

ASX ETF Portfolios

Three optimally balanced ASX ETF portfolios that aim to match the return of the S&P/ASX 200 Accumulation index, but with less risk and volatility.



August 2021

TABLE OF CONTENTS

Table of Contents	1
Important Information	2
Preface	3
Part 1	5
Goals and Design Process	5
Part 2	7
Asset Class Selection	7
Correlation coefficient	7
Selecting asset classes	8
Expanding the asset classes	9
ASX “All Weather” Portfolio	10
Real estate excluded	12
Global shares included	13
Part 3	14
ETF Selection	14
Shortlist #1 - Australian shares	14
Shortlist #2 - Global shares	15
Shortlist #3 - Bonds	16
Shortlist #4 - Gold	16
Shortlist #5 - Emerging Markets	17
Final Selections	17
Part 4	18
Optimal Portfolio Weighting	18
Portfolio Selection	19
Portfolio #1 - Balanced	20
Portfolio #2 - Balanced (ex-Australia)	24
Portfolio #3 - Growth	28
Part 4	32
Appendix	32
Caveats	32
Acknowledgements	33
Websites	33

IMPORTANT INFORMATION

The purpose of this Whitepaper is to outline the thought process and methodology behind the ASX ETF Portfolios.

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Back-testing Disclaimer

Back-testing software was used to test the investment strategy. Simulated results are calculated in perfect conditions without real-life issues like liquidity, taxation, and human error.

While we've done our best to ensure accuracy by using industry leading data and software, there could be errors.

Performance Disclaimer

Past performance is not indicative of future performance.

Risk Warning

Market Index can't stress enough; investing is risky and can result in loss of capital.

PREFACE

Australia is a nation of wealthy investors.

In 2020, the median wealth per Australian adult was US\$238,070, placing Australia first on the country rankings ahead of Belgium \$230,550, Hong Kong \$173,770 and New Zealand \$171,620. The United States ranked 23rd with \$78,724.¹

While a significant portion Australia's wealth is held in property, 46% of Australian adults hold investments outside superannuation and their primary residence.² According to the Australian Securities Exchange (ASX), 35% hold shares or other on-exchange investments.

Australia's Pension Asset market is worth US\$2.1 trillion³ and continually growing, courtesy of the Superannuation Guarantee that recently rose to 10.0% on 1 July 2021. As a percentage of Pension Assets to GDP, Australia ranks second behind the Netherlands and slightly ahead of Switzerland.

With 54% of Australia's superannuation invested in equities and only 14% in property⁴, the question needs to be asked - how effective is the average superannuation fund at building long-term wealth?

The stock market is a logical place to invest. It's transparent, liquid, and profitable over the long-term. Data from the Reserve Bank of Australia shows that with dividends reinvested, the Australian share market's 100-year average annual return is 10.6%. But are Australian investors reaping the rewards?

SUPERANNUATION FUNDS

Over the 15-year period from 1 January 2006 to 31 December 2020, 86.3% of Australian General Equity Funds failed to beat the S&P/ASX 200 index.⁵ With underperformance becoming standard, it's obvious why index funds are becoming so popular.

"My advice to the trustee [of my will] could not be more simple: Put 10% of the cash in short-term government bonds and 90% in a very low-cost S&P 500 index fund."

Warren Buffett

EXCHANGE TRADED FUNDS (ETFs)

ETFs are managed funds that trade on the ASX just like ordinary shares.

Most ETFs track a benchmark e.g. index, industry, commodity, etc. and provide a highly efficient, cost-effective way to gain exposure to an entire sector in one share transaction.

Australia's first ETF launched in August 2001, with SPDR S&P/ASX 200 (ASX:STW) tracking Australia's premier benchmark. With dividends reinvested, STW's 20-year statistics are:

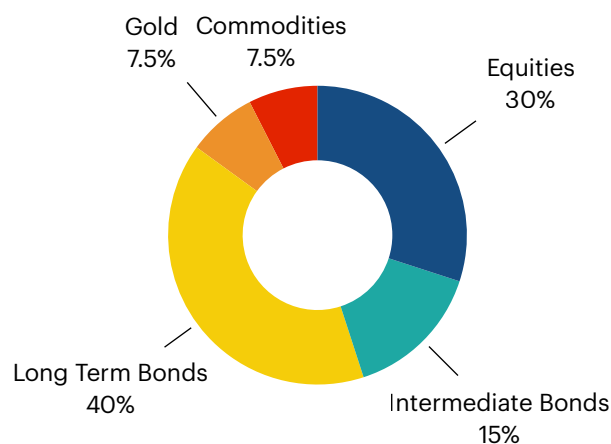
- 8.22% p.a. return
- Max Drawdown (loss) of -50.65% on 6 March 2009
- Max Drawdown Duration of 71.5 months from late 2007 to late 2013

While low cost index funds are a great option for investors with a long investment timeframe, they come at a cost - high volatility. By design, index tracking ETFs provide zero protection from a correction or crash.

There must be a better way to diversify a portfolio without sacrificing returns.

RAY DALIO'S "ALL WEATHER" PORTFOLIO

Ray Dalio is one of the world's most respected fund managers. He created his "All Weather" portfolio to leave a legacy through his children that would continue for decades after he is gone. It has been back-tested to 1925 with great success.



The All Weather Portfolio served as a starting point for our research.

Part 1

GOALS AND DESIGN PROCESS

Market Index's primary objective for this Whitepaper is to outline a series of low maintenance ETF portfolios that would be suitable for most investors to hold a bulk of their equity assets.

Our goal for each portfolio was simple: Match the returns of the S&P/ASX 200 Accumulation Index over the long-term, but with significantly less risk and volatility.

Three portfolios were created (Balanced, Balanced Ex-Australia and Growth) that contain between three and five ASX listed ETFs optimally weighted to balance risk and return.

We feel these portfolios are ideal for investors that:

- Believe the market is overheated and due for a correction, but don't want to sit in cash.
- Seek a long-term portfolio with less risk and volatility than an index fund.
- Are overweight Australian equities and seek to diversify their portfolio.

GOALS

The following three goals were established to define success:

1. Match the Benchmark Return

Defined as the annual percentage return of the S&P/ASX 200 Accumulation index.

2. Less Risk

Defined as Maximum Drawdown (MaxDD). Drawdown is the peak-to-trough drop in a portfolio's total value. If your portfolio's total value (open positions and cash) hit a high of \$56,000 then fell to \$47,600, then your drawdown would be -15%.

3. Less Volatility

Defined as the average 3-month Annualised Volatility of Returns. Volatility refers to the fluctuations in a portfolio's returns and is based on Standard Deviation.

DESIGN PROCESS

Creating the portfolio involved three stages:

1. Asset Class Selection

Primarily using beta to determine diversification benefits.

2. ETF Selection

Comparing ASX listed ETFs by their market capitalisation, liquidity, management fees, and inception date.

3. Optimal Portfolio Weighting

Optimised using modern portfolio theory and the efficient frontier.

Diversiview was used to establish optimal portfolio weights, and Amibroker Pro to calculate all performance metrics using full-adjusted data from Norgate Data that included dividends reinvested.



To easily find and compare any ASX listed ETF, please [click here](#)

Part 2

ASSET CLASS SELECTION

An asset class is a simplistic way to group financial assets that share similar qualities.

A core principle of portfolio diversification is to divide funds between multiple asset classes that have a low correlation. The lower the correlation, the more effectively an investor can use diversification to reduce portfolio risk.

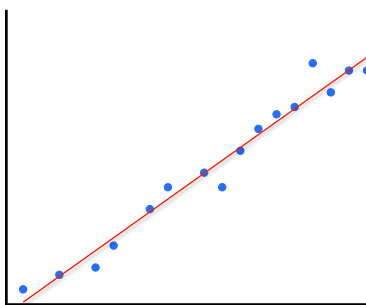
The assumption is that each asset class will respond differently to different market conditions, thus reducing the portfolio's volatility. Factors that contribute to poor performance of one asset class might boost returns in another.

For this, we use correlation coefficient.

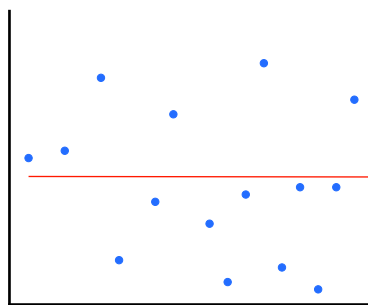
CORRELATION COEFFICIENT

Correlation coefficient formulas measure the strength of a relationship between two sets of data. The value ranges from -1.0 to 1.0.

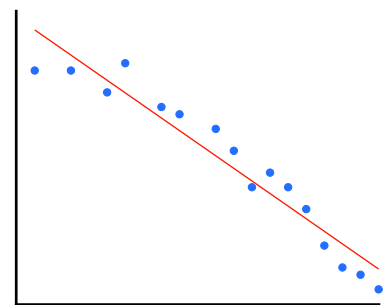
- 1.0 A perfect positive correlation
- 0.0 No correlation between the data points
- 1.0 A perfect negative (inverse) correlation



Positive Correlation



No Correlation

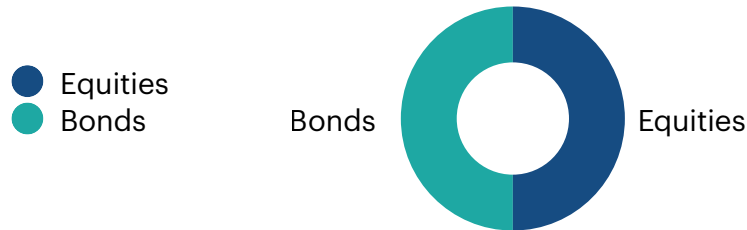


Negative Correlation

SELECTING ASSET CLASSES

Historically, the two main asset classes have been Equities (shares) and Bonds.

