

Australian Market Risk Premium

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1. Introduction

The Market Risk Premium (MRP) is the extra return investors require for holding risky assets. It plays a central role in valuation as it is a major input into the cost of capital. The required return by investors and the cost of capital are two sides of the same coin – they are the same concept viewed from the perspectives of the suppliers of capital (investors) and the users of capital (typically companies).

In order to estimate the required risk premium, we could just interrogate investors – but who do we ask - Chief Investment Officers in large pension funds, current and past individual investors, Corporate Finance Officers, future prospective investors? Even if we could identify the appropriate cohort, how do we know they are giving us reliable insight into their expectations? Surveys are conducted on these issues but they pose as many questions as they answer. For instance, does the age and experience of the respondent bias their expectations? If one has never experienced a decade of share prices going sideways (in nominal terms) then perhaps it is hard to allocate that prospect any subjective probability when deriving a personal MRP expectation. It could also be that many respondents are just reciting the MRP estimates they were taught in university finance faculties and business schools. Their personal estimates of the MRP could just be the historical estimates given the guise of personal expectations.

An alternative approach is to assume that investors base their expectations on that information they already have. In particular, we often assume that their past experience is a major driver of future expectations. This past experience has to be considered carefully. It cannot be the last few years of market returns. Individual years, particularly the last few years, demonstrate just how volatile can be the markets. Even decades of market returns can be unusually good or bad. *It is precisely the risk of experiencing these fluctuating returns for which one gets a risk premium.* We need many years of data to average out these risky outcomes and so distil the underlying excess of the risky asset return over the riskless asset return.

This long term averaging process itself introduces problems. The application of the risk premium is as a forward looking or ex-ante estimate but the historical averaging process is a backward looking or ex-post or realised estimate. When calculating the historical average for the MRP and then applying it against future expectations, are there any significant events in the past that impact the MRP estimate which we do not expect to reoccur in the future? If so, then these ought to be discounted out of the historical MRP estimates. The most vexing such event is the more than doubling of the Price Earnings Ratio (PER) of stock markets through the period 1980-1990. Do we discount this inflation in market price from the historical returns? After all, we commonly discount historical consumer purchasing inflation (CPI) out of stock and bond returns in order to get the underlying real return, so why should

we not also discount this other inflation (maybe it was an inflation in the price of risk)? One could argue that it represented a form of risk - a good outcome for holders of equity and a reciprocal bad outcome for issuers of equity whom, in hindsight, might much rather have issued more expensive equity in 1990 rather than cheaper equity in 1980. As such, if it is still a risk in the market then it ought to be included as part of the MRP.

The risk premium is a premium over and above the risk free rate. But what do we mean by the “risk-free rate”? There are so many rates as candidates for this measure that we have to be very careful and logical in what we consider to be a risk free rate. The most common candidates are Government rates as these have (in most cases) no default risk. If held to maturity there will be no capital gain or loss events caused by interest rate changes and the bond holder will achieve the promised yield to maturity (YTM). However, there is a whole plethora of these rates with different maturities ranging from very short-dated paper (bills) to very long dated paper (bonds). This yield to maturity structure or term structure of rates is really not that important for the MRP estimate. There is no obvious term structure for equity returns. We can safely assume the expected mean return per period on the equity market is the same for short-term investments as for long term investments. There is so much noise or standard error in the estimate of average equity return that we could not hope to make fine distinctions of mean returns by investment horizon. Hence the MRP measured at the long end of the interest yield curve will typically be less than the MRP measured at the short end of the yield curve (as the yield curve normally slopes upwards). However, as long as one is *consistent* and combines the MRP measured at the long end with long dated risk free rates (and similarly the short end MRP estimate with bill rates) then there will not be a problem.

A far more pernicious problem is that some analysts use *returns* on bonds as their risk free return estimate. This is wrong. Suppose interest rates move up and in response stock prices generally move down. This would be a *systematic* risk event for many stocks – many stock prices would also move down depending on the degree of interest rate sensitivity of each stock price. So interest rate risk is one input into the plethora of risks that go to make up the MRP. However, it is also a risk in bond returns as bond prices nearly always move in the exact opposite direction to rate moves. A typical Australian government bond portfolio has a duration of 3.6 years (call it 4 years for ease of mental arithmetic) so that if yields move up 25 basis points (bp) then the bond portfolio value moves down 1% or 100 bp. So the return on the equity market minus the return on the bond portfolio is not an absolute risk measure – there is some common risk in both so the difference in returns across equities and bonds cannot be a measure of the MRP. Bond holders typically did not anticipate the high inflation of 1975-1995 so they suffered capital losses in their bonds, particularly in the early years. These negative bond returns will tend to bias upwards the difference between equity and bond returns.

We use the long end of the YTM curve whenever possible for estimating the MRP. That is, we use the YTM on ten year bond portfolios. The reason is a pragmatic one. There is a lot more volatility in the rates at the short end than there is in the YTM at the long end. Hence there is a lot more statistical error in estimating the MRP when using bill rates instead of bond yields.

This last example of bond capital gains or losses also elucidates a problem with using historical averages for equity returns. A drop in bond rates from 6% pa to 5% pa will create a capital gain for the bond holder of 4%. Prior to the drop in rates bond holders were expecting to make 6% pa return on their bonds and now, looking ahead, they expect to make 5% pa return on their bonds. The increased return via the capital gain of 4% on top of the, now historical, expectation of 6% has not caused them to increase their return estimates. Rather, they have achieved the ex-post increased return of 4% as a consequence of the market reducing its ex-ante expectation down from 6% to 5%. If we apply the same logic to the equity market, then any reduction in the expected or ex-ante MRP will lead to an historical or ex-post capital gain in equity prices. But if we use the historical average of returns as our guide for future expectations then our estimate will move in the exactly wrong direction. The historical average MRP has increased whereas the forward looking or ex-ante risk premium has decreased. If we are using historical capital gains or losses as a guide to the MRP then we are implicitly assuming that these gains and losses have not come about from shifts in the expected MRP. This is an issue when deciding how to handle the shift in the market PER or its reciprocal, the earnings yield. If the shift down in the earnings yield reflects a fundamental decline in required risk premium, then we ought not to include its return impact in estimating the expected MRP.

Instead of trying to adjust the historical MRPs for unexpected changes we think may not reoccur, another approach is to find situations where the ex-ante MRP is priced in the market and attempt to extract out implied MRPs. One obvious case is the current price of shares where the price is presumably set by rational investors whom have used their expected MRP in deciding the current value. If we knew the model they used for valuation, or at least had a model that was consistent with their model and had consistent input data, then we could extract the implied MRP from the market. The most common way this is done is to use a simple dividend discount model applied to the whole market. As long as we use sensible long term assumptions on market-wide growth, then we can derive a simple model that does indeed give an estimator for the ex-ante MRP. Alas, in practice it has problems— if we follow the estimator through time it would have given us negative implied MRPs and these cannot be sensibly used in forward looking valuations. The trouble with the model is it is too rigorous in its assumptions. It is a perpetuity model that has constant assumptions but it is applied in an ever changing world. The poor thing is not up to the task. We are asking too much of it.

We need to be clear when estimating the MRP whether we are trying to estimate unconditional or conditional MRPs. The conditional MRP would be estimated conditional on the current state of our information, ie, the current state of our prospects. In contrast, the unconditional MRP is based on expected long term means. The easiest way to see the difference in these two measures is to think of the prospects for your football (or tennis, cricket or whatever) team winning the next grand final. These nearby prospects depend on the current state of your team versus the competition. Recent team form will be an important factor in determining your answer. However, if you are asked the prospects of your team winning the grand final in 40 years time, then this recent information is irrelevant. Most people fall back to the long term averages to answer this type of question. In the first case you are conditioning your answer on recent prospects whereas in the second case you are giving an unconditional estimate. The same phenomenon occurs in the MRP estimates. Some analysts are using conditional MRPs and some are using unconditional MRPs. Even though they parade as the one thing, the “MRP”, they are indeed quite different. This ambiguity is another source of confusion.

A couple of apparently arcane calculation issues are important to consider. These turn out to be fundamentally important issues but are often ignored. The two issues are first how returns are calculated and then averaged and secondly the order of taking averages in estimating the MRP. Do we calculate the average of equity returns minus the opening risk free rate or do we calculate the average of the differences between equity returns and bond yields?

The act of calculating average returns and then compounding these averages can lead to amazing biases in estimated total returns, particularly for the higher risk assets like equities. This whole issue pervades the performance reporting of equity fund managers. However, it has received much less attention in the field of the MRP. We must be careful to separate the two issues of calculating returns and reporting returns. Banks and financial institutions often report their rates as annual rates but do all their calculations with daily rates. Equity returns have an analogous problem, particularly with average returns. For example, between 31-Dec-1979 and 31-Jan-2005, the ASX All Ordinaries Accumulation index made a grand total return of 2,299%. On a monthly return basis, the average return is 1.196% per month. If we foolishly compound up this average from 31-dec-1979 to 31-Jan-2005 we calculate a total return of 3468% for the All Ordinaries Accumulation index, an amazing bias of 1,186%! If instead of arithmetic returns we calculate compound average monthly growth rates (the geometric average rate) or continuous average growth rates (using logs of prices) then the monthly average returns are 1.047% pm and 1.042% pm respectively. In both cases there is no bias at all when we compound up for the total period. In analogy with the banks, we will do all our return calculations using these geometric and continuous rates but report the rates as arithmetic equivalents. There is a

widely accepted argument that investors base their expectations on reported returns and these are typically arithmetic. We demonstrate how to convert CAGR to equivalent arithmetic averages.

The other issue for estimating averages is the order of calculating the average. First, we could calculate the equity return each period (month, quarter or year) and then subtract the opening period risk free rate. This would create a sequence of excess returns. This sequence would then be averaged over a window of given time horizon. The alternative approach is to estimate average equity returns over a window of given length and then subtract the opening risk free rate. If we think of the MRP as the expected risky asset return minus the expected (and also known) opening risk free rate, then under the heroic assumption of unbiased expectations, the coming average market return is an estimator for the expected risky asset return. In this case, the coming average market return minus the opening risk free rate is an unbiased estimator of the expected MRP. Accordingly, we prefer estimating the MRP by the second alternative – the coming risky asset return and subtract the opening risk free rate.

The obvious conclusion from the above discussion is that there is ample room for ambiguity in the words “market risk premium”. There is the question of whether it is a realised or expected risk premium, over what horizon do we measure the average, is it a conditional or unconditional estimate, what is the appropriate risk free rate, do we use bond returns or YTM, do we calculate arithmetic averages or geometric averages and do we calculate the average of the differences or the difference of the averages?

In order to avoid as much ambiguity as possible, we will adopt the following notation. The realised historical MRP will be denoted by $MRP(H)$, this historical average MRP adjusted for one-off unexpected changes as $MRP(Ha)$ and the implied MRP from current prices will be denoted as $MRP(I)$. All our estimates are unconditional ones. We leave the conditional estimates to those who are trying to forecast the nearby prospects of asset returns. Where it is important, the returns calculated in the classical discrete manner will be denoted as R^D and calculated as $R^D = (P^{close} - P^{open})/P^{open}$. Similarly, continuous returns will be denoted by R^C and calculated as $R^C = \ln(P^{close}/P^{open})$. Also, compound average growth rates, R^G , over a period of length T will be calculated as $P^{close}/P^{open} = (1+R^G)^T$.

The above issues and more are all investigated below. However, we first take a close look at the historical data used in this analysis. The data has been collected from many sources over the years and, unfortunately, the names of many very helpful people in the various Stock Exchanges around Australia have been long lost. I can only hope that the analysis does some justice to their generous assistance.

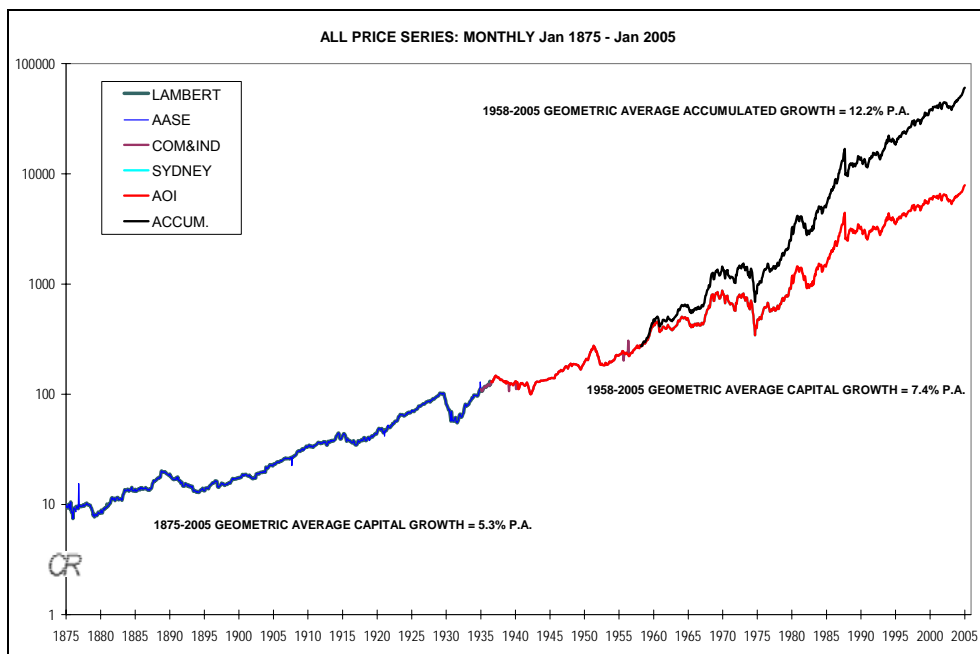
2. Data

In this section we examine the input data for estimating the Australian MRP. We look at the attributes of the data and consider how these attributes may impinge on the estimates of the MRP. The data we examine are stock indices, both price and accumulation, from 1875 to 2005, dividend yields from 1882 to 2005, market PER from 1961-2005, bond yields to maturity and CPI from 1875-2005 and GDP in constant prices and per capita from 1959-2004.

