901–1948, we use the 'Long-term Retail/Consumer Price Index' series from the Australian Bureau of Statistics (ABS, 2005). The index numbers in this series represent the average of the four quarterly index numbers in each calendar year. From 1948 onwards, we use the December year-end values of the 'CPI: All Groups Weighted Average of Eight Capital Cities' series, sourced from the ABS.

3.2.5. Imputation tax considerations

A dividend imputation tax system has operated in Australia since July 1987. Under the previous classical tax system, the after company, but before personal tax, return on equity consists of two components: capital gains and dividends. Comparable returns post-imputation now consist of three components: capital gains, dividends and the value of attached imputation (franking) credits. Existing stock accumulation indices in Australia take into account returns from (cash) dividends and capital gains only and, therefore, post-July 1987, these indices implicitly attribute no value to imputation credits distributed to investors. Under the imputation system, as corporate tax is akin to a prepayment of personal tax and to the extent that imputation credits are valued, returns derived from (unadjusted) accumulation indices underestimate the after-corporate-before-personal tax return on equity (Officer, 1994).

One view is that franking credits carry no value (i.e. 'gamma' is zero), in which case the traditional measurement of the historical equity risk premium (of capital gains plus cash dividends) requires no adjustment in an imputation environment. This is the approach implicitly adopted by Dimson *et al*. (2003). An alternative approach is to add back the value of imputation credits to the traditional measure of the equity risk premium. For instance, this approach has been adopted in practice recently by the Essential Services Commission (Victoria) and the Essential Services Commission of South Australia. The debate concerning the value of franking credits is discussed elsewhere and is outside the scope of this paper (Hathaway and Officer, 1996; Walker and Partington, 1999; Cannavan *et al*., 2004; Gray and Hall, 2006). Rather, we present three sets of estimates for the historical equity risk premium without passing judgement on which is the most appropriate figure. The first estimate coincides with the traditional measure of capital gains plus cash dividends. Then, we present two additional estimates of the *potential* impact of imputation on the historical equity risk premium in Australia. The first assumes that franking credits are fully valued and the other assumes that franking credits are valued at 50 cents in the dollar. Because of restrictions on data availability and the short sample period involved, these estimates are considered to be indicative only of the potential impact that imputation might have had on the equity risk premium.

To estimate the additional series, we require an annual series of imputation credit yields applicable to the underlying stock index. For the period 1998–2005, we use the (weighted) average imputation credit yield on the ASX All Ordinaries index for the 12 months ending December of each year, as sourced from the Australian Taxation Office. However, these data are not available prior to 1998, so for the period 1988–1997, we estimate the (weighted) average imputation credit yield c_t, for each year t, using the following model:

$$c_t = p_t d_t \frac{T_t}{1 - T_t}, \tag{1}$$

where d_t represents the annual dividend yield implied from the Historical Stock Price Index and the Historical Stock Accumulation Index, p_t is the (average) proportion franked and T_t is the tax rate at which dividends are franked. For this purpose, we assume dividends are, on average, 75 per cent franked at the current year's statutory tax rate.[23] Finally, we adjust our series of estimated imputation credit yields under different assumptions as to the value of those credits to determine alternate series of annual grossed-up equity risk premiums.

3.3. Estimation periods

The objective of the present paper is to present a new set of estimates of the historical equity risk premium in Australia corresponding to periods of increasing data quality but of decreasing sample size. We identify the following critical dates in our sample period: (i) 1883, the first (calendar) year for which data are available; (ii) 1937, the first year for which data are available on both a broad stock index (the Sydney All Ordinary Shares price index) and on marketable

[23] Using equation (1), data from the Australian Tax Office and assuming all dividends are franked at the current year's statutory tax rate, the level of franking associated with dividends paid on the ASX All Ordinaries index averaged 0.75 over the 7 year period from 1998 to 2005. For simplicity we ignore the fact that prior to 1 July 2002, companies might have maintained multiple franking accounts reflecting different statutory corporate tax rates. Corporate tax rates are sourced from the Australian Tax Office.

short-term government securities; (iii) 1958, the first year for which the Sydney All Ordinary Shares price index was calculated on a daily, rather than a retrospective, basis and (approximately) the first year for which marketable short-term government securities – seasonal securities/treasury notes – were issued; (iv) 1980, the first year for which the ASX All Ordinaries accumulation index was calculated on a daily, rather than a retrospective basis; and (v) 1988, the first (full) year of operation of the dividend imputation tax system in Australia.[24] The first four of the above dates correspond with periods of increasing data quality but of decreasing sample size. We stress that these estimation periods are not arbitrary but rather are determined by clearly identifiable and material changes in the underlying data. We also estimate the equity risk premium over three additional periods: 1883–1987 and 1900–2000, for the purposes of comparison with Officer (1989) and Dimson *et al*. (2002), and finally 1883–1957, being a period of relatively poor data quality given the cumulative nature of the improvements in data quality over time.

