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Are impact and financial returns mutually exclusive? Evidence from publicly-listed impact investments

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ABSTRACT

Interest in impact investing is on the rise. And yet, there is a relative scarcity of academic literature on the financial performance and diversification potential of impact investments. In this paper, we apply a risk factors and dynamic correlation analysis to an original dataset essentially made of European publicly-listed impact firms. Our findings point to a risk-adjusted underperformance of impact investments compared to mainstream markets, and reveal impact firms' failure to deliver non-negative returns to investors. This contradicts the practitioner literature, and suggests that investors must sacrifice financial returns for investing in line with their values. The results also indicate that the diversification potential of listed impact investments with regard to mainstream markets slowly decreases over time, suggesting that impact investors attach only limited weight to this aspect.

1. Introduction

The inclusion of the social and environmental dimensions of investment in finance is of increasing interest to both researchers and practitioners. In this paper, we focus on impact investments, which combine philanthropy with mainstream finance (Höchstädter & Scheck, 2015) and are defined by the Global Impact Investing Network (GIIN)[1] as '*investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return*'.[2]

Impact investing is part of a broader movement of social financial practices that aim to transform the investment paradigm (Hehenberger, Mair, & Metz, 2019) and promote the development of 'ethical capitalism' (Watts & Scales, 2020). Examples of such social financial practices include socially responsible investing (SRI; e.g. Lapanan, 2018; Nofsinger & Varma, 2014), microfinance (e.g. Dorfleitner, Röhe, & Renier, 2017; Morduch, 1999), social entrepreneurship (e.g. Dacin & Dacin, 2011) and corporate social responsibility (e.g. Liang & Renneboog, 2017).

However, impact investing differs from these practices, starting with socially responsible investing. Indeed, impact investors actively seek to fund projects with a positive and measurable social or environmental objective (Lee, Adbi, & Singh, 2020), whereas socially responsible investors rather aim to improve corporate practices based on Environmental, Social and Governance (ESG) criteria (Morduch & Ogden, 2018). Impact investing also differs from microfinance, as it involves investment into innovative organizations that tackle societal issues (Viviani & Maurel, 2019), whereas microfinance does not necessarily impose restrictions on the nature of the projects developed by micro-entrepreneurs (Watts & Scales, 2019). Impact investors carefully and exclusively select firms that are demonstrably able to deliver significant social value, and they hold a larger equity stake in those firms that are the most socially valuable (Chowdhry, Davies, & Waters, 2019).

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[1] Although the GIIN is currently the most influential body in the field of impact investing, other conceptions of impact investing exist too (although they are less influential). This situation is not characteristic of impact investing, since there is also a heterogeneity of conceptions for related practices, such as socially responsible investing (Sandberg, Juravle, Hedesström, & Hamilton, 2009).

[2] See https://thegiin.org/impact-investing/ (page consulted on 19 January 2021).

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Interest in impact investing has increased over recent years (Chowdhry et al., 2019). As a matter of fact, the European Sustainable Investment Forum documented an annual growth rate of 52 % between 2011 and 2017 in European impact investments (Eurosif, 2018), while in the United States, the Forum for Sustainable and Responsible Investment reported a 38 % growth in sustainable, responsible and impact investment between 2016 and 2018 (US SIF, 2018). Overall, the GIIN estimates the current market size to be of USD715 billion.[3]

Yet the field of impact investing is still young (Höchstädter & Scheck, 2015) and questions remain about both the financial performance and diversification potential of impact investments. While these issues have already been discussed in the literature, practitioner studies (e.g. Mudaliar & Bass, 2017) and the very few academic papers on the topic (e.g. Barber, Morse, & Yasuda, 2021) relied almost exclusively on privately-owned data. Our goal in this paper is therefore to take advantage of both the emergence of social stock exchanges and the increasing number of publicly-listed impact firms to improve our knowledge of those issues using public data. In particular, we investigate the critical question of whether listed impact firms provide investors with non-negative financial returns (Rangan, Appleby, & Moon, 2011).

Our empirical analysis relies on an impact investing index constructed from an original dataset essentially composed of European impact firms within the Impact Group (IG), a UK-based organization that identifies impact firms through a stringent admission process. We compare the Impact Investing Index to a series of MSCI benchmark indices over a period ranging from 2009 to 2018. We use the traditional four-factor model (Carhart, 1997; Fama & French, 1993) to analyze financial performance, and we rely on DCC-MVGARCH modelling (Engle & Sheppard, 2001; Engle, 2002) to assess diversification potential.

Overall, not only do our results hint at a risk-adjusted underperformance of impact compared to traditional investments, they also reveal impact firms' failure to deliver non-negative returns to investors, though some improvement is observed starting from 2014. This contradicts the win-win situation presented in the practitioner literature (e.g. Mudaliar & Bass, 2017). Our results also highlight a decreasing diversification potential of impact investments with regard to mainstream markets. Taken together, and in line with the results of Barber et al. (2021) and Riedl and Smeets (2017), these insights suggest that investors in listed impact firms must accept to pay a high price for investing according to their values.

The remainder of the paper is organized as follows. Section 2 provides a review of the impact investing literature. Section 3 discusses the challenge related to data accessibility, the empirical methodology and the features of the dataset. The results are presented in Section 4, and Section 5 contains robustness checks. Section 6 provides a discussion of the findings. Finally, we present our conclusions in Section 7.

2. A literature review of impact investing

Impact investing is a recent research field (Chowdhry et al., 2019; Höchstädter & Scheck, 2015) and, among numerous research gaps, two issues are of particular interest to investors, fund managers and researchers. Firstly, is impact investing a financially-sustainable investment practice (Hehenberger et al., 2019) that delivers non-negative financial returns alongside a positive societal impact? Secondly, do impact firms contribute to portfolio diversification?[4]

2.1. Financial performance

Numerous studies assess the financial performance of investments with a social dimension. To start with, a number of studies compare the financial performance of socially responsible and traditional investments. That literature stream delivers mixed results. For instance, Bialkowski and Starks (2016) conclude that there is no statistical difference in risk-adjusted returns between socially responsible and conventional equity mutual funds, whereas other studies highlight financial costs linked to socially responsible investing (e.g. Hong & Kacperczyk, 2009). Taking a wider perspective, Orlitzky (2011) and Revelli and Viviani (2015) argue that study results on the relationship between corporate social and financial performance vary a great deal. Some studies find a positive relationship whereas other studies find a nonsignificant or even a negative relationship. More recently, in an attempt to provide empirical evidence for the rationale behind the holding of socially responsible mutual funds by investors, Riedl and Smeets (2017) showed that financial motives play less of a role compared to social preferences and signaling in explaining investment decisions.

As for the field of impact investing more specifically, so far, contributions have mostly taken the form of non-academic, practitioner studies relying mainly on privately-owned data (e.g. Gray, Ashburn, Douglas, & Jeffers, 2015; Matthews, Sternlicht, Bouri, Mudaliar, & Schiff, 2015). Recently, Mudaliar and Bass (2017) reviewed practitioner studies dedicated to the financial performance of impact investments and concluded that market-rate financial returns were within reach in private equity impact investing. However, these works suffer from a series of drawbacks. For instance, some studies compare private equity and venture capital impact investments to mainstream public market benchmarks, whose functioning and risk-return profile might be significantly different. The fact that fees are not always properly taken into account constitutes another important issue.

In one of the very few academic studies on the financial performance of impact investments, Barber et al. (2021) find that venture and growth equity impact funds earn an internal rate of return that is 4.7 percentage points lower than traditional venture capital funds. They conclude that impact investors are willing to sacrifice part of the financial return for investing in dual-objective funds. A few attempts to study impact investments' financial performance relying on public data have also emerged in the past few years (e.g. Biasin et al., 2019; La Torre, Chiappini, & Mango, 2017).

2.2. Diversification potential

Whether impact investments contribute to portfolio diversification is another important issue. Results in the related SRI literature show that socially responsible investors attach only limited weight to diversification in their investment decisions. For instance, Barreda-Tarrazona, Matallín-Sáez, and Balaguer-Franch (2011) found that investors who cared about social responsibility would invest significantly more in the socially responsible alternative even if the return differential was highly unfavorable compared to other projects. Similarly, Riedl and Smeets (2017) found that only a marginal share of investors would hold socially responsible investment funds for diversification purposes.

[3] See https://thegiin.org/research/publication/impinv-survey-2020 (page consulted on 19 January 2021).

[4] These two issues are of particular relevance to asset managers who are bound to a fiduciary duty and whose clients request impact investments. These managers must know whether it is possible to do well while doing good at the same time.

As with socially responsible investing, impact investing reduces the size of the initial possible universe, thereby shifting the mean-variance frontier towards unfavorable risk-return trade-offs compared to mainstream portfolios (Renneboog, Horst, & Zhang, 2008). Consequently, according to traditional financial theory, there is no rationale for building a portfolio exclusively made of impact investments. However, it may prove coherent for investors to add impact assets to a portfolio initially made of traditional assets if this improves diversification. For the remainder of this paper, the terms 'diversification' and 'diversification potential' will always refer to impact investments' diversification potential with regard to traditional assets.

3. Data and methodology

3.1. The data challenge

Access to relevant data and metrics for impact investments constitutes a key issue. While several advances have been made in improving data accessibility, with projects such as IRIS Metrics[5], studies on impact investments still largely rely on privately-owned data, which leads to issues with transparency and replicability. Indeed, in a competitive marketplace, private impact funds generally do not share their investment data and, if they do, they are unlikely to report on underperforming investments (Watts & Scales, 2020), which might lead to performance overstatement. Added to that, the link between financial performance and societal impact is often hard to establish. It is therefore the objective of this paper to circumvent those issues and extend current knowledge on impact investing by relying on data from publicly-listed firms.

While several stock market indices already exist for socially responsible firms[6], to the best of our knowledge, there is no index which focuses exclusively on impact firms. Indeed, although the recent MSCI ACWI Sustainable Impact Index[7] seemed to go in the right direction, its constituent firms are in fact only required to generate '*at least* 50 *% of their sales from one of MSCI's Sustainable Impact categories*'[8], which leaves room for companies and activities that are inconsistent with the goals of impact investing. In this respect, the numerous projects that globally aim to set up stock exchanges for social firms constitute an unprecedented opportunity to study what investors can expect from listed impact companies.[9]

Among these so-called social stock exchanges, the case of the Impact Group (IG)[10] is particularly interesting. The IG is a licensee of the Social Stock Exchange (SSX)[11], whose conception of impact investing is based on the United Nations', which itself relies on the GIIN definition.[12] IG member companies undergo a strict admission process[13] and must commit to '*measuring and monitoring progress against relevant United Nations Sustainable Development Goals*'.[14] That being said, IG member firms are not directly traded on the IG platform. Rather, they are listed on mainstream exchanges such as the London Stock Exchange, the Frankfurt Stock Exchange or the NASDAQ. Hence, the IG's role is to provide investors with the 'impact investment' seal. This paper relies on the IG's original and unique dataset to assess the financial performance and diversification potential of listed impact firms.

3.2. The financial performance of impact investments

3.2.1. A multifactor analysis of impact investing

Our analysis of impact firms' financial performance relies on Carhart's (1997) four-factor model, which adds the so-called momentum factor to the Fama and French (1993) three-factor model. The momentum factor relates to Jeegadeesh and Titman's (1993) one-year momentum effect and to momentum investing[15], which makes the four-factor model an active management evaluation model. Recent work by Fama and French (2015) introduces a new five-factor model. However, that model does not consider the momentum factor and, as acknowledged by the authors themselves, it fails to '*capture the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability*'. Given these limitations, we decided to rely on the four-factor model, which is the most-frequently adopted specification in the related literature[16] and is presented in Eq. (1):

$$R_{i,t} - rf_t = \alpha_i + \beta_{MRP,i} MRP_t + \beta_{SMB,i} SMB_t + \beta_{HML,i} HML_t + \beta_{WML,i} WML_t + \varepsilon_{i,t} \quad (1)$$

where $R_{i,t}$ is the weekly return of index i at time t, rf_t is the risk-free rate[17] at time t, α_i is the intercept of the model for index i, and $\varepsilon_{i,t}$ is the disturbance term for index i at time t. $\beta_{MRP,i}$, $\beta_{SMB,i}$, $\beta_{HML,i}$ and $\beta_{WML,i}$ are the factor loadings on the market (MRP_t), firm size (SMB_t), book-to-market (HML_t) and momentum (WML_t) factors, respectively. Depending on the model specification (see below), we considered the perspective of either a developed market or a European investor as regards the four factors. All weekly returns are in United States dollars (USD), and data for the four factors were retrieved from Kenneth French's website.[18]

The main objective of this analysis is to compare the risk-adjusted performances (alphas) of impact and traditional companies, a question that goes beyond that of the financial sustainability of impact investing. Indeed, if impact firms are expected to be financially sustainable (Hehenberger et al., 2019), they are also considered riskier, notably because they are often pioneers in high-risk environments (Watts & Scales, 2020). Consequently, impact investors might accept non-negative returns that underperform with regard to the risks they take on (Morduch & Ogden, 2018), a practice which is the opposite of that of traditional investors. The analysis will also allow us to identify the factors that matter for understanding variations in the excess returns of impact

[5] See https://iris.thegiin.org/metrics (page consulted on 20 January 2021).
[6] See, for instance, MSCI KLD 400, MSCI SRI or MSCI ESG Leaders (https://www.msci.com/esg-indexes; page consulted on 20 January 2021).
[7] See https://www.msci.com/msci-acwi-sustainable-impact-index (page consulted on 20 January 2021).
[8] See https://www.msci.com/documents/10199/6d2b3e68-90e0-448e-bd52-eaf0397539d1 (page consulted on 20 January 2021).
[9] Past and current initiatives of this kind include: Germany's NExT SSE; the UK's Impact Group; Singapore's Impact Investment Exchange; South Africa's Nexii, SASIX and Johannesburg Stock Exchange; Canada's Social Venture Connexion; the United States' Mission Markets; Brazil's Bolsa de Valores Socioambientais and BriiX; Kenya's Social Investment eXchange.
[10] See https://impactgroup.info/ (page consulted on 20 January 2021).
[11] The SSX was launched in June 2013 with the aim to develop and democratize the market for impact investments, as well as increase funds flow to businesses with a social and/or environmental dimension.
[12] See http://www.undp.org/content/sdfinance/en/home/solutions/impact-investment.html (page consulted on 20 January 2021).
[13] For further details, see https://impactgroup.info/network-accreditation/ (page consulted on 20 January 2021).
[14] See https://impactgroup.info/network-accreditation/ (page consulted on 20 January 2021).
[15] Momentum investing consists in recommending buying or selling a security based on its past performance.
[16] See, for instance, Renneboog, Horst, and Zhang (2008); Nofsinger and Varma (2014) or Brière and Szafarz (2015).
[17] Depending on the model specification (see below), we use the US, UK or German one-month government bond yield as risk-free rate. US data were retrieved from Kenneth French's website, while UK and German data come from Datastream.
[18] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (page consulted on 20 January 2021).

companies, and to compare the results to those obtained for traditional firms. The analysis requires us to estimate Eq. (1) using excess returns for impact and traditional companies, the latter serving as benchmarks.

