Giants at the gate:
Investment returns and diseconomies of scale in private equity

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We examine the determinants of private equity returns using a newly constructed database of 7,500 investments worldwide over forty years. One in ten investments does not return any money, whereas one in four has an IRR above 50%. Performance does not appear scalable: investments held by private equity firms at times of a high number of other simultaneous investments underperform substantially. The median IRR is 33% in the lowest scale decile and 14% in the highest. Results survive multiple robustness tests and are consistent with the theoretical literature on organizational diseconomies. Diseconomies of scale are linked to firm structure: independent firms, less hierarchical firms, and those with managers of similar professional backgrounds exhibit smaller diseconomies of scale. These results also support the view that private equity firms exhibit skills and their actions are not mechanical or easily scalable.

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1. Introduction

This paper examines whether private equity (PE) investments display diseconomies of scale at the organizational level. Results help disentangling two views about the nature of PE returns. The first view, espoused by several critics of PE, points out that PE firms' profits stem from taking advantage of the tax treatment of debt, a levered bet on equity, thereby pocketing the debt-equity cost-of-capital spread, or simply buy value companies and pocket the value premium. An implication of this view is that returns should be scalable. One could even argue there would be economies of scale in implementing such strategies; E.g., repeated lenders obtaining more favorable conditions (Demiroglu and James, 2011, and Ivashina and Kovner, 2011).

An alternative view is that PE firms have skills which are difficult to scale up. This perspective is consistent with Kaplan and Lerner (2010) who argue that "fund size is the enemy of persistence" (p. 44). As the authors say, an increase in fund size may mean that top performance is hard to repeat. The idea is that if PE firms add value by undertaking non-mechanical actions which require attention, then we may expect larger firms to do less well. This view is supported by ample casual evidence. For instance, Lerner *et al*. (2004, p.44) argue that "the unprecedented growth of the private equity industry appeared to have changed the industry in some permanent ways. (…) These concerns were particularly acute on the buyout side, where multi-billion-dollar funds have become the norm."[1] And a recent piece in the Financial Times shows that these concerns are still in the minds of investors, quoting an investor "wary of firms that dramatically increase the size of their funds."[2]

There is a large body of literature in economics on the theoretical connection between firm size and performance which helps rationalize the second view of PE performance. Williamson (1975) was among the first to point to "organizational diseconomies" as a potential mechanism of diseconomies of scale. Holmström and Roberts (1998) argued that, among other things, problems transferring knowledge may influence scale diseconomies. Models such as those of Bolton and

[1] Lerner et al (2004) also cite a report by Swensen *et al*. (1999, p.5) stating that "many LBO firms appear to have explicitly lowered their return hurdles […], pricing deals to yield returns in the mid-to-high teens."
[2] Quote from Susan McAndrews, a partner at Pantheon Ventures, in the article titled "Big buy-out firms poor performers", by Steve Johnson in the *Financial Times*, January 17, 2011.

Dewatripont (1994), Garicano (2000), Stein (2002), and Vayanos (2003) have also formalized the importance of knowledge transfer and communication costs to diseconomies of scale. Garicano (2000, *abstract*) summarizes the idea as "the key trade-off an organization confronts occurs between communication and knowledge costs" meaning that as a firm scales up it benefits from an increased uptake of knowledge but is penalized by greater communication needs. Stein (2002) adds that the organizational diseconomies arising from coordination and communication costs in large firms may be more acute when the information that circulates is of a softer nature (e.g. trustworthiness of a borrower; company strategy).

In contrast to research on mutual fund and hedge funds, where diseconomies of scale have been found,[3] the literature on PE funds shows mixed evidence. Kaplan and Schoar (2005), Ljungqvist, Richardson and Wolfenson (2007), Robinson and Sensoy (2011a) and Harris, Jenkinson and Kaplan (2012) have found a mostly non-significant negative or positive relationship between fund size and returns. Recent papers by Robinson and Sensoy (2011b) and Higson and Stucke (2012) document a more stable positive association between fund size and fund returns, while Humphery-Jenner (2012) finds a consistent negative relation. As a means of comparison with the fund-level literature, we use data from Preqin for buyout funds and find a negative association between fund size and returns.[4] Since PE funds are considerably different from mutual funds and hedge funds, it is possible that the mixed results in PE originate from the sole focus on PE funds and total size.

Indeed, the organizational structure of PE firms and an application of the theories of optimal firm scale to PE suggest that fund-level data may not be the most appropriate way to test for the scalability of returns. First, investment decisions are taken at the firm level and not at the fund level.[5] The partners of a PE firm have a "carried interest" in each investment made by any of the funds they supervise and therefore influence decisions. Hence, unlike mutual funds, PE funds are not independent

[3] Chen et al (2004) and Polet and Wilson (2008) have documented diseconomies of scale for mutual funds, while Fung, Hsieh, Naik and Ramadorai (2008) and Teo (2009) have found diseconomies of scale for hedge funds.
[4] Following Appendix Table A.1, which provides the description of the variables in the paper, Table A.2. presents our fund-level estimates for "buyout" Preqin funds to mimic the funds in our sample for the rest of the paper.
[5] This seems to be the case during most of the past four decades. Although one may argue that in the past few years, certain funds have gained more autonomy as PE firms have increased their spectrum of fund offerings, it is still the case that PE firm partners exert important influence in the decisions made by their funds.

entities run by independent teams. This suggests that a PE firm raising three different funds in a short period of time and another raising only one single fund with a total size equal to the three other funds, operate at very similar scale. Again, this is different for mutual funds. Second, it is not theoretically clear that total size is the best proxy for scale in PE. If each PE investment, regardless of its size, requires a similar amount of management attention and communication among members of the PE firm (see Quindlen, 2000), then a firm managing 100 investments of $10 million each may thus need to operate at a larger scale than a firm managing 10 investments of $100 million each.

The arguments above suggest that we may benefit from a different approach to establish the link between size and returns in PE. In this paper, we use the theoretical literature on organizational economics to guide such an empirical approach. Based on data from fund-raising private placement memorandums (PPMs) collected from several investors around the world, we have created a dataset of all the individual investments of 254 PE firms. After applying a number of filters, which mainly exclude recent investments (because their performance is difficult to assess) our final sample contains 7,453 investments made by these PE firms in 81 countries between 1971 and 2005. Our database of individual investments, allows us to derive an alternative scale proxy that captures more closely the idea that communication costs may be a key determinant of performance. Specifically, we measure firm scale during the life of each investment as the average number of "simultaneous investments" (SI) managed by the firm during the investment's life. This approach also allows us to control for a wealth of other potential determinants of returns.

Our data shows that high returns in PE are not scalable. Investments held at times of a high number of simultaneous investments underperform substantially. The economic magnitude of the negative scale effect is large: a one-standard-deviation increase in SI is linked to an IRR reduction of 8%. Investments in the lowest SI decile earn a median IRR (PME) of 33% (1.57), whereas those in the highest SI decile earn a median IRR (PME) of 14% (1.05).[6] These results also hold in a regression setting controlling for other factors that could be associated with performance, including several

[6] The public market equivalent (PME), is calculated as the present value of the dividends over the present value of the investments. A PME greater than one is equivalent to outperformance of the CRSP value-weighted US stock index.

investment characteristics, PE firm characteristics, and fixed effects (country, industry, and time). A series of tests corroborates the robustness of the non-scalability of returns. Diseconomies of scale are present across subsamples, and survive the use of alternative econometric methods. We also show that differences in risk are unlikely to explain these findings.

Since our data comes from fund raising prospectuses sent by PE firms seeking to raise capital, our sample may suffer from a survivorship bias which could, under additional assumptions, generate diseconomies of scale mechanically. We carry out a series of tests to address this issue. First, and foremost, our results hold when we restrict the sample to first-time funds, for which survivorship bias could be said to be held constant. Second, we find that neither firm age nor fund sequence are significantly related to returns, while a survivorship bias would have generated a negative relationship. Finally, we collected information on dead PE firms and made unfavorable assumptions about their returns. We still find a significant negative relation between returns and SI.

We acknowledge that, as in previous papers that have analyzed the connection between scale and returns, it is hard to establish a causal effect between these variables. Although the econometric results with our investment-level data are encouraging, we cannot rule out completely that the link between returns and firm scale arises due to an omitted factor. But there are several arguments that help us alleviate such a concern. First, the omitted factor would need to be both firm and time specific, since diseconomies of scale are robust to both time and firm fixed effects. Although not impossible it is difficult to think of such a story. Second, we show that lagged firm scale is also negatively related to returns. Third, the different pieces of evidence mentioned throughout the paper are consistent with theories of diseconomies of scale and it would be difficult to explain them collectively by an omitted factor. Finally, even if this relationship is not clearly causal, the analysis presented at the end of the paper points to structural factors in PE firms underlying the connection between scale and returns. These factors have important implications for different types of investors.

Our paper complements a large literature in venture capital, an asset class similar to PE, that analyzes the trade-off between larger/smaller portfolios and diversified/concentrated portfolios and

usually posits that there are diseconomies of scale (Kanniainen and Keuschnigg 2003; Cumming 2006; Bernile *et al*. 2007; Bottazzi, Da Rin, and Hellmann 2008; Fulghieri and Sevilir 2008; Gompers, Kovner, Lerner and Scharfstein 2008; Cumming and Dai 2010; Hochberg and Westerfield 2009).[7]

The paper is organized as follows. After this introduction, Section 2 discusses the theories that motivate our empirical analysis. Section 3 describes the data and provides novel descriptive statistics on the cross-section of PE investment returns and characteristics. Section 4 empirically identifies the drivers behind the great variation in the performance of PE investments, and establishes the link between returns and scale. Section 5 contains a series of robustness tests such as alternative performance measures, different subsamples, survivorship bias, and reverse causality. Section 6 discusses other hypotheses and tests alternative channels by which firm scale may impair returns, such as scope and management load. This section also provides a more direct empirical test of the communication/hierarchy channel. The evidence supports Stein's (2002) idea that hierarchical firms and organizations in which information flow is more difficult display greater diseconomies of scale. The last section concludes positing several economic reasons based on supply and demand arguments that may explain the survival of the observed diseconomies of scale in PE.

2. Hypotheses and empirical design

Following the theoretical literature on organizational diseconomies outlined in the previous section, the connection between firm scale and returns implies that, as the PE firm scales up, its larger communication costs outweigh the benefits of its higher knowledge utilization rate. A simple illustration may help explain this hypothesis.

Consider two PE firms identical in every respect except in the number of their personnel. Firm A has two partners and four staff members, whereas firm B, five times larger, has ten partners and 20

[7] Our paper is also related to the literature on conglomerates. Lang and Stulz (1994) found that diversified firms trade at a discount, which is consistent with our results on diseconomies of scope presented in Section 6. But this evidence has been challenged recently by a series of papers arguing that the data on conglomerates is too noisy to establish such a connection (Graham, Lemmon, and Wolf 2002; Campa and Kedia 2002; Schoar 2002; Villalonga 2004). Our paper may contribute to this debate because our data is less likely to suffer from the contamination of internal capital reallocation across the segments of a conglomerate (Maksimovic and Phillips 2002).

staff members. In theory, firm B could be organized into five independent teams of two partners and four staff members each and therefore be in a position to make five times more investments than firm A. All else being equal, we should not expect the performance of the investments of firm A to be any different from that of firm B. Firm B, however, is unlikely to operate as five independent units, as its partners may need to agree on strategic decisions, and the employees need to communicate with each other and pass along information about the investments. Although firm B has a larger knowledge pool, the communication of soft information about each investment is more difficult and may lead to lengthier discussions that could prevent timely decision-making (Garicano 2000). Moreover, as argued in Stein (2002), some information may get lost as employees in charge of an investment report to the partner above them, who in turn reports to the rest of the partners. All of these factors may lower the quality of the decisions and lead to lower returns for firm B.

As we argued in the Introduction, our data is particularly suited to addressing this setup. If we assume that each investment requires a similar amount of attention and communication, we can measure firm scale at any point in time as the total number of investments managed simultaneously by the firm at that moment. Because we have individual investment returns, we can calculate this measure for each investment by computing the average number of simultaneous investments (SI) of the PE firm across each month of the investment's life (see Appendix A.1 for a detailed definition).

We conjecture that if during the life of investment *i* the PE firm holds many investments simultaneously, it is possible that the quality of the communication and the attention provided to investment *i* may be lower, ultimately leading to poorer performance. This rationale is the basis for our main hypothesis, namely that we expect a negative relation between the number of simultaneous investments (SI) supervised by a PE firm and investment returns.

The empirical corroboration of our main hypothesis faces three main challenges. First, diseconomies of scale may be not be empirically visible at all. If the flow of capital was frictionless, the theory described above may hold but its effects would not be empirically visible as firms with

lower communication costs would do more investments so that expected returns are equalized across firms (see Berk and Green, 2004).

We argue that there are several reasons why we would expect diseconomies of scale to be observable in PE. Frictions in the provision of capital to PE constitute a first set of arguments for this. As pointed out by Hochberg, Ljungqvist and Vissing-Jorgensen (2009), capital allocation in PE is not smooth. Investors can increase or decrease their allocation to a PE firm every three years on average. Additionally, because the investments are not publicly traded their valuation is difficult and learning about past returns is complicated. These arguments suggest that diseconomies of scale in PE may be particularly visible in the first years of a firm's life (e.g. among first-time funds). In addition to frictions we think there are four economic reasons that may explain why high-scale firms would choose to bear higher communication and hierarchy costs and still survive in the market. First, different PE firms may have different time horizons, so they may choose different growth rates. Fund managers with longer horizons may opt to remain small to ensure a steady income flow and forgo larger fees today. Second, some investors may invest in PE for reasons other than returns (e.g., to obtain investment banking fees). Third, some investors may feel more comfortable investing in large well-established firms or may associate quality more closely with a handful of highly successful investments which are more easily showcased by firms with extensive track records. Finally, it may not be easy to back-test fund selection strategies in private equity and arbitrage is generally difficult (e.g. no short sales; obligatory purchase of all the investments in a fund).[8]

The second challenge to the empirical corroboration of our main hypothesis comes from possibility that reasons other than those emerging from the communication cost theory could also result in a negative relation between the number of investments and returns. For this reason, our paper develops a series of tests that help us distinguish between alternative hypotheses about the source of scale diseconomies.

[8] The concluding section of the paper develops these arguments in detail and provides the available empirical evidence supporting these claims.

The first alternative is that the negative returns originate from diseconomies of scope. PE firms may invest into multiple industries spreading into unrelated sectors. Gompers, Kovner, Lerner and Scharfstein (2009) present evidence of diseconomies of scope for venture capital – a similar asset class. A second alternative hypothesis argues that the core problem may be the size of the investments rather than number of investments. A firm that ends up with a lot of capital may be forced to restrict itself to larger investments, which may be more efficiently priced. The literature on venture capital provides some empirical evidence of links between investment size and returns. Cumming and Dai (2010) show that venture capital firms that have more assets under management end up buying companies at higher prices. A third alternative hypothesis is that firms do not scale up their personnel enough as their size increases. As size increases and the PE firm undertakes more deals, the selection process and the monitoring of investments may deteriorate if it is not followed by a proportional increase in investment professionals. In such cases, employee workload is higher in larger firms and this may be the channel of scale diseconomies. In Section 6.1, we create measures that proxy for these three alternative hypotheses, develop a series of tests to assess the empirical impact on returns of these measures, and test if their impact remains when SI is held constant.

The final challenge to the empirical assessment of our main hypothesis is that although the tests just outlined help us reject alternative views, we should ideally provide a more direct empirical test of the communication/hierarchy channel. Stein (2002) posits that when the information about the projects of a firm is of a soft nature, hierarchical organizations in which communication is more difficult may face greater such diseconomies as information erodes through more management layers or cannot be credibly transmitted.

Using additional data from Galante Private Equity Directories, Section 6.2 of the paper develops three proxies of the organizational structure of PE firms to test the hierarchical and communication channels more directly. The theoretical prediction is about the cross-effect, so the final set of hypotheses tested analyze if flatter organizations or those where communication is more difficult exhibit smaller diseconomies of scale.

