Impact investment funds and the equity market: correlation, performance, risk and diversification effects – A global overview

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in Finance and Investments

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Declaration

I, Lucky Pane, declare that this research report is my own work, except where otherwise indicated and acknowledged. It is submitted for the degree of Master of Management in Finance & Investments in the University of the Witwatersrand's Business School, Johannesburg. This research report has not, either in whole or in part, been submitted for a degree or diploma to any other universities.

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Abstract

The aim of this paper is threefold. (1) To examine the financial performance of impact investment funds relative to the MSCI World Equity Index as well as traditional asset classes in major developed and emerging economies. (2) To assess the correlation between impact funds and traditional asset classes to see if there are diversification benefits. And finally, to examine the portfolio effects of including impact investment funds in a portfolio with traditional asset classes using mean variance optimization (MVO), capital asset pricing model (CAPM) and Black Litterman (BL) model. The study found that impact investment funds in both developed and emerging market economies deliver financial returns in line with and above the equity market. Broadly there was a negative or low correlation between impact investment funds and conventional asset classes (equities, bonds and cash). This bodes well for portfolio diversification. On comparing the performance of portfolios that include impact investments to portfolios that consist only of traditional asset classes, we found that for several countries in our sample, impact investments improved overall portfolio performance and risk. This was observed using various of performance measures: exported portfolio returns, standard deviation, Sharpe ratio, portfolio beta, Treynor ratio and Jensen Alpha ratio. Based on these findings, this study advocates for fund managers to allocate more capital towards impact investments as this is likely to boost their overall returns.

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1. Introduction

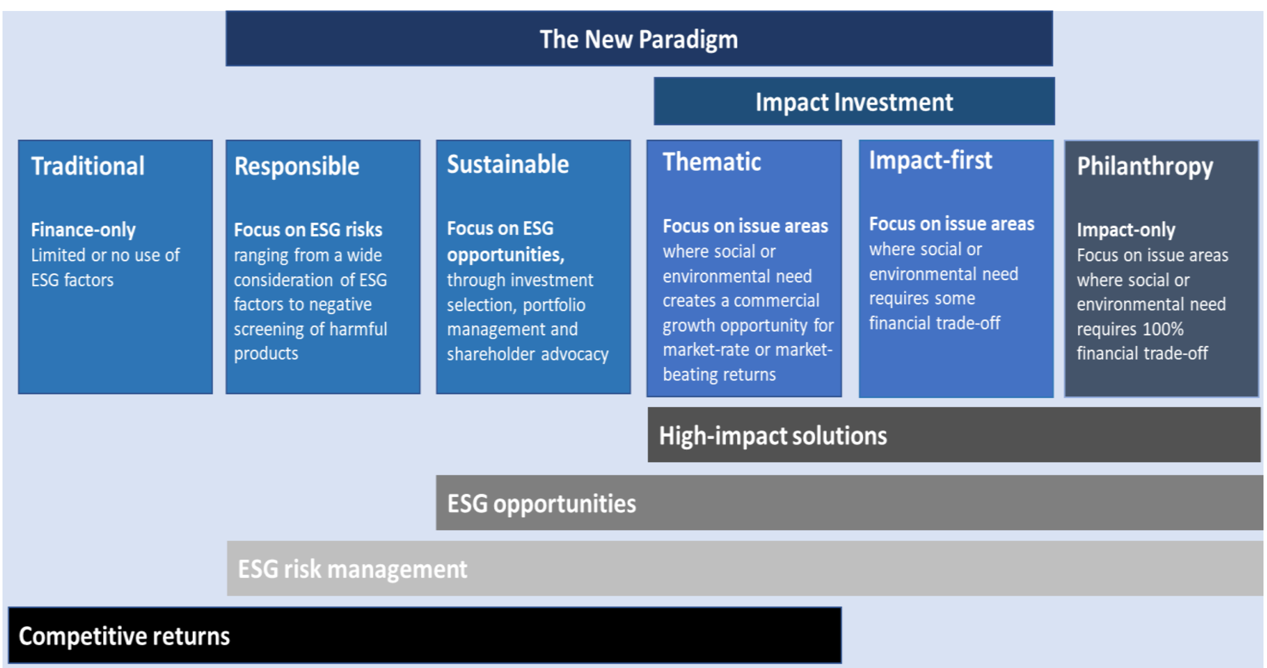
1.1 Developments in impact investing universe

According to the Global Impact Investing Network (GIIN) assets under management (AUM) of the impact investing industry totaled US$715 billion in 2019, 0.7% of the global equity market. Over the past decade, impact investing has gained significant momentum as both an investment strategy and an approach to addressing pressing social and environmental challenges (GIIN 2019). Currently, 1 340 organizations actively play in the impact investing space, most of which are asset managers (64% of AUM), followed by foundations (21%), banks (4%) and development finance institutions (2%). The remaining 9% is made up of family offices, pension funds/insurance companies and other investment companies.

Impact investing is defined as investments that are made with the goal of producing both a measurable and positive social and environmental impact whilst also generating a financial return for investors (Global Steering Group [GSG] for Impact Investing 2019). According to Blumberg & Hornsby (2013), "impact generation addresses the potential for real change presented by the organization and investment opportunity together" (p.28). Relative to traditional investments, delivering impact is comparable to delivering financial returns. Puttick & Ludlow (2012) describe risk as the uncertainty that the company will deliver on its proposed impact.

Other terms associated with or used for impact investing are Socially Responsible Investing (SRI), Environmental, Social & Governance (ESG) investing and developmental investing. Figure 1 below categorizes the investment market and demonstrates existing opportunities in the investment universe. Since definitions in the social and impact investment space are still blurred, some terms may be used interchangeably.

Figure 1: Spectrum of capital



Source: Nicklin (2012)

About two-thirds of participants in impact investing target market-rate returns, 19% require close to market returns while the remaining 15% target returns in line with capital preservation. This dispels the commonly held view amongst investors that impact investing is a tradeoff between social returns and financial returns. While this may have been true in the early days of impact investing, the industry has evolved remarkedly in the last decade (Snider 2016).

Impact investors allocate capital globally, with an equal split between developed and emerging markets (GIIN 2019). Capital is allocated to various sectors, including energy, microfinance, water & sanitation, food security & agriculture, affordable housing, healthcare, education and infrastructure. The players often invest using a wide range of instruments, including debt and equity or a combination of the two.

Impact investing is expected to grow exponentially going forward as more and more traditional investors adopt the United Nation's Sustainable Development Goals (SDGs) and the African Union Agenda 2063. Investors are becoming more responsible and intentionally pursuing impact in their investments. JP Morgan and GIIN (2015) project that impact investing will reach US$1 trillion in the next decade. Impact investing presents itself as an attractive investment vehicle for emerging markets, particularly Africa, amidst development challenges of poverty, economic and financial exclusion, poor education and health outcomes, amongst others (GSG 2019).

Today, there is a growing recognition and need for impact investing. Traditional investors are heeding the call and amending their mandates and strategies to align to global development goals that seek to achieve a better and more sustainable future for all. Jones et al. (2007) explains that impact investing is growing because investors are now concerned about the moral and social responsibility of the investee company towards the community in which they operate and not just on wealth maximization. For institutional investors, impact investment offers a competitive edge by enabling fund managers to address the growing requirement from clients that investments be aligned to their environmental and social values.

In addition, early research shows that impact investments are often uncorrelated to traditional investments, providing room for diversification in the portfolio, reducing portfolio risk and increasing sustainability (De Gruyter 2015). This bodes well for portfolio performance and fund managers.

Research by Ormiston et al. (2015) analyzed the percentage of the portfolio that investors allocate to impact investment. The findings vary significantly: foundations and charities target a total portfolio approach (100% of their portfolio in impact investments) while most institutional investors allocate a low to moderate percentage of their total portfolio. The latter proposition enables diversification while limiting the change in the current portfolio composition and having only a mute impact on overall returns.

1.2 Research problem

Much of the research on the performance of impact investment funds has focused on developed economies such as the US, Europe and Australia. As mentioned previously, emerging markets account for roughly half of the global impact investing AUM. It is important to examine the performance of emerging markets impact funds relative to market benchmarks and other asset classes. It is also critical to assess whether there are differences in performance between impact investment funds in developed markets versus emerging market economies as this will inform asset allocation and portfolio construction for asset managers. Many asset managers' mandates have financial returns as the primary objective even for impact funds.

Also, fund managers have been reluctant to allocate funds to impact investment due to a lack of a strong track record. Many of the previous studies suffered from small sample sizes. However, in the last decade there has been rapid growth in impact funds across different countries. This helps address the small sample challenge and there is now more data than when the analysis of such funds was undertaken about ten years ago.

1.3 Research significance and contribution

It is important to measure the performance of impact funds if more capital is to be directed into this space. There is an opportunity to lobby pension funds, insurance companies and developmental finance institutions to increase their allocation to impact investing. If the results of this study show that impact funds outperform or perform in line with the market, this will do away with the misconception that investors sacrifice financial returns for social impact. This may also encourage more capital allocation to impactful investments.

There is little literature, even internationally, on optimal ways to construct portfolios that include impact investment funds. There is a need to investigate the extent to which the inclusion of impact investment funds into a portfolio of traditional assets leads to substantially different portfolios in terms of risk, risk-return trade-off and diversification. This study is one of the few that look at optimizing impact investments using the Black Litterman model. Other studies have looked at optimizing hedge funds (Kooli and Selam 2010).

1.4 Research objectives

The aim of this research is threefold: (1) to compare the financial performance of impact investment funds with the MSCI World Index (global equity benchmark index) as well as individual traditional asset classes (equities, bonds and cash) of 12 developed and emerging market economies; (2) examine the correlation between impact investment funds and conventional assets for diversification benefits; and (3) to examine the effects of including impact funds in a portfolio consisting of traditional assets using three optimization techniques (Mean Variance, Capital Asset Pricing Model and Black Litterman).

The rest of the paper is structured as follows: Section 2 presents the literature review followed by the research methodology in section 3. Section 4 presents the empirical analysis and section 5 is the conclusion.

2. Literature review

2.1 Impact investing as an investment field

Impact investing is still at its infancy as a field of research, with few academic and theorical papers and written by only a small number of researchers. Most of the publications and papers are written by practitioners who are steering the field forward (Brandstetter & Lehner 2014). Internationally, research on impact investing has focused on the measurement of investment outcomes as well as the performance of impact investment funds relative to market benchmarks.

Over the last decade, impact investment as a field and asset class has grown with regards to participants, popularity, investment vehicles and market structures. The market has developed from ‘uncoordinated innovation’ to ‘market building’, with early-stage infrastructure being set up to catalyze increased activity and reduce transaction costs (GIIN 2011; Harji & Jackson 2012). While the growth in impact investing has been phenomenal over the last few years, it has been driven by bespoke individual investment opportunities that are limited in liquidity, diversification and scale. Large and structured investment funds and products are few and the track record is still being built. Global networks such as GIIN and the Impact Investing Policy Collaborative (IIPC) are focused on developing the market.

While not yet fully understood, impact investing is being gradually embraced by for-profit investors. Institutional investors are gradually warming up to impact investments as evidence of successful transactions abounds and products to place and manage capital continue to increase (Ormiston et al. 2015). Large institutional investors such as pension funds, endowments and insurers can play a fundamental role in driving future growth of impact investing as they hold assets worth over US$25 trillion, globally. Institutional investors can bring impact investing to scale, contribute towards developing the frequently required track record and increase the number of deals.

Impact investment is growing in both developed and developing countries (J.P. Morgan and GIIN 2013). According to Correlation Consulting (2012), opportunities for impact investing to grow are massive, especially if one considers the anticipated demand-side needs - US$1.3trn will be required to halve greenhouse emissions from the energy sector by 2050, US$41trn to modernize global infrastructure and US$5trn to reach the 4bn consumer market globally.

Financing of impact investments can be in the form of equity, debt, or a combination of the two, with differing levels of financial returns (below market, in line with market and above market). The differences in returns reflect investor risk appetite as well as the reason for investing in this market. Players in the impact investing field are pursuing different objectives – some seek commercial returns while others seek greater impact.

Differences in investor objectives has led to categorization of investments as ‘financial-first’ or ‘impact-first’ (Ormiston et al. 2015). Financial-first investors include commercial banks, development finance institutions, sovereign wealth funds and pension funds. These investors make investments that generate financial returns in line with or above the market, that also yield positive impact on society and the environment. No compromise is made regarding risk-reward as financial returns are important in meeting fiduciary obligations. Fiduciary duties influence investment strategies, the allocation process and the need for a rational decision-making process. These investors are not willing to trade financial returns for impact. This means that impact investment will not be an extension of a company’s social responsibility, but rather as a value creation strategy (Ormiston et al. 2015). Impact-first investors (foundations, philanthropy and family offices) emphasize high social and/or environmental returns which are accompanied by a low financial return requirement (Harji & Jackson 2012).

