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STOCK RETURNS *and holding periods*

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While it is generally accepted that equities achieve higher returns than fixed interest on average over the longer run, recent financial market volatility and poor equity performance have raised questions about the required holding period. Our study addresses this issue by examining US stocks and Treasury bills from 1963 to 2011. We find that a 15-year holding period is required to ensure a 95 per cent probability that stocks will outperform the risk-free rate of return. And, for large market capitalisation stock portfolios (favoured by pension funds) the investment horizon is even longer.

Corporate finance students at university learn two important lessons from the history of capital markets: 'risky assets, on average, earn a risk premium' and 'the greater the potential reward, the greater the risk' (Ross et al. 2011, p. 324 and p. 329). In the United States, large market capitalisation stocks, such as the S&P 500 index, earned an average return of 12.3 per cent per annum from 1926 to 2007 while small company stocks earned 17.1 per cent per annum, and US Treasury bills earned a paltry 3.8 per cent per annum over the same sample period (Ross et al. 2010, p. 382). For the period from 1979 to 2009, large market capitalisation stocks in Australia earned 14.8 per cent per annum and small market capitalisation stocks earned 18.48 per cent per annum, while 90-day bank bills earned 9.26 per cent per annum.[1] These returns are calculated over long time horizons, usually more than 30 years.

Although stocks deliver higher returns than risk-free rates over the long term, many investors have shorter investment horizons over which stocks may not earn a higher return than the risk-free rate. It is therefore important to understand how the probability of stock returns beating the risk-free rate varies with the length of the holding period. This issue relating to holding period returns has been highlighted in the aftermath of the global financial crisis (GFC), during which the risk-free rate of return has outperformed many risky assets over various holding periods.

Previous studies have documented the effects of risk, return and their impact on an investor's time horizon. Using US data, Choi and Mukherji (2010) show that the Sharpe ratio of an investment portfolio increases as the investment time horizon lengthens. McEnally (1985) finds that the standard deviation of annual stock returns decreases as the holding period increases. Alles and Athanassakos (2006) show that investing in higher-risk Canadian asset classes produces higher end-of-period terminal wealth values as the time horizon increases from one to 20 years. Based on data for US stocks from 1926 to 2007, Bennyhoff (2009) finds that average returns per annum increase with the length of the holding period (although there is a slight fall between holding periods of three and five years) and the standard deviation also declines. Kritzman and Rich (1998) also find that the standard deviation of annual stock returns declines as the length of the holding period increases.

Overall, this brief literature review suggests that returns increase while risk decreases as the investment time horizon lengthens. What is not quantified in the literature is the holding period required to be confident to ensure that stock returns can beat the risk-free rate of return. Our study answers this question by examining how the level of statistical confidence (i.e. returns on stocks versus the risk-free rate of return) changes with the duration of the holding period. This knowledge is particularly pertinent today given the heightened uncertainty following the GFC and outperformance of the risk-free rate over many risky asset classes in recent years. Of course, the extent to which historical data provides information about future outcomes is always open to debate.

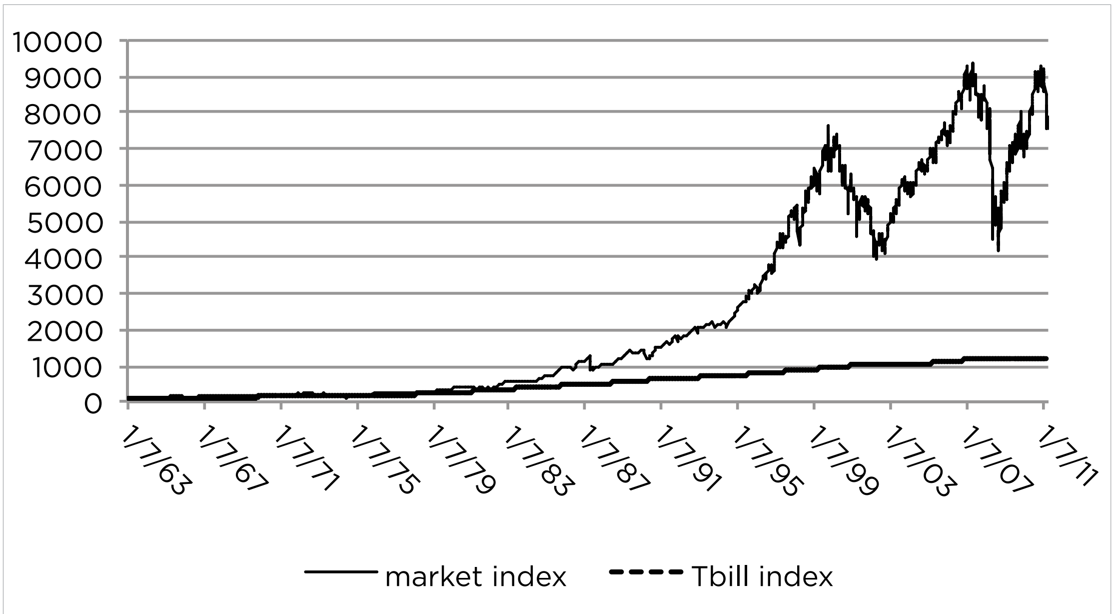
Investors who own large market capitalisation portfolios must endure an investment time horizon of 19 years to be 95 per cent statistically confident of beating the risk-free rate of return. This finding has important implications for superannuation funds because realising the equity risk premium from US large market capitalisation portfolios requires the longest period of time in comparison with other US stock portfolios.