3. Private Equity Investments: Data and Stylized Facts

3.1. The Sample

To address the issues raised in the previous section, we put together a comprehensive database of the individual investments made by private equity (PE) firms.[9] We assembled the data by collecting fund-raising prospectuses, usually referred to as private placement memorandums (PPMs). PPMs contain the performance and characteristics of all prior investments made by the firm.[10] Our sample contains the track records of 334 different PE firms with a total of 11,704 individual investments. Appendix Table A.3 details the construction of our sample.

Table 1 compares our sample with the two most comprehensive publicly available PE datasets: Capital IQ (used by Bernstein *et al*. 2010), and Thomson Reuters (used extensively in the literature). Although these commercial databases keep track of the industry, country, and initiation date of the investments, they do not contain performance information, which is available for our sample.

< Table 1 >

To compare coverage across databases, we applied filters excluding certain observations.[11] After the filtering, the number of observations in our comparable sample represents 83% of the number of investments in Capital IQ and 96% of those in Thomson. Given the nature of our data source, our coverage is much better before 2000 (we have 20% to 30% more investments than the commercial databases) than it is in more recent years (we have 40% to 50% fewer investments). Our database is less US-focused (including 74% of the US investments covered by the commercial

[9] Unlike other investment-level datasets, such as the CEPRES data (e.g. Cumming and Walz 2010) or the data in Ljungqvist *et al*. (2007), our dataset contains the full track record of each PE firm, allowing us to compute the number of simultaneous investments a firm is holding at any point in time. This is essential to calculate a good measure of firm scale.

[10] Private equity firms are organizations that manage private equity funds. A firm may have several funds running at each point in time. Funds have a finite life lasting 10 to 14 years. The typical firm launches a new fund every two to four years. When a firm raises a new fund, it gives a fund-raising prospectus to potential investors. Investors commit capital at fund inception and cannot add or withdraw capital during the fund's life. Several investors gave us access to their prospectuses but under signed confidentiality agreements which bar us from disclosing information about the identity of the PE firms and their investments.

[11] For the comparison with Capital IQ (panel A), we need to exclude from our sample all non-buyout investments made by buyout funds. We also remove all loans, public equity, and venture capital investments. Additionally, we remove investments made after 2005 because we do not include them in our analysis as the performance of investments made within the few months before the end of our sampling period are not reliable (see below). Finally, as in Bernstein *et al*. (2010), we include only investments made after 1986 and from OECD countries. For the comparison with the Thomson dataset, we apply the same filters as in panel A but keep the pre-1986 investments and non-OECD countries.

databases) but has greater coverage of the rest of the world. Our particularly high coverage of the early years should alleviate concerns of survivorship bias, while the good geographic coverage reduces the risk of a country-related sample bias.

Since our data is based on PPMs, it differs from earlier commercial and academic datasets in that it contains information about the returns of individual investments. Although not all PPMs come in the same format, most provide the same information. There are twelve pieces of useful investment-level data usually found in PPMs: (1) month and year of the initiation of the investment; (2) month and year of exit (date realized); (3) industry of the investment; (4) country where the investment is located; (5) value of equity invested (referred to as investment size below and often labeled as cost in PPMs); (6) total amount distributed (realized value); (7) current valuation of any unsold stake (unrealized value); (8) total value (the sum of (6) and (7)); (9) multiple (total value divided by investment size); (10) IRR; and (12) exit route (trade sale, IPO, and so on). Appendix Table A.1 provides detailed definitions of all variables, and Table A.4 reproduces a sample of a typical PE firm track record found in a PPM.

To carry out the analysis below, we need to eliminate several observations from the original 11,704 investments. Table 2 details the process of our sample construction. There are five different reasons for excluding observations from our initial sample. The specific filters used are listed in the first column of Table 2, whereas the second and third columns of the table show the number of PE firms and investments that remain in the sample after we impose each restriction.

We start at the top of the table with the 11,704 investments in our database. First, we remove the 210 debt and public equity investments because they are unlikely to receive the same kind of monitoring as buyout or venture capital investments do. We then exclude investments for which we could not find key pieces of information.[12] These exclusions are: (1) 261 investments for which we cannot compute the public market equivalent (PME; a performance measure) because the date of

[12] Although PPMs provide most of this information for each investment, sometimes a few items are missing. We search for the missing information on the website of the PE firm that carried out the transaction, as well as in Thomson and Capital IQ. The distribution of the sources of information for these variables is provided in Appendix Table A.1.

investment initiation or the multiple is missing; (2) the 132 investments of one firm that does not report investment size; and (c) 628 investments whose industry could not be identified.[13] Since part of the focus of our paper is on the scale of PE firms, we must also exclude the 288 investments of 13 firms with selected track records. These firms indicated that they were including only the performance history of current management, or of particular sectors or countries in which the fund intended to invest.[14] We also exclude 1,064 investments of 49 firms because they correspond to the managers' personal track records before they joined the fund-raising firm and we cannot be certain that the investments reported in this form represent the full track record of the firm where they worked before.[15] Finally, we exclude all investments made two years or less before the date of the PPMs. Nearly 45% of these investments are reported as "held at cost" with an IRR of zero, which is unlikely to be their true performance.[16] After all of these restrictions, our final sample contains 7,453 investments with minimal sample bias and all necessary information to carry out the analysis.

The last four columns of the table calculate four different return measures for the remaining observations in the sample at each step; these measures help us assess if the exclusions affect the

[13] We need the industry of the investment because it is a proxy for risk, and we use it to measure firm scope in Section 6.

[14] Six of the 13 excluded firms were raising regional funds and showed the track record for that region only, three firms included the track record of current management alone, and the final four firms included only the investments that fell within the mandate of the new fund. There may be a concern that some PE firms show a selected track record but do not say so. To assess this potential problem, we first went to the databases of Thomson and Capital IQ and verified that all the investments reported for each of our PE firms in those databases were also in our dataset. We find it to be the case. Second, we read the legal disclaimers of our PPMs. The typical PPM disclaimer states that the fund has "taken all reasonable care to ensure that the facts stated in the Memorandum are true and accurate in all material respects and there are no other facts, the omission of which would make misleading any statement in the Memoranda, whether of fact or of opinion. The General Partner accepts responsibility accordingly." Typically, the firm is only exempted from liability for estimates of economic trends, projected performance, forward-looking statements, and economic and market information prepared by third parties. Third, we mentioned this concern to the investors who provided us with the PPM and to industry lawyers. They dismissed the concern arguing that the legal disclaimer limiting the responsibility of the firm applies in practice only to forecasts and that a PE firm misrepresenting its past investment record could be sued. They also pointed out to us that, unlike hedge fund investors, PE investors know the investments made by the firm because investors are asked to provide capital for each investment separately and they receive audited annual reports containing the list of investments. Finally, they argued that new investors generally ask old investors about their experience with the PE firm. In these circumstances, excluding past investments from the PPM could cause great damage to the firm.

[15] These 49 track records are part of 43 different PPMs. Of these 43 PPMs (i) 27 have one track record but it is not the track record of the firm that is raising funds – these are all first-time funds; (ii) 11 have a track record of a firm other than the one raising funds; (iii) four have two track records of a firm other than the one raising funds; and (iv) one has three track records of a firm other than the one raising funds. Since we eliminate the track records that do not belong to the firm that is raising funds, we exclude a total of 49 track records.

[16] If we exclude all the investments held at cost we risk introducing an upward bias since these transactions could have performed less well than those exited quickly. We chose two years as the break point because the percentage of investments held-at-cost goes down substantially to 11% and 8% of all investments made three and four years before the date of the PPM.

sample characteristics. The four measures are the median of: (1) IRR, which is the measure of rate of return used in the industry and reported in PPMs: (2) PME, which measures total value created in excess of the benchmark of the CRSP US stock index; (3) MIRR (modified internal rate of return), which alleviates potential problems with the reinvestment assumption used to compute IRR (Ljungqvist *et al*. 2007); and (4) multiple. These columns show that each filter, with the exception of the last, leaves performance virtually unaffected. Excluding investments made within two years of the date of the PPM does increase the performance of the sample because, as mentioned above, nearly half have an IRR of 0%. In the robustness section, we restore some categories of excluded investments and show that the results still hold.

< Table 2 >

3.2. Basic Statistics for Private Equity Investment

Table 3 presents descriptive statistics that provide new information on several debates in the literature. The table shows the basic statistics of PE investments, including several performance measures (median IRR, PME, MIRR, and multiple), and the fraction of investments that went bankrupt (returning no equity to investors, or written-off, or entered formal bankruptcy procedure) or that could be described as home runs (IRR greater than 50%). It also provides numbers on the median duration, the median investment size. The last two columns show our measure of firm scale. We proxy firm scale by the average of the number of simultaneous investments by the PE firm (SI) during each month of the duration (life) of the focal investment. We construct two alternative SI measures. The first measure, labeled "SI full life," uses the full life of each investment to make the calculation. That is, we use the full life of the focal investment as the period for the calculation, and also consider the full life of all the simultaneous investments of the PE firm to calculate the average. The second SI measure, labeled "SI 4 years", only considers the first four years of the life of the focal investment, and caps to four years the life of all the simultaneous investments. We use four years because it corresponds to the median investment duration in our sample. The main benefit of using the second

measure is that it helps us avoid a potential mechanical relationship between scale and performance if firms hold on longer to loosing investments.

These statistics are shown for our full sample of 7,453 observations and for several subsamples that classify investments by exit route (Panel A), size (Panel B), country of investment (Panel C), and year of investment initiation (Panel D). Figure 1 complements the data with histograms of performance, duration, and size. The detailed definition of each variable is provided in Table A.1.

< Table 3 > < Figure 1 >

The first row of Panel A describes the full sample. The median investment has an IRR of 21%, an MIRR of 17%, a PME of 1.27, and a multiple of 1.90.[17] A unique feature of our data is that we have the distribution of investments' performance. Table 3 shows that 10% of all investments went bust while 25% of the deals were home runs. Figure 1 gives more details about the cross-section of performance. There is a much greater dispersion of individual investment returns than of fund returns (Kaplan and Schoar, 2005). A quarter of the investments lose all or part of the equity; half earn an IRR between 0% and 50%, and the final quarter post an IRR above 50%. The distribution of PME is very similar: nearly 40% of investments have a PME less than one and nearly 20% have a PME greater than three. This fat-tailed return distribution has implications for performance and risk evaluation.

The rest of the numbers describing the full sample provide important additional statistics that we explore in other panels of Table 3. The median investment is rather small, with an equity stake value of $15 million, and lasts about four years. Finally, in the last two cells of the first row we show the average number of simultaneous investments in the firm's portfolio (SI) during the investment's life. The median investment in our sample is held along an average of 17 other investments in the firm's portfolio during its entire life (i.e., SI full life), and 13 other investments if we cap the

[17] It is important to note that our median statistics cannot be interpreted as the overall performance of the private equity industry. Since we do not have the detailed cash flows, we cannot compute aggregate performance in a meaningful way. Interested readers may refer to Kaplan and Schoar (2005) Robinson and Sensoy (2011a) Harris, Jenkinson and Kaplan (2012) and Higson and Stucke (2012) among others for an answer on aggregate performance. Note also that our performance numbers are gross of fees and that fees impact returns significantly (Metrick and Yasuda, 2010).

investments' life to the first four years of their existence (i.e., SI 4 years). The correlation between these two measures of firm scale is 0.98.

The bottom rows of Panel A split investments by type of exit to explore the common association in the literature between fund performance and the fraction of investments exited through an IPO. About 22% of the investments for which we know the exit route are exited by an IPO. Our data shows that IPO-exited investments do have higher returns than the rest. Yet investments exited through a trade sale also perform well. The performance statistics for these subgroups suggest that any exit other than bankruptcy should be considered successful; the use of the fraction of IPOs as a measure of success in venture capital may thus not be generalized to private equity. This Panel also shows that Bankrupt investments have higher SI measures.

Panel B of Table 3 provides statistics by country of investment. Investments in developed countries have similar duration and performance, although Scandinavian deals stand out with higher PME (1.66 versus 1.33 for the US) and lower bankruptcy rates (5% versus 12% for the US). Investments in developing countries, however, seem different. They exhibit poorer performance across all measures, with the exception of bankruptcy rate. We might have expected to see the opposite as a result of the higher cost of capital in developing countries. The low returns of these deals may be the result of a combination of such factors as costly learning, lower leverage, poorer legal environments, and limited exit routes (Lerner and Schoar 2004; Cumming and Walz 2010).[18]

Panel C of Table 3 presents statistics by investment size. We do not observe any significant differences in performance across size categories. More interestingly, perhaps, this panel and the complementary graph in Figure 1 show that most PE investments are quite small. The median (average) size of the investments in our sample is only $15 ($36) million (2006 US dollars). Nearly 20% of the deals involve less than $5 million of equity. The multi-billion-dollar deals covered in the press are in fact a small minority. The last two columns of Panel C show that SI increases as the deals get larger.

[18] In terms of industry composition, we find a substantial number of deals in each of the 48 Fama-French industries (non-tabulated). The notion that PE focuses heavily on cash-rich industries is not borne out by our data.

The last panel of Table 3 (Panel D) shows statistics by year of investment initiation. The size of investments increases over time. The median deal was less than $13 million every year until 1997. By 2005, at $44 million, it had more than tripled. The increase in fund size over time probably allowed funds to target larger companies in later years. The last panel also documents the cycles in PE and the contra-cyclical nature of PE returns. Returns are high for investments initiated before 1987 as the junk bond market was booming. The investments initiated between 1988 and 1990 show lower returns, as the music stopped for the junk bond market. Investments done at the bottom of the ensuing recession (1991-1993) did much better, while those initiated in the mid-1990s had mild returns. Investments initiated between 1998 and 2000 show low IRR but high PME due to low stock-market returns. From 2001, investments exhibit high returns both in absolute and in relative terms. The last two columns show that SI has increased over time showing higher levels since the mid 1990s. Investments in the second part of the sample have 20 to 25% higher SI depending on the measure.

4. Determinants of the Performance of Private Equity Investments

In this section, we test our main hypothesis outlined in section 2. We thus investigate the determinants of performance, paying particular attention to the role of diseconomies of scale. Because of the similarity of results across all performance measures, we stop presenting results for MIRR and Multiple in the rest of the paper.

Table 4 develops our "base specification" that controls for potential determinants of returns other than firm scale. Starting with this table, we present regressions with the IRR (Panel A) and PME (Panel B) of investments as dependent variables. All independent variables are expressed as a z-score (that is, we subtract the sample mean and divide by the standard deviation of the sample).[19] Standard errors are obtained by two-dimensional clustering (firm and time) to account for the dependence in residuals within a given firm and a given year.

[19] This means that regression coefficients measure the change in the dependent variable arising from a one-standard-deviation increase in the independent variable. The transformation has no impact on inference but allows us to make direct comparisons of the economic magnitude of the different explanatory variables.

Unless otherwise indicated, all regressions in the paper use the "SI 4 years" scale measure. As previously argued, we made this choice to address the mechanical effect that could arise if investments that do well are exited quickly, whereas investments that do poorly take longer to exit and end up showing with a higher SI as the firm makes more investments over time. The correlations in Table A.6 certainly suggest this may be a possibility. SI computed over the full life has indeed a positive and significant correlation with investment duration. But the correlation between investment duration and "SI 4 years" is not significantly different from zero, thereby reducing the concern of a mechanical effect.

The first specification of each panel regresses investment IRR or PME on the log of "SI 4 years" and fixed effects for time, country, and industry of the investment. We control for time-fixed effects to capture such important time-dependent drivers of performance as the amount of "money-chasing deals" or credit conditions at the time of investment initiation (Gompers and Lerner 2000; Ljungqvist *et al*. 2007; Axelson, Jenkinson, Stromberg and Weisbach 2010; Robinson and Sensoy, 2011). We also control for investment location and industry fixed effects to capture risk differences.[20] Controlling for country fixed effects should capture an important variation in cost of capital across companies as shown by Doidge, Karolyi and Stulz (2007).

In this first specification, the coefficient of the log of SI is negative and statistically significant at one per cent. The magnitude of the scale effect is large: a one-standard-deviation increase in the log of SI decreases IRR by 7.9% annually and lowers PME by 0.12.

