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Does Fundamental Indexation Lead to Better Risk Adjusted Returns? New Evidence from Australian Securities Exchange

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1. Introduction

Passive portfolio management has gained in popularity over last few decades. Prior to the 1960s, the conventional wisdom was professional money managers were able to generate 'above average' returns owing to their superior skills compared to the lay investor. Since then, academic research in financial economics has increasingly unearthed evidence to the contrary. The inability of a vast majority of actively managed funds to consistently outperform the market has put a serious question mark over the claim of their possessing superior skills. That active investing involves much higher transaction costs (due to turnover) and management fees has made them less appealing to the modern investor. On the other hand, this has resulted in significant growth of investments in passively managed index funds. Vanguard, an investment management company that specialises in index funds, managed assets worth $1.4 trillion worldwide (of which $80 billion is in Australia alone) as of June 2010 (Vanguard, 2010). The Vanguard 500 Index fund, which made its debut in 1976 and tracks the S&P 500 index, is now one of the largest equity funds in the world.

Index funds tracking market capitalization based indices like S&P 500 are the most well known form of passive management, so much so that most consider them as identical. Elton, Gruber, Brown, and Goetzmann (2007) argue that this is essentially arbitrary and misleading. These authors define passive management as any form of portfolio management that is governed by a mechanical rule based on past data and not on forecasts of the manager. There are several portfolio management strategies that come under this more inclusive definition. Some of these are based on observed stock market anomalies like small company (low market capitalization) stocks earning higher risk adjusted return relative to large company (high market capitalization) stocks or low price earnings (P/E) ratio stocks outperforming high P/E stocks. The genesis of this lie in attempts to better passive management strategies that are purely based on tracking broad market capitalization based indices.

One such strategy that is currently attracting a lot of attention is the fundamental indexation strategy proposed by Arnott, Hsu, Moore (2005) (hereafter AHM). They argue that if stock prices are too noisy relative to their fundamentals, then by construction market capitalization weighted indexes would suffer from a price drag by becoming overweight in shares that are overpriced and underweight in shares that are underpriced relative to their fair value. As an alternative, the authors put forward a non-capitalization based indexing that assigns weight on stocks based on alternative measures of size like sales, cash flow, book value and

dividends. They call this fundamental indexation as weighting of stocks is based on accounting measures as proxies of fundamental value. The authors argue that by construction the fundamental index is not affected by valuation biases caused by market noise. The study finds that such a strategy outperforms cap-weighted strategy based on US market data over a period of 43 years.

Since the publication of the AHM study, fundamental indexation has drawn significant interest from academics and practitioners. While there has been some support for the fundamental indexing strategy in other markets, controversy has emerged on different fronts. The main criticism has been that it is actually a value strategy in disguise and does little beyond capturing the value premium. Second, the failings of the strategy in conditions of persistent mispricing have been pointed out. Finally, questions have been raised on the higher turnover costs of fundamental indexing compared to tracking a market capitalization weighted index as the latter requires very little rebalancing.

In this paper, we investigate the above issues on fundamental indexation with data from the Australian Securities Exchange (ASX) over a period of 25 years between 1985 and 2010. With respect to the superiority of fundamental indexation over cap weighted indexation, our results are broadly supportive of the findings of the AHM study. However, like some other subsequent studies, we find the fundamental indexation strategy to underperform during strong bull markets although this effect diminishes with longer time horizons. Overall, our findings indicate that fundamental indexation could offer potential outperformance of traditional market cap-weighted indexation even after adjusting for slightly higher transaction costs related to turnover.

Our paper makes two important contributions. First, the bulk of research on fundamental indexation has been conducted using data for the US and European markets. By exploring the data for the Australian stock market, where fundamental indexation strategy is being employed by some practitioners, we extend the geographic dimension of research in this area. The only study to have examined fundamental indexation in the Australian market is Mar, Bird, Casavecchia, and Yeung (2009). However, their study covered a limited period from 1995 to 2006 which, by the authors' own admission, characterised a 'value period' in Australian stock market. Our coverage of the 25-year period between 1985 and 2010 not only substantially extends the time horizon but more importantly captures significant market downturns of 1987 and more recent crisis of 2008-2009. Thus it allows for a richer analysis

through varied economic conditions and stock market cycles and testing whether prior results on various aspects of fundamental indexation still hold up. We also examine a wider range of variables as proxies of fundamentals than AHM or any of the studies individually. Some of these variables are unique to this study. Our results show that the excess returns derived from investing in fundamental indexation strategy in the Australian market is substantially higher than what has been observed in the US and European markets.

Second, we show that the excess returns of fundamental indexation over market cap-weighted indexation are not explained by value, size, or momentum factors. This is in stark contrast to several past empirical studies in the US (e.g. Jun and Malkiel (2008), Blitz and Swinkel (2009)) and international markets (e.g. Estrada, 2006) that find the superior performance of fundamental indexation could be mainly attributed to its value tilt. Similarly, the only previous study of fundamental indexation in Australian market by Mar et al (2009) found that its superiority is explained by increased exposure to value stocks. Our evidence is not supportive of this claim and suggests the need for further research about the source of outperformance.

2. Background and Prior Research

Fundamental indexation proposed by AHB and researched by subsequent studies is based on accounting valuation measures. The use of accounting data for security selection is not a new practice among investors. In fact, it greatly predates academic research in this area by many decades. There is anecdotal evidence of analysts (then known as statisticians) in Wall Street using limited accounting information of companies in asset valuation. Benjamin Graham, widely regarded as the pioneer of security analysis, used mainly accounting figures as the basis for stock selection. Graham and Dodd's book 'Security Analysis', which first went in print on 1934, emphasized the use of sales, earnings, dividends, current assets, book value, and cash in determining whether stocks of individual companies are overvalued or undervalued. This approach is commonly known as fundamental analysis and is about finding the fundamental or intrinsic value of a company's stock based on information reported in financial statements.[1] Friend (1977) and Blume and Friend (1978) suggest that investors rely on accounting data in making investing decisions. Barlev and Levy (1981) find that using ex-

[1] Fundamental analysis by market practitioners would normally include future projections of these accounting variables.

post accounting data for optimal portfolio selection from stocks listed in the Dow Jones index can be as effective as using ex-post market data.

In recent years, there has been renewed interest in stock selection based on accounting data motivated by research confirming post-earnings announcement drift in security prices. Ou & Penman (1989) show the existence of significant abnormal returns to an investment strategy that is based on the prediction of the sign of future changes in earnings per share (EPS) which they forecast using an exhaustive list of accounting ratios describing leverage, activity, and profitability extracted from the current accounting data. Similarly, Holthausen and Larcker (1992) find evidence of abnormal returns using a predictive model based on accounting ratios. Abarbanell & Bushee (1998) demonstrate that an investment strategy based on the fundamental signals extracted from financial statements like change in inventories, accounts receivables, gross margin among others, generate abnormal returns. Piotroski (2000) provides further evidence supporting the predictive ability of historical accounting signals about future stock price changes for a sample of value stocks (i.e. stocks with high book-to-market ratio). These results suggest that historical accounting information can predict future stock performance.

Modern finance, however, takes a dim view of the attempt to use past information in making profitable investment decisions. According to the efficient market hypothesis (EMH) all available information is already incorporated in the current market prices of securities. This rules out the possibility of generating abnormal returns using information that is already available to investor, which includes accounting data. Under the framework of the well known capital market asset pricing model CAPM of Sharpe (1964) and Lintner (1965) the market portfolio i.e. a portfolio which holds securities weighted by their market capitalization is shown to be mean-variance efficient. Therefore, to beat the cap-weighted market index investors must hold a portfolio that is riskier than the market portfolio.

The above theoretical argument for optimality of the capitalization weighted market portfolio is further bolstered by empirical studies of mutual fund performance. Starting with the seminal study of Jensen (1968), many researchers have examined the performance of fund managers relative to the market index. The bulk of the empirical evidence till this date indicates that the majority of active fund managers underperform the market index on a risk-adjusted basis. For example, by examining the performance of all US equity mutual funds during 1971-91 period, Malkiel (1995) finds that funds in aggregate underperformed the

benchmark index both before and after accounting for management expenses. According to Gruber (1996), who investigated performance of active equity funds in USA from 1985 to 1994, funds underperform an appropriately weighted average of indexes. Gotezmann and Zheng (2006) examine the aggregate performance of all equity funds that existed in the CRSP database since its inception till 2004. They report underperformance both for value-weighted as well as equally weighted portfolios created with those funds.

From the efficient market perspective, it is remarkable that the AHM study of 2005 puts forward an indexing strategy based on fundamental metrics derived from historical accounting data that so easily outperforms the cap-weighted market portfolio on a risk-adjusted basis. The authors create a composite index called the 'fundamental index' by combining the four metrics of book value, sales, cash flow and dividends. They find that, between 1964 and 2002, the fundamental index outperforms the comparable cap-weighted index (S&P 500) by almost 2% per annum while displaying the same volatility as the latter. Treynor (2005) tenders his view on the benefits of valuation-indifferent indexing through the examination of stock mispricing. He shows that the return drag on a market cap-weighted index is approximately equal to the noise in stock prices. Siegel (2006) also suggests that if stock prices are subject to noise then cap-weighted indexes maintain a risk-return profile inferior to that of the fundamental index as portfolio construction technique.[2]

Tamura and Shimizu (2005) conducts a study similar to the AHM in a global context. They construct global fundamental indexes using the same composite index metrics as AHM and tested these for the period January 1988 to August 2005. The results indicated their global fundamental index portfolio exceeded the returns of the cap-weighted MSCI World and FTSE Developed indexes with lower volatility. Hsu and Campollo (2006) investigate the source of the outperformance of fundamental index over cap-weighted indexes. The research also discusses periods of underperformance of the fundamental index, specifically the "tech bubble", in the context of sector allocation. They argue that since the volatility of relative prices is higher than the volatility of relative fundamental metrics, the sector allocations within a fundamental index portfolio remain steadier than those in a cap-weighted portfolio.

[2] Although most studies on fundamental indexation focussed on equities, they have been tested on markets for other asset categories. Arnott, Hsu, Li and Shepherd (2010) extend the valuation-indifferent methodology to investment grade, high yield and emerging market bonds and also report outperformance over the relevant valuation-weighted benchmarks. Hsu, Li and Kalesnik (2009) look into market valuation-indifferent weighting in real estate in the US and international markets and find evidence of outperformance.