An example two asset portfolio split 50/50 would look like this:



EQUITIES

Equities (shares) historically produce the highest returns over long timeframes, but contribute a majority of risk and volatility. Equities can be further broken down into subclasses e.g. domestic (Australian), global (foreign), emerging markets, etc.

BONDS

Bonds help reduce a portfolio's volatility. When shares fall, they cushion the blow. Historically, bonds have been negatively correlated with equities, although the US stock-bond correlation turned positive in the late 1990s.⁶ With interest rates currently at historically low levels, bonds are less ideal than decades ago.

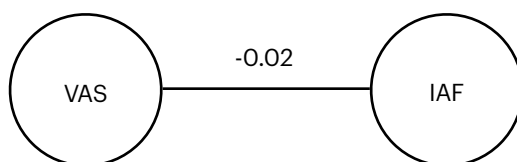
COMBINING THE TWO

To determine whether manipulating the weighting of the two asset class could help control risk through diversification, we simply determine the correlation between equities and bonds.

As a proxy for both, we selected the largest ASX listed ETF by market capitalisation that best represented the asset class:

- **Equities:** Vanguard Australian Shares (ASX:VAS) tracks the S&P/ASX 300 Accumulation index and we feel is the best proxy for the Australian share market.
- **Bonds:** iShares Core Composite Bond (ASX:IAF) measures the performance of the Australian bond market.

We then established the correlation between the asset classes going back to IAF's inception in 2012, and presumed the reinvestment of dividends.

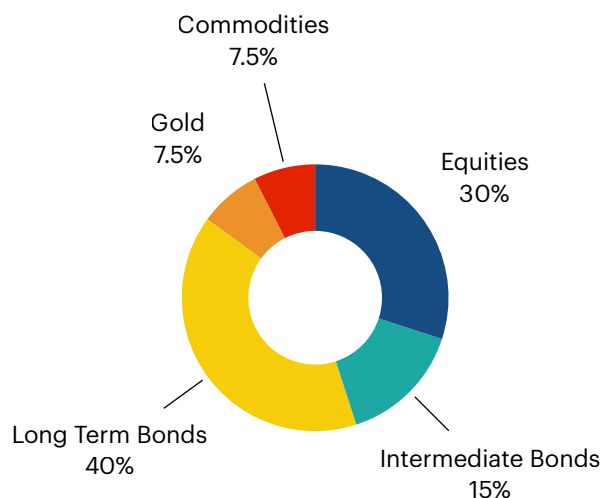


The correlation between VAS and IAF was -0.02, which indicates almost no relationship. It can therefore be concluded that adjusting a portfolio’s weighting of equities and bonds can be used successfully to control a portfolio’s risk.

EXPANDING THE ASSET CLASSES

While two asset classes can provide diversification benefits, most modern portfolios include additional classes.

Ray Dalio’s “All Weather” portfolio contains three asset classes (five depending on granularity), and is heavily weighted to bonds.



The inclusion of Gold & Commodities into Mr Dalio’s portfolio is considered by many as an insurance policy. The asset class protects against inflation and often performs well when equities do not.

“If you don’t own Gold, you know neither history nor economics.”

Ray Dalio

ASX ETF PORTFOLIOS

The chart below shows ETFS Physical Gold (ASX:GOLD) plotted against the S&P/ASX 200 index. Note the strong inverse relationship during the severe market downturns of 2008 and 2020.



ASX “ALL WEATHER” PORTFOLIO

Testing a similar strategy on the ASX required determining the most suitable Australian ETFs to represent each asset class.

EQUITIES

We continued using VAS to represent the Australian share market as it has the largest market capitalisation, a long track-record, and 300 constituents, which makes it ASX’s broadest exposure ETF.

INTERMEDIATE & LONG-TERM BONDS

Approximately 25 ASX ETFs track bonds and fixed interest securities. Unfortunately, most have low liquidity or a limited trading history. We decided to group Intermediate and Long Term Bonds into a single asset class, and continued using IAF as the proxy.

GOLD & COMMODITIES

ETFS Physical Precious Metals Basket (ASX:ETPMPM) is the only ASX listed ETF that provides access to a portfolio of commodities (gold, silver, platinum and palladium). It has a high

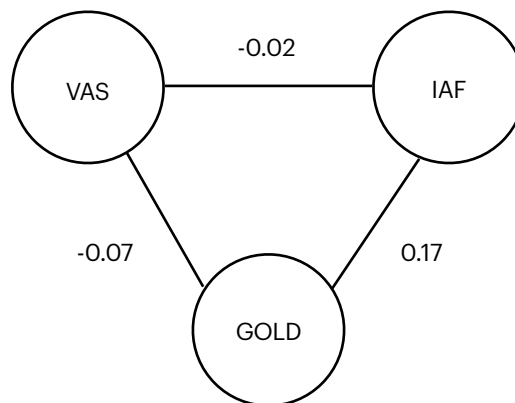
ASX ETF PORTFOLIOS

management fee of 0.44% and extremely poor liquidity. We decided to continue using a physical gold ETF to represent this component of the portfolio, and selected GOLD.

The ASX “All Weather” Portfolio was now divided into three asset classes:

- Equities
- Bonds
- Gold

We assessed the correlation between the classes:



Equities (ASX:VAS) have almost zero correlation to Gold (ASX:GOLD) and Bonds (ASX:IAF), while Gold (ASX:GOLD) and Bonds (ASX:IAF) have a weak positive correlation of 0.17.

It can be therefore concluded that these three asset classes alone could provide adequate diversification for many investors.

REAL ESTATE EXCLUDED

Real Estate was considered as an asset class, but eventually excluded.

The largest Real Estate ETF is Vanguard's Australian Property Securities (ASX:VAP). VAP is highly correlated to VAS, which is not surprising as real estate companies comprise 7.0% of the S&P/ASX 300 index.

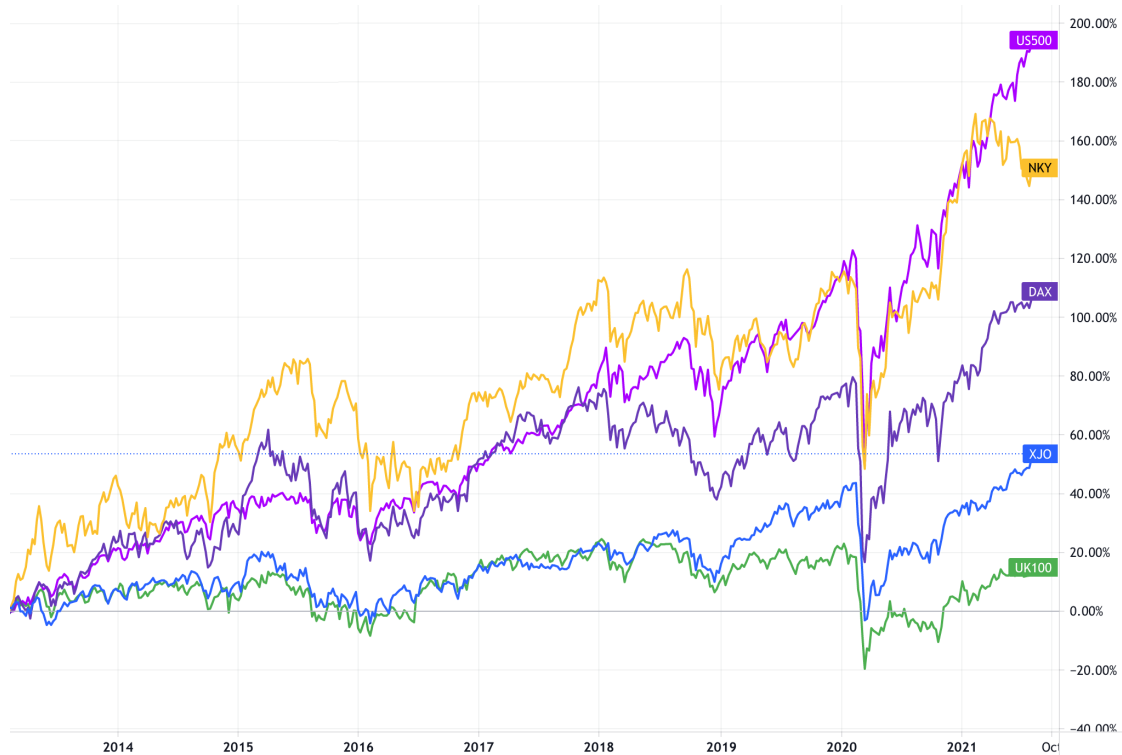
As the diversification benefit was minimal, we decided against including Australian Real Estate as an asset class.



GLOBAL SHARES INCLUDED

Share markets around the world cycle at different times.

The following chart compares the 8-year stock market performance between USA, Japan, Germany, Australia and UK. As a whole, the Australia has significantly underperformed the largest foreign markets.