< Table 4 >

Although Specification 1 suggests that PE returns are not scalable, the panels in Table 4 indicate that other variables may account for some of the large variation in PE investment returns. The investments made by small firms may differ from those of large firms in ways that must be controlled for. Specifications 2 to 6 of Table 4 test the explanatory power of other potential determinants of

[20] The specifications do not show each fixed effect. We find that investments initiated before the peak of PE cycles (that is, from 1984 to 1986 and from 2002 to 2005) have higher returns, whereas those initiated from 1998 to 2000 have lower returns. Several country-fixed effects are also significant. The two strongest country effects are the positive coefficients for Swedish and Finish investments. We do not find any significant industry-fixed effect.

performance. We introduce each variable one at a time, keeping investment time, country, and industry-fixed effects. The detailed definition of all variables is provided in Table A.1.

In Specification 2, we explore the connection between private and public equity markets. Our measure of "market return" for each investment is the average return of the CRSP value-weighted index over the life of the investment. This variable captures the change in equity valuations from the start of the life of the investment to the exit date. Stock-market performance has a significant impact on IRR: a one-standard-deviation increase in market return increases IRR by 13.7%. Market return is not significant, however, for PME. It may be because beta is close to one, so PME (the value added in addition to the stock market) is unrelated to stock-market returns.

The risk characteristics of investments may also be a major determinant of returns. For this reason, Specifications 3 and 4 introduce risk proxies in addition to the fixed effects already considered. In Specification 3, we introduce the log of investment size as an additional risk measure. We find that there is a significant negative relationship between size and both investment performance measures. Specification 4 adds a risk measure suggested by Jones and Rhodes-Kropf (2004), who argue that private equity firms that hold higher total risk should be expected to outperform. To proxy for the volatility of a PE firm's portfolio, we use the volatility and the cross-industry correlations of publicly traded companies in the same industry. Specification 4 shows that portfolio volatility is positively related to performance.

Specifications 5 and 6 in Table 4 introduce variables to control for PE firm characteristics that may be linked to its scale. First, as a result of different horizon preferences or of firm skills that affect their ability to exit deals, not all PE firms hold their investments for the same length of time. All else being equal, firms holding investments longer would be expected to be running more investments simultaneously. To take this possibility into account, in Specification 5 we compute the average duration of all investments held by the firm other than the focal investment. Specification 6, which introduces the firm's age, adds another potential firm-specific factor. PE firm performance may improve over time so controlling for past experience is important. One may also be concerned that of

a potential "life cycle" increase in SI over the life of the PE firm whereby SI may naturally rise over time if the firm exhibits good performance and survives. Results show that the duration of the rest of the portfolio and firm age are weakly related to returns when these are measured by IRR and not related to returns when these are measured by PME.

The final specification of the table is our base specification, which includes all the previously introduced variables plus the log of SI. The base specification shows that, holding SI constant, all other determinants of returns have effects similar to those in previous specifications, with the exception of portfolio volatility, which loses its impact. And even after other determinants of returns are controlled for, scale is strongly negatively related to investment performance for both IRR and PME. The economic magnitude of the log of SI is hardly affected by all of these control variables.

5. Robustness

In this section, we conduct five sets of checks to assess the robustness of diseconomies of scale. First, we assess risk differences between investments in lower and higher scale groups. Second, we show that the scale effect is not driven by a specific sub-set of observations or by some of the methodology choices we make. Third, we tackle the issue of the survivorship bias. Fourth, we address the possibility of reverse causality. Fifth, we look at the connection with the money chasing deal effect. The negative scale effect found in the previous section survives all of these robustness checks.[21]

5.1. Assessing Risk: Decile Analysis

Country fixed effects, industry fixed effects, portfolio volatility, and investment size capture some of the differences in risk across investments in the base specification. But since these are only proxies,

[21] We also find that the results hold when we add a firm fixed effect or a fund fixed effect (Table A.5). Including firm and fund fixed effects makes it possible to control for unobserved fixed fund and firm characteristics and thus addresses some of the problems with omitted variables. Some important investment characteristics are determined at the firm or fund level. For instance, one may argue that manager efforts would be positively related to performance but negatively related to SI. Indeed, the professionals of small PE firms have better incentives because they typically have a larger carried interest; they are said to be "closer to the carry." Since all the investments in a fund have the same carry distribution among employees of the firm, a fund fixed effect helps control for such differences in incentives. Similarly, we could argue that firms and funds may face different costs of capital or differ in their styles, strategies and risk-taking attitudes, and that these differences may be important omitted variables in our regression base specification.

we verify further that low-SI investments are not simply riskier than high-SI deals. In Table 5, we do an additional risk assessment by splitting investments into SI deciles and calculating Value-at-Risk measures and variances across deciles.

The first two rows show the lower and upper bounds of SI in each decile. The range of SI 4 years is extremely large: investments in the lowest-SI decile have five or less simultaneous investments, whereas investments in the highest-SI decile have more than 49 and less than 100.

Consistent with the base specification results, the performance statistics in Table 5 show that investments held at times of fewer simultaneous investments post higher returns. The magnitude of the performance difference is substantial. Investments in the lowest-SI decile have a median IRR of 33% and a median PME of 1.57, whereas those at the other end of the spectrum post a median IRR of only 14% and a median PME of 1.05. Figure 2 complements the evidence by plotting the performance measures across SI deciles and shows that the differences are not limited to the comparisons between the lowest and the highest deciles. There is a marked downward slope across all performance measures.

< Figure 2 > < Table 5 >

Although the nature of the data prevents us from constructing a direct measure of systematic risk, we can assess the risk differences by looking at Value-at-Risk measures across SI deciles. An advantage of these measures is that they are not sensitive to the non-normality of return distribution. Table 5 shows that deals in low-SI deciles are less likely to lose money, underperform the stock market, and go bankrupt than are those in high-SI deciles. These Value-at-Risk measures indicate that low-SI investments are less rather than more risky. Moreover, low SI deciles are characterized by higher rates of home runs (IRR above 50%) and strong outperformers (PME above 2).

The bottom of Table 5 presents statistics on the variance of performance. They show that low-SI deciles have higher variance, but the variance difference is driven by the high performers. Investments losing money have practically the same variance across SI deciles. On the whole, the statistics in this table do not support the view that small-scale PE firms hold riskier investments.

5.2. Sample Selection, Methodology, and Investment Subsamples

In Table 6, we assess the robustness of the negative scale effect to our sample selection and methodological choices. Each row of Table 6 subjects our base specification to a different check. For each regression, we show the coefficient for the log of SI, the adjusted R-squared, and the number of observations. Panel A presents results for IRR and Panel B for PME.

The first part of Panels A and B checks the robustness of our findings to the sample selection choices and the approach used for observations with some missing information. The first four rows reproduce the base specification results, excluding four different groups of investments. First, we exclude the 1,617 unrealized investments because of the flexibility in valuing non-liquidated deals. In the second row, we also exclude all partially realized investments. The regression in the third row excludes the 1,024 investments for which IRR was not reported in the PPM and we had to infer it from the investment's duration and multiple (see Table A.5.) Finally, the fourth row shows regression results excluding all three groups of investments mentioned above. Although the sample is sharply reduced by some of these exclusions, the negative scale effect survives with a similar and significant coefficient.

Instead of excluding observations, the fifth row of Table 6 restores to the sample used in the base specification all the investments initiated within two years of the writing of the PPM. As in the previous rows, the significance of the scale effect remains but the magnitude falls by 10%.

< Table 6 >

The second part of each panel of Table 6 presents robustness results using alternative methodological choices. Since IRR and PME can take on very high values, the base specification winsorized these measures at their 95th percentile. Specification 6 in each panel shows that the scale effect is very similar when we winsorize at the 99th percentile. In Specification 7 we switch from OLS to a Tobit regression that takes into account that IRR cannot be less than -100% and PME cannot be less than zero. Firm scale is still statistically significant. In Specifications 8 and 9, we change the time window over which we count simultaneous investments and find that our result is unaffected.

The rest of the specifications in Table 6 present results using different investment subsamples. The scale decile results in Table 6 could suggest that the scale effect is driven only by the lowest SI deciles. To check this possibility, Specifications 10 and 11 present our base regression with the sample split above and below median SI. Diseconomies of scale are similar in both subsamples. Rows 12 and 13 split the sample in 1995 to see if the scale effect is present in the two different PE industry cycles.[22] SI is significant at a 1% level test in both sub-periods but the effect is more than twice as large for the first time period. The relatively lower magnitude of the scale effect in the second period may be because our sample ends before the 2007 financial crisis. High-SI firms experienced large returns from 2002 to 2005 and recent anecdotal evidence suggests that these firms may have been among those that suffered the most with the crisis.[23] So it is possible that if we had post-crisis data the diseconomies of scale in the second cycle would be of a magnitude similar to those of the first cycle.

The last 3 rows of Table 6 split the sample into groups of countries. The descriptive statistics presented in Table 1 suggests that our sample under-represent US investments. So, it is important to verify that the scale effect holds equally for investments inside and outside the US. We find that the non-scalability of returns is strongest for the US and the developing countries subsamples.

5.3. Survivorship Bias

It is common for PE firms to start small, with a handful of investments, and to grow as they raise additional funds. If firms stop fund-raising following poor performance and the sensitivity of that decision to past performance decreases with firm age, then the nature of our data collection scheme would mean that our results could be generated spuriously due to a survivorship bias. Since this is an important concern, we carry out a series of tests to deal with the potential bias.

[22] Although our data starts in 1973, Panel E of Table 4 shows that the buyout industry really takes off in the mid 1980s. So, splitting our sample in 1995 allows us to capture the differences across the two decades of large PE activity.

[23] A recent Moody's research report, "$640 Billion & 640 Days Later: How Companies Sponsored by Big Private Equity Have Performed during the U.S. Recession," points out that in the wake of the recent financial crisis, the worst performing deals are those made by large PE firms. According to the report, "it appears that when you do a large dollar value transaction and you lever that company up, you seem to be at more risk of having problems in a downturn."

First, our base specification already controls for the age of the PE firm at the time of the investment initiation. If our results were indeed spurious, firm age would have been negatively related to returns and partly or fully eliminated the scale effect. We did not find significant evidence of this. Second, one may still argue that firm age is not the most appropriate proxy and that it is fund sequence that better captures the effect described above. Indeed, it is as a firm raises its second, third, or subsequent fund that the sensitivity of fund closure to past performance goes down. Table A.7 shows that controlling for fund sequence instead of firm age leaves the results are unchanged.

< Table 7 >

Third, possibly the strongest test for survivorship bias in our context is to restrict the sample to the first fund raised by each PE firm. In this sub-sample, survivorship bias could be said to hold constant: each of the first funds had returns that were good enough for their firm to raise another fund. Table 7 shows the same series of specifications in Table 4 for the sub-sample of first-time funds only, which represents about half of our full sample. Diseconomies of scale are of similar in this sub-sample than in the full sample of Table 4. The evidence does not seem consistent with a spurious relation created by a survivorship bias.

Finally, Table 8 present another test for a survivorship bias story. The concern addressed in this table is that we may be missing firms that did not survive and raised new funds. To address this issue, we use the Thomson PE firm directory of past years to retrieve firms that stopped fund raising and collect information on the investments made by these firms to "complete" our sample.[24] We define as "dead" those PE firms that, according to Thomson, did not raise a new fund after 2000.[25] Most dead firms are small: nearly 90% of them are in the bottom quartile of the size distribution of the firms in our database. We identified 45 dead PE firms that had made a total of 464 investments. The average (median) number of simultaneous investments of dead firms is 12 (7). Since we do not have the returns of these investments, we impute a very conservative return to each of them according to

[24] Thomson is the database with most comprehensive PE firm coverage during our sample period.
[25] Our results are robust to moving the threshold to any other year after 2000 in our sample. Of course, the higher the threshold, the higher the probability that we mis-classify as dead a firm that has simply not raised funds for a few years.

their exit status.[26] To run regressions similar to those we have been presenting, we also calculate the rest of the control variables in the base specification for each of the investments made by dead PE firms.

The first two regressions of Table 8 present the results when the 464 investments of dead firms are added to our sample. That the magnitude of the scale effect is reduced is, in view of the low returns we assigned these investments, hardly surprising. But the reduction is small and the statistical significance of the scale effect remains strong. To be even more conservative and cover the possibility that Thomson missed half of the dead PE firms, the last two regressions of Table 8 artificially double the number of investments made by dead firms. Although we are adding nearly one thousand investments made by dead firms, the coefficient on SI decreases only marginally and remains significant. These results suggest that it may take an implausible number of dead firms for survivorship bias alone to account for diseconomies of scale.

< Table 8 >

5.4. Reverse Causality and Omitted Variables

One could argue that as PE firms realize that their portfolio is doing poorly, they would undertake additional investments to attempt to improve performance. Our investment-level data, unlike fund-level data, are well suited for this kind of test. In this sub-section, we provide empirical evidence that is hard to reconcile with a simple reverse causality story that argues that lower returns may lead to higher SI.

A common test to deal with reverse causality is to lag the variable of interest. This test may be particularly weak in our setup because SI does not change much from one investment to the next and there is large time overlap from one investment to the next. For this reason, we create two-year "investment blocks" containing all the investments initiated by a firm within a specific two-year

[26] We assign a –100% return to any investment reported as deunct (32%) or without an exit (11%). For investments exited via an IPO (12% of the sample), we assign half of the median IRR and PME of IPO-exited investment in our sample (23% IRR and 1.09 PME). Finally, to investments exited via a sale (45% of the sample), we assign half of the median IRR of the sale-exited investments in our sample (18% IRR and 0.85 PME).

window. We count 1,170 such two-year investment blocks in our dataset. For each block, we compute the average log of SI, market return, and investment size for all investments in the block, as well as the volatility of returns across all block investments. Finally, as Kaplan and Schoar (2005) did for their funds, we measure experience with the log of the block sequence number in the firm's track record.

Table 9 shows results in which the units of observation are the two-year investment blocks we created. Specification 1 of this table replicates our base specification in Table 4 and the results are very similar. Specifications 2 and 3 show that lagged firm scale has a strong relation to current block performance. This result holds for both one-block and two-block lags. Specifications 4 and 5 test if the growth of SI between the earlier and the current block of investments (the difference in the means of the log of SI in successive blocks) is related to performance. We find that scale growth is negatively related to performance, but its significance is low in the PME specifications. Moreover, SI remains statistically significant when we control for scale growth (specification 5). These results should alleviate concerns about reverse causality.[27]

< Table 9 >

As mentioned in the introduction, given the nature of the data, it is hard to rule out that the link between returns and firm scale arises due to an omitted factor. While we cannot completely rule out this possibility, there are two arguments that diminish the seriousness of such a concern. First, the omitted factor would need to be both firm and time specific, since our effect is robust to both time and firm fixed effects (see Table A.8). A potential story about such an omitted factor would require PE firms with time-varying confidence. In this scenario, at a certain point in time, a PE firm would be more confident than its peers and would manage to convince investors to give it more capital which would allow it to undertake more investments. The over-confident firm would then be operating at a

[27] One may still argue that Table 9 is not enough to deal with the reverse causality concern since splitting the fund's investment into two-year blocks does not ensure non-overlap of investments between blocks. To avoid completely any potential overlap between lagged firm scale and current firm scale, we constructed an additional table in the exact same way as Table 9 but instead of capping each investment's life to four years (SI 4 years), we cap it at two years when we calculate SI. This eliminates the overlap. The magnitude of the scale effect is somewhat smaller, but it remains significant.

larger scale than its optimal capacity and its investments would end up underperforming those of its peers. We want to point out that for this story to hold, overconfidence needs to vary over time, since our results are robust to firm and fund fixed effects. This means that at another point in time, the same firm would need to be under-confident compared to its peers and end up over-performing. We find this possibility unlikely. In addition, this story lacks a compelling argument to justify very naïve investors.[28] Second, the different pieces of evidence mentioned throughout the paper, and in particular those in the next section, are consistent with theories of diseconomies of scale and we believe it would be difficult to explain them by omitted factors argument.

We acknowledge that although the arguments and the empirical tests presented in this section should alleviate endogeneity concerns, our paper, as with previous papers analyzing the connection between scale and returns, cannot completely rule out the possibility that an unobservable omitted factor explains the observed relationship between returns and firm scale. But we would like to argue that even if this relationship is only a correlation, the results presented here in conjunction with those at the end of Section 6 suggest that there are structural factors in PE firms that may be significant ingredients of the underlying connection between these two variables.