3.2.2. Impact companies' returns

We used a dataset assembled from the IG's database of listed impact firms. Our dataset included firms that were IG members in May 2018 (seven firms) and firms that had been members of the IG at some point before May 2018, but were no longer members at the time of data collection (ten firms). For the sake of consistency, we carefully checked whether these companies' activities were still in line with the IG's conception of impact investing. This process led to the exclusion of one firm from our dataset. As a matter of fact, the IG confirmed that leaving the network was not necessarily associated with impact deficiencies. The final dataset comprised 16 listed impact companies.[19] Tables A1 and A2 in the Appendix A list the characteristics of these companies. Table A1 is particularly relevant, as it lists IG member firms and provides an overview of their business activities. Although IG membership is granted according to proprietary criteria that turn the admission process into a black box, the information in Table A1 provides the outcome of that process and therefore makes it possible to transparently link the financial performance of member firms to their societal impact, a crucial point for investors, asset managers and researchers.

Table A2 shows that the sample contains only developed market companies, 69 % of which are located in the UK. Interestingly, all the companies were established after 1990. The majority of the firms (75 %) list on an exchange that is based in London, and have their stocks traded in GBp (penny stocks). The London Stock Exchange (LSE) is home to 56 % of the firms in the sample, with 37 % of the companies listed on the Alternative Investment Market (AIM), a sub-segment of the LSE dedicated to smaller, growing firms. Overall, firms in the sample belong to seven different sectors, ranging from energy and technology to real estate and financial services. Average market capitalizations range from USD0.55 m to USD809.73 m, with an average of USD156.89 m. However, the median average market capitalization is USD43.52 m, and 12 firms have an average market capitalization that is below USD80 m. This indicates that four firms have a large average market size compared to the rest of the sample.

Using weekly logarithmic returns for the 16 impact firms, we constructed a market capitalization-weighted Impact Investing Index (see Table A3 in the Appendix A for some descriptive statistics of its constituents).[20] Impact companies entered the index progressively, as they went public, between January 2009 and December 2016. The Impact Investing Index started with nine impact companies on 5 January 2009. The start date was chosen for two main reasons. Firstly, the GIIN was created in 2009, so choosing this start date ensured that the conception of impact investing used in the empirical work was consistent. Secondly, by starting in 2009, we also sought to remove the extreme first months of the 2008 financial crisis from the sample.

Despite the limited number of companies in the Impact Investing Index, we consider our dataset to be particularly relevant for the purpose of assessing listed impact companies. Indeed, it has the twofold advantage of proposing a transparent set of impact firms selected according to a rigorous process that remains, as far as we know, the only coherent initiative of this kind in the market.

3.2.3. Traditional companies' returns

The selection of benchmark indices consisting of non-impact, traditional companies was performed as follows. Table A2 shows that 81 % of the impact firms are located in Europe, 69 % in the UK. Hence, we began the selection of benchmark indices by restricting our scope to European and UK indices. For the UK, we started with MSCI UK's small and micro capitalization indices. Market capitalization figures for these indices and the Impact Investing Index are presented in Table 1. We concluded that the MSCI UK Micro Cap was the index that was closest to the figures of the Impact Investing Index and, therefore, we selected it as the first UK benchmark index. We also selected the MSCI UK Small + Micro Cap, for extending the scope of the analysis.

For European indices, we proceeded in a similar way, using MSCI Europe's small and micro capitalization indices as a starting point. These indices are presented in Table 2. We concluded that the MSCI Europe Micro Cap was the index that was closest to the figures of the Impact Investing Index. Therefore, we selected it as the first European benchmark index. The MSCI Europe Small + Micro Cap was also selected, for extending the scope of the analysis.

All total return data (reinvestment of dividends) for impact firms and benchmark indices, as well as market capitalization data for impact firms and exchange rates, are from Datastream.[21] It must be noted that a few impact companies were also included in the MSCI benchmark indices that we considered. However, it is reasonable to assume that the vast majority of these indices' constituents are non-impact firms.[22]

3.2.4. Indices' summary statistics

Table 3 displays summary statistics on the Impact Investing Index, the four benchmark indices and two reduced impact investing indices built for robustness-check purposes. The Impact Investing Index (Ex-US) excludes the three US firms from the impact sample, while the Impact Investing Index (UK-only) further excludes non-UK firms from the impact sample. All four benchmark indices have a positive annualized return ranging from 12.46 % to 15.18 %, while all three impact investing indices deliver a negative annualized return ranging from −7.07 % to −7.30 %. This is in line with the fact that only four impact firms exhibit a positive annualized return (see Table A3 in the Appendix A). Impact investing indices also produce the highest volatility (unconditional standard errors ranging from 2.89 % to 3.02 %). All indices are left-skewed and five have fat tails, an unfavorable profile for the returns' distributions. Finally, Dickey-Fuller tests confirmed the stationarity of all series.

Fig. 1 shows the evolution of the seven indices, using weekly cumulative returns. It can clearly be seen that all impact investing indices constantly underperform the four benchmark indices. Starting at 100, impact investing indices' values progressively decline

[19] Small sample sizes are a common feature of studies that attempt to work with publicly-listed impact firms. Indeed, La Torre et al. (2017) work with a sample of 8 firms, while Biasin et al. (2019) have a sample of 52 firms. However, the sample from Biasin et al. (2019) actually comprises two subsamples whose selection criteria differ.

[20] More precisely, we used daily, weekly and monthly logarithmic total returns, depending on the frequency that was most appropriate for a given methodology or for robustness checks. Indices' daily and weekly return series start on 5 January 2009, while indices' monthly return series start on 1 February 2009. All indices' return series end on 31 May 2018. Logarithmic total returns were computed using USD total return indices (reinvestment of dividends). As to weights, they were computed every period (i.e. every day, week or month, depending on the series' frequency) by dividing an impact firm's market capitalization by the total market capitalization of the Impact Investing Index.

[21] See https://www.refinitiv.com/en (page consulted on 20 January 2021).

[22] The MSCI UK Micro Cap contains 4 firms from the impact dataset out of a total of 435 at the time of the study. The MSCI UK Small + Micro Cap contains 6 firms from the impact dataset out of a total of 692 at the time of the study. The MSCI Europe Micro Cap contains 4 firms from the impact dataset out of a total of 1386 at the time of the study. Finally, the MSCI Europe Small + Micro Cap contains 6 firms from the impact dataset out of a total of 2377 at the time of the study.

Table 1
Market capitalization data for selected MSCI UK benchmark indices.

Constituent Sizes (M. Cap. in USDm)	Impact Investing Index	MSCI UK Small Cap Index	MSCI UK Micro Cap Index	MSCI UK Small + Micro Cap Index
Average	259	1 852	122	764
Largest	1 797	8 601	679	8 601
Smallest	0.47	73	0.52	0.52

Note: M. Cap. (market capitalization) data for the three MSCI UK indices and the Impact Investing Index. For each index, the average, largest and smallest market capitalization is presented. Data for all three MSCI indices are from MSCI as of 31 May 2018. The same holds for impact firms' market capitalization data from Datastream. All data are in USDm.

Table 2
Market capitalization data for selected MSCI Europe benchmark indices.

Constituent Sizes (M. Cap. in USDm)	Impact Investing Index	MSCI Europe Small Cap Index	MSCI Europe Micro Cap Index	MSCI Europe Small + Micro Cap Index
Average	259	1 450	103	665
Largest	1 797	9 787	863	9 787
Smallest	0.47	73	0.52	0.52

Note: M. Cap. (market capitalization) data for the three MSCI European indices and the Impact Investing Index. For each index, the average, largest and smallest market capitalization is presented. Data for all three MSCI indices are from MSCI as of 31 May 2018. The same holds for impact firms' market capitalization data from Datastream. All data are in USDm.

Table 3
Summary statistics on indices' weekly financial return series.

Index	Annualized Return (%)	Maximum (%)	Minimum (%)	Volatility (%)	Skewness	Kurtosis	Dickey-Fuller (P-value)
Impact Investing Index	−7.07	12.77	−12.49	2.89	−0.39	3.71	0.00
Impact Investing Index (Ex–US)	−7.30	12.54	−13.93	3.02	−0.39	3.60	0.00
Impact Investing Index (UK–only)	−7.17	12.54	−13.93	2.99	−0.42	3.79	0.00
MSCI UK Micro Cap	14.33	8.87	−14.24	2.06	−0.84	6.68	0.00
MSCI UK Small + Micro Cap	15.18	8.54	−15.85	2.47	−0.84	4.77	0.00
MSCI Europe Micro Cap	12.46	7.12	−8.53	1.93	−0.61	2.04	0.00
MSCI Europe Small + Micro Cap	14.06	7.92	−9.14	2.41	−0.60	1.95	0.00

Note: summary statistics of the USD weekly financial return series of the Impact Investing Index, the two reduced impact investing indices and the four MSCI benchmark indices. All series start on 5 January 2009 and end on 31 May 2018. The Impact Investing Index (Ex–US) consists only of European impact companies (UK firms included), whereas the Impact Investing Index (UK–only) consists exclusively of UK impact companies. The Impact Investing Index comprises all impact firms. Volatility is proxied by the unconditional standard error of weekly returns. Skewness measures the degree of asymmetry of the returns' distribution. Kurtosis is evidence of fat tails in the returns' distribution. Dickey-Fuller tests for the null hypothesis of a unit root.

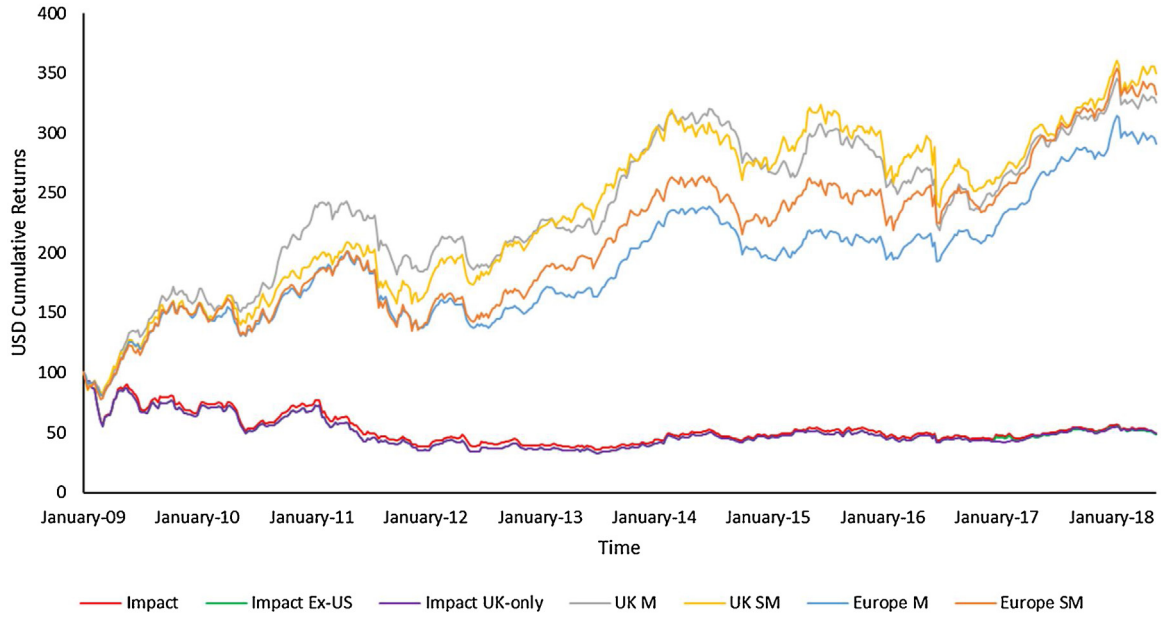

Fig. 1. Evolution of the Impact Investing Index, the two reduced impact investing indices and the four MSCI benchmark indices between 5 January 2009 and 31 May 2018, USD weekly cumulative returns (starting value of 100 on 5 January 2009).

until January 2012, and then stagnate around a value of 50 for the remaining years. By contrast, all four benchmark indices steadily increase in value and reach thresholds that lie between 290 and 350 at the end of the period under examination. Fig. 1 is in line with the descriptive analysis, particularly annualized returns, which also points to the strong relative underperformance of impact investing indices, as well as to their unfavorable risk-return profile when compared to the four benchmark indices.

