How Industry Concentration Influences the Performance of South African General Equity Funds

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I hereby declare that I have read and understood the regulations governing the submission of Master of Commerce dissertations, including those relating to length and plagiarism, as contained in the rules of the university, and that this dissertation conforms to those regulations.

SUPERVISOR: Dr Gizelle Willows

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ABSTRACT

Individual investors can invest in equity either through trading accounts provided by financial institutions or in equity funds with a fund manager. Fund managers will make different investing decisions that either negatively or positively influence the performance of the funds that an investor chooses to invest in. One such decision is the concentration of the fund in different companies, countries and industries. This research aims to determine how industry concentration influences the performance of South African general equity funds. Concentration is calculated using the industry concentration index formula. Over the period from 2006 to 2017, a mixed model regression, which accounts for both fixed and random effects, is used to determine the impact of concentration on fund performance. A random effect model was used as it models the variability between funds. The fixed effects that were controlled for in the model are concentration, the fund size, the gender and number of managers and the current market cycle which indicates whether the market was experiencing a financial crisis or not. The regression model is run over two models, each with two stages. Model 1 and Model 2 differ in that Model 1 includes year and quarter data as one fixed effect for time. In Model 2, the year and the quarter are included as two separate fixed effects. Stage 1 and Stage 2 differ in that Stage 1 does not consider management team variables while Stage 2 considers all variables. This research differs from prior research by considering the impact of concentration in specific industries as well as accounting for whether the market was experiencing a financial crisis or not. This research concludes that industry concentration can economically impact the performance of South African general equity funds and that, whether this impact is positive or negative depends on the industry in which the fund is concentrated.

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INTRODUCTION

"A wise person should have money in their head, but not in their heart"
Jonathan Swift, Anglo-Irish author and clergyman (Swift, Sheridan & Nichols, 1801, p. 327)

Money, and the making of money, is something that has intrigued, interested or consumed humankind over time[1] (Thomas, 2014). For years stock exchanges can and have been used as money-making tools, with the first genuine stock exchange opening in 1602 in Antwerp, Belgium (Hur, 2015; Roos & Marshall, 2011). In the 416 years since the establishment of this initial stock exchange there have been many changes across the world with the market capitalisation of stock exchanges worldwide reaching approximately $80 trillion as at December 2017 (Edwards, 2017; Worldbank, 2018). Stock exchanges provide a platform for investors to trade equity, bonds and various other instruments for wealth creation. Individual investors can invest in equity through trading accounts provided by financial institutions or equity funds with an asset manager. By investing in a fund with a manager, the individual relinquishes some of their responsibility relating to investment decisions to that manager. However, investors, such as fund managers, are not necessarily rational and may make investment decisions influenced by overconfidence, their unwillingness to admit mistakes or a need to follow the herd, among other things (Al Mamun, Syeed & Yasmeen, 2015; Damodaran, 2004; Igual & Santamaría, 2017). Behavioural finance provides an alternative view to the traditional finance model which assumes that investors are rational. Behavioural finance acknowledges behavioural biases that result in investors and fund managers making investing decisions that do not always result in the optimal outcome (Byrne & Brooks, 2008).

Fund managers will make different investing decisions that either negatively or positively influence the performance of the funds that an investor chooses to invest in. One of these decisions is the chosen concentration of that fund. This research aims to provide insight into the relationship between concentration and fund performance. Managers will decide on which countries, industries and companies their fund will be concentrated in and to what extent the fund is concentrated. Prior research has found

[1] See also works on the importance of money by Fortin, 2008; Goodhart, 1984; Headey & Wooden, 2005; Mitchell & Mickel, 1999

various and sometimes contradictory results as to the relationship between fund concentration and fund performance.

Research done on funds from the United States (US) found that funds diversified across industries and countries improved performance (Huij and Derwall, 2011). Multiple studies on US funds have found that performance was positively related to industry concentration (Goldman, Sun & Zhou, 2016; Hiraki, Liu & Wang, 2015; Pollet & Wilson, 2008; Sapp & Yan, 2008). Research done on the Taiwanese market supported the finding that industry concentration improves fund performance (Shyu, Lin & Chang, 2014). Recent research on funds worldwide support this finding further and adds that funds that are concentrated as per their concentrated investment strategies outperform their diversified counterparts (Choi, Fedenia, Skiba & Sokolyk, 2017). Research by Choi *et al.* (2017) found that when looking at investors worldwide, funds that concentrated their holdings as per their investment strategies, whether industry, home country or selective foreign country concentration, were positively related to improved fund performance. Delving further into concentration further contradictory evidence has been found surrounding concentrating in a particular company. Goldman *et al.* (2016) found that industry concentration, and specifically investing in the top one or two companies within an industry, improves fund performance. In other cases, concentration at company level did not improve fund performance and Pollet and Wilson (2008) and Sapp and Yan (2008) found that although industry concentration is positively related to fund performance, diversification across a number of companies was also positively related to improved performance.

While most of this prior research looked at industry concentration in aggregate, it did not focus on which industries specifically might improve performance. Research that did look at specific industries found that when looking at the value that active management could provide, performance of active managers was improved by funds concentrated in specifically energy, utilities and metal industries in the US market given the period 1980 to 2002 (Avramov & Wermers, 2006).

This research will investigate the relationship between total concentration and fund performance of South African general equity funds. The relationship between concentration and performance will be further assessed by identifying which

industries' concentration impacts the performance of funds. Furthermore, this research accounts for both the non-financial crisis and financial crisis market cycles that were seen between the second quarter of 2008 and the first quarter of 2009[2]. Specific industry concentration was previously considered in the US from 1980 to 2002 (Avramov & Wermers, 2006); however, this research's focus is more recent, 2006 to 2017, and based on the South African market. Further research into the Taiwanese market found that when accounting for different market cycles, namely tranquil versus turbulent market times, evidence was found that company concentration improved fund performance but only during tranquil times (Chen & Lai, 2014). However, Chen and Lai (2014) defined the market cycle as either tranquil and turbulent where turbulent was defined as when the US dot-com bubble burst and the global financial crisis and recession. The dot-com bubble bursting does not affect this research as it was in 2001 and 2002, before the period of the research. Chen and Lai defined the global financial crisis more broadly than this research to include the financial crisis considered in this research and the European debt crisis of 2010 to 2012. Thus, the financial crisis period as per Chen and Lai was quarter 3 of 2007 to quarter 2 of 2012. The European debt crisis was not included in the financial crisis period of this research as during this time the South African market shows an improvement as seen in the upward trend of the graph in Appendix 1. This very broad definition of the financial crisis period therefore cannot be applied to this research given the positive performance of the market during certain times in that broad definition. This author has not found evidence of research that has included both market cycle, defined as the financial crisis portion and non-financial crisis portion, of a period and specific industry concentration within a fund.

Evidence has been found that investors stay invested in funds that are underperforming (Cuthbertson, Nitzsche & O'Sullivan, 2008). By understanding if concentration improves fund performance, or if concentration within certain industries improves fund performance, investors and fund managers will be able to make more informed decisions. This research found that industry concentration, as measured by total industry concentration, does not improve fund performance for South African general equity funds. This negative relationship was investigated further and

[2] See Appendix 1

concentration in specific industries were considered. When looking at specific industry concentration, concentrating a portfolio in telecommunications or basic materials would have improved fund performance while non-equity instruments and technology, real estate or oil and gas sector concentration would have negatively impacted fund performance. While this research acknowledges that this insight might be limited by certain fund limitations and mandates, it will still provide a better awareness of how concentration has impacted, and can impact, a fund's return.

This research will continue with a review of prior literature on the efficient market hypothesis, active management and the influencers of fund returns, with a specific focus on fund concentration as a potential influencer. After that, the research question and method employed will be presented. The results of the empirical and regression analysis will then be given, including a discussion of the findings. To end, the conclusion and suggested areas for future research are presented.

LITERATURE REVIEW

INTRODUCTION

The net market capitalisation of the JSE (Johannesburg Stock Exchange), one of the top 20 exchanges in the world (Desjardins, 2017), at the end of February 2018 was approximately R14.8 trillion. One role of the JSE is that it provides investors with access to the South African equity market. Investors can engage in the market directly by buying and selling stock or by delegating their investing decisions to a fund manager. Individual investors have a range of options when choosing a fund manager. The choice of what fund manager to invest with is important as the decisions made by that chosen fund manager will influence the returns earned by the individual investor.

This literature review will begin by presenting the potential benefits of active fund management. As active fund management is advocated on the premise that fund managers can earn a return greater than the market, the different influencers of fund returns will be discussed. Focus is placed on how decisions surrounding the concentration of the portfolio can affect the return earned by an asset manager for an individual investor.

ACTIVE MANAGEMENT

Active fund management has been researched in various forms (Avramov & Wermers, 2006; Cremers & Petajisto, 2009; Kacperczyk, Sialm & Zheng, 2005; Wermers, 2000). An increasing number of investors are delegating their investment decisions to professional fund managers (Kacperczyk, Van Nieuwerburgh & Veldkamp, 2014) because they believe that professional fund managers are able to 'beat the market' (Wermers, 2003, p. 1). This implies that managers have the skill to provide returns that are in excess of holding a passive portfolio and can thus provide a positive alpha to their investors. A positive alpha can be defined as the excess return experienced by investors due to their, or their fund manager's, ability to outperform the benchmark by investing in mispriced stocks (Pástor & Stambaugh, 2002). A benchmark is a standard against which the performance of a fund can be measured (Economic Times Bureau, 2016). Common benchmarks used are market indices as they represent the underlying market that the fund is in (Cremers *et al.*, 2012). However, professional investment managers do not always outperform their benchmarks (Malkiel, 2005).

Professional fund managers achieve alpha by either overweighting or underweighting a stock relative to the index or benchmark (Petajisto, 2013). As per Cremers and Petajisto (2009), positive fund performance is related to active management. Furthermore, active management performance is a function of both the investing skill of the fund manager and the strategy's breadth (Grinold & Kahn, 2000). The breadth is defined by Grinold and Kahn (2000, p. 148) as 'the number of independent investment decisions that are made each year'. Brands, Brown and Gallagher (2005) offer the explanation that successful active management is a result of stock picking skill and portfolio management. However, fund returns are influenced by more factors than just this (Jordan & Riley, 2015). These are discussed next.

INFLUENCERS OF FUND RETURNS

As active fund management is advocated on the premise that fund managers can earn a return greater than the market, the different influencers of fund returns will be discussed. As there are investors and fund managers aim to earn a positive alpha, many different researchers aim to determine what exactly impacts fund returns. Various research has provided insight around fund mandates and liquidity, management skill and fund concentration and how these are influencers of fund returns (Baker, Litov, Wachter & Wurgler, 2010; Choi *et al.*, 2017; Cremers & Petajisto, 2009; Ferreira, Keswani, Miguel & Ramos, 2013; Goldman *et al.*, 2016; Huij & Post, 2011; Jordan & Riley, 2015; Kacperczyk *et al.*, 2014; Wermers, 2000). This literature review will continue by investigating these influencers in greater depth.

Fund mandates and liquidity

A fund's mandate outlines the investment policy, requirements and rules that govern the fund (Kennon, 2017). Almazan, Brown, Carlson and Chapman (2004) investigated the constraints that funds are subject to and concluded that returns are not affected by different levels of investment policy restrictions. More specifically, in the US market, Bauer, Koedijk and Otten (2005) established that returns are also not affected by whether the fund mandate is that of ethical or conventional investing. However, ethical and conventional funds do exhibit different styles and ethical funds tend to be more growth focused (Bauer *et al.*, 2005). When looking at low volatility funds that have been identified as better performers, Jordan and Riley (2015) identified that they are

characterised as being older funds with low turnover and low expense ratios. However, these fund mandate characteristics do not explain returns (Jordan & Riley, 2015).

Liquidity relates to the ease with which stocks can be bought and sold (Kennon, 2018). Ferreira *et al.* (2013) discovered that while US funds experienced decreasing returns to scale due to liquidity constraints, the same cannot be said for funds situated outside the US. Therefore, country-specific characteristics can also influence fund performance and some performance influencers are specific only to the US (Ferreira *et al.*, 2013). Pollet and Wilson (2008) further explain this negative relationship between returns and size because of an inability to scale a fund as it grows. This might be as a result of the lack of liquidity in certain stocks in the US market, the price of the stocks required to scale or because of capitalisation constraints. Sapp and Yan (2008) support these findings. Furthermore, Ferreira *et al.* (2013) looked at funds in multiple countries and found that funds situated in more liquid markets realised better performance.

Besides liquidity, Ferreira *et al.* (2013) also highlight that the strength of the legal institutions in a country and the level of financial development positively impacted returns. Returns are thus affected by the market in which the funds operate with emerging market funds outperforming those from the US (Huij & Post, 2011). This is consistent with the notion that emerging markets are less efficient and thus there is a greater chance for investors to take advantage of mispricing (Huij & Post, 2011).

Management skill

Prior research has found evidence that fund managers can and have outperformed their benchmarks; however, most research found that this is not true on average. Literature further provides insight into the reasons why many fund managers underperform and these include the manner in which the fund is sold and the manager's characteristics. Manager characteristics include both the luck and the skill, or the lack thereof, of the manager. Further research has been done on what influences management skill itself. This is discussed in detail below.