In this article, we investigate returns over holding periods from one to 20 years by employing daily US data from 1963 to 2011. We employ daily returns rather than monthly or annual returns for a number of reasons. First, this significantly increases the number of (overlapping) holding periods that we can analyse. Second, the daily sampling frequency provides us with the granularity to measure holding period returns to the exact day. Daily sampling frequency has been shown to be important over the long term as previous studies by Estrada (2008, 2009), Taleb (2007) and McLean (2012) suggest that missing the 10 highest return days or avoiding the 10 lowest return days over the long term can significantly alter the long-term compounding effect of the equity risk premium. For instance, McLean (2012) shows that investors who exclude the best 10 return days in the S&P 500 can realise a variation in the end-of-period portfolio value by at least 41 per cent over a 50-year time horizon. To fully capture these effects on investment time horizons, daily returns are employed in this study.

US data is employed as historical daily observations are not available for Australia for this length of time. We compare the stock market portfolio return and risk-free asset return for holding periods of 1, 3, 5, 8, 10, 15 and 20 years. We estimate a 20–30 per cent probability that stock market portfolio returns underperform the risk-free rate of return (i.e. US government one-month Treasury bill) when the holding period is less than 10 years. However, when the holding period increases to 15 years, there is a 95 per cent statistical probability that the average stock market return beats the risk-free rate of return. For our sample period, holding the market portfolio for 20 years always beats the risk-free asset no matter what day in history you entered the market. We also find that the Sharpe ratio monotonically rises with an increase in the holding period, which suggests that investors gain a higher risk–return trade-off as the holding period lengthens. These findings are generally consistent with the prior research from Alles and Athanassakos (2006) and McEnally (1985).

We also examine how different holding periods have different implications for returns on portfolios of small, medium and large market capitalisation stocks. We report that the chances of underperforming T-bills for small-

FIGURE 1: Time-series plot of stock market index and T-bill index



Note: This figure presents a total return index for both the US market portfolio return and the US government one-month T-bill return reconstructed with the index value commencing at 100 on 30 June 1963. The sample ends on 30 September 2011.

and medium-sized firm portfolios decreases rapidly as the holding period increases. However, investors who own large market capitalisation portfolios must endure an investment time horizon of 19 years to be 95 per cent statistically confident of beating the risk-free rate of return. This finding has important implications for superannuation funds because realising the equity risk premium from US large market capitalisation portfolios requires the longest period of time in comparison with other US stock portfolios. These long time horizons also provide new insights for individual investors about the risk reduction benefits of re-allocating long-term retirement savings from stocks to cash as they near retirement. The findings from this study suggest that the risk reduction benefits from the shift from stocks to T-bills may require a longer time horizon than previously anticipated.

Data and empirical results

For this study, we obtain daily arithmetic returns on US stock indices and US government one-month T-bills from 1 July 1963 to 30 September 2011 sourced from Professor Kenneth French's Data Library, which we convert into compound daily returns for the 12,148 days in the sample period.[2] The US stock data reflects total returns to the investor as they also include the reinvestment of dividends. Figure 1 shows the time series plot of the US market index and T-bill index constructed from this data. The US market index return in Figure 1 can be divided into two parts: the risk-free rate of return; and the additional return in owning the stock portfolio, which is the excess return.