Table 4
Unconditional correlations between the Impact Investing Index and MSCI benchmark indices.

Benchmark Index	MSCI UK Micro Cap	MSCI UK Small + Micro Cap	MSCI Europe Micro Cap	MSCI Europe Small + Micro Cap
First Half Correlation (%)	42.66***	40.57***	41.08***	39.80***
Second Half Correlation (%)	61.16***	58.37***	54.36***	51.25***
Fisher's r-to-z Test (P-value)	0.00	0.00	0.00	0.00

Note: unconditional correlations (%) between the Impact Investing Index and each of the four MSCI benchmark indices. Two correlations, one for the first half and one for the second half of the sampling period, are presented for each pair. Fisher's r-to-z tests test for the null hypothesis of equality between the two correlation coefficients. *** indicates statistical significance at the 1 % level.

From Fig. 1, we see that benchmark indices stop rising at the beginning of 2014, and subsequently decline for a couple of years. The decrease seems less pronounced for impact investing indices. To investigate the effects of that potential trend shift, we divided the sample in two periods: pre- and post-2014.[23] Table A4 in the Appendix A displays performance statistics for the Impact Investing Index and the four benchmark indices over those time periods. While the pre-2014 statistics are in line with previous results, the Impact Investing Index has a positive annualized return of 3.89 % that outperforms UK benchmark indices post-2014.[24] Hence, although impact investors lost close to half of their initial investment over the entire period studied, impact firms' financial performance improved in later years.[25] This may be due to impact companies taking more time to recover from the 2008 financial crisis, as well as to the progressive maturation process of the impact industry.

3.3. The diversification potential of impact investments

3.3.1. Dynamic conditional correlation multivariate GARCH

To assess whether adding impact assets to a portfolio of traditional investments improves diversification, we analyzed the financial return correlations between impact and traditional companies. Since the impact investing industry had grown, structured and transformed markedly since its inception in 2007, when the term was coined (Hehenberger et al., 2019), we suspected that impact firms' correlation with traditional companies might have changed over time. This is why we applied Dynamic Conditional Correlation Multivariate GARCH modelling (DCC-MVGARCH; Engle & Sheppard, 2001; Engle, 2002) to study the joint movements of listed impact and traditional firms. Brière and Szafarz (2015) applied the same methodology to microfinance and traditional financial institutions.

As in Engle and Sheppard (2001), we assumed that the n indices' daily logarithmic returns, represented by the vector $r_t = (r_{1t}, r_{2t}, \ldots, r_{nt})'$, are conditionally multivariate normal with μ, the expected value, and H_t, the covariance matrix, i.e. $r_t | I_t \sim N(\mu, H_t)$. I_t is the information set available at time t. The mean and variance equations of the standard $GARCH(P, Q)$ model are as specified in Eqs. (2) and (3).

$$r_t = \mu + u_t \tag{2}$$

with $u_t = H_t^{1/2} z_t$ and $z_t \sim N(0, 1)$, an $i.i.d.$ process.

$$h_{i,t} = \alpha_{i0} + \sum_{p=1}^{P} \alpha_{ip} u_{i,t-p}^2 + \sum_{q=1}^{Q} \beta_{iq} h_{i,t-q} \tag{3}$$

with $\alpha_{i0} > 0, \alpha_{ip} \geq 0\ (p = 1, \ldots, P), \beta_{iq} \geq 0\ (q = 1, \ldots, Q), \sum_{p=1}^{P} \alpha_{ip} + \sum_{q=1}^{Q} \beta_{iq} < 1$.

The covariance matrix H_t was calculated as follows:

$$H_t = D_t R_t D_t \tag{4}$$

with $D_t = diag(h_{1t}^{1/2}, \ldots, h_{nt}^{1/2})$ for n indices, and R_t is the time-varying correlation matrix of ε_t, the standardized residuals calculated as shown in Eq. (5).

$$\varepsilon_t = D_t^{-1} u_t \sim N(0, R_t) \tag{5}$$

R_t is calculated as follows:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{6}$$

$$Q_t = (1 - A - B)\overline{Q} + A\varepsilon_{t-1}\varepsilon_{t-1}^{'} + BQ_{t-1} \tag{7}$$

with $\overline{Q}$, the standardized residuals' unconditional covariance, and $Q_t^{*-1} = (diag\,(Q_t))^{-1/2}$. As we used a DCC(1,1)-MVGARCH model, we must have $A \geq 0$, $B \geq 0$ and $A + B < 1$. The model was estimated by applying Engle's (2002) two-step log-likelihood estimation technique.

3.3.2. Preliminary analysis: unconditional correlations

Vector r_t in Eq. (2) consists of daily returns for the Impact Investing Index and the benchmark indices. Following Brière and Szafarz (2015), Table 4 presents unconditional correlations between the Impact Investing Index and the benchmark indices. For each pair, we computed two separate unconditional correlation coefficients, over the first half (January 2009 to September 2013) and second half of the sampling period (October 2013 to May 2018), respectively. All unconditional correlations are statistically significant at the 1 % level, and range from 39.80 % to 61.16 %. For each pair, there seems to be an increase in correlation from one half of the sampling period to the next. This is confirmed by Fisher's r-to-z tests, which test for the statistical significance of the difference between two correlation coefficients.

However, the increase varies from one pair to another. The smallest increase, 11.45 percentage points, is found in the MSCI Europe Small + Micro Cap. The largest increase, 18.50 percentage points, is found in the MSCI UK Micro Cap. The pairs associated with the MSCI Europe Micro Cap and the MSCI UK Small + Micro Cap present increases of 13.28 and 17.80 percentage points, respectively. These preliminary results point to an increasing degree of co-movement, meaning that the diversification potential of impact investments may decrease over time, particularly with regard to MSCI UK benchmark indices.[26]

[23] We thank two anonymous referees for this suggestion.
[24] Robustness checks using monthly data confirm the results of the weekly descriptive analysis. See Tables IA.1 and IA.2, as well as Figures IA.1 to IA.3 in the Internet Appendix.
[25] See also Figs. A1 and A2 in the Appendix A.
[26] Table A5 in the Appendix A presents unconditional correlations for reduced impact investing indices. Results are qualitatively unchanged.

Table 5
Four-factor model estimation results.

Index	α	β_{MRP}	β_{SMB}	β_{HML}	β_{WML}	R^2
Impact Investing Index	−0.0021*	0.4516***	1.1001***	0.4156**	−0.2711**	0.21
	(0.0012)	(0.0740)	(0.2061)	(0.1716)	(0.1168)	
MSCI UK Micro Cap	−0.0009	0.1640***	0.7601***	0.2777***	−0.2379***	0.25
	(0.0006)	(0.0584)	(0.1064)	(0.0901)	(0.0598)	
MSCI UK Small + Micro Cap	−0.0003	0.3706***	0.8057***	0.3793***	−0.2839***	0.32
	(0.0007)	(0.0798)	(0.1228)	(0.1193)	(0.0637)	
MSCI Europe Micro Cap	−0.0008	0.5478***	0.9572***	0.2235**	−0.1159*	0.49
	(0.0006)	(0.0336)	(0.1145)	(0.1029)	(0.0612)	
MSCI Europe Small + Micro Cap	−0.0001	0.6886***	1.0063***	0.3392***	−0.2000***	0.54
	(0.0007)	(0.0411)	(0.1282)	(0.1117)	(0.0671)	

Note: coefficient estimates for the four-factor model linear regressions using factors from developed countries. The indices considered are the Impact Investing Index and the four MSCI benchmark indices. The one-month US, UK and German government bond yields are used as risk-free rates for specifications with the Impact Investing Index, MSCI UK indices and MSCI European indices, respectively. α is the intercept of the model, while β_{MRP}, β_{SMB}, β_{HML} and β_{WML} are the four factor loadings. Robust standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table 6
DCC-MVGARCH estimation results.

Index	μ	α_0	α_1	β_1	β_2	A	B
Impact Investing Index	0.0005*	0.1268e−4**	0.2273***	0.3314***	0.4070***	–	–
	(0.0002)	(0.0622e−4)	(0.0620)	(0.0924)	(0.1001)		
MSCI UK Micro Cap	0.0006***	2.3283e−6***	0.1560***	0.4295**	0.3906**	–	–
	(0.0001)	(0.8462e−6)	(0.0360)	(0.1851)	(0.1738)		
I.I. Index/MSCI UK Micro Cap	–	–	–	–	–	0.0266***	0.9641***
						(0.0071)	(0.0108)
Impact Investing Index	0.0004*	0.0961e−4*	0.1744***	0.8024***	–	–	–
	(0.0002)	(0.0527e−4)	(0.0561)	(0.0646)			
MSCI UK Small + Micro Cap	0.0008***	0.0335e−4***	0.1139***	0.8665***	–	–	–
	(0.0002)	(0.0106e−4)	(0.0225)	(0.0224)			
I.I. Index/MSCI UK Small + Micro Cap	–	–	–	–	–	0.0256***	0.9654***
						(0.0098)	(0.0169)
MSCI Europe Micro Cap	0.0006***	1.3516e−6***	0.0954***	0.8877***	–	–	–
	(0.0001)	(0.5112e−6)	(0.0212)	(0.0235)			
I.I. Index/MSCI Europe Micro Cap	–	–	–	–	–	0.0188**	0.9722***
						(0.0085)	(0.0119)
MSCI Europe Small + Micro Cap	0.0007***	0.0216e−4***	0.0984***	0.8881***	–	–	–
	(0.0002)	(0.0075e−4)	(0.0188)	(0.0205)			
I.I. Index/MSCI Eu. Small + Micro Cap	–	–	–	–	–	0.0485***	0.8461***
						(0.0161)	(0.0949)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the four pairs (the parameters are μ, α_0, α_1, β_1 and β_2), before the parameters A and B of the DCC are estimated. The indices considered are the Impact Investing Index (present in each of the four pairs) and the four MSCI benchmark indices (one per pair). Robust standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

4. Results

4.1. Financial performance

The results of the multifactor analysis are presented in Table 5.[27] We can observe that the Impact Investing Index's weekly alpha is negative, significant and has an annualized value of −10.30 %, while all four benchmark indices present negative yet non-significant alphas. Hence, unlike benchmark indices, the Impact Investing Index delivers returns that underperform relative to the risks taken on by impact investors. Moreover, the underperformance is such that returns are negative over the entire study period (see Table 3).

Looking at the other factors, we find that with a $\beta_{MRP} < 1$, the Impact Investing Index and the four benchmark indices are defensive assets, and therefore underreact to market volatility. All five indices have a positive and statistically significant β_{SMB}, meaning that part of the excess return is a reward for firm-size risk, which is in line with all five indices being small and micro cap-oriented. The value premium and the persistence of past returns also seem to explain variations in indices' excess returns.[28]

The Impact Investing Index's regression has the lowest R-squared value. This suggests that factors other than those found in the four-factor model may play some role in the specific context of impact investing. A multifactor model for impact investments might need to include a factor linked to the social and environmental mission of impact companies. Such a factor may negatively weigh on impact companies' excess returns. However, this will likely not prevent impact investors from investing in impact companies, given their high interest in the societal mission of these firms.

[27] We ran four-factor multiple linear regressions in line with the asymptotic Gauss-Markov assumptions for time series regression. Dickey-Fuller tests and autocorrelation functions confirmed the stationarity and weak dependence of the series, respectively. The regressions did not suffer from multicollinearity issues, with Variance Inflation Factors (VIF) below 2.5. White's tests revealed the presence of heteroskedasticity in the residuals of all regressions. Hence, we used White's heteroskedasticity-consistent standard errors. Durbin-Watson tests confirmed the presence of autocorrelation in the residuals of one regression, for which we used Newey-West standard errors that deal with both heteroskedasticity and autocorrelation issues.

[28] Table A6 in the Appendix A presents the results of the four-factor model estimation for reduced impact investing indices. The results confirm the underperformance of impact investing indices. We also ran four-factor model regressions using monthly data (see Table IA.3 in the Internet Appendix), and the results are in line with our main findings.