Although we get an improvement in data quality, we are also presented with a reduction in the statistical significance of the equity premium estimate, as a result largely of the high volatility of historical stock returns (see Jorion and Goetzmann, 1999). Furthermore, looking far into the past and calculating an arithmetic mean implicitly assumes we have a random sample of (1 year) observations on which to base our estimate. But as Welch (2000, p. 505) notes: ‘There is also the more mundane non-stationarity problem that 50-year old equity premiums may have little relevance to the world today.’

4. Results

Our focus is on the historical equity risk premium in Australia, but first we present results on the underlying components: stocks, dividends, bills and bonds, in both nominal and real terms. Table 1 sets out various statistics of the historical return on stocks over our eight sample periods from 1883 to 2005. For reasons discussed above we consider 1958 as a critical break in our sample period reflecting a switch from relatively poor quality data to relatively good quality data. We report the arithmetic mean, standard deviation and geometric mean of returns expressed in both nominal and real terms. Calculations are based on discrete returns and take into account cash dividends and capital gains

[24] We note that other studies use a different date to analyse the impact of the dividend imputation tax system relying on the argument that the immediate years following the introduction of imputation should be viewed as constituting an adjustment period (e.g. Brown and Clarke, 1993). Although this might be the case, the determination of the appropriate date as to when imputation was fully operational in a market sense is ultimately ad hoc. Moreover, regulatory systems continually change, and, for instance, the introduction of the 45 day rule arguably impacted on the workings of imputation in the market. Instead, as our study is purely empirical, we rely on what was observed in the market at the time.

Table 1
Historical stock returns 1883–2005

		Nominal				Real		
Period	Years	AM	SD	GM	Implied dividend return	AM	SD	GM
1883–2005	123	0.118**	0.160	0.107	0.051**	0.086**	0.165	0.073
1937–2005	69	0.126**	0.193	0.110	0.048**	0.071**	0.187	0.054
1958–2005	48	0.145**	0.220	0.124	0.048**	0.089**	0.210	0.068
1980–2005	26	0.156**	0.217	0.137	0.046**	0.103**	0.201	0.085
1988–2005	18	0.128**	0.143	0.119	0.045**	0.094**	0.143	0.085
1883–1987	105	0.117**	0.163	0.105	0.053**	0.084**	0.169	0.071
1900–2000	101	0.122**	0.169	0.110	0.050**	0.082**	0.172	0.067
1883–1957	75	0.102**	0.104	0.097	0.054**	0.084**	0.130	0.076

This table sets out various statistics of the historical return on stocks over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation, and GM is the geometric mean. The base data are an annual series of returns on a stock accumulation index. Calculations are based on discrete returns and take into account cash dividends and capital gains only. The real return each year is equal to the geometric difference between the nominal return and the inflation rate. Implied Dividend Return is the arithmetic mean of the annual series of dividend returns implied from the stock accumulation index and corresponding stock price index. The implied annual dividend return (based on opening prices) is equal to the simple difference between the annual return on the stock accumulation index and the annual return on the stock price index. ** indicates significance at the 5 per cent level based on a two-tailed *t*-test.

only at this point. The real return each year is equal to the geometric difference between the nominal return and the inflation rate. We also report the average annual dividend return implied from the stock accumulation index and corresponding stock price index. The implied dividend return each year (and based on opening prices) is equal to the simple difference between the annual return on the stock accumulation index and the annual return on the stock price index.