We calculate the excess return per annum for rolling series of N year holding periods (where N = 1,..., 20) as a compound annual rate of return. The first return is calculated from the first entry date (1 July 1963) until the end of the holding period, and the next return is calculated by rolling one day forward, and so on. For the one-year holding period we have 11,896 overlapping periods, for a two-year holding period we have 11,644 overlapping periods, and 11,392 for three years, and so on.[3] These holding period returns are converted into compound annual rates of return based on the following:

$$N\ year\ CARR = [(1 + HPR_{mr,N})^{\frac{1}{N}} - 1] - [(1 + HPR_{rf,N})^{\frac{1}{N}} - 1]$$

where:

N = number of years;

$CARR$ = compound annual rate of market return in excess of the risk-free rate;

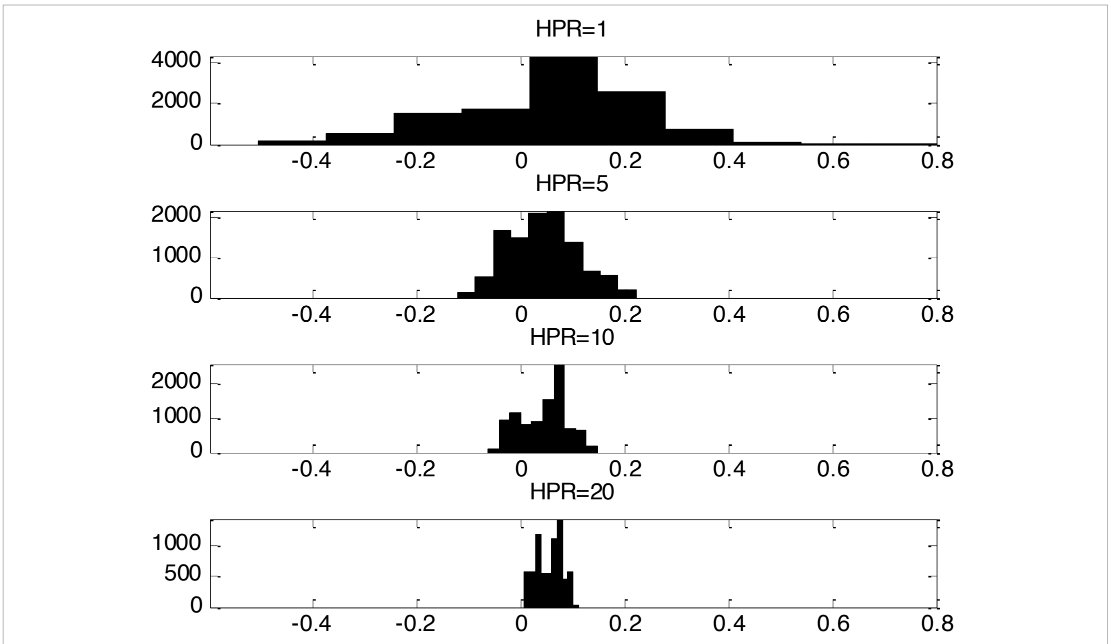
$HPR_{mr,N}$ = holding period return of the market portfolio for N year(s); and

$HPR_{rf,N}$ = holding period return of the risk-free rate of return for N year(s).

We report the summary statistics in Table 1 and graphically illustrate them in Figure 2. We also report the summary statistics of the risk-free rate of return in Table 2.

Figure 2 shows the histograms for 1, 5, 10 and 20-year holding periods for compound annual rates of excess returns. It clearly shows that owning stocks for longer holding periods reduces risk (i.e. the dispersion of CARR returns declines substantially) and stock returns are always higher than the risk-free T-bill returns for holding periods of 20 years for the period studied. Ultimately, our

FIGURE 2: Dispersion of CARR of excess returns for different holding periods



Note: This figure presents the distribution of average compound annual rate of excess returns over various holding periods. HPR=1, 5, 10 and 20 denotes the holding period of 1, 5, 10 and 20 years, respectively.

TABLE 1: Summary statistics of the CARR of excess returns

Holding Periods	1	3	5	8	10	15	20
Mean (×100)	5.83	4.18	4.31	4.44	4.45	5.26	5.49
Median (×100)	8.73	5.11	4.34	4.65	5.63	5.99	5.96
Standard Deviation (×100)	17.92	8.96	6.63	4.88	4.58	3.29	2.49
Minimum (×100)	-50.68	-20.98	-12.28	-7.34	-6.37	-2.30	0.63
Maximum (×100)	80.15	26.10	22.16	16.43	14.69	12.39	11.08
Percentage when excess return < 0 (%)	30.64	27.28	27.93	20.42	23.49	4.84	0.00

Note: All of the numbers are expressed in percentage terms. The excess return is defined as the market return over and above the risk-free rate of return. The first return is calculated from the first entry date (1 July 1963) until the holding period expires, and the next return is calculated by rolling one day forward, and so on. The holding period return is then expressed as a compound annual rate of return (CARR). Finally, the summary statistics of these thousands of CARRs are presented in this table. 'Percentage when excess return <0 (%)' denotes the probability of negative excess returns per annum out of the total number of excess returns.