2.2 Challenges of impact investment

Brandstetter & Lehner (2014) and Wood et al. (2013) mention that even though institutional investors are well positioned to drive growth of the impact investment market, several obstacles need to be cleared. Firstly, institutional investors require the necessary "infrastructure in terms of investable financial products and intermediaries" which are currently underdeveloped within this market. There is a need to grow and scale these intermediaries since mainstream investors prefer to purchase products from mainstream intermediaries. Secondly, institutional investors are bound to specific asset classes with specific benchmarks for expected risk and return. These investors are yet to incorporate environmental and social targets into their investment strategies. Thirdly, institutional investors use traditional portfolio allocation frameworks to make investment decisions. This may be a problem for impact investments as they do not necessarily follow the logic of traditional finance tools and frameworks.

Conventional financial models are only applicable where risk and return metrics can be measured and compared. Unfortunately, the impact investing market has not yet developed standardized measures that incorporate social returns and social risk. Brandstetter and Lehner (2014) highlight that since an optimized portfolio is critical for institutional investors, the projected market growth may not be achieved until impact investments' characteristics match the traditional portfolio tools. Since the work of De Gruyter (2015), there have been few other studies in developed economies that deal with integrating impact investments into traditional portfolio optimization tools (Erin et. Al. 2018; Tekula & Andersen 2019).

Saltuk et al. (2014) believes that there are two challenges limiting the growth of impact investing: lack of appropriate capital across the risk/return spectrum and the shortage of high-quality investment opportunities with a solid track record. This explains why institutional investors have not yet allocated the expected volume of capital and are still hesitant to invest in the space (Mudaliar & Schiff 2014).

Some researchers are proposing adapting the decision framework to incorporate impact investments (Geobey et.al. 2012; Lyons & Kickul 2013). This way, impact investments will be taken seriously as an alternative to mainstream investment products. The Black-Litterman (BL) model can be used to combine impact investment field's early stage with the mature research on portfolio construction.

2.3 Performance of impact investment funds versus equity benchmarks

2.3.1 Evidence of underperformance

Modern portfolio theory asserts that the investor's primary objective is to maximize returns for a given level of risk. That is, to hold a mean-variant efficient portfolio. This objective is achieved by holding a diversified portfolio. Jones et al. (2007) highlights that the most contentious issue in impact investing is whether financial returns are negatively affected by restricting the universe of funds and stocks that can be included in a portfolio. According to Humphrey (2011), the screening mechanism of Socially Responsible Investments (SRI)/impact investment funds limits the investment universe available to investors and could even exclude certain industries. Under these circumstances a fully diversified portfolio cannot be achieved (Chegut et al. 2011). Returns are likely to be suboptimal and idiosyncratic risk higher. Thus, impact investing contradicts modern portfolio theory as it represents a less diversified portfolio due to the screening process of portfolio formation.

Because earlier research on impact investing used negative screening techniques, the results showed higher total risk and underperformance (Bello 2005, Tippet 2001, Jones et al. 2007). In a study on US SRI funds, Hamilton et al. (1993) established that financial returns of 31 funds fell short of the S&P 500 performance by an average of 6.3% per year. Gregory et al. (1997) using a multi-factor Capital Asset Pricing Model (CAPM) found that SRI funds in Germany and US underperformed the market index.

The underperformance of impact investment funds in earlier studies could also be attributed to the smaller sample sizes due to fewer funds that existed at the time (Humphrey 2011). These studies also did not control for company sizes between SRI funds and the market. Generally, impact investment funds tend to invest in small companies compared to larger companies listed on stock exchanges. There are also the additional costs related to screening and monitoring social and ethical performance as well as high management fees (Jones et al. 2007; Cummings 2000).

Viviani (2015) gives two theoretical explanations for the differences in performance between impact investment portfolios and traditional portfolios: the extent of portfolio diversification and the cost of portfolio construction. Those against impact investing argue that these investments limit investment opportunities and the ability to diversify the portfolio through selection and exclusion constraints. "Fund managers have fewer assets to consider, which should lead to underperformance by moving down the efficient frontier" (Le Maux & Le Saout 2004, p.7). Clow (1999) concluded that the selective approach and constraints leads to a sector bias by reducing the quantity of investment opportunities and thus enlarging the risk. As such, these investments incur diversification costs (Girard et. al 2007). In addition, since impact investment transactions are relatively small, managing them could result in higher fees (Barnett & Salomon 2006; Bauer et al 2005).

Notwithstanding the above reasons for the short-term underperformance of impact investment funds relative to traditional investments, the gap in performance reduces in the medium-term, with impact funds outperforming in the long-term (Viviani 2005). Cummings (2000) and Barnett & Salomon (2006) concur that impact investment funds seem to outperform in the long run.

2.3.2 Evidence of outperformance

Snider (2016) notes that given enhancements in data and portfolio construction techniques, these results would likely look different if this analysis was conducted again in ten years' time. The study shows that companies that had fully adopted ESG principles reduced risk and enhanced shareholder value. Several studies show that these companies are generally better run, are more profitable and enjoy associated cost savings. The results of Snider's 2016 study found that "high sustainability" companies generated returns 47% above their "low sustainability" company counterparts for the period 1993 – 2010 whilst also depicting lower volatility.

Similarly, a study by CDP Global 500 Universe (2014) established that S&P 500 industry leaders on climate change produced 18% higher ROE, 50% reduced volatility over the past decade and 21% stronger dividend growth relative to their low scoring peers. Cambridge Associates & the GIIN (2015) found several trends with impact investment funds: impact investment funds that raised under US$100mn outperformed similar sized funds in the comparative universe; emerging markets impact investing funds, especially those focused on Africa, performed particularly well; and market-rate returns are available in impact investing.

2.3.3 No difference in performance

Comparing 25 retail SRI funds and 281 traditional funds, Bauer et al. (2006) found that neither SRI funds nor traditional funds generated alphas that were significantly different from zero. Furthermore, there was no difference in the performance of SRI and traditional funds. Gil-Bazo et al. (2010), Climent & Soriano (2011) and Humphrey & Lee (2011) found that SRI funds performed on a par with conventional portfolios. Rathner (2012) examined 517 SRI funds in Europe and North America and found that 73 underperformed, 68 outperformed and 376 showed no significant performance difference relative to the market benchmark.

The study by Viviani (2015) asserted that the relationship between SRI and performance is insignificant. "Thus, the adoption of ESG standards does not generate notable costs or benefits for an investor with a global perspective", (p.15). This challenges the hypothesis that SRIs are inefficient. Viviani (2015) argues that the key determining factors of financial performance of impact investment funds include: fund manager skills, the ability to diversify the portfolio, ability to select assets, mapping out the strategy and minimizing costs (selection and active management).

2.3.4 Reasons for conflicting results

Overall, the research on financial performance of impact investment funds in developed economies has been mixed. Jones et al. (2007) noted that previous studies were set back by methodological issues - small sample sizes, different approaches to estimating return performance and inconsistencies in the time frames selected. This results in the inconsistent findings reported in the literature. Vivian (2015) argues that differences in performance of impact investments is driven by data. Researchers use different data and different methods. Data mining/bias may be the problem as researchers could only be reporting the best performing assets in their sample from a bigger universe of impact investment funds.

The mixed empirical results can also be attributed to other factors as well – different geographies with differing regulations and funds spanning different countries. The study by Vivian (2015) showed that negative screening and shareholder activism are more common in the US while positive screening is more common in Europe. Negative screening leads to less diversified portfolios compared to positive screening. Thus, as per modern portfolio theory, US impact investment funds can be expected to underperform relative to their European counterparts. Hudson (2006) mentions that the performance of SRI funds depends on the composition of the portfolio and their orientation towards environmental, social and governance criteria. The work of Dimson et al. (2012) shows that SRI funds tilted towards governance outperform those focused on environment and social criteria because governance is the way in which the providers of capital assure themselves of making returns.

2.4 Empirical findings on optimization techniques

2.4.1 Mean-Variance Optimization (MVO)

Markowitz (2010) expressed the investment decision-making process as an optimization problem. The mean-variance optimization (MVO) framework implies that investors make their decision based on the trade-off between risk and return. This tradeoff can be depicted through a quadratic utility function. By maximizing the utility, an investor maximizes his return and minimizes risk (Rubinstein, 2002). The MVO is affected by an investor's specific risk-aversion parameter that determines the trade-off between the expected portfolio return and portfolio risk. Total portfolio risk can be reduced by selecting assets that have uncorrelated returns (Markowitz 1952).

Cevizci (2016) highlighted the following advantages of the MVO: (1) sets a framework for investor constraints in the model; (2) investor can choose the risk level (exposure to various risk factors, stock universe and the performance benchmarks); (3) portfolio performance is not reliant on the performance of individual stocks, due to simplicity in implementation; and (4) portfolio changes can be made timeously.

Notwithstanding these advantages, empirical literature and investment professionals argue that applying Markowitz's model tends to produce unreliable and unintuitive results. According to Cevizci (2016), the MVO is completely a mathematical model which does not make investment sense and portfolios may not have investment value. Portfolio results rely on the structure of variance – covariance matrix. This means that the model can produce unintuitive portfolios. Secondly, the model maximizes estimation errors. Unfortunately, the risk and return estimates depend on these errors. The model puts a higher weight on assets with higher projected returns, negative correlations and small variances. This leads to over estimation. Intuitive restrictions should be added to the model to obtain meaningful results.

Many studies attribute the poor out-of-sample performance of the MVO model to the estimation errors (Allaj 2019). Levy (2014) suggests introducing short selling on the MVO to solve the estimation error problem. Kooli & Selam (2010) propose allocating more weight to the investments that have a significant estimation error. Since the model relies heavily on inputs, estimation errors in the forecasts significantly affect the resulting portfolio weights. Thus, minor changes in initial data lead to significant portfolio changes. The resulting optimization process will not lead to a well-diversified portfolio.

Black & Litterman (1992) highlight that standard optimization tools require investors to forecast expected returns for all assets even though this is not always possible. The authors also emphasized that the MVO framework relies on historical data to predict future returns, which can be misleading since past performance cannot be used as a proxy for future performance. Fabozzi et. al. (2009) established that the variance is not enough to capture investor's risk since each investor's perception of risk differs and is subjective. Some investors may worry about drastic market volatility regardless of direction while others may be concerned about extreme losses caused by downside fluctuations. Because of these shortcomings, the BL model is used as an alternative to the traditional Markowitz framework.

2.4.2 Capital Asset Pricing Model (CAPM)

The CAPM, authored by Sharpe (1964), Linter (1965) and Black et al. (1972), has been one of the leading theories in financial economics for the past few decades. The model is built on the premises of Modern Portfolio Theory (Danthine and Donaldson 2005). The CAPM states that, in equilibrium, the expected return of an asset is determined by the risk-free rate, beta and the expected risk premium (Lam 2001). If the CAPM holds, the relationship between the expected return and risk will be linear. The CAPM explains the differences in the risk premium across assets (Acheampong and Agalega 2013). Risk premium differs across assets, due to the risk associated with the returns of the different assets. According to the model, beta is the sole determinant of the riskiness of an asset, and thus, the excess return per unit of riskiness is the same across all assets.

Despite the CAPM being widely used as a pricing model, it was not supported by empirical evidence due to its strong assumptions. The CAPM is a static model in which expected equity returns are constant (Guo 2004). Systematic risk, as measured by beta, is assumed to remain the same over time. However, empirical evidence shows that beta is not constant (Kim 1993, Cheng 1997, among others). Consequently, expected returns are time variant, as shown by Merton (1973) and Campbell et al. (1993). This means that equity returns are not only affected by systematic risk, but also by other factors as well (mentioned below). Thus, the failure of the CAPM can be attributed to the assumption of constant expected returns.

Several studies have established that the intercept of the CAPM was larger than the risk-free rate, beta was smaller than that predicted by the CAPM, and beta only slightly explained cross-sectional stock returns (Black, Jensen & Sholes (1972), Fama & French (1992). Banz (1981) discovered that stocks with small market capitalization recorded higher average returns than expected by the CAPM, while stocks with large market capitalization recorded lower than expected returns. In 1973, Fama and Macbeth concluded that beta does not fully account for the risk-return relationship, and French (1992) found the risk-return relationship to be weaker than the relationship between returns and other factors. These findings were contrary to the common view that beta was the only factor explaining stock returns.

Subsequent equilibrium models relaxed the assumptions of the CAPM. Academics have developed models that follow more realistic world scenarios (Mazzola & Gerace 2015). This move saw an improvement in empirical results from the 1970s to date.