Various research has been done on whether fund managers can outperform the market (Benson, Brailsford & Humphrey, 2006; Cremers, Ferreira, Matos & Starks, 2016; Cuthbertson *et al.*, 2008; Ferreira *et al.*, 2013; Petajisto, 2013; Wermers, 2000).

Literature suggests that only a select few managers are able to outperform their benchmark. Benson *et al.* (2006) found that socially responsible fund managers and conventional managers do not differ in their stock picking ability but only a small percentage of managers produce a positive alpha. Wermers (2000) established that, on average, funds do outperform their benchmarks by 1.3% per annum but, after considering expenses, this positive return is mitigated and funds underperform. More recent research has been done that shows that there are only certain managers that are able to outperform their benchmarks (Cremers et al., 2016; Cremers & Petajisto, 2009; Cuthbertson et al., 2008; Petajisto, 2013). Positive performance associated with manager skill was found in the top-performing UK equity mutual funds (Cuthbertson *et al.*, 2008). That only certain managers outperform their benchmark was confirmed by Ferreira *et al.* (2013) and Cremers *et al.* (2016) who considered actively managed funds in 27 and 32 countries respectively and found that, on average, they underperformed the market or that average return was approximately zero. As there is evidence of managers that underperform their benchmarks and those that outperform, further insight is thus required to understand why this is the case.

Managers may outperform their benchmark as a result of various factors including the presence of explicit indexing in the country where the fund is sold, the manner in which the fund is sold, the luck of the manager or the skill of that manager. Index funds can exist either explicitly or implicitly within a market. An implicit index fund, also known as closet index funds, are defined as funds who market themselves as active and charge active management fees but who essentially hold their benchmark (Cremers et al., 2016). In countries where there are more explicit index funds, average alpha generated by active managers is higher than in countries with more implicit index funds (Cremers et al., 2016). Del Guercio and Reuter (2012) provide evidence that the way in which funds are sold to investors influences the returns earned: funds sold through brokers were found to underperform their benchmark between 1.13% and 1.32% per annum while the after fee alphas for funds sold directly to investors were indistinguishable from index funds. Del Guercio and Reuter further explain that the reason other studies found that active managers generally underperform their benchmark is because the way in which funds were sold to investors was not considered. The manner in which funds were sold is not the only reason why managers underperform their benchmarks: performance by managers could also be

as a result of chance or skill. Cuthbertson *et al.* (2008) found evidence of poor performance due to both bad luck and lack of skill.

Various research agrees that manager skill influences the performance of funds (Avramov & Wermers, 2006; Benson *et al.*, 2006; Cremers & Petajisto, 2009; Ferreira *et al.*, 2013; Wermers, 2000). Skill is associated with having superior private information and therefore relying less on public information (Choi *et al.*, 2017; Kacperczyk, Sialm, & Zheng, 2007). Managers might be incentivised to deviate from a diversified fund, and thereby concentrate their fund, in order to take advantage of their own perceived informational advantage (Kacperczyk *et al.*, 2005). Skill is also shown through stock picking ability. Benson *et al.* (2006) indicate that the vast majority of managers do not realise positive alphas because of their lack of stock picking ability. Cremers and Petajisto (2009) support this by highlighting that managers who essentially hold the index, and thus show little to no stock picking ability, underperform because of their fees. However, managers may have stock picking ability but choose not to exercise it in situations that may threaten their job[3]. Additionally, research has found underperformance due to overconfidence as managers do not apply optimum diversification either due to underestimating the transaction costs associated with diversification or through poor stock selection (Chen & Lai, 2014; Pollet & Wilson, 2008). Cremers and Petajisto also show that fund managers who made decisions based on certain characteristics of the stocks appear to have no skill and also underperform to their benchmarks (Cremers & Petajisto, 2009).

Evidence of stock picking ability, and thus management skill, however, was found when performance was linked to the manager's ability to invest in specific industries; thus, the skill involved was identifying the correct industry to invest in (Avramov & Wermers, 2006; Choi *et al.*, 2017; Hiraki *et al.*, 2015). Baker *et al.* (2010) present evidence that fund managers show skill by identifying stocks that will perform well in the future; in other words, they buy stocks that outperform those that they sell. This supports the findings of Cremers and Petajisto (2009) who indicate that it is the most active stock pickers[4] that have enough skill to outperform their benchmark on a net basis. In a more recent study, Petajisto (2013) confirmed this and established that

[3] The author would like to thank an anonymous reviewer for this insight.
[4] 'Most active stock pickers' refers to managers that are differentiated from the benchmark, not managers that are trading often. (Cremers & Petajisto, 2009)

after fees, the most active managers realised returns of 1.26% per annum. Management skill, as evidenced by superior stock picking ability, thus improves a manager's performance.

Kacperczyk *et al.* (2014) propose that management skill is evidenced by stock picking ability and the ability to time the market, depending on the market cycle. In a bull market, Kacperczyk *et al.* find evidence of management skill through stock picking ability while in a recession, this skill is evidenced by managers being able to time the market. The reason why both are considered when determining manager skill is that there is evidence of the same managers being able to do both of these activities, depending on the market cycle (Kacperczyk *et al.*, 2014). This finding is echoed by research done on the Taiwanese market. Defining the market as either tranquil or turbulent, when the market is more volatile and experiencing the effects of a financial crisis, Chen & Lai (2014) found evidence of managed skill during tranquil market periods. Berk and Van Binsbergen (2015) offer a different way of measuring management skill and believe alpha represents the returns earned not the skill employed. Skill should thus be measured as the value extracted from the market (Berk & Van Binsbergen, 2015). Considering this measure, Berk and Van Binsbergen also find evidence of fund manager skill.

Given that evidence of management skill has been found by different research, what determines or influences management skill should also be investigated. Determinants of management skill are varied but multifaceted. The education, gender and buy-in of the respective managers are possible influencers of skill. Gottesman and Morey (2006) investigated the relevance of education and found a positive relationship between education and performance. This was established by looking at the qualification of the fund managers and the quality of the educational institution from which that qualification was received. Managers with an MBA (Master of Business Administration) from top-ranked institutions realised better performance than those without an MBA or those with an MBA from a lower-ranked institution. Other qualifications, such as a non-MBA master's, CFA (certified financial analyst) or doctorate, were not related to improved manager performance (Gottesman & Morey, 2006).

Atkinson, Baird and Frye (2003) found that the gender of the fund manager influences investment behaviour. This results in lower net asset flows into female-managed funds (Atkinson *et al.*, 2003). However, Barber and Odean (2001), in US-based research, found that men reduce their returns through the costs associated with trading more than women do. This increased trading was associated with the overconfidence of male investors. Beckmann and Menkhoff (2008) found further evidence in the US, Germany, Italy and Thailand that male managers were more overconfident than female managers. However, the effect was not significant at the fund level. South Africa-based research agrees with the previous research that male investors traded more frequently and thus show greater overconfidence than women (Willows & West, 2015a). Willows and West (2015b) recognise that both gender and age influence trading frequency, and thus overconfidence. With their more recent research, they also supported their initial findings (Willows & West, 2015a) that on a risk adjusted basis women are better investors than men.

As with education, management buy-in is seen to positively influence returns (Khorana, Servaes & Wedge, 2007). Khorana *et al.* (2007) show a direct relationship between a manager's personal investment into the funds they are managing and increased performance in US funds. Managers will invest more in the funds that are smaller, have lower initial investment fees, have performed better historically and funds that they have been managing for a longer time (Khorana *et al.*, 2007). Management buy-in can be linked to whether fund management is insourced or outsourced and the possible effect that may have on fund returns. Chen, Hong and Kubik (2013) find that outsourced funds significantly underperform their insourced counterparts. The reason is twofold. Firstly, the outsourced management are restricted by their inability to make key decisions because of the contractual arrangement. Secondly, the outsourced managers take less risks because they are eligible to lose the management of the fund if the risks they take are deemed to be excessive (Chen *et al.*, 2013).

This section reviewed literature that provided evidence that some fund managers can outperform their benchmarks. The reason why managers could outperform their benchmark was largely due to the skill of those managers. Managers showed skill through their superior stock picking ability and their ability to time the market. Stock

picking ability was shown when managers selected certain stocks or industries that outperformed the market. Therefore, management skill, or lack thereof, has been found to influence fund performance.

Fund concentration

Concentration of a fund can positively and negatively affect performance. For US funds from 1984 to 1999, Kacperczyk *et al.* (2005) discovered that, on average, the more concentrated the fund, the better the performance. However, Sapp and Yan (2008) disagree with this finding, stating that, after considering expenses, concentrated funds over a similar time period underperformed their diversified counterparts (Sapp & Yan, 2008).

Brands *et al.* (2005) researched Australian equity funds and discovered that funds concentrated outside the largest 50 stocks on the Australian stock exchange and stocks that were overweighted in the portfolio had a positive impact on returns. This supports the initial findings of Kacperczyk *et al.* (2005). Concentrated funds with better performance were concentrated at the stock, industry and sector level (Brands *et al.*, 2005). This is supported by Huij and Derwall (2011) and Busse, Green and Baks (2006) who concluded that concentrated funds outperform diversified funds.

Huij and Derwall (2011) identified that concentrated funds with high levels of tracking error[5] outperformed diversified funds. There is evidence from Taiwanese funds from 2002 to 2009 that supports these findings and further suggests that funds with fewer stocks, that are concentrated within industries, performed better (Shyu *et al.*, 2014). More recently, Goldman *et al.* (2016) found that performance was positively related to concentration within the top one or two stocks within a specific industry sector. This implies that funds with higher within-sector concentration demonstrate better performance (Goldman *et al.*, 2016).

Managers might be incentivised to deviate from a diversified fund, and thereby concentrate their fund, in order to take advantage of their own perceived informational advantage (Kacperczyk *et al.*, 2005). A positive performance from concentrated funds

[5] As per Petajisto (2013): 'tracking error measures the volatility of the fund that is not explained by movements in the fund's benchmark index'.

arises when the large bets of concentrated managers outperform the top-performing stocks of the more diversified funds (Busse *et al.*, 2006). Huij and Derwall (2011) indicate a positive relationship with the underlying breadth of the portfolio strategies which aligns with the fundamental law of active management. This was evidenced by concentrated funds with high tracking error volatility realising better performance than diversified funds. A positive relationship between tracking error and the breadth of the underlying investment strategy was found by measuring breadth as the number of different capital markets in which the fund was concentrated (Huij & Derwall, 2011). Therefore, a fund with a high level of tracking error concentrated in multiple capital markets is expected to outperform one with high tracking error concentrated in one or two segments (Huij & Derwall, 2011). Other aspects of concentrated funds are that they are smaller and are benchmarked to more narrow indexes (Brands *et al.*, 2005). Kacperczyk *et al.* (2005) also found that more concentrated funds tend to contain more growth and small cap stocks and are concentrated in limited industries.

Sapp and Yan (2008) suggest that it is understandable for managers who believe in their own skills to gravitate to more concentrated funds to leverage performance. However, Sapp and Yan found underperformance in concentrated funds and suggested agency and liquidity problems to be the reason (Sapp & Yan, 2008). Pollet and Wilson (2008) support this statement by showing that diversified funds will perform better with fund managers who have superior stock selection skills and when diversification negates the costs associated with large concentration in specific stocks, specifically when liquidity is a constraint.

Conclusion

Research has provided insight as to what the influencers of fund returns may be. The literature reviewed considered fund mandate, liquidity, management skill and the concentration of the fund to be possible influencers of fund return. Fund mandate was not found to be a major influencer on return and liquidity impacted return differently depending on the market in which the fund was situated. Research found evidence of both managers with skill and those without but did show that managers with skill did have the ability to outperform their benchmarks and thus could influence returns. Managers showed skill through their superior stock picking ability and their ability to time the market. Stock picking ability was shown when managers selected certain

stocks or industries that outperformed the market. Contradictory evidence was found as to whether fund concentration negatively or positively influenced return but research did show that the concentration of a fund did influence fund performance. This literature review continues by further investigating the impact of concentration on fund return and the relationship between management and fund concentration.

CONCENTRATION AND DIVERSIFICATION

Both fund and manager characteristics influence the level of concentration. Goldman *et al.* (2016) found that funds managed by one manager are more concentrated, and performed better, than those managed by multiple managers. If management style changes from one to more managers, there is evidence that both concentration and performance decrease (Goldman *et al.*, 2016). A manager characteristic that influences how a manager concentrates their fund is whether that manager has a link, or connection, to the company whose equity they are buying. US fund managers place more weight on firms that are connected to them (Cohen, Frazzini & Malloy, 2008). A firm is considered connected to a manager if that manager is associated with the directors of the firm through their university (Cohen *et al.*, 2008). Cohen *et al.* (2008) found that managers place larger bets on these connected stocks and that this improved the performance of the portfolio because of the informational advantages gained by the fund managers because of the connectedness. However, as mentioned earlier, Huij and Derwall (2011) shows that performance is driven not only by the manager's ability to make these large bets but mostly by the underlying breadth of their investment strategy. This differs from the findings of Busse *et al.* (2006) who evidenced positive performance by managers taking big bets on relatively few stocks.