In Tables 2 and 3 we set out corresponding statistics for the historical return on bills and bonds, respectively. Results of note include:

1 Stocks have substantially outperformed both bills and bonds over 120 years. From 1883 to 2005, the nominal return on stocks, bills and bonds averaged 11.8, 5.3 and 5.7 per cent, respectively. Based on the corresponding geometric mean returns, an investment of \$A1 in stocks at the end of 1882 and rolled over at the end of each year stocks would have grown to \$A273 466 at the end of 2005. A similar investment in bills would have grown to \$A539 and a similar investment in bonds would have grown to \$A834. In real terms, the

Table 2
Historical bill returns 1883–2005

Period	Years	Nominal			Real		
		AM	SD	GM	AM	SD	GM
1883–2005	123	0.053**	0.032	0.052	0.021**	0.054	0.020
1937–2005	69	0.062**	0.040	0.061	0.009	0.046	0.008
1958–2005	48	0.076**	0.040	0.076	0.023**	0.037	0.022
1980–2005	26	0.094**	0.044	0.093	0.044**	0.026	0.043
1988–2005	18	0.076**	0.039	0.075	0.042**	0.027	0.042
1883–1987	105	0.049**	0.029	0.049	0.018**	0.057	0.016
1900–2000	101	0.054**	0.035	0.054	0.015**	0.054	0.014
1883–1957	75	0.038**	0.010	0.038	0.020**	0.063	0.018

This table sets out various statistics of the historical return on bills over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation, and GM is the geometric mean. From 1960, the base data is an annual series of returns on a bill index. From 1937 to 1959, the base data are an annual series of yields on 'short' term government securities as at December of each year. Prior to 1937, the base data is the mid point of the 3 month deposit and discount rates offered by Australian trading banks at the end of December of each year. Calculations are based on discrete returns. The real return each year is equal to the geometric difference between the nominal return and the inflation rate. ** indicates significance at the 5 per cent level based on a two-tailed *t*-test.

corresponding returns are 8.6, 2.1 and 2.5 per cent p.a., meaning a $A1 investment in each of stocks, bills and bonds at the end of 1882 and rolled over at the end of each year would have grown to $A5627, $A11 and $A17 at the end of 2005.

2 Stocks have also substantially outperformed both bills and bonds in more recent years. Over almost 50 years from 1958 to 2005, the nominal return on stocks, bills and bonds averaged 14.5, 7.6 and 8.2 per cent p.a., respectively. In real terms, the corresponding returns are 8.9, 2.3 and 2.8 per cent.

3 The (null) hypothesis of no change in the mean return on stocks between 1883–1957 and 1958–2005 cannot be rejected, irrespective of whether returns are expressed in nominal or in real terms.[25] However, the nominal mean return on both bills and bonds are statistically significantly higher over 1958–2005 compared to 1883–1957 (*t*-test not reported), but when returns are expressed in real terms, the (null) hypothesis of equal means cannot be rejected. Therefore, it is reasonable to argue that *if* there has been any long-term change in the

[25] The mean nominal equity return over 1883–1957 is 10.2 per cent p.a. compared to 14.5 per cent p.a. over 1958–2005, a difference that appears large but one that is accompanied by large standard errors.

Table 3
Historical bond returns 1883–2005

Period	Years	Nominal			Real		
		AM	SD	GM	AM	SD	GM
1883–2005	123	0.057**	0.030	0.056	0.025**	0.051	0.023
1937–2005	69	0.068**	0.035	0.068	0.015**	0.043	0.014
1958–2005	48	0.082**	0.034	0.081	0.028**	0.032	0.027
1980–2005	26	0.096**	0.036	0.095	0.045**	0.023	0.045
1988–2005	18	0.077**	0.027	0.077	0.044**	0.023	0.044
1883–1987	105	0.053**	0.029	0.053	0.021**	0.054	0.020
1900–2000	101	0.060**	0.032	0.060	0.021**	0.052	0.020
1883–1957	75	0.041**	0.009	0.041	0.023**	0.060	0.021

This table sets out various statistics of the historical return on bonds over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation, and GM is the geometric mean. The base data are an annual series of yields on long-term government securities as at December of each year. Calculations are based on discrete returns. The real return each year is equal to the geometric difference between the nominal return and the inflation rate. ** indicates significance at the 5 per cent level based on a two-tailed *t*-test.

equity risk premium then it has been driven by changes in nominal yields rather than changes in equity returns.