Estrada (2008) applies fundamental indexation technique to international diversification by giving each country a weight according to its dividend per share and then measuring the portfolio performance (using country ETFs as the investable security). The findings suggest that over a 32-year (1974-2005) period, the dividend-weighted fundamental index outperformed the cap-weighted index on an absolute as well as on a risk-adjusted basis. However, the author also found that a simple value strategy based on dividend yield would have outperformed the fundamental indexation strategy for the same period. Walkshäusl and Lobe (2010) use data from 1982 to 2008 to create a global fundamental index as well as individual country indexes for 28 developed and 22 emerging markets. In addition to the fundamental metrics used by AHM - book value, cash flows, dividend paid, employees, income and sales - the authors test the net payout metric, defined as dividends paid plus cash used for repurchases minus cash received from issuances. Although they find evidence of global fundamental index outperforming global cap-weighted index, the evidence for outperformance of individual country-specific indexes is not compelling.

One of the main critiques of fundamental indexation is that it is a strategy to capture value premium already well documented in literature (Ball, 1978; Stattman, 1980; Fama and French, 1992) but is not as effective at capturing the value effect as an intentional value tilt would be.[3] Jun and Malkiel (2008) examines the returns of the fundamental index and conclude that the methodology does not add any value above that which is explained by the Fama and French three-factor model. Blitz and Swinkels (2009) critique follows the same line – that fundamental indexation is simply an active value strategy. They find that more sophisticated quantitative strategies, capturing more than one market anomaly, may provide a better risk-return profile for investors. Amenc, Goultz and Le Sourd (2009) show that when this value bias is adjusted for, the published fundamental index RAFI 1000 Index does not outperform the market cap-weighted index. Perold (2007) examines the theory behind fundamental indexation, the 'noisy market hypothesis', and argues that it is "fundamentally flawed". His primary criticism of the theory revolves around the assertion by fundamental index proponents that one can outperform the cap-weighted index without knowing fair value. The paper also states that the fundamental index performance suffers in conditions of persistent mispricing or under-reacting stock prices.

[3] Some critiques argue that, apart from value premium, it is also an attempt to capture size premium (Banz, 1981) to a small extent.

The only published study to investigate fundamental indexation exclusively in the Australian stock market is Mar, Bird, Casavecchia and Yeung (2009). They create fundamental index portfolios on the metrics of book value-to-equity, three-year rolling average cashflows and three-year rolling average revenue for the period 1995 to 2006. They find that the composite fundamental index outperforms the market cap-weighted reference portfolio by an average of 1.93% per year. The only time it is found to underperform is during the "tech bubble". Using the Carhart four-factor model, the authors find that the fundamental index exhibits a significant value bias, while size and momentum are not significant factors in the explaining the excess return. Finally, their paper demonstrates that the fundamental index is not disadvantaged by liquidity and turnover. The effect of transaction costs is examined and it is found that a 1% transaction cost is not sufficient to cancel out the excess return.

Some of the global research on fundamental indexation covers Australia by default. For example, Tamura and Shimizu (2005) holds a fundamental-weighted portfolio of 80 Australian stocks from January 1988 to August 2005. They found the Australian region index to outperform the benchmark on a statistically significant basis with a beta of less than one. Walkshäusl and Lobe (2010) also find that the fundamental index portfolio in Australia was one of the few that beat the benchmark at a statistically significant level after controlling for data snooping.

3. Data and Index Construction

3.1 Data

Our dataset covers a period of 25 years between April 1985 and March 2010. It includes data on returns of ASX listed companies as well as on a range of fundamental measures like sales, book value (BV), operating profit (OP), earnings before interest and tax (EBIT), dividends, and employee numbers. The data on fundamental measures for individual companies used in this study was drawn from the Aspect Huntley and Worldscope (Factset) databases. Stock price and returns are from Standard and Poors (S&P), but where S&P data was unavailable, Factset data was used. The use of two databases of company fundamentals is to assist with error-checking and allows for a longer testing period than previous studies like Mar et al (2009) as Worldscope data is available from 1985. The AHM study makes the points that by reweighting a cap-weighted index, stocks with strong fundamentals but low market capitalization may be excluded; likewise, companies with poor fundamentals but high

capitalization may get included. To avoid such possibilities, we start with the universe of all stocks listed on the ASX at the time of reconstitution each year.

3.2 Index Construction

3.2.1 Individual Indexes

Fundamental indexes were constructed individually on each of the following measures.

i. Sales (Net)
ii. Book value
iii. Book value minus intangibles
iv. Operating income
v. Earnings before Interest and Taxes (EBIT)
vi. Total dividend paid
vii. Total dividend paid plus cash used to repurchase common stock (buybacks)
viii. Net payout
ix. Employee numbers

Most of the above measures were selected from prior fundamental index research. The original AHM study used book value, operating income, revenue, dividends, and employment to form indexes. Other authors tested various combinations among these fundamental metrics in different markets. The only study of fundamental indexation in the Australian market, Mar et al (2009), employed just three measures - book value, operating income, and revenue.

The 'net payout' metric used in this paper was earlier used by Walkshäusl and Lobe (2010). The idea behind using it is that net payout (defined as dividends plus cash paid for stock buybacks and minus cash received for stock issuances) might be a better representation of company size than pure dividends. A dividend plus buyback metric is included as a halfway point between the dividend and net payout measures, and to represent a larger amount of companies as many are excluded from the net payout index due to having a negative value (from subtracting cash received for stock issuances).[4]

[4] Data for franking levels is not available until 1997, and therefore a "grossed-up dividend paid" or "grossed-up dividend paid plus buybacks" factor were excluded from this research. However, as the Australian imputation taxation system has an impact on the payment of dividends by distributing companies, it would be a worthwhile factor to include in future studies.

Two fundamental measures are unique to this research paper. The 'book value minus intangibles' measure is included to obtain a more tangible evaluation of company size than the book value measure used in the AHM construction. Similarly, the EBIT measure is a new inclusion to testing of the fundamental indexation concept. Due to the similarity in definitions, it can be hypothesised that this metric will perform much like the operating income measure; however, it is included to see whether non-operating income and extraordinary items would substantially alter the result.

At the end of March every year, fundamental indexes are formed and held for 12 months and then rebalanced. Three indexes are constructed for each measure using trailing 5-year average data, trailing 3-year average data and the latest data (hereon 5-yr, 3-yr and 1-yr). In line with the AHM construction methodology, the 3-yr and 5-yr indexes will take a simple average of the trailing data for each company. However, where a data field is blank for a certain year, the average is taken of the available data.[5] The companies are then ranked on the absolute value of the fundamental measure each year. Where the absolute value is negative, it is given a 0 value in order to hold only long positions within the index. The top 200 companies by each measure are used to construct the fundamental indexes. Companies within each index are weighted in accordance with the magnitude of the respective fundamental measures. It is to be noted that in some of the earlier years in our sample period, data is available for less than 200 companies. In these cases, all companies are included in the index in a weighted manner. There are a number of reasons for using the top 200 companies in constructing the fundamental indexes. First, the performance could be compared with the benchmark S&P ASX200, the most popular cap-weighted index in Australian market. Second, the Australian fundamental index portfolios run by both Realindex Investments and FTSE are made of 200 companies. Finally, while using more companies would be more representative of the Australian market in later years of our sample period but data in the earlier years is limited.

Consistent with the FTSE RAFI index construction methodology, the indexes are created at the end of March and rebalanced on an annual basis (FTSE, 2008). Blitz, van der Grient and van Vliet (2010) find that the rebalance date had little effect over the long run; thus March was selected purely on the basis of a pre-established methodology. Although Stotz, Döhnert, and Wanzenried (2007) conclude that daily rebalancing added up to 0.95% excess

[5] This differs to the treatment of a data field for which the value is zero. Any field that had a value is included in the trailing average.

performance a year, their results also show that it results in higher volatility. Moreover, such frequent rebalancing undermines the passive characteristic of fundamental indexation that the original AHM study intends to create, and results in a higher level of turnover.[6]

3.2.2 Composite index

We also construct a composite index by combining the individual fundamental measures. Prior research papers of fundamental indexation used different combinations of individual fundamental measures, numbers of measures and trailing average periods for their composite index. As Arnott and West (2006) explain, the reasoning behind having a number of measures rather than just one is that each metric has a bias. For example, the 'dividend paid' metric has a bias towards established companies while the 'employee number' metric has a bias to large companies and places the same importance on a shelf-stacker as a biological scientist. Similarly, the 'sales' metric may be inconsistent across industries (such as financial services) and a portfolio based on 'profits' metric may overweight and underweight companies with highly cyclical income (Arnott & West, 2006).

Four fundamental measures - book value, net sales, operating income and net payment - are being used for the composite portfolio to be consistent with prior research, which used between three and five fundamental measures in their composite index. Four measures seem sufficient to balance the biases from individual measures, but not so many that the transparency and repeatability of the process is eliminated. The employee numbers metric is excluded from the composite portfolio, due to the lack of data available, the errors in the source data and the fact that companies have not consistently reported employee numbers.

As the first measure, we use book value minus intangibles to get a more tangible evaluation of book value. For this metric, we use just the latest data, rather than rolling averages, to ensure that it is representative of any significant changes to firm size as a result of mergers and acquisitions. The second factor used is net sales, consistent with most of the tests of the methodology which either use a sales or revenue metric. A 5-year trailing average is used for this metric as the AHM study recommends, in order to avoid substantially higher volatility and turnover.

[6] The AHM study does examine rebalancing on a more frequent basis and found that the results were similar but with increased turnover.

Both EBIT and operating income are used by studies in the past as representation of a company's profitability. We use operating income for the construction of the composite portfolio to exclude non-operating income and extraordinary items. A 5-year trailing average is also used for this metric, to smooth potential overweights to companies with highly cyclical income. Finally, this composite portfolio contains a net payment metric . This is similar to the paper of Walkshäusl and Lobe (2010) and based on the testing done by Boudoukh, Michaely, Richardson, and Roberts (2007), who find that the stock return predictability in a time-series is much stronger when (net) payout yields are used instead of the dividend yield.

As per the construction for individual indexes, each company is given a weight according to their relative size against the top 200 companies by that fundamental measure. For the composite index, the company's weight across the four fundamental metrics is averaged. The top two-hundred companies on the average result are taken, and then the weights renormalised to equal one. Equal weighting of each metric is used for the composite portfolio for ease of replication and transparency.