2.1 Price and accumulation series 1875 to 2005

Up until 1980, the Australian stock market was a set of state-based companies each running its own exchange business. Gradually, these businesses coalesced into one joint business, now called the Australian Stock Exchange (ASX). This business history is reflected in the history of the market indices. Various indices and sub-sectors were introduced over the years and in some cases back-dated calculations were created – see our paper *LongTerm.doc* for a fuller discussion of these historical issues. These various indices can be located under different names – Australian Associated Stock Exchanges (AASE) indices, Commercial & Industrial index, Melbourne index and Sydney index, Lambert index etc. They are collectively plotted in Figure 1.

Figure 1: Australian equity price series 1875-2005



Apart from a couple of suspicious data points, the Lambert, AASE, Commercial & Industrial and Sydney indices all coincide for the period 1875-1934. This indicates they are all essentially the same

series. Mr. D. Lamberton was engaged by the Sydney Exchange for the post World War II index revision and for the back-calculation of the Commercial & Industrial Index. So we have an historical index of industrials only. It excludes mining and finance for the period pre-1934. It is a price series only.

Accumulation series took much longer to appear than did price series. A back-dated accumulation series to 1929 is available but it is an annual series only and not shown here. The Statex Actuaries accumulation index is not used as there were problems with its early calculations. Further changes have occurred recently with the index service passing to Standard & Poors, the cut-over taking place in April 2000. S&P have back-calculated their All Ordinaries index of 500 stocks to June 1992 and it is not the same as the ASX All Ordinaries index of 251 stocks after 1992 up to its demise in 2000. The ASX index showed somewhat higher returns than the S&P index. We use the back-dated S&P indices, price and accumulation, from 1992.

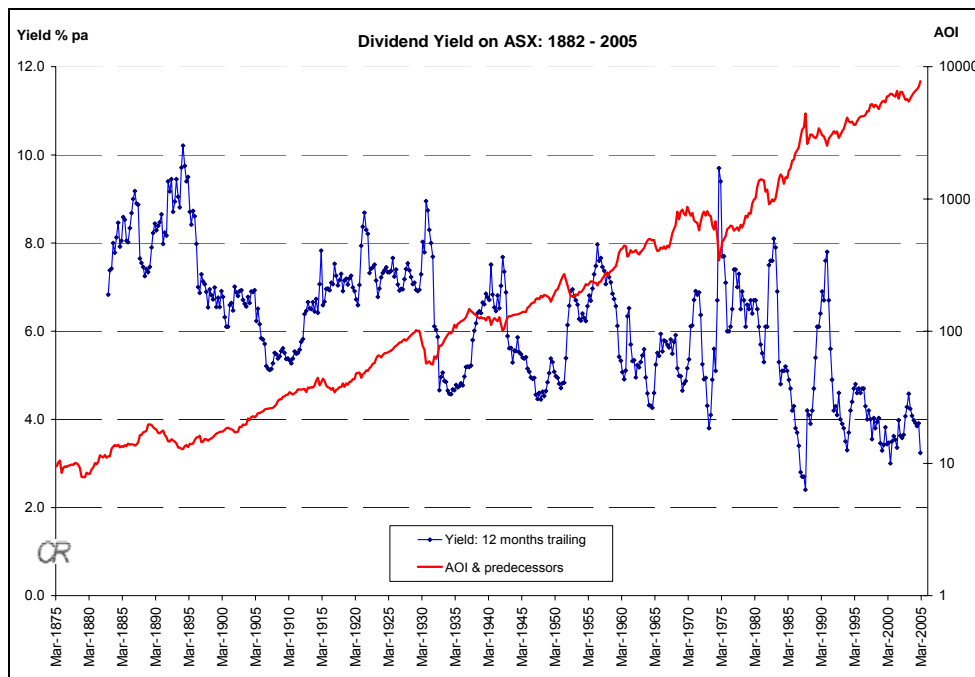
2.2 Dividends and Earnings yields

As well as the back-dating of the ASX price index post World War II, historical dividend yields were also back-dated by the Sydney Stock Exchange. The earliest we can find is to 1882. This series along with subsequent dividend yield series is spliced into the ASX All Ordinaries historical dividend yield series which is calculated from September 1959. The whole series is plotted in Figure 2.

The volatility in dividend yield is no more than the volatility in share price. This is easily observed by estimating the volatility of both the price and accumulation series and observing that the two volatilities are indistinguishable. Cash dividends are very stable (more stable than interest rates) as company boards are loath to make rash changes in dividend policy. If we neglect the volatility in this yield series and focus on the long term trend downwards in the dividend yields, we observe that the annual yield has dropped from above 8% in 1882 to below 4% in 2004. Unfortunately we do not have any earnings yield data prior to 1959 so we cannot observe whether this trend was due to a change in dividend payout policy. The post-1959 data suggests that it was *not* due to variations in payout as the payout rate was reasonably steady (but see comments below on payout ratio re imputation tax).

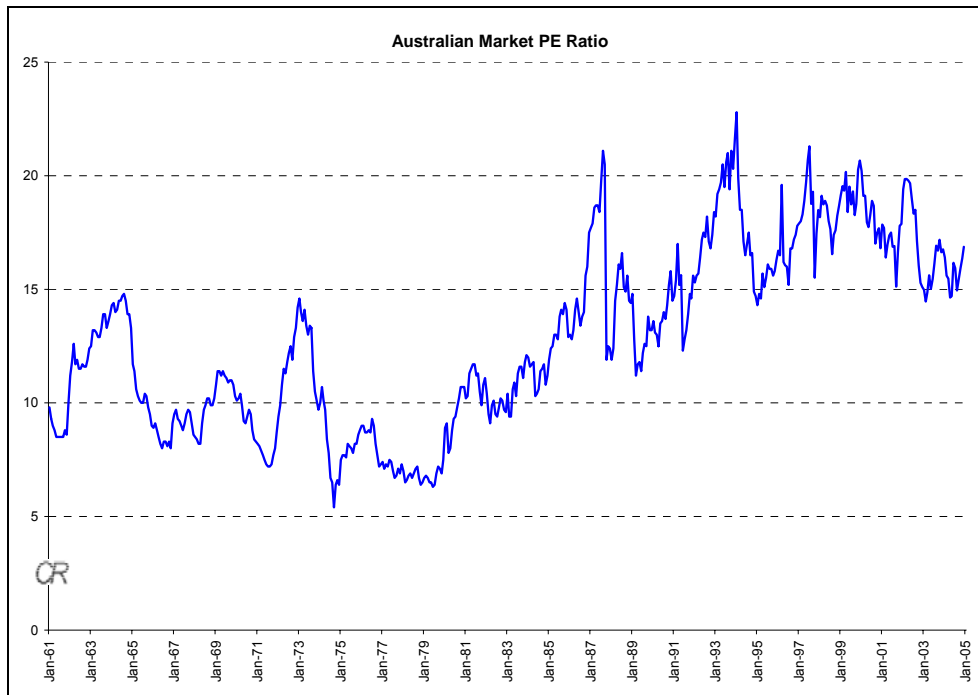
This plot has major implications for dividend discount models (DDMs). A DDM model calibrated on past data would have to include an allowance for the fall in dividend yield. Presumably this decline in yields will continue in the foreseeable future. However whether or not it does so is not important to the MRP estimates. These are based on total market return and are agnostic as to the composition of those returns, be they capital gains or dividends (but see comment below on missing franking credits).

Figure 2: ASX Dividend yield 1882-2005



We have PER and earnings yield data back to 1961. The Australian market, like other markets around the world, has demonstrated a price re-rating which in our case occurred over the period of about 1980 to 1990. The annual earnings yields moved from about 11% to under 6% (approximately 5.8%) which is a PER re-rating from about 9 times to about 17 times. This is a factor increase of 1.9 so the price of earnings almost doubled. This price inflation for equities is very important with respect to the MRP estimates. Historical stock returns include this price inflation. Some analysts discount it out of their MRP estimates on the grounds it will not occur again, that is, it is an historical one-off event - our Australian estimate, see below, is that it has added an annual 52 bp to the 1882-2005 compound average growth rate and an annual average 145 bp to the 1961-2005 compound average growth rate (the price inflation has only happened in the post 1960 data). These analysts are essentially accepting that the current PER is a fair price for future earnings. Others assume that the PER ratio will display some type of mean reversion and the current “high” prices in equities will revert back to some norm. They are essentially asserting that there will be some reciprocal negative impact on future equity returns from this reversion. The implication is even more severe for their MRP estimates as the reversion subtracts returns from future market returns

Figure 3: Australian PER, 1961-2005



Even though we only have Australian data post 1961 for earnings, we are reasonable confident the PER inflation is a one-off historical event as it also happened in the USA market at approximately the same period as in Australia and it only happened once there.

We see from Figure 4 that the earnings yields and dividend yields have more or less moved together. This implies a reasonably stable payout ratio which is what we do indeed calculate. Figure 5 demonstrates the ratio of dividend yields to earnings yields. Both are trailing yields but that should not be material as the ratio of the two yields eliminates the price factor.

The payout ratio averaged just below 60% for many years until dividend imputation was introduced on 1 July 1987. Franking credits are only accessible if companies pay out franked dividends. A franking credit is a pre-payment of an investor's personal tax (a personal taxpayer pays tax on the total of cash dividend and franking credit at their marginal tax rate and then gets a credit for the tax already paid by the company as company tax). As such, shareholders can only get a benefit from the credits if the company pays out (franked) dividends. Until recently, excess credits could not be redeemed but could be used to pay other tax liabilities. Now some classes of investors can redeem their unused credits as cash. If the dividends and accompanying credits are not paid out, the capital paid as company tax remains with the Federal government. There was a large push by some shareholders to access the franking credits in the early years after 1987 and this is observed in the temporarily high payout ratio

which, for a short period, exceeded 100% (dividends were paid out of retained earnings and franking credits were paid out the company's Franking Account Balance, FAB). The payout ratio is now apparently reverting back to its long term average of about 60%.

Figure 4: Australian market yields, 1959-2005

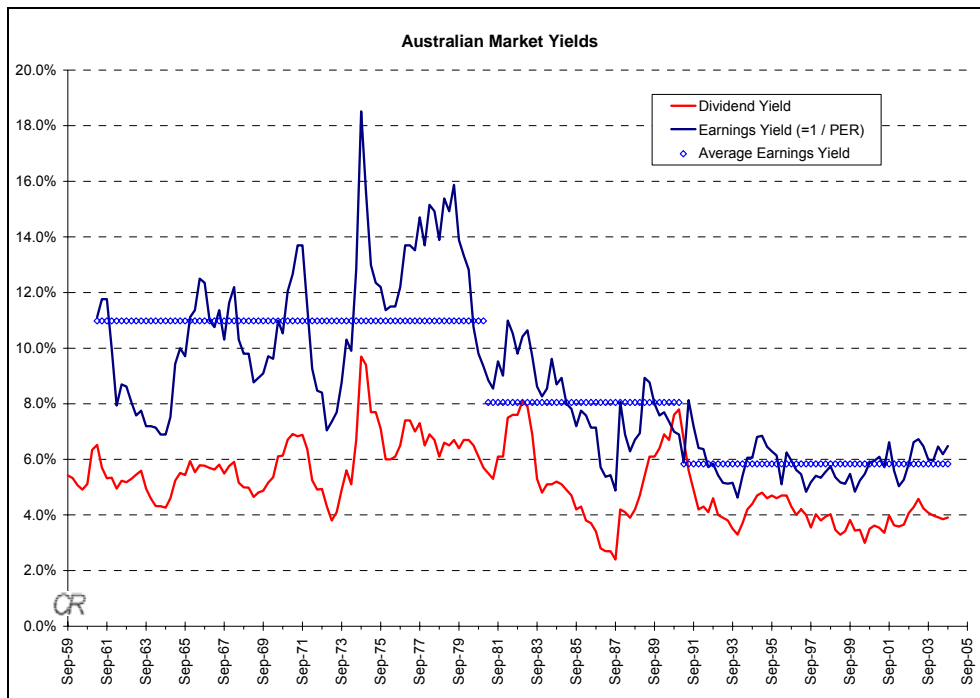
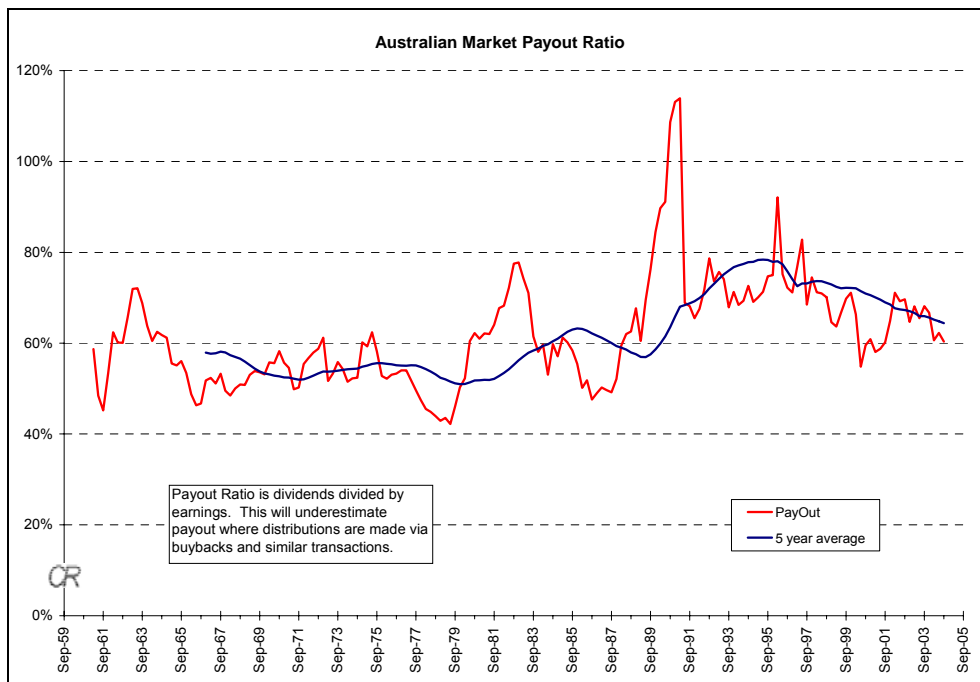