TABLE 2: Summary statistics of the CARR of the risk-free rate

Holding Periods	1	3	5	8	10	15	20
Mean (×100)	5.47	5.60	5.73	5.85	5.96	6.20	6.33
Median (×100)	5.20	5.25	5.37	5.49	5.62	6.22	7.11
Standard Deviation (×100)	2.93	2.60	2.34	2.15	2.01	1.69	1.38
Minimum (×100)	0.00	0.08	1.51	1.93	1.84	2.90	3.21
Maximum (×100)	15.29	12.65	11.14	10.06	9.19	8.32	7.72

Note: All of the numbers are expressed in percentage terms. The risk-free rate of return is defined as the return from US government one-month Treasury bills. The first return is calculated from the first entry date (1 July 1963) until the holding period expires, and the next return is calculated by rolling one day forward, and so on. The holding period return is then expressed as a compound annual rate of return (CARR). Finally, the summary statistics of these thousands of CARRs of the risk-free rate are presented in this table.

concern is with the probability of those excess returns being less than zero (i.e. the frequency of observations less than zero in the Figure 2 histograms). But, it is also instructive to examine the properties of those distributions which are presented in Table 1.

Table 1 presents the summary statistics of the compound annual rate of excess returns (i.e. the return greater than the risk-free rate) over various holding periods (N) in years. As the holding period lengthens, the mean and median excess returns rise to reflect their long-term historical excess return. The standard deviation of these CARRs in Table 1 declines steadily as the holding period increases, implying lower levels of risk with longer investment horizons. This is also reflected in the maximum and minimum values of the rolling excess returns, that is, the difference between the maximum and minimum returns shrinks considerably as the holding period increases.

Interestingly, in the period studied, when US stocks were held for 20 years, the excess return never fell below zero. Therefore, US stock returns always outperformed T-bills in a 20-year investment time horizon but this did not occur for shorter holding periods. Table 1 also reports a 31 per cent probability of stocks underperforming T-bill returns in a single-year holding period. The chance of stocks underperforming T-bills declines to 23.49 per cent over a 10-year holding period.

Table 2 presents the same summary statistics of the CARRs for the risk-free rate of return (US one-month Treasury bills). Table 2 reports an incremental increase in the average returns of the risk-free rate as the holding period increases. This rising return reflects the mean rate of return earned by holding US T-bills over the long term.

Figure 3 shows that the longer is the holding period, the lower is the percentage of negative excess returns (although it is not a smooth range of probabilities). It is important to acknowledge that the y-axis denoting probabilities in Figure 3 commences at 32 per cent for one year to 19 per cent for seven years and then subsequently rises to 25 per cent for 11 years. These variations or 'kinks' in the probability curve in Figure 3 are supported by Estrada (2008, 2009) and McLean (2012) who show that the compounding effects of returns may be distorted over long investment time horizons when large (but infrequent) return days are excluded from the investment time horizon. The variations in the probability curve in Figure 3 are caused by periods of stock return underperformance or outperformance at the first entry date or at the end of each holding period, or a combination of both.

Figure 4 presents the average Sharpe ratio over $N = 1, 2, \ldots, 20$ annual holding periods. Clearly, the Sharpe ratio increases as N increases, implying a higher risk-adjusted performance for longer holding periods.

FIGURE 3: Percentage of negative excess returns

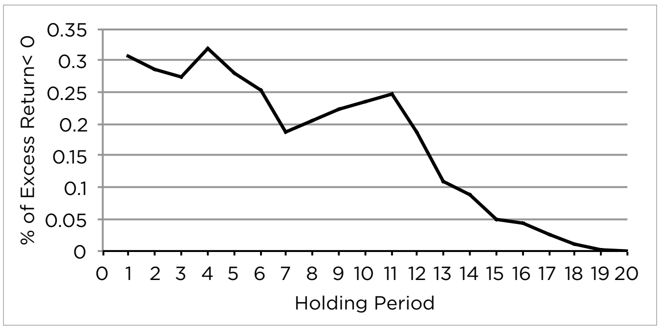
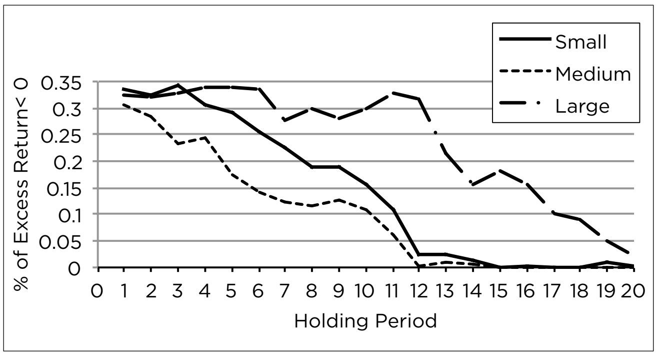