4 The standard deviations of the nominal return on stocks, bills and bonds over 1883–2005 are 16.0, 3.2 and 3.0 per cent p.a., respectively. Over 1958–2005, the corresponding figures are 22.0, 4.0 and 3.4 per cent p.a. and in each case, this represents a statistically significant increase over the earlier 1883–1957 period (F-test not reported). However, when returns are expressed in real terms the annual standard deviations are 21.0, 3.7 and 3.2 per cent p.a. over 1958–2005 compared to 13.0, 6.3 and 6.0 per cent p.a. over 1883–1957.

In comparison to Officer (1989) who reports that the nominal return on stocks and bonds averaged 13.1 and 5.2 per cent p.a., respectively, over 1883–1987, we find that the respective averages are 11.7 and 5.3 per cent p.a. In another comparison, over 1900–2000, we find that the nominal return on stocks, bills and bonds averaged 12.2, 5.4 and 6.0 per cent p.a., respectively, compared to 13.3, 4.6 and 5.8 per cent reported by Dimson *et al*. (2002).[26]

[26] See table 18.1 in Dimson *et al*. (2002). This suggests that only a small difference, on average, is due to our use of a yield-based measure of bond returns compared to the total return-based measure of bond returns used by Dimson *et al*. (2002).

Table 4
Historical equity risk premium 1883–2005

Period	Years	Nominal			Real		
		AM	SD	GM	AM	SD	GM
Panel A: Relative to bills							
1883–2005	123	0.066**	0.160	0.053	0.065**	0.152	0.053
1937–2005	69	0.064**	0.191	0.046	0.062**	0.178	0.047
1958–2005	48	0.068**	0.221	0.045	0.066**	0.205	0.046
1980–2005	26	0.062	0.219	0.039	0.059	0.204	0.040
1988–2005	18	0.052	0.152	0.042	0.052	0.147	0.042
1883–1987	105	0.068**	0.162	0.055	0.067**	0.153	0.055
1900–2000 (simple diff)	101	0.068**	0.168	0.054	0.067**	0.159	0.054
1900–2000 (geometric diff)	101	0.065**	0.156	0.053	0.065**	0.156	0.053
1883–1957	75	0.064**	0.106	0.058	0.064**	0.106	0.058
Panel B: Relative to bonds							
1883–2005	123	0.062**	0.160	0.049	0.061**	0.151	0.050
1937–2005	69	0.058**	0.191	0.040	0.056**	0.178	0.041
1958–2005	48	0.063**	0.220	0.040	0.061**	0.205	0.041
1980–2005	26	0.060	0.217	0.038	0.057	0.203	0.038
1988–2005	18	0.051	0.150	0.040	0.050	0.145	0.040
1883–1987	105	0.064**	0.162	0.051	0.063**	0.153	0.052
1900–2000 (simple diff)	101	0.062**	0.168	0.048	0.061**	0.158	0.049
1900–2000 (geometric diff)	101	0.059**	0.155	0.047	0.059**	0.155	0.047
1883–1957	75	0.061**	0.106	0.056	0.061**	0.106	0.056

This table sets out various statistics of the historical equity risk premium over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation, and GM is the geometric mean. The base data are: (i) an annual series of nominal equity premiums defined as the (simple) difference between the nominal stock return and the nominal risk free rate; and (ii) an annual series of real equity premiums defined as the (simple) difference between the real stock return and the real risk free rate, where the real return each year is equal to the geometric difference between the nominal return and the inflation rate. For the period 1900–2000, we also show results for equity premiums defined as the geometric difference between the stock return and the risk free rate. The stock return is based on a stock accumulation index and takes into account cash dividends and capital gains only. Two measures of the risk free rate are used: the return on bills and the return on bonds. Calculations are based on discrete returns. ** indicates significance at the 5 per cent level based on a two-tailed t-test.

We now turn to the results on the historical equity risk premium. Table 4 sets out various statistics of the nominal historical equity risk premium over our eight sample periods, measured as a simple difference relative to both the return on bills (Panel A) and bonds (Panel B). For the period 1900–2000, we also show results for equity risk premiums defined as a geometric difference. We focus on the nominal rates for ease of comparison with prior studies. Results of note include:

5 Relative to bills, the equity risk premium averaged 6.6 per cent p.a. over 1883–2005 and 6.8 per cent p.a. over 1958–2005, which are both statistically significant.
6 Relative to bonds, the equity risk premium averaged 6.2 per cent p.a. over 1883–2005 and 6.3 per cent p.a. over 1958–2005, which are both statistically significant.