3.2.3 Comparative Indexes

A cap-weighted index is constructed for a fair comparison. Free-float adjusted market capitalization is available from 1993 in the Worldscope database. Like the fundamental indexes, the cap-weighted index is rebalanced only once a year at the end of March. The end result turns out to be quite similar to that of the S&P ASX 200 and performance is highly correlated. The cap-weighted index (called Reference henceforth) is used in our analysis for the sub-period 1993-2010. For the full sample period i.e. 1985-2010, we use the ASX 200 Accumulation index as the comparator for the fundamental indexes.

4. Results

4.1 Performance and Risk-Return Characteristics

4.1.1 Individual Indexes

We test the fundamental index portfolios and the market cap reference portfolio on performance by calculating monthly returns and comparing them both in terms of absolute and risk adjusted basis. To report the latter, we compute Sharpe ratio as per Sharpe (1966).[7] As market capitalization data for individual companies is not available prior to 1993, there are two sets of performance comparisons: one for the entire sample period from 1985 onwards and another for sub-sample period from 1993 onwards. For the first set of comparisons, we compare the performance of individual and composite fundamental indexes to the market cap-weighted S&P/ASX 200 (and prior to 31 May 1992, the ASX All Ordinaries Accumulation) index, which is the most well known benchmark of the Australian stock market. For the sub-sample period commencing from April 1993, we compare the performance of individual and composite fundamental indexes to the cap-weighted 'reference' portfolio which we construct using the same methodology as that used for the fundamental indexes.

In terms of total returns over the full 25- year period, all the fundamental indexes achieve statistically significant outperformance over the S&P/ASX 200 Index. Similarly, since 1993 each of the fundamental indexes demonstrates statistically significant outperformance over the reference market cap portfolio. Tables 1 and 2 show that, over the full sample and sub-sample period, the individual fundamental indexes not only generate higher geometric annual returns than the cap-weighted indexes, many do so with similar or lower volatility.

Table 1: Performance of Individual Indexes (March 1985 to March 2010)

	Geometric Return	Ending Value $1	Volatility	Sharpe Ratio	Excess Return	t-stat of excess return
Net Sales - Latest	16.59%	$ 46.44	16.02%	0.48	4.84%	3.91*
Net Sales - 3 year	17.14%	$ 52.22	15.97%	0.52	5.39%	4.43*
Net Sales - 5 year	17.64%	$ 58.06	15.93%	0.55	5.88%	4.88*
Book Value - Latest	15.05%	$ 33.27	16.18%	0.39	3.29%	3.36*
Book Value - 3 year	15.40%	$ 35.91	16.11%	0.41	3.64%	3.71*
Book Value - 5 year	15.58%	$ 37.31	15.96%	0.43	3.82%	3.88*

[7] We also report 'alpha' measures following Jensen (1968), Fama and French (1993) and Carhart (1997) for the composite fundamental index and reference cap-weighted index in section 4.1.4

Book Value ex Intangibles - Latest	15.26%	$ 34.83	16.06%	0.41	3.50%	3.04*
Book Value ex Intangibles - 3 year	15.66%	$ 37.99	16.05%	0.43	3.90%	3.45*
Book Value ex Intangibles - 5 year	15.84%	$ 39.49	15.91%	0.44	4.08%	3.65*
Operating Income - Latest	15.20%	$ 34.39	16.04%	0.40	3.44%	3.15*
Operating Income - 3 year	15.72%	$ 38.47	15.88%	0.44	3.96%	3.74*
Operating Income - 5 year	15.56%	$ 37.14	15.80%	0.43	3.80%	3.60*
EBIT - Latest	15.83%	$ 39.42	16.16%	0.43	4.08%	3.85*
EBIT - 3 year	16.09%	$ 41.70	15.97%	0.46	4.34%	4.19*
EBIT - 5 year	15.79%	$ 39.07	15.91%	0.44	4.03%	3.92*
Dividend Paid - Latest	15.55%	$ 37.09	15.17%	0.45	3.79%	2.63*
Dividend Paid - 3 year	15.24%	$ 34.67	15.11%	0.43	3.48%	2.64*
Dividend Paid - 5 year	15.37%	$ 35.65	14.97%	0.44	3.61%	2.76*
Dividend + Buybacks - Latest	15.81%	$ 39.22	15.11%	0.46	4.05%	2.84*
Dividend + Buybacks - 3 year	15.35%	$ 35.49	15.00%	0.44	3.59%	2.72*
Dividend + Buybacks - 5 year	15.32%	$ 35.29	14.82%	0.44	3.56%	2.70*
Net Payment - Latest	16.27%	$ 43.35	15.40%	0.48	4.52%	3.13*
Net Payment - 3 year	15.77%	$ 38.86	15.47%	0.45	4.01%	3.31*
Net Payment - 5 year	15.66%	$ 38.02	15.42%	0.45	3.91%	3.37*
Employees - Latest	16.70%	$ 47.54	16.13%	0.49	4.95%	3.02*
Employees - 3 year	16.85%	$ 49.02	15.93%	0.50	5.09%	3.28*
Employees - 5 year	16.66%	$ 47.08	15.86%	0.49	4.90%	3.15*
S&P ASX 200 Accumulation	*11.76%*	*$ 16.10*	*16.72%*	*0.19*	-	-

*Excess returns are significant at 1% level

Table 2: Performance of Individual Indexes (March 1993 to March 2010)

	Geometric Return	Ending Value $1	Volatility	Sharpe Ratio	Excess Return	t-stat of excess return
Net Sales - Latest	15.67%	$ 11.87	13.34%	0.48	4.49%	3.77**
Net Sales - 3 year	16.34%	$ 13.11	13.17%	0.52	5.17%	4.17**
Net Sales - 5 year	17.09%	$ 14.61	13.17%	0.55	5.92%	4.72**
Book Value - Latest	13.29%	$ 8.34	13.67%	0.36	2.12%	2.81**
Book Value - 3 year	13.68%	$ 8.85	13.54%	0.38	2.51%	3.10**
Book Value - 5 year	13.91%	$ 9.15	13.37%	0.40	2.74%	3.22**
Book Value ex Intangibles - Latest	14.03%	$ 9.32	13.72%	0.39	2.86%	2.52*
Book Value ex Intangibles - 3 year	14.45%	$ 9.92	13.64%	0.41	3.28%	2.85**
Book Value ex Intangibles - 5 year	14.64%	$ 10.21	13.43%	0.43	3.47%	3.06**
Operating Income - Latest	13.66%	$ 8.82	13.30%	0.39	2.49%	2.44*
Operating Income - 3 year	14.05%	$ 9.35	13.08%	0.41	2.88%	2.81**
Operating Income - 5 year	13.78%	$ 8.98	13.04%	0.40	2.61%	2.57*
EBIT - Latest	14.72%	$ 10.32	13.30%	0.44	3.55%	3.86**
EBIT - 3 year	14.90%	$ 10.60	13.12%	0.45	3.73%	4.00**
EBIT - 5 year	14.54%	$ 10.05	13.11%	0.43	3.37%	3.68**
Dividend Paid - Latest	14.39%	$ 9.83	12.87%	0.44	3.22%	2.41*
Dividend Paid - 3 year	13.85%	$ 9.07	12.55%	0.42	2.68%	2.18*
Dividend Paid - 5 year	14.06%	$ 9.37	12.39%	0.44	2.89%	2.33*
Dividend + Buybacks - Latest	15.04%	$ 10.83	12.77%	0.47	3.87%	3.16**
Dividend + Buybacks - 3 year	14.29%	$ 9.69	12.46%	0.44	3.12%	2.75**
Dividend + Buybacks - 5 year	14.41%	$ 9.86	12.25%	0.46	3.24%	2.83**
Net Payment - Latest	16.40%	$ 13.23	12.69%	0.54	5.23%	3.57**
Net Payment - 3 year	14.91%	$ 10.62	12.58%	0.47	3.74%	3.09**
Net Payment - 5 year	14.65%	$ 10.21	12.49%	0.46	3.47%	3.07**
Employees - Latest	15.16%	$ 11.02	12.91%	0.47	3.99%	2.55*

Employees - 3 year	15.41%	$ 11.42	12.65%	0.49	4.23%	2.67**
Employees - 5 year	15.22%	$ 11.11	12.56%	0.49	4.05%	2.52*
Reference	*11.17%*	*$ 6.05*	*13.42%*	*0.27*	-	-

**Excess returns are significant at 1% level * Excess returns are significant at 5% level.

Over the full sample period 1985-2010, the average geometric return for the individual fundamental indexes is 15.89%, which is 4.13% higher than the geometric mean return of the S&P ASX 200 index. From 1993 onwards, the individual fundamental indexes returned 14.69% per annum on average, which was 3.52% higher than that of the cap-weighted reference portfolio. This is much higher than the magnitude of outperformance reported by previous studies in different geographical markets.[8] We find that the excess returns to be statistically significant for all individual and composite fundamental indexes.

At 15.72%, the average volatility of the fundamental indexes over the full sample period is a full 1% lower than that of S&P ASX 200 index. For the sub-sample period commencing 1993, the difference is much smaller but the average standard deviation of fundamental indexes is still 0.41% lower than that of the reference portfolio. This is contrary to Mar et al (2009) who found the volatility of the cap-weighted Australian index to be slightly lower than all of the individual fundamental indexes. However, the Sharpe ratio measures in both Mar et al (2009) and our paper show that all the individual fundamental indexes outperform the cap-weighted counterparts on a risk-adjusted basis.

As in the AHM study, among the individual fundamental indexes, we find the net sales portfolios have the highest terminal value. The portfolios formed on the basis of dividends and operating profits, on the other hand, fare the poorest but both of them outperform the cap-weighted indexes quite easily. Also similar to findings of many past studies, our results show that the dividend portfolios have the lowest volatility. This is mainly due to the reason that dividend-paying companies are very often large and well-established 'value' companies with lower risk perception. The results for single year and multi-year fundamental indexes are quite similar. With the exception of the dividend indexes, the returns for multi-year indexes are marginally higher relative to single year indexes. In terms of volatility of returns, however, there is a noticeable decline in all indexes formed with longer period data. This

[8] The AHM study finds the fundamental index returns are about 2% higher than the cap-weighted index in USA. Stotz et al (2010) and Mar et al (2009) reports similar magnitude of outperformance for European and Australian stocks respectively.

suggests that fundamental indexes that are constructed using multi-year data may provide superior risk-return profile for investors in most cases.