We felt that using a single ETF comprised solely of ASX companies to represent the equities component of a portfolio was not enough diversification, and would likely generate inferior returns.

So we included two additional sub-categories to include with VAS:

- Global shares (broad)
- Emerging markets

After much testing, one thing became clear:

The addition of iShares Global 100 (ASX:I00), an ETF that comprises the 100 largest global stocks, significantly improved returns and reduced risk.

Part 3

ETF SELECTION

Once the portfolio's asset classes were determined, the next step was to identify the most appropriate ASX listed ETFs to use as a proxy for each asset class.

We used four criteria:

1. **Size:** Market capitalisation
2. **Liquidity:** 4-week average daily turnover (value traded)
3. **Management Fee:** Percentage per annum
4. **Inception date:** First trade date

SHORTLIST #1 - AUSTRALIAN SHARES

The ETFs shortlisted to represent Australian equities were:

- Betashares Australia 200 (ASX:A200)
- iShares Core S&P/ASX 200 (ASX:IOZ)
- SPDR S&P/ASX 200 (ASX:STW)
- Vanguard Australian Shares (ASX:VAS)

ETF	Size	Liquidity	Mgt Fee	Inception
A200	\$1.53 B	\$6.0m	0.07%	8 May 2018
IOZ	\$3.94 B	\$14.1m	0.09%	9 Dec 2010
STW	\$4.84 B	\$6.7m	0.13%	27 Aug 2001
VAS	\$9.01 B	\$17.1m	0.10%	8 May 2009

Market Index selected VAS due to its size, liquidity, and because it has 300 constituents.

ASX ETF PORTFOLIOS

A200, IOZ and STW only contain 200 companies, which means VAS better represents the Australian share market as a whole. However, the difference is minimal and any of the four ETFs would be an acceptable proxy for Australian equities.

Investors seeking an Environmental, Social, and Governance (ESG) alternative could consider:

- Betashares Australian Sustainability Leaders (ASX:FAIR), or;
- Vanguard Ethically Conscious Australian Shares (ASX:VETH)

SHORTLIST #2 - GLOBAL SHARES

The ETFs shortlisted to represent Global Shares were:

- iShares Global 100 (ASX:IOO)
- Vanguard MSCI International Shares (ASX:VGS)
- SPDR S&P World Ex-Australia (ASX:WZOZ)

ETF	Size	Liquidity	Mgt Fee	Inception
IOO	\$2.50 B	\$3.1m	0.40%	10 Oct 2007
VGS	\$3.80 B	\$11.6m	0.18%	20 Nov 2014
WZOZ	\$272m	\$67k	0.30%	19 Mar 2013

At face value, VGS appears to be the best option. It contains approximately 1,500 companies, has the highest liquidity and lowest management fee.

IOO by comparison only contains 100 companies, but it has a longer track-record and outperforms VGS over almost any randomly selected timeframe.

Market Index selected IOO.

SHORTLIST #3 - BONDS

The ETFs shortlisted to represent Bonds were:

- BetaShares Australian Investment Grade Corporate Bond (ASX:CRED)
- iShares Core Composite Bond (ASX:IAF)
- Vanguard Australian Corporate Fixed Interest (ASX:VACF)
- Vanguard Australian Government Bond (ASX:VGB)

ETF	Size	Liquidity	Mgt Fee	Inception
CRED	\$507m	\$1.2m	0.25%	31 May 2018
IAF	\$1.83 B	\$4.5m	0.15%	14 Mar 2012
VAF	\$1.46 B	\$2.3m	0.20%	31 Oct 2012
VGB	\$546m	\$1.1m	0.20%	30 Apr 2012

Market Index selected IAF as it's the largest, most liquid and has the lowest management fee.

SHORTLIST #4 - GOLD

Market Index elected for a physical gold ETF, and not an ETF comprised of gold companies. Physical gold is less likely to be negatively impacted during market downturns.

Only three ETFs track the price of gold:

- ETFs Metal Securities Australia (ASX:GOLD)
- Perth Mint Gold (ASX:PMGOLD)
- Betashares Gold Bullion (ASX:QAU)

ETF	Size	Liquidity	Mgt Fee	Inception
GOLD	\$2.12 B	\$4.5m	0.40%	28 Mar 2003
PMGOLD	\$580m	\$1.3m	0.15%	5 Jan 2011
QAU	\$302m	\$1.9m	0.59%	4 May 2011

ASX ETF PORTFOLIOS

PMGOLD holders don't actually own gold, they own a right to gold held at the Perth Mint. The holdings are backed by the Government of Western Australia, and PMGOLD can be physically redeemed for any of Perth Mint's bullion bars.

During our research, we were unable to clearly establish the fees involved in PMGOLD going back to inception (buy/sell spread, unusual annual fees, etc), and as the returns were almost identical between PMGOLD and GOLD, we decided on GOLD for all back-testing purposes.

In 2021, both PMGOLD and GOLD would be suitable ETFs to represent physical gold.

SHORTLIST #5 - EMERGING MARKETS

The ETFs shortlisted to represent Emerging Markets were:

- iShares MSCI Emerging Markets (ASX:IEM)
- Vanguard FTSE Emerging Markets (ASX:VGE)

ETF	Size	Liquidity	Mgt Fee	Inception
IEM	\$973m	\$2.7m	0.68%	10 Oct 2007
VGE	\$632m	\$1.2m	0.48%	21 Nov 2013

Market Index selected IEM as it's the largest, most liquid, and had a longer track-record for our backtesting. IEM and VGE are highly correlated and either would be suitable.

FINAL SELECTIONS

ETF	Size	Liquidity	Mgt Fee	Inception
Vanguard Australian Shares (ASX:VAS)	\$9.01 B	\$17.1m	0.10%	2009
iShares Global 100 (ASX:IOO)	\$2.50 B	\$3.1m	0.40%	2007
iShares Core Composite Bond (ASX:IAF)	\$1.83 B	\$4.5m	0.15%	2012
ETFs Metal Securities Australia (ASX:GOLD)	\$2.12 B	\$4.5m	0.40%	2003
iShares MSCI Emerging Markets (ASX:IEM)	\$973m	\$2.7m	0.68%	2007

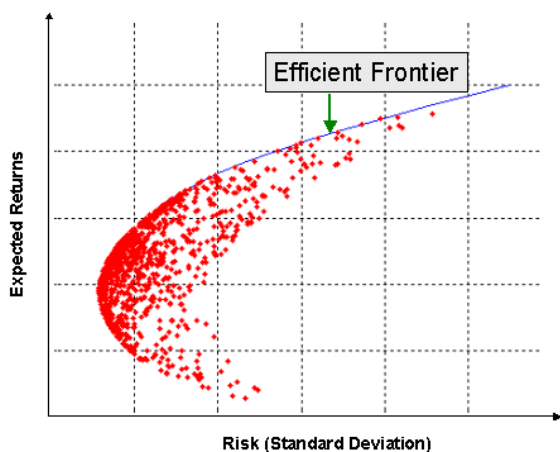
All data as at August 2021.

Part 4

OPTIMAL PORTFOLIO WEIGHTING

The efficient frontier is the set of investment portfolios that provide the highest return for a defined level of risk.

The concept was introduced by Nobel Prize winner Harry Markowitz in 1952, and is a cornerstone of Modern Portfolio Theory (MPT).



By plotting risk (x-axis) and return (y-axis) for multiple portfolios on a chart, an investor can determine the optimal portfolio composition that generates the highest return for any level of market risk.

In the example (left), each red dot represents a portfolio combination.

The portfolios positioned on the left edge (blue line) sit on the efficient frontier as they have the highest return for the level of risk taken.

As one goal of the ETF portfolios is to match the return of the S&P/ASX 200 Accumulation index, we simply establish the index's historical return to use as the target, then select the optimal portfolio combinations according to risk and volatility.

The S&P/ASX 200 Accumulation index metrics for the period 1 July 2012 to 30 June 2021 are:

- **Annual return:** 11.08% p.a.
- **Max Drawdown:** -35.93%
- **Volatility:** 13.19%

Using the annual return of 11.08% p.a. as a target, we optimised portfolio combinations for various investment objectives using efficient frontier theory.

PORTFOLIO SELECTION

We decided on two balanced portfolios (with and without Australia) and a growth portfolio.

1. Balanced

A mixture of Global Equities, Australian Equities, Bonds and Gold. Suitable for investors with minimal Australian shareholdings that seek a diversified portfolio with less risk and volatility than an index fund.

2. Balanced (excluding Australia)

A mixture of Global Equities, Bonds and Gold. Suitable for investors seeking to diversify a portfolio that is overweight Australian shares. Possibly the best portfolio for those who trade Australian shares and simply wish to counterbalance their Australian investments.

3. Growth

A mixture of Global Equities, Australian Equities, Emerging Markets, Bonds and Gold. Suitable for investors with minimal share holdings that want a single ETF strategy that's less volatile than an ASX index fund. Although being the most diversified, its increased exposure to equities (especially Australian) increases volatility.

While we're measuring success against the S&P/ASX 200 Accumulation index, it's important to note that superannuation funds tend to measure success against a benchmark that matches their portfolio's ratio of growth to defensive assets. Equities are considered growth assets, while bonds and gold are considered defensive.

Comparing fund categories allows for accurate "apples-to-apples" comparisons as it's easier for a high growth portfolio to generate higher returns. A superannuation fund portfolio containing a single index fund (e.g. VAS) would be considered aggressive.