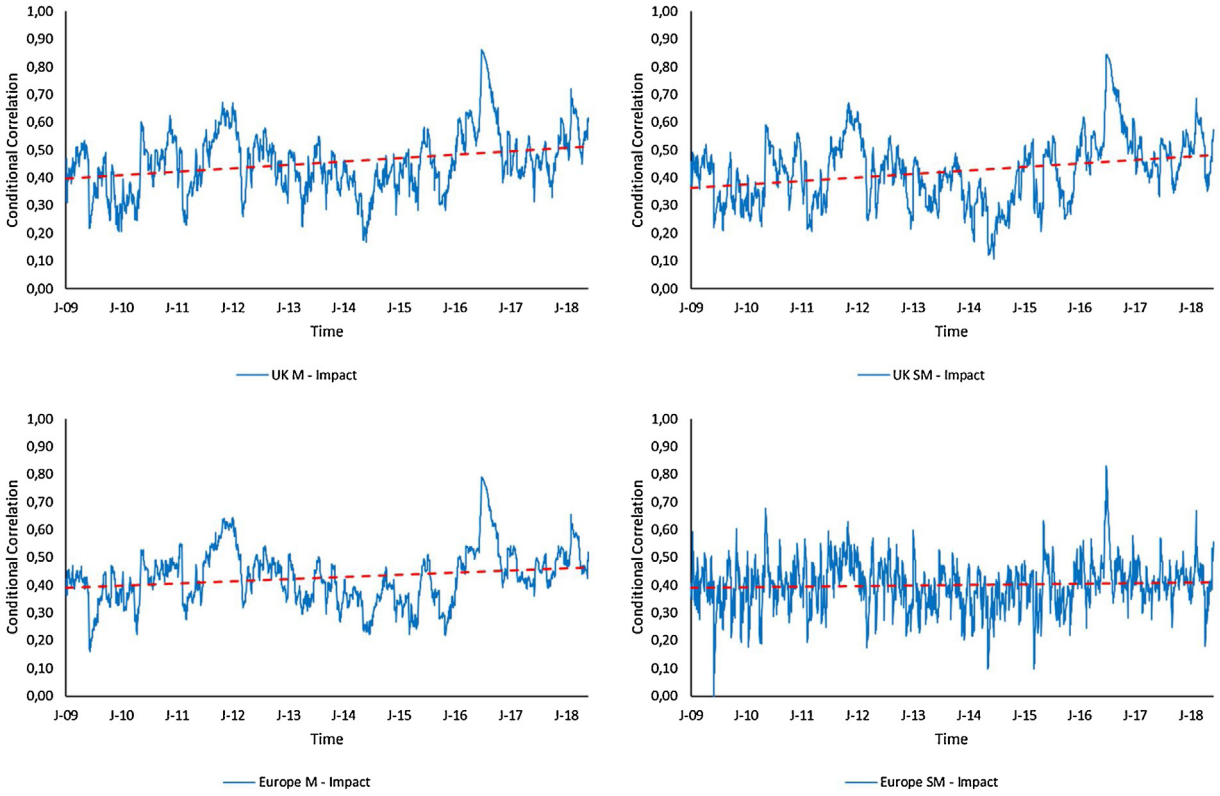

Fig. 2. Dynamic Conditional Correlation (DCC) between the Impact Investing Index and the four MSCI benchmark indices ('J-09' stands for 'January 2009').

That being said, the results in Table A7 in the Appendix A show that the Impact Investing Index's underperformance disappears in the post-2014 period (positive and non-significant alpha). These results are in line with the descriptive findings documented in Section 3.2.4, and indicate that impact firms' risk-adjusted performance improved in later years. Yet, given our findings over the entire study period, the fact that some impact firms in our sample have been listed for more than a decade suggests that negative returns may not necessarily be perceived as a drawback by impact investors, as discussed in Section 6.

4.2. Diversification potential

With regard to the DCC-MVGARCH estimation results, Box-Pierce testing on squared standardized residuals led us to consider the univariate GARCH(1, 1) specification as the most appropriate for the data. The only exception is the pair of indices associated with the MSCI UK Micro Cap, for which we used the univariate GARCH(1, 2) specification.[29] Table 6 presents the results of the two-step estimation procedure. In the first step, univariate GARCH models were estimated (parameters are μ, α_0, α_1, β_1 and β_2). In the second step, the parameters A and B of the dynamic correlation were estimated. The majority of the coefficients have a strong statistical significance, often at the 1% level. This is particularly true for two of the three lagged values in the variance equation (α_1 and β_1), which reflects time-varying volatility.

Fig. 2 shows the evolution of the four dynamic conditional correlations. The two dynamic correlations with MSCI UK indices follow a similar pattern, while there are differences in the two dynamic correlations with MSCI European indices. Thus, the graphs indicate that the Impact Investing Index is similarly correlated to the two MSCI UK indices, but differently correlated to the two MSCI European indices. Moreover, looking at the red trend lines, the four graphs suggest an average conditional correlation that lies between 35 % and 50 %[30], and slightly increases over time (between five and ten percentage points) for three pairs out of four.[31] These results are in line with (though to a less pronounced extent) the preliminary findings on unconditional correlations: on average, the degree of co-movement increases over time, implying a decrease in the Impact Investing Index's diversification potential with regard to traditional indices.[32] Figs. A5 and A6 in the Appendix A suggest that the post-2014 period is when the correlations increased.[33]

Assuming that MSCI benchmark indices are well-diversified, the increase in correlation can be explained in two ways that need not be mutually exclusive. Firstly, the growing number of firms within

[29] The GARCH(1, 2) specification is $h_{i,t} = \alpha_{i0} + \alpha_{i1} u^2_{i,t-1} + \beta_{i1} h_{i,t-1} + \beta_{i2} h_{i,t-2}$.

[30] It is difficult to decide how to determine whether those figures are indicative of a 'high' or 'low' degree of diversification as, to the best of our knowledge, there exists no formal demarcation threshold between the two. In fact, the lower the correlation, the better for diversification purposes. As a point of comparison, De Santis and Gerard (1997) find an average correlation of 43% between stock indices of G7 countries (and Switzerland) over a 25-year period, while Goetzmann and Kumar (2008) find average correlations of between 13 % and 34 % for equity portfolios of US households over a six-year period.

[31] The average conditional correlation stagnates for the pair of indices associated with the MSCI Europe Small + Micro Cap.

[32] Tables A8 and A9, as well as Figs. A3 and A4 in the Appendix A present the results of the DCC analysis with reduced impact investing indices. These results are in line with and support our main findings. We also tested the robustness of our main results via the three-step estimation of both DCC and ADCC models using either GARCH or EGARCH univariate specifications. Table IA.4 in the Internet Appendix presents the results of log-likelihood ratio tests that confirmed the relevance of the DCC model over the ADCC model. Table IA.6 presents the estimation results of three-step DCC-MV(E)GARCH models with all three impact investing indices. The univariate specification for each pair of indices is determined based on the AIC, as reported in Table IA.5. Finally, the evolution of dynamic conditional correlations shown in Figures IA.4 to IA.6 confirms the robustness of our main findings.

[33] See Tables A10 and A11 for coefficient estimates.

Table 7
Mean-variance portfolio analysis.

Portfolio Type	MSCI World	MSCI Emerging Markets	IBOXX Overall	Crude Oil WTI	Gold Bullion	Impact Investing Index	Sharpe Ratio	Value-at-Risk
Panel A: overall sample								
Mainstream	−0.186	0.218	0.986	−0.002	−0.016	0.000	0.630	−0.009
Impact	0.424	−0.206	0.892	−0.032	−0.014	−0.064	1.722	−0.007
Panel B: pre-2014								
Mainstream	0.192	−0.164	0.938	0.146	−0.112	0.000	1.263	−0.010
Impact	0.424	−0.206	0.892	−0.032	−0.014	−0.064	1.821	−0.007
Panel C: post-2014								
Mainstream	0.288	0.042	0.872	−0.084	−0.118	0.000	1.530	−0.007
Impact	0.424	−0.206	0.892	−0.032	−0.014	−0.064	1.630	−0.005

Note: this table presents the results of a mean-variance portfolio analysis with no short-selling restrictions. Weekly data in Panels A and B both start on 5 January 2009, and end on 31 May 2018 and 31 December 2013, respectively. Weekly data in Panel C start on 1 January 2014 and end on 31 May 2018. Each of the three panels presents two portfolios. The 'Impact' portfolio extends the initial possible universe of the 'Mainstream' portfolio by adding the Impact Investing Index to the list of assets. Mainstream assets are equity (MSCI World and MSCI Emerging Markets), investment grade bonds (IBOXX Overall Index) and commodities (Crude Oil WTI and Gold Bullion). Columns 2–7 report the weights attached to each asset to maximize the portfolio's Sharpe ratio, presented in column 8. Finally, the historical Value-at-Risk of the portfolio is presented in column 9.

the Impact Investing Index may contribute to a higher level of diversification in the index. Secondly, the transformative nature of the impact investing industry over the past decade may have changed the return dynamics among firms within the Impact Investing Index. The latter explanation is supported by the construction and use of an alternative Impact Investing Index consisting of only the nine impact firms that were listed as of January 2009. Fig. A7 in the Appendix A shows the evolution of the four dynamic correlations, using this alternative Impact Investing Index. It clearly shows that the increase in correlation remains present even with no further firms being added to the Impact Investing Index (see also Table A12 in the Appendix A, for coefficient estimates).

As impact companies survive in public markets, these results suggest that impact investors do not attach much weight to the decreasing diversification potential of impact investments with regard to mainstream markets. This may be due to investors' intrinsic social preferences (Riedl & Smeets, 2017), or to the growing level of diversification within listed impact investing. It is nevertheless worth observing that investors may improve their portfolio performance by short selling impact firms. Taking the perspective of an international investor in equity, bonds and commodities, results of the mean-variance analysis presented in Table 7 show that the portfolio's Sharpe ratio and Value-at-Risk may be improved when short selling the Impact Investing Index (weight of −6.4 %), independent of the time period under consideration.[34]

5. Robustness checks

The empirical analysis performed in this paper is based on comparing an Impact Investing Index consisting of 16 firms with MSCI indices composed of several hundreds of companies. While this approach has the advantage of being straightforward, one may argue that the results are driven by the small number of constituents of the Impact Investing Index compared to benchmark indices. In order to address this issue, we constructed two new benchmark indices, each of which also consists of 16 companies. We then reassessed the financial performance and diversification potential of the Impact Investing Index with regard to those two new indices, using the same empirical methodology as presented in Sections 3.2.1 and 3.3.1.

The MSCI UK and Europe Small + Micro Cap indices, composed of 692 and 2377 companies, respectively, on 31 May 2018, served as initial possible universes for the construction of the two new benchmark indices. We applied a selection process based on two criteria[35] — sector representation and market capitalization proximity — to select the 16 firms that composed each of the two new indices. More precisely, we first singled out the seven sectors within the MSCI UK and Europe Small + Micro Cap indices that matched the seven sectors of the impact sample. We then selected firms within each sector, based on market capitalization data as of 31 May 2018. For instance, three firms in the impact sample belong to the real estate sector (see Table A2 in the Appendix A). Hence, we selected the three companies within the MSCI real estate sector that were closest to those three impact firms in terms of market capitalization as of 31 May 2018. The selection process led to the construction of the two new traditional benchmark indices: the UK Index and the European Index.[36] Market capitalization figures for the UK Index, the European Index and the Impact Investing Index are presented in Table 8, which shows that the two new benchmark indices are closer in terms of market capitalization to the Impact Investing Index than the four MSCI benchmark indices used in the main analysis (see Tables 1 and 2).

Table 8
Robustness analysis: market capitalization data.

Constituent Sizes (M. Cap. in USDm)	Impact Investing Index	UK Index	European Index
Average	259	246	262
Largest	1 797	1 783	1 806
Smallest	0.47	0.52	0.52

Note: M. Cap. (market capitalization) data for the Impact Investing Index and the two indices constructed for robustness-check purposes. For each index, the average, largest and smallest market capitalization is presented. Data for both the UK and European Index are from MSCI as of 31 May 2018. The same holds for impact firms' market capitalization data from Datastream. All data are in USDm.

Tables A13 and A15, as well as Fig. A8 in the Appendix A show that the results of the assessment of the Impact Investing Index's financial performance are largely unchanged with respect to the main analysis. The only two qualitative changes are that (i) the European Index's alpha is slightly below the Impact Investing Index's, and (ii) the UK Index has a slightly higher volatility than the Impact Investing Index. Robustness checks for the assessment of the Impact Investing Index's diversification potential are more nuanced. Even though the results presented in Table A14 in the Appendix A show a significant increase in correlation between the

[34] We thank an anonymous referee for suggesting this analysis.

[35] Belghitar, Clark, and Deshmukh (2014) also apply a selection process based on industrial classification and market capitalization proximity to match conventional and socially responsible companies.

[36] It must be noted that the UK Index and the European Index do not contain any of the 16 impact firms that constitute the Impact Investing Index.

first and second half of the sampling period for the pair associated with the UK Index, there seems to be no increase in Fig. A9 in the Appendix A.[37] As for the pair associated with the European Index, both Table A14 and Fig. A9 point to a stable correlation over time. These results are not necessarily surprising, since the two new benchmark indices have the same number of constituents as the Impact Investing Index, and are also quite close to it in terms of sectors represented and market capitalization figures.

6. Discussion

Overall, our results show that, over the entire period under study, investors who committed to listed impact firms had to accept returns that underperformed relative to risks and that often turned negative, even though impact firms' performance improved in later years. Our findings also suggest that the diversification potential of impact investments with regard to mainstream markets decreased over time. Hence, from a financial perspective, listed impact investments are not particularly appealing to investors. Yet the fact that some impact firms have been listed for more than a decade suggests that some investors do not perceive the underperformance of their impact investments as a drawback. There are several possible reasons for such behavior on the part of these investors.

For example, investors may be funding impact firms in spite of capital losses because those firms pay dividends that offset the losses (although the fact that our results rely on dividend-adjusted series would tend to invalidate this hypothesis). Moreover, our findings do not imply that impact firms' business models are not viable. Indeed, even though some of the impact firms from our sample have lost money in the past few years, others have generated constant profit. Most importantly, three of the four firms with the largest average market size have been constantly profitable in the past few years.