2.4.3 Black-Litterman (BL) model

Black & Litterman (1992) combined the MVO approach with the CAPM to address the shortcomings of the traditional optimization framework, specifically the difficulties of estimating returns and the model's sensitivity to return assumptions. The BL model makes two important contributions to the problem of asset allocation. Firstly, an intuitive prior generates return estimates from the equilibrium market portfolio by using reverse optimization as a starting point for estimating asset returns. Creating an intuitive connection back to the market is a remarkable development to the process of return estimation (Brandstetter & Lehner 2014). Secondly, the BL model provides an opportunity for investors to incorporate their unique views regarding the performance of various assets into the optimization process. Usually fund managers have specific views regarding expected returns which differ from the implied equilibrium returns (Idzorek, 2005). These views are then combined with the intuitive prior information to obtain a new combined distribution (Walters 2014).

Allaj (2019) found that strategies based on the BL model can produce portfolios with superior performance. Moreover, the BL model out-performed other asset allocation strategies such as the naïve, risk-parity and market strategy. Harris et al. (2016) uses a dynamic BL model which accounts for the non-normality of returns and time-varying distribution of returns. They found that the dynamic BL portfolios outperformed the benchmark and the 1/N portfolio. These portfolios were more diversified than the mean-variance portfolio. Furthermore, they found that the dynamic conditional correlation (DCC) model is a better suited volatility model for a dynamic BL portfolio.

2.5 Empirical findings on performance measures

Performance measures enable investors to compare investment portfolios and to evaluate the real value add of managers. Sharpe (1966) is the forefather of performance measurement and following his work, new measures have been developed since the 1970s. Massimiliano et al. (2013) grouped major performance measures into four groups: relative performance measures, absolute performance measures, density-based performance measures and utility-based performance measures. Below each category is described and examples given.

- ***Relative performance measures*** compare the expected return of portfolios in excess of a threshold, per unit of risk. The Sharpe ratio (Sharpe, 1966) is the most well measure in this group. Other examples: Double Sharpe Ratio, Adjusted for Skewness Sharpe Ratio, Sharpe Information Ratio, Treynor Reward-to-Volatility Ratio, Reward-to-Value-at-Risk Ratio, Gini Ratio, "L-performance" Measure, Reward-to-Lower Partial Moment Ratio and Ulcer Index Performance.

- ***Absolute performance measures:*** based on some rewards when compared to those of a reference portfolio. The most well-known measure is the Jensen alpha (Jensen, 1968). Other examples include the Black Zero-beta CAPM, Net Selectivity Index, Conditional Performance Measure and Market Timing Model.

- ***Density-based performance measures*** consider some general features of the return distribution. They can be defined as the ratio of two Generalized Partial Moments or two Power Expected Shortfalls. Examples include Gain-Loss Ratio, the Keating-Shadwick Omega Measure, Loss-Averse Performance Measures and Upside-Potential Ratio.

- ***Utility-based performance measures:*** linked to an investors' utility function. The main objective of these measures is to directly incorporate the investor's preferences and risk profiles, through representative utility functions. Examples include Morningstar's Risk-Adjusted Return, Stutzer's Performance Index, Lambda Measure.

Many of these performance measures have their origin in Modern Portfolio Theory (Le Sourd, 2007). However, recently developed measures have moved away from this theory and gone beyond cases of mean-variance (Peyper 2014). The plethora of performance measures is an indication that there is no single universally accepted risk adjusted performance measure. These measures have been used to gauge the performance of traditional assets and hedge funds. Their use in impact investing funds is still at early stages.

3. Research methodology

In this study, we first compare the financial performance of impact funds to traditional asset classes (equities, bonds and cash) as well as the global equity benchmark (MSCI World Index), using descriptive statistics (mean, variance, standard deviation, etc.). The analysis examines returns data for twelve countries, six in developed markets and six in emerging markets. Secondly, we examine the correlation between impact investment funds and traditional assets to see if there are any diversification benefits. Thirdly, we examine the effects of including impact funds in a portfolio consisting of traditional assets using three optimization techniques (MVO, CAPM and BL model). The three models are compared to one another. Two portfolios are simulated – one consisting only of traditional assets and another which includes impact investments. The results of the two portfolios are compared. We show the results for the case where short selling is allowed and a case where short selling is not allowed.

The two optimized portfolios are compared uses various portfolio evaluation measures (Sharpe ratio, standard deviation, beta, Treynor ratio and Jensen Alpha ratio). From this analysis, we will be able to tell whether there is value in including impact investments in a portfolio. Before getting into the research methodology, we make several assumptions that will be used as inputs in the three models.

3.1 Assumptions used in the construction of MVO, CAPM and BL models

- For the risk-free rate, the US 10-year Treasury yield of 1.62% is used because it is tracked by investors in developed and developing countries for many reasons. US monetary policy and its impact on US yields influences global monetary policy direction. The 10-year bond is used as a proxy for pricing other asset classes and as a benchmark for comparing returns. Globally, the 10-year Treasury yield is closely watched as an indicator of broader investor confidence. Lastly, the US bond is used as a benchmark because it is viewed as the safest investment since it has the full backing of the US government. We use the ten-year instrument because asset/fund managers invest mainly for the long term, over the business cycle.
- We focus on excess returns when comparing portfolio performance.
- For the BL model, the following market weights are used: equities - 40%; bonds – 40%; cash – 10% and impact investment funds – 10%. The weights assigned to cash and impact funds are for demonstration purposes to see the impact on the portfolio. Otherwise, if they were based on actual global AUM, they would be less than 5% each. The same market weights are applied for each country.
- For the BL model, we assume the following views across the countries: equities will outperform bonds by 5% per annum; bonds will outperform cash by 3% and impact investment funds will outperform bonds by 3% per annum.
- Short selling is permitted.

3.2 Correlation matrix

To assess the **correlation** between impact investment funds and traditional asset classes, the **standard correlation matrix** is used. Correlation measures the association/relationship between two series.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \quad (1)$$

where x_i and y_i are the two series. The correlation coefficient is bounded to lie on the (-1, 1) interval. A correlation of 1 (-1) indicates a perfect positive (negative) association between the series.

3.3 Optimization techniques

Below, we explain the process of constructing the different portfolios using the three models stated above.

3.3.1 Mean Variance Optimization

The approach of Osman (2019) is followed for MVO. However, before getting into the MVO process, the mathematical representation for portfolio expected return, standard deviation and covariance are shown below. The **expected portfolio return** is the weighted average of the returns of the assets making the portfolio.

$$\mu_p = E[r_p] = \sum_{i=1}^{n} \omega_i \, \mu_i = \mu^T W \quad (2)$$

$where$

ω_i is the weight of asset *i*; the percentage of capital that will be invested in asset *i*
r_p is the expected return of the asset
μ_p is the expected return of the portfolio

The **variance** of the portfolio is calculated as follows:

$$Var\left(r_p\right) = \sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} \omega_i \, \sigma_{ij} \omega_j = W^T \sum W \quad (3)$$

The representation is in matrix form: W is the weight matrix and Σ is the covariance matrix.

The **covariance** measures the linear association between two variables. It measures whether they on average move in the same direction (positive covariance), in opposite directions (negative covariance) or have no association (zero covariance). The covariance matrix is estimated as follows:

$$\sigma_{ij} = cov\left(r^i r^j\right) = \frac{\sum_{i=1}^{m} (r_t^i - \mu_i)\left(r_t^j - \mu_j\right)}{m} \quad (4)$$

Where

r^i is the values of variable r^i
μ_i is the mean of variable r^i
r^j is the values of variable r^j
μ_j is the mean of variable r^j
m is the number of data points

$$\Omega_{(m+n)} = \begin{bmatrix} \sigma_1^2 & \sigma_{1,2} & . & . & \sigma_{1,n} \\ \sigma_{2,1} & \sigma_2^2 & . & . & \sigma_{1,n} \\ \sigma_{2,1} & \sigma_2^2 & . & . & \sigma_{1,n} \\ . & . & . & . & . \\ . & . & . & . & . \\ \sigma_{m.1} & \sigma_m^2 & . & . & \sigma_m^2 \end{bmatrix} \quad (5)$$

The initial model of Markowitz (1952) proposes that the investor maximizes the portfolio expected return and minimizes the portfolio variance concurrently (equation 6 and 7). The Markowitz quadratic optimization for the case where short selling is excluded is solved as follows:

$$\max \mu_p = \sum_{i=1}^{n} \omega_i \mu_i \quad (6)$$

$$\min \sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} \omega_i \sigma_{ij} \omega_j \quad (7)$$

$$\max \lambda \ [\sum_{i=1}^{n} w_i u_i] - (1-\lambda)\left[\sum_{i=1}^{n} \sum_{j=1}^{n} \omega_i \sigma_{ij} \omega_j\right] \quad (8)$$

$$s.t. \sum_{i=}^{n} \omega_i = 1 \qquad \omega_i \geq 0$$

$\lambda \epsilon [0, 1]$ conveys investors' risk aversion – the extent to which an investor is willing to take risk to increase returns or sacrifice returns for a low level of risk. The case with λ = 1 represents maximizing the portfolio mean return without paying attention to the variance and the optimal solution will be formed only by the asset with the greatest expected return. However, the case with λ = 0 represents minimizing the total variance associated to the portfolio regardless of the mean returns and the optimal solution will apparently include several assets. Any value of λ inside the interval (0,1) represents a trade-off between mean return and variance. In equation 8, Markowitz excludes short selling by restricting the portfolio weights to be greater than zero ($\omega_i \geq 0$). In equation 9 below, this constraint is removed, and the portfolio weights can be negative, but the total must still sum to 1.

For the case of short selling, the optimization problem is:

$$\min (1-\lambda) \sum_{i=1}^{n} \sum_{j=1}^{n} \omega_i \sigma_{ij} \omega_j \lambda [\sum_{i}^{n} \omega_i \mu_i] \quad (9)$$

$$s.t. \sum_{i=}^{n} \omega_i = 1$$

In explaining the advantage of short selling in an efficient portfolio, Levy and Ritov (2001) note that if no short selling is allowed, as more assets are added to the portfolio, their weights will typically be zero. The study found that at some stage the Sharpe ratio does not improve as more assets are added to the portfolio. However, when short selling is permitted, the efficient frontier can be extended by considering combinations of the new asset with others within the portfolio. Thus, for a given risk-free rate, the new asset potentially has the same probability of being positively or negatively weighted. Hence as the number of assets within the portfolio increases, about have of them are likely to be held short.

3.3.2 BL model return derivation

In deriving the BL model, the approach by Kooli & Selam (2008) is followed. The BL is useful due to the implied returns resulting from the following relationship:

$$\prod = \lambda \Sigma \, \omega_{mkt} \tag{10}$$

Where ∏ is the implied excess equilibrium returns (*N* x 1 column vector), ω_{mkt} is the market capitalization weight of the assets (N x 1 column vector) in the portfolio, λ is the risk aversion coefficient (1 x 1) corresponding to the market risk premium on the variance and Σ is the covariance matrix of returns (*N* x *N* matrix).

The main aim is to find expected returns by combining market equilibrium and investor views. In this paper, relative views are given. Equities will outperform bonds by 5% per annum; bonds will outperform cash by 3% and impact investment funds will outperform bonds by 3% per annum. These views will be incorporated in the optimization process. The BL model will allocate higher weights to these assets in the respective portfolios. To incorporate these views into model, the following relationship is assumed:

$$Q + \varepsilon = \begin{bmatrix} Q_1 \\ . \\ Q_k \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ . \\ \varepsilon_k \end{bmatrix} \tag{11}$$

Where Q is the view vector (K x 1 column vector), K is the number of views and ε is the error term vector indicating the uncertainty associated with these opinions with a mean of 0 and covariance matrix Ω. Instead of using the error term vector, the variance of each error term is used. These variances form Ω, a diagonal covariance matrix. The off-diagonal elements of Ω are equal to zero since the views are independent of each other. The higher the investor's confidence regarding the views expressed, the more they assign importance to their views and the lower the variance (ω_K).

$$\Omega = \begin{bmatrix} \omega_1 & 0 & 0 \\ 0 & . & 0 \\ 0 & 0 & \omega_K \end{bmatrix} \tag{12}$$

Matrix **P** represents the assets considered by investors in their forecasts. The rows in this matrix correspond to the managers' views, while the columns are the number of assets in the portfolio. This is the link matrix. In general:

$$\mathbf{P} = \begin{bmatrix} p_{1,1} & \cdot & p_{1,N} \\ \cdot & \cdot & \cdot \\ p_{K,1} & \cdot & p_{K,N} \end{bmatrix} \tag{13}$$

Per view, assigned a value of 1 to the asset that is expected to perform better and -1 to the asset that is expected to underperform, zero for every other asset. The sum of the row must be zero. The views are expressed by:

$$\mathrm{P.E}[r] = Q + \varepsilon \tag{14}$$

$\mathrm{E}[R]$ are the expected returns that cannot be observed. These will be incorporated both with the various investors' views and the equilibrium relations ∏, taken from the initial market capitalization. $\mathrm{P.E}[R]$ is assumed to be normally distributed, with mean Q and variance Ω (covariance matrix).

$$\mathrm{P.E}[r] \sim N(Q, \Omega) \tag{15}$$

To calculate excess returns using the BL model, the following equation is used:

$$E(r) - r_f = A[(\tau\Sigma)^{-1} + P^T\Omega^{-1}P]^{-1}[(\tau\Sigma)^{-1}\prod + P^T\Omega^{-1}Q] \tag{16}$$

where

A is the price of risk
τ is the scalar, which depends on the investors' confidence in the market
Σ is variance covariance matrix
∏ is the implicit return vector
P is the link matrix
Q is the view matrix
Ω is uncertainty of views matrix, $\Omega = \tau PSP^T$

$E(r)$ is the new return vector according to the Black–Litterman approach (N x 1 column vector). Based on the new returns vector, the portfolio is finally optimized, and an efficient frontier is constructed.