4.1.2 Composite Fundamental Index

As discussed in 3.5, the composite index was made up of four equally weighted fundamental metrics: five-year trailing average operating income, net payments, net sales and the latest book value minus intangibles. The performance results of the composite index, the individual constituents of the composite index, and the comparable indexes are provided in table 3.

Table 3: Composite Fundamental Index Performance (1985-2010)

	Annual total return	Ending Value of $1	Volatility
Panel A: 1985-2010			
Book Value ex Intangibles - Latest	15.26%***	$ 34.83	16.06%
Net Sales - 5 year	17.64%***	$ 58.06	15.93%
Operating Income - 5 year	15.56%***	$ 37.14	15.80%
Net Payment - 5 year	15.66%***	$ 38.02	15.42%
Average	16.03%	$ 42.01	15.80%
Composite	*16.19%***	*$ 42.57*	*15.65%*
S&P ASX Accumulation	11.76%	$ 16.10	16.72%
Panel B: 1993 - 2010			
Book Value ex Intangibles - Latest	14.03%**	$ 9.32	13.72%
Net Sales - 5 year	17.09%***	$ 14.61	13.17%
Operating Income - 5 year	13.78%**	$ 8.98	13.04%
Net Payment - 5 year	14.65%***	$ 10.21	12.49%
Average	14.89%	$ 10.78	13.10%
Composite	14.99%***	$ 10.97	12.91%
Reference	11.17%	$ 6.05	13.42%

* Excess return statistically significant at 10% level. ** Excess return statistically significant at 5% level. *** Excess return statistically significant at 1% level.

The performance of the composite index is strong over both time periods relative to the two market cap-weighted benchmarks. As the figures show, the composite index outperforms the cap-weighted index with lower volatility as well as outperforming the average of the four individual metrics.

Having seen the superior risk-return characteristics of the composite index, it is still important for investors to know that there can be prolonged periods where the fundamental indexes underperform cap-weighted indexes. Chen, Chen and Bassett (2007) points out that

fundamental weighting would not be profitable if actual prices stray far from fundamentals for long periods. We attempt to find out whether there is any relationship between market returns and performance of composite index. This is done by grouping rolling one year periods in terms of returns of S&P ASX 200 and finding out that over how many such periods the composite index returns are above those of the S&P ASX 200.

Table 4: Composite Fundamental Index Wins over S&P ASX 200 Accumulation Index Using 1 Year Rolling Returns (1985-2010)

Market Return	Composite Fundamental Index wins (%)	Number of periods
greater than 30%	50%	42
20% to 30%	47%	51
10% to 20%	71%	75
0% to 10%	86%	56
-10% to 0%	91%	34
-20% to -10%	89%	18
less than -20%	100%	13

Table 4 reports the composite index wins over the market cap-weighted index. It is clear that fundamental index wins are more frequent as market returns decrease. In other words, the composite fundamental index consistently adds value in downward markets while value is added only about half the time in very strong market environments when returns are above 20%. However, one has to be mindful that number of rolling one year periods of such high returns is not trivial. In fact, they are nearly a third of all rolling one year periods between 1985 and 2010.

We also analyse the periods of outperformance and underperformance of the composite index during the sub-sample period. Figure 1 depicts the excess return of the composite index over the comparable reference index on a rolling one year basis from 1993 to 2010. Two distinct periods of extended underperformance against the reference index are observed: January-September 2000 and October 2004-November 2006. The first period of underperformance comes at the height of the “tech bubble”, which is consistent with findings of past studies. This period was a strong growth period when the cap-weighted index by its very construction benefitted by putting more weight into stocks whose price increased at a greater pace than the rest of the market. The second period of underperformance was also recorded during a prolonged growth phase in the stock market.

Figure 1: Composite Fundamental Index 1 Year Rolling Excess Return over Reference Index

Figure 2 shows excess return of the fundamental index on a 5-year rolling basis. In this case, any underperformance of the fundamental index is completely eliminated. The excess returns of the composite index in this case are always observed to be positive. Whilst based on data over a brief sample period of 17 years it would be inappropriate to conclude that such excess returns would exist in the future, this certainly lends support to the argument that investors with longer horizon would find the composite fundamental index more appealing over the cap-weighted index.

Figure 2: Composite Fundamental Index 5 Year Rolling Excess Return over Reference Index

4.1.3 Robustness Check

To test the robustness of the outperformance using this methodology, we do three robustness checks for our results under varying economic and market conditions. First, we look into the performance of fundamental indexes relative to cap-weighted indexes over the contraction and expansion phases of the business cycle. These phases are defined in accordance with the identification of peaks and troughs of business cycles by months reported by Melbourne Institute (2010). The months from a peak to nearest future trough are included as contraction phase and those from trough to next peak as expansion phase. Second, relative performance over rising (bull) and falling (bear) markets is examined. A rising or falling market, for the purposes of this study, is simply characterised by a period of prolonged positive (negative) return in the stock market which results in a gain (loss) of over 15%. Finally, we compare relative performance over periods of rising and falling interest rates. An increase (decrease) by 100 basis points in the Reserve Bank of Australia's (RBA) cash rate from the previous low (high) within a year is considered as rising (falling) interest rate regimes. Prior to the RBA's targeting of cash rates, a 3-month rolling average is used to determine periods of rising and falling rates. The results are presented in table 5.

Table 5: Fundamental Index performance in Different Economic and Market Conditions (1985 – 2010)

Panel A: Expanding and Contracting Phases of the Business Cycle

	Expanding			Contracting		
	Annual return	Volatility	Sharpe Ratio	Annual return	Volatility	Sharpe Ratio
Net Sales - Latest	20.85%*	16.97%	0.552	10.49%**	14.38%	0.076
Net Sales - 3 year	20.90%**	16.94%	0.563	11.73%***	14.33%	0.156
Net Sales - 5 year	21.87%***	16.96%	0.634	11.57%**	14.18%	0.147
Book Value - Latest	19.42%**	17.22%	0.509	8.80%	14.38%	-0.033
Book Value - 3 year	20.05%***	17.25%	0.542	8.77%	14.10%	-0.036
Book Value - 5 year	20.23%***	17.18%	0.555	8.94%	13.80%	-0.025
Book Value ex Intangibles - Latest	19.67%*	17.13%	0.483	8.95%	14.19%	-0.023
Book Value ex Intangibles - 3 year	20.24%**	17.22%	0.519	9.11%	13.98%	-0.013
Book Value ex Intangibles - 5 year	20.30%**	17.17%	0.528	9.46%	13.68%	0.010
Operating Income - Latest	18.51%**	17.14%	0.527	10.41%**	14.19%	0.071
Operating Income - 3 year	19.52%**	16.95%	0.563	10.25%**	14.05%	0.062
Operating Income - 5 year	19.33%**	16.97%	0.565	10.12%**	13.80%	0.054
EBIT - Latest	20.20%**	17.01%	0.553	9.57%	14.70%	0.016
EBIT - 3 year	20.44%***	16.90%	0.582	9.87%*	14.36%	0.036
EBIT - 5 year	20.04%***	16.93%	0.572	9.69%*	14.13%	0.025
Dividend Paid - Latest	20.12%**	16.11%	0.614	9.01%	13.52%	-0.020
Dividend Paid - 3 year	19.75%**	16.12%	0.581	8.79%	13.31%	-0.036

Dividend Paid - 5 year	19.73%**	16.03%	0.587	9.12%	13.09%	-0.014
Dividends + Buybacks - Latest	20.34%*	15.96%	0.626	9.32%	13.61%	0.001
Dividends + Buybacks - 3 year	19.82%*	15.95%	0.574	8.96%	13.33%	-0.025
Dividends + Buybacks - 5 year	19.68%*	15.83%	0.567	9.08%	13.04%	-0.016
Net Payment - Latest	20.74%**	16.48%	0.653	9.88%	13.49%	0.039
Net Payment - 3 year	20.41%**	16.54%	0.605	9.13%	13.59%	-0.012
Net Payment - 5 year	20.34%**	16.52%	0.613	8.98%	13.45%	-0.022
Employees - Latest	20.26%	16.79%	0.502	11.56%*	15.05%	0.137
Employees - 3 year	20.89%*	16.66%	0.545	11.03%	14.69%	0.108
Employees - 5 year	20.57%	16.62%	0.525	11.02%	14.59%	0.108
Composite	***20.22%****	***16.78%***	***0.583***	***10.39%****	***13.69%***	***0.073***
S&P ASX Accumulation	***14.81%***	***18.12%***	***0.264***	***7.33%***	***14.32%***	***-0.128***

Panel B: Rising and falling stock markets

	Bull Markets			Bear Markets		
	Annual return	Volatility	Sharpe Ratio	Annual return	Volatility	Sharpe Ratio
Net Sales - Latest	62.10%	10.90%	15.64	-35.82%*	21.81%	-6.45
Net Sales - 3yr	61.92%	10.76%	15.82	-36.03%**	22.28%	-6.35
Net Sales - 5yr	61.88%	10.80%	15.74	-35.84%**	22.23%	-6.33
Book Value - Latest	59.14%	11.18%	14.44	-37.11%	22.37%	-6.48
Book Value - 3yr	59.36%	11.28%	14.37	-36.31%	22.40%	-6.36
Book Value - 5yr	58.99%	11.20%	14.37	-35.44%*	22.26%	-6.27
Book Value ex Intangibles - Latest	60.29%	11.09%	14.82	-36.65%	22.21%	-6.46
Book Value ex Intangibles - 3yr	60.66%	11.16%	14.85	-36.18%	22.32%	-6.37
Book Value ex Intangibles - 5yr	60.46%	11.07%	14.91	-35.43%*	22.12%	-6.31
Operating Income - Latest	59.20%	10.67%	15.18	-37.50%	22.26%	-6.57
Operating Income - 3yr	60.05%**	10.73%	15.38	-36.50%	21.72%	-6.59
Operating Income - 5yr	59.43%*	10.74%	15.17	-36.30%	21.54%	-6.62
EBIT - Latest	59.93%	10.97%	14.95	-37.69%	22.35%	-6.56
EBIT - 3yr	60.85%	10.79%	15.49	-37.01%	21.90%	-6.60
EBIT - 5yr	59.90%	10.77%	15.23	-37.02%	21.79%	-6.64
Dividend Paid - Latest	58.16%	10.82%	14.57	-33.92%*	19.81%	-6.79
Dividend Paid - 3yr	57.60%	10.58%	14.78	-34.30%**	20.15%	-6.75
Dividend Paid - 5yr	57.31%	10.47%	14.84	-33.52%**	20.00%	-6.67
Dividends + Buybacks - Latest	58.48%	10.70%	14.83	-33.53%*	19.39%	-6.86
Dividends + Buybacks - 3yr	57.48%	10.56%	14.77	-34.03%*	19.69%	-6.85
Dividends + Buybacks - 5yr	56.86%	10.46%	14.71	-33.28%**	19.43%	-6.82
Net Payment - Latest	60.54%	11.13%	14.91	-32.32%***	20.04%	-6.45
Net Payment - 3yr	60.04%	11.02%	14.94	-34.48%**	21.03%	-6.48
Net Payment - 5yr	59.45%	10.97%	14.86	-34.24%**	20.88%	-6.50
Employees - Latest	60.57%	11.69%	14.17	-35.03%*	20.92%	-6.60
Employees - 3yr	61.03%	11.52%	14.51	-34.63%*	21.24%	-6.45
Employees - 5yr	60.63%	11.52%	14.42	-34.51%*	21.28%	-6.42
Composite	60.32%	10.65%	15.52	-35.58%**	21.64%	-6.47
S&P ASX 200 Accumulation	55.23%	10.44%	14.42	-40.36%	25.40%	-6.13