Figure 5: Australian payout ratio



2.2.1 Missing Franking Credit yields

The return on the stock market is an after company tax but before personal tax return (as are indeed nearly all returns we observe on capital markets). The MRP is usually added to a market risk-free rate and that combination is also an after company tax but before personal tax rate. So the MRP has to be constructed in a *consistent* manner. The ASX and now S&P add back cash dividends but not franking credits to the accumulation index. This means that the accumulation index no longer describes a simple before personal tax return on investment as taxpayers have to pay personal tax on the credits as well as the cash and capital gains already included in the indices. Franking credits are valuable which is seen when stocks go ex-dividend. On average, they fall further if franked than if unfranked. This means that investors are, on average, giving up more capital per dividend on the ex-dividend date than they did before franking credits were introduced.

The current company tax rate is 30% and the current annual cash dividend yield is about 3.5%. This is a capitalisation weighted average yield and it implies that the grossed-up annual dividend yield is 5% which means that if all dividends were fully franked then credits would add another 1.5% annually to investors pre-tax income. However not all dividends are 100% franked (the capitalisation weighted average for 1988-2004 is 70% franked¹) and not all credits are fully valued (we value franking credits at 50% of their theoretical value – see our paper *ImputationUpdate_Nov2004.doc*). This means that the 1.5% must be reduced first by 70% to a value of 1.05% and then reduced further by 50% so the value added by the credits is reduced to 0.53%. Hence, the ASX and now S&P indices miss out on about 53 bp of pre-tax value per annum. These values are measured in their price index as otherwise lower capital prices for shares.

When estimating the MRP post-1988 we are missing one component of shareholder returns, namely the market value of the franking credits. This means that the average annual market return and the average MRP will be under-estimated by about 53 bp. Note that the tax rate has varied a lot over the period 1988-2005 and is now at its lowest level in that period. This means that the credits were materially bigger under the higher tax rate regimes (the grossed-up values were higher). We can find no time variation in the value of the credits but just observe changes in the quantum of credit per dividend as the company tax rate changed. The average and most prevalent tax rate over the period was 36% which combined with the historically higher dividend yields suggests our estimate of 53 bp is on the low side for the period 1988-2005. This is a measurement problem only, not a theoretical problem and we do not need to derive a model to incorporate it. The problem arises solely due to the

¹ Estimated from our database of 6000+ dividend, franking and drop-off events 1985-2005.

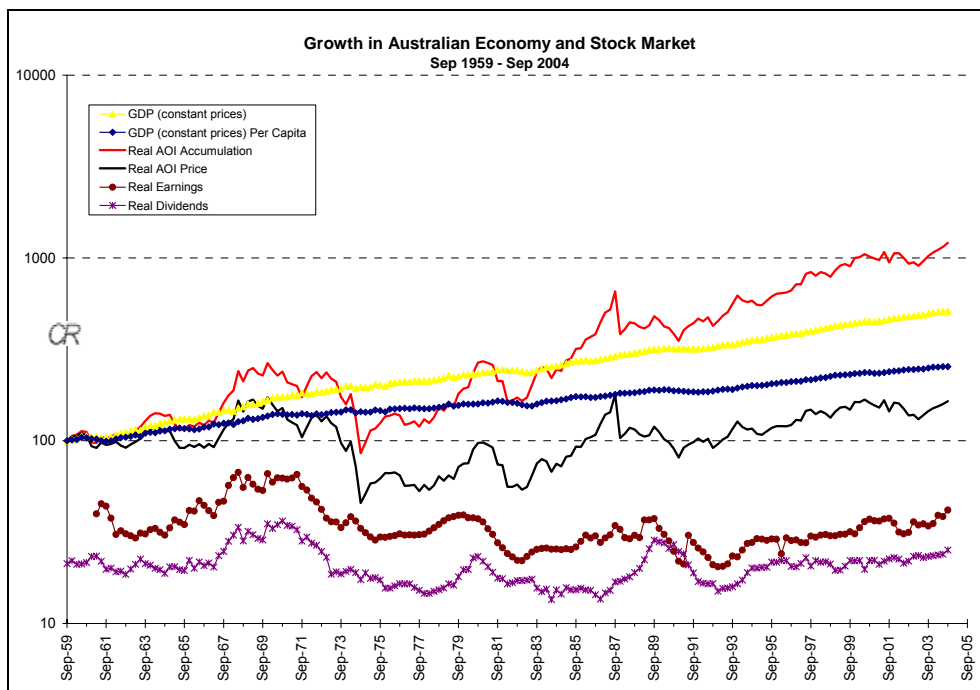
manner in which the ASX and now S&P calculate their accumulation indices. All we need do to overcome this is to add back 53 bp to the estimated MRP post-1987. We add back 53 bp per annum (4.4 bp per month) to the All Ordinaries accumulation index returns for each of the 199 months from July 1987 to January 2005. We thus ignore any seasonality in dividend payments.

2.3 GDP Per Capita and Earnings

Per share earnings (EPS) are expected to grow no faster and maybe somewhat slower than the economy as a whole. A part of the growth in the economy is from new enterprises which are not (yet) listed on the market. Hence while they appear in GDP growth they do not appear in contemporaneous ASX data. The growth in EPS is very much a function of corporate retention rates. If companies paid out all earnings then there would be no growth at all in EPS. Rather there would growth in shares on issue. These data are plotted in Figure 7.

The overall rather flat nature of the *real* EPS data indicates that Australian companies held back enough capital to finance just nominal growth. The suggestion of the data is that between 1970 and 1990, Australian companies could not find sufficient cause to hold back capital for real growth and actually experienced a real decline in EPS. Post-1990 it also seems that this trend has reversed and Australian companies are now delivering real EPS growth. We will see below (Section 6 and see also our paper *LongTerm.doc*) that this period coincided with the boom in the Resource sector. At its peak in 1980, this sector represented 57% of the ASX market.

Figure 6: Per capita GDP and Market yields



It would appear at face value that this sector did not deliver enough growth to justify retaining capital. Perhaps too many “dry holes” were dug and plugged which destroyed real growth in EPS. Much the same results have occurred for Canada – falling real EPS and real DPS growth and rising real GDP growth per capita. Like Australia, Canada has also been restructuring from a resources economy to a service economy.

Can we expect real EPS growth to continue or will it revert to the historical average of about zero or little growth? This is an important question for the MRP estimates because continued growth would justify high (or even higher) Price Earnings Ratios. In this case, the historical growth in PER between 1980 and 1990 might be not be seen as a one-off that will never reoccur. Hence we would not be justified in automatically deducting the historical price inflation factor out of the historical MRP in order to get a forward-looking estimate of the MRP.

It is hard to envisage that companies will be able to maintain indefinitely this growth in real EPS. Political pressures would emerge to counteract that increased share of productivity going to companies. Rather, it is more realistic to see the real EPS growth as temporary and most productivity benefits would be captured by consumers and workers. In an open competitive economy that is the more realistic scenario. The more likely outcome is that real EPS growth will mean revert around the long term average of 0%-1% growth.

In this case, we would be justified in deducting the one-off PER inflation of 1980-1990 out of the historical MRP.

2.4 Bond yields and Australian CPI

The risk free rate we use is the nominal yield to maturity on government securities. For the earlier historical data it is YTM on trades of NSW Government paper of various maturities. For the middle part of the 20th Century it is the YTM on Federal Government bonds of various maturities and in the latter part of the data it is the YTM on purely 10 year Federal Government securities. Figure 8 exhibits this data. All the data are monthly observations but in the early data there were periods of no trades so the last YTM data available are carried forward. The most obvious feature is the high nominal yields for the period 1975-1995 which obviously corresponds to the period of high inflation as can be seen in the inflation data in Figure 9.

The CPI data in Figure 9 are annual data in the period up to June 1948 converted into the compound quarterly equivalent and then actual quarterly data from September 1948 to 2005. Unlike the data

post-1948, the early data exhibits periods of negative inflation. This was particularly prevalent in the period 1920-1935 but also occurred in the 1880's. The period 1975-1995 was one of prolonged high inflation.

Figure 7: YTM on government securities

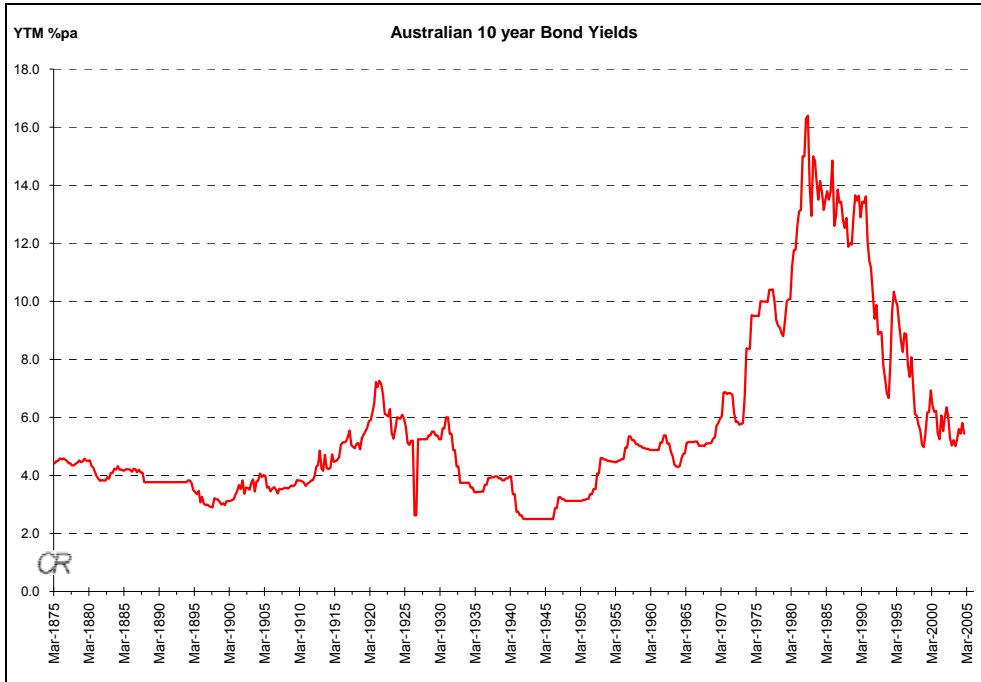
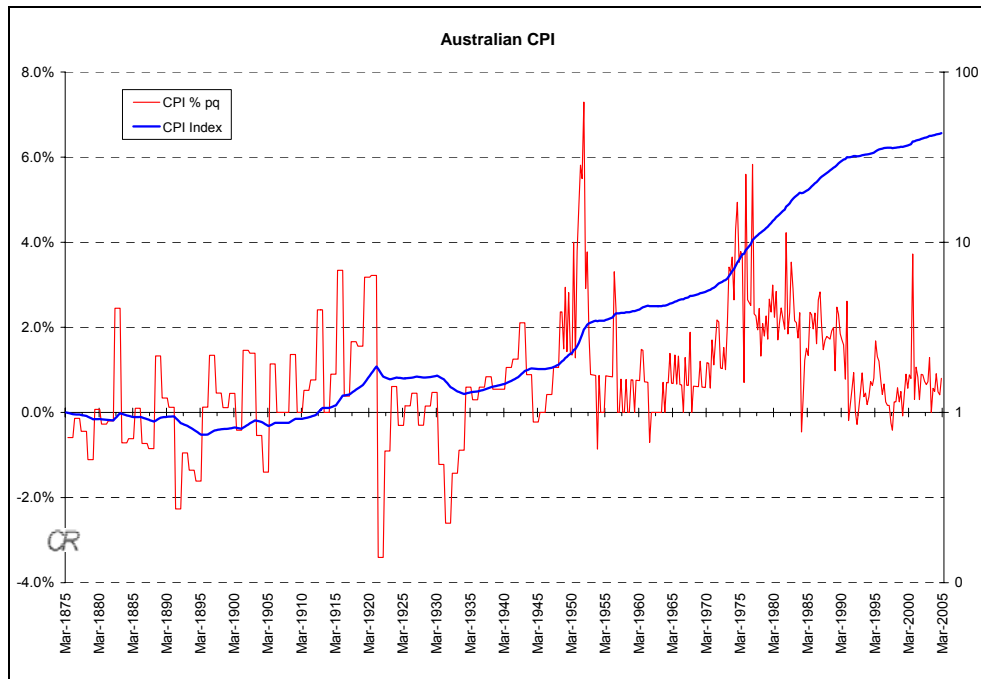


Figure 8: Australian CPI



For estimating the MRP we prefer first to estimate the return on equities over a coming period and then subtract the beginning period risk free rate. Both of these have inflation in the measures so the resulting historical MRP(H) estimate is a real measure. Equally, we could estimate coming real returns on equity and subtract the opening real yield on bonds. Where we do not have an accumulation index, we estimate the real total return on equity by discounting CPI out of the ASX price index and compound that real return with the nominal dividend yield. It is not material whether we extract CPI out of the capital returns or the dividend yield. As long as we use a consistent compounding equation (such as the Fisher equation) we will get consistent estimates of real return on equity. When the accumulation index is available, we take CPI out of this accumulation index in order to estimate real returns on equity.