The following table lists Australian Super Fund returns over eight different timeframes.

CATEGORY	1mth	3mth	1yr	3yr	5yr	7yr	10yr	15yr
All Growth (96-100%)	2.4	7.1	26.7	10.3	11.6	10.0	10.3	7.1
High Growth (81-95%)	2.3	6.3	22.4	9.2	10.4	9.5	9.7	6.9
Growth (61-80%)	2.0	5.2	18.0	7.9	8.8	8.2	8.6	6.5
Balanced (41-60%)	1.4	4.0	13.0	6.2	6.7	6.4	7.0	5.6
Conservative (21-40%)	1.0	2.6	7.9	4.6	4.8	4.9	5.5	5.0

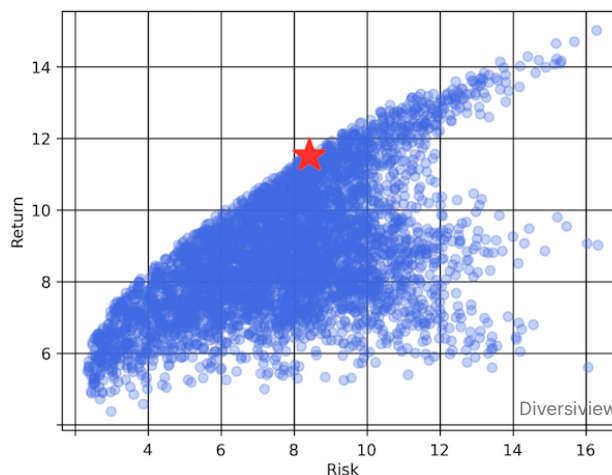
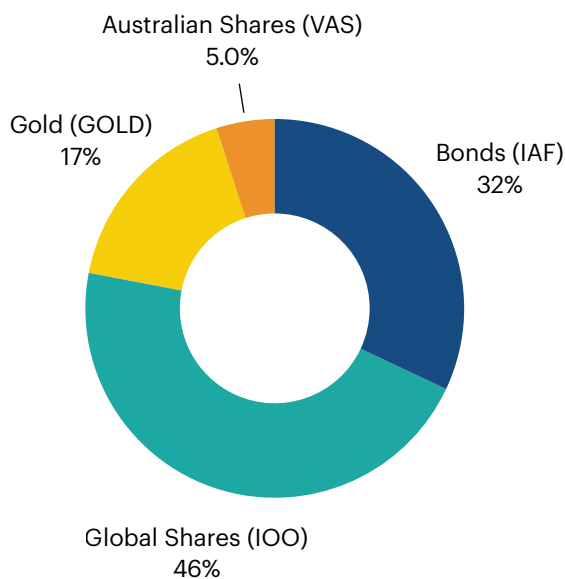
Source: Chant West. Net of fees to 30 June 2021. All returns expressed as a percentage.

PORTFOLIO #1 - BALANCED

The Balanced Portfolio would be suitable for investors that hold minimal Australian shares and seek a diversified portfolio with significantly less risk and volatility than an ASX index fund.

The four ETF combination that generated the lowest risk for the 11% target return was:

- 46% - iShares Global 100 (ASX:IOO)
- 32% - iShares Core Composite Bond (ASX:IAF)
- 17% - ETFs Metal Securities Australia (ASX:GOLD)
- 5% - Vanguard Australian Shares (ASX:VAS)



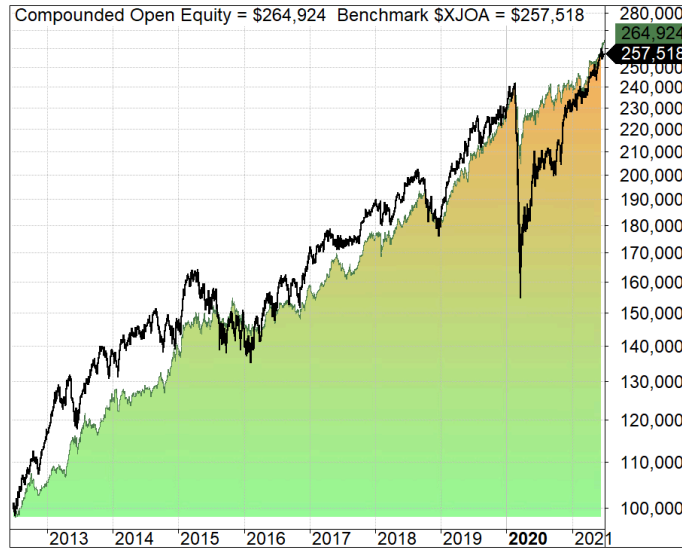
July 2012 to June 2021

Testing was conducted with and without rebalancing every 3-years.

	With Rebalancing	No Rebalance	S&P/ASX 200 Acc.
Compounded Annual Return	10.49%	11.43%	11.08%
Max Drawdown (Loss)	-11.35%	-15.53%	-35.93%
Average Volatility	6.65%	8.22%	13.19%

Equity Curve (no rebalance)

After 9-years, the final portfolio composition was IOO (69%), IAF (17%), GOLD (9%) and VAS (5%). The portfolio became increasingly correlated to the market over time, but the high bond and gold holding still provided strong support during the 2020 crash.

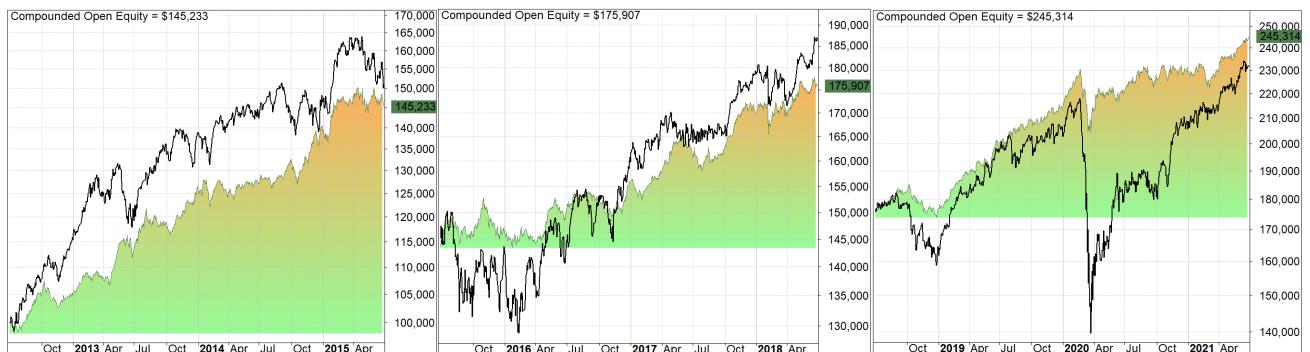


ETF Portfolio (Balanced)

Equity Curves (with rebalancing)

Rebalancing provided significant risk and volatility improvements with only a minor 0.94% reduction in annual return.

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. The S&P/ASX 200 Accumulation index is overlaid (black).



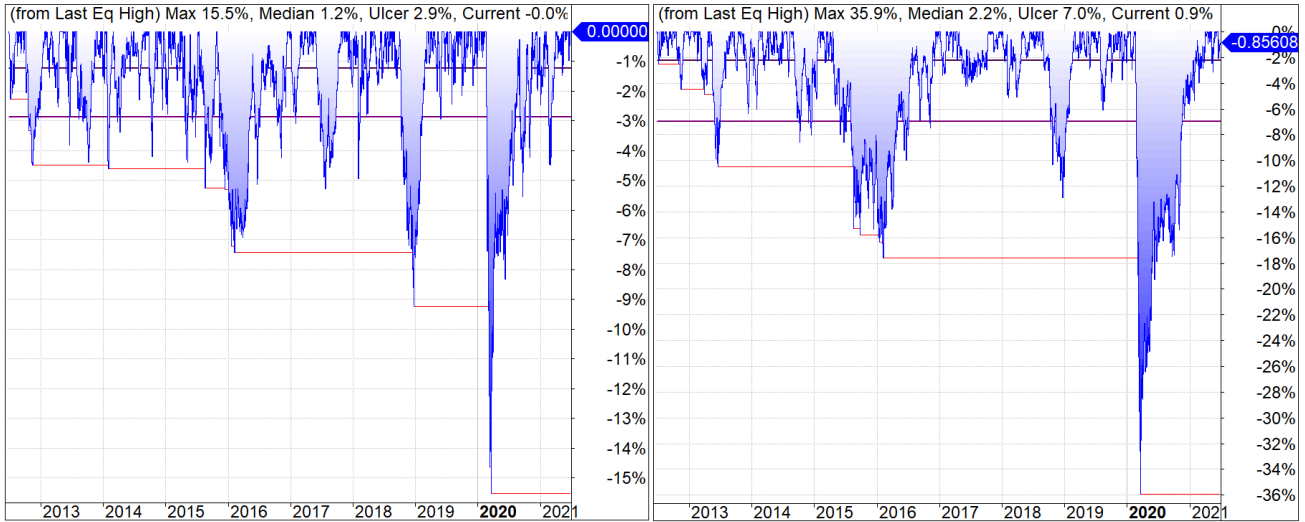
2012 to 2015

2015 to 2018

2018 to 2021

Drawdown (no rebalance)

The portfolio's five largest drawdowns were approximately half the S&P/ASX 200 Accumulation index's drawdowns. The portfolio experienced a MaxDD of -15.53% during the 2020 crash.