In comparison with prior studies, we find that over 1883–1987, the equity risk premium relative to bonds averaged 6.4 per cent p.a., which compares to 7.9 per cent p.a. reported by Officer (1989). In another comparison, over 1900–2000, the equity risk premium relative to bonds averaged 6.2 per cent p.a., which compares to 7.5 per cent p.a. reported by Dimson *et al*. (2002).[27] Furthermore, over 1900–2000, the equity risk premium relative to bills averaged 6.8 per cent p.a., which compares to 8.7 per cent p.a. reported by Dimson *et al*. (2002).[28] From the earlier results, the difference is largely explained by our lower estimate of stock returns over the period prior to 1958 and in the case of Dimson *et al*. the difference is explained by a combination of our lower estimate of stock returns prior to 1958 and higher estimate of bill returns prior to 1960.

In summary, our estimates of the historical equity risk premium are materially lower than those reported in prior studies. We examine the sensitivity of our results to the dividend yield series used in the retrospective construction of the underlying stock accumulation index prior to 1958: being the date that Officer (1989) and Dimson *et al*. (2002) stop using data sourced from Lamberton. As noted earlier, although there might be uncertainty about the appropriate magnitude of the adjustment to be made to the Lamberton/SSE dividend yield series, it is clear that an adjustment is required. In the absence of doing so, estimates of the historical stock return and, hence, the historical equity risk premium will be overstated. Specifically, our Historical Stock Accumulation Index Series is based on the Lamberton/SSE dividend yield series reduced by a factor of 25 per cent. Instead, we now recalculate the index assuming no such adjustment is made to the Lamberton/Sydney series.

Using the unadjusted dividend yield series, we find that over 1883–1957, the nominal return on equity averaged 12.0 per cent p.a., which when combined with an average return on bonds of 4.1 per cent p.a. over the period yields an

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[27] The estimate of 7.5 per cent p.a. is based on simple differencing and is implied from the arithmetic average (nominal) returns reported in table 18.1 of Dimson *et al*. (2002). Based on geometric differencing, we estimate the premium over 1900–2000 at 5.9 per cent p.a. compared to 8.0 per cent p.a. in Dimson *et al*. (2002).

[28] The estimate of 8.7 per cent p.a. is based on simple differencing and is implied from the arithmetic average (nominal) returns reported in table 18.1 of Dimson *et al*. (2002). Based on geometric differencing, we estimate the premium over 1900–2000 at 6.5 per cent p.a. compared to 8.5 per cent p.a. in Dimson *et al*. (2002).

average equity risk premium relative to bonds of 8.0 per cent p.a. Over a similar period, Officer (1989) reports corresponding returns of 12.1 and 4.0 per cent p.a. giving an average equity premium relative to bonds of 8.1 per cent p.a.[29] Accordingly, the difference between our results and those of Officer (1989) and Dimson *et al*. (2002), which is largely explained by our estimate of lower stock returns, appears in turn to be largely explained by differences in the dividend yield series used in the retrospective construction of the underlying stock accumulation index for the period prior to 1958.[30]

Finally, we turn to the potential impact of imputation. We re-estimate the returns on equity from 1988 under two assumptions. First, we assume that imputation credits are fully valued (which places an upper bound on the potential impact of imputation) and, second, we assume credits are valued at 50 cents in the dollar. The effect of these adjustments is to raise the average return on stocks such that the fully grossed-up nominal return averaged 12.1 per cent p.a. over 1883–2005, 15.2 per cent p.a. over 1958–2005 and 14.7 per cent p.a. over 1988–2005. The corresponding returns, based on dividends and capital gains only, are 11.8, 14.5 and 12.8 per cent p.a.

The impact of imputation on equity returns flows through to the equity risk premium. In Table 5, we present statistics on the historical equity risk premium assuming that (distributed) imputation credits are fully valued, whereas in Table 6 we assume that credits are valued at 50 cents in the dollar. Note that we do not imply that credits should be valued at these levels but rather present them as reference points. These two tables set out the statistics on the historical equity risk premium, grossed-up for the value of imputation credits, and measured relative to both bills and bonds.

From Table 5, relative to bills, the fully grossed-up equity premium averaged 6.8 per cent p.a. over 1883–2005, 7.6 per cent p.a. over 1958–2005 and 7.2 per cent p.a. over 1988–2005, which are significant at levels of 1, 5 and 10 per cent, respectively. Relative to bonds, the fully grossed-up equity premium averaged 6.5 per cent p.a. over 1883–2005, 7.0 per cent p.a. over 1958–2005 and 7.0 per cent p.a. over 1988–2005, which are significant at levels of 1, 5 and 10 per cent, respectively.