Strong and Xu (2003) and Pool, Stoffman and Yonker (2012) provide evidence that connectedness influences a manager's decision-making. For international funds, managers from the US, United Kingdom, Europe and Japan show bias towards their home country (Strong & Xu, 2003). Furthermore, US fund managers overweight certain stocks because of their home state investment bias (Pool *et al.*, 2012). As there is no evidence that this improves performance (Pool *et al.*, 2012), a home state bias could result in decreased returns if these stocks do not outperform other investment opportunities. Thus, they are not as a result of informed decision-making (Pool *et al.*, 2012).

Industry concentration within a portfolio is considered an influencer of fund performance. Benson *et al.* (2006) found that, although socially responsible funds and conventional funds experienced similar performance, their returns were generated through exposure to different industries. Hou and Robinson (2006) found that concentrated industries themselves experienced lower returns and this translated to certain industry fund returns. Conversely, firms in more competitive industries earn higher returns because they are exposed to more innovation risk and distress risk (Hou & Robinson, 2006). Avramov and Wermers (2006) found that performance was improved by portfolios concentrated in energy, utilities and metal industries while having less focus on computer and business equipment industries. Industry concentration may be driven by superior information or an understanding of one or a few industries and thus lead to improved returns. Alternatively, industry concentration could be as a result of a lack of management skill, resulting in diminished returns (Kacperczyk *et al.*, 2005; Shyu *et al.*, 2014). In Taiwan, funds with high industry concentration can realise large excess returns in relation to more diversified funds. This concentration can aid returns as it is not as expensive as large-scale diversification (Shyu *et al.*, 2014).

Supporting the findings of positive returns from industry concentration, venture capital investments in the United Kingdom are negatively impacted by industry diversification (Cressy, Malipiero & Munari, 2014). However, these same investments were positively influenced by geographic diversification (Cressy *et al.*, 2014). Diversification influences both conventional funds and socially responsible funds similarly and both groups underperformed in relation to their benchmarks (Bello, 2005).

Increasing the number of funds invested in provides a diversification benefit (Brands & Gallagher, 2005). However, this benefit is diminished by investing in multiple funds as the sum of all the funds then start imitating the underlying benchmark. The optimal number of actively managed funds to invest in was found to be six (Brands & Gallagher, 2005).

Chiou (2008) found that investors in less developed countries, specifically in East Asia and Latin America, could benefit more from international diversification. However, this diversification benefit is decreasing as the global markets become more integrated (Chiou, 2008). Diversification benefits may also be limited to a certain number of

stocks. Shyu *et al.* (2014) found that once funds hold too many stocks the supervision and transaction costs associated with these many stocks are greater than the benefit realised from diversification. In Taiwan, the optimal number of stocks to invest in was 28 (Shyu *et al.*, 2014).

Huberman (2001) highlights that because investors select their portfolios with the intention of maximising their return, investors' aversions to risk should result in them diversifying their portfolio. Cressy *et al.* (2014) points out that this is aligned with traditional finance theory that suggests that diversification decreases the non-systematic risk of the fund because of stock-specific characteristics. Funds that increase their risk appetite underperform those who have stable risk exposure over time (Brown, Garlappi & Tiu, 2010; Huang, Sialm & Zhang, 2011). Pollet and Wilson (2008) further provide evidence that when looking at risk-adjusted returns, diversification provides higher returns. This is specifically when these funds invest in the small-cap sector (Pollet & Wilson, 2008).

The literature reviewed provides contradictory results as to whether fund managers, and thus investors, should favour diversification or concentration within their funds. Various research has however shown that there is a positive relationship between industry concentration and positive fund performance, although evidence to the contrary has also been found (Goldman *et al.*, 2016; Hiraki *et al.*, 2015; Pollet & Wilson, 2008; Sapp & Yan, 2008)..

CONCLUSION

Individual investors can invest in the market by investing in an equity fund. Research has provided insight as to what the influencers of fund returns may be. The literature reviewed considered fund mandate, liquidity, management skill and the concentration of the fund to be possible influencers of fund return. Fund mandate was not found to be a major influencer on return and liquidity impacted return differently depending on the market in which the fund was situated. Research found evidence of both managers with skill and those without; but did show that managers with skill did have the ability to outperform their benchmarks and thus could influence returns. Managers showed skill through their superior stock picking ability and their ability to time the market. Thus, the decisions fund managers make concerning stock selection and market timing could either negatively or positively influence the performance of the funds that

an investor chooses to invest in. Managers will decide in which countries, industries and companies their fund will be concentrated and the extent to which the fund is concentrated. Prior research has found various and sometimes contradictory results as to the relationship between fund concentration and fund performance.

Research done on funds from the US found that funds diversified across industries and countries improved performance (Huij & Derwall, 2011). Multiple studies on US funds have found that performance was positively related to industry concentration (Goldman *et al.*, 2016; Hiraki *et al.*, 2015; Pollet & Wilson, 2008; Sapp & Yan, 2008). Research done on the Taiwanese market supported the finding that industry concentration improves fund performance (Shyu *et al.*, 2014). Recent research on funds worldwide supports this finding further and adds that funds that are concentrated as per their concentrated investment strategies outperform their diversified counterparts (Choi *et al.*, 2017). Research by Choi *et al.* (2017) found that when looking at investors worldwide, that funds that concentrated their holdings as per their investment strategies, being either industry, home country or selective foreign country concentration, showed improved fund performance. Delving further into concentration, further contradictory evidence has been found surrounding concentrating in a particular stock. Goldman *et al.* (2016) found that industry concentration, and specifically investing in the top one or two stocks within an industry, improved fund performance. In other cases, concentration at stock level did not improve fund performance and Pollet and Wilson (2008) and Sapp and Yan (2008) found that although industry concentration is positively related to fund performance, diversification across a number of companies was also positively related to improved performance.

While most of this prior research looked at industry concentration in aggregate, it did not focus on which industries specifically might improve performance. Research that did look at specific industries found that when looking at the value that active management could provide, performance of active managers was improved by funds concentrated in specifically energy, utilities and metal industries in the US market given the period 1980 to 2002 (Avramov & Wermers, 2006).

METHOD

OBJECTIVE

As investors select their portfolios with the intention of maximising their return, investors' aversion to risk should result in them diversifying their portfolio (Huberman, 2001). This concept is aligned with traditional finance theory that suggests that diversification decreases the non-systematic risk of the fund because of stock-specific characteristics (Cressy *et al.*, 2014). The literature reviewed presents opposing evidence as to whether diversification or concentration improves fund performance, especially in the presence or absence of management skill. However, various research has shown a positive relationship between industry concentration and improved fund performance (Chen & Lai, 2014; Choi *et al.*, 2017; Goldman *et al.*, 2016; Hiraki *et al.*, 2015; Shyu *et al.*, 2014). Such literature is specifically limited for emerging markets, namely South Africa (Huij & Post, 2011). Therefore, the objective of this research is to determine the industry concentration of South African general equity funds and determine whether concentration improves fund performance.

RESEARCH QUESTION

The research question proposed by this study is as follows:

Does industry concentration improve fund performance of South African general equity funds?

To answer this research question, this research will calculate the industry concentration index of South African general equity funds. Following that, the impact of industry concentration on fund performance will be determined using a mixed effects regression analysis. Other variables that may impact fund performance, and the relationship between concentration and fund performance, will also be considered and included in the mixed effects regression. Additionally, this research will assess the concentration of a fund within a specific industry to provide greater insight into how concentration influences fund performance.

The fundamental information this research requires is data on South African general equity funds (as defined by ASISA, the Association for Savings and Investment SA,

and the FTSE/JSE ALSI, the JSE All Share Index). This chapter will continue with a description of the data, variables and tests to be performed.

RESEARCH DATA

This research spans the period from 1 January 2006 to 30 June 2017 (the period). The length of the period allows for a larger sample size and more robust statistical testing. The period includes data relating to the 2008 global financial crisis (Fratzscher, 2012; Willows & West, 2015b). This is controlled for in the regression by including a fixed effect variable for 'market cycle'. Furthermore, two versions of each regression analysis will be performed. In the first version, the 'market cycle' fixed effect variable is included and, in the second instance, the global financial crisis period is removed from the data set, i.e. the data tested pertains only to movements before and after the crisis. This is done to assess whether including the financial crisis period in the data set influences whether concentration in certain industries improves fund performance.

The market cycle is determined using a trend analysis of the JSE market size over the period (see Appendix 1). The large drop in JSE ALSI values from the second quarter of 2008 to the first quarter of 2009 is considered to be the relevant financial crisis that is controlled for in this research. This market cycle period is consistent with that found by Willows and West (2015b). Market cycle is a binary variable taking the variable 1 when the market is not experiencing a financial crisis and 0 for the period relating to the relevant financial crisis.

Quarterly data will be used as reliable data for all relevant variables could be obtained on a quarterly basis. Where data was not available on a quarterly basis for some of the other variables included in the testing, either monthly or daily data was transformed to align with the quarterly data received for fund returns.

South African general equity funds

South African general equity funds are defined as funds that invest a minimum of 80% of their market value in equities across all industry groups (ASISA, 2013). Therefore, general equity funds were selected because of their large exposure to the South African market. This allows for comparison between the equity fund and the South African equity market. The South African benchmark for these funds is the JSE ALSI (ASISA, 2013; Allan Gray, 2017).

The general equity fund data required is twofold: firstly, the return of that fund for each period and, secondly, the percentage each fund was invested in each respective industry on the JSE at a time. This data was obtained from the Morningstar Direct database. Morningstar data has been used in various other studies and can be viewed as a reliable source (Barron & Ni, 2015; Bogle, 2014; Bryan & Li, 2016; Hiraki *et al.*, 2015; Huij & Derwall, 2011). Data quality is assured through a quality control programme and a commitment to data quality that results in data only being taken from the primary source (Morningstar, 2011).

At the time of this research, there were 230 South African general equity funds. However, for 19 of the funds, there was limited or missing information pertaining to concentration, fund size or return. Therefore, these funds were excluded from the sample. This resulted in a final sample of 211 funds to be used in the mixed effects regression model, allowing for a total of 4 755 observations. It must be noted that not all 211 funds existed for the entire period under consideration. However, this does not have an effect on the analysis or results, as this study is not looking at the performance of funds over time but the impact of concentration on fund performance at a point in time.

Return is used to measure the fund's performance for the quarter. Consistent with prior literature, the returns for each fund are used after management fees (Goldman *et al.*, 2016). This allows for a fair comparison against what an investor would receive if they had invested in the market directly (Jensen, 2016; Superlife, 2015). Return for a quarter is considered relative to the concentration of the previous quarter. In other words, the return in quarter 2 is considered with reference to the concentration to quarter 1. This one quarter lag is used to allow for the impact of a change of concentration to reflect in the return earned by the fund. This method is consistent with previous research (Bollen & Busse, 2005; Choi *et al.*, 2017; Ghysels, Plazzi & Valkanov, 2016).

The percentage each fund was invested in each respective industry classification on the JSE at the beginning of each quarter is required to calculate the concentration of the fund. The 10 categories in which a fund could be invested in consist broadly of oil and gas, basic materials, industrials, consumer goods, consumer services, health care, telecommunications, utilities, financials, and technology (FTSE Russell, 2009).

The Morningstar data provided industry exposure to one additional classification. This was because the financials industry could be broken into two classifications, namely financial services and real estate. Therefore, this research will be considering the concentration of a fund in these 11 industry classifications. By having 11 classifications, as opposed to the standard 10, this research is able to investigate the impact of concentration on fund performance more thoroughly and thus provide more insightful results.

As per the industry classification benchmark, the industries could be further divided into 19 super sectors. However, this fund investment data (on the 19 super sectors[6]) was unavailable. Given the scope of this research, the 11 classifications used are deemed sufficient as the industry classification index is determined using industry information (Goldman *et al.*, 2016; Hiraki *et al.*, 2015; Kacperczyk *et al.*, 2005). Furthermore, using the 11 classifications reduces the potential noise in the model allowing for more robust statistical output and provides for further insight into how concentration influences fund returns as per research question two.

JSE ALSI data

The JSE ALSI is used as a proxy for the market as it represents 99% of the equities on the JSE (FTSE Russell, 2017) and it is the recommended benchmark for general equity funds (ASISA, 2013). The Johannesburg Stock Exchange provided the data required for the ALSI, including the weightings of the JSE ALSI across the industry classifications and the performance of the JSE for each period under consideration. This information can be relied upon as it is taken from the primary source, i.e. the stock exchange itself (The National Library of Jamaica, 2013).

The performance of the JSE is relevant as the performance of a fund may be influenced by the underlying market and thus should be included in the model (Mensi *et al.*, 2014). Further, investors have a choice after deciding to invest in equity either to invest in the market itself, through a proxy, or in a fund. The JSE ALSI data, a proxy for the market, is thus required to compare the industry concentration and performance of a fund to the market.

[6] See Table 2 in Appendix 2 for detail on the super sectors (FTSE Russell, 2009).