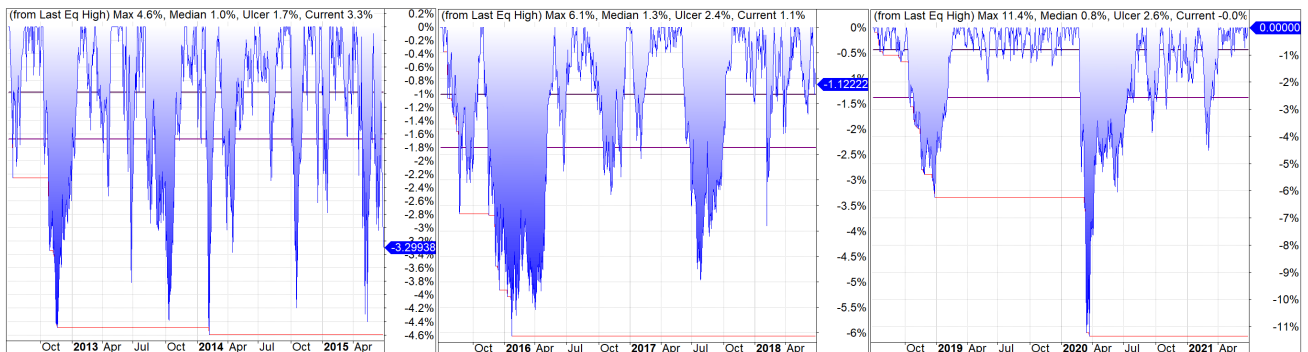
ETF Portfolio (Balanced)

S&P/ASX 200 Accumulation Index

Drawdowns (with rebalancing)

Rebalancing prevented equities becoming overweight in the later years, and this reduced MaxDD down to -11.35% during the 2020 crash.

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



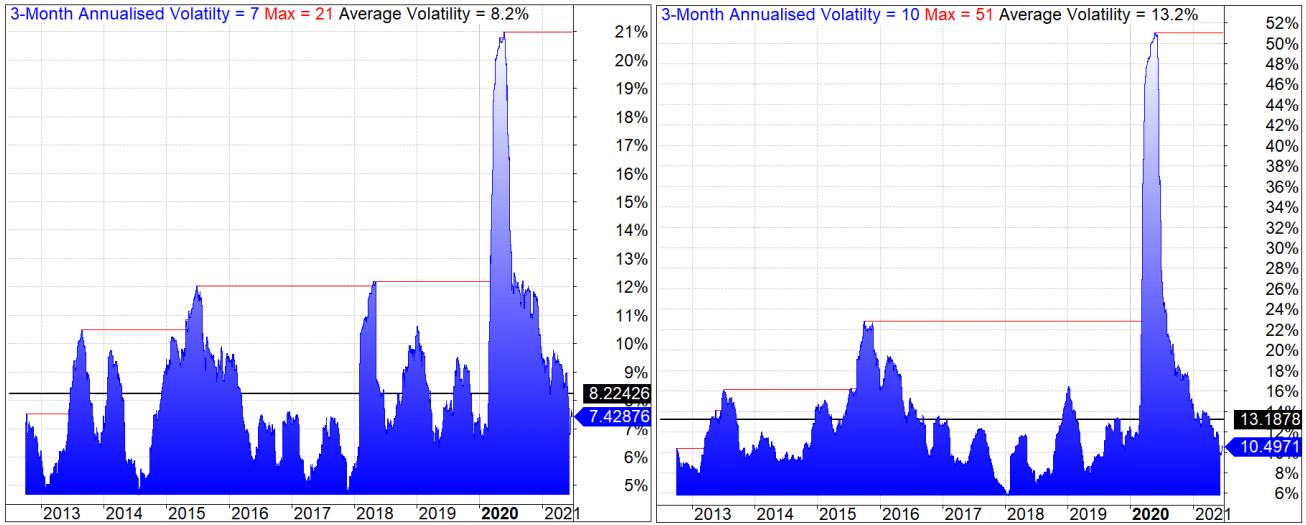
2012 to 2015

2015 to 2018

2018 to 2021

Volatility (no rebalance)

The portfolio exhibited approximately 38% less volatility than the benchmark index.

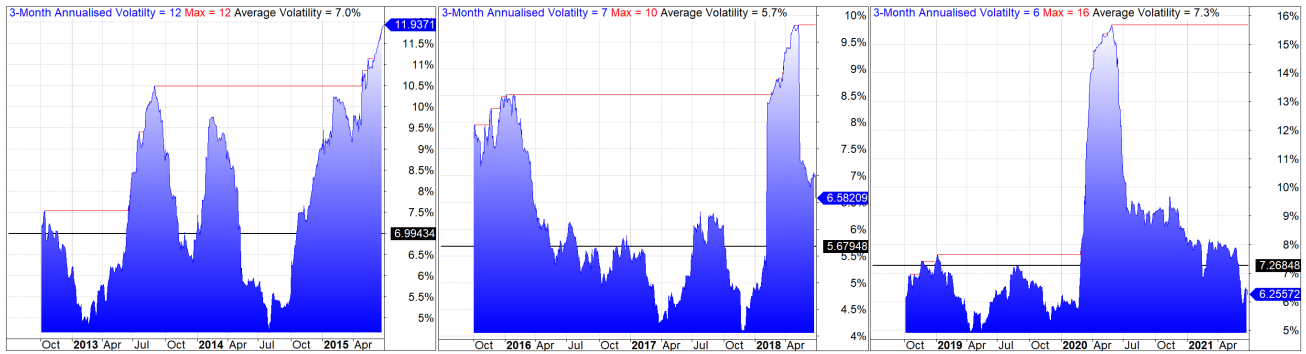


ETF Portfolio (Balanced)

S&P/ASX 200 Accumulation Index

Volatility (with rebalancing)

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



2012 to 2015

2015 to 2018

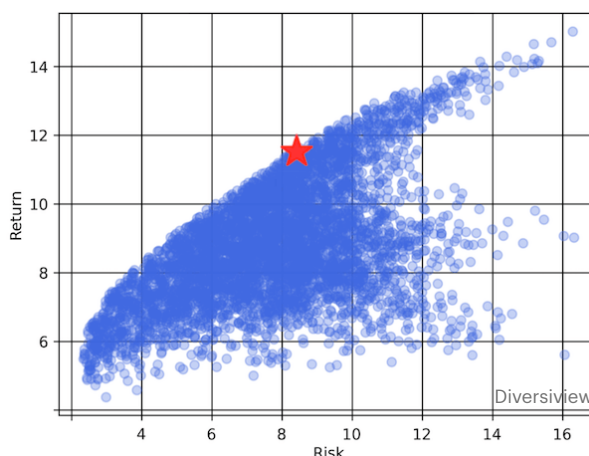
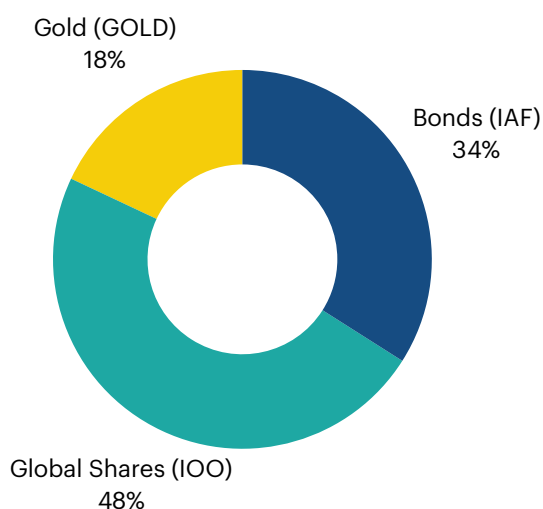
2018 to 2021

PORTFOLIO #2 - BALANCED (EX-AUSTRALIA)

The Balanced Portfolio (ex-Australia) would be suitable for investors that already hold Australian equities through direct shares e.g. BHP, CBA, etc. and wish to diversify through an ETF Portfolio that excludes Australian equities.

The three ETF combination that generated the lowest risk for the 11% target return was:

- 48% - iShares Global 100 (ASX:IOO)
- 34% - iShares Core Composite Bond (ASX:IAF)
- 18% - ETFs Metal Securities Australia (ASX:GOLD)



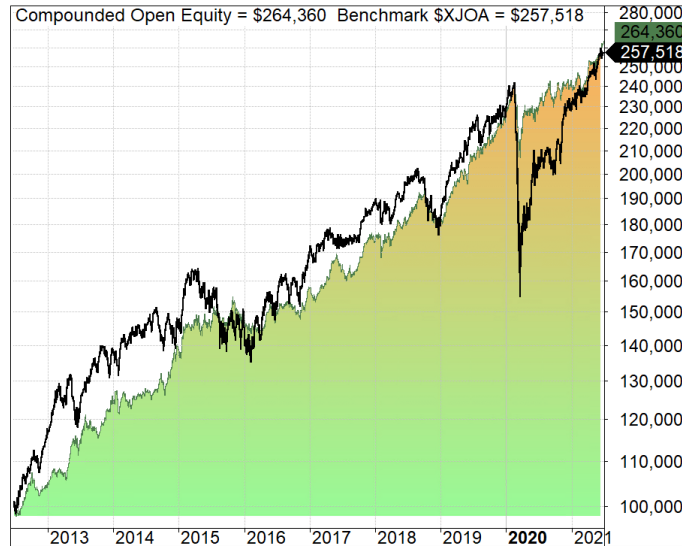
July 2012 to June 2021

Testing was conducted with and without rebalancing every 3-years.