5.5. Money Chasing Deals

Our documented firms scale effect is reminiscent of the "money-chasing-deals" effect advocated by Gompers and Lerner (2000), Kaplan and Schoar (2005) and Kaplan and Stromberg (2009).[29] These papers show that funds that are started at times when more money is allocated to private equity exhibit lower returns. In our paper, any such macro effects have been captured by the year fixed effect in our

[28] Another potential story would involve PE firms with different costs of capital because, for unobservable reasons, some can borrow at a lower cost than others. One could then argue that a low cost-of-capital firm may then make more low-return investments. But this story needs diseconomies of scale to explain why the returns of the low-cost firm are lower than those of its peers. Without diseconomies of scale the low cost-of-capital firm could have the same expected returns as its peers and make more profits thanks to its lower cost of capital. Finally, we also want to point out, that as in the over-confidence story outlined above, this pattern needs to be time-varying since the scale effect resists fund and firm fixed effects.

[29] Robinson and Sensoy (2011) recently show that if one corrects for stock-market returns, evidence of money chasing deals vanishes. In our specifications here we control for contemporaneous market returns but because unlike Robinson and Sensoy (2011) we do not have the detailed cash flows our proxy is less precise.

regressions. But, in this section, we remove year fixed effects and see how firm scale and the overall money in the industry interact and relate to performance.

There are several reasons why this analysis is relevant. First, the money-chasing-deals effect has never been shown at the investment level and, given the wealth of control variables in our dataset, it is interesting to see if it survives. Second, one could also argue that the money-chasing-deals effect may be explained by the diseconomies of scale if firms simply make more deals during those years and the increased communication costs are the underlying reasons for the underperformance. Finally, our data also allows us to control for several alternative explanations for money-chasing-deals. One could argue that investments become larger when money is chasing them and size may be negatively related to returns. It could also be that more money is invested when stock-market returns are expected to be lower and thus the effect captured by money-chasing-deals is just a cost of capital effect. We also bring in here the Baker and Wurgler (2006) sentiment index to see whether general optimism also plays a role in the money-chasing-deal effect and in our firm scale result.

The results in Table 10 show a large and significant effect for all three variables: firm scale, money-chasing-deals and sentiment. The significance of the money-chasing-deals effect is larger than previously documented, possibly due to the larger coverage of our data.

< Table 10>

6. Additional hypotheses on the scalability of returns

6.1. Alternative channels leading to diseconomies of scale

The evidence of diseconomies of scale presented in the previous sections is consistent with the theoretical arguments of the communication and hierarchy costs literature (Garicano 2000; Stein 2002). However, there may be alternative channels leading to scale diseconomies. Section 2 developed three such alternatives that would be consistent with the diseconomies of scale documented in our paper.

The alternative hypotheses state that diseconomies emerge from either the scope of the investments, the total size of assets under management, or the load of investment professionals. To capture firm scope, we follow the methodology in the conglomerate literature and construct two measures: (1) a counter of the number of industries in which the PE firm has investments over the life of the focal investment; and (2) one minus the industry Herfindhal index for the sectors in which the PE firm invests over the life of the focal investment. To develop a proxy for assets under management in the context of our paper, we calculate the log of the average of total equity invested in investments held simultaneously by the PE firm over the life of the focal investment. Finally, we develop a proxy for the investment managers' workload collecting additional information. We use the Galante Private Equity Directory, which lists the "key personnel," also called "professionals," in each PE firm. With this information, we compute the ratio of the number of simultaneous investments to the number of professionals working at the firm in the year in which the investment is initiated.[30]

To assess these alternative theories, we look at the direct impact of the proxies and test if the effect of each of these measures remains significant when SI is held constant. Results are shown in Table 11. Each row of the table presents the results using a different proxy for these three channels. Each row shows the most relevant parameters of two econometric specifications. The first specification uses all the controls of our base specification in Table 4, adding the new variable specified in the first column of the table. The second specification includes Log SI as an additional regressor to ascertain if the effect of the alternative measure remains when SI is held constant.[31]

The first two rows of each panel of Table 11 present the results of including two different measures of scope. When introduced alone, these measures are statistically and economically significant. Both a higher industry concentration and a lower number of industries in the portfolio improve performance. However, the introduction of SI renders both scope measures insignificant.

[30] Although Galante is the best available source for this kind of data, it does not cover all the firms in our sample, since the first edition of Galante appeared only in 1996 (covering the year 1995) and it sometimes begins coverage of a particular firm a few years after it is founded. For these reasons, the number of investments with coverage is reduced to a bit more than 40% of our sample.

[31] One should be mindful however that most of these variables are highly correlated with one another (Table A.5).

These findings provide evidence for the notion that it is the amount of information that matters (the number of projects) rather than the diversity of this information. The third row of Table 11 shows that the inclusion of a proxy for assets under management (log EUM) is negatively related to returns, but only if the log of SI is not included. In other words, although EUM and SI are highly correlated, the proxy for the size of the portfolio under management loses its significance when the log of SI is controlled for. Finally, the fourth row of the table looks at the effect of the number of simultaneous investments per employee. The estimates show that, with or without controlling for the log of SI, workload per professional does not have a significant impact on performance. [32] Overall, the results in Table 11 show that, consistent with the hypotheses in section 2, the key driver of returns is the number of investments held simultaneously in the portfolio (SI).

< Table 11 >

6.2. Structural PE firm factors behind the Non-scalability of Returns

As explained in section 2, although the tests carried out in Table 11 help us establish that SI seems to be the main driver of diseconomies of scale, we would ideally like to provide a more direct test of the communication/hierarchy channel described in the literature (e.g. Stein, 2002). In this section, we gather additional data to create three proxies of such costs and assess whether diseconomies of scale are more severe in PE firm structures where communications/hierarchy costs are expected to be larger.

The first two proxies focus on the concept of hierarchy and management layers of the firm. Our first proxy is constructed by separating independent PE firms from those that belong to a financial group (non-independent). This classification is based on information provided by the "type of organization" field in the Galante Private Equity Directories. In our sample, then, there are 4,900 investments made by independent firms and 2,322 made by firms that are part of financial groups. The second measure counts the number of different job titles of the key employees listed in Galante during

[32] For a subset of firms, the Galante Private Equity Directory also reports the total number of people working at the firm under "total staff." We use this information to compute an alternative measure of employee workload as the log of the ratio of SI to the number of total staff working for the PE firm during the investment's initiation year; results are unaffected.

the investment's initiation year. This measure is closer to the concept of hierarchy but is available for only about one-third of our sample.

The third measure is a proxy for possible communication breakdowns stemming from the diversity of management backgrounds.[33] The development of this measure requires the collection of additional data. In particular, we collect the list of professionals working at each PE firm from Galante and their biographies from either the PPM (65% of cases) or the PE firms' websites (35% of cases). We classify each professional as having one of three possible backgrounds: finance, consulting, or other. Our measure is one minus the Herfindhal index of the professional background of the employees working at the PE firm the year of the initiation of the investment. Table A.1 provides details for the construction of all three measures.

< Table 12 >

Since the theoretical prediction is about the cross-effect, Table 12 assesses the impact of the organizational structure of PE firms on investment returns by breaking firms in the sample down by the degree to which they are hierarchical and by the diversity of the professional backgrounds of their staff. Panel A separates the investments made by independent firms from those made by firms belonging to a financial group. Panel B separates the investments made by "flat" firms from those made by "steeper" (i.e., more hierarchical than the median) firms. Panel C separates the investments made by firms in which the diversity of the background of professionals is above or below the median. Each panel presents results for both IRR and PME.

All three panels yield the same results. Diseconomies of scale are substantially smaller in flatter organizations and in those in which management has more homogenous backgrounds. In panel A, diseconomies of scale are about half as great for independent firms as they are for firms belonging to a financial group. If we look at panel B, which splits the sample by number of management layers, the negative scale returns are around twice as large in steep organizations as they are in flat ones.

[33] Acharya *et al*. (2009) explore the impact of the skills of partners with different backgrounds. General partners with an operational background generate significantly higher outperformance in organic deals, whereas those with a finance background generate higher outperformance in M&A deals.

Panel C shows similar results, with companies with more homogenous management exhibiting negative scale results of only half the size of those with less homogenous management. The difference between the coefficients of scale diseconomies across subgroups is statistically significant for all three classifications and for both return measures (IRR and PME).[34]

Those findings are among the first to illustrate empirically some of the mechanisms of diseconomies of scale, i.e. the link between diseconomies of scale and the higher communication costs posited in the theoretical literature.

7. Conclusion

Our study makes three main contributions. First, it provides a series of new facts and statistics about on the cross-section of PE investments that shed light on issues currently being debated in the industry and in academia. Second, our paper shows that returns in PE do not seem scalable. We find that investments carried out at times when there is a large number of simultaneous investments underperform. The non-scalability of returns implies that PE firms exhibit some skills. Third, although we cannot establish a clear causal relationship between scale and returns, our data allow us to point out some of the main PE firm characteristics that are associated with the negative relation between these two variables. The evidence is consistent with the view that PE performance suffers from structural features that curtail information flows and reduce the value-added capacity of management in more hierarchical firms and those in which communication is more difficult.

To conclude the study, we address the issue of why some firms would chose to grow larger in scale, hurting their returns, and why investors would keep investing in them. Although a full analysis of these questions is beyond the scope of the paper, we want to review several potential supply-and-demand factors that provide the economic rationale which may be behind why some firms choose to

[34] We also obtain the same results when we run regressions with the interaction terms between the log of SI and our measures of hierarchy (results not shown). In addition, in Table 12, we implicitly assume that the organizational structure of PE firms is optimized once and for all when the firm is set up, which may be too restrictive. It is possible that PE firms optimize their hierarchy over time and that organizations handling more investments become more hierarchical. We also regress each of the three measures of organizational structure on firm scale (i.e., the log of SI). We then run the same regressions as in Table 12, but we substitute the log of SI for the residual of each of the three regressions. The results are similar to those in Table 12 and are shown in Table A.9.

be over-sized and allow these underperforming PE firms to survive. All of these explanations are promising areas of research.

We have grouped these economic reasons in four sets. First, as shown by Chung, Sensoy and Weisbach (2010), being large increases fees today, but lower returns hurt fees in the future. PE firms may have different time horizons, so they may choose different growth rates. For example, publicly traded PE firms or those run by managers closer to retirement may opt for large size today at the cost of poorer future performance. Fund managers with longer horizons may opt to remain smaller to ensure a steady income flow in the medium term. These arguments seem consistent with findings in the literature on performance persistence. That literature shows a tendency for high-performing firms to restrict their size in order to remain top performers and for low-performing firms to offer the lowest returns acceptable to investors (Hochberg, Ljungqvist, and Vissing-Jorgensen 2009).

A second possibility is that, as argued by Lerner, Schoar, and Wong (2007), some investors are ill-equipped to invest in PE. Firms with extensive track records may find it easier to window dress. In addition, less sophisticated investors may be more comfortable investing in large, well-established firms. Metrick (2007) lists the firms perceived to be the top tier in venture capital and the few investments that made them famous. So, investors may associate the quality of PE firms more closely with a handful of highly successful investments than with the full track record.[35]

A third possibility is that some investors invest in PE for reasons other than returns. Ljungqvist *et al*. (2007), for example, report that their data provider is one of the largest PE investors and acquires stakes in other companies to generate business for other company divisions (the M&A or the underwriting arm, for example). Large PE firms generate substantial investment banking fees that could lead some investors to back investments in hopes of earning the fees. Similarly, there is anecdotal evidence that large PE investors are often invited to co-invest in selected investments

[35] "People used to say 'no one ever got fired for buying IBM'. Substitute 'invest with' for 'buying' and 'brand name private equity firms' for 'IBM' and you capture the attitude of some private equity investors and advisers. This phenomenon is not unique to private equity, but the shortage of consistent, comprehensive, independent performance data has allowed this behavior in private equity to be more persuasive and longer lasting." *Financial Times*, January 17, 2011.

without paying fees. Large PE firms can offer more (in dollar value) of such opportunities for their most knowledgeable investors.

A fourth possibility is that investors do not find it easy to back-test fund-selection strategies, making learning and optimally adjusting firm size a difficult task. After all, it took us several years to build our own dataset. It is also important to bear in mind that arbitrage is difficult in PE, as investors cannot really pick and choose; they must take all the investments in a fund. Finally, many investors have told us that they are forced to invest large amounts in PE, an obligation that causes them to focus on large-scale firms.

Our findings have important implications for investors. Large investors may find it justifiable to invest in large PE firms which are less hierarchical. But small investors may find it more beneficial to avoid large PE firms and turn towards smaller, independent and more focused PE firms.

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Table 1 - Coverage analysis

The table compares our sample of PE investments and the two largest commercial databases available: Capital IQ (Panel A) and Thomson Reuters (Panel B). The Capital IQ sample is from Bernstein *et al*. (2010). The Thomson Reuters sample corresponds to the "buyouts and acquisitions" made by all "buyout funds". Each panel shows the filters applied to make the datasets comparable. Sample comparisons are shown splitting investments by period of investment initiation and by investment location.

Panel A: Comparison with Capital IQ data

	Number of observations in		
	Our dataset	Capital IQ	Coverage
Filters to make the samples comparable			
Our initial sample	**11,704**		
Exclude debt and public equity investments	11,483		
Exclude venture capital investments	10,855		
Exclude post-2005 investments	10,104		
Exclude pre-1986 investments	9,827		
Exclude non-OECD countries	9,062		
Comparison samples	**9,062**	**10,969**	**83%**
Comparison by period of investment initiation			
1986–1995	2,601	2,020	129%
1996–2000	3,954	3,398	116%
2001–2005	2,507	5,217	48%
Comparison by investment location			
North America	4,055	5,514	74%
Europe	4,842	4,642	104%
Other OECD: Australia, Israel, Japan, South Korea	165	161	102%

Panel B: Comparison with Thomson Reuters data

	Number of observations in		
	Our dataset	Thomson Reuters	Coverage
Filters to make the samples comparable			
Our initial sample	**11,704**		
Exclude debt and public equity investments	11,483		
Exclude venture capital investments	10,855		
Exclude post-2005 investments	10,104		
Comparison samples	**10,130**	**10,515**	**96%**
Comparison by period of investment initiation			
1973–1995	3,014	2,354	128%
1996–2000	4,327	3,336	130%
2001–2005	2,789	4,825	58%
Comparison by investment location			
North America	4,318	5,910	73%
Europe	4,966	4,122	120%
Rest of the world	846	483	175%

Table 2 – Construction of the sample of investments

The table describes the filters applied to our initial sample to attain the sample used in the empirical analysis. The first two columns of each row show the number of firms and the number of private equity investments available for our analysis after each filter. The last four columns show the median of four different performance statistics (IRR, PME, Modified IRR [or MIRR], and Multiple) for the sample resulting after each filter is applied. The last row of the table corresponds to our final sample used in the rest of the tables.

	Number of		Median			
	Firms	Investments	IRR	PME	MIRR	Multiple
Initial sample	334	11,704				
Exclude debt and public equity investments	333	11,494				
Exclude investments for which PME cannot be computed	329	11,233	0.16	1.15	0.13	1.55
Exclude investments for which investment size is not reported	328	11,101	0.15	1.13	0.13	1.53
Exclude investments with missing industry information	320	10,473	0.16	1.15	0.13	1.57
Exclude firms with selected track record	307	10,185	0.16	1.14	0.13	1.55
Exclude firms reporting investments made by the managers before they worked at the firm	258	9,121	0.17	1.15	0.14	1.60
Exclude investments made less than two years before date at which PPM is written	254	7,453	0.21	1.27	0.17	1.90

Table 3 – Private equity investment performance and duration

The table shows basic statistics for the full sample of 7,453 investments and for sub-samples classifying investments by: exit route (Panel A), country of investment location (Panel B), size (Panel C), and year of initiation (Panel D). The statistics include: the median of four performance measures (IRR, PME, MIRR, and Multiple), the fraction of investments that went bankrupt, and the fraction of "home runs" (investments with an IRR above 50%). The last four columns provide the median duration, the median investment size, and the median SI (number of simultaneous investments in the firm's portfolio) taking into account the full life of the investments (SI full life) and over the first four years of the investments' life (SI 4 years). All variables are defined in Table A.1.