To calculate portfolio weights, the Z-score for each asset is calculated. We then sum the Z-scores. The Z-score for each asset relative to the sum of Z-scores, gives the portfolio weight per asset.

$$Z = \frac{x - \mu}{\sigma} \tag{17}$$

where

x is the raw score
μ is the population mean
σ is the population standard deviation

3.3.3 CAPM derivation

The CAPM is a market equilibrium model, which is as an extension of the mean-variance framework (Danthine & Donaldson 2005). It models the theoretical expected return of an asset as a function of its covariance with the market portfolio and the overall variance and expected return of this portfolio (Hirani & Wallström 2014). The model assumes there is a linear relationship between risk and return. Its algebraic expression is as follows:

$$E(R_i) - R_f \; = \; R_f + \; \beta_i \, E\big(R_m - \; R_f\big) \tag{18}$$

$where$

$E(R_i) - R_f$ is the expected excess return on the *ith* asset
R_f is the risk-free interest rate
$E(R_m - \; R_f)$ is the expected excess return on the market portfolio
$\beta_i \; = \; \frac{Cov\,(R_i R_m)}{Var\,(R_m)}$ is the sensitivity of the expected return for the *ith* asset to the expected market return

The portfolio weights for the CAPM are calculated in the same way as for the BL model, using z-score. The model asserts that the higher the asset's covariance with the already diversified market portfolio, the higher the expected return will need to be for the asset to be included in the portfolio. This is because the asset's β with the market portfolio is the only risk that the investor cannot do away with by diversifying his portfolio (Hirani & Wallstrồm 2014).

3.4 Portfolio performance and valuation

The following **measures are used to compare portfolio performance** of impact investment funds and traditional assets:

- **Jensen's alpha** - a measure of out- or underperformance relative to the market derived from the simple CAPM.

  $$Jensen's\ alpha = \Big[R_p - \; \big[R_f + \; \beta_p * \big(R_m - \; R_f\big)\big]\Big] \tag{19}$$

  $where$
  R_p = Expected portfolio return
  R_f = Risk free rate
  β_p = Beta of the portfolio
  R_m = Expected market return

- **Sharpe ratio** - the average return earned in excess of the risk-free rate per unit of volatility or total risk.

  $$Sharpe\ ratio = \frac{R_p - R_f}{\sigma_p} \tag{20}$$

  $where$
  σ_p = standard deviation of portfolio excess returns

- **Treynor ratio** - the average return earned in excess of the risk-free rate per unit of systematic risk.

  $$Treynor\ ratio = \frac{R_p - R_f}{\beta} \tag{21}$$

To measure **risk**; the variance, standard deviation and CAPM betas will be used.

- **Variance** is defined as the sum of the squared distances of each term in the distribution from the mean (μ), divided by the number of terms in the distribution (N).

$$\sigma^2 = \frac{\sum(x-\mu)^2}{N} \tag{22}$$

- **Standard deviation** is a measure of how spread-out observations are. It is the square root of the variance.

$$\sigma = \sqrt{\sigma^2} \tag{23}$$

- **CAPM beta** is a measure of the volatility, or systematic risk, of a security or portfolio in comparison to the market.

$$Beta = \frac{Covariance\ R_p R_m}{Variance R_m} \tag{24}$$

4. Empirical analysis

4.1 Data

In this study, we analyze impact investment funds' return on equity data from twelve countries, six in developed markets (US, UK, Canada, France, Germany and Australia) and six from emerging markets (Brazil, South Korea, Poland, Turkey, China and South Africa). These countries were chosen because they are dominant players in the impact investing space in their regions. According to the 2018 GIIN Annual Impact Investing Survey; US and Canada accounted for 20% of AUM, Asia -18%, Sub Saharan Africa (70% SA) – 12% and Western Europe (France, Germany and UK) -11%. The sample needed to be representative of the global AUM.

Australia	8	Brazil	12
Canada	15	China	33
France	52	Poland	5
Germany	20	South Africa	7
UK	75	South Korea	21
US	15	Turkey	6

Table 1: Number of funds per country

The annual returns data was obtained from S&P Capital IQ for the period 2004 to 2019 (16 observations). Most developed countries had a complete dataset for the period under review while some emerging markets countries had between 12-14 observations. Table 1 above shows the number of funds per country. Developed countries generally have a high number of funds as they have been operating in the space for longer while in emerging markets, China and South Korea have most funds. In total, there are 269 funds.

To compare the performance of impact investment funds and to assess the effects of their inclusion in a portfolio consisting of traditional asset classes, we use the equity index, government bond (10 year) and money market (3- or 6-months instruments) returns data for each country. This data is sourced from Bloomberg, Factset and S&P Capital IQ.

The MSCI World Index is used as a market benchmark and the market portfolio because it is representative of the global equity market. It consists of stocks in the US, Europe, Emerging Markets, Canada and Asia. The index includes large and medium sized stocks.

In figure 2 and 3 below, we show the descriptive statistics for each country, covering impact investment funds, equities, bonds, cash and the MSCI World Index. The descriptive statistics include the returns' mean, standard error, median, standard deviation, variance, kurtosis, skewness, range, minimum and maximum values.

Figure 2: Descriptive statistics of developed economies

a) Australia

	Impact	Equities	Bonds	MSCI WI
Mean	-3,0	6,0	4,0	8,7
Standard Error	2,7	4,4	0,4	3,2
Median	-3,1	9,2	3,8	11,9
Standard Deviation	10,6	17,4	1,5	12,9
Sample Variance	112,5	303,9	2,3	166,2
Kurtosis	0,0	2,5	-1,3	1,1
Skewness	0,1	-1,3	0,0	-1,3
Range	40,1	72,1	5,0	45,6
Minimum	-21,7	-41,3	1,4	-21,7
Maximum	18,4	30,8	6,3	23,9

b) Canada

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	-5,8	5,8	2,7	1,6	8,7
Standard Error	4,6	4,0	0,3	0,3	3,2
Median	0,5	8,5	2,4	1,0	11,9
Standard Deviation	18,3	16,1	1,0	1,2	12,9
Sample Variance	334,7	260,8	1,0	1,5	166,2
Kurtosis	-0,9	1,5	-1,5	0,1	1,1
Skewness	-0,6	-1,1	0,4	1,2	-1,3
Range	57,4	65,7	2,9	3,7	45,6
Minimum	-42,1	-35,0	1,5	0,3	-21,7
Maximum	15,3	30,7	4,3	4,1	23,9

c) France

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	31,8	4,9	2,3	0,7	8,7
Standard Error	2,8	5,1	0,4	0,4	3,2
Median	31,7	6,8	2,8	0,1	11,9
Standard Deviation	10,7	19,0	1,5	1,6	12,9
Sample Variance	114,0	362,6	2,1	2,5	166,2
Kurtosis	3,9	2,3	-1,7	-0,3	1,1
Skewness	0,2	-1,4	-0,2	1,0	-1,3
Range	51,5	68,8	4,3	4,8	45,6
Minimum	6,5	-44,2	0,1	-0,9	-21,7
Maximum	58,1	24,7	4,5	3,9	23,9

d) Germany

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	14,6	9,8	2,0	0,6	8,7
Standard Error	3,5	4,9	0,4	0,4	3,2
Median	15,6	14,4	1,8	0,0	11,9
Standard Deviation	13,8	19,4	1,5	1,6	12,9
Sample Variance	191,1	377,0	2,4	2,4	166,2
Kurtosis	0,0	1,7	-1,6	0,0	1,1
Skewness	0,3	-1,4	0,1	1,1	-1,3
Range	50,2	69,4	4,5	4,7	45,6
Minimum	-6,7	-40,4	-0,2	-1,0	-21,7
Maximum	43,6	29,1	4,3	3,7	23,9

e) United Kingdom

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	27,8	4,1	2,7	1,6	8,7
Standard Error	5,4	3,3	0,3	0,5	3,2
Median	33,6	7,8	2,5	0,5	11,9
Standard Deviation	20,1	13,2	1,4	2,0	12,9
Sample Variance	405,5	174,1	1,9	4,1	166,2
Kurtosis	9,9	2,3	-1,6	-0,4	1,1
Skewness	-2,9	-1,3	0,1	1,2	-1,3
Range	86,3	53,4	4,0	5,3	45,6
Minimum	-37,5	-31,3	0,7	0,0	-21,7
Maximum	48,9	22,1	4,7	5,3	23,9

f) United States of America

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	5,1	8,1	3,0	1,3	8,7
Standard Error	3,3	4,0	0,2	0,4	3,2
Median	7,2	10,2	2,6	0,3	11,9
Standard Deviation	13,2	16,1	1,0	1,6	12,9
Sample Variance	173,4	260,0	1,0	2,6	166,2
Kurtosis	1,3	4,0	-1,3	0,1	1,1
Skewness	-0,4	-1,5	0,5	1,1	-1,3
Range	54,6	68,1	2,9	4,9	45,6
Minimum	-22,3	-38,5	1,8	0,0	-21,7
Maximum	32,3	29,6	4,7	4,9	23,9

Figure 2 shows descriptive statistics for developed economies. Average impact investing returns in Australia and Canada are negative for the period 2004-2019 while US impact investing returns averaged 5.1%. These were below the MSCI World Index average of 8.7%. Impact investing in Europe appears to be thriving, with average returns for France, Germany and UK outperforming the MSCI World Index significantly. This observation is in line with study of Vivian (2015).

In Australia and Canada, impact investment funds underperformed traditional asset classes. This contrasts with France, Germany and UK where the funds outperformed traditional asset classes. The overall returns for impact investing funds have increased in the past five years. The outperformance in European funds reflects an improvement in the management of the funds, increased fund manager experience and knowledge of the most efficient ways to deploy capital. This is also seen by a rapid rise in the number of impact investment funds in Europe relative to other regions.

The returns of impact investment funds in developed economies are more volatile compared to those of the benchmark index, with Canada, Germany, UK and US recording larger standard deviations than the MSCI World Index. The volatility is also seen in the wider range of returns of impact funds compared to the MSCI World Index. Bonds and cash across the six developed economies have a smaller standard deviation relative to the standard deviation of impact funds. The standard deviation of local equities was within a similar range with those of impact investing funds.