	With Rebalancing	No Rebalance	S&P/ASX 200 Acc.
Compounded Annual Return	10.41%	11.41%	11.08%
Max Drawdown (Loss)	-10.64%	-14.41%	-35.93%
Average Volatility	6.67%	8.27%	13.19%

Equity Curve (no rebalance)

After 9-years, the final portfolio composition was IOO (72%), IAF (18%) and GOLD (10%). The portfolio performance was almost identical to the Balanced Portfolio.

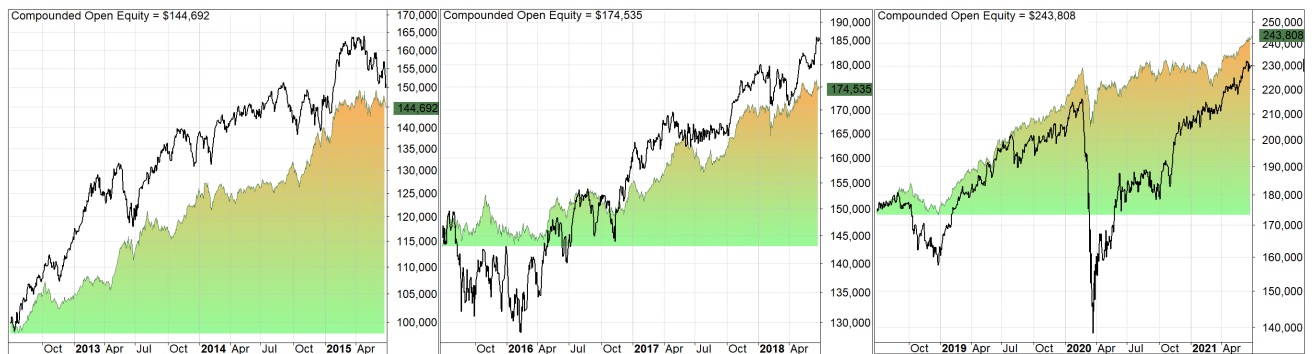


ETF Portfolio (Balanced) Ex-Australia

Equity Curves (with rebalancing)

Rebalancing provided significant risk and volatility improvements, but with a 1.0% reduction in annual return. The tradeoff would be beneficial for most investors.

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. The S&P/ASX 200 Accumulation index is overlaid (black).



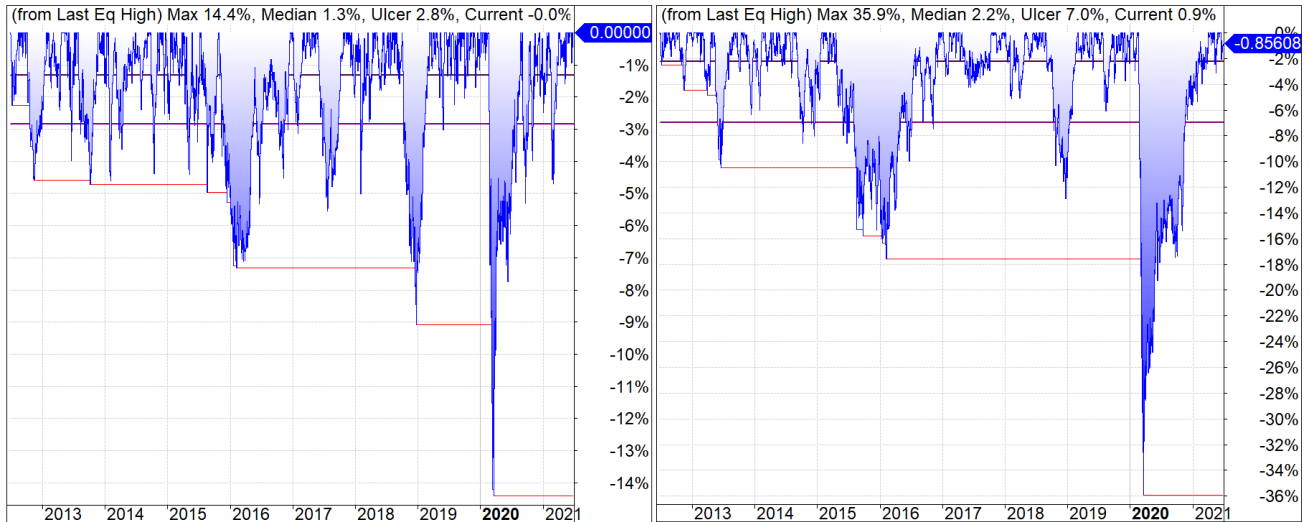
2012 to 2015

2015 to 2018

2018 to 2021

Drawdown (no rebalance)

The portfolio exhibited very similar drawdown patterns with Australian shares removed. Drawdowns were approximately 60% less than the benchmark index, but increased in severity over the nine year period partially due to the portfolio becoming overweight Global Shares.



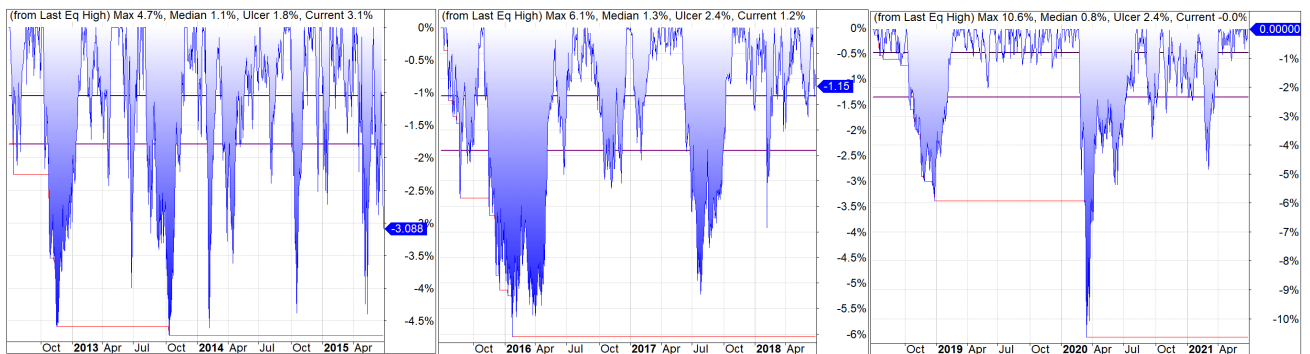
ETF Portfolio (Balanced) Ex-Australia

S&P/ASX 200 Accumulation Index

Drawdown (with rebalancing)

Rebalancing prevented equities becoming overweight in the later years, and this reduced the MaxDD to -10.64%. This is a massive difference compared to the benchmark index's -35.93%.

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



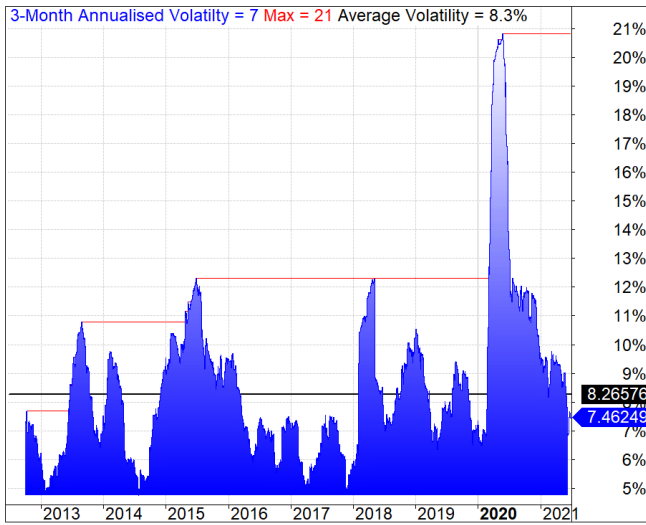
2012 to 2015

2015 to 2018

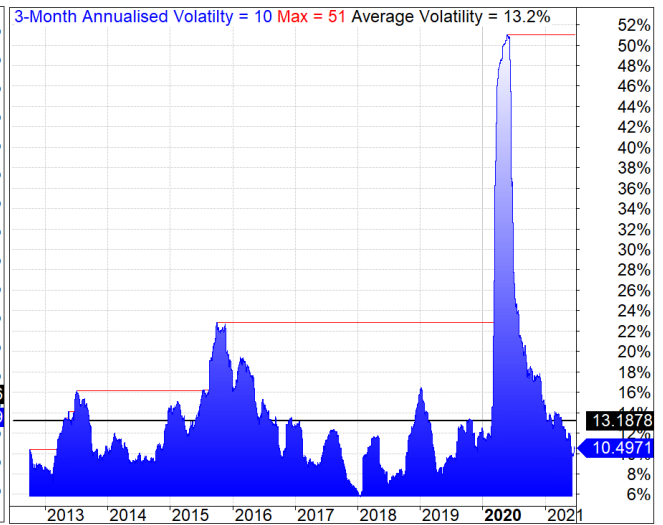
2018 to 2021

Volatility (no rebalance)

Excluding Australian shares slightly increased volatility.