Panel A: Performance by exit route

	Number of	Median			Fraction			Median			
	investments	IRR	PME	MIRR	Multiple	Bankrupt	Home-run	Duration	Investment size	SI full life	SI 4 years
Full sample	7453	0.21	1.27	0.17	1.90	0.10	0.25	3.92	15	18	14
Realized	5106	0.26	1.40	0.23	2.10	0.15	0.30	3.92	12	17	14
. IPO exit	631	0.46	2.18	0.39	3.36	0.00	0.46	3.62	18	17	13
. Sale exit	1350	0.36	1.70	0.31	2.57	0.00	0.36	3.67	12	16	13
. Bankrupt	749	-1.00	0.00	-1.00	0.00	1.00	0.00	4.00	14	21	17
. Other	81	0.33	1.33	0.25	2.42	0.00	0.31	4.75	5	12	10
. Unknown	2295	0.29	1.53	0.26	2.20	0.00	0.31	3.58	12	17	14
Partially realized	730	0.26	1.66	0.21	2.41	0.03	0.28	4.17	25	19	15
Unrealized	1617	0.05	0.96	0.04	1.18	0.00	0.09	3.92	19	19	15

Panel B: Performance by investment location

	Number of	Median			Fraction			Median			
	investments	IRR	PME	MIRR	Multiple	Bankrupt	Home-run	Duration	Investment size	SI full life	SI 4 years
U.S.	3163	0.22	1.33	0.18	1.96	0.12	0.27	4.00	19	16	13
Rest developed countries	3524	0.22	1.27	0.18	1.90	0.08	0.25	3.75	13	20	16
. UK	1427	0.21	1.18	0.17	1.83	0.09	0.25	3.67	14	25	21
. France	478	0.22	1.27	0.18	1.92	0.08	0.21	3.75	9	20	15
. Scandinavia	428	0.24	1.66	0.21	2.24	0.05	0.31	3.92	12	18	14
. Germany	259	0.25	1.42	0.22	2.11	0.13	0.28	4.00	23	28	21
. Italy	259	0.20	1.10	0.18	1.75	0.08	0.25	3.58	7	13	11
. Netherlands	174	0.20	1.36	0.18	1.89	0.06	0.26	3.79	16	18	15
. Other	504	0.23	1.32	0.19	1.90	0.07	0.26	3.71	14	13	10
Developing countries	759	0.13	1.10	0.12	1.54	0.11	0.16	4.00	9	16	13

Panel C: Performance by investment size

	Number of	Median			Fraction			Median		
	investments	IRR	PME	MIRR	Multiple	Bankrupt	Home-run	Duration	Investment size	SI full life	SI 4 years
< $5 million (mln)	1632	0.21	1.21	0.18	1.90	0.12	0.29	4.00	3	16	13
$5 mln to $10 mln	1272	0.20	1.23	0.17	1.90	0.09	0.26	4.00	7	16	13
$10 mln to $20 mln	1454	0.20	1.26	0.17	1.87	0.10	0.24	3.83	14	18	15
$20 mln to $50 mln	1612	0.22	1.33	0.18	1.87	0.10	0.23	3.83	31	18	14
> $50 mln	1483	0.20	1.32	0.17	1.90	0.09	0.22	3.92	103	19	15

Panel D: Performance by period of investment initiation

	Number of	Median			Fraction			Median		
	investments	IRR	PME	MIRR	Multiple	Bankrupt	Home-run	Duration	Investment size	SI full life	SI 4 years
≤ 1985	226	0.48	2.29	0.40	4.40	0.08	0.48	4.00	4	9	7
1986	87	0.48	2.13	0.36	3.50	0.07	0.48	4.08	9	10	9
1987	75	0.31	1.54	0.28	2.10	0.16	0.33	4.00	9	12	10
1988	121	0.22	1.05	0.16	2.30	0.08	0.26	4.40	10	11	9
1989	135	0.18	1.13	0.15	2.02	0.13	0.21	4.50	12	9	8
1990	174	0.15	0.96	0.13	2.12	0.11	0.18	5.00	13	13	10
1991	198	0.27	1.31	0.22	2.43	0.05	0.28	4.04	8	15	13
1992	280	0.26	1.16	0.21	2.34	0.09	0.25	4.01	10	16	14
1993	280	0.35	1.36	0.28	2.37	0.07	0.36	4.00	11	15	12
1994	453	0.23	0.97	0.19	1.97	0.11	0.26	4.00	8	19	16
1995	480	0.19	0.91	0.17	1.90	0.13	0.23	4.00	11	22	19
1996	584	0.19	1.02	0.16	1.84	0.12	0.26	4.00	12	18	15
1997	665	0.16	1.09	0.13	1.61	0.10	0.24	4.00	13	20	16
1998	647	0.11	1.19	0.09	1.43	0.13	0.19	4.00	16	19	15
1999	736	0.10	1.41	0.09	1.44	0.11	0.14	4.00	21	19	16
2000	740	0.03	1.29	0.03	1.09	0.18	0.09	4.00	17	19	17
2001	398	0.22	1.62	0.19	1.88	0.09	0.21	3.86	18	19	15
2002	361	0.31	1.54	0.27	2.14	0.04	0.32	3.33	22	21	15
2003	389	0.47	1.73	0.39	2.60	0.04	0.45	2.92	26	20	14
2004	289	0.37	1.50	0.32	2.10	0.04	0.40	2.65	30	21	15
2005	135	0.32	1.35	0.27	1.80	0.06	0.34	2.25	44	24	16
1973-1995	2509	0.26	1.17	0.21	2.30	0.10	0.29	4.00	9	15	12
1996-2005	4944	0.18	1.33	0.15	1.70	0.11	0.23	3.67	18	19	16

Table 4 - Base regression

The table shows regression results using ordinary least squares. The dependent variables are the investment's IRR (Panel A) and the investment's PME (Panel B). Log SI is the log of the number of simultaneous investments. All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

Panel A: The dependent variable is the investment's IRR

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	**Base**
Log SI 4 years	-0.079[a]						-0.080[a]
	0.010						*0.011*
Market return		0.137[a]					0.136[a]
		0.019					*0.019*
Log investment size			-0.058[a]				-0.056[a]
			0.012				*0.012*
Portfolio volatility				0.048[a]			0.009
				0.011			*0.011*
Duration rest portfolio					-0.016[c]		-0.005
					0.009		*0.010*
Log firm age						-0.021[b]	0.014
						0.009	*0.010*
Time fixed effects	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.093	0.098	0.087	0.086	0.082	0.082	0.115
Number of investments	7453	7453	7453	7453	7453	7453	7453

Panel B: The dependent variable is the investment's PME

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	**Base**
Log SI 4 years	-0.120[a]						-0.142[a]
	0.020						*0.026*
Market return		-0.036					-0.046
		0.034					*0.034*
Log investment size			-0.184[a]				-0.203[a]
			0.030				*0.032*
Portfolio volatility				0.090[a]			0.013
				0.026			*0.028*
Duration rest portfolio					0.038		0.055[b]
					0.024		*0.026*
Log firm age						-0.022	0.032
						0.023	*0.026*
Time fixed effects	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.063	0.061	0.070	0.063	0.061	0.061	0.077
Number of investments	7453	7453	7453	7453	7453	7453	7453

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 5 – Statistics by PE firm scale decile

The table breaks the sample of investments down into SI deciles and provides various statistics for each group. SI 4 years is the number of simultaneous investments considering the first four years of the investments' life. The first column shows the statistics for the full sample, while the last column shows the difference between the lowest and the highest SI deciles and the statistical significance of the difference. We use a sign test for differences in medians, a t-test for differences in averages, an F-test for differences in variance, and a Chi-squared test for differences in proportions. All variables are defined in Table A.1.

SI-4-years deciles	All	Low	2	3	4	5	6	7	8	9	High	Low-High
Lower bound SI 4 years	1.00	1.00	5.02	7.08	9.28	11.83	14.27	17.76	22.95	32.57	49.20	
Upper bound SI 4 years	99.90	5.00	7.08	9.27	11.82	14.27	17.73	22.94	32.55	49.08	99.90	
Median duration	3.92	3.50	3.75	3.58	4.00	4.00	3.83	4.00	3.75	4.00	4.00	-0.50[a]
Median IRR	0.21	0.33	0.24	0.25	0.20	0.20	0.21	0.10	0.17	0.17	0.14	0.19[a]
Median PME	1.27	1.57	1.39	1.38	1.21	1.25	1.40	1.15	1.19	1.14	1.05	0.52[a]
Median MIRR	0.17	0.28	0.19	0.22	0.15	0.17	0.18	0.09	0.16	0.15	0.12	0.16[a]
Median Multiple	1.90	2.47	2.00	2.10	1.90	2.00	1.90	1.44	1.70	1.80	1.67	0.80[a]
% Bankrupt	0.10	0.07	0.08	0.08	0.10	0.11	0.08	0.10	0.12	0.16	0.13	-0.06[a]
% With losses (IRR<0%)	0.25	0.14	0.20	0.19	0.26	0.26	0.25	0.31	0.27	0.30	0.32	-0.18[a]
% Home runs (IRR>50%)	0.25	0.37	0.26	0.30	0.25	0.27	0.26	0.17	0.23	0.23	0.17	0.20[a]
% Underperformance (PME<1)	0.40	0.29	0.35	0.35	0.43	0.42	0.38	0.45	0.44	0.45	0.49	-0.19[a]
% Strong outperformance (PME>2)	0.31	0.40	0.35	0.33	0.32	0.30	0.32	0.26	0.28	0.32	0.24	0.16[a]
Variance (IRR) – All	0.43	0.46	0.37	0.41	0.44	0.45	0.40	0.38	0.46	0.49	0.37	0.08[b]
Variance (IRR) if IRR<0%	0.16	0.17	0.17	0.17	0.16	0.17	0.14	0.15	0.16	0.15	0.16	0.01
Variance (IRR) if IRR>0%	0.26	0.31	0.23	0.25	0.26	0.25	0.26	0.24	0.28	0.25	0.19	0.11[a]
Variance (PME) – All	2.95	3.83	2.90	2.80	2.98	2.89	2.69	2.64	2.88	3.67	1.78	2.05[a]
Variance (PME) if PME<1	0.12	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.12	0.12	0.11	0.02
Variance (PME) if PME>1	2.74	3.51	2.65	2.61	2.74	2.71	2.42	2.58	2.74	3.33	1.56	1.96[a]

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 6 – Robustness of diseconomies of scale to empirical approach and sub-sample analysis

The table shows regression results using ordinary least squares. The dependent variables are the investment's IRR (Panel A) and the investment's PME (Panel B). Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life.The control variables in each regression are those of the base specification in table 5 (market return, log investment size, portfolio volatility, duration rest portfolio, log firm age, time fixed effects, country fixed effects, and industry fixed effects). All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in table A.1.

Panel A: The dependent variable is the investment's IRR

	Log SI 4 years	Control variables	Adjusted R^2	Number of investments
Sample selection				
1. Excluding unrealized investments	-0.090[a] *0.013*	yes	0.118	5836
2. Excluding unrealized and partially realized investments	-0.093[a] *0.015*	yes	0.116	5106
3. Excluding all investments with inferred IRR	-0.084[a] *0.013*	yes	0.113	6429
4. Excluding unrealized, partially realized investments, and all investments with inferred IRR	-0.100[a] *0.017*	yes	0.119	4575
5. Adding investments made less than two years before date the PPM is written	-0.073[a] *0.010*	yes	0.096	9121
Change of methodology				
6. Winsorize at 99th percentile instead of 95th percentile	-0.097[a] *0.016*	yes	0.086	7453
7. Tobit instead of OLS estimation	-0.091[a] *0.010*	yes	0.122	7453
8. SI computed considering the full life of the investments	-0.087[a] *0.011*	yes	0.118	7453
9. SI computed considering the first two years of the investments' life	-0.068[a] *0.010*	yes	0.112	7453
Sub-samples of investments				
10. Investments with SI 4 years below sample median	-0.062[a] *0.015*	yes	0.115	3726
11. Investments with SI 4 years above sample median	-0.062[a] *0.014*	yes	0.105	3727
12. Investments initiated by 1995 (1973-1995)	-0.113[a] *0.017*	yes	0.138	2509
13. Investments initiated after 1995 (1996-2005)	-0.055[a] *0.013*	yes	0.119	4944
14. Investments in the US	-0.101[a] *0.016*	yes	0.119	3163
15. Investments in other developed countries	-0.068[a] *0.013*	yes	0.106	3531
16. Investments in developing countries	-0.102[a] *0.024*	yes	0.145	759

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Panel B: The dependent variable is the investment's PME

	Log SI 4 years	Control variables	Adjusted R^2	Number of investments
Sample selection				
1. Excluding unrealized investments	-0.153[a] *0.025*	yes	0.087	5836
2. Excluding unrealized and partially realized investments	-0.157[a] *0.028*	yes	0.083	5106
3. Excluding all investments with inferred or assumed duration (hence with inferred PME)	-0.147[a] *0.025*	yes	0.063	5698
4. Excluding unrealized and partially realized investments, and excluding all investments with inferred or assumed duration	-0.178[a] *0.037*	yes	0.077	3361
5. Adding investments made less than two years before date the PPM is written	-0.145[a] *0.022*	yes	0.051	9121
Change of methodology				
6. Winsorize at 99th percentile instead of 95th percentile	-0.142[a] *0.024*	yes	0.070	7453
7. Tobit instead of OLS estimation	-0.151[a] *0.023*	yes	0.069	7453
8. SI computed considering the full life of the investments	-0.164[a] *0.025*	yes	0.078	7453
9. SI computed considering the first two years of the investments' life	-0.134[a] *0.025*	yes	0.076	7453
Sub-samples of investments				
10. Investments with SI 4 years below sample median	-0.161[a] *0.033*	yes	0.065	3726
11. Investments with SI 4 years above sample median	-0.085[a] *0.027*	yes	0.078	3727
12. Investments initiated by 1995 (1973-1995)	-0.208[a] *0.036*	yes	0.151	2509
13. Investments initiated after 1995 (1996-2005)	-0.077[a] *0.026*	yes	0.054	4944
14. Investments in the US	-0.163[a] *0.035*	yes	0.075	3163
15. Investment in other developed countries	-0.123[a] *0.029*	yes	0.051	3531
16. Investments in developing countries	-0.203[a] *0.052*	yes	0.117	759

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 7 – Survivorship bias: restricting the sample to first time funds

The table shows regression results using ordinary least squares. The dependent variables are the investment's IRR (Panel A) and the investment's PME (Panel B). Log SI is the log of the number of simultaneous investments. All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1. The sample is restricted to the first fund raised by each private equity firm.