Figure 3: Descriptive statistics of emerging market economies

a) Brazil

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	13,9	14,7	11,7	9,5	8,7
Standard Error	5,1	7,5	0,6	1,0	3,2
Median	12,0	16,4	12,3	10,4	11,9
Standard Deviation	19,2	29,9	2,3	3,3	12,9
Sample Variance	369,3	895,9	5,5	10,9	166,2
Kurtosis	-0,6	0,7	1,1	-0,8	1,1
Skewness	0,3	0,3	-0,2	0,0	-1,3
Range	64,2	123,9	9,7	10,5	45,6
Minimum	-12,8	-41,2	6,8	4,3	-21,7
Maximum	51,5	82,7	16,5	14,9	23,9

b) China

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	8,3	14,4	3,6	3,0	8,7
Standard Error	1,1	12,7	0,2	0,2	3,2
Median	8,1	-1,8	3,6	2,9	11,9
Standard Deviation	3,0	50,6	0,6	0,8	12,9
Sample Variance	9,1	2562,2	0,3	0,6	166,2
Kurtosis	-0,5	0,6	-0,2	0,5	1,1
Skewness	0,1	1,0	0,2	-0,5	-1,3
Range	8,9	194,1	2,1	2,8	45,6
Minimum	4,0	-65,4	2,6	1,4	-21,7
Maximum	12,9	128,7	4,6	4,1	23,9

c) Poland

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	4,9	4,6	4,4	2,0	8,7
Standard Error	4,2	5,7	0,4	0,4	3,2
Median	6,0	5,0	4,7	1,5	11,9
Standard Deviation	16,2	22,9	1,4	1,1	12,9
Sample Variance	263,4	525,7	2,0	1,3	166,2
Kurtosis	-0,5	0,2	-1,6	1,7	1,1
Skewness	-0,2	-0,7	-0,2	1,4	-1,3
Range	55,8	83,9	4,1	3,6	45,6
Minimum	-26,0	-48,2	2,1	0,8	-21,7
Maximum	29,8	35,7	6,3	4,4	23,9

d) South Africa

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	14,4	12,3	8,3	6,4	8,7
Standard Error	2,8	4,4	0,2	0,3	3,2
Median	12,0	15,3	8,2	6,7	11,9
Standard Deviation	11,1	17,7	0,8	0,9	12,9
Sample Variance	124,1	314,3	0,6	0,8	166,2
Kurtosis	5,4	0,3	-0,6	-1,1	1,1
Skewness	2,0	-0,3	0,0	-0,8	-1,3
Range	47,0	69,7	2,9	2,2	45,6
Minimum	1,4	-25,9	6,8	5,1	-21,7
Maximum	48,4	43,8	9,7	7,4	23,9

e) South Korea

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	5,4	9,0	3,6	2,6	8,7
Standard Error	3,4	5,9	0,3	0,3	3,2
Median	3,7	5,8	3,7	2,7	11,9
Standard Deviation	12,4	23,8	1,4	1,1	12,9
Sample Variance	153,7	564,6	1,9	1,1	166,2
Kurtosis	5,3	0,7	-1,4	0,8	1,1
Skewness	1,9	0,1	0,1	0,8	-1,3
Range	51,2	94,7	4,0	4,0	45,6
Minimum	-10,9	-40,7	1,7	1,3	-21,7
Maximum	40,3	54,0	5,7	5,2	23,9

f) Turkey

	Impact	Equities	Bonds	Cash	MSCI WI
Mean	15,3	18,1	11,4	11,2	8,7
Standard Error	2,1	9,5	0,9	1,4	3,2
Median	16,5	25,2	10,5	10,6	11,9
Standard Deviation	7,9	38,1	3,4	4,2	12,9
Sample Variance	62,2	1449,3	11,7	18,0	166,2
Kurtosis	-1,4	-0,2	-0,4	3,9	1,1
Skewness	0,2	0,1	0,7	1,7	-1,3
Range	23,6	148,3	10,7	15,0	45,6
Minimum	4,5	-51,6	6,6	6,1	-21,7
Maximum	28,1	96,6	17,3	21,1	23,9

In figure 3, the descriptive statistics of emerging market economies are shown. The average impact investing returns of Brazil, South Africa and Turkey outperformed the 8.7% average return of the MSCI World Index whilst the returns of China, Poland and South Korea fell short of the return reported by the MSCI benchmark. Interestingly, impact investing funds in emerging markets appear less volatile than the MSCI World index, as the standard deviation of China, South Africa, South Korea and Turkey was smaller than that of the MSCI index.

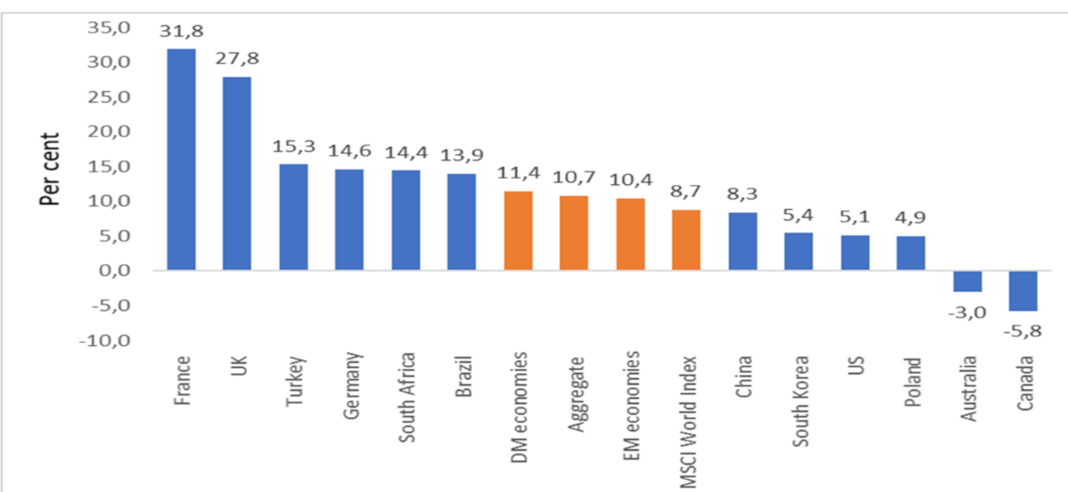
Comparing the returns of impact funds versus traditional asset classes, the results are mixed. Returns of impact funds across the six economies analyzed were mostly higher than the average returns for bonds and cash but lower than the returns of local equities. Equities in Brazil, China, South Korea and Turkey outperformed impact investment funds in their respective countries.

Just as in developed economies, the standard deviation of impact funds was larger than the standard deviation of bonds and money market instruments, indicating greater risk inherent in impact investing as an asset class. However, impact investment funds in the six emerging market economies, are less volatile than their respective equity markets – lower standard deviation of impact funds compared to that of equity markets. The range of returns of impact investing funds is wider than that of the MSCI benchmark.

4.1.1 Return characteristics of impact investment funds

In this section, the returns profile of impact investment funds is analyzed. Impact investing funds from the twelve economies reported an average return of 10.7% over the period 2004-2019, higher than the average return of the MSCI World Index (8.7%). Impact funds in developed economies recorded an average return of 11.4% while funds in emerging market economies had average returns of 10.4%. This is evidence that impact investment funds can deliver returns in line and/or above returns of traditional asset classes. Impact investing funds in France and the UK reported a stellar performance of 31.8% and 27.8%, respectively over the period 2004-2019 while returns of impact funds in Australia and Canada contracted by 3% and 5.8%, respectively. Amongst emerging market economies, Turkey delivered the highest returns (15.3%), followed by South Africa (14.4%). Poland was the laggard, reporting average returns of 4.9%. See figure 4 below.

Figure 4: Average annual returns: 2004-2019



4.2 Results

4.2.1 Correlation – diversification effects

This section explores the correlation of impact investment funds with the MSCI benchmark index as well as conventional asset classes. Table 2 depicts the correlation matrix of assets in developed economies. Impact funds in Canada, France and Germany have low or negative correlation with the MSCI World Index. This bodes well for diversification purposes. In contrast, there is a moderate correlation between impact funds of Australia, UK and US, and the MSCI benchmark.

From table 2, we also observe low or negative correlation between impact funds and traditional asset classes. This indicates that there could be positive portfolio benefits to including impact investment funds in a portfolio with traditional assets. In Australia, there is a negative correlation between impact funds and equities and bonds, Germany exhibits a negative correlation between its impact funds and bonds and the money market, respectively. A similar correlation is observed for impact investments in the UK. Canada, France and US show low/weak positive correlation between their impact investment funds and conventional asset classes.

	Australia	**Canada**	**France**	**Germany**	**UK**	**US**
	Impact	Impact	Impact	Impact	Impact	Impact
Impact	1,00	1,00	1,00	1,00	1,00	1,00
Equities	-0,21	0,37	0,14	0,39	-0,22	0,25
Bonds	-0,15	0,23	0,33	-0,10	-0,38	-0,18
Cash	n/a	0,21	0,35	-0,03	0,09	0,15
MSCI World Index	0,46	-0,17	0,09	0,04	0,64	0,45

Table 2: Correlation of impact funds with traditional assets classes - Developed economies

In table 3 below, the correlation matrix of emerging market economies' returns is shown. Impact investment funds in Brazil, China, Poland and Turkey have a negative or low positive correlation with the MSCI World Index. This bodes well for diversification of the portfolio. A low positive correlation is also observed between the MSCI benchmark and impact investment funds of South Africa and South Korea.

	Brazil	**China**	**Poland**	**SA**	**South Korea**	**Turkey**
	Impact	Impact	Impact	Impact	Impact	Impact
Impact	1,00	1,00	1,00	1,00	1,00	1,00
Equities	0,30	0,09	-0,22	-0,08	-0,08	-0,32
Bonds	-0,44	0,07	0,06	0,30	-0,37	-0,28
Cash	-0,38	0,14	-0,53	0,35	-0,18	-0,28
MSCI World Index	0,25	-0,08	-0,04	0,35	0,43	0,05

Table 3: Correlation of impact funds with traditional assets classes – emerging markets economies

A look at correlation between impact investment funds and country specific conventional assets shows that South Korea, Turkey and Poland impact funds are negatively correlated to equity, bond and money markets. China's impact funds have weak positive correlation with all three traditional asset classes. In Brazil, impact investment funds are negatively correlated to bond and money markets and there's low positive correlation with the equity market. Given the negative and/or relatively low correlation, the inclusion of impact funds in a portfolio with conventional assets is likely to deliver better portfolio returns and lower portfolio volatility.

South Africa's correlation results stand out in that its impact investment funds showed slightly higher correlation relative to the results of the other five countries - bonds (30%) and cash (35%). However, correlation between impact funds and the equity market in SA is negative (-0,08%).

4.2.2 Portfolio effects of impact investment funds in a portfolio with traditional assets

In this section, the output of the MVO, CAPM and BL models are shown, specifically the expected portfolio performance and risk measures. The left panel shows the portfolio that consists of impact investment funds combined with traditional assets while the right panel shows a portfolio of traditional assets only. This allows us to see the effect of including impact investment funds in the portfolio. For each model, two scenarios are shown – where short selling is permitted (unrestricted weights) and where no short selling is permitted. The results of each country are reported below.

Appendix 1 shows the portfolio allocation weights for each country, for the scenarios where short selling is permitted and where it is not permitted. All three models made a higher allocation to bonds compared to the other asset classes. A notable allocation to impact investment funds is observed in the portfolios of France, Germany, UK, US, China, SA and Turkey. Below we will see how this allocation to impact investment funds affects overall portfolio performance. In Appendix 2 we show the complete models and calculations of MVO, CAPM and BL for the United Kingdom as an example. The same process was undertaken for each of the twelve countries. The excel file containing the models for all countries is available upon request.

4.2.2.1 Expected portfolio returns

Figure 5 depicts the expected portfolio returns for the twelve countries in our study.

Australia

Excess portfolio returns for the portfolio with impact funds are similar under both scenarios where short selling and no shorting is allowed for each model. The MVO generates the highest excess return of 2.5% and 2.4%, for short selling and no-short selling respectively. The CAPM and BL models generates returns of 1.6% and 0.8%, respectively. Excess returns for the conventional portfolio are in similar range compared to the portfolio which includes impact funds for the MVO and CAPM. However, the BL model for the traditional portfolio delivers a portfolio excess return of 1.0%, marginally higher than 0.8% for BL model inclusive of impact investment funds.

Canada

Comparison between models under portfolio with impact investments: The BL model under the portfolio that includes impact investment funds outperforms the CAPM and MVO when short selling is permitted. However, the CAPM performs better than the other two models when short selling is not allowed.

Comparison between portfolios: A comparison of the two portfolios shows that the portfolio which includes impact investment funds outperforms the traditional asset portfolio under the MVO and BL when short selling is not permitted. Excess portfolio returns of the BL model are higher for the portfolio with impact funds compared to the portfolio with only conventional assets when short selling is permitted. This is an indication that including impact investment funds in a portfolio can boost overall portfolio performance. The CAPM delivers excess returns of 1.6% for both portfolios, whether short selling is allowed or not.

France

Performance between models in the portfolio inclusive of impact investments: The MVO reported much higher excess returns of 8.5% where short selling is allowed and 14.3% where no short selling is allowed, outperforming both the CAPM and BL models.

Comparing the two portfolios: The portfolio which includes impact investment funds outperformed the portfolio of traditional assets for all three models whether short selling is permitted or not. Impact investments in France have delivered solid returns over the last decade and their inclusion in investment portfolios will result in a significant difference in portfolio performance. Excess returns of this portfolio are much high than the returns of the conventional portfolio.

Germany

Comparison between models under the portfolio with impact investments: Looking at excess returns, the MVO model, which allocated a noticeable weight to impact funds, delivered higher returns compared to both the CAPM and BL model.

Comparison between portfolios: When we compare the traditional portfolio to the portfolio with impact investment funds, the latter outperforms the former when using the MVO and BL models, while the excess returns delivered by the CAPM are similar for the two portfolios. The outcomes of the MVO and BL models show that including impact funds in a portfolio does add value to the portfolio. This also means that fund managers can generate even higher returns if they allocate a bigger share of capital to impact investments.

United Kingdom

Comparing models under the portfolio that includes impact funds: The CAPM model delivers higher performance when short selling is permitted. *Comparison between the two portfolios:* When we compare the conventional portfolio of assets with the portfolio that includes impact investment funds, the latter portfolio outperforms the former for all three models – higher excess returns.

United States

Comparing performance of three models for portfolio that includes impact funds: All three models generate excess returns ranging between 1.2% and 1.7% whether short selling is allowed or not. The BL model is an exception, with excess return of 0.6% when short selling is not allowed. *Comparing portfolio of traditional assets to portfolio with impact funds:* For the US, the two portfolios perform similarly in terms of excess returns.