Control variables

Given the type of regression analysis used to determine the relationship between fund concentration and fund performance, other variables that are fixed effects in the regression will be considered. As per the literature reviewed, fund size (Ferreira *et al.*, 2013; Pollet & Wilson, 2008), the number of managers managing the fund (Goldman *et al.*, 2016), the gender of the management team (Willows & West, 2015b) and the current market cycle (Chen & Lai, 2014; Kacperczyk *et al.*, 2014) are all offered as possible influencers of fund performance. These will be included as fixed effect variables in the testing employed.

Fund size data is available from Morningstar Direct. Following prior literature, the natural logarithm of the fund sizes is used in the regression to normalise the data (Goldman *et al.*, 2016). Data on which managers were managing the funds over different time periods was also obtained from Morningstar Direct. The number of managers per quarter could be calculated directly but to determine the overall gender of the management team, the gender of each manager had to be determined by inspecting publicly available professional information. Detail on the market cycle variable was discussed earlier in this chapter.

This fund manager information, i.e. number of managers and gender of management team, was not available for all funds for all quarters in the period examined. Therefore, testing that includes these two variables will be done on a limited sample of 189 funds with 4 040 observations. This remains a sufficiently large sample size to allow for robust statistical testing. The gender of the management team is a categorical variable and is shown relative to a male management team.

For this research, the dependent variable is fund performance as measured by the fund return of South African general equity funds. The independent variables will be the concentration of the fund, fund size, number of managers, gender of management team and market cycle.

RESEARCH METHOD

In order to determine the impact of concentration on fund performance, concentration itself must first be calculated. Once the concentration measure (ICI) of a fund is calculated, the relationship between ICI and fund performance must be identified.

Total ICI is calculated in order to answer the research question. This is explained in more detail in the next subsection of this chapter.

Calculating concentration

As per Kacperczyk *et al.* (2005), Goldman *et al.* (2016) and Hiraki *et al.* (2015), an industry concentration index can be calculated using the following formula:

$$Total\ ICI_t = \sum_{i=1}^{12} (W_{i,t} - w_{i,t})^2$$

W represents the weight of industry classifications in a fund, w represents the weight of the industry classifications of the market and i represents 12 industry classifications all at time t. Total ICI at time t is determined as the sum of the 11 industry classification ICI values (ICI_1–ICI_{11}) and the concentration for the portion of the fund not invested in equity (ICI_{12}). This 12th classification was added so as to include the concentration of the non-equity portion of the fund in the ICI. This arises as South African general equity funds are only required to have 80% of the portfolio in equity (ASISA, 2013; Allan Gray, 2017).

For each fund, the total ICI is calculated for every quarter where information is available. This index measures the degree to which a general equity fund differs from the market. If the weights of a fund's investments in all the industry classifications are the same as those of the market, the index is equal to zero. Conversely, the more a fund differs from the market, in terms of its distribution of value across the 11 industry classifications and the 12th non-equity instruments, the greater the ICI value[7]. By squaring the sum of the differences, no negative values are included in the ICI calculation. Therefore, whether an industry is under- or over-weighted in a fund, in relation to the market, the concentration value will increase.

Mixed effects model regression

A linear regression is an analysis where one or more predictor variables are modelled in order to explain the outcome of the dependent or response variable. Such a regression has six key assumptions: 1) a linear relationship between the predictor and response variables, 2) the mean of the residuals is zero, 3) homoscedasticity of

[7] See illustrative examples 3 and 4 in appendix 3.

residuals, 4) no autocorrelation of residuals, 5) no or little multicollinearity and 6) multivariate normality of all variables (Mcculloch, 2003; Winter, 2013). The fourth assumption for a linear regression is, in other words, that the observations of the predictor variables must be independent from one another. This research uses time series data that is susceptible to inter-correlation. The predictor variables are not independent as the performance of a fund at time t+1 is likely to not be independent from the performance of the same fund at time t. Independence is the key assumption and this assumption is violated as multiple responses over time are taken for each fund. As the assumptions of a linear regression cannot be adhered to in this research, such a regression is not appropriate and a different model must be used.

Non–independence of the predictor variables can be accounted for by adding a random effect into the regression model (Mcculloch, 2003; Winter, 2013). A mixed effects regression model includes both fixed effects and random effects. Fixed effects are the predictor variables this research has chosen to include in the model. This mixed effects model is therefore appropriate for this research as fixed effects of funds are sampled over a specific time period and thus multiple responses are taken from each fund. This results in the responses not being independent from one another. It is thus necessary for a random effect to be included in the model to account for the lack of independence between the responses.

The regression assumes a normal distribution of fixed effects (Helwig, 2017). In this model, funds are the random effect as a random effect has different levels, represented here by different funds, that were selected from a population. If this study were to be repeated, different levels, namely funds, would be selected. The random effect models the variability between funds. The random effects for this model are not large, which implies low variability between funds. The model is fitted using restricted maximum likelihood (reml) (Mcculloch, 2003; Winter, 2013).The fit of the model will be tested via residual analysis and a likelihood ratio (LR) test will be performed as a means of evaluating whether a mixed effect model regression is an improvement on using a linear model regression.

To answer the research question, the regression analysis will be run over two models, each with two stages. Model 1 and Model 2 differ in that Model 1 will include yearly and quarterly data as one variable or fixed effect for time. This is to determine if there

is a linear trend across time and describes the long-term variation or trend in the data. In Model 2, the year and the quarter will be included as two separate variables or fixed effects. This will still demonstrate a linear trend across time but will also account for the effect of the different quarters and will consider the interaction between the years and the quarters. Therefore, Model 1 is a cruder model as it does not consider the effect of the interplay between quarters and years and simply considers time across 46 intervals (four quarters per year for the 11 and a half years considered in this research).

Stage 1 and Stage 2 differ in that Stage 1 will include all funds but does not consider management team variables while Stage 2 will include a reduced number of funds but considers all variables. As discussed in the subsection ‘Control variables’ in this chapter, Stage 2’s sample size is reduced because management team information was not available for every fund.

RESULTS

EMPIRICAL RESULTS

The purpose of this research is to determine if industry concentration improves the fund performance of South African general equity funds. This question is answered by calculating the industry concentration index (ICI) of South African general equity funds, on a quarterly basis, from January 2006 to June 2017. This research also considers other variables that may impact the relationship between concentration and fund performance, including the size of the fund, market cycle, the number of managers responsible for the fund and the gender of that management team.

This chapter will begin by providing some descriptive statistics to describe the data used. Subsequently, the results of the regression analyses will be presented. The regression results will be presented in two parts: firstly, the regression output for the model that included total concentration will be presented and discussed. Secondly, the same will be done for the regression output where concentration was calculated separately for the 12 industry classifications.

Descriptive statistics

A summary of the minimum, mean and maximum values of the various variables used over the period (n = 46[8] time points) is given in Table 1.

[8] n = 11.5 years × 4 quarters per annum = 46

Table 1: Summary of descriptive statistics

	Minimum	Mean	Maximum
Fund return	–22.94%	2.41%	37.62%
ALSI return	–21.36%	2.14%	13.71%
Fund size	R5 501	R1 448 598 699	R41 367 858 729
Total ICI	41.73	1 265.86	12 274.21
ICI 1 – Technology	<0.0001	55.21	673.16
ICI 2 – Telecommunications	<0.0001	19.39	395.40
ICI 3 – Consumer services	<0.0001	50.41	653.08
ICI 4 – Consumer goods	<0.0001	170.88	900.41
ICI 5 – Industrials	<0.0001	31.58	1 640.86
ICI 6 – Basic materials	<0.0001	227.59	3 121.59
ICI 7 – Financial services	<0.0001	81.92	1 782.93
ICI 8 – Real estate	<0.0001	13.36	411.68
ICI 9 – Health care	<0.0001	10.80	806.76
ICI 10 – Oil and gas	0.00	10.96	138.14
ICI 11 – Utilities	0.00	0.01	8.69
ICI 12 – Non-equity investments	<0.0001	594.14	9 889.63

Fund performance is measured as fund return in percentage terms. The mean return for the funds used was 2.41% per quarter. This is greater than the mean of the JSE ALSI returns for the period which was 2.14%. The fund returns showed large fluctuations with a minimum return of –22.94% and a maximum return of 37.62%. The lowest fund return was realised by the SATRIX ALSI index fund in the third quarter of 2008 which was during the 2008 financial crisis. This was also the quarter in which the JSE ALSI, which represents the market, had a minimum return of –21.36%. The highest return was earned at the beginning of 2016 by the Investec SA Value fund.

Fund size is measured in rand. The mean fund size was R1.45 billion while the minimum and maximum values were R5 501 and R41.37 billion respectively. The difference between minimum and maximum fund size is notably large. The second smallest fund size is R14 140 and both of these small fund sizes related to the first quarter that a fund was in existence. Newer funds are expected to be smaller (Haslem, 2003, p. 65).

The minimum ICI value related to the Stanlib Index fund in the second quarter of 2011. This indicated a very small level of concentration as the fund's concentration was almost identical to the market in that quarter[9]. The maximum total ICI value was in the second quarter of 2008 by Steyn Capital and was largely as a result of a large concentration in non-equity instruments during the financial crisis period.

ICI_1–ICI_{11} represent specific industries that a fund can invest in. Among these 11 industry classifications, the basic materials industry had the highest mean concentration value. This indicates that, on average, the portion of a fund that is invested in basic materials is either 15%[10] more or 15% less than the portion that the basic materials industry represents in the market as a whole. Further, the figures in Table 1 indicates that, on average, funds invested approximately 3%[11] more or less in oil and gas or health care than the portion that these industries represent in the market.

The basic materials industry classification had the highest concentration value, ignoring the non-equity portion of the funds, and this related to the Investec Value fund for the second quarter of 2016. The minimum ICI values of zero indicated that the fund is invested in these industries in exactly the same proportion that the market is. Utilities and oil and gas have these zero values because for most of the period studied utilities represented 0% of the market and, from late 2015, oil and gas was the same. For the remainder of the industries, the minimum value of less than 0.001 shows that there were funds who mimicked the market for these industries at some point and thus the fund differed by less than 0.01% from the market.

Data relating to the management teams of the general equity funds is considered with respect to the size of the team and the gender of the team. The size of the management team ranged from one to six people. The distribution of funds among these values is shown in Table 2.

[9] A total ICI value of 41.73 equates to an average investment difference of 1.86% per the 12 industry classifications (1.8648^2 × 12 industry classifications = 41.73).
[10] $\sqrt{227.59} = 15.086$ and $(-15.086)^2 = 227.59$
[11] $\sqrt{10.8} = 3.29$ and $\sqrt{10.96} = 3.31$

Table 2: Number of fund managers in a team and the percentage of funds they manage

Management team size	Percentage of funds managed
1	70.9% (n = 3 599)
2	23.2% (n = 1 178)
3	4.8% (n = 242)
4	0.6% (n = 33)
5	0.4% (n = 22)
6	0.1% (n = 4)

The majority of funds (70.9%) were managed by only one fund manager. Of the 5 078 quarters observed, a total of 301 (5.9%) quarters had three or more fund managers. This shows that few funds have more than one or two managers for any given period. Goldman *et al.* (2016) found a more even spread between the number of managers when looking at US funds for a different period, namely 1990 to 2012. However, the largest percentage of funds (34%) were also managed by only one manager.

Regarding the gender of the management team, a team could be either female only[12], male only or a combination of male and female fund managers, i.e. mixed gender management teams. For all observations in the sample, 89.6% (n = 4 551) of the quarters were managed by male only management teams; 5.6% (n = 285) by females only and the remaining 4.8% (n = 242) by mixed gender management teams. The dominance of male only fund managers found in this research is consistent with prior literature (Barber & Odean, 2001; Willows & West, 2015b). Additional reasons for male dominance have been offered and Barber, Scherbina, and Schlusche (2017) found that female fund managers have less job security and are less likely to be promoted. Additionally, perception, gender bias and less fund flows to female managers contributes to the male dominance in fund managers (Barber, Scherbina, & Schlusche, 2017; Connington, 2017; Vlastelica, 2017). Whether the gender of the management team positively influences return will be further investigated in the regression analyses to follow.

[12] This research follows a heteronormative approach to gender.

REGRESSION ANALYSIS

A mixed model regression, as opposed to a linear model, was used in this research. Likelihood ratio (LR) tests were performed to determine if each mixed effect model was an improvement when compared to a linear model. For several of the regressions, the LR test did not show that the mixed effect model was better than the linear model. However, for a couple of the models the LR test did show an improvement. The mixed model is still used in this research as, by design, the mixed model is more appropriate because the assumptions for a linear regression do not hold given the data used in this research (Helwig, 2017). The mixed model accounts for random effects that allow for the assumption of no autocorrelation to not be violated.

For the regression outputs, the Wald chi-squared reports the test statistic for the model with its associated probability value. This gives an overall result for the regression model as a whole and indicates whether the model with the set of predictors selected is an improvement to the null model. For all the regression models run, the Wald chi-squared test statistic is significant and thus indicates that the fixed effects included in the model were correctly selected.

The goodness of fit tests for the regression models were done using residual analysis. The residuals for all the models, once plotted, were mostly observed in a horizontal band with some outlying and clustering of residuals visible. This shows no serious deviation from the assumption of constant variance and thus the models are a good fit. In other words, as there is no obvious pattern or curve to the residuals, the assumption of residuals having constant variance is not violated.