Investors may also be investing a more or less substantial share of their wealth into impact companies for signaling purposes. Riedl and Smeets (2017) have clearly demonstrated this in the context of socially responsible investing: investors who are prone to talking extensively about their investments are also more likely to invest in socially responsible mutual funds. In the same vein, Bénabou and Tirole (2006) explain that noticeable prosocial deeds can encourage prosocial behavior for self-image reasons.

Another explanation is the presence in the market of investors who derive non-financial utility from their investments. Such profit-sacrificing investors may knowingly accept a below-market rate of return if this allows them to generate some positive non-financial impact through their investments. This is in line with Bollen (2007) suggestion that socially responsible investors have a multi-attribute utility function Bollen's (2007). Similarly, Barigozzi and Tedeschi (2015) talk about social entrepreneurs receiving a nonmonetary premium for the launching of ethical and socially responsible projects. According to Morduch and Ogden (2018), what makes impact investment different is precisely '*the willingness to accept a financial trade-off*'. They argue that, in the absence of such a trade-off, traditional investors would be likely to fund impact companies and thus, there would be no need for impact investors. The cut in financial utility one may be ready to accept in order to invest according to one's values must not be underestimated. Indeed, Riedl and Smeets (2017) have demonstrated that intrinsic social preferences supplant financial motives in socially responsible investors' decisions. They have also confirmed the statement made by Barigozzi and Tedeschi (2015) that socially responsible investors may expect a lower financial return on their investments compared to conventional investors.

As to the level of diversification with regard to mainstream markets, the fact that this may not be of primary importance to impact investors is not necessarily surprising. Barreda-Tarrazona et al. (2011) found that socially responsible investors gave only limited weight to diversification in their investment decisions and, more recently, Riedl and Smeets (2017) reported that '*only* 5.4 *% of all socially responsible investors indicate that they hold SRI funds to pursue diversification benefits*'. Hence, even though impact investors may place some importance on diversification within impact investing, diversification with regard to mainstream markets seems not to be their primary objective.

7. Conclusion

Interest in impact investments has increased over recent years (Barber et al., 2021; Chowdhry et al., 2019). However, both the industry and research field are still in their infancy (Höchstädter & Scheck, 2015), and various aspects of impact investments' financial performance and diversification potential, notably with regard to mainstream markets, remain unclear.

Our objective in this paper was to contribute to the literature by providing a formal assessment of impact investing, relying exclusively on public data. To this end, we constructed an Impact Investing Index essentially made of European listed impact firms within the UK's Impact Group. We assessed the index's financial performance and diversification potential using several MSCI indices as benchmarks.

Our results contradict non-academic performance studies on private impact funds (see Mudaliar & Bass, 2017), which argue that market-rate financial returns are within reach in impact investing, and go beyond the results of Barber et al. (2021) who concluded that the returns were below market, yet positive. Indeed, not only do our results point to a risk-adjusted underperformance, they also reveal impact firms' failure to deliver non-negative returns to investors, even though performance improved post-2014. These results are in line with the argument set out by Morduch and Ogden (2018) and Chowdhry et al. (2019) that impact investments are financially costly. As for impact investments' diversification potential, the results suggest an increase in the degree of co-movement with traditional indices, implying that the diversification potential of listed impact firms with regard to mainstream markets slowly decreases over time. These findings are consistent with those of Brière and Szafarz (2015) in the context of listed microfinance.

Overall, a generalization of our findings to a larger population of impact firms would likely show a decrease in the financial appeal of impact investments, which may in turn impede the development of the industry. Accordingly, despite recent improvements in financial performance, the rapid growth of the industry, and more particularly the survival of listed impact firms, hints at the presence in the market of investors who derive non-financial utility from their investments (Chowdhry et al., 2019). It is therefore crucial for future research to assess whether our findings apply to a larger population of impact firms. It is also important to investigate the drivers of the financial underperformance of impact investments, particularly with regard to impact firms' business model and organizational structure.

Declaration of Competing Interest

The authors report no declarations of interest.

[37] See Table A16 in the Appendix A for the coefficient estimates of the dynamic conditional correlation modelling.

Acknowledgement

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Appendix A

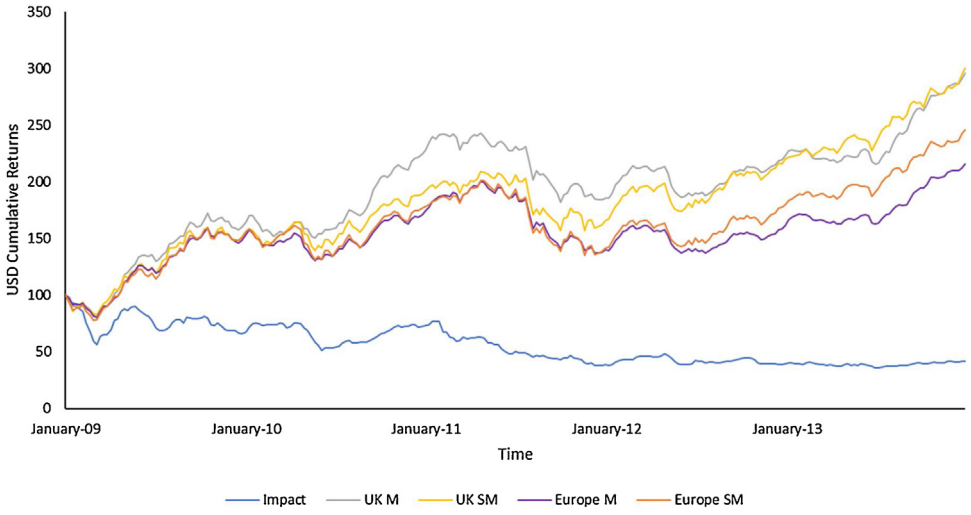

Fig. A1. Evolution of the Impact Investing Index and the four MSCI benchmark indices between 5 January 2009 and 31 December 2013, USD weekly cumulative returns (starting value of 100 on 5 January 2009).

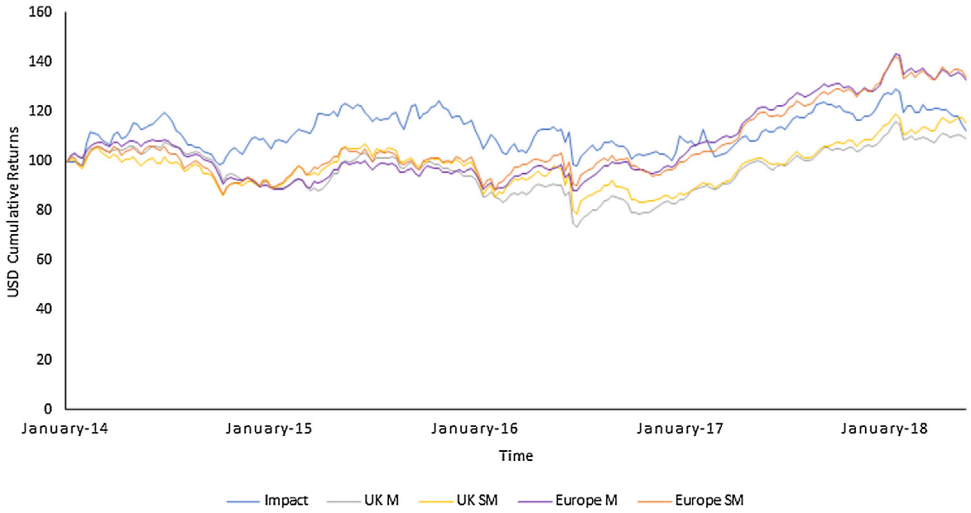

Fig. A2. Evolution of the Impact Investing Index and the four MSCI benchmark indices between 1 January 2014 and 31 May 2018, USD weekly cumulative returns (starting value of 100 on 1 January 2014).

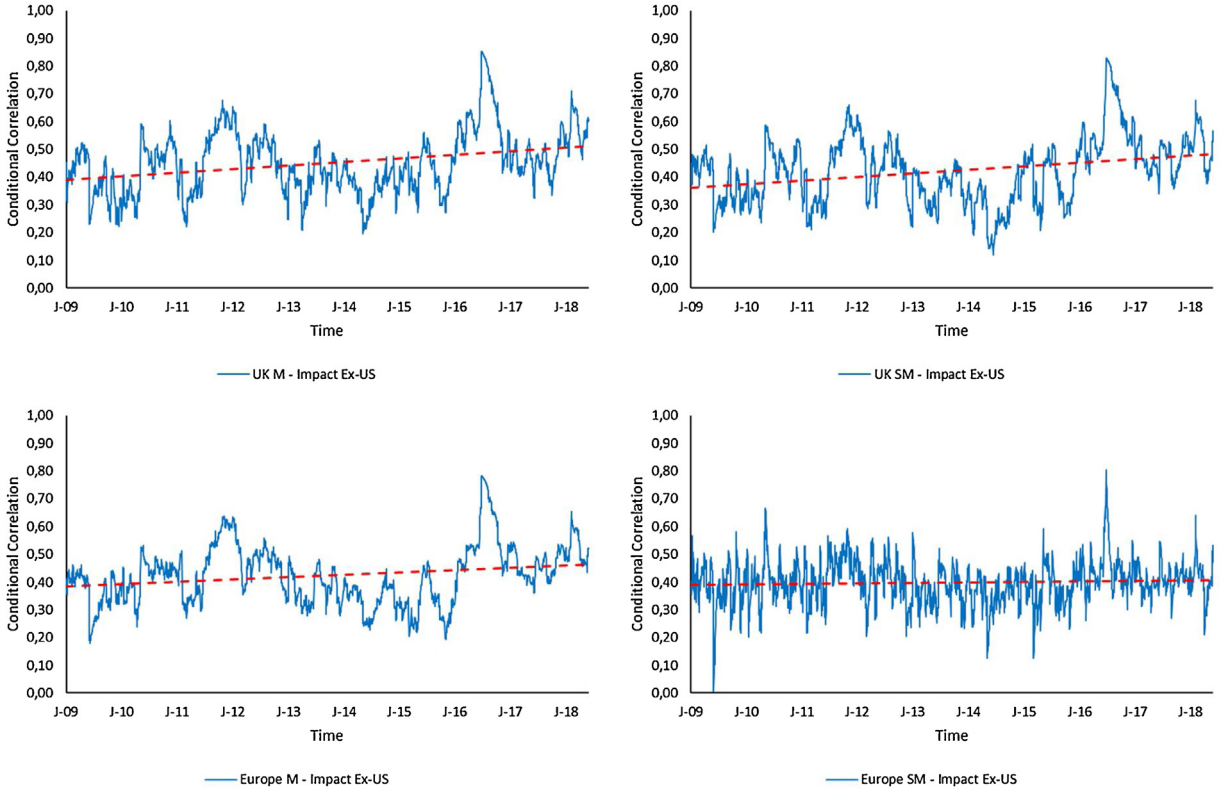

Fig. A3. Dynamic Conditional Correlation (DCC) between the Impact Investing Index (Ex-US) and the four MSCI benchmark indices ('J-09' stands for 'January 2009').

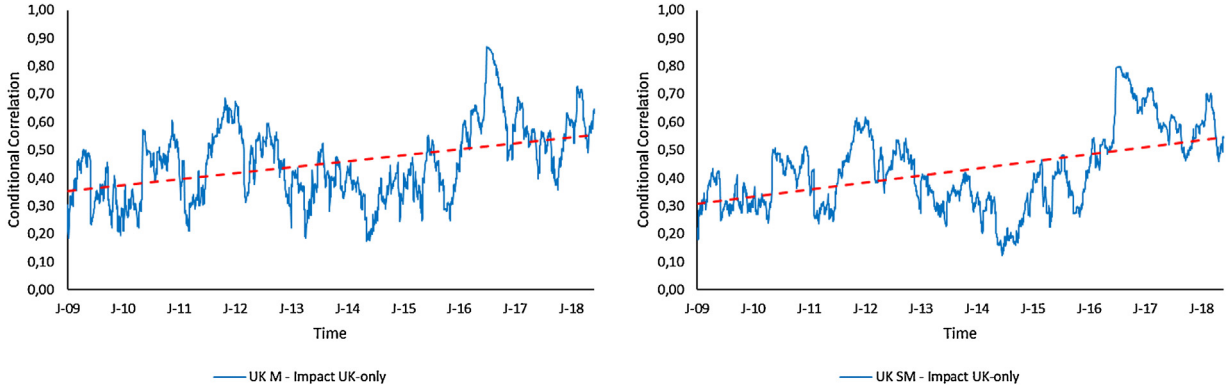

Fig. A4. Dynamic Conditional Correlation (DCC) between the Impact Investing Index (UK-only) and the two MSCI UK benchmark indices ('J-09' stands for 'January 2009').

Table A1
Summary of impact companies' business activities.

Company Name	Business Activities
Accsys Technologies	Produce durable and high-performance wood products as an alternative to resource-depleting and carbon-polluting solutions.
Ashley House	Improve access to better services and environments in the health and affordable housing sectors.
Assura	Invest in and manage healthcare buildings to improve access to NHS services, tests and treatments.
Capital for Colleagues	Advise, invest in and support the growth of the employee-owned business sector.
Good Energy Group	Help households and businesses to generate, store and share renewable energy.
HaloSource	Provide clean water technology solutions to the issue of water stress.
ITM Power	Enhance the use of renewable energy through manufacturing of integrated hydrogen energy solutions.
MagneGas	Convert hydrocarbon-based renewable feedstock into fossil fuel substitutes.
Menhaden Capital	Invest in businesses that deliver or benefit from the efficient use of energy and resources.
Obtala Limited	Produce, manufacture and supply sustainable African hardwood.
Primary Health Properties	Invest in flexible and modern healthcare real estate dedicated to local primary healthcare.
ProCredit Holding	Run development-oriented commercial banks that operate in South Eastern and Eastern Europe as well as in South America.
Ripasso Energy	Produce sustainable electricity through the transformation of heat energy.
SurePure	Offer a greener alternative to pasteurization and chemical-based purification processes.
V22	Enhance the production of social artistic events through shared ownership of an art organization.
Walls & Futures REIT	Address social housing needs through providing homes to vulnerable people.