Figure 5: Expected portfolio returns

Portfolio with impact investment funds						
Expected portfolio returns						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	2,5	1,6	0,8	2,4	1,6	0,8
Canada	1,0	1,6	2,0	1,0	1,6	0,7
France	8,5	1,6	2,1	14,3	3,9	0,8
Germany	2,2	1,6	2,7	4,8	1,6	1,0
United Kingdom	2,7	3,8	1,1	3,7	3,5	0,4
United States	1,2	1,7	1,5	1,4	1,7	0,6
Emerging countries						
Brazil	15,6	2,0	2,8	9,5	2,0	4,7
China	12,0	2,1	12,2	10,1	2,1	13,5
Poland	3,3	1,6	1,6	2,4	1,6	1,1
South Africa	6,0	1,5	40,7	6,7	1,6	0,8
South Korea	3,5	1,7	4,1	1,6	1,7	1,2
Turkey	11,1	3,0	2,5	10,3	3,0	2,4

Portfolio of traditional assets						
Expected portfolio returns						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	2,3	1,6	1,0	2,4	1,6	1,0
Canada	1,0	1,6	1,8	1,1	1,6	0,2
France	0,9	0,3	2,0	0,7	0,0	0,6
Germany	1,5	1,6	2,6	3,9	1,6	0,6
United Kingdom	1,1	1,6	1,0	1,1	1,6	0,6
United States	1,2	1,7	1,2	1,4	1,7	1,5
Emerging countries						
Brazil	16,0	1,9	2,4	9,5	1,4	7,1
China	11,9	1,5	11,9	1,9	1,4	0,0
Poland	3,2	1,6	1,5	2,4	1,6	0,6
South Africa	14,8	1,6	25,4	5,9	1,6	0,3
South Korea	3,2	1,6	3,4	1,6	1,6	0,5
Turkey	10,1	5,3	2,7	9,8	2,9	2,6

Brazil

Comparing performance of three models for portfolio that includes impact funds: The MVO model outperforms both the CAPM and BL as it reported higher excess returns. Short selling works best for the Brazilian portfolio.

Comparing portfolio of traditional assets to the portfolio with impact funds: The performance delivered by the models are mixed. The CAPM within the portfolio which includes impact funds outperforms the CAPM under the portfolio of traditional assets. The MVO models delivered similar performance for both portfolios. The BL model in the portfolio with impact funds underperformed the BL in the portfolio of conventional assets when no short selling is allowed.

China

The performance of the portfolio with impact funds outperforms the portfolio of traditional assets for all three models and for both short selling and no short selling. Again, proving that there is merit to including impact investments in the portfolio to improve overall portfolio performance. *Comparing models under the portfolio which includes impact funds:* Both the MVO and BL models generate excess returns that are greater than 10%.

Poland

Comparing portfolio of traditional assets to the portfolio with impact funds: The performance of both portfolios is in a similar range for all three models when observing the reported excess returns. Interestingly, the BL model which allocated 6% to impact investment delivered a return of 1.1% compared to 0.6% of the BL model for the portfolio of conventional assets. Thus, we can conclude that since the other models did not make an allocation towards impact investments, there was no difference in performance of the two portfolios. However, the model that gave some weight to impact investment reported a slightly better performance.

South Africa

Comparing performance of models for portfolio consisting of impact funds: In the scenario where short selling is allowed, the BL model outperforms the MVO and CAPM, with an excess return of 40.7%.

Comparing portfolio of traditional assets to portfolio with impact funds: Since the BL model is the only model that had a noticeable allocation for impact investments, the portfolio with impact funds outperforms the portfolio of traditional assets for the BL model. As mentioned above, South Africa's impact funds were moderately positively correlated with the local bond and money markets. This could be the reason why there is not much improvement in portfolio performance when impact investments are added to the portfolio with traditional assets.

South Korea

In the case of South Korea, the portfolio with impact investment funds delivers better performance than the portfolio of traditional assets for all three models whether short selling is allowed or not. The BL model which made a higher allocation to impact funds, delivered the highest excess return of 4.1% in the scenario where short selling is permitted. Once again, the inclusion of impact investments in a portfolio generates higher performance.

Turkey

Comparison of models under the portfolio that includes impact funds: The MVO model comes out as the star performer, generating excess return of 11.1% and 10.3% for the two scenarios of short selling and no short selling.

Comparing portfolio of traditional assets to portfolio with impact funds: The portfolio which includes impact investments performs better than the portfolio of traditional assets when using the MVO model. However, the former performs better than the latter when using the CAPM and BL models.

4.2.2.2 Portfolio standard deviation

Figure 6 below reports the portfolio standard deviation of the twelve country under study.

Australia: Under both portfolios (one including impact investment and one excluding), the three respective models report similar standard deviations. For both portfolios, the CAPM has the lowest standard deviation (implying low risk) while the BL model has the highest (implying the high risk). For the case of Australia, including impact investment funds in the portfolio does not necessarily reduce the risk of the overall portfolio. See figure 6.

Canada: The standard deviations reported by the three models under the portfolio of traditional assets are lower compared to the standard deviations of the models in the portfolio which includes impact investment funds. This means that adding impact funds in the portfolio increases its risk. For Canada, allocating capital using the MVO model would be best since it generates the lowest standard deviation.

France: when short selling is not permitted, the portfolio of conventional assets reports lower standard deviations for all three models compared to the portfolio with impact investment funds. When short selling is permitted, the MVO and BL models record lower standard deviations for the portfolio of traditional assets. Thus, for France we can conclude that including impact investment funds in a portfolio increases its risk. The higher excess returns reported above for France compensate for the higher risk.

Germany: The MVO and CAPM models for the portfolio with impact investment funds have lower standard deviations compared to the portfolio of conventional assets. This indicates that including impact investments in the portfolio not only generates higher excess returns, but also lowers the risk of the overall portfolio. However, the BL model of the portfolio inclusive of impact funds has a higher standard deviation compared to the traditional portfolio for both cases where short selling is permitted and when it is not permitted.

UK: Generally, the portfolio with impact funds also exhibits less volatility compared to the portfolio of traditional assets for the MVO and CAPM models as reported by the standard deviation. The results of the BL model are mixed for the two portfolios, depending on whether short selling is allowed or not.

US: The MVO and the CAPM report similar standard deviations for the two portfolios (one including impact funds and the other excluding impact funds). This is consistent with the results above, where excess returns for the two portfolios were similar. The BL model results are mixed depending on whether short selling is permitted or not. When short selling is allowed, the portfolio with impact funds is riskier compared to the portfolio of traditional assets, and vice versa when short selling is not permitted.

Figure 6: Portfolio standard deviation

Portfolio with impact investment funds						
Portfolio standard deviation						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	1,5	1,4	4,2	1,5	1,4	4,3
Canada	0,9	0,9	6,6	1,0	1,0	3,7
France	2,8	1,3	6,8	4,8	10,3	3,8
Germany	1,7	1,4	7,5	4,5	1,4	4,4
United Kingdom	0,6	1,3	4,9	0,9	1,5	3,3
United States	0,8	0,9	5,7	1,0	0,9	4,0
Emerging countries						
Brazil	0,3	0,3	7,8	1,8	2,2	18,5
China	0,5	0,5	16,3	0,6	0,6	29,8
Poland	1,6	0,9	5,8	1,2	0,9	4,5
South Africa	0,9	0,6	29,9	0,8	0,7	1,6
South Korea	1,7	0,9	9,5	0,9	1,0	4,3
Turkey	2,0	2,9	7,4	2,4	2,0	7,2

Portfolio of traditional assets						
Portfolio standard deviation						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	1,4	1,4	4,8	1,5	1,5	4,8
Canada	-0,8	0,9	6,3	-0,5	1,0	0,9
France	1,1	8,9	6,6	1,6	2,3	2,9
Germany	7,6	1,5	7,3	8,8	1,5	2,5
United Kingdom	1,2	1,3	4,6	1,3	1,3	4,4
United States	0,8	0,9	5,2	1,0	1,0	9,4
Emerging countries						
Brazil	0,5	0,5	7,3	4,2	2,2	29,0
China	0,5	0,5	16,1	0,6	0,6	0,6
Poland	1,5	0,9	5,8	1,2	1,0	2,5
South Africa	1,3	0,7	23,6	0,6	0,7	0,8
South Korea	1,9	1,0	8,7	0,9	1,0	1,7
Turkey	2,9	6,2	7,7	2,5	3,7	7,6

Brazil: The standard deviations of the portfolio with impact investment funds are lower for all the three models compared to the portfolio of traditional assets. This implies that adding impact investment funds to the portfolio reduces overall portfolio risk.

China: The standard deviations of the two portfolios are similar, indicating that there is no difference in portfolio risk whether impact investment funds are included in the portfolio or not. However, the standard deviation of the BL model for the portfolio with impact investment funds is much higher (29.8%) when no short selling is permitted relative to the portfolio of traditional assets (0.6%). The MVO model reports the lowest standard deviation for both portfolios and whether short selling is permitted or not, relative to the other two models. See figure 6 above.

Poland: Just as in the case of China, the standard deviations of both portfolios (one with impact funds and the other without) are in similar range for the MVO model and CAPM. In the case where no short selling is allowed, the BL standard deviation of the portfolio with impact investment funds is higher, implying a riskier portfolio compared to the portfolio of traditional assets.

South Africa: The standard deviations of the MVO and CAPMs are in similar range for both portfolios, indicating that the level of risk remains the same whether impact funds are added to the portfolio or not. The standard deviation of the BL model is higher for the portfolio with impact funds compared to that of the portfolio of conventional assets.

In the case of **South Korea**, similar findings are observed as in the case for South Africa.

Turkey: The standard deviations of all three models for the portfolio which includes impact investment funds are lower than for the portfolio of traditional assets. This indicates that there is value in adding impact funds to a portfolio of traditional assets as they lower overall portfolio risk for Turkey. See figure 6 above.

4.2.2.3: CAPM betas

Figure 7 below shows the portfolio betas for each country, for the portfolio that includes impact investment funds and the portfolio consisting only of conventional assets. Comparing the two portfolios, the betas are relatively low, hovering around 0%. This means that the respective portfolios are less volatile than the equity benchmark (MSCI World Index) and are thus less risky. However, SA's BL model results are an exception. Under the scenario where short selling is permitted, the portfolio which includes impact investment funds has a beta of 3.8% while the portfolio with only traditional assets has a beta of 2.0. This indicates that SA's portfolios are more volatile than the market. The portfolio with impact funds is more volatile than the portfolio of traditional assets.

Figure 7: Portfolio betas

Portfolio with impact investment funds						
Portfolio beta						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	0,00	0,02	0,09	0,02	0,02	0,09
Canada	0,01	0,02	-0,15	0,01	0,02	0,06
France	0,01	0,01	-0,04	0,04	0,07	0,07
Germany	-0,01	0,02	-0,08	0,06	0,02	0,09
United Kingdom	0,06	0,06	0,08	0,11	0,08	0,13
United States	0,01	0,02	0,05	0,03	0,03	0,14
Emerging countries						
Brazil	0,05	0,05	0,14	-0,02	0,02	-0,17
China	0,02	0,04	1,07	0,00	0,04	-0,11
Poland	-0,01	0,01	0,05	0,00	0,01	0,09
South Africa	0,04	-0,04	3,77	0,00	-0,01	0,04
South Korea	0,00	0,02	0,00	0,01	0,00	0,00
Turkey	-0,03	0,14	-0,17	0,02	0,14	-0,04

Portfolio of traditional assets						
Portfolio beta						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	0,01	0,01	0,09	0,02	0,02	0,09
Canada	0,01	0,02	-0,12	0,02	0,02	0,02
France	-0,01	0,26	-0,05	0,01	0,05	0,05
Germany	-4,52	0,02	-0,07	0,20	0,02	0,05
United Kingdom	0,01	0,00	-0,07	0,02	0,01	0,07
United States	0,01	0,02	-0,02	0,03	0,02	0,24
Emerging countries						
Brazil	0,05	0,05	0,15	-0,03	-0,02	-0,34
China	0,00	0,00	0,70	0,03	-0,02	-0,02
Poland	-0,01	0,01	0,06	0,00	0,01	0,04
South Africa	0,06	-0,01	1,95	-0,02	-0,01	0,01
South Korea	-0,03	0,02	-0,17	0,01	0,02	0,00
Turkey	-0,05	0,39	-0,18	0,02	0,14	-0,05

4.2.2.4 Sharpe, Treynor and Jensen Alpha ratios

Figure 8 to 10 show the output of the Sharpe, Treynor and Jensen Alpha ratios. Below we interpret the results.