3. Calculating average returns and bias

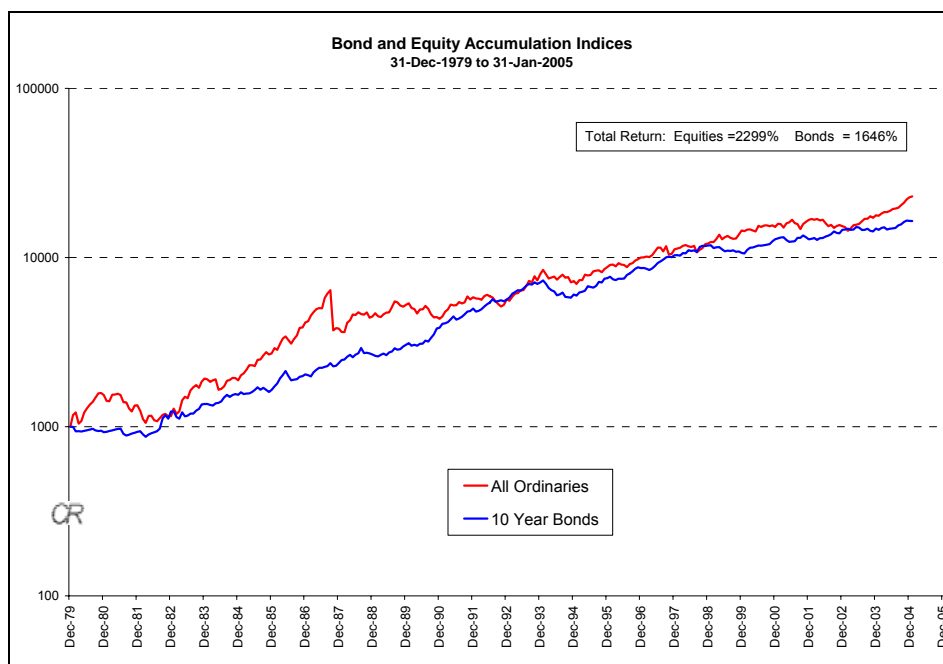
3.1 Bias in historical return averages

The act of calculating average returns and then compounding these averages can lead to amazing biases in estimated total returns, particularly for the higher risk assets like equities. As a naïve example, an opening \$1.00 stock price doubles and then halves. It is back to its opening value. The arithmetic average return is 25% per period ($R^D = 25\% = (100\% + -50\%)/2$) whereas the compound average growth rate (the geometric mean) is clearly zero ($1+R^G = 1+ 0\% = [(1+100\%)(1-50\%)]^{1/2}$). The continuous average return is also zero ($R^C = 0\% = [\ln(\$2.00/\$1.00) + \ln(\$1.00/\$2.00)]/2$). The bias in this arithmetic average is so large because the example has been chosen to have highly volatile returns. The general relationship between arithmetic averages and continuous averages is ²

$$R^D \approx R^C + \frac{1}{2}\sigma^2.$$

We observe that the bias is approximately half the variance of the returns. The more volatile the asset class, the more biased is the return from averaging classical or discrete returns calculated in the well-known manner of the change in price divided by the opening price. In order to demonstrate this issue with familiar assets, we compare the average returns calculated in all three ways for both the All Ordinaries Accumulation index and the 10 year bond return accumulation index. The data are plotted in Figure 9 and the return statistics are in Table 1. The bond series is less volatile than the equities series and so exhibits less arithmetic average bias.

Figure 9: Total returns for bonds and equities 1979-2005



² See the Appendix for a development of this relationship.

Table 1 : Bond and Equity accumulation returns, Dec 1979 - Jan 2005

	Discrete Returns		CAGR		Continuous Returns	
Monthly Returns	AOI	BOND10	AOI	BOND10	AOI	BOND10
Mean pm	1.196%	0.978%	1.047%	0.935%	1.042%	0.930%
Std Dev pm	5.26%	2.94%	5.26%	2.94%	5.60%	2.91%
Annual Returns						
Mean pa = 12*monthly average	14.36%	11.73%			12.50%	11.17%
Mean pa = monthly ave compounded	15.34%	12.38%	13.31%	11.81%		
Annual Volatility						
Volatility pa = $\sqrt{12}$ * volatility pm	18.22%	10.20%	18.22%	10.20%	19.39%	10.09%
Bias in Total Return						
Total return	2299%	1646%	2299%	1646%	2299%	1646%
Mean	1.196%	0.978%	1.047%	0.935%	1.042%	0.930%
"Total return" from compounding	3486%	1769%	2299%	1646%	2299%	1646%
Bias (total)	1186%	124%	0%	0%	0%	0%
Mean (<i>corrected for bias</i>)	1.040%	0.934%				

Between 31-Dec-1979 and 31-Jan-2005, the ASX All Ordinaries Accumulation index made a grand total return of 2,299%. On a monthly return basis, the arithmetic average return is 1.196% per month. If we foolishly compound up this arithmetic average from 31-dec-1779 to 31-Jan-2005 we calculate a total return of 3,468% for the All Ordinaries Accumulation index, an amazing bias of 1,186%! If instead of arithmetic returns we calculate compound average monthly growth rates (the geometric average rate) or continuous average growth rates (using logs of prices) then the monthly average returns are 1.047% pm and 1.042% pm respectively. In both cases there is no bias at all when we compound up for the total period. The bias in the monthly arithmetic average is approximately half the variance, namely

$$\text{Bias} \approx \frac{1}{2}\sigma^2 = \frac{1}{2}(0.056)^2 = 0.157\% \text{ pm}$$

This small bias in the monthly average, less than 16 bps, accumulates up to a total bias of 1,186% over the period, which is a demonstration of the power of compounding.

Another problem with arithmetic returns is that when we decompose returns into components, for example nominal return attributed to real returns and inflation, we have an interaction term to contend with, viz

$$(1+R_{\text{nom}}) = (1+R_{\text{real}})(1+I)$$

or

$$R_{\text{nom}} = R_{\text{real}} + I + R_{\text{real}} \times I.$$

Nominal returns are not just the sum of real returns and inflation but also include the cross product or interaction term. It is not uncommon to see people ignore this term because it is typically quite small but, just like the bias in the arithmetic average, it can accumulate up to a very large error.

These problems can easily be avoided if we calculate returns as continuous or log returns. In this case we have

$$R^C = \ln(P_{t+1}/P_t) \quad \text{or} \quad P_{t+1} = P_t \exp(R^C)$$

and there is no interaction term, because the compounding of continuous returns is just the simple addition of continuous returns, for example

$$e^{R_{\text{nom}}} = e^{R_{\text{real}}} \cdot e^I = e^{(R_{\text{real}} + I)}$$

or

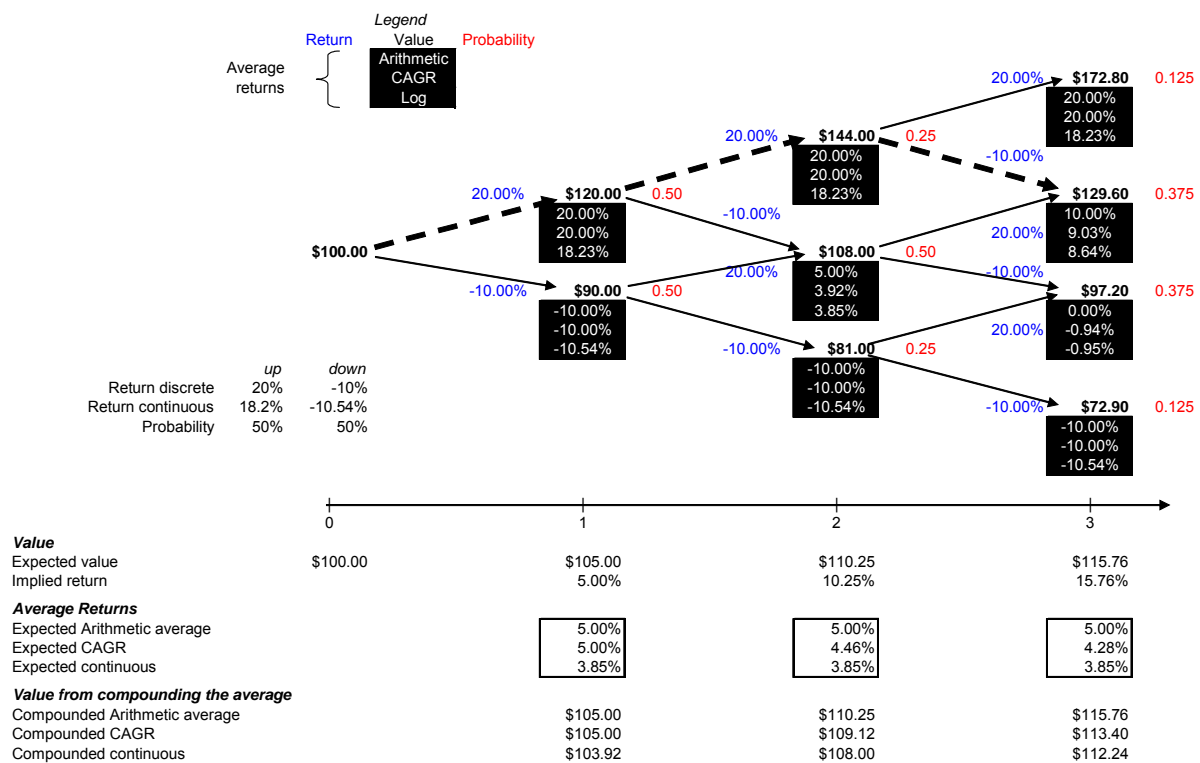
$$R_{\text{nom}} = R_{\text{real}} + I.$$

3.2 MRP should be based on expected arithmetic averages

Faced with such blatant bias, one would be forgiven for being surprised that the correct calculation method for the expected MRP is the *arithmetic average* not the CAGR nor the continuous average

return. The reason is quite simple. The above example is based on historical returns of bonds and equities and is effectively a performance analysis of the indices (and also of fund managers following an index replication strategy). The conclusion is that the past performance of the index or the fund ought to be reported as CAGR (or continuous returns) and not as historical arithmetic averages. However, for using the MRP we wish to take a forward view of returns, not an historical view. The past performance of the market represents one sequence of outcomes which could have happened from a whole plethora of possible outcomes. The following diagram is a stylised sketch of a set of future market possibilities. Each period return is independent of the previous and the market may rise by 20% or fall by 10% with equal probabilities. At each point in the array, the realised average returns are calculated and, combined with the probabilities, the expected average returns across the distribution of outcomes are then calculated.

Figure 10: Why we use the Arithmetic Average returns



The dashed line through the array represents one possible sequence of outcomes. If we arrive at period t=3 having made the sequence of +20%, +20% and -10% then the arithmetic average return is 10% per period. But this is a biased statement of our actual outcome for which we have made an average of only 9.03% per period. Compounding 10% for three periods gives an outcome of \$133.10 which is biased up compared to the actual outcome of \$129.60. Note that the CAGR only depends on

the first and last values and not on the journey between them. It does not recognise the risk along the way. The only risk recognised is any implicit risk in the return represented by the ending value.

At period $t=3$, the dashed line represents our history and it should be analysed using CAGR or continuous growth rates. But we can see from the calculations at the bottom of this figure that the arithmetic average gives us an unbiased estimator of our future *expected* outcomes after compounding up the average return. Both the CAGR and the continuous growth rate underestimate the expected outcome. Note that the CAGR is falling. It is converging to the continuous rate. (If your bank started calculating credit card rates as hourly rates instead of daily rates as they do now, then their interest charge on your credit card would converge to the log or continuous equivalent of the discrete rate). Except for pathological cases, the continuous rate average is always less than the discrete rate average because of the relationship

$$R^C \approx R^D - \frac{1}{2}\sigma^2.$$

For a one period return, it is trivial that the arithmetic return is always the same as the geometric return. The geometric average return (CAGR) starts off equal to the arithmetic return but progressively falls towards the continuous rate.