Note: this table provides a brief summary of each impact company's business activities. Additional information is available on impact companies' websites.

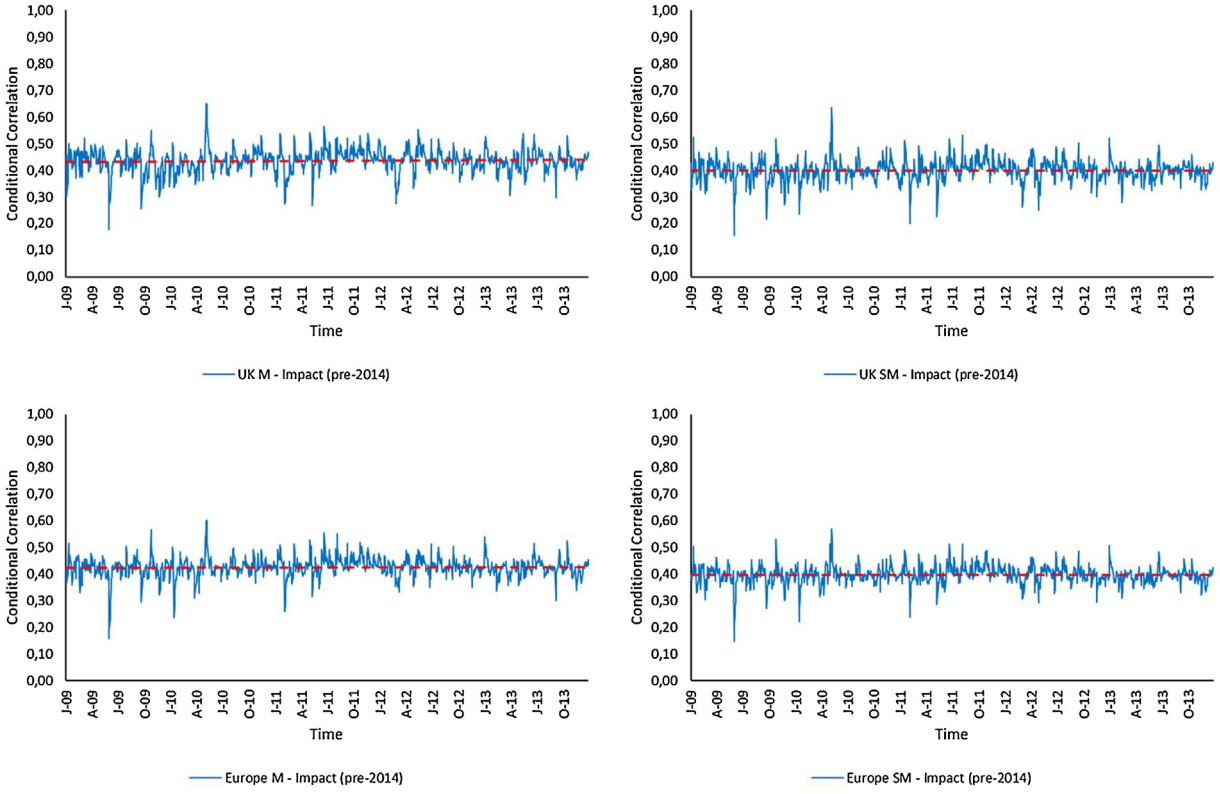

Fig. A5. Dynamic Conditional Correlation (DCC) between the Impact Investing Index and the four MSCI benchmark indices. Series start on 5 January 2009 and end on 31 December 2013 ('J-09' stands for 'January 2009').

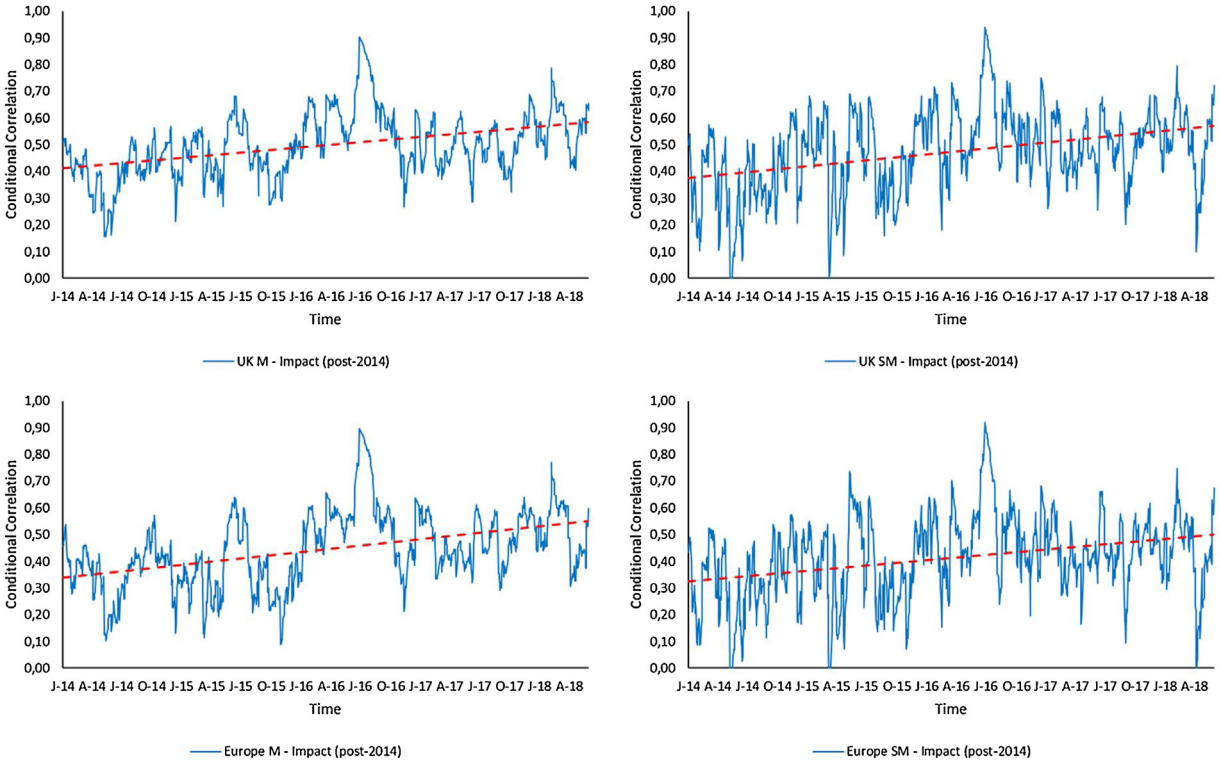

Fig. A6. Dynamic Conditional Correlation (DCC) between the Impact Investing Index and the four MSCI benchmark indices. Series start on 1 January 2014 and end on 31 May 2018 ('J-14' stands for 'January 2014').

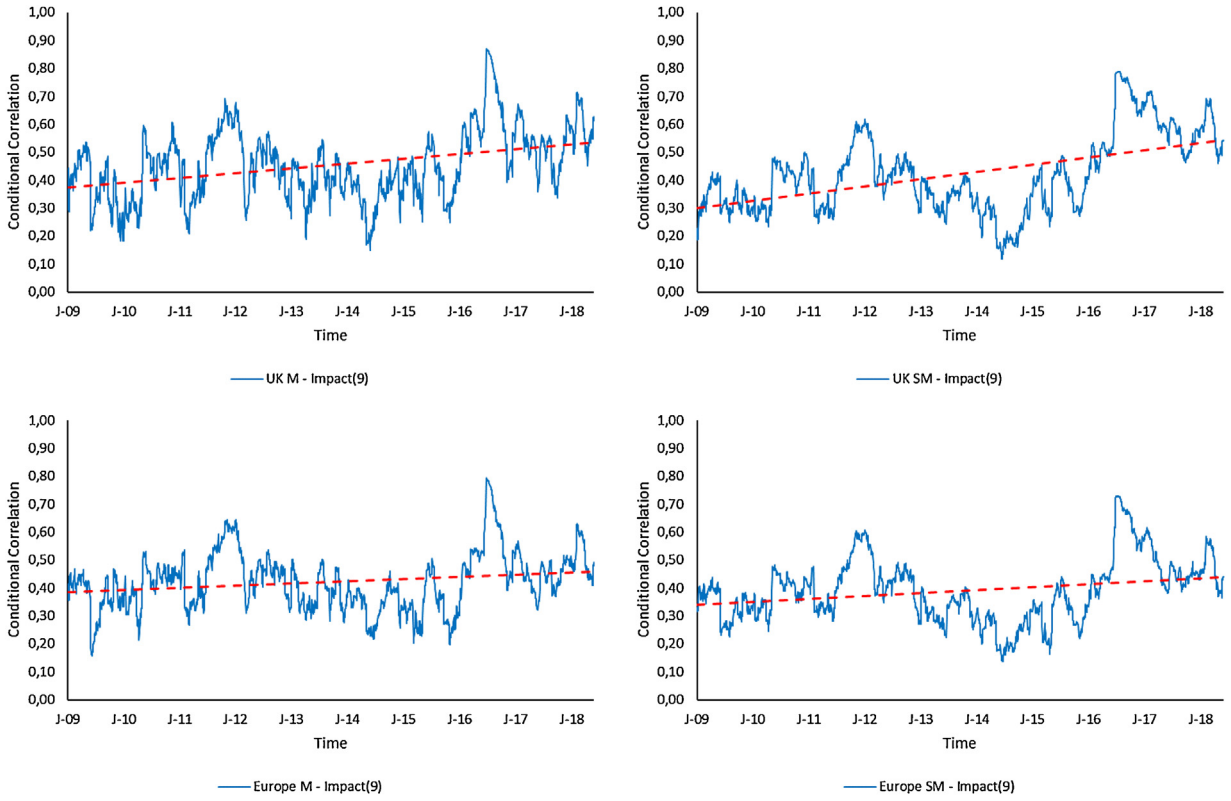

Fig. A7. Dynamic Conditional Correlation (DCC) between the nine-firm Impact Investing Index and the four MSCI benchmark indices ('J-09' stands for 'January 2009').

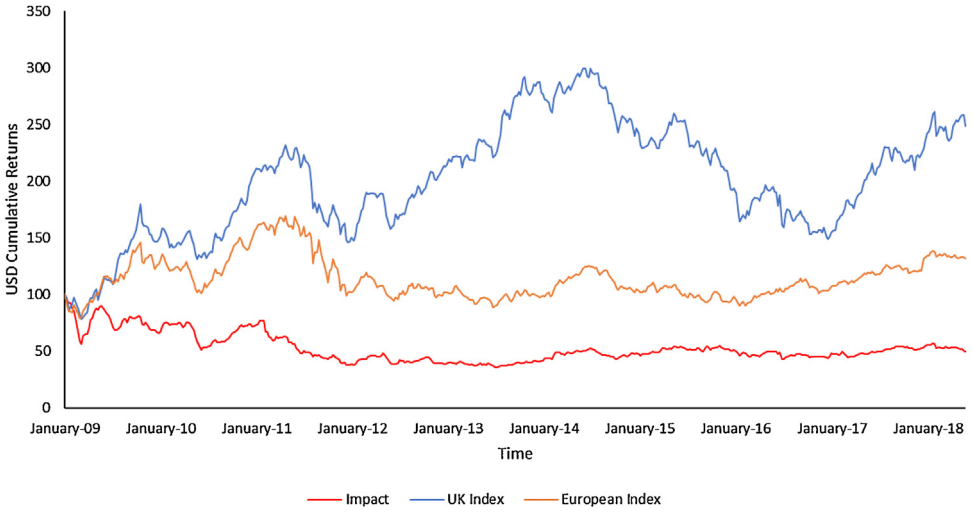

Fig. A8. Evolution of the Impact Investing Index and the two benchmark indices constructed for robustness-check purposes between 5 January 2009 and 31 May 2018, USD weekly cumulative returns (starting value of 100 on 5 January 2009).

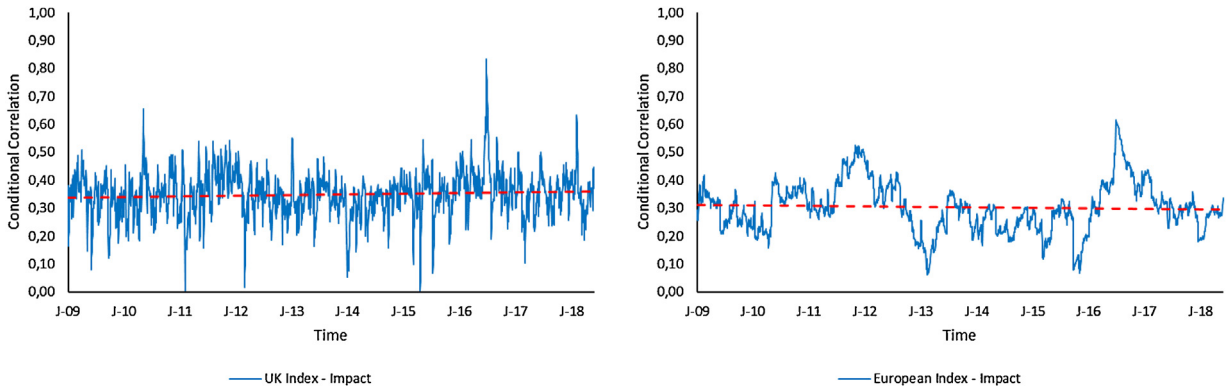

Fig. A9. Dynamic Conditional Correlation (DCC) between the Impact Investing Index and the two benchmark indices constructed for robustness-check purposes ('J-09' stands for 'January 2009').