Panel C: Increasing and decreasing interest rate environments

	Increasing			Decreasing		
	Annual total return	Volatility	Sharpe ratio	Annual total return	Volatility	Sharpe ratio
Net Sales - Latest	12.59%	11.80%	0.41	20.41%***	19.07%	0.55
Net Sales - 3yr	13.45%	11.75%	0.48	20.65%***	19.03%	0.56
Net Sales - 5yr	13.23%	11.66%	0.47	21.86%***	19.01%	0.62
Book Value - Latest	12.04%	11.69%	0.37	17.90%***	19.42%	0.42

Book Value - 3yr	11.93%	11.58%	0.36	18.70%***	19.35%	0.46
Book Value - 5yr	11.94%	11.50%	0.37	19.04%***	19.16%	0.48
Book Value ex Intangibles - Latest	11.94%	11.62%	0.36	18.41%***	19.26%	0.45
Book Value ex Intangibles - 3yr	12.17%	11.53%	0.38	18.98%***	19.29%	0.48
Book Value ex Intangibles - 5yr	12.21%	11.40%	0.39	19.30%***	19.13%	0.49
Operating Income - Latest	12.23%	12.42%	0.36	18.01%***	18.77%	0.44
Operating Income - 3yr	12.58%	12.23%	0.40	18.70%***	18.62%	0.48
Operating Income - 5yr	12.17%	12.19%	0.37	18.78%***	18.52%	0.49
EBIT - Latest	13.22%*	11.82%	0.46	18.30%***	19.33%	0.44
EBIT - 3yr	13.05%*	11.67%	0.45	18.98%***	19.09%	0.48
EBIT - 5yr	12.64%	11.73%	0.42	18.78%***	18.96%	0.47
Dividend Paid - Latest	11.44%	11.17%	0.34	19.48%***	18.07%	0.53
Dividend Paid - 3yr	11.22%	11.07%	0.32	19.08%***	18.02%	0.51
Dividend Paid - 5yr	11.30%	10.99%	0.33	19.25%***	17.83%	0.53
Dividend Paid + Buybacks - Latest	12.26%	11.18%	0.40	19.18%***	17.97%	0.52
Dividend Paid + Buybacks - 3yr	11.82%	11.09%	0.37	18.70%***	17.85%	0.50
Dividend Paid + Buybacks - 5yr	11.74%	10.97%	0.37	18.73%***	17.62%	0.51
Net Payment - Latest	12.29%	11.48%	0.40	20.07%***	18.26%	0.56
Net Payment - 3yr	12.15%	11.47%	0.38	19.21%***	18.39%	0.51
Net Payment - 5yr	11.90%	11.45%	0.36	19.26%***	18.31%	0.52
Employees - Latest	13.17%	12.18%	0.44	20.07%***	19.05%	0.53
Employees - 3yr	13.12%	11.91%	0.45	20.39%***	18.88%	0.56
Employees - 5yr	12.98%	11.78%	0.44	20.16%***	18.85%	0.55
Composite	***12.69%***	***11.61%***	***0.42***	***19.52%******	***18.60%***	***0.52***
S&P/ASX 200 Accumulation	***10.82%***	***12.17%***	***0.26***	***12.63%***	***20.05%***	***0.17***

* Excess return significant at 10% confidence level. ** Excess return significant at 5% confidence level. *** Excess return significant at 1% confidence level.

Results in Panel A show that each of the individual fundamental indexes as well as the composite index outperformed the S&P/ASX 200 in both phases of the business cycle. However, there was variation in the extent of outperformance in the two phases. Whilst most of the individual indexes achieved statistically significant excess returns over the cap-weighted index in expansion phase of the business cycle, this was not the case during the contraction phase. Only fundamental indexes based on net sales and operating income had significantly superior returns during these periods. Unsurprisingly, these indexes also had the highest Sharpe ratios. Dividend based indexes, on the other hand, performed the best among all indexes during expansions. But during contraction phase, like many other indexes, they resulted in negative Sharpe ratios. However, the composite indexes had positive Sharpe measures during both phases of the business cycle.

Panel B shows the performance of the fundamental and the market cap indexes in bullish and bearish conditions in the equity markets. Bull (Bear) markets were typically characterised by extremely high (low) returns and low (high) volatilities. Under bullish market conditions, the individual fundamental indexes generally delivered higher returns as S&P/ ASX 200 with

similar volatilities. However, the superior performance was not significant in most cases. In contrast, under bearish market conditions, more individual indexes like those based on dividends, employees and net sales outperformed the cap-weighted index on a statistically significant basis. The composite index outperformed the cap-weighted index under both bullish and bearish stock market conditions. The cap-weighted index had the higher volatility than any of the individual as well as the composite fundamental indexes during bear market conditions.[9]

Panel C reports the results of the final test of robustness – relative performance over environments of falling and rising interest rates. All indexes recorded much higher returns and volatilities during falling interest rate environments compared to those witnessed when interest rates were rising. All the individual fundamental indexes outperformed the S&P/ASX 200 on a risk adjusted basis under both regimes. Yet there was striking difference in statistical significance of the results in rising and falling interest rate environments. The superior performance of none of the individual fundamental indexes was significant in increasing interest rate environments while all the indexes outperformed S&P/ASX 200 at 1% significance level under conditions when interest rates plummeted.

4.1.4 Factor Characteristics

Having established the superior performance of fundamental indexation among Australian equities over our sample period, we turn to examine the well-known risk factors and anomalies in finance literature- market, value, size and momentum - that could explain the excess returns. This is important to identify the source of outperformance i.e. whether the excess returns of fundamental indexes over the cap-weighted index could be explained by these risk factors. Initially the following regression is done for the fundamental index following Jensen (1968):

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i\left(R_{mt} - R_{ft}\right) + \varepsilon_{it} \qquad (1)$$

Where R_{it} is the monthly return on the fundamental index, R_{ft} is the one month interbank borrowing rate and R_{mt} is the monthly return on the cap-weighted index. The Jensen's alpha

[9] This higher volatility has perversely resulted in a higher Sharpe ratio for the cap-weighted index as the excess returns over risk free rate are negative in bear markets.

is given by α_{it} which gives the excess return of fundamental index that is unexplained by the excess return of the cap-weighted market index.

Second, we apply the 3-factor model of Fama and French (1993) to regress returns of the fundamental index to allow for risk adjustment after controlling for 'size' and 'value' factors.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i(R_{mt} - R_{ft}) + \gamma_i.SMB_t + \delta_i.HML_i + \varepsilon_{it} \qquad (2)$$

In addition to the excess return of market index as in (1), the 3-factor model captures the excess return of small stocks over large stocks (SMB) and that of value stocks over growth stocks (HML). We proxy the *SMB* return by the return difference between monthly returns of ASX Small Ordinaries and ASX 100 index. We use the monthly HML data for Australia available on Ken French's website.

Finally, we employ the 4-factor model proposed by Carhart (1997) where the Fama-French 3-factor model is extended by inclusion of the momentum (MOM) factor. This is given by

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i(R_{mt} - R_{ft}) + \gamma_i.SMB_t + \delta_i.HML_i + \theta_t.MOM_i + \varepsilon_{it} \qquad (3)$$

The MOM factor captures the persistence of returns and is computed by the return differentials between the winners and the loser stocks in the recent past. We follow Jegadeesh and Titman (1993) to construct momentum portfolios using monthly returns data from CRIF database. Stocks listed in the ASX are grouped into quintiles where the top quintile consists of best performers (winners) and the bottom quintile contains worst performers (losers) during past 6 months. Monthly returns are calculated by entering a long position in an equally weighted portfolio of winners and a short position in an equally weighted loser portfolio.[10]

Table 6 reports the results of the regressions using 1, 3, and 4 factors respectively for the composite index.[11] We also include the result of the 4-factor regression for the cap-weighted reference index. All the regressions are conducted with data from April 1993 onwards due to unavailability of data for all the factors prior to 1993.

[10] Due to differential rates of return accruing to different portfolios, the momentum portfolios are rebalanced monthly following Jegadeesh and Titman (1993) throughout the holding period to maintain an equal weighting.
[11] Results for regression of individual indexes are available from the authors on request.

Table 6: Factor Characteristics of Fundamental Indexes

Index	Alpha	β	HML	SMB	MOM	R-Sq.
Composite (1- factor)	0.0035** (3.86)	0.9153** (38.00)				0.8773
Composite (3 -factor)	0.0032** (3.59)	0.9249** (38.49)	0.0746** (3.22)	-0.0237 (-0.73)		0.8836
Composite (4- factor)	0.0039** (4.11)	0.8997** (35.89)	0.0461 (1.91)	-0.0590 (-1.77)	-0.0831** (-3.07)	0.8784
***Reference* (4- Factor)**	0.0004 (0.55)	0.9862** (50.02)	0.0409* (2.15)	-0.0764** (-2.92)	-0.0496* (-2.33)	0.9331

** significant at 1% level, * significant at 5% level

The R-Square value of the composite index is about 88% for all the three models showing that each of these models do a good job of explaining the variation of excess returns of fundamental indexes. For the cap-weighted reference index, the 4-factor model has even higher explanatory power (above 93%). The market factor is significant in all the models at 1%. The market beta coefficients indicate that the composite index bears slightly less systematic risk than the overall market. Again, the magnitude of the beta coefficient for the composite index is slightly lower than that for the cap-weighted index which has a beta very close to 1. Hence, fundamental index returns could not be distinguished from cap-weighted index returns based on the market factor.