We reiterate that because of restrictions on data availability and the short sample period involved, these estimates are considered to be indicative only of the potential impact that imputation might have on the equity risk premium in Australia.

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[29] See table 14.1 in Officer (1989) and note that his sample commences in 1882 whereas ours commences in 1883.

[30] As a further test, we use a dividend adjustment factor of 0.875. We find that over 1883–1957, the nominal return on equity averaged 11.1 per cent p.a., which when combined with an average return on bonds of 4.1 per cent p.a. over the period yields an average equity risk premium relative to bonds of 7.0 per cent p.a.

Table 5
Historical equity risk premium 1883–2005 (grossed-up for the value of imputation credits assuming credits are fully valued)

		Nominal			Real		
Period	Years	AM	SD	GM	AM	SD	GM
Panel A: Relative to bills							
1883–2005	123	0.068**	0.160	0.056	0.067**	0.152	0.056
1937–2005	69	0.069**	0.192	0.052	0.067**	0.178	0.052
1958–2005	48	0.076**	0.221	0.052	0.073**	0.205	0.053
1980–2005	26	0.075	0.219	0.053	0.072	0.204	0.053
1988–2005	18	0.072	0.153	0.061	0.070	0.148	0.060
1883–1987	105	0.068**	0.162	0.055	0.067**	0.153	0.055
1900–2000 (simple diff)	101	0.071**	0.168	0.057	0.069**	0.158	0.057
1900–2000 (geometric diff)	101	0.067**	0.156	0.056	0.067**	0.156	0.056
1883–1957	75	0.064**	0.106	0.058	0.064**	0.106	0.058
Panel B: Relative to bonds							
1883–2005	123	0.065**	0.160	0.052	0.064**	0.152	0.053
1937–2005	69	0.063**	0.191	0.045	0.061**	0.178	0.046
1958–2005	48	0.070**	0.220	0.047	0.068**	0.205	0.048
1980–2005	26	0.073	0.218	0.052	0.070	0.203	0.051
1988–2005	18	0.070	0.151	0.060	0.069	0.147	0.059
1883–1987	105	0.064**	0.162	0.051	0.063**	0.153	0.052
1900–2000 (simple diff)	101	0.065**	0.168	0.051	0.063**	0.158	0.051
1900–2000 (geometric diff)	101	0.061**	0.155	0.049	0.061**	0.155	0.049
1883–1957	75	0.061	0.106**	0.056	0.061**	0.106	0.056

This table sets out various statistics of the historical equity risk premium over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation, and GM is the geometric mean of returns. The base data are: (i) an annual series of nominal equity premiums defined as the (simple) difference between the nominal stock return and the nominal risk free rate; and (ii) an annual series of real equity premiums defined as the (simple) difference between the real stock return and the real risk free rate, where the real return each year is equal to the geometric difference between the nominal return and the inflation rate. For the period 1900–2000, we also show results for equity premiums defined as the geometric difference between the stock return and the risk free rate. The stock return is based on a stock accumulation index and takes into account cash dividends, capital gains and the value of imputation credits assuming credits are fully valued. Two measures of the risk free rate are used: the return on bills and the return on bonds. Calculations are based on discrete returns. ** indicates significance at the 5 per cent level based on a two-tailed *t*-test.

5. Conclusion

The present paper examines the data that underpin a number of widely cited estimates of the historical equity risk premium in Australia, with a view to

Table 6
Historical equity risk premium 1883–2005 (grossed-up for the value of imputation credits assuming credits are valued at 50 cents in the dollar)