Table A2
Summary characteristics of impact companies.

Company Name	Inception Year	Stock Exchange	Sector	Currency	Location	Average Market Cap. (USDm)
Accsys Technologies	2005	AIM (London Stock Exchange)	Construction and Materials	GBp (Pence)	UK	246.49
Ashley House	1991	AIM (London Stock Exchange)	Construction and Materials	GBp (Pence)	UK	18.65
Assura	2003	London Stock Exchange	Real Estate	GBp (Pence)	UK	653.76
Capital for Colleagues	2013	NEX Exchange (London)	Financial Services	GBp (Pence)	UK	7.29
Good Energy Group	1999	AIM (London Stock Exchange)	Energy	GBp (Pence)	UK	31.15
HaloSource	1994	AIM (London Stock Exchange)	Technology	GBp (Pence)	USA	44.91
ITM Power	2001	AIM (London Stock Exchange)	Energy	GBp (Pence)	UK	73.36
MagneGas	2007	NASDAQ	Energy	USD	USA	28.29
Menhaden Capital	2015	London Stock Exchange	Financial Services	GBp (Pence)	UK	77.96
Obtala	2007	AIM (London Stock Exchange)	Consumer Goods	GBp (Pence)	UK	69.33
Primary Health Properties	1995	London Stock Exchange	Real Estate	GBp (Pence)	UK	385.29
ProCredit Holding	1998	Frankfurt Stock Exchange	Financial Services	EUR	DE	809.73
Ripasso Energy	2008	NGM Nordic MTF, Börse Stuttgart	Energy	SEK	SE	42.13
SurePure	2005	OTCQB (OTC Markets Group)	Technology	USD	USA	17.70
V22	2006	NEX Exchange (London)	Retail	GBp (Pence)	UK	0.55
Walls & Futures REIT	2008	NEX Exchange (London)	Real Estate	GBp (Pence)	UK	3.65

Note: summary characteristics of the final impact sample's constituents. Inception Year, Stock Exchange, Sector, Currency and Location data come from constituents' websites and research reports published on the Impact Group's website. Average Market Cap. stands for the USDm average daily market capitalization of the company during its presence in the impact sample. Market capitalization data come from Datastream.

Table A3
Summary statistics of impact companies' weekly financial return series.

Company Name	Start Date	End Date	Annualized Return (%)	Maximum (%)	Minimum (%)	Skewness	Kurtosis
Accsys Technologies	05-01-09	31-05-18	−27.80	25.69	−29.94	0.02	4.02
Ashley House	05-01-09	31-05-18	−22.70	37.09	−23.48	1.11	8.83
Assura	05-01-09	31-05-18	3.13	5.18	−13.83	0.07	4.50
Capital for Colleagues	24-03-14	31-05-18	−11.36	16.10	−20.42	−5.14	44.96
Good Energy Group	05-01-09	31-05-18	4.22	24.28	−35.12	−0.14	10.61
HaloSource	18-10-10	31-05-18	−48.64	25.10	−69.59	−4.21	32.98
ITM Power	05-01-09	31-05-18	−7.64	40.09	−30.76	1.11	3.98
MagneGas	05-01-09	31-05-18	−61.46	81.03	−57.35	1.18	7.40
Menhaden Capital	29-06-15	31-05-18	−17.24	8.36	−10.90	−1.13	5.22
Obtala	05-01-09	31-05-18	−17.76	26.68	−27.86	0.19	4.20
Primary Health Properties	05-01-09	31-05-18	8.89	11.08	−9.50	0.04	3.91
ProCredit Holding	26-12-16	31-05-18	−7.57	21.53	−18.01	0.57	7.51
Ripasso Energy	05-12-16	31-05-18	13.02	50.25	−29.49	1.81	6.65
SurePure	19-09-11	31-05-18	−73.65	74.83	−53.03	0.78	6.19
V22	05-01-09	31-05-18	−13.97	59.26	−68.29	−1.45	30.42
Walls & Futures REIT	05-12-16	31-05-18	−7.29	5.94	−15.67	−2.97	13.87

Note: summary statistics of the USD weekly financial return series of the 16 impact companies. Start Date and End Date are the dates at which the series begin and end, respectively. Skewness measures the degree of asymmetry of the returns' distribution. Kurtosis is evidence of fat tails in the returns' distribution.

Table A4
Performance statistics pre- and post-2014.

Index	Annualized Return (%)	Volatility (%)
Panel A: pre-2014		
Impact Investing Index	−15.77	3.40
MSCI UK Micro Cap	26.21	2.28
MSCI UK Small + Micro Cap	26.52	2.72

Table A4 (*Continued*)

Index	Annualized Return (%)	Volatility (%)
MSCI Europe Micro Cap	17.50	2.26
MSCI Europe Small + Micro Cap	20.65	2.83
Panel B: post-2014		
Impact Investing Index	3.89	2.16
MSCI UK Micro Cap	2.19	1.74
MSCI UK Small + Micro Cap	3.53	2.13
MSCI Europe Micro Cap	7.01	1.46
MSCI Europe Small + Micro Cap	7.03	1.81

Note: performance statistics of the USD weekly financial return series of the Impact Investing Index and the four MSCI benchmark indices. Series in Panel A start on 5 January 2009 and end on 31 December 2013, while series in Panel B start on 1 January 2014 and end on 31 May 2018. Volatility is proxied by the unconditional standard error of weekly returns.

Table A5
Unconditional correlations between reduced impact investing indices and MSCI benchmark indices.

Benchmark Index	MSCI UK Micro Cap	MSCI UK Small + Micro Cap	MSCI Europe Micro Cap	MSCI Europe Small + Micro Cap
Panel A: Impact Investing Index (Ex-US)				
First Half Correlation (%)	42.93***	41.05***	41.45***	40.35***
Second Half Correlation (%)	60.87***	58.05***	53.98***	50.89***
Fisher's r-to-z Test (P-value)	0.00	0.00	0.00	0.00
Panel B: Impact Investing Index (UK-only)				
First Half Correlation (%)	42.93***	41.05***	–	–
Second Half Correlation (%)	63.12***	59.90***	–	–
Fisher's r-to-z Test (P-value)	0.00	0.00	–	–

Note: unconditional correlations (%) between reduced impact investing indices and each of the four MSCI benchmark indices. The Impact Investing Index (Ex-US) consists only of European impact companies (UK firms included; Panel A), whereas the Impact Investing Index (UK-only) consists exclusively of UK impact companies (Panel B). Two correlations, one for the first half and one for the second half of the sampling period, are presented for each pair. Fisher's r-to-z tests test for the null hypothesis of equality between the two correlation coefficients. *** indicates statistical significance at the 1% level.

Table A6
Four-factor model estimation results with reduced impact investing indices.

Index	α	β_{MRP}	β_{SMB}	β_{HML}	β_{WML}	R^2
Panel A: Impact Investing Index (Ex-US)						
Impact Investing Index (Ex-US)	−0.0039***	0.7375***	1.1970***	−0.1982	−0.1706	0.28
	(0.0012)	(0.0683)	(0.1778)	(0.1423)	(0.1203)	
MSCI UK Micro Cap	−0.0008	0.2314***	0.7140***	0.1939***	−0.1455***	0.26
	(0.0006)	(0.0539)	(0.0902)	(0.0710)	(0.0509)	
MSCI UK Small + Micro Cap	−0.0001	0.4115***	0.7280***	0.2129**	−0.1874***	0.33
	(0.0007)	(0.0689)	(0.1011)	(0.0985)	(0.0526)	
MSCI Europe Micro Cap	−0.0007	0.6212***	1.0743***	0.0010	−0.0804	0.56
	(0.0006)	(0.0296)	(0.0880)	(0.0675)	(0.0495)	
MSCI Europe Small + Micro Cap	0.0001	0.7461***	1.0408***	0.0770	−0.1302***	0.58
	(0.0006)	(0.0381)	(0.0943)	(0.0757)	(0.0488)	
Panel B: Impact Investing Index (UK-only)						
Impact Investing Index (UK-only)	−0.0043***	0.3608***	0.7014***	0.0924	−0.1633	0.11
	(0.0013)	(0.0674)	(0.1512)	(0.1329)	(0.1089)	

Note: coefficient estimates for the four-factor model linear regressions using factors from European countries. The indices considered are the two reduced impact investing indices and the four MSCI benchmark indices. The Impact Investing Index (Ex-US) consists only of European impact companies (UK firms included; Panel A), whereas the Impact Investing Index (UK-only) consists exclusively of UK impact companies (Panel B). The Impact Investing Index (UK-only) specification from Panel B is to be compared to both MSCI UK specifications from Panel A. The one-month UK government bond yield is used as risk-free rate for specifications with the Impact Investing Index (UK-only) as well as MSCI UK indices. The one-month German government bond yield is used as risk-free rate for specifications with the Impact Investing Index (Ex-US) as well as MSCI European indices. α is the intercept of the model, while β_{MRP}, β_{SMB}, β_{HML} and β_{WML} are the four factor loadings. Robust standard errors are in parentheses. ** and *** indicate statistical significance at the 5% and 1% levels, respectively.

Table A7
Four-factor model estimation results pre- and post-2014.

Index	α	β_{MRP}	β_{SMB}	β_{HML}	β_{WML}	R^2
Panel A: pre-2014						
Impact Investing Index	−0.0046**	0.4532***	1.5083***	0.5543**	−0.4221***	0.27
	(0.0021)	(0.0959)	(0.3133)	(0.2737)	(0.1276)	
MSCI UK Micro Cap	−0.0007	0.2068***	1.1223***	0.3794***	−0.3366***	0.39
	(0.0009)	(0.0567)	(0.1538)	(0.1212)	(0.0611)	
MSCI UK Small + Micro Cap	0.0001	0.3962***	0.9697***	0.5489***	−0.3573***	0.44
	(0.0010)	(0.0707)	(0.1760)	(0.1663)	(0.0735)	
MSCI Europe Micro Cap	−0.0049***	0.5015***	1.1073***	0.2788**	−0.2089***	0.47
	(0.0010)	(0.0427)	(0.1731)	(0.1446)	(0.0704)	

Table A7 (*Continued*)

Index	α	β_{MRP}	β_{SMB}	β_{HML}	β_{WML}	R^2
MSCI Europe Small + Micro Cap	−0.0029**	0.6370***	1.1263***	0.5070***	−0.2939***	0.54
	(0.0011)	(0.0528)	(0.1967)	(0.1626)	(0.0802)	
Panel B: post-2014						
Impact Investing Index	0.0004	0.4063***	0.6882***	0.4596***	0.0597	0.13
	(0.0013)	(0.1196)	(0.1901)	(0.1707)	(0.1385)	
MSCI UK Micro Cap	−0.0015*	0.0762	0.3670***	0.2215**	−0.0230	0.07
	(0.0008)	(0.1163)	(0.1230)	(0.1107)	(0.0867)	
MSCI UK Small + Micro Cap	−0.0010	0.2706	0.6790***	0.1843	−0.1061	0.15
	(0.0010)	(0.1753)	(0.1725)	(0.1366)	(0.1077)	
MSCI Europe Micro Cap	0.0038***	0.4498***	0.7346***	0.3250***	0.0583	0.38
	(0.0008)	(0.0655)	(0.1221)	(0.1113)	(0.0853)	
MSCI Europe Small + Micro Cap	0.0025***	0.6524***	0.8970***	0.2998**	0.0180	0.45
	(0.0009)	(0.0908)	(0.1571)	(0.1272)	(0.0965)	

Note: coefficient estimates for the four-factor model linear regressions using factors from developed countries. The indices considered are the Impact Investing Index and the four MSCI benchmark indices. Series in Panel A start on 5 January 2009 and end on 31 December 2013, while series in Panel B start on 1 January 2014 and end on 31 May 2018. The one-month US, UK and German government bond yields are used as risk-free rates for specifications with the Impact Investing Index, MSCI UK indices and MSCI European indices, respectively. α is the intercept of the model, while β_{MRP}, β_{SMB}, β_{HML} and β_{WML} are the four factor loadings. Robust standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A8
DCC-MVGARCH estimation results with the Impact Investing Index (Ex-US).