Of the other three, the size (SMB) factor appears to have no significant relationship with the composite index. This may be surprising considering the expectation that the fundamental index would display a bias towards small stocks in comparison to a cap-weighted index. The relationship of the size factor with the cap-weighted reference portfolio is significant but negative.[12] This would suggest that the cap-weighted index returns are more closely

[12] The size premium during our full sample period was negative. Past studies of the Australian market present conflicting results on the existence of the size premium. Some find evidence of a positive premium (e.g. Gaunt (2004)) while others report negative premium (e.g. Faff (2001). Most of them indicate the evidence on size factor is weaker compared to US market.

correlated with large stocks returns than small stocks returns. For the composite index, the value (HML) factor is significant only in the 3 factor model but not in the 4-factor model. This is markedly different from most studies, including Mar et al. (2009) study in the Australian market, which attributes the superior returns of the fundamental index over the cap-weighted index to a value tilt in its composition. On the other hand, like Mar et al. (2009), we find a significant value bias in the cap-weighted index. The coefficient of the momentum factor is negative and significant. This is also reported in previous studies like Mar et al. (2009) and Stotz et al. (2010) that could be a result of the contrarian nature of the fundamental indexation strategy. Interestingly, the momentum factor also displays a negative relationship with the reference portfolio although the magnitude of the coefficient is half that of the composite index.

The alpha coefficients for the composite index are quite revealing. The alphas are similar for the models with 1, 3, and 4 factors, which suggests that the additional risk factors do little to explain the excess returns of the fundamental index. The alphas for the composite index are significantly positive in all the models and show that the fundamental index is able to generate excess return that is not attributable to any of the 4 factors in the Carhart model. This contradicts the earlier findings of Mar et al. (2009) who reported that fundamental index superiority over cap-weighted index in Australia was largely attributable to value bias and the alpha was insignificant after controlling for the 4 factors.[13]

4.2 Portfolio Holdings Comparison

Holdings are compared across portfolios at the individual company level and the sector level. At the individual company level, we examine the holdings of BHP Billiton stock in the cap-weighted and fundamental indexes. This stock was selected due to the fact that as at March 2009 (the final rebalance date for this study), it was the largest stock in the cap-weighted and fundamentals-weighted indexes, and it has been listed long enough to span the entire sample period. We also scrutinise the variation of allocation to different sectors over time for both the cap-weighted and fundamental composite index portfolios. Similar to Hsu and Campollo (2006), composite index holdings is compared with the market cap reference portfolio at a

[13] The AHM (2005) study found positive alpha for fundamental index in the US market but they used a single factor model only.

sector level on a rolling 12 month basis. Quarterly sector allocation is calculated through Factset using the Factset sector groupings. Finally, we look at portfolio concentration, which we measure as the total weight allocated to the top ten stocks. Concentration is examined at the latest rebalance (March 2009) as well as an average from 1993 to 2009, using monthly price-drifted indexes.

Table 7 shows the variations in annual allocated weights for BHP over the period April 1993 to March 2009 and the standard deviation of these weights across different index portfolios. It illustrates that the 5-year trailing data indexes slightly underweighted the company compared to the 3-year indexes and the indexes based on the latest data for all individual fundamental indexes except the dividends and employees. The standard deviation of the weight also fell rapidly using longer term trailing average data. This seems to suggest that indexes constructed using data over longer periods would result in less variation in portfolio weights that in turn would reduce turnover.

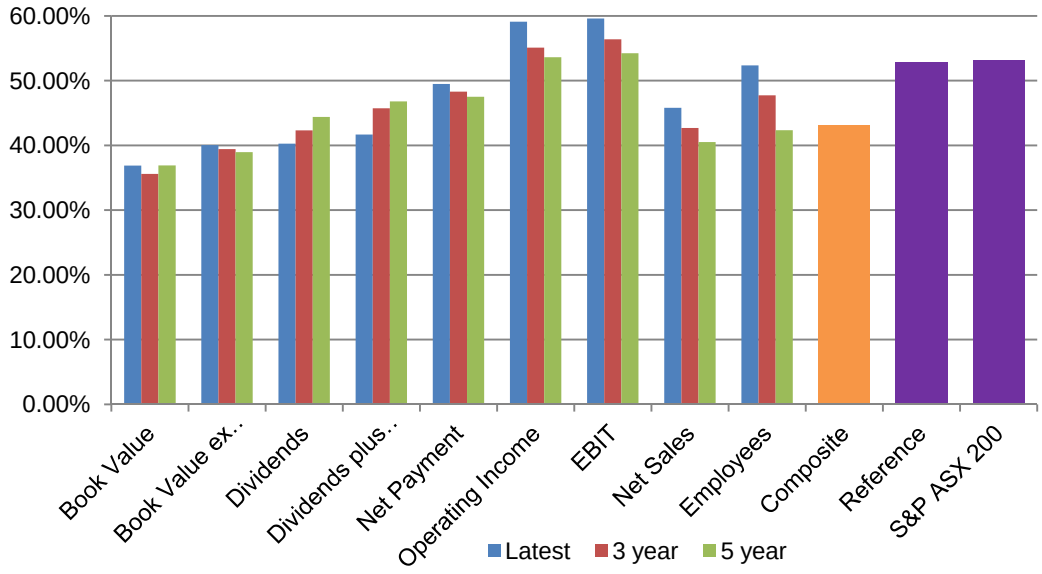
Table 7: Index Weighting of BHP Billiton (March 1993 to March 2009)

	Latest		3 year		5 year	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Net Sales	5.970%	0.896%	5.913%	0.729%	5.825%	0.571%
Book Value	5.585%	1.264%	5.558%	1.024%	5.491%	0.802%
Book Value ex Intangibles	6.987%	1.636%	6.896%	1.151%	6.782%	0.900%
Operating Income	8.610%	5.236%	8.090%	4.263%	7.804%	3.422%
EBIT	6.900%	3.642%	6.692%	3.370%	6.603%	2.845%
Dividends Paid	5.196%	1.533%	5.299%	1.206%	5.349%	1.143%
Dividends Paid + Buybacks	5.777%	2.764%	5.584%	2.205%	5.411%	1.844%
Net Payment	4.833%	5.823%	4.306%	4.288%	4.174%	3.486%
Employees	3.915%	1.019%	4.044%	0.874%	4.170%	0.755%
Composite	*6.190%*	*2.014%*				
Reference	9.595%	3.457%				

Figure 3 shows the combined weight of the top ten companies as at the March 2009 rebalance. Although each individual index has its biases, on examination of their holdings, it seems that the top 10 companies in the indexes are largely overlapping. At the 2009 rebalance across the nine individual fundamental indexes, 23 different companies made up the top ten holdings for the indexes constructed with 5 years' trailing data; 24 companies for the indexes with 3 years' trailing data and 26 companies for the indexes with latest data. It can be seen that for every fundamental measure except dividends and dividends plus buybacks, using the

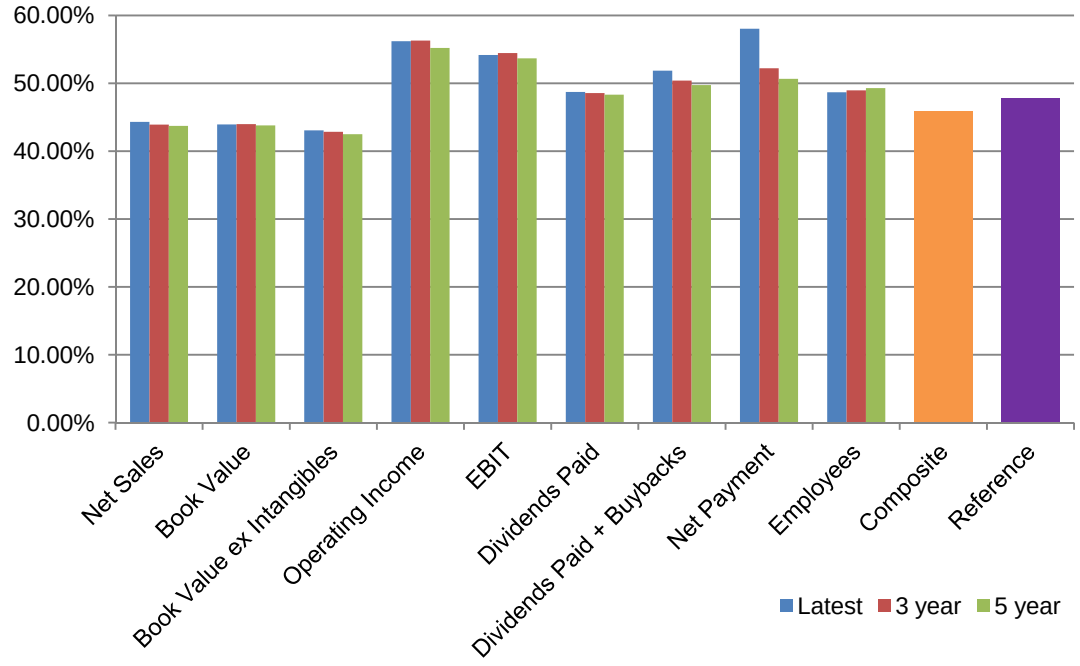
trailing average over longer period tends to reduce the weight allocated to the largest companies.

Figure 3: Weights Allocated to Top Ten Companies (as on March 2009 Rebalance)



Much of the difference in portfolio concentration for individual fundamental indexes is evened out when we look at their average weights over a longer period. Figure 4 shows average concentration of the fundamental index portfolios using monthly holdings from April 1993 to March 2009. Over the long run, the composite index appears to be less concentrated than the cap-weighted reference index, and therefore more diversified. There are only small differences in most of the fundamental indexes from using data over lagged periods of different lengths. The employees index is the only example of where concentration can be seen to be moving the opposite way i.e. it becomes more concentrated in the top ten stocks by using lagged data.