Two sets of mixed effect regression tests were run. To answer the research question, the regression analysis in Table 3 uses total ICI as an independent variable. To provide greater insight as to how specific industry concentration impacted performance, total ICI is disaggregated into the 12 industry classifications which are used as separate independent variables in the regression analysis in Table 4. This chapter will continue by describing the detailed results obtained from the regression analyses performed.

Total concentration

To identify if industry concentration has improved fund performance of South African general equity funds, Table 3 presents the results of the mixed model regression using total ICI as an independent variable. The regression was performed twice, over two stages. Model 1 includes the year and quarter as one fixed effect for time while Model 2 includes year and quarter as two separate fixed effects allowing for comparison between intercepts and slopes for the different quarters. Stage 1 excludes management team information so as to not adjust the sample size and Stage 2 then includes management team information.

The formulae for the models are as follows:

Table 3: Model 1: Stage 1:

$$Fund\ return = \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle + \beta_4\ Time + \mu + \varepsilon$$

Table 3: Model 1: Stage 2:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle \\ & + \beta_4\ Female\ management\ team \\ & + \beta_5\ Mixed\ gender\ management\ team \\ & + \beta_6\ Size\ of\ management\ team + \beta_7\ Time + \mu + \varepsilon \end{aligned}$$

Table 3: Model 2: Stage 1:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle \\ & + \beta_4\ Quarter\ 2\ relative\ to\ quarter\ 1 \\ & + \beta_5 Quarter\ 3\ relative\ to\ quarter\ 1 \\ & + \beta_6\ Quarter\ 4\ relative\ to\ quarter\ 1 + \beta_7\ Year \\ & + \beta_8\ Interaction\ between\ year\ and\ quarter\ 1 \\ & + \beta_9\ Interaction\ between\ year\ and\ quarter\ 2 \\ & + \beta_{10}\ Interaction\ between\ year\ and\ quarter\ 3 \\ & + \beta_{11}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon \end{aligned}$$

Table 3: Model 2: Stage 2:

$$
\begin{aligned}
Fund\ return = {} & \beta_0 + \beta_1\, Total\ ICI + \beta_2\, Fund\ size + \beta_3\, Market\ cycle \\
& + \beta_4\, Female\ management\ team \\
& + \beta_5\, Mixed\ gender\ management\ team \\
& + \beta_6\, Size\ of\ management\ team + \beta_7\, Quarter\ 2\ relative\ to\ quarter\ 1 \\
& + \beta_8 Quarter\ 3\ relative\ to\ quarter\ 1 \\
& + \beta_9\, Quarter\ 4\ relative\ to\ quarter\ 1 + \beta_{10}\, Year \\
& + \beta_{11}\, Interaction\ between\ year\ and\ quarter\ 1 \\
& + \beta_{12}\, Interaction\ between\ year\ and\ quarter\ 2 \\
& + \beta_{13}\, Interaction\ between\ year\ and\ quarter\ 3 \\
& + \beta_{14}\, Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon
\end{aligned}
$$

In the regression formulas, β_0 represents the constant, while β_1 to β_{14} are the fixed portion of the model and represent the influencers of fund returns tested; μ signifies the random effect to account for the variability between funds and refers to factors not identified or included in the model, and therefore not controlled for, and ε is the errors assumed to be multivariate normal with mean 0 and variance σ^2_ε (Helwig, 2017). Table 3 presents the coefficients and standard errors in the model.

As indicated in the method chapter, the gender of the management team is a categorical variable and the male management team is the reference group. Therefore, the other groups of management team's gender, namely female and mixed gender management teams, are assessed against the reference management team. For the time variables, quarter 1 is used as the reference quarter for the four quarters and quarterly performance is assessed with reference to quarter 1 performance. The year 2006 is used as the reference year and the proceeding years are assessed relatively to the performance in the year 2006.

Table 3: Mixed effects model outputs for total concentration and fund return run

	Model 1: Year and quarter as one variable		Model 2: Year and quarter as separate variables	
	Stage 1: Excluding management team variables	**Stage 2: All variables**	**Stage 1: Excluding management team variables**	**Stage 2: All variables**
Total ICI	< –0.001	< –0.001*	< –0.001	< –0.001*
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
Natural Log Fund Size	0.0807**	0.054	0.0666*	0.038
	(0.037)	(0.037)	(0.035)	(0.038)
Market Cycle	12.575***	12.78***	12.928***	13.094***
	(0.368)	(0.387)	(0.350)	(0.370)
Female Management Team		0.218		0.254
		(0.316)		(0.300)
Mixed Gender Management Team		–0.345		–0.335
		(0.359)		(0.342)
Size of Management Team		0.118		0.146
		(0.123)		(0.117)
Time	–0.152***	–0.157***		
	(0.007)	(0.007)		
Quarter 2 Relative to Quarter 1			–0.737	–0.570
			(0.498)	(0.533)
Quarter 3 Relative to Quarter 1			5.267***	4.909***
			(0.513)	(0.549)
Quarter 4 Relative to Quarter 1			6.434***	5.944***
			(0.503)	(0.538)
Year			–0.113**	–0.149***
			(0.047)	(0.050)
Interaction Between Year and Quarter 1			0	–
			–	–
Interaction Between Year and Quarter 2			–0.269***	–0.281***
			(0.062)	(0.066)
Interaction Between Year and Quarter 3			–0.844***	–0.807***
			(0.068)	(0.072)
Interaction Between Year and Quarter 4			–0.999***	–0.936***
			(0.066)	(0.706)
Constant	–6.485***	–6.111***	–9.573***	–9.018***

	(0.820)	(0.879)	(0.829)	(0.893)
Observations	4 755	4 229	4 755	4 229
Number of Funds	211	189	211	189
Test Statistic: Wald X^2	1333.94***	1245.80***	2065.63***	1826.32***
		standard error of the coefficients in parentheses		
				*** p<0.01. ** p<0.05. * p<0.1

In both models, for Stage 2 only, total ICI shows a statistically significant negative correlation to fund return, at the 10% significance level. Contrary to much prior research on industry concentration (Choi *et al.*, 2017; Goldman *et al.*, 2016; Hiraki *et al.*, 2015; Shyu *et al.*, 2014), these findings indicate that total industry concentration has a negative relationship with fund performance. This implies that there is little benefit to increasing the concentration of a portfolio. This finding agrees with research by Huij and Derwall (2011) that diversification across industries has a positive relationship with fund performance. In Stage 2 management team information is included as control variables, resulting in a reduced sample size. This might indicate significant differences in the two samples tested in Stage 1 and Stage 2. Stage 1 and Stage 2 differ in that Stage 1 does not consider management team variables while Stage 2 considers all variables.

The mixed effect regression models as shown in Table 3 were run separately on two samples of data, i.e. all funds (Stage 1 data where n = 211) and funds with management team information (Stage 2 data where n = 189). The results show that, while both data sets have similar fund returns, there are differences in terms of total ICI and fund size. Funds without available management data have higher concentration values and smaller fund sizes. Therefore, the data used in Stage 1 has a higher average total ICI and a lower average fund size. However, these differences were not statistically significant and the data sets are similar enough to not significantly impact the testing performed and shown in Table 3.

In both models, for Stage 1 only, fund size shows a statistically positive correlation to fund return. As fund size increases, fund performance increases. This is contrary to prior research for US funds (Ferreira *et al.*, 2013; Pollet & Wilson, 2008) but similar to research on non-US funds (Ferreira *et al.*, 2013). This means that an increase in fund

size of R1 million resulted in a quarterly increase in fund performance of 1.1149%[13]. This equates to an annual increase in fund performance of 4.4596% which on an average sized portfolio of R1 448 598 699 results in a monetary gain of R64 691 708. As Stage 1 includes fewer variables than Stage 2, and fund size is not statistically significant for Stage 2, this result may be better explained by the other variables considered in Stage 2. However, as Stage 1 data has a lower average fund size, this finding implies that for smaller funds an increase in size has a positive impact on performance. This could be as a result of liquidity issues or concentration risk that larger funds face as they expand (Chadha, 2012; Chen, Hong, Huang & Kubik, 2004; Ferreira *et al.*, 2013; Pollet & Wilson, 2008). This means that an increase in the size of the fund will not allow for increased performance as the fund manager will be constrained in his investment choices, either because the fund is so large that acquiring more shares in a specific company is difficult or expensive or because fund mandates do not allow for further concentration into a particular industry or company. The positive coefficient for size may however be as a consequence of improved fund performance rather than a factor. Funds that are performing well may be attractive to investors and thus would attract inflows[14].

In both stages of both models, the market cycle has a statistically significant positive relationship to fund return at the 1% level. This is understandable because as the market improves, equity returns and fund performance is expected to improve (Grinold & Kahn, 2000). To further assess this, both stages of both models in Table 3 were rerun, but after excluding the quarters falling within the financial crisis from the data set, i.e. the models were performed on a market not in a financial crisis. From the second quarter of 2008 to the first quarter of 2009 is considered to be the relevant financial crisis in this research[15]. The mixed effects model output for regressions using total ICI on the period excluding the financial cycle, as opposed to the entire period as shown in Table 3, is shown in Table 8 in Appendix 4. The regression results differ in one area from the initial version of the model in Table 3 to the version run on the period excluding the financial crisis. In the model excluding the financial crisis, for Stage 1 of Model 2, total ICI also shows a statistically significant negative correlation to fund

[13] Ln(1 000 000) × 0,0807 = 1.1149

[14] The author would like to thank an anonymous reviewer for this insight.

[15] See Appendix 1

return, at the 10% significance level. The relationship between total concentration and fund performance is thus more significant when excluding the financial crisis.

Year 0, the base year, is 2006 and the base quarter is quarter 1. The remaining time periods are tested in relation to the base year or base quarter, wherever relevant. For Model 1, the time variable represents year and quarter together and is considered such that the effect of the quarters is ignored. Time is statistically significant at the 1% level. The relationship between time, as indicated by this variable, and fund performance is negative. This shows that, relative to prior years, fund performance decreased over time. To clarify, the negative coefficient for the relationship between time and fund performance does not indicate that performance is negative but rather that performance increased at a decreasing rate. This result is repeated in Model 2, where the year variable shows a statistically significant negative correlation with fund performance. To reiterate, this does not indicate that performance is negative year on year but that it decreased over time. This is expected given the low growth that the South African market has been experiencing, specifically during the last three years of the period (Benn, 2018; Omarjee, 2017).

In Model 2 quarters 2, 3 and 4 are assessed relative to quarter 1. The positive relationship of quarters 3 and 4 relative to quarter 1 indicates that fund performance improved in the second half of the year relative to the first quarter of the year. This finding is such for every year for the period, namely from 2006 to 2017. Furthermore, the interaction between year and quarters 2, 3 and 4 is statistically significant and negatively correlated to fund performance. The results of the interaction effect between the specific years (2006 to 2017) and the quarters echo the results in Model 1 and indicate that, relative to prior years, fund performance decreased over time. Therefore, although fund performance normally improved in the second half of the year, there is still a general downward trend in returns over the years as mentioned in the previous paragraph.

As male management teams are the reference group the other groups of management teams, namely female and mixed gender management teams, are assessed against the male management team. The information relating to management teams show no statistically significant relationship to fund return, in both models. However, it is noted that the coefficients for the female only management teams are positive, when

compared to male only management teams. This relates to previous research which suggested that female investors outperformed their male counterparts (Barber & Odean, 2001; Willows & West, 2015b). This might be indicative of improved fund performance by female fund managers and is an area of future research within this study.

The regressions were run using total ICI as an independent variable and showed a statistically significant negative relationship between total ICI and fund performance when all variables were included in the model. This research thus found that industry concentration, as measured by total ICI, did not improve fund performance for South African general equity funds. This indicates that it is beneficial to look at the concentration within the 12 classifications in more detail and highlights the necessity of further assessment of the impact of concentration on fund performance.

Concentration per industry

To assess if industry concentration within a specific industry has improved fund performance of South African general equity funds the same models as explained previously were run, but with different independent variables. Where total ICI was used in Table 3, each of the 12 industry classifications concentration indexes will be used as separate independent variables in Table 4. The regression was again performed twice, over two stages. Model 1 includes the year and quarter as one fixed effect for time while Model 2 includes year and quarter as two separate fixed effects. Stage 1 excludes management team information to maintain the full sample size and Stage 2 includes management team information on a reduced sample size.