Australia: The *Sharpe ratios* generated by the CAPM and BL model are similar for the two portfolios, suggesting that in the case of Australia impact investments do not necessarily improve overall portfolio performance. However, MVO model produces a *Sharpe ratio* of 1.6 for the portfolio of traditional assets, which is higher the Sharpe ratio of 0.6 reported for the portfolio with impact investments (figure 8). Using the *Treynor ratios*, the portfolio of conventional assets outperforms the portfolio which includes impact investments. All three models reported higher Treynor ratios for the former portfolio relative to the latter (figure 9). We come to the same conclusion when the *Jensen Alpha ratios* are used (figure 10).

Canada: Just as in the case of Australia, the *Sharpe ratios* of the CAPM and BL model are the same for the two portfolios. The MVO model generated higher *Sharpe ratios* for the portfolio of conventional assets compared to those of the portfolio inclusive of impact funds. For the different models, the results of the *Treynor and Jensen Alpha* ratios are mixed: there are instances where the portfolio with impact funds performs better and there are cases where the portfolio of traditional assets outperforms. See figure 9 and 10. Comparing between models, the *Sharpe and Treynor ratios* of the CAPM are higher for the portfolio which includes impact investments.

France: The *Sharpe and Treynor ratios* of the MVO model and CAPM are higher for portfolio which includes impact investments compared to those of the portfolio of traditional assets. This indicates that for France, including impact investments in portfolio construction is likely to lead to better performance. The BL model results were the same for the two portfolios. Using the *Jensen Alpha ratios*, for all three models and under both cases where short selling is allowed and not allowed, the portfolio which includes impact investments outperforms the portfolio of conventional assets. The *Sharpe ratio, Treynor ratio and the Jensen Alpha ratio* of the MVO model is higher than those of the CAPM and BL model, indicating that the fund manager should use MVO for asset allocation.

Germany: The *Sharpe ratios* of the MVO model for the portfolio consisting of impact investment funds are higher than those of the portfolio of traditional assets, suggesting that impact funds in Germany improve overall portfolio performance. The *Sharpe ratios* reported by the CAPM and BL model for the two portfolios are the same. The *Treynor and Jensen Alpha ratios* also indicate that the portfolio which includes impact funds outperforms the portfolio of traditional assets. According to the *Sharpe and Treynor ratios*, the CAPM will generate better risk adjusted excess returns.

United Kingdom: The portfolio with impact investment funds performs better than the portfolio of traditional assets when using the *Sharpe and Jensen Alpha ratios* of the MVO model and CAPM. However, according to the BL model, there is no difference in performance between the two portfolios since the *Sharpe ratios* are same. Using the *Treynor ratio*, the portfolio which includes impact investments outperforms the portfolio of conventional assets for the MVO and BL models. Treynor ratios of the MVO and BL models are higher for the portfolio with impact investments compared to the portfolio of traditional assets. Overall, the three ratios indicate that adding impact investments in the portfolio leads to improved portfolio outcomes.

United States: Using the CAPM and BL model's *Sharpe ratios* show that the portfolio which includes impact funds delivers better performance than the portfolio of traditional assets while portfolio performance is the same under the MVO model. See figure 8 below. For the *Treynor ratios*, MVO and BL models show an outperformance by the portfolio with impact investments relative to the portfolio of traditional assets (figure 9). However, using the *Jensen Alpha ratio*, all three models favour the portfolio of traditional assets over the portfolio with impact investments (figure 10).

Figure 8: Portfolio Sharpe ratio

Portfolio with impact investment funds							Portfolio of traditional assets						
Sharpe ratio							**Sharpe ratio**						
	Unrestricted weights			No short selling weights				Unrestricted weights			No short selling weights		
Developed countries	MVO	CAPM	BL	MVO	CAPM	BL	**Developed countries**	MVO	CAPM	BL	MVO	CAPM	BL
Australia	0,6	1,2	0,2	0,5	1,1	0,2	Australia	1,6	1,1	0,2	1,6	1,1	0,2
Canada	-0,7	1,8	0,3	-0,7	1,7	0,2	Canada	0,8	1,8	0,3	1,0	1,7	0,2
France	2,5	1,2	0,3	2,6	0,4	0,2	France	-0,7	0,0	0,3	-0,6	0,0	0,2
Germany	0,4	1,1	0,4	0,7	1,1	0,2	Germany	0,0	1,1	0,4	0,3	1,1	0,2
United Kingdom	1,7	2,9	0,2	2,4	2,3	0,1	United Kingdom	-0,5	1,2	0,2	-0,4	1,2	0,1
United States	-0,5	1,9	0,3	-0,2	1,8	0,2	United States	-0,5	1,7	0,2	-0,2	1,7	0,2
Emerging countries							**Emerging countries**						
Brazil	61,0	7,8	0,4	4,3	0,9	0,3	Brazil	33,8	4,0	0,3	1,9	0,6	0,2
China	24,1	3,9	0,7	18,2	3,3	0,5	China	23,7	3,2	0,7	0,6	2,6	0,0
Poland	2,1	1,8	0,3	0,7	1,8	0,2	Poland	2,1	1,7	0,3	0,7	1,7	0,3
South Africa	7,0	2,3	1,4	8,9	2,2	0,5	South Africa	11,6	2,2	1,1	7,2	2,2	0,4
South Korea	2,1	1,8	0,4	0,0	1,7	0,3	South Korea	1,7	1,7	0,4	0,0	1,6	0,3
Turkey	5,6	1,0	0,3	3,6	1,5	0,3	Turkey	3,5	0,9	0,4	3,2	0,8	0,3

Figure 9: Portfolio Treynor ratios

Portfolio with impact investment funds							Portfolio of traditional assets						
Treynor ratio							**Treynor ratio**						
	Unrestricted weights			No short selling weights				Unrestricted weights			No short selling weights		
Developed countries	MVO	CAPM	BL	MVO	CAPM	BL	**Developed countries**	MVO	CAPM	BL	MVO	CAPM	BL
Australia	-189,3	82,1	9,0	39,6	69,7	9,6	Australia	173,8	123,7	11,9	144,4	100,3	11,9
Canada	-49,5	93,2	-13,2	-46,8	76,1	11,9	Canada	-68,8	96,3	-14,7	-26,4	76,1	10,2
France	560,3	265,9	-47,4	355,3	51,8	11,8	France	90,1	1,0	-39,7	-171,7	1,0	12,1
Germany	-92,3	93,9	-33,3	57,5	90,8	11,5	Germany	0,0	80,1	-35,3	11,2	80,1	11,6
United Kingdom	16,3	62,7	13,7	18,5	41,6	2,9	United Kingdom	-52,7	357,7	-13,6	-30,2	131,1	8,4
United States	-28,9	70,8	32,6	-7,6	54,4	4,6	United States	-30,9	99,1	-74,8	-8,2	77,2	6,1
Emerging countries							**Emerging countries**						
Brazil	284,8	36,4	19,4	-379,6	120,4	-28,2	Brazil	321,0	38,4	16,6	-308,2	-72,4	-20,9
China	769,8	51,8	11,3	-2251,5	57,9	-121,7	China	6285,4	-604,3	16,8	10,8	-82,3	-1,5
Poland	-238,5	165,5	31,8	-1317,3	144,8	11,6	Poland	-253,3	244,0	27,7	8407,4	165,1	18,0
South Africa	166,2	-41,9	10,8	-1869,1	-109,5	21,6	South Africa	228,9	-109,5	13,0	-252,0	-109,5	51,5
South Korea	5534,8	68,5	6411,2	2,1	2638,1	1840,6	South Korea	-96,0	90,1	-19,9	-0,1	92,9	154,5
Turkey	-420,2	20,9	-14,6	408,3	20,9	-57,1	Turkey	-192,3	13,8	-15,0	389,6	21,4	-48,8

Figure 10: Jensen Alpha ratios

Portfolio with impact investment funds						
Jensen alpha ratio						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	0,94	-0,14	-1,45	0,63	-0,16	-1,40
Canada	-0,67	-0,13	1,45	-0,77	-0,14	-1,34
France	6,78	-0,05	0,78	12,43	1,73	-1,31
Germany	0,64	-0,13	1,68	2,80	-0,16	-1,22
United Kingdom	0,60	1,74	-1,08	1,31	1,25	-2,18
United States	-0,49	-0,10	-0,46	-0,40	-0,16	-1,96
Emerging countries						
Brazil	13,61	-0,01	0,15	8,02	0,27	4,28
China	10,22	0,15	2,91	8,55	0,22	12,68
Poland	1,78	-0,07	-0,42	0,81	-0,08	-1,20
South Africa	4,12	0,13	12,22	5,12	0,10	-1,10
South Korea	1,90	-0,13	2,46	-0,06	0,06	-0,45
Turkey	9,62	0,37	2,13	8,52	0,36	1,03

Portfolio of traditional assets						
Jensen alpha ratio						
	Unrestricted weights			No short selling weights		
Developed countries	**MVO**	**CAPM**	**BL**	**MVO**	**CAPM**	**BL**
Australia	0,63	-0,07	-1,21	0,63	-0,09	-1,21
Canada	-0,73	-0,12	1,06	-0,64	-0,14	-1,57
France	-0,68	-3,24	0,70	-0,95	-1,92	-1,38
Germany	3,01	-0,14	1,46	0,82	-0,14	-1,39
United Kingdom	-0,64	-0,02	-0,17	-0,60	-0,07	-1,52
United States	-0,49	-0,08	-0,27	-0,39	-0,12	-1,87
Emerging countries						
Brazil	14,02	-0,06	-0,23	8,02	-0,06	7,84
China	10,22	-0,05	5,23	0,11	-0,05	-1,47
Poland	1,68	-0,06	-0,48	0,80	-0,07	-1,23
South Africa	12,76	0,10	9,88	4,41	0,10	-1,35
South Korea	1,82	-0,13	3,03	-0,06	-0,11	-1,11
Turkey	8,85	0,97	2,40	8,01	0,32	1,38

Brazil: The *Sharpe ratios* of the portfolio which includes impact investments are higher for all three models compared to the portfolio of conventional assets. Using the *Sharpe ratio*, the MVO model generates the highest risk adjusted excess returns, beating the CAPM and BL model (figure 8). The *Treynor and Jensen Alpha ratios* report mixed results, with the portfolio of traditional assets performing better under certain models, depending whether short selling is allowed or not, and similarly for the portfolio with impact funds. Short selling works best for the Brazilian portfolio. See figure 9 and 10 above.

China: Using the Sharpe ratio, the portfolio which includes impact investment funds recorded improved performance for all three models, whether short selling is permitted or not, compared to the portfolio which consists only of traditional assets. In contrast, the portfolio of traditional assets outperforms the portfolio with impact funds when the *Treynor ratio* is used. Using the *Jensen Alpha ratio*, the portfolio which includes impact investments delivers higher performance when no short selling is permitted compared to the portfolio which consists of conventional assets. We observe mixed results when short selling is permitted between the two models.

Poland: Both portfolios perform similarly for all three models according to the *Sharpe and Jensen Alpha ratios.* Thus, for Poland, impact investments do not add significant value to the overall portfolio. Using the *Treynor ratio*, the performance of the two portfolios is mixed (figure 9 above).

South Africa: Using the *Sharpe and Jensen Alpha ratios*, the portfolio which includes impact investments marginally outperforms the portfolio which consists only of conventional assets for the CAPM and BL model. This shows that including impact investments in the portfolio improves overall performance. In the scenario where short selling is allowed, the BL model outperforms the MVO and CAPM, with the highest *Jensen Alpha ratio*. The *Treynor ratios* reports mixed results for the two portfolios.

South Korea: The portfolio with impact investments delivers better performance compared to the portfolio of traditional assets, according to the *Sharpe ratio* for the MVO model and CAPM. Similarly, when using the *Treynor and Jensen Alpha* ratios, the portfolio which includes impact funds shows outperformance for the MVO and BL models.

Turkey: The *Sharpe ratios* of the portfolio with impact investments are greater than those of the portfolio of conventional assets for the MVO and CAPM while the two portfolios perform similarly according to the BL model. The *Treynor and Jensen Alpha ratios* record mixed performance for the two portfolios depending on the model and whether short selling is allowed or not.

5.Conclusion

The aim of this paper is threefold. (1) To examine the financial performance of impact investment funds relative to the MSCI World Equity Index as well as traditional asset classes in major developed and emerging economies. (2) To assess the correlation between impact funds and traditional asset classes to see if there are diversification benefits. And finally, to examine the portfolio effects of including impact investment funds in a portfolio with traditional asset classes using MVO, CAPM and BL model.