In summary, the arithmetic average is the appropriate one to use for forward estimates of expected returns but the CAGR or the continuous rates are the ones to use for historical data. These CAGR and continuous rates are also the best ones to use for disaggregating returns because we do not have to deal with any cross-product or interaction terms in the decomposition.

Accordingly, we make all our estimates and analyses of historical data using CAGR and average log returns (ie, average continuous rates) and then adjust these values for current market volatility by the relationship

$$R^D = R^C + \frac{1}{2}\sigma^2.$$

This approach has the happy side effect of only using current market volatility and we know that the market volatility is declining from its highs in 1980 see Figure 18 in Section 6.1. Note that if we had used historical arithmetic averages all the way through the past data, the bias would have been greater around 1980 because that was a period of high market volatility- 20% volatility causes a bias of 2% ($=\frac{1}{2}(.20)^2$). It is also the period when the earnings yield started to fall to its current level.

4. Historical risk premia; MRP(H)

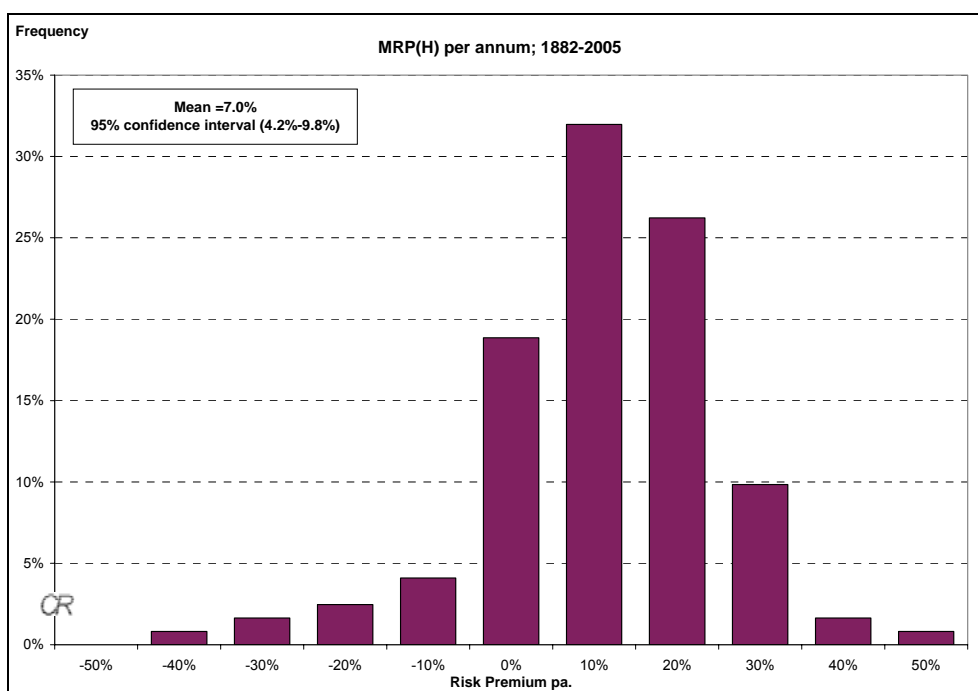
When calculating historical MRP estimates, MRP(H), we can approach this in a number of ways. We can estimate the return per period on the market and subtract from that the opening risk free rate. This will generate a sequence of excess returns that are implicitly real – we would be subtracting nominal risk free rates from nominal market returns. These excess returns are averaged over a window of a given time length. The alternative approach is to estimate average equity returns over a window of given length and then subtract the opening risk free rate. If we think of the MRP as the expected risky asset return minus the expected (and also known) opening risk free rate, then under the assumption of unbiased expectations, the coming average market return is an estimator for the expected risky asset return. In this case, the coming average market return minus the opening risk free rate is an unbiased estimator of the expected MRP.

We estimate the MRP by both approaches but concentrate on the second alternative – we estimate coming risky asset return and subtract the opening risk free rate.

4.1 Method 1: averages of excess returns.

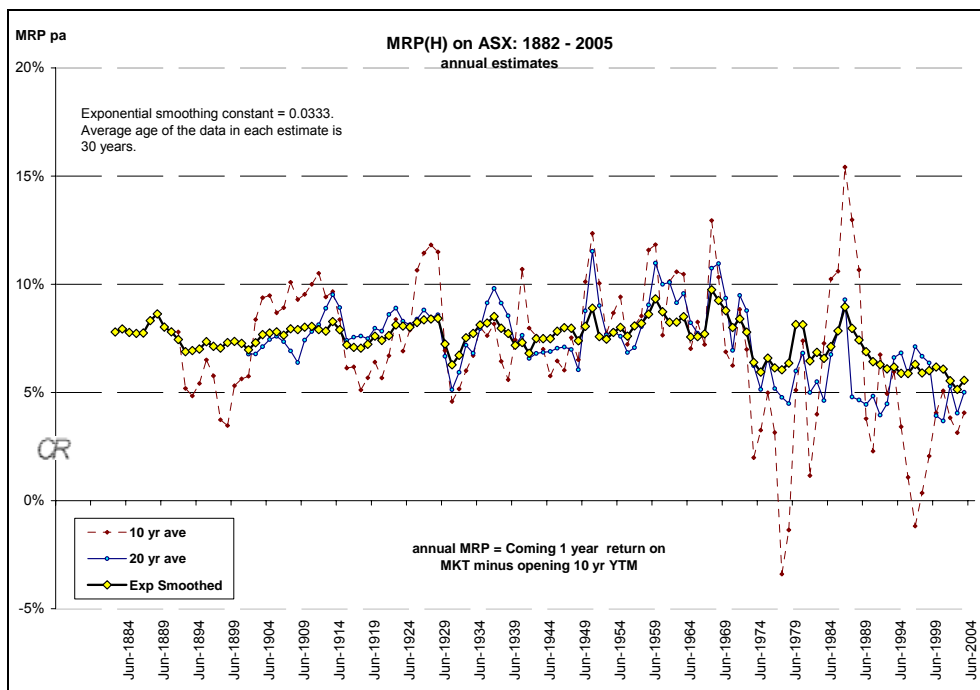
First we estimate the MRP(H) using the average of the differences approach. For each year we calculate the difference between the return per annum on the market and the opening risk free rate. The overall average for the whole period is 7% p.a. with a substantial standard error of measurement.

Figure 11: Annual market risk premia distribution; 1882-2005



The annual estimate could be anywhere in the range 4% - 10% pa. This wide standard error is after averaging all 122 years of observations. We can break this estimate down into various sub-periods but then we must be careful not to rely solely on statistical estimates for averages of the MRP(H) in sub-periods as the estimation error becomes much higher when we reduce the estimation time frames. Instead of arbitrarily breaking the estimate into sub-periods, we plot the averages of these estimates through time, using a 10 year, 20 year and 30 year (effective) time window for each estimate. The results are in Figure 12.

Figure 12: MRP(H) plotted through time



We observe that the historical MRP averaged about 8% pa for many years but has since declined to about 5% pa (latest data point = 5.6%). The overall average of 7% disguises this change. The change has mainly happened in the last 30 years. It approximately coincides with the decline in the earnings yield of the Australian market – see Figure 4.

4.2 Method 2: Difference of average market return minus risk free rate

In this case we estimate the coming average return on the market (both arithmetic and geometric averages) and then deduct the opening risk free rate. The logic is that we estimate the MRP as the expected risky asset return minus the expected (and also known) opening risk free rate. We are assuming that the coming average market return is an unbiased estimator of investor expectations.

Figure 13a: MRP based on 10 year ahead returns: Arithmetic mean

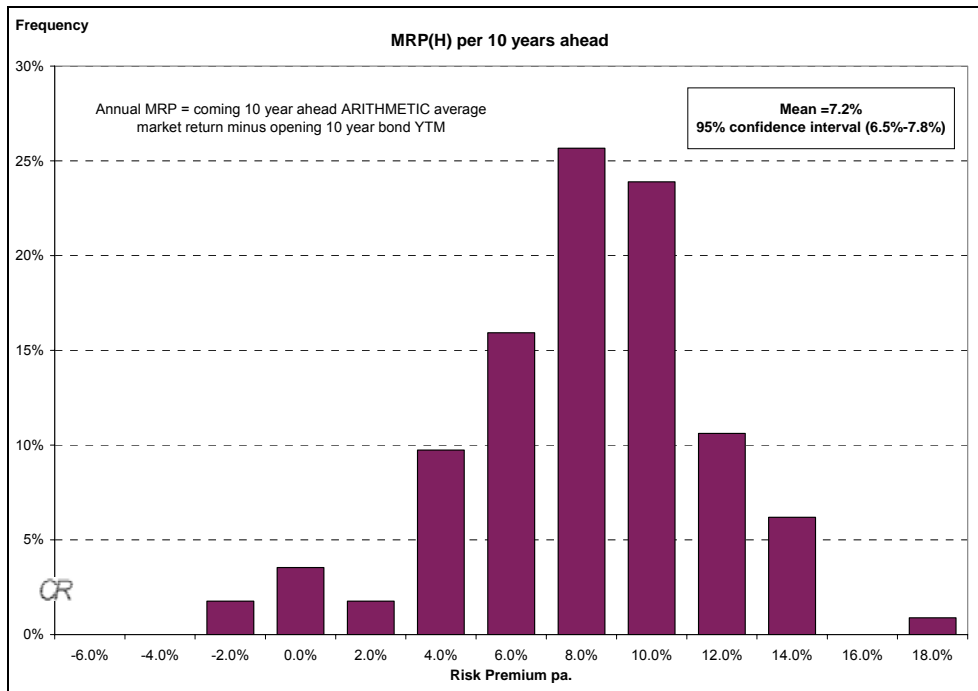
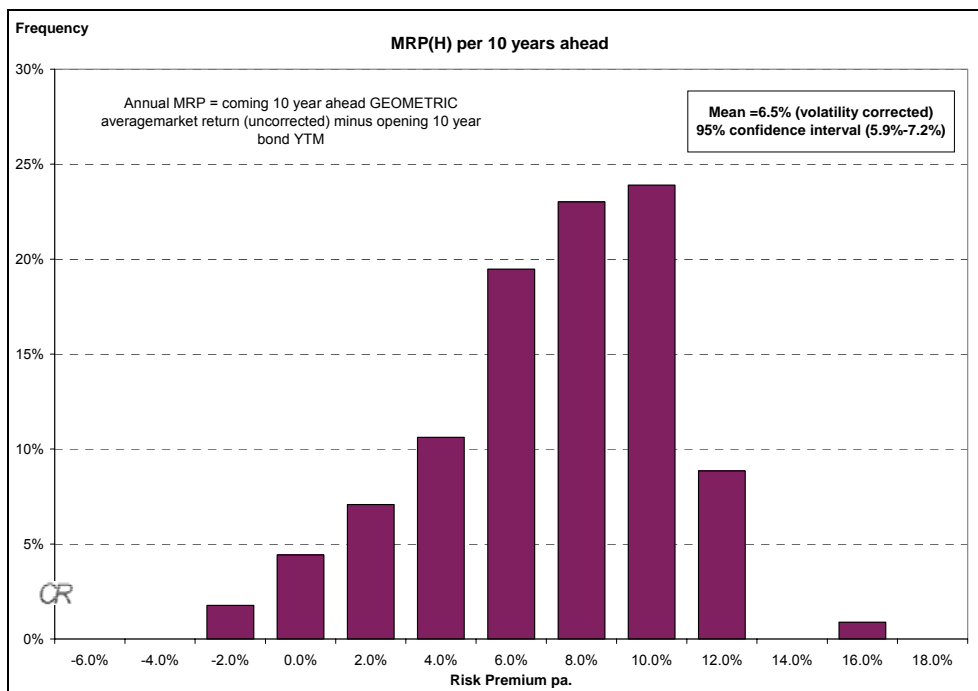


Figure 13b: MRP based on 10 year ahead returns: Geometric mean

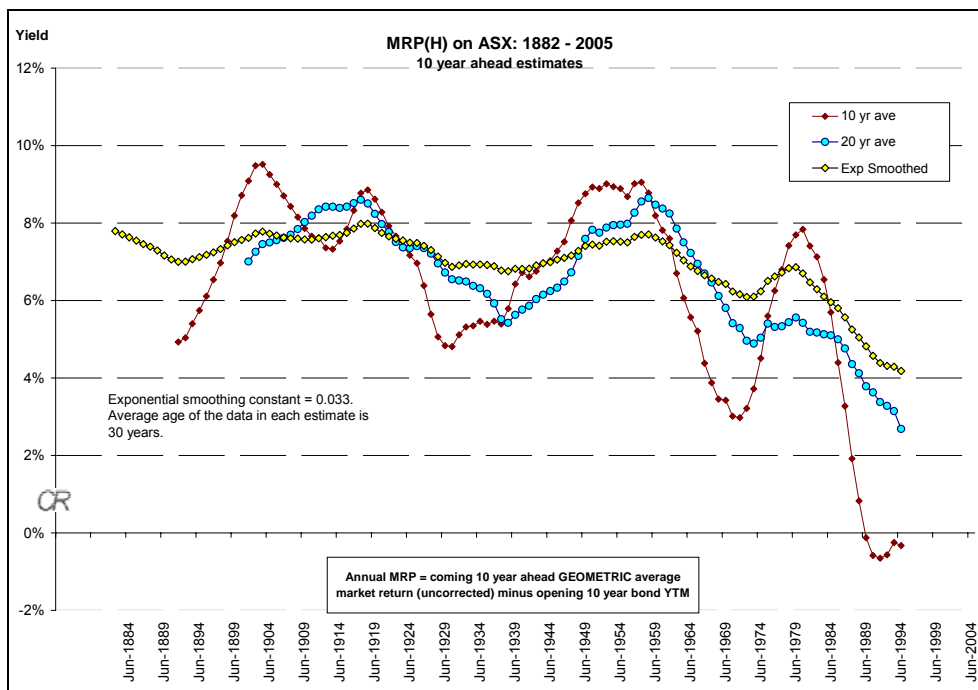


When comparing Figures 13a and 13b, we observe both a marked change in the distribution (the geometric return distribution is more skewed) and a substantial change in the mean estimate. The uncorrected geometric mean return in Figure 13b is 6.0% pa to which a volatility correction of 0.5%

has been added (current market volatility is 10% pa so the correction is $\frac{1}{2} (0.10)^2$). This contrasts with the arithmetic mean estimate of 7.2% pa. As noted above, the higher the historical market volatility, the higher the bias in the historical mean arithmetic estimator when we are analysing past performance of markets. To make it quite clear, we are here analysing past average performance of the market (expressing it as an MRP) and using it subsequently to look forward for MRP applications. We should be analysing past data with geometric means and then applying it as an arithmetic mean. At any point in time, looking backwards at the market history tells us what the compound average return has been. This is why we are analysing the past with geometric means and then applying a volatility correction.