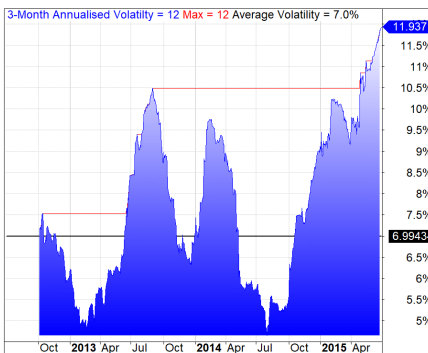
ETF Portfolio (Balanced) Ex-Australia



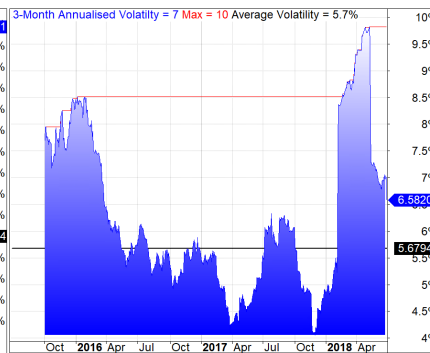
S&P/ASX 200 Accumulation Index

Volatility (with rebalancing)

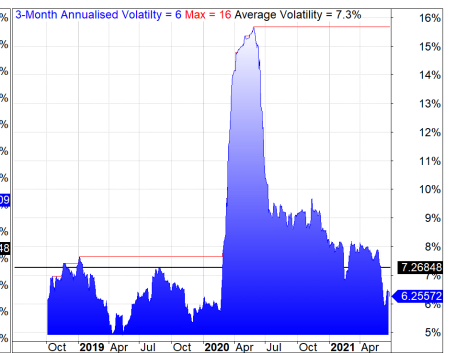
The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



2012 to 2015



2015 to 2018



2018 to 2021

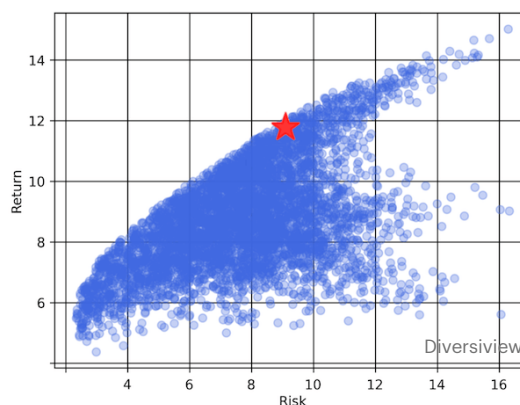
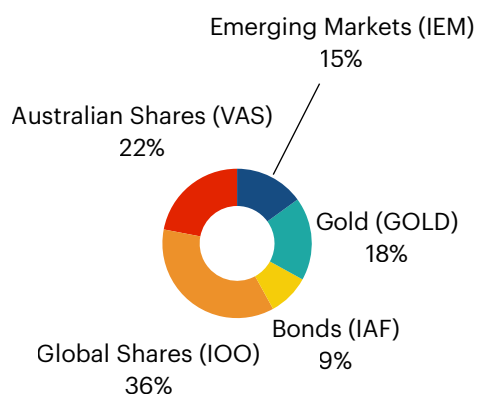
PORTFOLIO #3 - GROWTH

The Growth Portfolio might be considered inferior to the diversified portfolios by many investors, as the small performance increase comes with a moderate increase in risk and volatility. The portfolio would be best suited for investors that believe one of two things:

1. Australian and/or Emerging Markets are expected to outperform the US
2. Large-cap technology (e.g. Apple, Microsoft, Amazon, etc.) is overvalued and expected to underperform the Australian market

The five ETF portfolio combination that generated the lowest risk for the 11% target return was:

- 36% - iShares Global 100 (ASX:IOO)
- 22% - Vanguard Australian Shares (ASX:VAS)
- 18% - ETFs Metal Securities Australia (ASX:GOLD)
- 15% - iShares MSCI Emerging Markets (ASX:IEM)
- 9% - iShares Core Composite Bond (ASX:IAF)



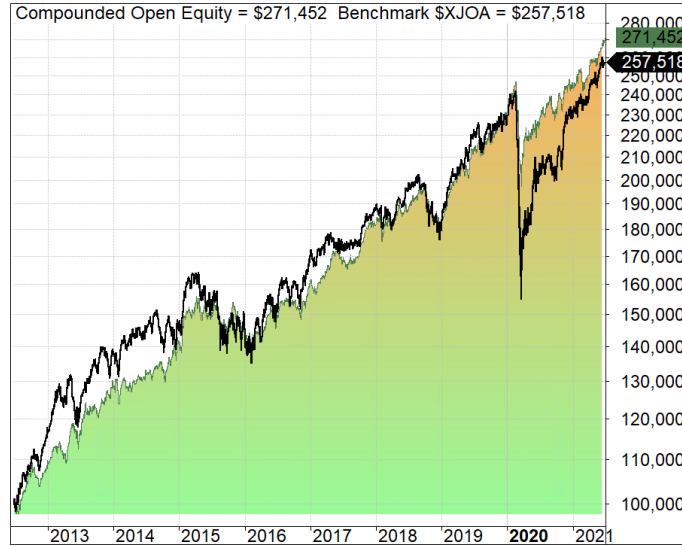
July 2012 to June 2021

Testing was conducted with and without rebalancing every 3-years.

	With Rebalancing	No Rebalance	S&P/ASX 200 Acc.
Compounded Annual Return	11.19%	11.73%	11.08%
Max Drawdown (Loss)	-16.95%	-20.16%	-35.93%
Average Volatility	7.96%	9.29%	13.19%

Equity Curve (no rebalance)

After 9-years, the final portfolio weighting was IOO (52%), VAS (21%), IEM (12%), GOLD (10%) and IAF (5%). Global equities were the core driver, and the higher exposure to Australian and Emerging Markets increased the MaxDD to -20.16%.

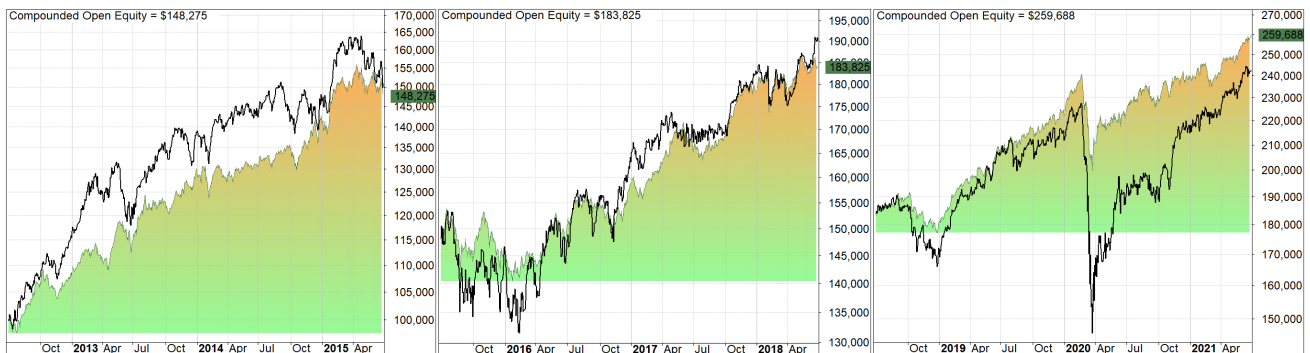


ETF Portfolio (Growth)

Equity Curves (with rebalancing)

Rebalancing provided significant risk and volatility improvements with only a minor 0.54% reduction in annual return.

The following charts represents three financial years with rebalances occurring at the end of each 3-year period. The S&P/ASX 200 Accumulation index is overlaid (black).



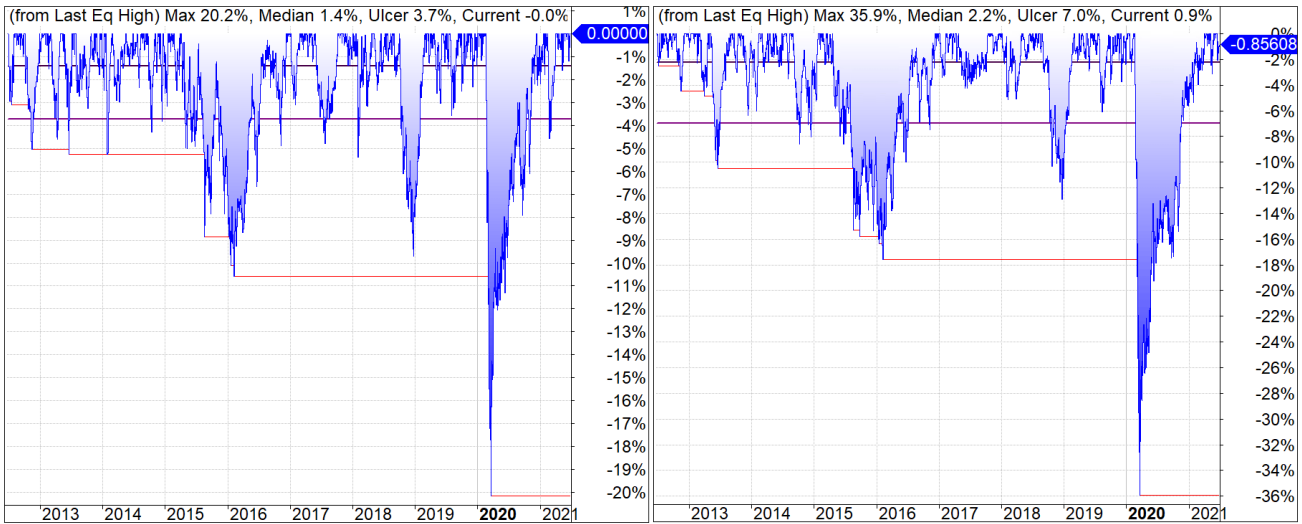
2012 to 2015

2015 to 2018

2018 to 2021

Drawdown (no rebalance)

Higher exposure to equities means larger drawdowns during market corrections.