		Nominal			Real		
Period	Years	AM	SD	GM	AM	SD	GM
Panel A: Relative to bills							
1883–2005	123	0.067**	0.160	0.054	0.066**	0.152	0.055
1937–2005	69	0.066**	0.191	0.049	0.064**	0.178	0.049
1958–2005	48	0.072**	0.221	0.049	0.070**	0.205	0.050
1980–2005	26	0.068	0.219	0.046	0.065	0.204	0.046
1988–2005	18	0.062	0.152	0.051	0.061	0.147	0.051
1883–1987	105	0.068**	0.162	0.055	0.067**	0.153	0.055
1900–2000 (simple diff)	101	0.069**	0.168	0.055	0.068**	0.158	0.056
1900–2000 (geometric diff)	101	0.066**	0.156	0.054	0.066**	0.156	0.054
1883–1957	75	0.064**	0.106	0.058	0.064**	0.106	0.058
Panel B: Relative to bonds							
1883–2005	123	0.063**	0.160	0.051	0.063**	0.151	0.051
1937–2005	69	0.060**	0.191	0.043	0.059**	0.178	0.044
1958–2005	48	0.067**	0.220	0.043	0.064**	0.205	0.045
1980–2005	26	0.067	0.217	0.045	0.064	0.203	0.045
1988–2005	18	0.060	0.150	0.050	0.059	0.146	0.049
1883–1987	105	0.064**	0.162	0.051	0.063**	0.153	0.052
1900–2000 (simple diff)	101	0.063**	0.168	0.049	0.062**	0.158	0.050
1900–2000 (geometric diff)	101	0.060**	0.155	0.048	0.060**	0.155	0.048
1883–1957	75	0.061**	0.106	0.056	0.061**	0.106	0.056

This table sets out various statistics of the historical equity risk premium over a number of sample periods from January 1883 to December 2005. The first four periods are ones of increasing data quality but decreasing sample size. The fifth period reflects the introduction of the dividend imputation tax system in Australia. The next two periods are similar to those used in the widely cited studies of Officer (1989) and Dimson *et al*. (2002). The final period is one of relatively poor data quality. AM is the arithmetic mean, SD is the standard deviation and GM is the geometric mean of returns. The base data are: (i) an annual series of nominal equity premiums defined as the (simple) difference between the nominal stock return and the nominal risk free rate; and (ii) an annual series of real equity premiums defined as the (simple) difference between the real stock return and the real risk free rate, where the real return each year is equal to the geometric difference between the nominal return and the inflation rate. For the period 1900–2000, we also show results for equity premiums defined as the geometric difference between the stock return and the risk free rate. The stock return is based on a stock accumulation index and takes into account cash dividends, capital gains and the value of imputation credits assuming credits are valued at 50 cents in the dollar. Two measures of the risk free rate are used: the return on bills and the return on bonds. Calculations are based on discrete returns. ** indicates significance at the 5 per cent level based on a two-tailed *t*-test.

obtaining a better understanding of the historical record. We find that concerns about data quality become increasingly important the further back into the past one looks and, in particular, there are sufficient deficiencies in data quality prior to 1958 to warrant any estimates based thereon to be treated with caution. We present a new set of estimates of the historical equity risk premium corresponding to periods of increasing data quality but of decreasing sample size. Relative to bonds (bills), the equity premium has averaged 6.2 per cent (6.6 per cent) p.a. over the full sample period of 1883–2005, and 6.3 per cent (6.8 per cent) p.a. over 1958–2005, a period of relatively good data quality. We also provide estimates of the equity risk premium that are grossed-up for the value of franking credits.

Our results are materially lower than those cited elsewhere, such as in Officer (1989) who reports 7.9 per cent p.a. over 1883–1987 relative to bonds, and in Dimson *et al*. (2002) who report 7.5 per cent (8.7 per cent) p.a. over 1900–2000 relative to bonds (bills). The difference in the findings is largely explained by our estimate of lower stock returns prior to 1958 (and to a lesser extent higher bill returns prior to 1960). Our results suggest the historical equity risk premium in Australia is substantially lower than prior studies otherwise suggest.

Given the heavy reliance of the historical equity premium in policy and practice matters, we end with a final word of caution. The sample mean is an unbiased estimator of the true population mean for any population whose mean exists. If we assume that future returns are drawn from the same population from which past returns are drawn then the reliance on the historical record can be justified. However, if we cannot assume that future returns are drawn from the same population as past returns, for example, because of a perceived structural break in the economy, then a more direct and hence better approach is to simply exclude that part of the sample period which relates to the prebreak economic conditions, as by definition, the full sample no longer constitutes a random sample from which a sensible estimate may be determined. Similarly, the same logic applies where there are concerns over a data series such that parts of the series are constructed so to measure a different variable or where questions over data quality inhibit recognition of the population. But this is not to justify the exclusion of an individual data point *within* a sample simply because it is rare or large.

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