The overall average of 6.5% once again seems to mask a shift down in the MRP estimate. Again we plot the averages of these estimates through time, using a 10 year, 20 year and 30 year (effective) time window for each estimate. The results are in Figure 14. Once again we see that it has declined in recent years. The long term average is now down to approximately 4% (uncorrected – to adjust for current market volatility add 0.5% ie a mean of 4.5%). Whilst there appears to be a slow trend downwards for many decades, it seems to have accelerated in recent years – bear in mind that there is substantial estimation error around each point estimate so we cannot be over confident in making any claims for time trends when such claims are based solely on statistical evidence.

Figure 14: MRP(H) 10 years ahead over time



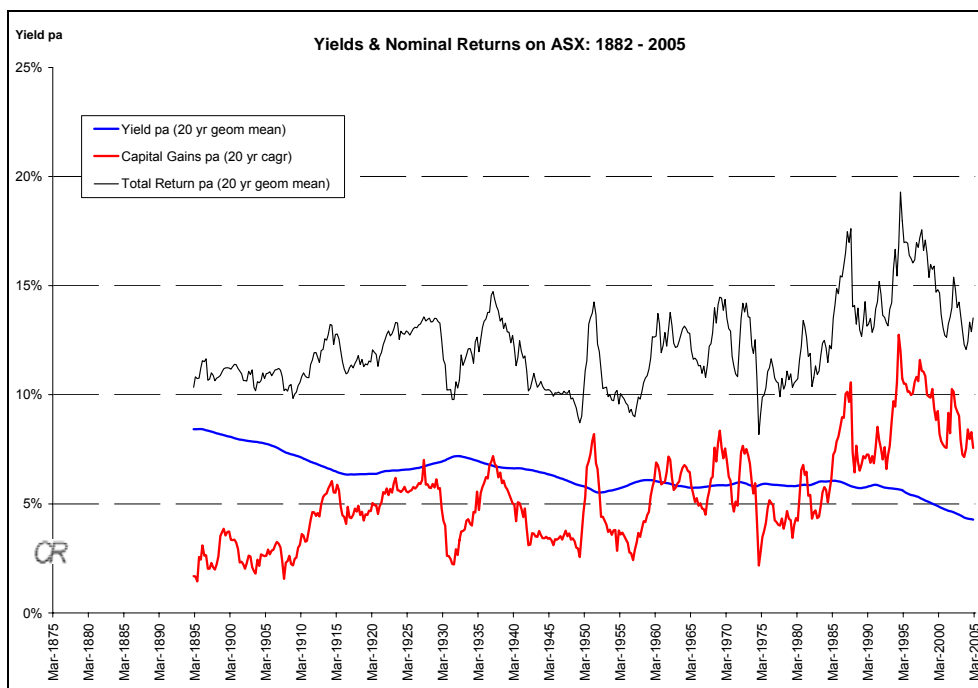
All the above estimates are based on the difference of two nominal returns: nominal market returns minus nominal bond yields. However, these two returns may contain subtle risk differences within them. Bond holders have to build all their inflation expectations into their initial purchase price. It is very unlikely that 10 year bond holders happily bought their bonds in 1972 yielding less than 6% pa when coming inflation reached a peak of over 18% pa. Stock holders also would not have foreseen this inflation coming – many bond holders were also stockholders. However, whilst inflation hurts stocks in the short run, eventually the inflation cost is passed on to customers and so earnings and dividends have a built-in partial correction mechanism for inflation, unlike nominal bonds with fixed dollar amounts of coupon payment.

To investigate this issue and its potential impact on the MRP, we contemplate estimates of the real MRP based on real stock returns and real bond yields. First we calculate historical real market returns.

4.3 Real and nominal Australian market returns 1882-2005

The 20 year CAGR nominal market returns, both capital-only and total return, and the dividend yield are plotted in Figure 15. Until recent years, the average nominal total returns hovered around 10-14% per annum. At about 1980, the nominal returns started a strong increase, peaking in 1994 and then tapering off. We can see in Figure 15 that this is all due to capital changes and not dividends. In the early years, capital returns were very low and dividend yields quite high.

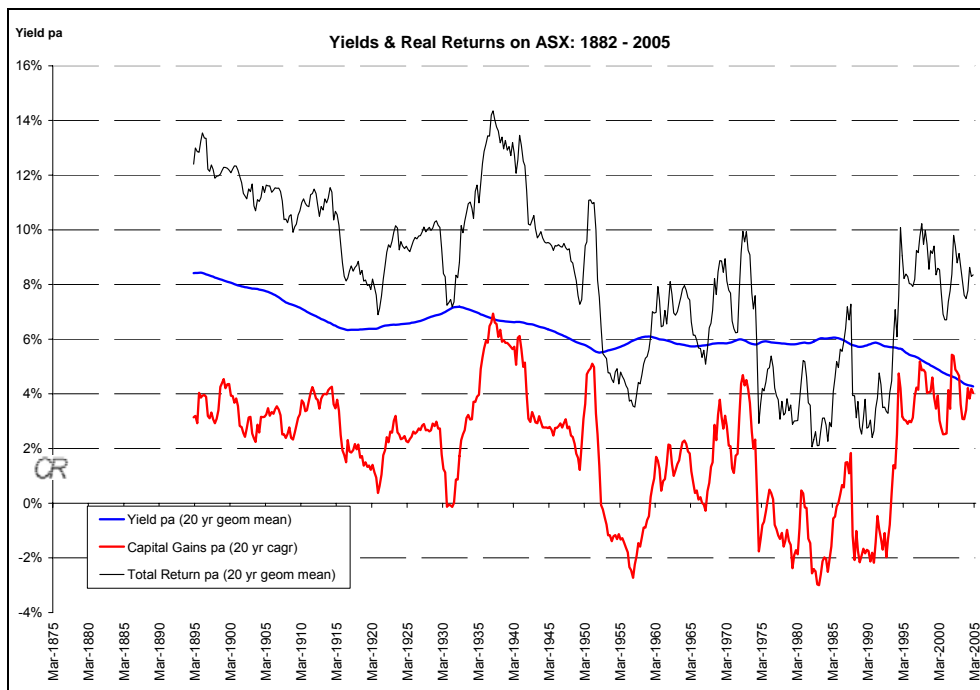
Figure 15: Nominal Australian market returns 1882-2005



There was a marked substitution of capital returns for dividend yields in the 40 years pre-1915 and then a very gradual substitution for 60 years which again accelerated in the 30 years 1975 to 2005.

We might think of the 1980 increase in nominal returns as inflation flowing through investment returns via earnings inflation. We can take inflation as CPI out of the capital or income series (one or other but not both) so that we can calculate a real return on equities. The results are in Figure 16, taking CPI out of capital returns.

Figure 16: Real return on the Australian market 1882-2005



There was a long trend down in real returns in the first 50 years. Note that in some cases the real return is *greater* than the nominal return as inflation in some periods was negative, particularly in the 1930s. Subsequently, real capital returns basically averaged around 2% until they suddenly dropped into a negative range for a prolonged period from 1975–1995, as well as a post-Korean War period. Note that until 1975 the nominal capital returns still hovered basically in the range 4%-8% pa.

Whilst taking inflation out of both prices and returns may be a common practice today, it was certainly not so common at all for the period pre-1975. Prior to Bretton Woods (post World War II), the Australian currency was on a formal peg to the gold standard. Subsequent to Bretton Woods, the USD was on a promised gold standard which effectively passed through to other currencies like the

Australian currency. The US government broke the promised gold standard in the early 1970s. This saw the Australian currency take on a managed float and then totally floated in December 1983. There was unlikely to be strong inflation expectations in a world of pegged currencies. We might then think of the nominal return on the market as approximating the *expected* real return in a world with little or no inflation expectations.

All this changed post-1974. The world experienced a prolonged bout of inflation that did not wash out of the Australian market until after 1990. Inflation expectations were certainly built into market prices subsequent to 1974-75. We can see this in the nominal bond yields in Figure 7. But as we see in Figure 16, this was inadequate for the stock market to deliver real capital returns for the period 1975-1995. Real earnings per share (EPS) declined from about 1970, hit a low in 1992 and then gradually increased. But this EPS effect alone was not enough to restore real returns on equity. The equity market responded by also inflating the earnings multiplier per share, the PER, from 1980 onwards, which, combined with the gradual increase in real EPS, restored real capital returns in the market after 1995.

No doubt this was a complex adjustment process and it is still not well understood today. The underlying economic activity driving the market was also changing. The investors in the market would have been looking to those businesses and industries that held prospects for delivering real returns. The dynamics of both expectations for return and risk and the supply of return and risk and how these played out across the range of previously listed, new listings and still-born listings (wannabes to which the market did not wish to supply capital) would be most difficult to untangle. However, all we need consider for the purposes of estimating the MRP is which series do we take as the real return series? The above discussion suggests that the nominal series would have been a satisfactory model of *expected* real returns up to 1973-74 and then the CPI-adjusted series would be the preferable model for expected real returns post 1975. However, a large part of this latter period was one of adjustment which apparently took a fairly long time to establish. It not obvious that this period is a sensible one for us to use for propagating forward the appropriate risk premium. We will see below that the implied MRP also reflects this severe adjustment period. For a long time, the implied MRP was negative. It is silly to propagate forward a negative MRP just because it happens to be the most recent data.

We conclude that there is not much validity in basing MRP estimates on real market returns so we do not attempt to do this exercise. The data have far too many imperfections and may not represent the simple deduction of inflation expectations as we would be naively assuming.

4.4 Summary of MRP(H) estimation results

Summarising the results of the historical risk premia analysis we make the following observations:

- The historical market risk premia based on all the data and using the biased arithmetic average has an overall mean of 7% pa. This is an unacceptable estimate because it puts far too much weight on a history that has significantly changed. Most of these changes have taken place over the last 30 years.
- The historical market risk premia based on all the data and using the unbiased geometric average has an overall mean of 6% pa.
- The inflation in the PER has added 52 bp to the annual geometric mean of the whole-period estimate from 1882-2005 and it has added 145 bp to the annual geometric mean post 1961.
- The geometric mean over time has recently reduced to 5% pa or 4% pa depending on whether we use one year ahead returns or ten year ahead returns. These estimates put most weight on data from recent years and so are based predominantly on the market data with the recent PER inflation included.
- The whole period geometric average of 6% minus the PER inflation effect that has occurred in recent years implies reducing the historical geometric average from 6% to 4.55% (600 bp minus 145 bp). This is reasonably consistent with the recent averages of between 4% and 5% which would be based on data heavily weighted to the post-1975 period within which these PER adjustments had already occurred on the market.
- Upon adjusting to a forward-looking average based on arithmetic means, these become 4.5% pa and 5.5% pa respectively (using the current market volatility of 10% pa).
- Our preferred method is the average 10 year ahead market returns. The logic for this choice is that it represents the expected return on the market minus the prevailing risk free rate (under the heroic assumption that return expectations were unbiased).
- There is not much point in estimating risk premia from real returns on the market because we have no confidence that the historical nominal returns adjusted for CPI would have represented expected real returns. This is especially so for the period pre-1975.

Overall, our preferred MRP is 4.5% pa.

The following is a summary table of the above observations.