Index	μ	α_0	α_1	β_1	β_2	A	B
Impact Investing Index (Ex-US)	0.0005**	0.1560e–4*	0.2535***	0.3039***	0.4078***	–	–
	(0.0002)	(0.0860e–4)	(0.0740)	(0.0973)	(0.1121)		
MSCI UK Micro Cap	0.0006***	2.3283e–6***	0.1560***	0.4295**	0.3906**	–	–
	(0.0001)	(0.8462e–6)	(0.0360)	(0.1851)	(0.1738)		
I.I. Index (Ex-US)/MSCI UK Micro Cap	–	–	–	–	–	0.0240***	0.9693***
						(0.0064)	(0.0097)
Impact Investing Index (Ex-US)	0.0004*	0.1144e–4	0.1907***	0.7869***	–	–	–
	(0.0002)	(0.0714e–4)	(0.0651)	(0.0770)			
MSCI UK Small + Micro Cap	0.0008***	0.0335e–4***	0.1139***	0.8665***	–	–	–
	(0.0002)	(0.0106e–4)	(0.0225)	(0.0224)			
I.I. Index (Ex-US)/MSCI UK Small + Micro Cap	–	–	–	–	–	0.0229***	0.9701***
						(0.0088)	(0.0154)
MSCI Europe Micro Cap	0.0006***	1.3516e–6***	0.0954***	0.8877***	–	–	–
	(0.0001)	(0.5112e–6)	(0.0212)	(0.0235)			
I.I. Index (Ex-US)/MSCI Europe Micro Cap	–	–	–	–	–	0.0173**	0.9771***
						(0.0068)	(0.0104)
MSCI Europe Small + Micro Cap	0.0007***	0.0216e–4***	0.0984***	0.8881***	–	–	–
	(0.0002)	(0.0075e–4)	(0.0188)	(0.0205)			
I.I. Index (Ex-US)/MSCI Eu. Small + Micro Cap	–	–	–	–	–	0.0415**	0.8558***
						(0.0181)	(0.1107)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the four pairs (the parameters are μ, α_0, α_1, β_1 and β_2), before the parameters A and B of the DCC are estimated. The indices considered are the Impact Investing Index (Ex-US) (present in each of the four pairs) and the four MSCI benchmark indices (one per pair). Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A9
DCC-MVGARCH estimation results with the Impact Investing Index (UK-only).

Index	μ	α_0	α_1	β_1	β_2	A	B
Impact Investing Index (UK-only)	0.0005**	0.1737e–4*	0.2413***	0.2894***	0.4212***	–	–
	(0.0002)	(0.0902e–4)	(0.0725)	(0.0989)	(0.1182)		
MSCI UK Micro Cap	0.0006***	2.3283e–6***	0.1560***	0.4295**	0.3906**	–	–
	(0.0001)	(0.8462e–6)	(0.0360)	(0.1851)	(0.1738)		
I.I. Index (UK-only)/MSCI UK Micro Cap	–	–	–	–	–	0.0239**	0.9747***
						(0.0119)	(0.0164)
Impact Investing Index (UK-only)	0.0005*	0.1264e–4*	0.1823***	0.7864***	–	–	–
	(0.0003)	(0.0745e–4)	(0.0645)	(0.0787)			
MSCI UK Small + Micro Cap	0.0008***	0.0335e–4***	0.1139***	0.8665***	–	–	–
	(0.0002)	(0.0106e–4)	(0.0225)	(0.0224)			
I.I. Index (UK-only)/MSCI UK Small + Micro Cap	–	–	–	–	–	0.0156	0.9844***
						(0.0332)	(0.0390)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the two pairs (the parameters are μ, α_0, α_1, β_1 and β_2), before the parameters A and B of the DCC are estimated. The indices considered are the Impact Investing Index (UK-only) (present in each of the two pairs) and the two MSCI UK benchmark indices (one per pair). Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A10
DCC-MVGARCH estimation results pre-2014.

Index	μ	α_0	α_1	β_1	β_2	A	B
Impact Investing Index	0.0005	0.1190e–4**	0.1765***	0.0410	0.7565***	–	–
	(0.0004)	(0.0600e–4)	(0.0485)	(0.0757)	(0.0981)		
MSCI UK Micro Cap	0.0011***	1.0190e–6	0.0890***	0.2753**	0.6242***	–	–
	(0.0002)	(0.6507e–6)	(0.0253)	(0.1371)	(0.1322)		
I.I. Index/MSCI UK Micro Cap	–	–	–	–	–	0.0358*	0.7075***
						(0.0202)	(0.1226)
Impact Investing Index	0.0004	0.0974e–4	0.1322	0.8491***	–	–	–
	(0.0005)	(0.1295e–4)	(0.1053)	(0.1262)			
MSCI UK Small + Micro Cap	0.0011***	0.0151e–4*	0.0627***	0.9295***	–	–	–
	(0.0003)	(0.0087e–4)	(0.0159)	(0.0169)			
I.I. Index/MSCI UK Small + Micro Cap	–	–	–	–	–	0.0362**	0.6141***
						(0.0151)	(0.2093)
MSCI Europe Micro Cap	0.0010***	0.0086e–4	0.0511***	0.9395***	–	–	–
	(0.0002)	(0.0058e–4)	(0.0141)	(0.0166)			
I.I. Index/MSCI Europe Micro Cap	–	–	–	–	–	0.0305*	0.6388***
						(0.0161)	(0.2280)
MSCI Europe Small + Micro Cap	0.0011***	0.0173e–4	0.0602***	0.9310***	–	–	–
	(0.0003)	(0.0107e–4)	(0.0146)	(0.0166)			
I.I. Index/MSCI Eu. Small + Micro Cap	–	–	–	–	–	0.0292**	0.6243***
						(0.0138)	(0.2301)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the four pairs (the parameters are μ, α_0, α_1, β_1 and β_2), before the parameters A and B of the DCC are estimated. The indices considered are the Impact Investing Index (present in each of the four pairs) and the four MSCI benchmark indices (one per pair). Series start on 5 January 2009 and end on 31 December 2013. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A11
DCC-MVGARCH estimation results post-2014.

Index	μ	α_0	α_1	β_1	A	B
Impact Investing Index	0.0002	0.1733e–4**	0.2119***	0.6818***	–	–
	(0.0003)	(0.0823e–4)	(0.0597)	(0.0744)		
MSCI UK Micro Cap	0.0003	3.7862e–6*	0.1870***	0.7591***	–	–
	(0.0002)	(2.0288e–6)	(0.0528)	(0.0530)		
I.I. Index/MSCI UK Micro Cap	–	–	–	–	0.0444***	0.9307***
					(0.0134)	(0.0221)
MSCI UK Small + Micro Cap	0.0006**	0.0894e–4***	0.1771***	0.7334***	–	–
	(0.0002)	(0.0342e–4)	(0.0365)	(0.0483)		
I.I. Index/MSCI UK Small + Micro Cap	–	–	–	–	0.0806***	0.8631***
					(0.0226)	(0.0448)
MSCI Europe Micro Cap	0.0004**	4.0923e–6**	0.1757***	0.7323***	–	–
	(0.0002)	(1.8474e–6)	(0.0432)	(0.0674)		
I.I. Index/MSCI Europe Micro Cap	–	–	–	–	0.0464***	0.9322***
					(0.0157)	(0.0243)
MSCI Europe Small + Micro Cap	0.0006***	7.9267e–6**	0.1898***	0.7103***	–	–
	(0.0002)	(3.1063e–6)	(0.0477)	(0.0726)		
I.I. Index/MSCI Eu. Small + Micro Cap	–	–	–	–	0.0807***	0.8634***
					(0.0235)	(0.0492)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the four pairs (the parameters are μ, α_0, α_1 and β_1), before the parameters A and B of the DCC are estimated. The indices considered are the Impact Investing Index (present in each of the four pairs) and the four MSCI benchmark indices (one per pair). Series start on 1 January 2014 and end on 31 May 2018. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A12
Robustness analysis: DCC-MVGARCH estimation results (1).

Index	μ	α_0	α_1	β_1	β_2	A	B
Impact Investing Index (9)	0.0005**	0.1641e–4**	0.2340***	0.2940***	0.4261***	–	–
	(0.0002)	(0.0796e–4)	(0.0680)	(0.0975)	(0.1096)		
MSCI UK Micro Cap	0.0006***	2.3283e–6***	0.1560***	0.4295**	0.3906**	–	–
	(0.0001)	(0.8462e–6)	(0.0360)	(0.1851)	(0.1738)		
I.I. Index (9)/MSCI UK Micro Cap	–	–	–	–	–	0.0273***	0.9674***
						(0.0083)	(0.0155)
Impact Investing Index (9)	0.0005*	0.1225e–4*	0.1790***	0.7901***	–	–	–
	(0.0003)	(0.0645e–4)	(0.0590)	(0.0695)			
MSCI UK Small + Micro Cap	0.0008***	0.0335e–4***	0.1139***	0.8665***	–	–	–
	(0.0002)	(0.0106e–4)	(0.0225)	(0.0224)			
I.I. Index (9)/MSCI UK Small + Micro Cap	–	–	–	–	–	0.0149	0.9851***
						(0.0255)	(0.0301)
MSCI Europe Micro Cap	0.0006***	1.3516e–6***	0.0954***	0.8877***	–	–	–
	(0.0001)	(0.5112e–6)	(0.0212)	(0.0235)			
I.I. Index (9)/MSCI Europe Micro Cap	–	–	–	–	–	0.0193**	0.9726***
						(0.0086)	(0.0125)

Table A12 (*Continued*)

Index	μ	α_0	α_1	β_1	β_2	A	B
MSCI Europe Small + Micro Cap	0.0007***	0.0216e–4***	0.0984***	0.8881***	–	–	–
	(0.0002)	(0.0075e–4)	(0.0188)	(0.0205)			
I.I. Index (9)/MSCI Eu. Small + Micro Cap	–	–	–	–	–	0.0138**	0.9846***
						(0.0066)	(0.0102)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the four pairs (the parameters are $\mu, \alpha_0, \alpha_1, \beta_1$ and β_2), before the parameters A and B of the DCC are estimated. The indices considered are the nine-firm Impact Investing Index — Impact Investing Index (9) — (present in each of the four pairs), and the four MSCI benchmark indices (one per pair). The univariate GARCH(1, 2) specification is used for the pair of indices associated with the MSCI UK Micro Cap. The univariate GARCH(1, 1) specification is used for the remaining pairs of indices. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A13
Robustness analysis: summary statistics on indices' weekly financial return series.

Index	Annualized Return (%)	Maximum (%)	Minimum (%)	Volatility (%)	Skewness	Kurtosis	Dickey-Fuller (P-value)
Impact Investing Index	−7.07	12.77	−12.49	2.89	−0.39	3.71	0.00
UK Index	11.20	9.74	−14.16	2.97	−0.47	2.07	0.00
European Index	2.93	8.99	−14.53	2.79	−0.54	2.95	0.00

Note: summary statistics of the USD weekly financial return series of the Impact Investing Index and the two benchmark indices constructed for robustness-check purposes. All series start on 5 January 2009 and end on 31 May 2018. Volatility is proxied by the unconditional standard error of weekly returns. Skewness measures the degree of asymmetry of the returns' distribution. Kurtosis is evidence of fat tails in the returns' distribution. Dickey-Fuller tests for the null hypothesis of a unit root.

Table A14
Robustness analysis: unconditional correlations.

Benchmark Index	UK Index	European Index
First Half Correlation (%)	33.73***	31.26***
Second Half Correlation (%)	48.61***	33.27***
Fisher's r-to-z Test (P-value)	0.00	57.55

Note: unconditional correlations (%) between the Impact Investing Index and the two benchmark indices constructed for robustness-check purposes. Two correlations, one for the first half and one for the second half of the sampling period, are presented for each pair. Fisher's r-to-z tests test for the null hypothesis of equality between the two correlation coefficients. *** indicates statistical significance at the 1 % level.

Table A15
Robustness analysis: Four-factor model estimation results.

Index	α	β_{MRP}	β_{SMB}	β_{HML}	β_{WML}	R^2
Impact Investing Index	−0.0021*	0.4517***	1.1001***	0.4156**	−0.2711**	0.21
	(0.0012)	(0.0740)	(0.2061)	(0.1716)	(0.1168)	
UK Index	−0.0009	0.3471***	0.8658***	0.4832***	−0.2863***	0.19
	(0.0010)	(0.0802)	(0.1688)	(0.1580)	(0.1004)	
European Index	−0.0022**	0.6066***	0.9074***	0.2016	−0.1898**	0.32
	(0.0010)	(0.0509)	(0.1743)	(0.1717)	(0.0862)	

Note: coefficient estimates for the four-factor model linear regressions using factors from developed countries. The indices considered are the Impact Investing Index and the two benchmark indices constructed for robustness-check purposes. The one-month US, UK and German government bond yields are used as risk-free rates for specifications with the Impact Investing Index, the UK Index and the European Index, respectively. α is the intercept of the model, while β_{MRP}, β_{SMB}, β_{HML} and β_{WML} are the four factor loadings. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Table A16
Robustness analysis: DCC-MVGARCH estimation results (2).

Index	μ	α_0	α_1	β_1	A	B
Impact Investing Index	0.0004*	0.0961e–4*	0.1744***	0.8024***	–	–
	(0.0002)	(0.0527e–4)	(0.0561)	(0.0646)		
UK Index	0.0006**	0.1008e–4**	0.0875***	0.8728***	–	–
	(0.0003)	(0.0484e–4)	(0.0303)	(0.0433)		
I.I. Index/UK Index	–	–	–	–	0.0491	0.8000***
					(0.0308)	(0.1818)
European Index	0.0004	0.0289e–4	0.0431***	0.9410***	–	–
	(0.0003)	(0.0181e–4)	(0.0110)	(0.0139)		
I.I. Index/European Index	–	–	–	–	0.0149***	0.9749***
					(0.0057)	(0.0079)

Note: coefficient estimates from univariate GARCH processes and Dynamic Conditional Correlations (DCC). Univariate GARCH processes are estimated for each index in each of the two pairs (the parameters are μ, α_0, α_1 and β_1), before the parameters A and B of the DCC are estimated. Indices considered are the Impact Investing Index (present in each of the two pairs) and the two benchmark indices constructed for robustness-check purposes (one per pair). Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.qref.2021.04.010.

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