The findings of the study are as follows:

- Impact investing funds from the twelve economies reported an average return of 10.7% over the period 2004-2019, higher than the average return of the MSCI World Equity Index (8.7%). Impact funds in developed economies recorded an average return of 11.4% while funds in emerging market economies had average returns of 10.4%. This is evidence that impact investment funds can deliver returns in line with and/or above returns of traditional asset classes.
- Negative/low correlations were observed between impact investment funds and traditional assets of the following countries: Germany, Australia, UK, Brazil, China, Poland, South Korea and Turkey. This means that adding impact investments into a portfolio with equities, bonds and cash could potentially improve overall portfolio performance – diversification benefits. Impact investment funds of Canada, France, Germany, China, Poland and Turkey had a negative/low correlation to the MSCI World Index. Moderately positive correlations were reported for France, Canada, US and South Africa.
- Looking at portfolio weights, it was observed that portfolios that made a higher allocation to impact funds delivered better performance than portfolios that consisted only of conventional assets. This shows the benefits of diversifying conventional portfolios by including impact investment funds.
- Portfolios consisting of impact investments broadly outperformed their counterpart portfolios of traditional investments as per various measures:
    - *Using expected portfolio returns*; portfolios with impact funds of Canada, France Germany, UK, China and South Korea outperformed portfolios consisting of traditional assets only.
    - *Using standard deviation*; portfolios which included impact investments for Germany, UK, Brazil and Turkey were less risky than their counterpart portfolios consisting only of conventional investments. Impact funds inclusive portfolios of France and Canada were riskier while the portfolios of China, Poland, South Africa and South Korea had a similar level of risk to the portfolios of traditional assets only.
    - *Betas* of both portfolios (including impact investments and excluding) for the different countries in the sample were relatively low, implying that the various portfolios were less volatile than the MSCI World Index.

    - *Using the Sharpe ratios*; portfolios inclusive of impact investments for Germany, UK, US, Brazil, China, South Africa, South Korea and Turkey outperformed their counterpart portfolios consisting only of conventional assets.
    - *Using the Treynor ratios*; France, Germany, UK and South Korea's portfolio of impact investments performed better than their counterpart portfolio of conventional assets.
    - *Using the Jensen Alpha ratios*; portfolios with impact investments of France, Germany, UK, US, China, South Africa and South Korea delivered higher performance than their equivalent portfolios of conventional assets.
- This study, using various measures and metrices, has shown that fund managers can generate better performance by including impact investments in their portfolios. There are some diversification benefits to having impact investments in the portfolio in both developed and emerging markets, Furthermore, this study also advocates for fund managers to allocate more capital towards impact investments as this is likely to boost their overall returns.
- Future research should focus on adapting traditional optimization techniques to account for the unique characteristics of impact investments. Specifically, we need a technique that will quantify impact and then incorporate this measure to the existing risk and return framework.

Appendix 1: Portfolio allocation weights by country

Australia

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	-0,06	0,02	0,03	0,00	0,02	0,02
Equities	0,12	-0,01	0,23	0,01	0,00	0,23
Bonds	0,93	0,99	0,74	0,99	0,98	0,75
Total weight	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,01	-0,01	0,26	0,01	0,00	0,26
Bonds	1,01	1,01	0,74	0,99	1,00	0,74
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Canada

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	-0,02	0,00	0,09	0,01	0,00	0,00
Equities	0,21	-0,02	0,16	0,02	0,00	0,21
Bonds	0,96	0,89	6,85	0,97	0,84	0,79
Cash	-0,17	0,13	-6,09	0,00	0,16	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,31	-0,02	0,17	0,01	0,00	0,05
Bonds	0,84	0,89	6,81	0,99	0,84	0,37
Cash	-0,15	0,13	-5,98	0,00	0,16	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

France

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	1,26	-0,01	0,12	0,46	1,00	0,03
Equities	0,01	0,02	0,26	0,01	0,00	0,21
Bonds	1,30	0,81	6,64	0,53	0,00	0,76
Cash	-1,56	0,18	-6,02	0,00	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,20	0,24	0,26	0,03	0,10	0,16
Bonds	1,40	-7,76	6,63	0,97	0,00	0,84
Cash	-0,61	8,52	-5,90	0,00	0,90	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Germany

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	1,09	0,02	0,13	0,30	0,02	0,07
Equities	0,41	0,00	0,25	0,09	0,00	0,19
Bonds	0,19	0,65	8,49	0,61	0,64	0,78
Cash	-0,69	0,33	-7,87	0,00	0,32	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,21	0,01	0,27	0,47	0,01	0,11
Bonds	-11,86	0,63	8,42	0,46	0,63	0,89
Cash	13,07	0,36	-7,69	0,08	0,36	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

United Kingdom

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,69	0,08	0,21	0,89	0,07	0,07
Equities	0,00	0,01	0,27	0,00	0,01	0,24
Bonds	0,57	1,66	4,43	0,10	0,92	0,68
Cash	-0,27	-0,76	-3,90	0,00	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,16	-0,01	0,22	0,02	0,00	0,32
Bonds	0,91	1,14	3,45	0,98	1,00	0,68
Cash	-0,07	-0,14	-2,67	0,00	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

United States

Portfolio with impact investment funds

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,29	0,03	0,24	0,00	0,02	0,07
Equities	0,08	-0,01	0,14	0,01	0,00	0,23
Bonds	0,81	1,28	5,20	0,98	0,98	0,70
Cash	-0,17	-0,30	-4,57	0,00	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,01	0,00	0,18	0,01	0,00	0,60
Bonds	1,21	1,14	4,46	0,99	1,00	0,40
Cash	-0,22	-0,15	-3,65	0,00	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Brazil

Portfolio with impact investment funds

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,02	0,02	-0,03	0,01	0,09	0,12
Equities	-0,03	-0,03	0,08	0,01	0,00	0,61
Bonds	3,62	3,62	10,36	0,69	0,99	0,19
Cash	-2,62	-2,61	-9,41	0,29	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,02	-0,02	0,07	0,01	0,01	1,00
Bonds	3,85	3,84	9,69	0,71	0,99	0,00
Cash	-2,82	-2,81	-8,76	0,29	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

China

Portfolio with impact investment funds

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,04	0,11	0,94	0,13	0,14	0,27
Equities	0,00	0,00	0,22	0,00	0,00	0,61
Bonds	1,83	1,58	37,78	0,84	0,86	0,13
Cash	-0,86	-0,68	-37,95	0,02	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,00	0,00	0,22	0,00	0,00	0,00
Bonds	1,85	1,64	38,16	0,97	1,00	1,00
Cash	-0,85	-0,63	-37,38	0,03	0,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Poland

Portfolio with impact investment funds

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,00	0,02	0,02	0,01	0,02	0,06
Equities	-0,01	0,00	0,20	0,00	0,00	0,20
Bonds	1,21	0,24	2,48	0,83	0,23	0,48
Cash	-0,20	0,74	-1,69	0,16	0,75	0,26
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,01	-0,01	0,20	0,00	0,00	0,09
Bonds	1,17	0,34	2,32	0,84	0,33	0,91
Cash	-0,16	0,67	-1,53	0,16	0,67	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

South Africa

Portfolio with impact investment funds

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,17	-0,02	2,18	0,01	0,00	0,01
Equities	-0,14	0,03	-1,70	0,00	0,03	0,09
Bonds	16,76	-0,73	196,52	0,58	0,09	0,90
Cash	-15,78	1,72	-196,00	0,41	0,88	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets

Portfolio allocation weights	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,03	0,03	-1,05	0,00	0,03	0,03
Bonds	5,57	0,09	125,45	0,59	0,09	0,97
Cash	-4,54	0,88	-123,40	0,41	0,88	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

South Korea

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,09	0,03	0,41	0,01	0,03	0,07
Equities	-0,03	-0,01	0,10	0,01	0,00	0,16
Bonds	2,49	0,08	13,58	0,58	0,00	0,76
Cash	-1,55	0,91	-13,09	0,41	0,97	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	-0,03	-0,01	0,10	0,01	0,00	0,03
Bonds	2,42	-0,14	10,77	0,58	0,00	0,97
Cash	-1,39	1,15	-9,87	0,42	1,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Turkey

Portfolio with impact investment funds						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Impact	0,25	0,26	0,21	0,13	0,00	0,17
Equities	0,05	0,04	0,23	0,01	0,00	0,22
Bonds	0,70	-0,22	1,27	0,56	0,00	0,61
Cash	0,01	0,92	-0,72	0,30	1,00	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Portfolio of traditional assets						
Portfolio allocation weights						
	Unrestricted weights			No short selling weights		
	MVO	CAPM	BL	MVO	CAPM	BL
Equities	0,05	0,03	0,23	0,01	0,03	0,23
Bonds	0,99	-1,34	1,46	0,64	0,00	0,77
Cash	-0,04	2,31	-0,69	0,35	0,97	0,00
Total weights	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Appendix 2: UK MVO calculations (with impact funds)

1	2	3	4	5	6	7	8	9	10	11	12	13
Assets	Mean return	Excess return	Beta	Error variance	Treynor ratio	Sharpe Beta	Beta^2/Error	Cumulative sum 7	Cumulative sum 8	C	Z	Absolute Z
Bonds	2.7	1.1	0.0	1.7	88.8	0.008	0.0001	0.008	0.0001	1.26	0.57	0.57
Impact	27.8	26.2	1.0	223.1	26.6	0.116	0.0043	0.124	0.0044	11.42	0.07	0.07
Equities	4.1	2.5	0.2	168.8	12.2	0.003	0.0002	0.127	0.0047	11.43	0.00	0.00
Cash	1.6	0.0	0.1	2.8	-0.7	-0.001	0.0013	0.126	0.0059	10.19	-0.26	0.26

	Weights (short)	Weights (no shorts)
Impact	0.64	0.89
Bonds	0.07	0.10
Equities	0.00	0.00
Cash	-0.29	

Performance		
Portfolio return	2,67	3,74
Portfolio variance	2,8	5,8
Portfolio std dev	1,7	2,4
Sharpe ratio	0,6	0,9
Portfolio beta	0,06	0,11
Treynor ratio	16,3	18,5
Jensen alpha	0,6	1,3

		Calculating portfolio variance		
	1. Beta matrix multiplication			
	0.0002	0.012265	0.002519	0.000736
Shorting	0.012265	0.968706	0.198918	0.058113
	0.002519	0.198918	0.040847	0.011933
	0.000736	0.058113	0.011933	0.003486
	0.000155	0.012265	0.002519	
No shorting	0.012265	0.968706	0.198918	
	0.002519	0.198918	0.040847	
	2. Market variance*Beta matrix			
	0.0242	1.911274	0.392469	0.114657
Shorting	1.911274	150.9519	30.99707	9.055587
	0.392469	30.99707	6.365063	1.85951
	0.114657	9.055587	1.85951	0.543244
	0.0242	1.911274	0.392469	
No shorting	1.911274	150.9519	30.99707	
	0.392469	30.99707	6.365063	
	3. Error Variance Diagonal matrix			
	1.7			
Shorting		**223.1**		
			168.8	
				2.8
	1.7			
No shorting		**223.1**		
			168.8	
	4. Variance covariance matrix			
	1.7	1.9	0.4	0.1
Shorting	1.9	374.1	31.0	9.1
	0.4	31.0	175.2	1.9
	0.1	9.1	1.9	3.3
	1.7	1.9	0.4	
No shorting	1.9	374.1	31.0	
	0.4	31.0	175.2	

UK BL and CAPM calculations

Risk aversion A				
0,05				
Variance covariance matrix				
	Impact	*Equities*	*Bonds*	*Cash*
Impact	376,53	-54,94	-9,52	2,94
Equities	-54,94	163,20	3,60	3,84
Bonds	-9,52	3,60	1,80	2,01
Cash	2,94	3,84	2,01	3,83
Implied equilibrium excess returns	R=ASw			
Impact	0,5551			
Equities	2,8115			
Bonds	0,0644			
Cash	0,1377			

		Link matrix			
Views	Q	*Impact*	*Equities*	*Bonds*	*Cash*
View 1	0,4	0	1	-1	0
View 2	0,4	0	0	1	-1
View 3	0,4	1	0	-1	0
Omega (uncertainty)					
157,8	0,0	-47,2			
0,0	1,6	-12,3			
-47,2	-12,3	397,4			
Expected returns					
	Impact	Equities	Bonds	Cash	
Impact	188,88	-26,85	-4,14	2,09	
Equities	-26,85	82,22	2,42	2,54	
Bonds	-4,14	2,42	1,52	1,62	
Cash	2,09	2,54	1,62	2,53	
Impact	0,017				
Equities	0,025				
Bonds	0,340				
Cash	-0,336				
BL expected returns					
Impact	0,4074				
Equities	1,5356				
Bonds	-0,0379				
Cash	-0,2013				

	Portfolio allocation calculations					
	u-rf			**Z**		
	Historical	CAPM	BL	Historical	CAPM	BL
Impact	26,2	27,4	0,407	0,211	0,184	0,009
Equities	2,5	2,1	1,536	0,047	0,033	0,012
Bonds	1,1	1,6	-0,038	4,504	3,685	0,202
Cash	0,0	1,6	-0,201	-2,581	-1,684	-0,178
				2,180	2,219	0,046

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