The formulae for the models are as follows:

Table 4: Model 1: Stage 1:

$$Fund\ return = \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non - equity\ investments + \beta_{13}\ Fund\ size + \beta_{14}\ Market\ cycle + \beta_{15}\ Time + \mu + \varepsilon$$

Table 4: Model 1: Stage 2:

$$Fund\ return = \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non - equity\ investments + \beta_{13}\ Fund\ size + \beta_{14}\ Market\ cycle + \beta_{15}\ Female\ management\ team + \beta_{16}\ Mixed\ gender\ management\ team + \beta_{17}\ Size\ of\ management\ team + \beta_{18}\ Time + \mu + \varepsilon$$

Table 4: Model 2: Stage 1:

$$
\begin{aligned}
Fund\ return = {} & \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications \\
& + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods \\
& + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 \\
& - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care \\
& + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non \\
& - equity\ investments + \beta_{13}\ Fund\ size\ + \beta_{14}\ Market\ cycle \\
& + \beta_{15}\ Quarter\ 2\ relative\ to\ quarter\ 1 \\
& + \beta_{16} Quarter\ 3\ relative\ to\ quarter\ 1 \\
& + \beta_{17}\ Quarter\ 4\ relative\ to\ quarter\ 1\ + \beta_{18}\ Year \\
& + \beta_{19}\ Interaction\ between\ year\ and\ quarter\ 1 \\
& + \beta_{20}\ Interaction\ between\ year\ and\ quarter\ 2 \\
& + \beta_{21}\ Interaction\ between\ year\ and\ quarter\ 3 \\
& + \beta_{21}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon
\end{aligned}
$$

Table 4: Model 2: Stage 2:

$$
\begin{aligned}
Fund\ return = {} & \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications \\
& + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods \\
& + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 \\
& - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care \\
& + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non \\
& - equity\ investments + \beta_{13}\ Fund\ size\ + \beta_{14}\ Market\ cycle \\
& + \beta_{15}\ Female\ management\ team \\
& + \beta_{16}\ Mixed\ gender\ management\ team \\
& + \beta_{17}\ Size\ of\ management\ team \\
& + \beta_{18}\ Quarter\ 2\ relative\ to\ quarter\ 1 \\
& + \beta_{19} Quarter\ 3\ relative\ to\ quarter\ 1 \\
& + \beta_{20}\ Quarter\ 4\ relative\ to\ quarter\ 1\ + \beta_{21}\ Year \\
& + \beta_{22}\ Interaction\ between\ year\ and\ quarter\ 1 \\
& + \beta_{23}\ Interaction\ between\ year\ and\ quarter\ 2 \\
& + \beta_{24}\ Interaction\ between\ year\ and\ quarter\ 3 \\
& + \beta_{25}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon
\end{aligned}
$$

In the regression formulas β_0 represents the constant, while β_1 to β_{25} are the fixed portion of the model and represent the influencers of fund returns tested; μ signifies the random effect to account for the variability between funds and refers to factors not identified or included in the model, and therefore not controlled for, and ε is the errors assumed to be multivariate normal with mean 0 and variance σ^2_ε (Helwig, 2017). Table 4 presents the coefficients and standard errors in the model.

Table 4: Mixed effects model output for regressions using ICI 1–12

	Model 1: Year and quarter as one variable		Model 2: Year and quarter as separate variables	
	Stage 1: Excluding management team variables	Stage 2: All variables	Stage 1: Excluding management team variables	Stage 2: All variables
ICI 1 – Technology	–0.003***	–0.004***	–0.004***	–0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
ICI 2 - Telecommunications	0.015***	0.013***	0.015***	0.014***
	(0.002)	(0.003)	(0.002)	(0.002)
ICI 3 – Consumer services	< –0.001	–0.001	< –0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ICI 4 – Consumer goods	< –0.001	< –0.001	< –0.001	< –0.001
	(0.000)	(0.001)	< (0.001)	< (0.001)
ICI 5 – Industrials	–0.001	< –0.001	–0.001	< –0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ICI 6 – Basic materials	0.001*	0.001***	0.001**	0.001***
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 7 – Financial services	< –0.001	–0.001	< –0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ICI 8 – Real estate	–0.006*	–0.007**	–0.007**	–0.008**
	(0.003)	(0.003)	(0.003)	(0.003)
ICI 9 – Health care	–0.002	–0.001	–0.001	–0.001
	(0.002)	(0.002)	(0.002)	(0.002)
ICI 10 – Oil and gas	–0.022***	–0.023***	–0.023***	–0.025***
	(0.005)	(0.005)	(0.005)	(0.005)
ICI 11 – Utilities	0.461	0.460	0.520	0.518
	(0.359)	(0.357)	(0.339)	(0.339)
ICI 12 – Non-equity investments	< –0.001	< –0.001**	< –0.001**	< –0.001**
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
Natural Log Fund Size	0.09**	0.065	0.074**	0.047
	(0.038)	(0.040)	(0.036)	(0.038)
Market Cycle	12.399***	12.669***	12.78***	13.004***
	(0.368)	(0.387)	(0.349)	(0.369)

Female Management Team		0.226		0.274
		(0.317)		(0.301)
Mixed Gender Management Team		–0.451		–0.428
		(0.359)		(0.341)
Size of Management Team		0.156*		0.249**
		(0.126)		(0.119)
Time	–0.121***	–0.121***		
	(0.009)	(0.010)		
Quarter 2 Relative to Quarter 1			–0.714	–0.562
			(0.494)	(0.529)
Quarter 3 Relative to Quarter 1			5.389***	5.036***
			(0.509)	(0.545)
Quarter 4 Relative to Quarter 1			6.563***	6.097***
			(0.499)	(0.534)
Year			0.026	0.000
			(0.053)	(0.056)
Interaction Between Year and Quarter 1			–	–
			–	–
Interaction Between Year and Quarter 2			–0.272***	–0.282***
			(0.062)	(0.066)
Interaction Between Year and Quarter 3			–0.858***	–0.819***
			(0.067)	(0.071)
Interaction Between Year and Quarter 4			–1.005***	–0.943***
			(0.066)	(0.070)
Constant	(7.216)***	(7.230)***	(10.37)***	(10.16)***
	(0.841)	(0.900)	(0.846)	(0.908)
Observations	4 755	4 229	4 755	4 229
Number of Funds	211	189	211	189
Test Statistic: Wald X^2	654.88***	609.83***	1725.16***	1478.80***
			standard error of the coefficient in parentheses	
				*** p<0,01, ** p<0,05, * p<0,1

Across both stages of both models in Table 4, five industries' concentration index, namely technology, telecommunication, basic materials, real estate and oil and gas, are statistically significant in predicting fund performance. The telecommunication industry (at the 1% significance level) and basic materials industry had a positive relationship with fund performance. Looking at the coefficient for telecommunications from Model 1 Stage 1, increasing concentration by 5% in the telecommunications industry would have resulted in a 0.375%[16] increase in fund return per quarter or a 1.5% annual return. The telecommunications industry consists only of MTN Group, Vodacom Group, Telkom SA SOC and Blue Label Telecoms Ltd. An area for future research is to investigate which of these companies contribute to the positive performance, or if it a combination of the four. The basic materials industry is one of the largest on the JSE and, as at the end July 2017, represented approximately 17% of the market. The basic materials sector is dominated by the mining sector (representing 82%) and forestry companies (18%). The South African Chamber of Mines president is quoted as saying that 'mining is the flywheel of the South African economy. When mining does well, it lifts many other sectors, those who supply inputs into the industry and through the significant export revenue it brings back into the economy. The converse is also true – when mining struggles, most other economic sectors also feel the pain' (Mgojo, 2017, p. 1). Although the mining sector has played a pivotal role in the South African economy, and thus the market, since the late 1800s the relevance thereof in the last decade and for the future is in question (Jansen van Vuuren, 2018). This finding provides an additional avenue for future research as to the impact of the mining sector, and the concentration therein, on South African fund performance in the short, medium and long term.

Contrarily, increased concentration in the technology (at the 1% significance level), real estate or oil and gas (also at the 1% significance level) industries reduced fund return. Looking at the coefficient for technology and oil and gas from Model 1 Stage 1, increasing concentration in the technology industry by 5% would have resulted in a 0.3% decrease in annual fund returns. An increase in the oil and gas industry would have resulted in a 2.2% decrease in annual fund returns. Given that the average return of the funds for a quarter is 2.41%, these values are economically significant and imply

[16] $5^2 \times 0.015 = 0.375\%$

that concentration in certain industries will influence fund performance. Although economically significant on large portfolios, the financial impact of investing in the technology industry is not as severe as that of investing in the oil and gas industry. For the period under consideration, two companies dominated the technology industry, namely Datatec Limited and EOH Holdings Limited. Looking at the market value of the stock prices over time, both companies showed conservatively positive performance until the third quarter of 2015 and then a steady decline in value from the end of 2015, although the decline was more significant for EOH Holdings. The negative performance of the stock price from the third quarter of 2015 is likely to be the reason for the negative relationship with returns. As the decline of the sector is near the end of the period researched the negative impact on fund performance may be as a result of the more recent decline and is an area for future research. The negative impact on fund performance is more economically significant for the oil and gas industry. The oil and gas industry consists of various small companies and one major player, Sasol, who represents approximately 90% of the industry at the end of the period. Further research is required to determine if it is the major player in the sector that influences the negative relationship or if it is the smaller companies that contribute to the finding.

For Model 1 when looking at the relationship between time, represented by the year and quarter together variable, and fund performance, the output shows a statistically significant negative relationship between time and fund performance. This is the same as what was found in Table 3. Unlike in Table 3, in Table 4 the year variable in Model 2 is no longer statistically significant. However, the relationship between the quarters and the interaction between the quarters and the years is the same as in Table 3. Thus, the regression still shows that, although fund performance normally improved in the second half of the year, there is still a general downward trend in returns over the years.

What differs from Table 3 to Table 4 is that the size of the management team is statistically significant at the 10% level in Table 4. The difference between the models in Table 3 and those in Table 4 is the inclusion of the concentration for each industry. This finding thus implies that by including the individual concentrations for each industry more correct results are obtained from the regression analysis and the indirect relationship between concentration and management team is better accounted for.

Management team is a significant variable and positively related to fund performance in these models. As management team size increased, fund performance improved. This is contradictory to some previous research (Goldman *et al.*, 2016). This is a relevant finding because, as detailed in the descriptive statistics section of this chapter, the majority of South African funds (70.9%) are managed by one manager. This relationship is more statistically significant (at the 1% level) when the models are rerun to exclude the quarters falling within the financial crisis from the data set. The output is given in Table 9 in Appendix 5 and further detailed below. Further research is required on the relationship between fund performance, the number of fund managers and what the optimum number of fund managers may be.

As found in Table 3 when including total concentration, the market cycle has a statistically significant positive relationship with fund return at the 1% level. To further assess this, both stages of both models in Table 4 were rerun, but after excluding the quarters falling within the financial crisis from the data set. The output is given in Table 9 in Appendix 5. The results of excluding the financial crisis from the data set showed that while the technology, oil and gas, and real estate industries remained statistically significant and negatively correlated with fund performance, only the telecommunications industry was statistically significant and positively correlated with fund performance. Therefore, the basic materials industry is no longer statistically significant in all stages of the models. This finding implies that concentration in basic materials is not related to positive fund performance when the market is not experiencing a financial crisis. Furthermore, the utilities industry was statistically significant (at the 10% level) and positively related to fund performance in Model 2. As this version of the model relates only to the non-financial crisis period and includes management variables, this finding implies that including manager variables provides more insight as it accounts for the indirect effect of manager information on concentrating in utilities. This finding further implies that concentrating in utilities may only improve fund performance if the market is not in a financial crisis. This finding is in line with prior research which has found the energy and utilities industries contributed to improved fund performance (Avramov & Wermers, 2006).

The final industry classification of non-equity instruments[17] shows that increased exposure outside of equity investments lowers fund return. This is not unexpected, as literature has shown superior return from equity investments (Black, 2003; Grinold & Kahn, 2000). Over the period, concentrating a portfolio in telecommunications or basic materials would have improved fund performance while technology, real estate or oil and gas concentration would have negatively impacted fund performance.

[17] Non-equity investments were included as an industry classification to account for the portion of the funds not invested in equity.

CONCLUSION

The aim of this research was to determine if industry concentration improved fund performance. The mixed model regression run provided evidence that total concentration had a negative relationship with fund performance, but the coefficients in the regression analysis were small and the statistical significance low. However, when looking at concentration at an industry level, more insight was gained and multiple industries were found to influence returns at a statistically significant level. Over the period from 2006 to 2017, concentrating a portfolio in telecommunications or basic materials improved fund performance. Looking at the coefficient for telecommunications from Model 1 Stage 1, increasing concentration by 5% in the telecommunications industry would have resulted in a 0.375%[18] increase in fund return per quarter or a 1.5% annual return. The telecommunications industry consists only of MTN Group, Vodacom Group, Telkom SA SOC and Blue Label Telecoms Ltd. An area for future research is to investigate which of these stocks contribute to the positive performance, or if it is a combination of the four. The basic materials industry is one of the largest on the JSE and, as at the end July 2017, represented approximately 17% of the market. The basic materials sector is dominated by the mining sector (representing 82%). Although the mining sector has played a pivotal role in the South African economy, and thus the market, since the late 1800s the relevance thereof in the last decade and for the future is in question (Jansen van Vuuren, 2018). This finding provides an additional avenue for future research as to the impact of the mining sector, and the concentration therein, on South African fund performance in the short, medium and long term.