Table 2: Summary of MRP estimates

Period	Comment	Arithmetic Average	Geometric Average	Adjusted Geometric Average
1875-2005	1 year returns	7%	7%	
	10 year returns	7.2%	6.0%	6.5%
	PER inflation effect		0.52%	
	10 year returns, PER effect removed		5.48%	
1960-2005	1 year returns (most recent)	5.6%		
	10 year returns (most recent)		4%	4.5%
	PER inflation effect		1.45%	
1875-2005	10 year returns, PER effect post-1960 removed		4.55%	
1961-1980	Implied MRP from earnings yields (see Section 5.2 below)	4%		

5. Implied MRP from prices, MRP(I)

5.1 Models

A very simple constant growth dividend discount model is all we need to establish the implied MRP, which we denote by MRP(I). For such a model we have

$$\text{Value}_t = \frac{\text{Div}_{t+1}}{\text{Rfree} + \text{RP} - g}.$$

In this model, g is the growth (assumed constant) in the dividend per share. It is *not* the natural growth in the business per se. That would be the growth in the total earnings of the business, maybe driven by population growth and productivity gains and so correlated with GDP per capita,. If a company paid out all of its earnings then there would be no growth in dividends per share. Instead, there would be growth in shares on issue as the company issued more equity in order to acquire capital. This is exactly what would happen if the company offered a DRP scheme and all shareholders elected to accept all dividends via such DRPs.

To back out the implied market risk premium (RP) arising from the current market prices, we make the model value meet the market price, i.e. we set $\text{Value}_t = P_t$.

$$P_t = \frac{\text{Div}_{t+1}}{\text{Rfree} + \text{RP} - g}$$

$$1 = \frac{\text{Div}_{t+1} / P_t}{\text{Rfree} + \text{RP} - g}$$

$$1 = \frac{\text{DivYield}_{t+1}}{\text{Rfree} + \text{RP} - g}$$

Solving for the implied risk premium we get

$$\text{RP} = (1 + g)\text{DivYield}_t + g - \text{Rfree}.$$

In equilibrium we expect growth in earnings per share and growth in dividends per share to match the return on equity from the retained earnings (see the comment above re growth and payout of earnings). For a constant model, everything must always be in equilibrium. Hence we must have

$$g = \text{Re}(\text{retained}\%) = (\text{Rfree} + \text{RP})(\text{retained}\%).$$

Combining this with the RP formula, we have

$$RP = \text{DivYield}_{t+1} + (R_{\text{free}} + RP) * (\text{retained}\%) - R_{\text{free}}$$

$$RP(1 - \text{retained}\%) = \text{DivYield}_{t+1} + R_{\text{free}}(\text{retained}\% - 1)$$

$$RP = \frac{\text{DivYield}_{t+1}}{(1 - \text{retained}\%)} - R_{\text{free}}$$

$$RP = \text{EarnYield}_{t+1} - R_{\text{free}}$$

In summary, the implied market risk premia is the ex-ante earnings yield minus the prevailing market risk free rate.

5.2 Estimates of MRP(I)

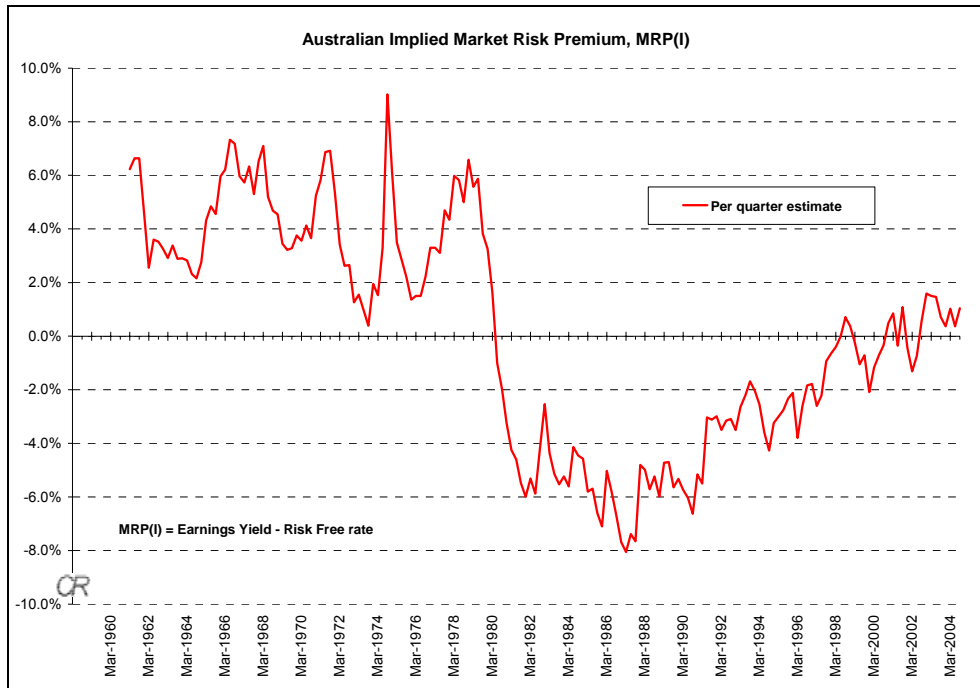
The estimates for the implied market risk premium are simple to calculate. We take published earnings yield (maybe adjusted from trailing or ex-post stock prices to ex-ante prices) and subtract the prevailing risk free rate. These data are plotted below in Figure 17. This is the trailing or ex-post earnings yield but the adjusted or ex-ante plot looks very similar to the one being displayed. We only have reliable published data on earnings and dividends in Australia since 1961. Certainly we have dividend data since 1875 but, as is common around the world, market data such as prices and dividends have been available for many years but financial data such as earnings have been difficult if not impossible to assemble.

The results of the implied MRP(I) are instructive. The MRP(I) averaged about 4% per annum for many years until the period 1979-1981. At that time the implied MRP dramatically became negative. A negative forward-looking MRP is nonsense. Taken at face value, it amounts to an investor *paying* someone to take on risk. If we consult the earnings yield plot (Figure 4) we see that this period was the onset of the earnings yield revision period where earnings yields began to decrease from their historical average of about 11% pa to their current average of 6% pa.

If we also consult the 10 year bond yield plot (Figure 7) we observe that this was the beginning of the period of very high nominal bond yields. So the negative estimate of the implied market risk premium is explained by falling earnings yields and rising bond yields. This is a transition period. It would appear it has taken many years to dissipate the effects of the changes. We must be careful not to ask

too much of this model. Recall that it is based on a constant growth assumption. Any model which makes such highly stylised and constant assumptions about the world is going to struggle to be relevant in a world undergoing dramatic changes. The result of the model suggesting negative risk premia is an outcome of a too precious model rather than the investment world being irrational.

Figure 17: Australian implied market risk premia



The more vexing question is whether or not the transition period has completed and we can take the current estimates of MRP(I) as forecasts for the expected MRP demanded by investors. If so, then we can observe that the latest MRP(I) are of the order of 1% per annum. This is remarkably low. It would imply that either the price of risk or the level of perceived risk (or both) have declined dramatically over the last 25 years. If the only the price of risk declined then we would observe a drop in the level of risk but a stability in the Sharpe Ratio. If the price of risk changed then we would also observe a decline in the Sharpe Ratio of the market – a drop in expected reward per unit of risk. We examine these issues in Section 6.

An important issue is whether or not investors in ASX shares will accept the current 1% implied risk premium. If they perceive the risk premium to be higher than that (recall the comments above on surveys of expectations) then they might abandon the equity market in favour of lower risk assets and in the process, restore the equity risk premium to a higher level than 1%.

5.3 Comparing MRP(I) to MRP(Ha)

This comparison is invidious. Our preferred adjusted MRP from historical data is $MRP(Ha) = 4.5\%$ pa. The implied MRP from the most recent earnings yield and bond yield data is $MRP(I) = 1\%$. If we go back just a few years to approximately 1980-2000, the $MRP(I)$ was negative. This makes no sense. No one ought to pretend that forward-looking risk premia are negative. However, the $MRP(I) = 1\%$ is a legitimate (if remarkably low) estimate. However, it places all the evidence for the MRP on the most recent data whereas the $MRP(Ha)$ places much more weight on the last 30 years. If risks take a long period to evolve and manifest in the market, then estimates based on just one year of data are precarious ones, notwithstanding that they are based on supposed forward-looking valuations embodied in current prices.

The period of 196-1980 shows that the implied risk premium $MRP(I)$, averaged around 4%. Rarely did it ever get above 6% in any one year. But the 30 year arithmetic average MRP (see Figure 12) averaged around 7%-8% and never went below 5%. In contrast, the market was never using such high estimates if we take the signal from the implied risk premia as the market's estimate. This is further evidence that the historical arithmetic average estimates are biased high.

We put little faith in the $MRP(I)$ data post 1980 and prefer to use the $MRP(Ha)$ estimates of 4.5% pa.

6. Possible reasons for MRP(I) being less than MRP(H)

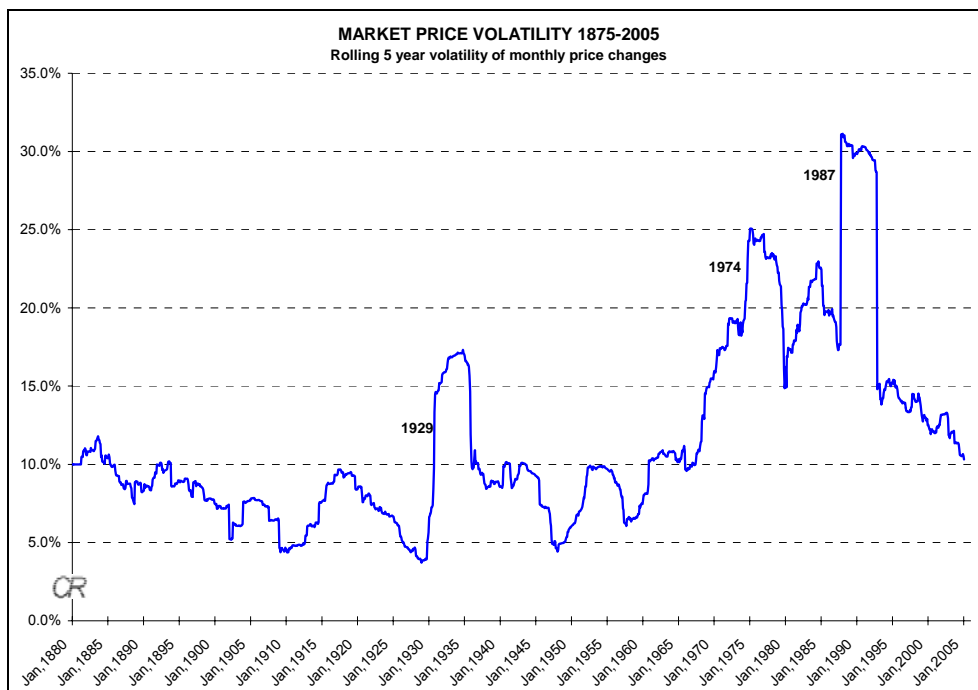
The risk premium is the amount of return premium required by investors for bearing expected risk. We can think of this as the product of the price per unit of risk multiplied by the amount of risk. There are three basic reasons why the historical MRP and the expected MRP may fall. Either one or other of these two factors may change or the market has made a pricing mistake, ie

1. The market is now delivering and is expected to deliver lower risk to investors.
2. Investors now and in the future require a lower price per unit risk.
3. The market is now making a collective mistake in its current pricing of risk.

6.1 Total risk

There is evidence that the total market risk is falling and may possibly continue to fall. First we look at market price volatility over the period 1875 – 2005. We use a rolling 60 month estimate. We make no pretence that this is the best estimator for market volatility over time. All we want to observe is the overall picture of market volatility, not make fine-tuned estimates of volatility.

Figure 18: Australian market volatility 1875-2005



The obvious feature of this plot is the initial decline in volatility up to 1930 followed by a relatively small set of cycles in volatility and then the much larger cycle beginning in the mid-1960s which is now waning. Superimposed in this general picture are three sudden increases in volatility (in 1929,

1974 and 1987) which are artefacts of the estimation process caused by three big drops in market price. These three big drops in share price enter the respective five-year estimation windows then suddenly drop out as the window leaves behind that single point of change.

While this plot only shows volatility of prices, the volatility of the accumulation index (if we had it that far back) would be almost identical because dividend payments are very stable in comparison to stock prices. This should not be confused with volatile dividend *yield* series but then all the volatility of dividend yields is due to the volatile price denominator and next to nothing is due to the non-volatile numerator of the dividend amount.

The volatility of the ASX has averaged 13.5% per annum over the period 1875-2005. Around this average there has been much variation. The biggest change occurred over the period of approximately 1970-1990. This coincided with the booming resource sector in Australia. In 1980, the Resource sector peaked at 55% of the market capitalisation (Industrial were 37% and Financials 8%). But by 2000, Resources had dropped to 14% of the market (Industrials 57% and Financials 28% - see our paper *LongTerm.doc* for a fuller description of these issues). The Resource sector appeared anomalous to Australian investors – it offered higher risk (measured both by volatility and beta against the ASX index) but offered lower returns than the general market. The impact of this was to depress the Sharpe Ratio metric for the whole market. The explanation lies in viewing the Australian Resource sector from the point of view of foreign investors. When compared to an international index, such as the MSCI, the Australian Resource sector offered much lower systematic risk. When the Resource returns are calibrated using the CAPM against the MSCI, we observe that there were on average no excess returns so Australian Resource stocks returned normal returns for international investors.

While this Resource boom event was playing out, an underlying shift was occurring in the development of the Service sector relative to the Industrial sector. We have seen fundamental changes in the economy which are reflected in the ASX indices. The agrarian economy was eclipsed by the industrial economy which has in turn been eclipsed by the service economy. These changes are reflected in the listings on the market. The growth of the Finance sector exhibits the growth in the services economy but so too does the composition of the Industrial sector. Service industries such as Media have come to play a dominant role in that sector as well.