Panel A: The dependent variable is the investment's IRR

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	**Base**
Log SI 4 years	-0.100[a]						-0.109[a]
	0.015						*0.017*
Market return		0.088[a]					0.085[a]
		0.025					*0.025*
Log investment size			-0.048[a]				-0.051[a]
			0.016				*0.015*
Portfolio volatility				0.035[b]			0.001
				0.017			*0.017*
Duration rest portfolio					-0.019		-0.007
					0.014		*0.014*
Log firm age						-0.006	0.027[b]
						0.013	*0.013*
Time fixed effects	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.086	0.077	0.073	0.072	0.070	0.069	0.097
Number of investments	3610	3610	3610	3610	3610	3610	3610

Panel B: The dependent variable is the investment's PME

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	**Base**
Log SI 4 years	-0.161[a]						-0.203[a]
	0.028						*0.032*
Market return		-0.085[b]					-0.089[b]
		0.040					*0.039*
Log investment size			-0.095[a]				-0.106[a]
			0.033				*0.032*
Portfolio volatility				0.008			-0.048
				0.033			*0.034*
Duration rest portfolio					-0.021		-0.003
					0.029		*0.030*
Log firm age						0.006	0.064[b]
						0.027	*0.029*
Time fixed effects	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.088	0.080	0.082	0.079	0.079	0.079	0.095
Number of investments	3610	3610	3610	3610	3610	3610	3610

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 8 – Survivorship bias: Adding dead firms

The table shows regression results using ordinary least squares. The sample of investments used in this table consists of our full sample of investments plus the 464 investments made by 45 private equity firms that did not raise a new fund after 2000 (dead firms). The source used to identify dead firms and the information to compute the explanatory variables of the investments made by these firms is Thomson. Since the information provided by Thomson does not include investment returns, we impute returns according to the exit status of each investment. We assign an IRR of -100% and a PME of 0 to any investment reported as defunct (32% of all cases) or without an exit (11% of all cases). For investments exited via an IPO (12% of all cases), we assign half of the median IRR and PME of the IPO-exited investment in our sample (i.e., 23% IRR and 1.09 PME). Finally, for investments exited via a sale (45% of all cases), we assign half of the median IRR of the sale-exited investments in our sample (i.e., 18% IRR and 0.85 PME). The dependent variables are the investment's IRR (panel A) and the investment's PME (panel B). Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life. All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

	Adding the investments made by dead firms		Adding twice the investments made by dead firms	
Dependent variable:	IRR	PME	IRR	PME
Log SI 4 years	-0.075[a]	-0.112[a]	-0.071[a]	-0.104[a]
	0.012	*0.023*	*0.013*	*0.024*
Market return	0.121[a]	-0.044	0.116[a]	-0.031
	0.018	*0.031*	*0.017*	*0.028*
Log investment size	-0.017	-0.106[a]	0.002	-0.072[b]
	0.013	*0.032*	*0.012*	*0.031*
Portfolio volatility	0.012	0.024	0.010	0.021
	0.011	*0.027*	*0.011*	*0.026*
Duration rest portfolio	0.018[c]	0.102[a]	0.024[b]	0.111[a]
	0.010	*0.025*	*0.010*	*0.024*
Log firm age	0.001	-0.002	-0.009	-0.020
	0.010	*0.025*	*0.010*	*0.025*
Time fixed effects	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes
Adjusted R^2	0.092	0.051	0.094	0.047
Number of investments	7917	7917	8381	8381

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 9 – Reverse causality

The table shows regression results using ordinary least squares for two-year investment blocks of each PE firm. Each investment block contains all the investments initiated by each PE firm during a two-year period. Panels A and B only differ in the number of years of the investments' life considered to calculate log SI. The dependent variables in both panels are the mean IRR of block *t* and the mean PME of block *t*. The means of these two performance measures are calculated as the (size-weighted) average of the performance of all investments in the block, winsorizing investment return and investment size at the 95th percentile. All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

Panel A: Log SI is computed considering the first four years of the investments' life

	The dependent variable is the mean IRR of block *t*					The dependent variable is the mean PME of block *t*				
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5
Mean log SI 4 years of block *t*	-0.106[a]				-0.066[a]	-0.352[a]				-0.218[a]
	0.018				*0.013*	*0.058*				*0.039*
Mean log SI 4 years of block *t*-1		-0.061[a]					-0.212[a]			
		0.015					*0.043*			
Mean log SI 4 years of block *t*-2			-0.062[a]					-0.232[a]		
			0.022					*0.043*		
Mean log SI 4 years of block *t* minus mean log SI 4 years of block *t*-1				-0.039[a]	-0.032[a]				-0.102[a]	-0.079[b]
				0.012	*0.010*				*0.039*	*0.034*
Mean log investment size of block *t*	-0.027[b]	-0.033[b]	-0.037[b]	-0.047[b]	-0.040[c]	-0.090[a]	-0.088[b]	-0.094[c]	-0.129[b]	-0.108[c]
	0.013	*0.017*	*0.019*	*0.023*	*0.022*	*0.033*	*0.042*	*0.048*	*0.058*	*0.056*
Block volatility	0.048	0.008	-0.027	-0.006	0.018	0.253[c]	0.183	0.052	0.027	0.103[c]
	0.044	*0.050*	*0.067*	*0.016*	*0.017*	*0.137*	*0.159*	*0.191*	*0.049*	*0.054*
Log block sequence number	0.012	0.014	-0.006	-0.012	-0.006	0.065	0.170[c]	0.118	0.032	0.051
	0.020	*0.034*	*0.060*	*0.017*	*0.017*	*0.059*	*0.092*	*0.142*	*0.046*	*0.048*
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.165	0.142	0.149	0.138	0.157	0.104	0.060	0.054	0.049	0.076
Number of blocks	1170	916	685	916	916	1170	916	685	916	916

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 10 – Money-chasing deals and firms scale

The table shows regression results using ordinary least squares. The dependent variables are the investment's IRR (Panel A) and the investment's PME (Panel B). Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life. Explanatory variables also include i) the average of the sentiment index of Baker and Wurgler (2006) from three months before investment initiation date to three months after; and ii) Private equity commitments to stock-market, which is the amount allocated to private equity in the year of investment initiation divided by the total stock-market capitalization at the beginning of that year (from Kaplan and Stromberg, 2009). Because the latter variable starts in 1985, our sample size decreases to 7280. All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

Panel A: The dependent variable is the investment's IRR

	Spec 1	Spec 2	Spec 3	Spec 4
Sentiment, *t*			-0.040[a]	-0.030[a]
			0.011	*0.011*
PE commitments to stock market, *t*		-0.039[a]		-0.031[a]
		0.010		*0.010*
Log SI 4 years	-0.087[a]			-0.083[a]
	0.012			*0.012*
Market return	0.132[a]	0.125[a]	0.113[a]	0.113[a]
	0.012	*0.012*	*0.014*	*0.013*
Log investment size	-0.038[a]	-0.033[a]	-0.035[a]	-0.039[a]
	0.012	*0.012*	*0.012*	*0.012*
Portfolio volatility	0.011	0.036[a]	0.035[a]	0.012
	0.012	*0.012*	*0.011*	*0.012*
Duration rest portfolio	-0.036[a]	-0.041[a]	-0.037[a]	-0.038[a]
	0.009	*0.010*	*0.010*	*0.009*
Log firm age	0.040[a]	0.019[b]	0.016[c]	0.044[a]
	0.009	*0.009*	*0.009*	*0.009*
Time fixed effects	no	no	no	no
Country and industry fixed effects	yes	yes	yes	yes
Adjusted R^2	0.083	0.074	0.073	0.087
Number of investments	7280	7280	7280	7280

Panel B: The dependent variable is the investment's PME

Sentiment, *t*			-0.070[a]	-0.054[b]
			0.026	*0.026*
PE commitments to stock market, *t*		-0.060[b]		-0.045[c]
		0.025		*0.025*
Log SI-capped	-0.163[a]			-0.155[a]
	0.027			*0.027*
Market return	-0.109[a]	-0.120[a]	-0.144[a]	-0.141[a]
	0.026	*0.026*	*0.028*	*0.028*
Log investment size	-0.169[a]	-0.158[a]	-0.163[a]	-0.170[a]
	0.033	*0.034*	*0.033*	*0.033*
Portfolio volatility	0.026	0.072[a]	0.070[b]	0.028
	0.029	*0.028*	*0.028*	*0.029*
Duration rest portfolio	0.014	0.005	0.011	0.012
	0.025	*0.025*	*0.025*	*0.025*
Log firm age	0.078[a]	0.037	0.032	0.083[a]
	0.025	*0.025*	*0.025*	*0.025*
Time fixed effects	no	no	no	no
Country and industry fixed effects	yes	yes	yes	yes
Adjusted R^2	0.047	0.042	0.042	0.048
Number of investments	7280	7280	7280	7280

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 11 – Alternative scale measures

The table shows regression results using ordinary least squares. The dependent variables are the investment's IRR (panel A) and the investment's PME (panel B). Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life. The control variables in each regression are those of the base specification in table 5 (market return, log investment size, portfolio volatility, duration rest portfolio, log firm age, time fixed effects, country fixed effects, and industry fixed effects). Each line shows a summary of the results obtained after running two different regressions. The first regression includes the above-mentioned control variables and the alternative measure, while the second regression includes, in addition, Log SI. All explanatory variables shown are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

Panel A: The dependent variable is investment's IRR

	Log SI 4 years is not included		Log SI 4 years is included			Number of investments
Alternative measures	Alternative measure	Adjusted R^2	Alternative measure	Log SI 4 years	Adjusted R^2	
Log number of industries held	-0.075[a]	0.114	0.015	-0.094[a]	0.115	7453
	0.011		*0.024*	*0.023*		
One minus Herfindhal industries	-0.051[a]	0.110	-0.010	-0.075[a]	0.115	7453
	0.011		*0.012*	*0.012*		
Log EUM	-0.077[a]	0.112	0.010	-0.086[a]	0.115	7453
	0.014		*0.022*	*0.016*		
Log SI capped per professional	-0.018	0.142	-0.002	-0.059[a]	0.145	3068
	0.015		*0.015*	*0.019*		

Panel B: The dependent variable is investment's PME

	Log SI 4 years is not included		Log SI 4 years is included			Number of investments
Alternative measures	Alternative measure	Adj. R^2	Alternative measure	Log SI 4 years	Adj. R^2	
Log number of industries held	-0.119[a]	0.075	0.104[c]	-0.234[a]	0.077	7453
	0.026		*0.058*	*0.056*		
One minus Herfindhal industries	-0.071[a]	0.073	-0.004	-0.140[a]	0.077	7453
	0.027		*0.031*	*0.030*		
Log EUM	-0.124[a]	0.074	0.127[b]	-0.216[a]	0.078	7453
	0.037		*0.057*	*0.040*		
Log SI capped per professional	-0.010	0.070	-0.016	-0.052[a]	0.070	3068
	0.035		*0.039*	*0.049*		

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%

Table 12 – Organization structure and diseconomies of scale

The table shows regression results using ordinary least squares. Regressions are run on two different sub-samples in each panel. In Panel A, the two sub-samples are: (i) the investments made by independent PE firms; and (ii) the investments made by firms that are part of a financial group (non-independent firms). In Panel B the two sub-samples are: (i) the investments made by PE firms with a hierarchy score below the median; and (ii) the investments made by PE firms with a hierarchy score above the median. In Panel C the two sub-samples are: (i) the investments made by PE firms whose employees' background diversity is less than the median; and (ii) the investments made by PE firms whose employees' background diversity is greater than the median. The dependent variables in each panel are the investment's IRR and the investment's PME. Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life. The control variables in each regression are those of the base specification in Table 4 (market return, log investment size, portfolio volatility, duration rest portfolio, log firm age, time fixed effects, country fixed effects, and industry fixed effects). All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. The table also presents a t-test of the difference in coefficients of Log SI in each of the two subgroups. All variables are defined in Table A.1.

Panel A: Independent versus non-independent firms

Dependent variable is…	Investment's IRR			Investment's PME		
	independent	not independent	difference	independent	not independent	difference
Log SI 4 years	-0.069[a]	-0.111[a]	0.042[a]	-0.103[a]	-0.206[a]	0.103[a]
	0.013	*0.020*	*0.016*	*0.028*	*0.041*	*0.033*
Control variables	yes	yes		yes	yes	
Adjusted R^2	0.118	0.118		0.073	0.077	
Number of investments	4900	2322		4900	2322	

Panel B: Hierarchy

Dependent variable is…	Investment's IRR			Investment's PME		
	below median	above median	difference	below median	above median	difference
Log SI 4 years	-0.048[b]	-0.088[a]	0.040[c]	-0.051	-0.131[b]	0.080[c]
	0.023	*0.024*	*0.024*	*0.046*	*0.051*	*0.048*
Control variables	yes	yes		yes	Yes	
Adjusted R^2	0.121	0.163		0.072	0.084	
Number of investments	1547	1353		1547	1353	

Panel C: Professionals' background diversity

Dependent variable is…	Investment's IRR			Investment's PME		
	below median	above median	difference	below median	above median	difference
Log SI 4 years	-0.042[b]	-0.077[a]	0.036[c]	-0.049	-0.145[a]	0.096[b]
	0.021	*0.021*	*0.021*	*0.052*	*0.044*	*0.048*
Control variables	yes	yes		yes	yes	
Adjusted R^2	0.092	0.135		0.027	0.087	
Number of investments	1647	1508		1647	1508	

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Figure 1: Distribution of performance, duration, and size

This figure shows histograms of IRR, public market equivalent (PME), investment duration (in years), and investment size (equity invested in millions of 2006 US dollars). The first bar of each histogram includes all observations below the threshold. The last bar of each histogram includes all observations in the threshold and above.

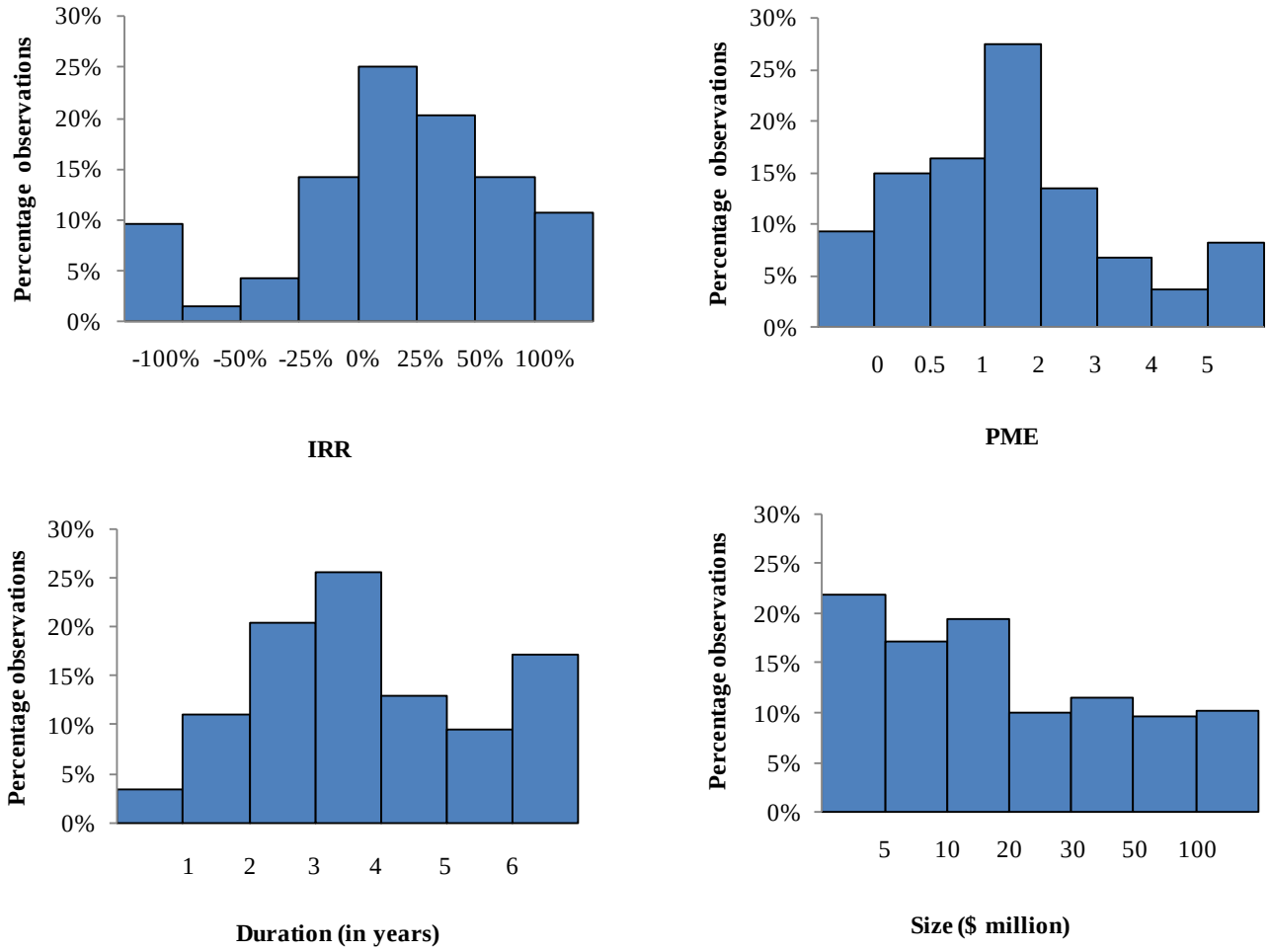

Figure 2: Performance and firm scale

The figure shows the median IRR and PME in each SI-4-year decile.