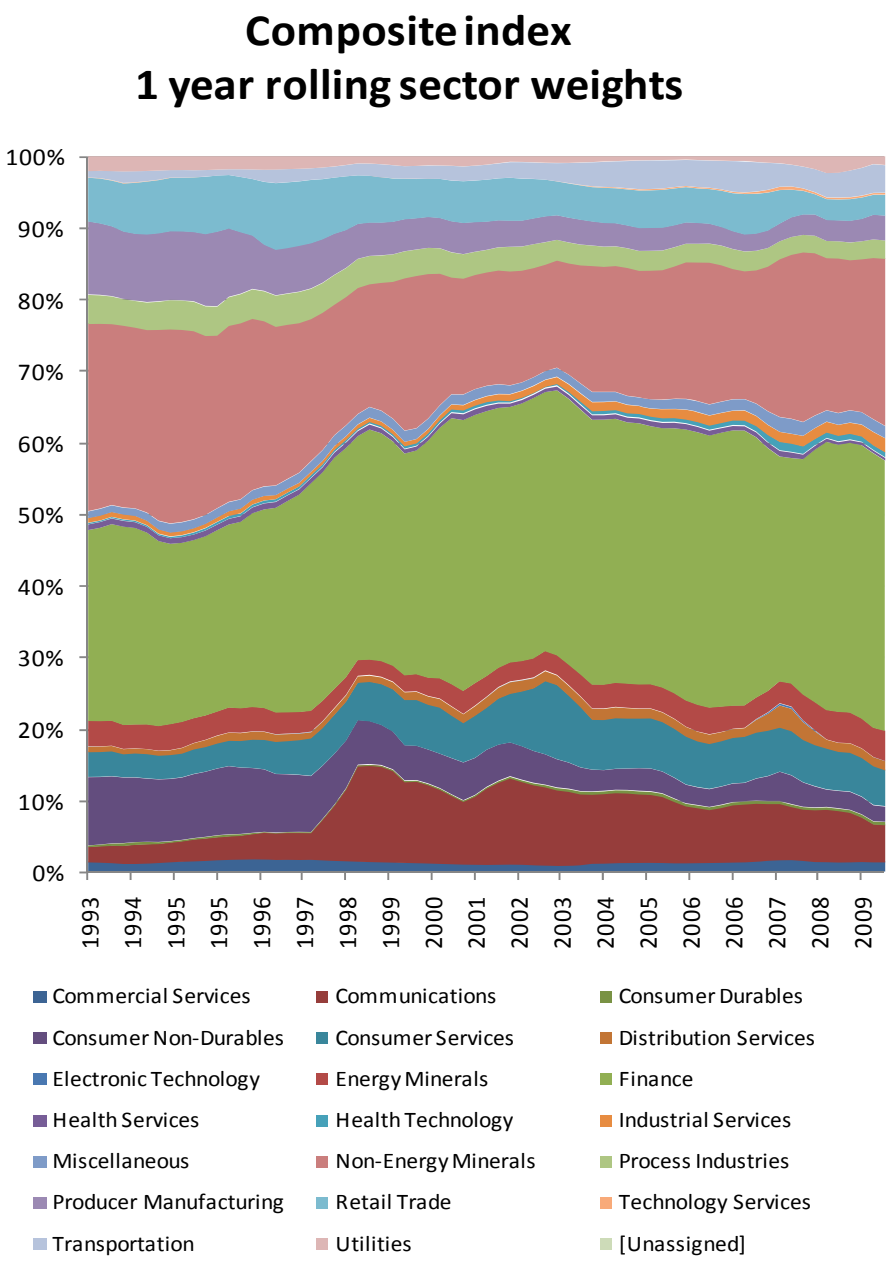
Figure 4: Average Index Weighting in Top Ten Companies (based on monthly holdings from March 1993 to February 2010)

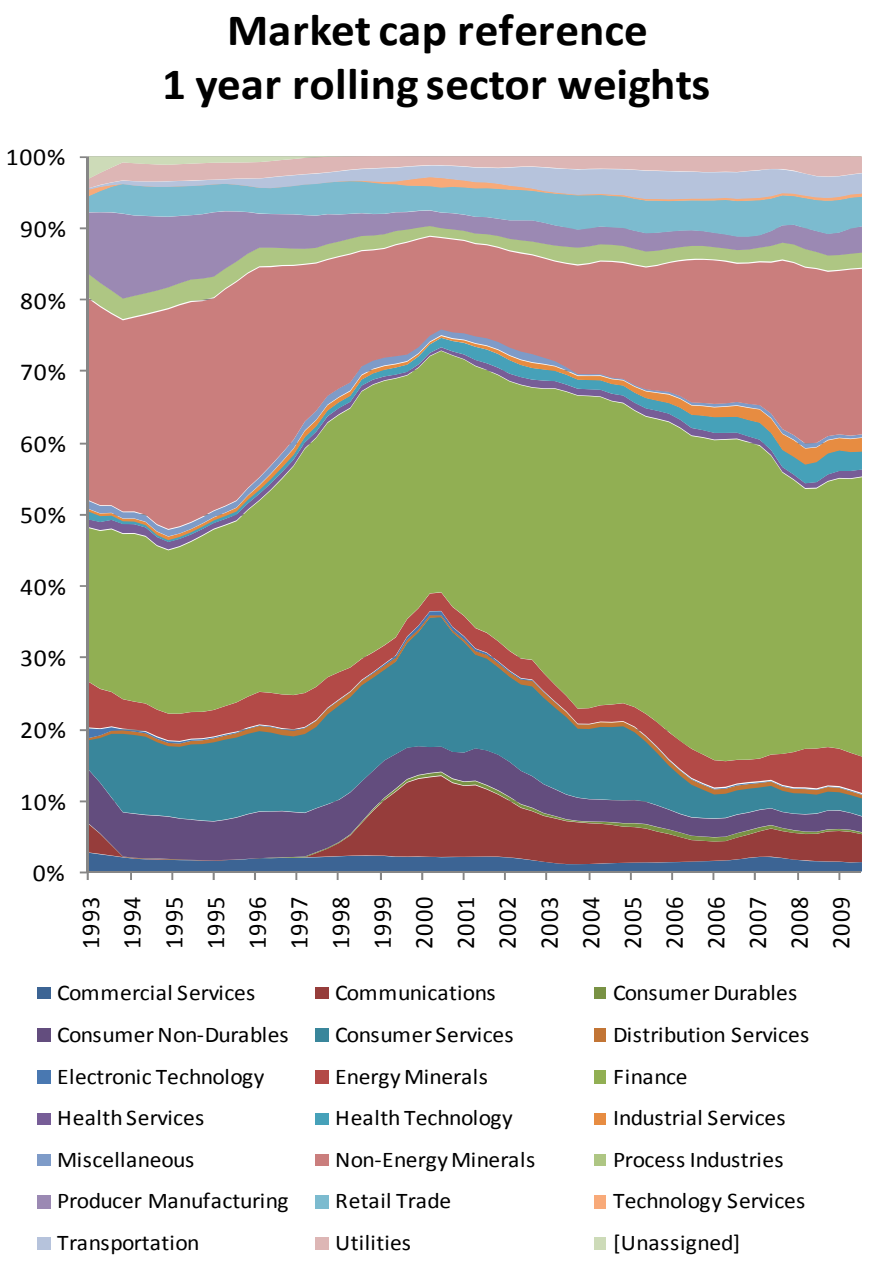


The original AHM study and later papers like Hsu and Campollo (2006) take a look at the sector weights of the fundamental index portfolio through time against that of the cap-weighted index. The authors illustrate the more static nature of the sector allocation of the fundamental index methodology, as it rebalances out of sectors that have performed well (such as technology sector during late 1990s) rather than increasing weight as price increases. Figures 5(a) and 5(b) show the rolling one-year sector weights for the composite and the cap-weighted reference index. The sector allocation for composite fundamental index seems to be more stable than that of cap-weighted index over time.[14] Therefore, the Australian evidence appears to be in line with the findings of the above studies.

[14] Large changes in sector allocation within the composite fundamental index (and cap-weighted reference index) are primarily driven by entry or exit of large companies. For example, the Telecommunications sector saw a large boost in the 1998 rebalance, as Telstra (TLS) listed towards the end of the previous year. In the March 1998 rebalance, it was ranked first on fundamentals in the composite portfolio and given a weight of 7.35%.

Figures 5(a): Composite Fundamental Index Sector Weights and 5(b) Cap-weighted Index Sector Weights





4.3 Turnover and Liquidity

4.3.1 Turnover

All the index portfolios are back-tested for turnover. Each portfolio is price drifted from the date of reconstitution (end of March) until the date of the following reconstitution. Turnover is calculated as the difference between the holdings of the price-drifted 31 March portfolio and the rebalance portfolio. One-way turnover is quoted in the results as, without cash flows, buys and sells are the same. The AHM study examined the reduction in excess return, assuming a 2% transaction cost (of that magnitude to include both transaction fees and price impact). Similarly, we look at excess return assuming 2% transaction costs which we calculate as follows:

$$Net\ Excess\ Return = Gross\ Excess\ Return - (Two\ way\ turnover\ \times\ 2\%) \quad (4)$$

We also compute the magnitude of the transaction cost that is required to be incurred before excess returns from fundamental index are completely eroded. We call this the threshold transaction cost which is given by:

$$Maximum\ Cost = \ Excess\ Return\ \div (Two\ way\ turnover) \quad (5)$$

Table 8 presents the average portfolio turnover for the different indexes. The results show that the portfolio turnovers for fundamental indexes are, as per expectation, much higher than the reference market cap-weighted index. However, they certainly seem to be lower in comparison to actively managed portfolios. Also the AHM study and subsequent papers like Arnott and West (2006) found that by using trailing average data for construction of fundamental indexes, rather than the latest data, turnover was minimised. We find that it is indeed the case.

Table 8: Average Portfolio Turnover (1993 to 2010)

	Latest	3 Year	5 Year
Net Sales	14.21%	13.08%	12.56%
Book Value	14.68%	13.08%	12.55%
Book Value ex Intangibles	15.88%	13.47%	12.77%
Operating Income	19.20%	13.87%	12.00%
EBIT	18.53%	13.76%	11.84%

Dividend Paid	20.47%	13.84%	12.44%
Dividends + Buybacks	26.70%	15.57%	13.39%
Net Payment	36.03%	18.21%	15.07%
Employees	17.70%	13.94%	12.09%
Composite	*12.91%*		
Reference	8.64%		

Higher turnover for any of the fundamental index portfolios obviously would result in higher transaction costs compared to the reference portfolio. The critical question here, however, is whether the transaction cost differences are large enough to neutralise the excess returns of the former over the latter. Table 9 shows excess return under the condition of 2% transaction costs (including market impact) assuming a flat fee across all buy and sell orders. Such transaction costs, we find, decrease the excess return of the composite index by 52 basis points bringing them down to 2.54% per annum. Remarkably, all the fundamental indexes are still able to achieve an excess return over the reference index after adjusting for transaction costs.