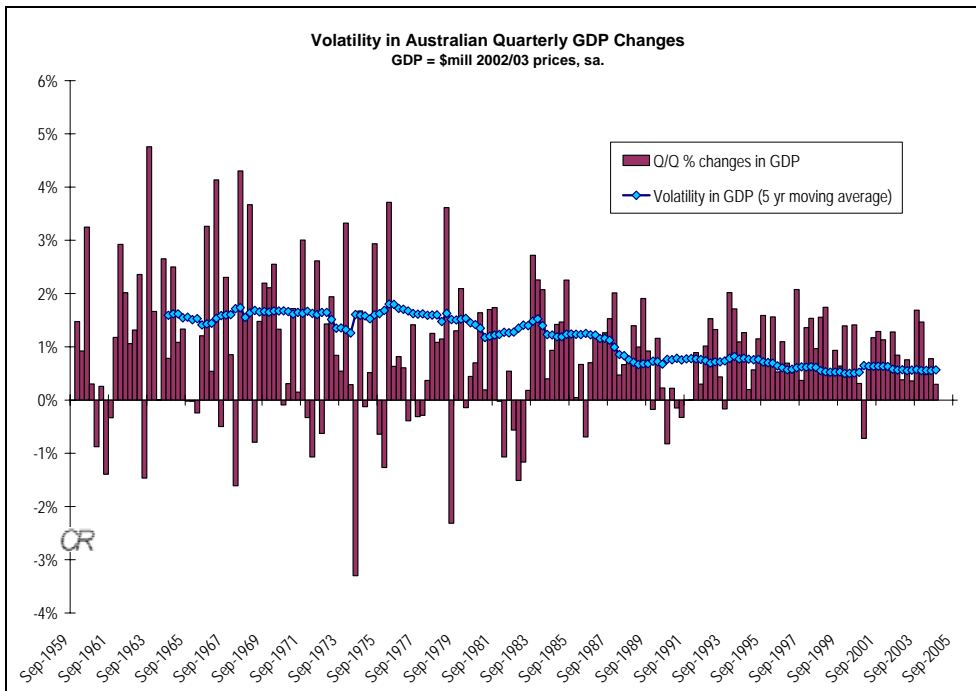
There are two basic and related reasons why there would be a decline in market-wide volatility of listed companies. Either the correlated or systematic risk (and hence the discount rate) is declining or

the cash flows (corporate earnings) are becoming less volatile. These two reasons are not automatically related. Corporate earnings could retain their volatility but become less correlated, so reducing systematic risk among companies and it is systematic or correlated risk which drives portfolio volatility. A market index is just a very large paper portfolio. There is some evidence for this in USA statistics.³ This is attributed to a structural move in the USA towards service industries that possibly have sales inherently less cross-correlated than industrial company sales. (We have no such evidence for declining correlation among Australian corporate earnings.)

The second reason for lower systematic risk is that total volatility in earnings is declining. There is evidence for this in the real GDP data for Australia. The volatility of quarter-on-quarter volatility has steadily declined since the 1950. This is not just a statistical artefact (which would happen if we were just getting better at measuring GDP) because exactly the same phenomenon is seen in USA GDP data. If GDP growth is a proxy for company earnings growth then the decline in real GDP volatility is an indicator for the decline in the volatility of company earnings. (GDP can only be a proxy for earnings instead of sales as sales includes many costs incurred by companies which are the earnings of other sectors which are also counted in GDP so they would be double counted.) The temporarily large size of the Resources sector of the Australian economy could very well have been a factor in the large swings in GDP over the period 1970-1990. The rise of the Service sector and the incidental eclipse of the Resource sector could very well explain the drop in GDP volatility. We must use a structural argument such as the rise of the Service sector because this is a phenomenon observed in both the USA and Australia. Possibly service industries have less inherent correlation with each other than do industrial businesses. For example, water and electricity demand (and utilities in general) will have some income effect and price effect but they will not have nearly the volatility in demand as experienced by general industrial, commercial and retail businesses. Hence we expect them to have lower volatility of earnings.

³ Campbell, Lettau, Malkiel & Xu, 2001. They found for 1962-1997 that USA stock idiosyncratic risk (company specific stock risk) increased but there was no similar trend in industry or market risk. Rather, idiosyncratic risk became an increasing proportion of total stock risk and correlations between the returns of companies declined.

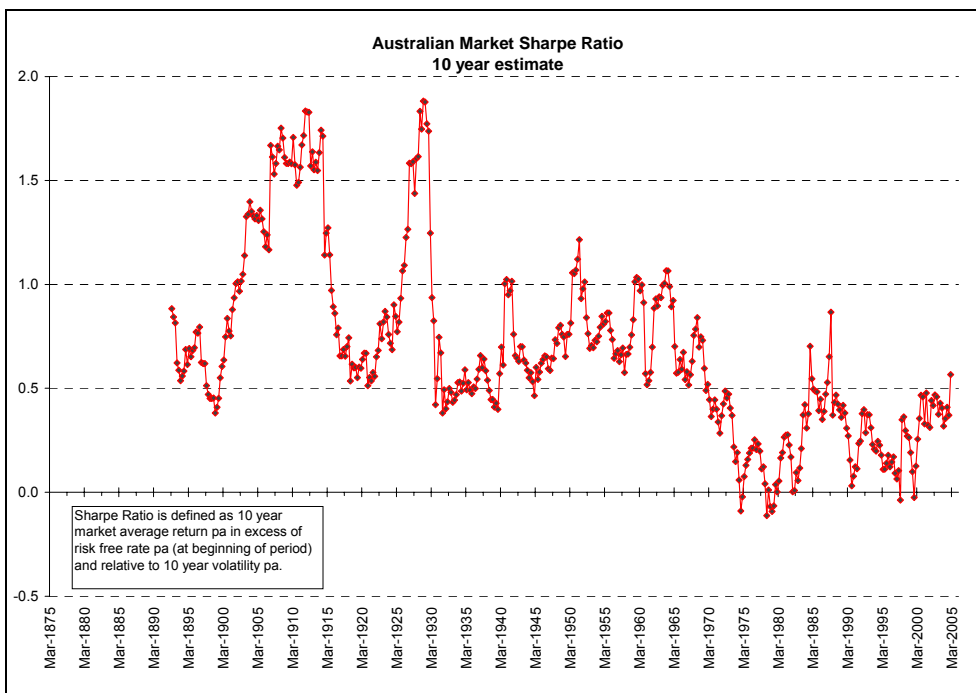
Figure 19: Volatility in Australian GDP



6.2 Price Per Unit Risk

The second reason that the MRP may have declined is that investors now demand a lower price per unit risk. This is fundamentally different from the total amount of risk declining as seen in Section 6.1 above. The price per unit risk reflects the appetite or demand for risk by investors.

Figure 20: Australian market-wide Sharpe Ratio



In order to investigate this issue, we calculate the market-wide Sharpe Ratio (SR) by estimating the ratio of the coming 10 year excess return (arithmetic average market return per annum minus beginning period risk free rate) to the coming 10 year market volatility. If we make the heroic assumption that investors on average expected the realised 10 year returns then these SR estimates are estimates for the ex-ante price of risk. The outcome is most instructive. There have been three regimes in the SR. The first period (up to the 1930-40 estimates) exhibits big swings in the SR. It is hard to accept that the appetite for risk among investors moved this much so it probably reflects mainly noise in the data. The middle period (up to the 1970-80 estimates) exhibits a more stable period of SR estimates averaging about 0.7. The latter period exhibits much lower SR estimates, averaging about 0.27. Allowing for the length of the 10 year estimation window, this drop in SR regime approximately corresponds to the drop in the earnings yield from 11% pa to 6% pa. (or the rise in PER from 9 to 17). It has recently risen back to about 0.5. We can see this overview as the market restoring its reward for risk after it was substantially damaged in the period 1970-1990.

Another reason for the seemingly sudden drop in the SR after 1970 could very well be the Resource phenomenon in Australia. Resource stocks brought more volatility to the Australian stock market but did not deliver commensurate returns to investors. This would depress the SR estimates. However, there is not much material change in SR estimate by dropping the 1970-80 to 1980-90 window which covers the resource sector boom. The SR estimate marginally increases to 0.30 in this case. In any event, there has been a significant shift down in the price per unit risk of the Australian market in the last 75 years.

6.3 Market Error?

It is possible that the market has erroneously priced in earnings growth that will not happen. In this case, there has been a monumental stuff up around the world because the same PER inflation phenomenon has occurred elsewhere, not the least being the USA market. This must be a behavioural mistake as it cannot be just a random outcome. Once people realise they have made a mistake, they will want to correct it. In this case there would be a nasty period of price correction and these negative returns would restore the previous status quo – and perhaps restore the historical risk premium as an ex-ante premium (and in the process substantially *reduce* the historical or ex-post MRP). There is nothing constructive we can add to this scenario other than to hope it never happens.

7 Summary

We estimate the current Australian market risk premium as 4.5% pa. We have arrived at this estimate from analysing the current state of the Australian market after reviewing market data from 1875-2005. Along the way we examined data on the market price index and accumulation index, as far back as 1875. We included inflation (CPI), bond yields, dividend yields (from 1875) and earnings (from 1959). Because returns are meant to be post-company tax but before personal tax, we include franking credits missing out of total returns since 1987. The effect is an average 53 bp per annum of missing risk premium.

Historical returns should be analysed using geometric growth averages. Arithmetic averages will over-state average returns and the more volatile the return series, the greater the bias. It is appropriate to analyse historical performance using geometric average returns but for estimating expected returns such as MRP we should use arithmetic means. The simple solution to this problem is to analyse historical returns using compound average growth rates and then make an adjustment to these to convert them to equivalent arithmetic returns. We developed the connection and the adjustment formula between these two averages.

Of far more interest than the algebra is the impact of real EPS growth and PER inflation upon historical MRP estimates. We conclude that the PER inflation that appeared between 1975 and 1990 has added 52 bp to the whole period historical MRP and 145 bp to the MRP if applied only to the period post 1960. We form MRP estimates based on market data for the last 30 years, weighted more towards the recent data than the earlier data. These estimates will include any PER inflation effects as it was by then priced into the market. Under the assumption that the market is now fairly priced, we would not need to make any adjustments to the MRP other than volatility adjustment between geometric average returns of 4% pa to arithmetic average returns of 4.5% pa. This extra 50 p is based on the current market volatility of 10% pa.

We also examined the implied risk premia from the excess of earnings yield over the risk free rate. These have recently been negative. However, most of this negative implied MRP comes from the yield reduction from the PER inflation. Earnings yields have dropped from the historical 11% pa to less than 6% pa. Along with high nominal bond yields, this implied (for an period of approximately 20 years) that MRPs were negative. We are sceptical that this combination offers a reasonable guide to the MRP implied from prices. All it demonstrates is that markets can take a long time to adjust to fundamental structural changes.

We found good reason to believe that the MRP has declined in recent years. The MRP should be the combination of two parts: the amount of risk being borne in the market place and the price per unit risk. The total risk in the market is declining. We can directly observe that the volatility of the market is declining off a peak in 1980 which coincided with the Resources boom in Australia from 1970 - 1990. The underlying reason we see for this is the decline in the volatility of GDP (as a proxy for earnings). This has happened as the underlying economic activity in the economy (and thus in the listing mix on the ASX) has gradually changed from an industrial economy to a service economy. Along the way we had a Resources boom which temporarily disguised this transition. That has now passed and we are seeing the underlying low volatility from a service-dominated economy.

Another feature also emerged. The price per unit risk (the Australian market Sharpe Ratio) is declining. We have no insights into why this is happening. Perhaps it is a basic outcome of governments coercing (forcing?) people to save for their own future retirement income, either directly or through pensions funds. This is adding demand for risky assets which is bidding down the price of risk.

Whatever the cause, we are seeing a “double whammy” effect of declining total risk and a declining price for risk. This is reducing the market risk premium.

We can only hope our kids believe it as they take our assets off of hands and pay for our retirement.

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Using the approximation $\ln(1+x) = x - x^2/2 + x^3/3 - \dots$ we reduce this to

$$N \ln(G) = N \ln(A) + \sum d_i - \frac{1}{2} \sum d_i^2 + o(d_i^3)$$

and substituting in the properties 1 and 2 above, we have

$$N \ln(G) = N \ln(A) - N \frac{\sigma^2}{2A^2} + o(d_i^3)$$

and after simplifying this we have

$$\ln\left(\left(\frac{G}{A}\right)^2\right) = -\frac{\sigma^2}{A^2} + o(d_i^3).$$

If we again use the approximation $\ln(1+x) = x - x^2/2 + \dots$ we reduce this to

$$\left(\frac{G}{A}\right)^2 - 1 \approx -\frac{\sigma^2}{A^2}$$

or

$$A^2 \approx G^2 + \sigma^2$$

Recall that A and G are the means of $1+R_i$ so to get the actual arithmetic mean (AM) and geometric mean (GM) result we have the approximation

$$(1 + AM)^2 \approx (1 + GM)^2 + \sigma^2.$$

This is often approximated further by using the relationship $(1+x)^2 = 1+2x+x^2 \approx 1+2x$ so the approximation becomes

$$1 + 2AM \approx 1 + 2GM + \sigma^2$$

or

$$AM \approx GM + \frac{1}{2} \sigma^2$$

This is the approximation used in Section 3.1 above and is a commonly used version.