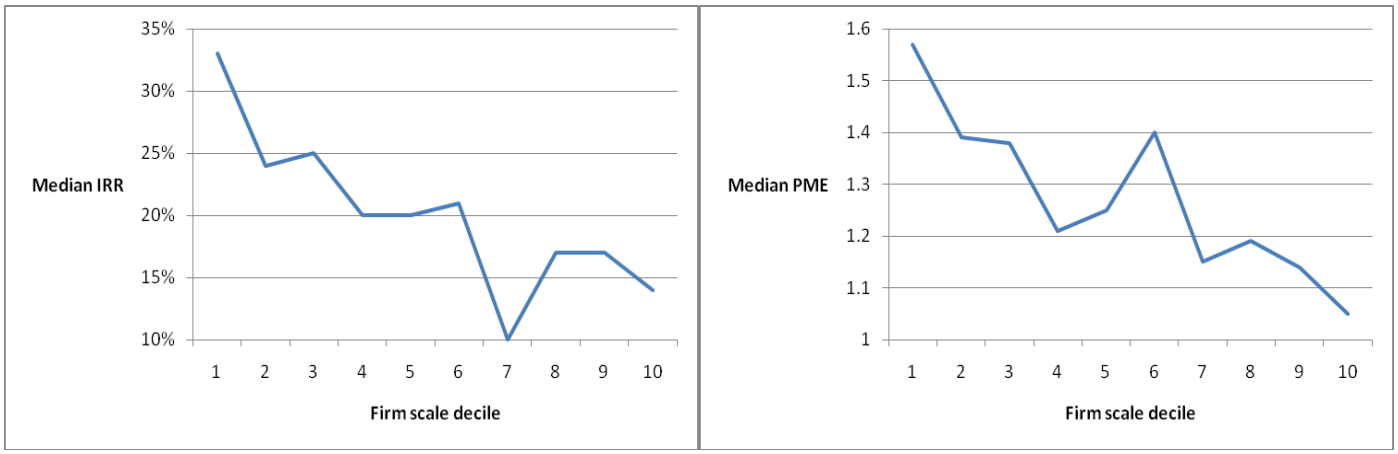

Table A.1 – Variable descriptions

This table describes the variables used in the paper. The unit of observation is an investment made by a private equity firm (PE firm). Unless specified otherwise, the source of the variables is the private placement memorandum (PPM).

Variable name	Variable description
PE firm	A private equity firm (PE firm) is an organization that undertakes buyout investments. Since the focus of the paper is on the PE industry, we exclude from the sample firms specifically raising money for venture capital or other alternative investments such as timber, infrastructure, land, real estate, or mezzanine. These asset classes are sometimes also referred to as private equity.
PE fund	A private equity fund (PE fund) is a buyout investment fund that is managed by a PE firm. A PE firm may have several funds running at the same time. The typical PE firm launches a new fund every two to four years. Funds have a finite life lasting ten to fourteen years.
Investment	An investment is a private equity transaction realized by a PE firm. PE firms report their investments per company. So we follow this practice considering one company as a single investment including all "add-on" acquisitions and divestments made by the company as part of the same investment. We exclude debt and public equity investments.
Block of investments *t*	We define the block of investments of a PE firm at time *t* as the group of all the investments initiated by the PE firm in the two-year block starting at time *t*. As an illustration of the procedure we follow, consider a firm that made investments between 1994 and 1998. We would split its investments into three different blocks: block 1 would have investments made in 1994-95; block 2 investments made in 1996-97; and block three investments made in 1998.
Multiple	The multiple of the investment is the ratio of total cash received from the investment plus its current valuation (if not fully liquidated) to the total cash invested. The measure is gross of fees. Different PPMs use different currencies to report performance: 57% of PPM use US dollars, 29% use euros, 9% use GBP, and 5% use other currencies such as Yen and Canadian dollars.
Duration	The length in years between the investment initiation date and the investment exit date. The source of the year of investment initiation is the PPM in 100% of the cases. For the 730 partially realized and the 1,617 unrealized investments in the sample, the exit date is set as the date of the writing of the PPM. For 3351 realized investments, the exit date is the termination date reported in the PPM (81% of the cases) or in the website of the PE firm (19% of the cases). For the other 1,755 realized investments, we could not find the exit date in either source. So, for 1,125 of them, we infer the exit date using the date of the investment initiation, the investment's multiple, and its IRR according to the formula specified in Table A.3. For the remaining 630 investments for which the lack of information prevented us from applying this formula, we assume the exit date to be four years after the investment initiation date because four years is the median holding period of our sample. There are 379 investments for which our sources do not provide the month of initiation and 260 for which they do not provide the month of exit. For these cases, we assume the month to be June of the reported year unless the resulting duration is less than one year. In such cases, we assume the month to be January for investment initiation and December for investment exit.
IRR	The internal rate of return, gross of fees, of the investment. Different PPMs use different currencies to report performance: 57% of PPM use US dollars, 29% use euros, 9% use GBP, and 5% use other currencies such as yen and Canadian dollars. For 1,024 investments with missing IRR in the PPM, we infer it using the multiple and the duration provided in the PPM according to the formula specified in table A.3. We Winsorize IRR at the 95th percentile (178%). Figures for IRR are often Winsorized at 1000%, and sometimes at 500% in the PPM.
PME	The public market equivalent (PME) is the ratio of the present value of dividends to the present value of the amount invested. To calculate this measure, we assume that the full amount of the investment is made at the investment initiation date, and that all distributions take place at the exit date. To discount the cash flows, we use CRSP value-weighted return series. The measure is gross of fees and is computed in the currency originally used in the PPM to report performance.
MIRR	To calculate the Modified IRR, we follow Ljungqvist *et al*. (2007) and compute the measure as the multiple of the investment raised to the power of one over the duration of the investment minus one. This calculation implicitly assumes that intermediary dividends are reinvested at a zero rate of return and that intermediate investments are also financed at a zero rate of return.

Table A.1 (cont')

Variable name	Variable description
Log SI	The natural logarithm of the average of the number of simultaneous investments by the PE firm during each month of the duration (life) of the investment. We construct two alternative SI measures. The first measure, labeled "SI full life," uses the full life of each investment to make the calculation. That is, we use the full life of the focal investment as the period for the calculation, and also consider the full life of all the simultaneous investments of the PE firm to calculate the average. The second SI measure, labeled "SI 4 years", only considers the first four years of the life of the focal investment, and caps to four years the life of all the simultaneous investments. We use four years because it corresponds to the median investment duration in our sample. In some tables, we additionally compute SI only considering the first two years of the investments' life (SI 2 years). When the same PE firm invests in the same company at the same time via different funds, we count the investment only once.
Log investment size	The natural logarithm of the total amount of equity paid by the PE firm for the investment. Total equity is also called investment size and is used to weight investment performance within a fund or a block. For 57% of the investments in our sample, investment size is reported in US dollars. In all other cases, we convert investment size to US dollars using the exchange rate provided in Datastream for the investment initiation date. The investment size is expressed in millions of 2006 US dollars using the consumer price index.
Bankrupt	We classify as "bankrupt" investments reported as "bankrupt" or "written off" in the PPM or if they are reported to return no capital.
Home run	We classify investments as "home runs" if their IRR is above 50%.
Exit route	The type of exit route for a realized or a partially realized investment. We group investments in five different exit routes: (1) investments exited via an IPO; (2) investments exited via a sale, which are those sold to a corporation or a financial institution; (3) bankrupt investments; and (4) other exits, which include recapitalizations, and all of those cases that the PPM reports as "other" or "complex". When a company is partially exited via an IPO, we classify the exit status as IPO irrespective of the method of the exit for the remaining shares. The information sources for the type of exit route are the PPM (57%), the Thomson database (34%), and the websites of PE firms (9%).
Developing and developed countries	We classify as developing those countries located in Africa, the Middle East, Asia (excluding Japan), Eastern Europe, and Latin America. We classify as developed countries the US, the UK, Canada, Western European countries, Japan, Australia, and New Zealand. The sources of information about the investments' country of location are the PPM (34%), the Thomson database (33%), the websites of PE firms (30%), and the Capital IQ database (3%).
Market return	The average of the monthly returns of the CRSP value-weighted index between the investment initiation and the investment exit dates. We annualize the rate by compounding the monthly average.
Portfolio Volatility	The average of the monthly volatility of the portfolio of investments of the PE firm over the life (duration) of the focal investment. To compute this measure, we calculate for each month of the life of the focal investment the square root of $[w_{1,t} \ldots w_{48,t}].\Omega.[w_{1,t} \ldots w_{48,t}]'$ and then average across all months. We define $w_{i,t}$ as the (size-weighted) fraction of money invested by the PE firm in industry *i*, and Ω as the variance covariance matrix of the 48 Fama-French industry returns between 1973 and 2007 obtained from Ken French's website.
Duration rest of portfolio	The average duration of the rest of the investments in the portfolio of the PE firm over the life of the focal investment. To obtain this measure, we compute the duration of each investment in the portfolio of the PE firm (excluding the focal investment) and then calculate the (equally-weighted) average for each month over the life of the focal investment. We exclude all months during which there are no investments in the PE firm other than the focal investment.
Log firm age	The natural logarithm of one plus the number of years between the date of the first investment made by the PE firm and the investment initiation date of the focal investment.

Table A.1 (cont')

Variable name	Variable description
Time fixed effects	Fixed effects based on the year of investment initiation.
Country fixed effects	Fixed effects based on the country of investment location. The information sources for the country of the investment are the PPM (34%), the websites of PE firms (30%), the Thomson database (33%), and the Capital IQ database (3%).
Industry fixed effects	Fixed effects based on the industry of the investment. The industries are manually assigned to one of the 48 Fama-French industry classification using their SIC codes or their would-be SIC codes (based on the information in siccode.com). We classify as "machinery" the industry of 112 investments for which the PPM reported "manufacturing" as the sector and we could not find further details in other databases. The information sources for the industry of the investments are the PPM (60%), the websites of PE firms (16%), the Thomson database (20%) and the Capital IQ database (4%).
Fund or firm fixed effects	Fixed effects based on the fund or firm that made the investment according to the PPM. There are 1,095 investments for which we know the PE firm but not the PE fund that made them. These investments are excluded when running fund fixed effects or fund level regressions.
Mean log SI of block *t-h*	The equally-weighted average of the Log SI of all the investments that belong to a PE firm's block of investments, where *t-h* refers to the sequence of this block of investments in the track record of the PE firm.
Mean log investment size of block t	The equally-weighted average of the variable called "Log investment size" across all investments in block of investments *t*.
Mean market return of block *t*	The equally-weighted average of the variable called "market return" across all investments in a block of investments.
Block volatility	The standard deviation of the IRR or the PME of all the investments that belong to the block of investments *t*.
Block sequence number	The sequence number of block of investments *t* in the PE firm's track record.
Block country/industry	The most frequent country or industry of the investments in block of investments *t.* Where two countries or industries are equally frequent, we keep the country or the industry with the larger investments in terms of size. This variable is used to define the country and industry fixed effects in block-level regressions.
Mean log SI 4 years of fund	The equally-weighted average of the variable called "Log SI" across all investments that belong to a PE fund. Log SI 4 years is the log of the number of simultaneous investments over the first four years of the life of the focal investment.
Log fund size	The natural logarithm of the capital committed to the PE fund in million of US dollars. The information sources for the variable are the PPM (72%), the websites of PE firms (12%), and the Thomson database (16%).
Mean market return of fund	The equally-weighted average of the variable called "market return" across the investments that belong to the fund of the focal investment.
Fund volatility	The standard deviation of the IRR or the PME of all investments that belong to the fund of the focal investment.
Fund sequence number	The sequence number of the PE fund in the PE firm's track record. If several funds of the same PE firm have the same starting year, we assume that smaller funds started earlier.
Fund country/industry	The most frequent country or industry of the investments in a PE fund. Where two countries or industries are equally frequent, we keep the country or the industry with the larger investments in terms of size. This variable is used to define the country and industry fixed-effects in fund-level regressions.

Table A.1 (cont')

Variable name	Variable description
Log EUM	The natural logarithm of the average of the total equity invested by the firm during each month of the life of the focal investment. The total equity invested in a given month is the sum of all the "investment size" for all the investments simultaneously held by the firm that month.
Number of industries held	The average of the number of different industries in which the PE firm has investments in each month of the life of the focal investment. . To be consistent with the SI computation, we also cap all investments' life to four years here. The industry groups we use are the 48 Fama-French industries.
One minus Herfindhal industries	One minus the average of the monthly Herfindhal index of industry concentration during each month of the life of the focal investment. To be consistent with the SI computation, we also cap all investments' life to four years here. We calculate the monthly Herfindhal index of industry concentration based on the number of investments the PE firm has in each industry. We use one minus the Herfindhal index to have a measure of dispersion rather than concentration.
Log SI per professional	The natural logarithm of the ratio of the number of simultaneous investments (SI) to the number of professionals working at the PE firm in the year of initiation of the investment. If the number of professionals is missing for one year but is known for the year t-1 and t+1, we assign to the missing year t the average of the years t-1 and t+1. Individuals with job titles containing the words "analysts" and "assistants" are not included in the count of professionals. The sources for the data are the Galante Private Equity Directories from 1996 (hence covering year 1995) to 2006.
Independent PE firm	A PE firm is classified as either independent or not independent (belonging to a financial group) based on the information contained in the field called "type of organization" in the Galante Private Equity Directory. A firm is classified as independent if none of the following terms is contained in the type of organization field: (i) private equity subsidiary; (ii) investment advisory firm; (iii) merchant banking; (iv) investment banking firm; (v) merger & acquisition firm. Other items that are found in the field are: (i) private venture capital investment firm; (ii) public venture capital investment firm; (iii) private buyout investment firm; (iv) public buyout investment firm; (v) private investment firm; (vi) public investment firm. There were 76 firms which were not found in the Galante Private Equity Directory. We classified these firms based on the information contained in the section called "about us" or "history" of their website. Of these 76 firms there were 16 for which we could not find reliable information either because they did not have a website (12 cases), or because their website did not provide the required information (4 cases). We classified those 16 cases as missing. There were only 5 cases in which we found that the PE firm changed its type of organization during our sample period. We have classified the investments made by those firms at different times according to the classification of the firm at the time of investment initiation.
Hierarchy	The number of different job titles among the professionals working in the PE firm during the year of the initiation of the investment. We count all the titles provided in the Galante Private Equity Directories except those that contain the words "analyst" or "assistant." Because we are interested in constructing a proxy for the number of layers in a firm, in the cases of firms with multiple offices we count the job titles separately for each office and aggregate them for the firm. In some cases, the information of the title of a specific professional was missing. We discarded all the firm-years in which more than-one third of the listed professionals had no job title associated with their name. The sources of the variable are the Galante Private Equity Directories from 1996 to 2006.
Professionals' background diversity	One minus the Herfindhal index of the professional backgrounds of the employees working at the PE firm the year of investment inception. To construct this variable, we obtained the list of professionals working at each PE firm from the Galante Private Equity directories and collected the biographies of each professional. The sources of the biographies are the PPM (65% of cases) and the websites of the PE firms (35% of cases). Professionals at the PE firm are classified as having one of three different backgrounds: (1) finance background, if they spent most of their pre-PE career working in a financial institution; (2) consulting background, if they spent most of their pre-PE career working in a consulting or accounting firm; and (3) other background, if they spent most of their pre-PE career working in other industries or if they have always worked in PE. Individuals with job titles containing the words "analyst" or "assistant" are not included in the count of professionals. The Herfindhal index is based on the proportions of the three different backgrounds the year of the investment's initiation in the PE firm.

Table A.2: Fund size and fund performance using Preqin data

This table shows results from OLS regressions of fund performance on fund size and other characteristics using Preqin data. To mimic the sample of funds used in our paper, the sample of Preqin funds selected for this table only includes funds classified as "buyout" in Preqin with vintage year before 2005. We show results for the full sample of buyout funds ("All BO") and the sub-sample of US focused buyout funds ("US BO").