Conversely, concentration in the technology, real estate or oil and gas industries negatively impacted fund performance. Looking at the coefficient for technology and oil and gas from Model 1 Stage 1, increasing concentration by 5% in these industries would have resulted in a 0.3% and 2.2% decrease in annual fund returns, respectively. Given that the average return of the funds for a quarter is 2.41%, these values are economically significant and imply that concentration in certain industries will influence fund performance. Although economically significant on large portfolios, the financial impact of investing in the technology industry is not as severe as that of investing in

[18] $5^2 \times 0.015 = 0.375\%$

the oil and gas industry. The oil and gas industry consists of various small companies and one major player, Sasol, who represents approximately 90% of the industry at the end of the period. Further research is required to determine if it is the major player in the sector that influences the negative relationship or if it is the smaller companies that contribute to the finding. Concentration outside of equity investments also negatively impacted fund performance. When the regression was run on the period excluding the financial crisis, similar results were produced as when run on the entire period but it did highlight another industry, utilities, that influenced returns at a statistically significant level. This finding further implies that concentrating in utilities may only improve fund performance if the market is not in a financial crisis. Additionally, concentration in the basic materials industry was no longer statistically significant when the financial crisis period was excluded. This finding implies that concentration in basic materials is not related to positive fund performance when the market is not experiencing a financial crisis.

In the model, other aspects, such as the market cycle and management information, were also considered to be possible influencers of returns. This research found that the market cycle positively influenced fund performance at a statistically significant level. The regression models were thus run excluding the period that related to the financial crisis but similar relationships between concentration and fund performance were found, as stated above. The gender of the management teams did not produce statistically significant results. Nonetheless, when looking at the coefficients of the regression models the results implied that female only management teams outperformed their male only counterparts and male only management teams outperformed mixed gender teams. The size of the management team showed a statistically significant relationship with fund performance when included in the regression considering specific industry concentration. This is contradictory to previous research and is an area for further research. This is a relevant finding as the majority of South African funds (70.9%) for the period of this research were managed by one manager.

Previous research has found contradictory evidence on whether industry concentration improves fund performance with most literature reviewed finding a positive relationship between industry concentration and fund performance.

Furthermore, literature provided little insight as to concentration in which industries positively or negatively influenced performance. By understanding if concentration improves fund performance investors and fund managers will be able to make more informed decisions. This research found that industry concentration, as measured by total industry concentration, does not improve fund performance for South African general equity funds. However, when looking at specific industry concentration, concentrating a portfolio in telecommunications or basic materials would have improved fund performance while non-equity instruments and technology, real estate or oil and gas sector concentration would have negatively impacted fund performance. Furthermore, this research accounts for both the non-financial crisis and financial crisis market cycles that were seen between the second quarter of 2008 and the first quarter of 2009 and found similar relationships between concentration and fund performance, as stated above. This author has not found evidence of research that has included both market cycle, defined as the financial crisis portion and non-financial crisis portion of a period, and specific industry concentration within a fund. While this research acknowledges that this insight might be limited by certain fund limitations and mandates, it provides a better awareness of how industry concentration has impacted, and can impact, a fund's return.

AREAS FOR FURTHER RESEARCH

This research was done over the period 2006 to 2017 and the impact of concentration of a fund for a quarter was assessed relative to the performance of the fund in the following quarter. Future research can be done using a longer time period, thus investigating the impact of concentration on return longer than a period later, namely biyearly or yearly.

A recommendation for further research is to extend testing for industries that have a statistically significant impact on fund performance to determine if there are specific companies within that industry that strongly influence the relationship with performance.

Although this research did not focus on management data, the regressions performed implied that female only management teams potentially outperform male only fund management teams who, in turn, outperform mixed gender management teams. Furthermore, when industry concentration was included in the model, the size of the management team positively influenced returns. However, this result was not seen when total concentration was used and differs from prior research. Thus, further research is proposed to assess how the size and gender of the management team influences the performance of funds.

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APPENDICES

APPENDIX 1

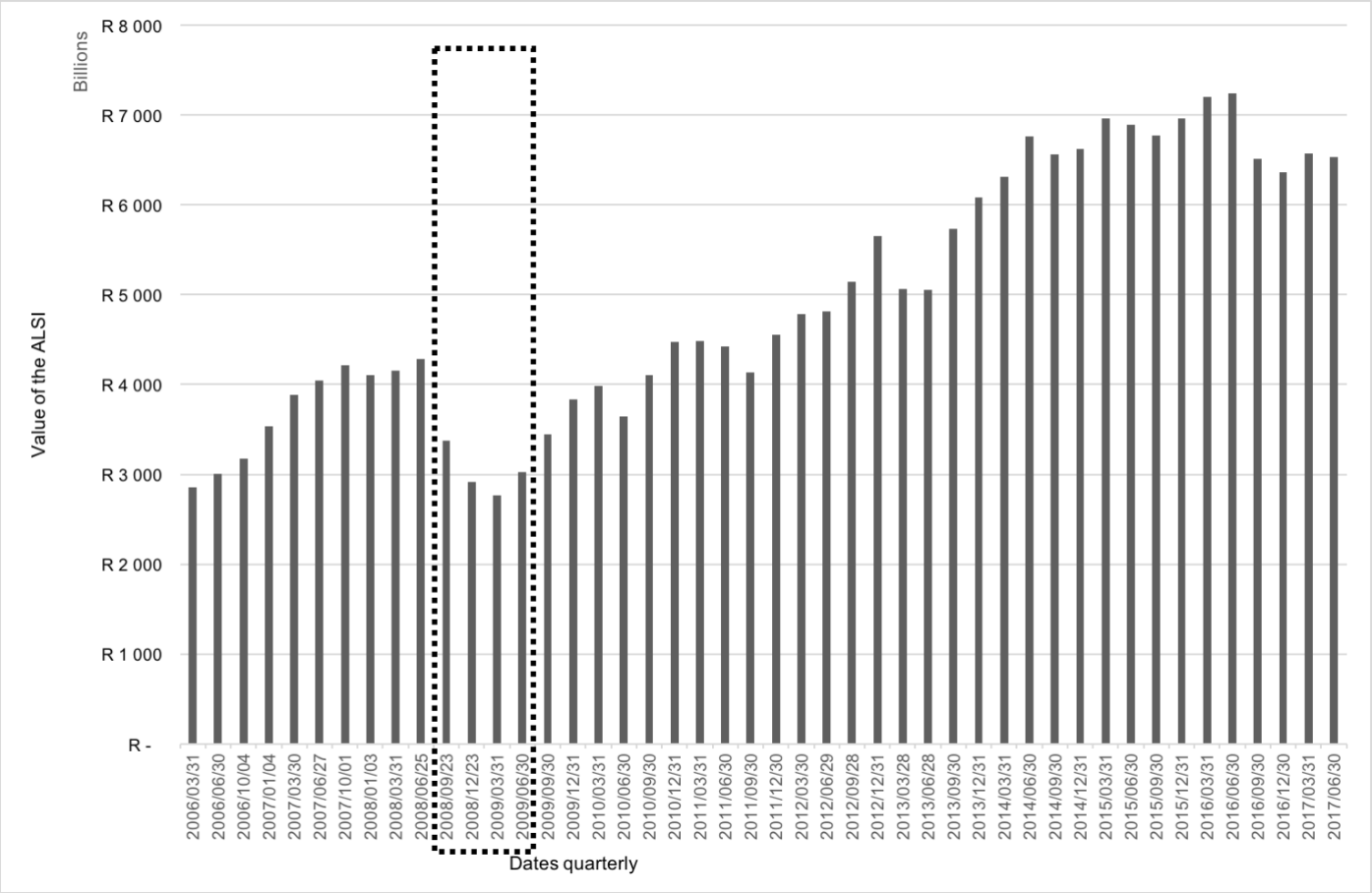

Figure 1: JSE ALSI values over time

APPENDIX 2

Table 5: Industry Classification Benchmark (ICB)

Industry	Super Sector	Sector	Sub-Sector
0001 Oil & Gas	0500 Oil & Gas	0530 Oil & Gas Producers	0533 Exploration & Production
			0537 Integrated Oil & Gas
		0570 Oil Equipment, Services & Distribution	0573 Oil Equipment & Services
			0577 Pipelines
		0580 Alternative Energy	**0583 Renewable Energy Equipment**
			0587 Alternative Fuels
1000 Basic Materials	1300 Chemicals	1350 Chemicals	1353 Commodity Chemicals
			1357 Specialty Chemicals
	1700 Basic Resources	1730 Forestry & Paper	1733 Forestry
			1737 Paper
		1750 Industrial Metals **& Mining**	1753 Aluminium
			1755 Nonferrous Metals
			1757 **Iron &** Steel
		1770 Mining	1771 Coal
			1773 Diamonds & Gemstones
			1775 General Mining
			1777 Gold Mining
			1779 Platinum & Precious Metals
2000 Industrials	2300 Construction & Materials	2350 Construction & Materials	2353 Building Materials & Fixtures
			2357 Heavy Construction
	2700 Industrial Goods & Services	2710 Aerospace & Defence	2713 Aerospace
			2717 Defence
		2720 General Industrials	2723 Containers & Packaging
			2727 Diversified Industrials
		2730 Electronic & Electrical Equipment	2733 Electrical Components & Equipment
			2737 Electronic Equipment
		2750 Industrial Engineering	2753 Commercial Vehicles & Trucks
			2757 Industrial Machinery
		2770 Industrial Transportation	2771 Delivery Services
			2773 Marine Transportation
			2775 Railroads
			2777 Transportation Services
			2779 Trucking
		2790 Support Services	2791 Business Support Services
			2793 Business Training & Employment Agencies
			2795 Financial Administration
			2797 Industrial Suppliers
			2799 Waste & Disposal Services
3000 Consumer Goods	3300 Automobiles & Parts	3350 Automobiles & Parts	3353 Automobiles
			3355 Auto Parts
			3357 Tires
	3500 Food & Beverage	3530 Beverages	3533 Brewers
			3535 Distillers & Vintners
			3537 Soft Drinks
		3570 Food Producers	3573 Farming, Fishing & Plantations
			3577 Food Products
	3700 Personal & Household Goods	3720 Household Goods **& Home Construction**	3722 Durable Household Products
			3724 Nondurable Household Products
			3726 Furnishings
			3728 Home Construction
		3740 Leisure Goods	3743 Consumer Electronics
			3745 Recreational Products
			3747 Toys
		3760 Personal Goods	3763 Clothing & Accessories
			3765 Footwear
			3767 Personal Products
		3780 Tobacco	3785 Tobacco

Industry	Super Sector	Sector	Sub-Sector
4000 Health Care	4500 Health Care	4530 Health Care Equipment & Services	4533 Health Care Providers
			4535 Medical Equipment
			4537 Medical Supplies
		4570 Pharmaceuticals & Biotechnology	4573 Biotechnology
			4577 Pharmaceuticals
5000 Consumer Services	5300 Retail	5330 Food & Drug Retailers	5333 Drug Retailers
			5337 Food Retailers & Wholesalers
		5370 General Retailers	5371 Apparel Retailers
			5373 Broadline Retailers
			5375 Home Improvement Retailers
			5377 Specialized Consumer Services
			5379 Specialty Retailers
	5500 Media	5550 Media	5553 Broadcasting & Entertainment
			5555 Media Agencies
			5557 Publishing
	5700 Travel & Leisure	5750 Travel & Leisure	5751 Airlines
			5752 Gambling
			5753 Hotels
			5755 Recreational Services
			5757 Restaurants & Bars
			5759 Travel & Tourism
6000 Telecommunications	6500 Telecommunications	6530 Fixed Line Telecommunications	6535 Fixed Line Telecommunications
		6570 Mobile Telecommunications	6575 Mobile Telecommunications
7000 Utilities	7500 Utilities	7530 Electricity	7535 **Conventional** Electricity
			7537 Alternative Electricity
		7570 Gas, Water & Multi-utilities	7573 Gas Distribution
			7575 Multi-utilities
			7577 Water
8000 Financials	8300 Banks	8350 Banks	8355 Banks
	8500 Insurance	8530 Nonlife Insurance	8532 Full Line Insurance
			8534 Insurance Brokers
			8536 Property & Casualty Insurance
			8538 Reinsurance
		8570 Life Insurance	8575 Life Insurance
	8600 Real Estate	**8630 Real Estate Investment & Services**	**8633 Real Estate Holdings & Development**
			8637 Real Estate Services
		8670 Real Estate Investment Trusts	**8671 Industrial & Office REITs**
			8672 Retail REITs
			8673 Residential REITs
			8674 Diversified REITs
			8675 Specialty REITs
			8676 Mortgage REITs
			8677 Hotel & Lodging REITs
	8700 Financial Services	8770 **Financial Services**	8771 Asset Managers
			8773 Consumer Finance
			8775 Specialty Finance
			8777 Investment Services
			8779 Mortgage Finance
		8980 Equity Investment Instruments	8985 Equity Investment Instruments
		8990 Non-equity Investment Instruments	8995 Non-equity Investment Instruments
9000 Technology	9500 Technology	9530 Software & Computer Services	9533 Computer Services
			9535 Internet
			9537 Software
		9570 Technology Hardware & Equipment	9572 Computer Hardware
			9574 Electronic Office Equipment
			9576 Semiconductors
			9578 Telecommunications Equipment

** ICB changes effective in 2009 are in Bold*

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APPENDIX 3

Illustrative examples 3 and 4 in Table 6 and Table 7 are provided to show how total ICI values are calculated for two different funds, the first a highly concentrated fund and the second a fund with industry weightings similar to the market. Only five industries are included in these examples for ease of illustration.