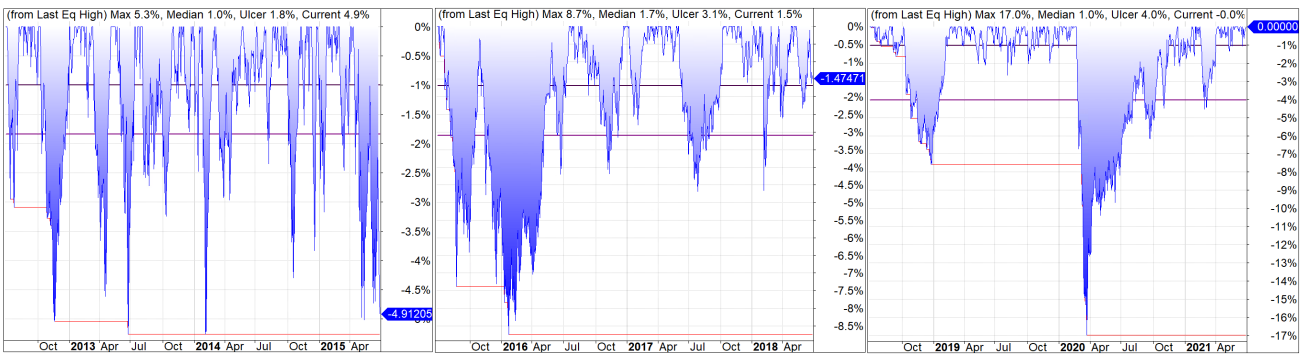
ETF Portfolio (Growth)

S&P/ASX 200 Accumulation Index

Drawdown (with rebalancing)

Rebalancing prevented equities becoming overweight in the later years, and this reduced the MaxDD to -16.95%. This is a massive difference compared to the benchmark index's -35.93%.

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



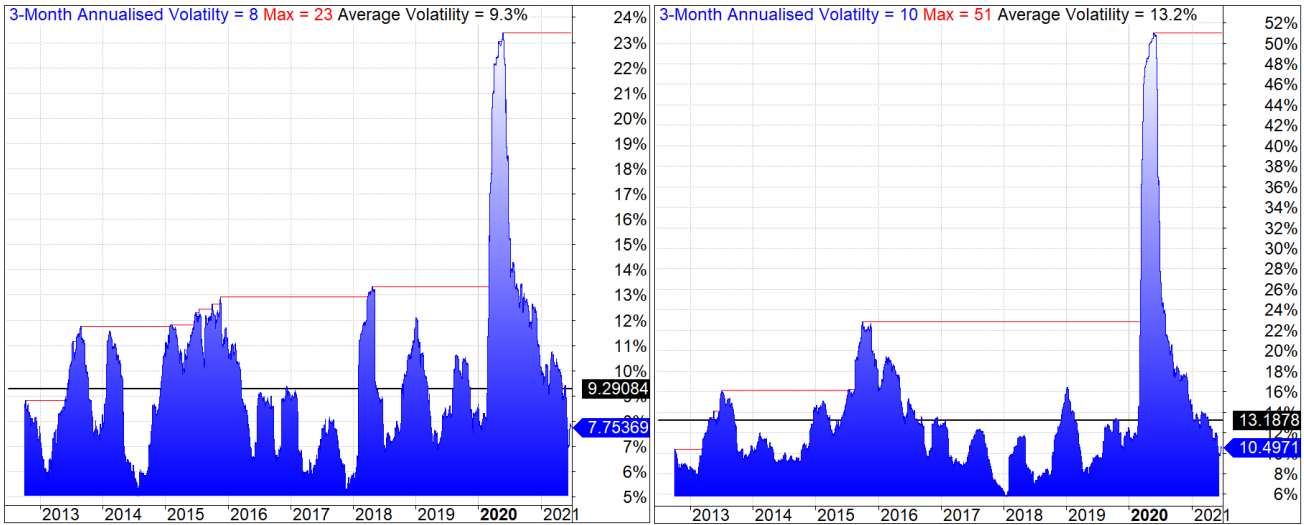
2012 to 2015

2015 to 2018

2018 to 2021

Volatility (no rebalance)

Volatility was approximately 30% lower than the benchmark index.

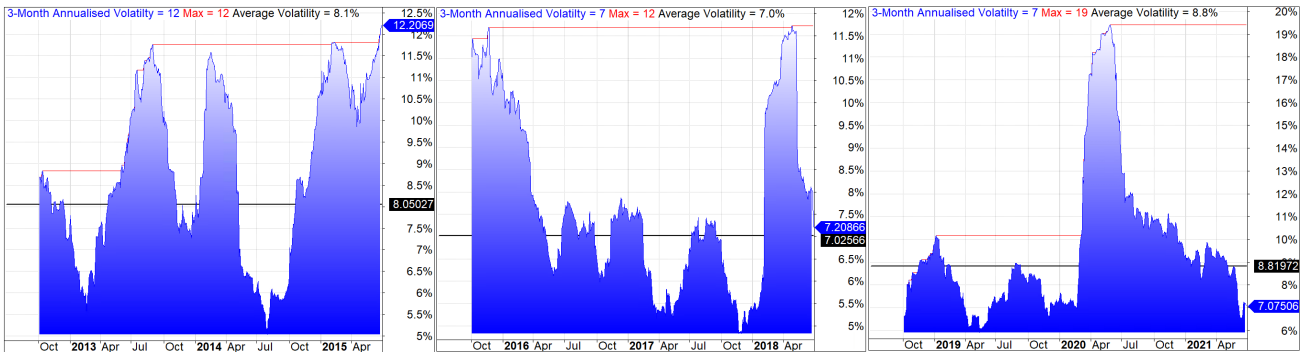


ETF Portfolio (Growth)

S&P/ASX 200 Accumulation Index

Volatility (with rebalancing)

The following charts represent three financial years with rebalances occurring at the end of each 3-year period. Please note that each chart has a different y-axis scale.



2012 to 2015

2015 to 2018

2018 to 2021

Part 4

APPENDIX

CAVEATS

Some things to be aware of:

LIMITED DATASET

Australia's first Bond ETF launched in March 2012, so accurately back-testing an ETF portfolio prior to this date was not possible.

CORRELATION DATA

Correlations were calculated using 10-years of data (if available) as shorter timeframes may generate less accurate correlations. All data was adjusted for dividends and corporate actions.

CAPITAL GAINS TAX (CGT)

Taxation can significantly impact a portfolio's performance. Rebalancing will trigger CGT obligations and tax implications should be carefully considered.

OVERWEIGHT TECHNOLOGY

iShares Global 100 (ASX:I00) has ~29% exposure to the Technology sector, and 72% weighting to US markets. Any large correction that predominately affects technology companies (e.g. Apple, Amazon, etc.) or the US markets will cause increased volatility in the portfolios.

EMERGING MARKETS

Emerging markets underperformed during the 9-year testing window. If there's major movement of funds into emerging markets in the future, it may be prudent to incorporate the sector into the balanced portfolios.

HISTORICAL RETURNS & VOLATILITY

Modern portfolio theory uses historical returns and volatility to establish optimal portfolio weightings. If an asset class experiences a major change in either of those metrics, then the results will be less reliable. As every financial website's disclaimer says: "Past performance is not indicative of future performance".

ACKNOWLEDGEMENTS

The following resources assisted in the creation of the ASX ETF Portfolios:

WEBSITES

Diversiview

<https://diversiview.online>

Diversiview was used for all efficient frontier calculations. The team are highly responsive and we look forward to future developments in their software.

StockSpot

<https://www.stockspot.com.au>

StockSpot manage ETF Portfolios for an annual fee. While we have never used their services, they'd be our choice for a hands-off approach to ETF investing.

Vanguard

<https://www.vanguard.com.au>

Provider of Vanguard Australian Shares (ASX:VAS)

BlackRock

<https://www.blackrock.com>

Provider of iShares Global 100 (ASX:I00) and iShares Core Composite Bond (ASX:IAF)

ETF Securities

<https://www.etfsecurities.com.au>

Provider of ETFs Metal Securities Australia (ASX:GOLD)

BetaShares

<https://www.betashares.com.au>

While not used in the final portfolios, BetaShares offer a wide range of ASX listed ETFs.

REFERENCES

¹ Credit Suisse - Global Wealth Report, June 2021

² ASX Australian Investor Study, 2020

³ Willis Towers Watson - Global Pension Assets Study, 2020

⁴ The Association of Superannuation Funds of Australia (ASFA), 2021

⁵ SPIVA® Australia Scorecard, 2020

⁶ RBA - A Century of Stock-Bond Correlations, Bulletin, September 2014