Preqin data	Dependent variable = IRR				Dependent variable = Multiple			
	All BO		US BO		All BO		US BO	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
ln(Fund Size)	-0.01	-0.13***	-0.01	-0.16***	-0.08**	-0.65**	-0.11**	-0.83**
	0.01	*0.04*	*0.01*	*0.06*	*0.04*	*0.26*	*0.05*	*0.37*
$\ln(\text{Fund Size})^2$		0.01***		0.01**		0.05**		0.06*
		0.00		*0.00*		*0.02*		*0.03*
ln(Fund No.)		0.01		0.01		0.15*		0.25**
		0.01		*0.02*		*0.08*		*0.12*
Constant	0.30***	0.65***	0.33***	0.75***	4.03***	5.58***	4.49***	6.54***
	0.04	*0.12*	*0.05*	*0.16*	*0.25*	*0.73*	*0.34*	*1.07*
Sample	All BO	All BO	US BO	US BO	All BO	All BO	US BO	US BO
Vintage Year FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	605	605	417	417	660	660	439	439
R-squared	0.12	0.14	0.15	0.16	0.22	0.23	0.26	0.28

Table A.3 - The sample of PPM and firm track records

The table describes our sample of PPM and firm track records. Panel A shows the total number of private placement memorandum (PPM) collected and their type. Panel B splits PPM by number of PE firm track records contained in each PPM and provides the total number of firms and investments in each of the groups. The sample was assembled by collecting fund-raising prospectuses, usually referred to as private placement memorandums (PPMs). PPMs contain the performance and characteristics of all prior investments made by the firm.[1] The collection started in 2001 and ended in 2007, with a total of 523 "unique" PPMs from both US and European investors.[2] Since the focus of the paper is on the PE industry, we asked investors to provide us with PPMs aimed at raising PE funds. Some, however, gave us PPMs to raise venture capital funds (104 cases) and other alternative investment funds such as timber, infrastructure, land, real estate, or mezzanine (29 cases). We exclude these PPMs from our sample. We also exclude 73 PPMs without a track record – these are all first-time funds. These exclusions leave us with a sample of 317 PPMs. As Panel B shows, 301 PPMs contain the track record of only one firm. In a few cases, however, the PPMs also contain the track records of PE firms for which some of the partners had previously worked. For this reason, our final sample contains the track records of 334 different PE firms with a total of 11,704 individual investments.

Panel A: Private placement memoranda (PPM)

	Number of PPM
PPM collected	523
PPM of venture capital funds	104
PPM of other alternative funds (timber, real estate, infrastructure, debt, and so on)	29
PPM without track record	73
PPM available for analysis	**317**

Panel B: PE firm track records per private placement memorandum (PPM)

	Number of PPM	Number of firms	Number of investments
PPM containing one track record	301	301	11,116
PPM containing two track records	15	30	512
PPM containing three track records	1	3	76
Total	**317**	**334**	**11,704**

[1] Private equity firms are organizations that manage private equity funds. A firm may have several funds running at each point in time. Funds have a finite life lasting 10 to 14 years. The typical firm launches a new fund every two to four years. When a firm raises a new fund, it gives a fund-raising prospectus to potential investors. Investors commit capital at fund inception and cannot add or withdraw capital during the fund's life. Several investors gave us access to their prospectuses but under signed confidentiality agreements which bar us from disclosing information about the identity of the PE firms and their investments.

[2] On some occasions, we received the same PPM from different investors. We disregard such duplicate PPMs. Sometimes, we received more than one PPM from the same PE firm at different points in time (*e.g.*, one PPM for its 2003 fund and another for its 2006 fund). In these cases, we keep the more recent PPM.

Table A.4 - Example of a PPM

Appendix D. Fund IV Track record
Status as at June 30, 2007, In million of Euro

Company	Date of investment	Date realized	Sector	Country	Cost	Realized value	Unrealized Value	Total value	Multiple	IRR	Exit
Realized investments											
X1	Apr-00	Apr-06	Healthcare	France	60	_	_	0	0.0	n.m.	
X2	May-01	May-06	Industrial	UK	140	120	_	120	0.9	n.m.	Trade sale
X3	Mar-01	Jun-03	Consumer	Germany	115	950	_	850	7.4	100%	IPO
X4	Mar-01	Jul-06	Chemicals	Germany	60	85	_	85	1.4	25%	Trade sale
Total Realized					375	1155		1055	2.8	51%	_
Partly realized investments											
X5	Oct-00	_	Healthcare	France	500	130	300	430	0.9	n.m.	
X6	Apr-04	_	Industrial	UK	200	150	190	340	1.7	100%	
X7	Feb-03	_	Healthcare	France	179	444	43	487	2.7	51%	
Total Partly Realized					879	724	533	1257	1.4	31%	
Unrealized investments											
X8	Dec-05	_	Healthcare	France	140	_	280	280	2.0	25%	
X9	Jul-02	_	Industrial	UK	450	_	450	450	1.0	n.m.	
Total Unrealized					590	_	730	730	1.2	10%	
Total					1844	1879	1283	3042	1.6	40%	

Table A.5 - Statistics on missing information

This table shows some descriptive statistics about different groups of investments classified according to the availability of the information in the PPM to compute the duration and the IRR of the investment. For the cases when a piece of information to calculate duration was missing, we inferred duration using the investment's IRR and the Multiple according to the following formula: Multiple = $(1+IRR)^{duration}$. We used the same formula to infer IRR when duration and the Multiple were provided in the PPM. Table A1 provides detailed definitions of all the variables.

	Number of	Median					Median		
	investments	IRR	PME	MIRR	Multiple	Duration	Investment size	SI full life	SI 4 years
Duration									
. Available in PPM	5698	0.20	1.26	0.16	1.89	3.83	15	17	15
. Assumed									
.. Inferred from IRR	1125	0.37	1.88	0.37	2.70	3.02	13	17	15
.. Set to median (IRR is -1 or 0)	325	-1.00	0.00	-1.00	0.00	4.00	13	23	20
.. Set to median (no IRR was available)	305	-0.14	0.38	-0.14	0.55	4.00	14	26	22
IRR									
. Available in PPM	6429	0.26	1.42	0.21	2.08	3.67	15	17	15
. Inferred from duration									
.. Inferred with available duration	719	-0.10	0.37	-0.10	0.60	5.00	16	25	21
.. Inferred with assumed duration	305	-0.14	0.38	-0.14	0.54	4.00	14	27	22

Table A.6 - Correlation matrix and distribution

Panels A and B of this table show the correlation matrix for the (z-score of the) main variables used in regressions. Panel C shows the distribution of these variables. All variables are defined in Table A.1.

Panel A: Correlation matrix

		1	2	3	4	5	6	7	8
1	IRR	1.00							
2	MIRR	0.97[a]	1.00						
3	PME	0.76[a]	0.77[a]	1.00					
4	Log SI 4 years	-0.13[a]	-0.13[a]	-0.12[a]	1.00				
5	Market return	0.20[a]	0.20[a]	-0.05[a]	0.00	1.00			
6	Log investment size	-0.07[a]	-0.05[a]	-0.08[a]	0.05[a]	-0.12[a]	1.00		
7	Portfolio volatility	0.07[a]	0.05[a]	0.06[a]	-0.27[a]	0.02[c]	-0.15[a]	1.00	
8	Duration rest of portfolio	-0.04[a]	-0.05[a]	0.01	0.09[a]	0.02	-0.06[a]	-0.05[a]	1.00
9	Log firm age	-0.03[b]	-0.02[b]	-0.01	0.34[a]	-0.07[a]	0.23[a]	-0.15[a]	0.20[a]

Panel B: Correlation matrix

		4	10	11	12	13	14	15	16	17
4	Log SI 4 years	1.00								
10	Log SI full life	0.98[a]	1.00							
11	Duration investment	0.02	0.07[a]	1.00						
12	Log EUM	0.65[a]	0.67[a]	0.08[a]	1.00					
13	Log number of industries held	0.90[a]	0.90[a]	0.08[a]	0.60[a]	1.00				
14	One minus Herfindhal industries	0.60[a]	0.58[a]	0.06[a]	0.38[a]	0.84[a]	1.00			
15	Log SI per professional	0.40[a]	0.40[a]	0.04[c]	0.10[a]	0.26[a]	0.09[a]	1.00		
16	Independent PE firm	0.00	0.00	0.02	-0.08[a]	0.02[c]	0.02[c]	-0.11[a]	1.00	
17	Hierarchy	0.51[a]	0.54[a]	-0.08[a]	0.32[a]	0.48[a]	0.24[a]	-0.27[a]	0.20[a]	1.00
18	Professionals' background diversity	0.17[a]	0.14[a]	-0.09[a]	0.07[a]	0.17[a]	0.12[a]	-0.24[a]	-0.04	0.41[a]

Panel C: Distribution

		Mean	Stdev	Min	25th percentile	50th percentile	75th percentile	Max
1	IRR	0.24	0.66	-1.00	0.00	0.21	0.50	1.90
2	MIRR	0.19	0.58	-1.00	-0.01	0.17	0.43	1.55
3	PME	1.75	1.67	0.00	0.55	1.27	2.39	6.19
4	Log SI 4 years	2.70	0.87	0.00	2.08	2.66	3.32	4.60
5	Market return	0.12	0.10	-0.35	0.05	0.13	0.19	1.15
6	Log investment size	2.65	1.50	-8.77	1.74	2.70	3.66	5.31
7	Portfolio volatility	26.56	4.37	15.59	23.92	26.19	28.38	60.94
8	Duration rest of portfolio	4.65	1.02	0.00	3.98	4.73	5.35	8.11
9	Log firm age	1.41	1.30	-2.48	0.88	1.76	2.31	3.34
10	Log SI full life	2.89	0.87	0.00	2.28	2.87	3.50	4.91
11	Duration investment	4.04	1.96	0.25	2.57	3.92	5.25	8.11
12	Log EUM	6.06	1.53	-2.02	4.97	6.08	7.23	9.25
13	Log number of industries held	2.28	0.67	0.00	1.84	2.33	2.79	3.58
14	One minus Herfindhal industries	0.81	0.14	0.00	0.78	0.86	0.90	0.95
15	Log SI per professional	0.92	0.57	0.25	0.50	0.66	1.20	3.50
16	Independent PE firm	0.68	0.47	0.00	0.00	1.00	1.00	1.00
17	Hierarchy	6.74	7.90	1.00	3.00	4.00	7.00	42.00
18	Professionals' background diversity	0.49	0.12	0.13	0.44	0.50	0.59	0.67

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table A.7. Controlling for fund sequence number

This table reproduces the same regression specifications as inTable 4 adding the fund sequence number as a control variable.

	The dependent variable is					
	the investment's IRR			the investment's PME		
	(1)	(2)	(3)	(1)	(2)	(3)
Log SI 4 years	-0.079[a]		-0.081[a]	-0.120[a]		-0.133[a]
	0.010		*0.011*	*0.020*		*0.022*
Fund sequence number		**-0.018[c]**	**0.006**		**-0.010**	**0.031**
		0.010	***0.011***		***0.022***	***0.025***
Market return			0.124[a]			-0.051[c]
			0.019			*0.031*
Log investment size			-0.057[a]			-0.132[a]
			0.012			*0.025*
Portfolio volatility			0.010			0.007
			0.011			*0.023*
Duration rest portfolio			-0.006			0.034
			0.010			*0.021*
Log firm age			0.012			0.013
			0.011			*0.024*
Time fixed effects	Yes	yes	yes	yes	yes	yes
Country fixed effects	Yes	yes	yes	yes	yes	yes
Industry fixed effects	Yes	yes	yes	yes	yes	yes
Adjusted R^2	0.093	0.082	0.112	0.063	0.057	0.070
Number of investments	7453	7453	7453	7453	7453	7453

Table A.8 – Firm and fund fixed effects

The table shows regression results using firm and fund fixed effects. The sample used in firm fixed effects regressions is our full sample. The sample used in fund fixed effects regressions excludes all investments for which we do not know the identity of the fund that made them. The dependent variables are the investment's IRR (Panel A) and the investment's PME (Panel B). Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life.All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. All variables are defined in Table A.1.

	Firm fixed effects		Fund fixed effects	
Dependent variable:	IRR	PME	IRR	PME
Log SI 4 years	-0.212[a]	-0.486[a]	-0.209[a]	-0.384[a]
	0.025	*0.067*	*0.033*	*0.076*
Market return	0.136[a]	-0.061[c]	0.136[a]	-0.073[c]
	0.020	*0.036*	*0.020*	*0.037*
Log investment size	-0.090[a]	-0.320[a]	-0.077[a]	-0.278[a]
	0.014	*0.038*	*0.016*	*0.041*
Portfolio volatility	0.003	-0.045	-0.023	-0.085[c]
	0.015	*0.039*	*0.017*	*0.044*
Duration rest portfolio	0.012	0.104[a]	0.055[a]	0.237[a]
	0.015	*0.039*	*0.019*	*0.048*
Log firm age	0.044[a]	0.090[b]	0.033[b]	0.031
	0.014	*0.041*	*0.016*	*0.046*
Time fixed effects	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes
Firm fixed effects	yes	yes	no	no
Fund fixed effects	no	no	yes	yes
Adjusted R^2	0.148	0.112	0.158	0.129
Number of investments	7453	7453	6358	6358

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table A.9 – Organization structure (net of firm scale) and diseconomies of scale

The table shows regression results using ordinary least squares. Panel A runs regressions of the three organization structure proxies of independent PE firm, hierarchy and professionals' background diversity on the log of SI and a constant. The residuals of each of these regressions are used in the three subsequent panels B, C and D. As in the previous table, the regressions in the last three panels are run on two different sub-samples. In Panel B, the two sub-samples are: (i) the investments made by independent PE firms; and (ii) the investments made by firms that are part of a financial group (non-independent firms). In Panel C the two sub-samples are: (i) the investments made by PE firms with a hierarchy score below the median; and (ii) the investments made by PE firms with a hierarchy score above the median. In Panel D the two sub-samples are: (i) the investments made by PE firms whose employees' background diversity is less than the median; and (ii) the investments made by PE firms whose employees' background diversity is greater than the median. The dependent variables in each of the last three panels are the investment's IRR and the investment's PME. Log SI 4 years is the log of the number of simultaneous investments considering the first four years of the investments' life. The control variables in each regression are those of the base specification in Table 5 (market return, log investment size, portfolio volatility, duration rest portfolio, log firm age, and time, country and industry fixed effects). All explanatory variables are expressed as a z-score. Standard errors are clustered by PE firm and investment year. The last three panels also present a t-test of the difference in coefficients of Log SI in each of the two subgroups. All variables are defined in Table A.1.

Panel A: Regression of organization structure measures on the log of SI 4 years

Dependent variable is…	Independent PE firm (1)	Hierarchy (2)	Professionals' background diversity (3)
Constant	0.687[a]	-9.625[a]	0.444[a]
	0.019	*0.580*	*0.039*
Log SI-capped	-0.003	5.700[a]	0.040[a]
	0.051	*0.176*	*0.012*
Adjusted R^2	0.000	0.263	0.003
Number of investments	7222	2900	3155

Panel B: Independent versus non-independent firms (using the residual from specification (1) of Panel A)

Dependent variable is…	Investment's IRR			Investment's PME		
	independent	not independent	difference	independent	not independent	difference
Residual log SI 4 years	-0.064[a]	-0.112[a]	0.048[a]	-0.081[a]	-0.203[a]	0.122[a]
	0.014	*0.016*	*0.015*	*0.029*	*0.033*	*0.031*
Control variables	yes	yes		yes	yes	
Adjusted R^2	0.114	0.124		0.076	0.082	
Number of investments	3611	3611		3611	3611	

Panel C: Hierarchy (using the residual from specification (2) of Panel A)

Dependent variable is…	Investment's IRR			Investment's PME		
	below median	above median	difference	below median	above median	difference
Residual log SI 4 years	-0.022	-0.089[a]	0.067[a]	0.002	-0.103[b]	0.105[b]
	0.026	*0.022*	*0.024*	*0.051*	*0.048*	*0.049*
Control variables	yes	yes		yes	yes	
Adjusted R^2	0.140	0.165		0.116	0.071	
Number of investments	1450	1450		1450	1450	

Panel D: Professionals' background diversity (using the residual from specification (3) of Panel A)

Dependent variable is…	Investment's IRR			Investment's PME		
	below median	above median	difference	below median	above median	difference
Residual log SI 4 years	-0.040[c]	-0.103[a]	0.062[a]	-0.069	-0.180[a]	0.112[b]
	0.021	*0.020*	*0.021*	*0.050*	*0.047*	*0.048*
Control variables	yes	yes		yes	yes	
Adjusted R^2	0.087	0.155		0.034	0.096	
Number of investments	1578	1577		1578	1577	

[a] significant at 1%; [b] significant at 5%; [c] significant at 10%.