FIGURE 4: Plot of Sharpe ratio for different holding periods

FIGURE 5: Percentage of negative excess returns for different size portfolios



Note: The figure presents the percentage of negative excess returns for the small-, medium- and large-sized firm stock portfolios. 'Small' denotes the bottom 20% (i.e. small-sized firm) stock portfolio. 'Medium' denotes the middle 20% (i.e. medium-sized firm) stock portfolio. 'Large' denotes the top 20% (i.e. large-sized firm) stock portfolio.

We also test (using a nonparametric Wilcoxon rank-sum test)[4] whether the median excess returns differ significantly for different holding periods (of 5, 8 and 10 years). We reject (at a 1 per cent significance level) the null hypothesis of no difference — which is consistent with the visual impression from Table 1 that median excess returns become larger as the holding period increases from five to 10 years.

Finally, we examine whether US stocks sorted by firm size provide us with new knowledge. We obtain the Fama and French (1992, 1993) market capitalisation size portfolio returns from the Kenneth French Data Library and examine the three types of quintile size portfolios. The small-sized firm stock portfolio consists of stocks from the smallest 20 per cent of US publicly listed firms. The medium-sized firm portfolio comprises the middle 20 per cent of stocks (i.e. medium-sized firm stocks). The large-sized firm portfolio consists of the top 20 per cent (i.e. the largest-sized firm stocks). The results for these size portfolios are illustrated in Figure 5. Similar to Figure 3, the findings in Figure 5 reveal a general pattern of decline in the percentage of negative excess returns for all three portfolios. Interestingly, while the percentage of negative returns for small- and medium-sized firm portfolios immediately declines as the holding period increases, the large-sized firm portfolio declines only when the holding period exceeds 12 years. Figure 5 also reveals that the US large market capitalisation portfolio requires a holding period of 19 years to exhibit a 95 per cent statistical probability of outperforming the risk-free rate.

These findings are consistent with related research by Mukherji (2008) which shows that US small company stocks are preferred to large company stocks when constructing mean-variance portfolios with higher target returns and longer investment horizons. This preference towards small company stock returns over the long-term can be explained by the Fama and French (1992, 1993) small firm (SMB) risk factor (or premium) that is well documented in the finance literature. Figure 5 represents the difference in performance between small cap returns (11.81 per cent p.a.) versus large cap returns (i.e. 10.11 per cent p.a.) within an investment time horizon context.

These results have significant implications for both institutional and individual investors. Australian superannuation funds who own US large market cap portfolios require a longer holding period to be confident of realising the equity risk premium in comparison with holding the overall US market portfolio, small-cap or mid-cap stock portfolios. For individual investors, the long investment time horizons estimated in this study suggest that, as we approach retirement, the asset allocation away from stocks and into cash may need to occur earlier than many finance professionals currently suggest.

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Conclusion

This article examines the effects of holding periods on daily US equity returns and Treasury bills from 1963 to 2011. The findings show that a holding period of 15 years is required to ensure a 95 per cent probability that stocks will outperform the risk-free rate of return. An analysis of firm-size portfolios reveals that the large market cap portfolio in this study requires a holding period of 19 years to exhibit the same statistical probability of beating T-bill returns. This finding has important implications for superannuation funds who favour US large market capitalisation portfolios as these results suggest that owners of large-cap portfolios require an exceedingly long investment horizon in order to beat the risk-free rate of return.

As mentioned in Blanchard (1993) and Fama and French (2002), the use of historical returns to estimate expected returns (in the future) is common practice among academics and industry professionals. This historical study provides a new perspective on the risks associated with realising the US equity risk premium over varying investment time horizons. Investigating the holding period effect on the equity risk premium in Australia and across international stock markets offers interesting directions for future research. ■

Notes

1. Short-term Treasury bills (or Treasury Notes) are usually considered as risk-free assets. However, as the Treasury Note in Australia was discontinued from July 2002 to February 2009, 90-day bank bills rates are used instead.
2. Accessed at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
3. The number of overlapping periods declines as the length of the holding period increases because of the fixed number of daily observations.
4. As the data employed in this study consists of overlapping holding period returns, the data observations are not independent and identically distributed (IID) and, therefore, we employ the nonparametric Wilcoxon rank-sum test. Results are available on request.

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