Illustrative example 3 (Table 6) represents a hypothetical situation in which an equity fund differs notably from the market, for each industry classification, by 5% to 25%. This fund represents a highly concentrated fund. Conversely, illustrative example 4 (Table 7) represents another hypothetical situation in which an equity fund differs only slightly from the market and is thus similar to the market. In this example, for each industry classification, the fund differs from the market by less than 5%. This fund represents the opposite to a highly concentrated fund.

Table 6: Illustrative example 3: Calculating total ICI on a highly concentrated fund

Industry classification	*Weight in the market*	*Weight in fund*	*Total ICI for the fund*
1	10	20	100
2	20	40	400
3	40	15	625
4	5	0	25
5	25	5	400
Non-equity	0	20	400
Total	**100**	**100**	**1950**

Table 7: Illustrative example 4: Calculating total ICI on a fund similar to the market

Industry classification	*Weight in the market*	*Weight in fund*	*Total ICI for the fund*
1	10	13	9
2	20	18	4
3	40	45	25
4	5	4	1
5	25	20	25
Non-equity	0	0	0
Total	**100**	**100**	**64**

[19] Source: https://www.jse.co.za/content/JSEIndexClassificationandCodesItems/Industry%20Classification%20Benchmark%20(ICB).pdf

APPENDIX 4

The mixed effects model output for regressions using total ICI on the period excluding the financial cycle, as opposed to the entire period as shown in Table 3, is shown in Table 8. Table 8 presents the coefficients and standard errors in the model. The market cycle variable is not included in this regression output as the regression is run specifically on non-financial crisis data only.

The formulae for the models are as follows:

Table 8: Model 1: Stage 1:

$$Fund\ return = \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle + \beta_4\ Time + \mu + \varepsilon$$

Table 8: Model 1: Stage 2:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle \\ & + \beta_4\ Female\ management\ team \\ & + \beta_5\ Mixed\ gender\ management\ team \\ & + \beta_6\ Size\ of\ management\ team + \beta_7 Time + \mu + \varepsilon \end{aligned}$$

Table 8: Model 2: Stage 1:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle \\ & + \beta_4\ Quarter\ 2\ relative\ to\ quarter\ 1 \\ & + \beta_5 Quarter\ 3\ relative\ to\ quarter\ 1 \\ & + \beta_6\ Quarter\ 4\ relative\ to\ quarter\ 1 + \beta_7\ Year \\ & + \beta_8\ Interaction\ between\ year\ and\ quarter\ 1 \\ & + \beta_9\ Interaction\ between\ year\ and\ quarter\ 2 \\ & + \beta_{10}\ Interaction\ between\ year\ and\ quarter\ 3 \\ & + \beta_{11}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon \end{aligned}$$

Table 8: Model 2: Stage 2:

$$Fund\ return = \beta_0 + \beta_1\ Total\ ICI + \beta_2\ Fund\ size + \beta_3\ Market\ cycle + \beta_4\ Female\ management\ team + \beta_5\ Mixed\ gender\ management\ team + \beta_6\ Size\ of\ management\ team + \beta_7\ Quarter\ 2\ relative\ to\ quarter\ 1 + \beta_8 Quarter\ 3\ relative\ to\ quarter\ 1 + \beta_9\ Quarter\ 4\ relative\ to\ quarter\ 1 + \beta_{10}\ Year + \beta_{11}\ Interaction\ between\ year\ and\ quarter\ 1 + \beta_{12}\ Interaction\ between\ year\ and\ quarter\ 2 + \beta_{13}\ Interaction\ between\ year\ and\ quarter\ 3 + \beta_{14}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon$$

Table 8: Mixed effects model output for regressions using total ICI run on the period excluding the financial crisis

	Model 1: Year and quarter as one variable		**Model 2: Year and quarter as separate variables**	
	Stage 1: Excluding management team variables	**Stage 2: All variables**	**Stage 1: Excluding management team variables**	**Stage 2: All variables**
Total ICI	< –0.001	< –0.001*	< –0.001*	< –0.001**
	(0.000)	(< 0.001)	(< 0.001)	(< 0.001)
Natural Log Fund Size	0.08**	0.053	0.0619*	0.029
	(0.038)	(0.040)	(0.035)	(0.037)
Female Management Team		0.249		0.281
		(0.316)		(0.291)
Mixed Gender Management Team		–0.386		–0.383
		(0.361)		(0.332)
Size of Management Team		0.102		0.139
		(0.125)		(0.115)
Time	–0.153***	–0.157***		
	(0.007)	(0.007)		
Quarter 2 relative to quarter 1			–0.571	–0.455
			(0.517)	(0.556)

Quarter 3 relative to quarter 1			8.01***	7.71***
			(0.533)	(0.573)
Quarter 4 relative to quarter 1			9.722***	9.244***
			(0.536)	(0.574)
Year			0.043	0.009
			(0.047)	(0.050)
Interaction between year and quarter 1			–	–
			–	–
Interaction between year and quarter 2			–0.282***	0.289***
			(0.064)	(0.068)
Interaction between year and quarter 3			–1.154***	–1.123***
			(0.069)	(0.073)
Interaction between year and quarter 4			–1.376***	–1.313***
			(0.069)	(0.073)
Constant	6.137***	6.7332***	2.027**	2.82***
	(0.794)	(0.846)	(0.797)	(0.854)
Observations	4 545	4 040	4 545	4 040
Number of Funds	211	189	211	189
Test Statistic: Wald X^2	560.86***	527.16***	1581.39***	1354.30***
			standard error of the coefficients in parentheses	
			*** p<0.01. ** p<0.05. * p<0.1	

APPENDIX 5

Table 9 presents the mixed effects model output for regressions using ICI 1 to 12 on the period excluding the financial cycle, as opposed to the entire period as shown in Table 4. Table 9 presents the coefficients and standard errors in the model. The market cycle variable is not included in this regression output as the regression is run specifically on non-financial crisis data only.

The formulae for the models is as follows

Table 9: Model 1: Stage 1:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications \\ & + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods \\ & + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 \\ & - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care \\ & + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non \\ & - equity\ investments + \beta_{13}\ Fund\ size + \beta_{14}\ Market\ cycle + \beta_{15}\ Time \\ & + \mu + \varepsilon \end{aligned}$$

Table 9: Model 1: Stage 2:

$$\begin{aligned} Fund\ return = {} & \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications \\ & + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods \\ & + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 \\ & - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care \\ & + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non \\ & - equity\ investments + \beta_{13}\ Fund\ size + \beta_{14}\ Market\ cycle \\ & + \beta_{15}\ Female\ management\ team \\ & + \beta_{16}\ Mixed\ gender\ management\ team \\ & + \beta_{17}\ Size\ of\ management\ team + \beta_{18}\ Time + \mu + \varepsilon \end{aligned}$$

Table 9: Model 2: Stage 1:

$$
\begin{aligned}
Fund\ return = {} & \beta_0 + \beta_1\ ICI\ 1 - Technology + \beta_2\ ICI\ 2 - Telecommunications \\
& + \beta_3\ ICI\ 3 - Consumer\ services + \beta_4\ ICI\ 4 - Consumer\ goods \\
& + \beta_5\ ICI\ 5 - Industrials + \beta_6\ ICI\ 6 - Basic\ materials + \beta_7\ ICI\ 7 \\
& - Financial\ services + \beta_8\ ICI\ 8 - Real\ estate + \beta_9\ ICI\ 9 - Health\ care \\
& + \beta_{10}\ ICI\ 10 - Oil\ and\ gas + \beta_{11}\ ICI\ 11 - Utilities + \beta_{12}\ ICI\ 12 - Non \\
& - equity\ investments + \beta_{13}\ Fund\ size\ + \beta_{14}\ Market\ cycle \\
& + \beta_{15}\ Quarter\ 2\ relative\ to\ quarter\ 1 \\
& + \beta_{16} Quarter\ 3\ relative\ to\ quarter\ 1 \\
& + \beta_{17}\ Quarter\ 4\ relative\ to\ quarter\ 1\ + \beta_{18}\ Year \\
& + \beta_{19}\ Interaction\ between\ year\ and\ quarter\ 1 \\
& + \beta_{20}\ Interaction\ between\ year\ and\ quarter\ 2 \\
& + \beta_{21}\ Interaction\ between\ year\ and\ quarter\ 3 \\
& + \beta_{21}\ Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon
\end{aligned}
$$

Table 9: Model 2: Stage 2:

$$
\begin{aligned}
&\boldsymbol{Fund\ return} \\
&= \beta_0 + \beta_1\, ICI\ 1 - Technology + \beta_2\, ICI\ 2 - Telecommunications \\
&+ \beta_3\, ICI\ 3 - Consumer\ services + \beta_4\, ICI\ 4 - Consumer\ goods \\
&+ \beta_5\, ICI\ 5 - Industrials + \beta_6\, ICI\ 6 - Basic\ materials + \beta_7\, ICI\ 7 \\
&- Financial\ services + \beta_8\, ICI\ 8 - Real\ estate + \beta_9\, ICI\ 9 \\
&- Health\ care + \beta_{10}\, ICI\ 10 - Oil\ and\ gas + \beta_{11}\, ICI\ 11 - Utilities \\
&+ \beta_{12}\, ICI\ 12 - Non - equity\ investments + \beta_{13}\, Fund\ size \\
&+ \beta_{14}\, Market\ cycle + \beta_{15}\, Female\ management\ team \\
&+ \beta_{16}\, Mixed\ gender\ management\ team \\
&+ \beta_{17}\, Size\ of\ management\ team \\
&+ \beta_{18}\, Quarter\ 2\ relative\ to\ quarter\ 1 \\
&+ \beta_{19} Quarter\ 3\ relative\ to\ quarter\ 1 \\
&+ \beta_{20}\, Quarter\ 4\ relative\ to\ quarter\ 1 + \beta_{21}\, Year \\
&+ \beta_{22}\, Interaction\ between\ year\ and\ quarter\ 1 \\
&+ \beta_{23}\, Interaction\ between\ year\ and\ quarter\ 2 \\
&+ \beta_{24}\, Interaction\ between\ year\ and\ quarter\ 3 \\
&+ \beta_{25}\, Interaction\ between\ year\ and\ quarter\ 4 + \mu + \varepsilon
\end{aligned}
$$

Table 9: Mixed effects model output for regressions using ICI 1–12 run on the period excluding the financial crisis

	Model 1: Year and quarter as one variable		Model 2: Year and quarter as separate variables	
	Stage 1: Excluding management team variables	**Stage 2: All variables**	**Stage 1: Excluding management team variables**	**Stage 2: All variables**
ICI 1 – Technology	–0.003***	–0.003***	–0.003***	–0.003***
	(0.00)	(0.00)	(0.00)	(0.00)
ICI 2 – Telecommunications	0.016***	0.145***	0.017***	0.016***
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 3 – Consumer services	< –0.001	< –0.001	< –0.001	< –0.001
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 4 – consumer goods	< –0.001	< –0.001	< –0.001	< –0.001
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 5 – Industrials	< –0.001	< –0.001	< –0.001	< –0.001
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 6 – Basic materials	< 0.001	< 0.001	< 0.001	< 0.001**
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 7 – Financial services	< –0.001	< –0.001	< –0.001	< –0.001
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 8 – Real estate	–0.006*	–0.006*	–0.007**	–0.007**
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 9 – Health care	< –0.001	< –0.001	< –0.001	< –0.001
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
ICI 10 – Oil and gas	–0.023***	–0.023***	–0.022***	–0.024***
	(0.01)	(0.01)	< (0.001)	(0.01)
ICI 11 – Utilities	0.47	0.47	0.562*	0.559*
	(0.36)	(0.35)	(0.33)	(0.32)
ICI 12 – Non-equity investments	< –0.001	< –0.001*	< –0.001	< –0.001***
	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)
Natural Log Fund Size	0.094**	0.069*	0.075**	0.05
	(0.04)	(0.04)	(0.03)	(0.04)

Female Management Team		0.26		0.30
		(0.32)		(0.29)
Mixed Gender Management Team		–0.49		–0.47
		(0.36)		(0.33)
Size of Management Team		0.20		0.243**
		(0.13)		(0.12)
Time	–0.124***	–0.123***		
	(0.01)	(0.01)		
Quarter 2 relative to quarter 1			–0.54	–0.42
			(0.51)	(0.55)
Quarter 3 relative to quarter 1			8.137***	7.843***
			(0.53)	(0.57)
Quarter 4 relative to quarter 1			9.803***	9.356***
			(0.53)	(0.57)
Year			0.163***	0.143**
			(0.05)	(0.06)
Interaction between year and quarter 1			–	–
			–	–
Interaction between year and quarter 2			–0.286***	–0.293***
			(0.06)	(0.07)
Interaction between year and quarter 3			–1.17***	–1.136***
			(0.07)	(0.07)
Interaction between year and quarter 4			–1.379***	–1.317***
			(0.07)	(0.07)
Constant	5.193***	5.42***	1.07	1.505*
	(0.82)	(0.87)	(0.82)	(0.87)
Observations	4 545	4 040	4 545	4 040
Number of Funds	211	189	211	189
Test Statistic: Wald X^2	1436.32***	210.46***	2206.02***	1953.54***
		standard error of the coefficients in parentheses		
				*** p<0.01. ** p<0.05. * p<0.1