Table 9: Net Excess Return of Fundamental Index over Reference Portfolio (March 1993 to March 2010)

	Latest	3 year	5 year
Net Sales	3.93%	4.65%	5.42%
Book Value	1.53%	1.99%	2.24%
Book Value ex Intangibles	2.23%	2.74%	2.96%
Operating Income	1.72%	2.33%	2.13%
EBIT	2.80%	3.18%	2.89%
Dividend Paid	2.40%	2.12%	2.40%
Dividend + Buybacks	2.80%	2.50%	2.70%
Net Payment	3.79%	3.01%	2.87%
Employees	3.28%	3.68%	3.56%
Composite	*2.54%*		

From the above results, it appears that transaction costs need to be far larger than 2% in order to make an investor indifferent in choosing between fundamental index and a cap-weighted index. How large transaction costs need to be in order to erode excess return of the fundamental index over the market cap-weighted reference index? We estimate these for different fundamental indexes and report the same in table 10. The results suggest that transaction costs have to be substantially larger to nullify the superior performance of the fundamental indexes. For individual indexes, they have to be as high as 15.82% (almost 8 times our assumed level) for an indexation strategy based on net sales. Even for a strategy based on operating income, the least successful of the fundamental measures in our study,

transaction costs would have to increase by more than 200% to erode all excess returns over cap-weighted index. For the composite index, the costs have to go up by nearly 500% to bring the returns at par with the cap-weighted index. These results indicate that fundamental indexation's superiority over traditional cap-weighted indexation is likely to prevail even in presence of transaction costs unless they are set at an unrealistically high level.[15]

Table 10: Required transaction costs to erode excess return over reference portfolio (March 1993 to March 2010)

	Latest	3 Year	5 Year
Net Sales	15.82%	19.77%	23.55%
Book Value	7.22%	9.61%	10.90%
Book Value ex Intangibles	9.02%	12.18%	13.59%
Operating Income	6.49%	10.39%	10.87%
EBIT	9.57%	13.55%	14.22%
Dividend Paid	7.87%	9.67%	11.62%
Dividends + Buybacks	7.25%	10.01%	12.10%
Net Payment	7.26%	10.27%	11.53%
Employees	11.28%	15.19%	16.74%
Composite	*11.85%*		

4.3.2 Liquidity

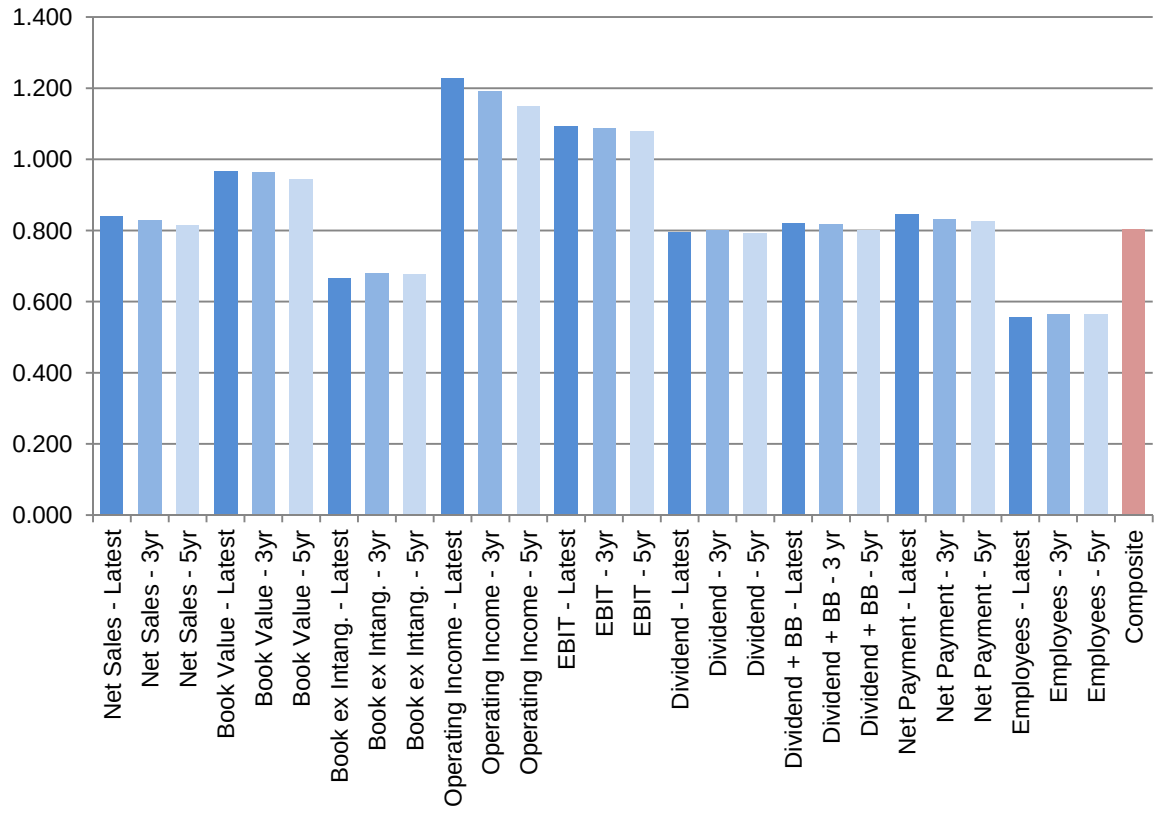
A well-known virtue of cap-weighted indexes is liquidity due to holding stocks in proportion with their capitalization. Despite the fundamental indexes' superior risk-adjusted performance demonstrated in this paper, lack of liquidity can potentially offset its advantage. This can happen if fundamental indexes place higher weightings on smaller, illiquid stocks. Difficulties in purchase and sale of the desired number of stocks would make it difficult for the investor to replicate the index and therefore, act as a potential deterrent to fundamental indexation. In this context, it is important to examine the liquidity characteristics of the fundamental indexes vis-à-vis the cap-weighted index.

We measure liquidity in terms of CAP ratio. This is a ratio of average capitalization of the fundamental index weighted by the fundamental measure and the average capitalization of the market index. AHM study suggests that an inference to be made from this ratio is the

[15] In discussing transaction costs and turnover of the composite fundamental Index, Arnott and West (2006) makes this pertinent point that the composite's turnover tends to be in larger-capitalization issues that have witnessed changes in their fundamentals while the turnover of cap-weighted portfolios are mostly related to the smaller companies (higher transaction costs) that fall off or step into the cap-weighted list. The former's reweighting of larger securities is likely to involve smaller transaction costs compared to the latter.

aggregate amount of money that can be invested in the fundamental indexes relative to the cap-weighted reference index. The CAP ratios for different fundamental indexes are shown in Figure 6. The results show fundamental indexes quite favourably in terms of their liquidity. For example, the amount of money that could be invested in the composite index portfolio (with its average CAP Ratio of 0.8048) is approximately four-fifths of that in the cap-weighted reference index (with a CAP Ratio of 1). This suggests that the composite fundamental index for Australia has more capacity than its US counterpart that had a CAP Ratio 0.66 in the AHM study. Many individual fundamental indexes do better than the composite index with a few of them exceeding a CAP ratio of 1.

Figure 6: Average CAP Ratio versus market cap reference (1993 to 2010)



While reviewing portfolio composition in 4.2, we found that concentration is generally lower in indexes constructed from 5-year trailing data in comparison to those from 3-year trailing data and latest data. It is, therefore, expected that the CAP ratio would be lower in the 5-year trailing data indexes. This is found to be the case as the CAP ratio decreases for indexes

based on 5-year trailing average data, with the exception of 'employees' (again to be to be expected given our previous results) and the 'book value ex intangibles' measures.

5. Conclusion

We have examined many facets of fundamental indexation in the Australian market between 1985 and 2010, primarily focussing on whether this portfolio construction methodology adds value over traditional cap-weighted indexing for passive portfolio management. In line with prior empirical studies on fundamental indexation in other geographical markets, we found that fundamental indexes based on accounting measures of size like sales, book value, earnings, and cash flow outperformed the cap-weighted index with similar or lower volatility. Similarly, the composite fundamental index formed by combining the individual fundamental measures was found to outperform the reference index by over 350 basis points with lower volatility. Robustness checks confirmed the outperformance across varying market conditions. Statistically significant excess returns, however, were not sustained in environments of rising stock markets and increasing interest rates. By investigating the periods of underperformance, we found that the composite fundamental index underperformed in strong bull markets and in times where prices stray from fundamentals for prolonged periods. However, over a rolling five-year time period, this underperformance diminishes and therefore the strategy seems to hold more appeal to investors with long-term horizons. Overall, the fundamental index strategy appears to have worked well within the universe of stocks listed in the ASX for the last 25 years. It has offered a low-turnover, high capacity indexing strategy with similar volatility to the cap-weighted index with the potential for outperformance between 2% and 5% over rolling five-year periods.

Due to the higher turnover of stocks compared to the cap-weighted index, transaction costs could act as a potential deterrent for executing fundamental indexation strategies. However, we found such concern to be unfounded as all the indexes maintained their outperformance even when 2% transaction costs were taken into account. Our results indicate that the transaction costs need to increase to unrealistic levels to nullify the return advantage of fundamental indexation over cap-weighted indexation. Though most fundamental indexes are not as liquid as the cap-weighted index, they do not appear to be lagging behind too far in terms of capacity and therefore, investability.

The superior performance of fundamental index in our study is not explained by value, size, or momentum factors as conjectured in the literature. This is significant as many researchers have suggested that the outperformance of the fundamental Index could be entirely attributed to these stylised factors. By using a reasonably long sample period of 25 years, which included significant market upswings and downturns, we find that the excess returns from fundamental indexation were not achieved on the back of the value premium. The evidence presented in this paper shows that it might be premature and simplistic to dismiss it as just a value strategy without further investigation into the exact source of outperformance.

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