Asset Sorting in Private Equity*

Vladimir A. Gatchev, Vladimir I. Ivanov, Christo A. Pirinsky

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Abstract

The compensation of the general partners in a typical private equity firm is linked to the performance of the individual funds in the firm rather than its aggregate performance. We argue this compensation structure provides incentives for the general partners to arrange assets across funds in a manner that increases fees collected from investors. We refer to this practice as asset sorting and explore its prevalence in the VC industry. Using a sample of VC investments between 1980 and 2022, we find significant evidence for asset sorting in the industry. The effect is economically significant, yet notably smaller for firms with greater legal exposure. We also find that asset sorting is not related to investment performance and intensifies in cold markets.

JEL classification: G11, G24, M12

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* Gatchev is with the University of Central Florida, Orlando, FL 32816-1400, vgatchev@ucf.edu, (407) 823-3694; Ivanov is with the U.S. Securities and Exchange Commission, Washington DC, Ivanov, ivanovv@sec.gov, (202) 551-5307; Pirinsky is with the University of Central Florida, Orlando, FL 32816-1400, cpirinsky@ucf.edu, (407) 823-5962. *The U.S. Securities and Exchange Commission disclaims responsibility for any private publication or statement of any SEC employee or Commissioner. This article expresses the author's views and does not necessarily reflect those of the Commission, the Commissioners, or other members of the staff.* For helpful comments and suggestions, we thank Vikas Agarwal, Douglas Cumming, Lora Dimitrova, John Griffin, Paul Jarley, Sofia Johan, Anzhela Knyazeva, Kevin Mullally, Al Sheen, Ajai Singh, Qinghai Wang, and seminar participants at Florida Atlantic University, the US Securities and Exchange Commission, the University of Central Florida, and the Dean's Advisory Board Meeting. We remain responsible for any errors.

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1. Introduction

The compensation of the general partners (GPs) in venture capital (VC), leveraged buyouts (LBOs), and other private equity (PE) firms is usually linked to the performance of the individual segments of the enterprise rather than its aggregate performance.[1] For example, it is common for the GPs in private equity firms to receive a percentage of the profits generated by the individual funds in their portfolios above a certain predefined threshold, a practice commonly referred to as carried interest or carry (see Gompers and Lerner 1999a). Using insights from option pricing theory (Black and Scholes 1973), we argue the call option nature of fund-based carry incentivizes managing partners to sort investments into multiple funds in a manner that increases the volatility of fund performance and thus the value of the carried interest. We refer to this possibility as *asset sorting* and explore its prevalence and implications in the VC industry over the 1980-2022 period.[2]

To increase the volatility of fund performance and maximize the value of their contracts, the GPs have an incentive to group investments with highly correlated payoffs into separate funds. They may use various public and private information sources to do that. While the information set of managers is not easily observable, one could assess their propensity to engage in asset sorting *ex post* by comparing the variance of fund profits and GP compensation in the actual allocation versus a counterfactual allocation. In the counterfactual allocation, each investment is placed in another fund managed by the same VC firm that invests in companies with similar characteristics and geographic location as the company of the original investment. If VC firms strategically sort

[1] According to a recent McKinsey report, the PE industry in North America (mainly the US) raised approximately $690 billion in 2021, with the VC and buyout firms alone raising approximately $400 billion. For the same year, buyout and VC firms had approximately $2.5 trillion of assets under management. See McKinsey & Company, "Private Markets Rally to New Heights", McKinsey Global Private Markets Review 2022.

[2] We focus on VCs because they have a relatively simple equity-based capital structure. The asset-sorting incentives analyzed in this paper, however, are expected to apply to other organizations such as buyout firms.

assets into portfolios, the average volatility of fund performance and GP compensation will be higher under the realized allocations relative to the counterfactual allocations.

We present significant evidence for asset sorting. First, we find that new investments are allocated into funds in a manner that increases their performance volatility. We measure performance using investment success, where an investment is defined as successful if the underlying company goes public or is acquired in the future. Second, we assess the economic magnitude of asset sorting by simulating the carried interest collected by the VC firm under the realized and the counterfactual allocations. Based on various specifications, we estimate the economic value of asset sorting to range from around 0.4% to around 1.6% of each new investment. In further analysis, we show that asset sorting is not significantly related to investment performance and intensifies in cold markets when firm investment opportunities shrink.

One strategy for increasing fund volatility (and carried interest) would be to group good and bad investments in separate funds. While *ex ante* all investments may appear similar (after all, why would VC firms knowingly make bad investments?), *ex post* some investments perform better than others. We argue that if GPs are strategically allocating investments across funds, then they would be more likely to allocate better performing investments into better performing funds. We show this is indeed the case. Using past financing rounds as a measure of company performance, we find that better performing companies are more likely to receive additional financing from funds with better performing portfolios within the same VC firm. As predicted, these allocations increase fund performance volatility and compensation of the GPs.

Although asset sorting benefits the GPs, it might not be done with the intent to increase carried interest. If GPs are sorting opportunistically, then the activity should weaken when legal exposure strengthens. To shed some light on this possibility, we bifurcate the sample into firms

that file Form ADV with the Securities and Exchange Commission (SEC) and firms that do not. SEC-filing firms are expected to be subject to greater regulatory scrutiny than non-SEC-filing firms. The requirements for filing Form ADV with the SEC are complex. Regulations vary at the state level and exempt certain VC firms from filing with the SEC, depending on their Assets Under Management (AUM), number of clients, and other exempting factors. To account for the variations in state-level rules, we implement a difference-in-differences approach using firm fixed effects. We find that SEC-filing firms sort less compared to the control group. An examination of Form ADV filings by VC firms further reveals that these firms are well-aware of the existing conflicts of interest related to allocations of investments in multiple funds.

In sum, we find that the GPs of private equity firms arrange assets strategically across funds to increase their total compensation. The economic effect of asset sorting is likely greater than our estimates indicate. First, our tests take the number of funds managed by a given VC firm as given. If firms are sorting assets opportunistically, then the number of funds managed by a VC firm could be strategically inflated. Second, our estimates measure only the part of the cost that is borne by investors. Some of the cost could be already transferred to the GPs in the form of restrictive covenants in the LP agreement, costly dispute resolutions, and lost business. Third, the GPs could sort along multiple dimensions. For example, they could cherry pick both the investment and the strategic exit option. Such strategic behavior by GPs has been documented by Robinson and Sensoy (2013) who show that GPs strategically time distributions to LPs around the waterfall date. This timing allows GPs to earn immediate carry on the distributions and minimizes the risk that the investments might later decline in value.

The paper contributes to the literature on corporate governance by identifying a new agency cost in financial intermediaries. Robinson and Sensoy (2013) contend that the relationship

between GPs and LPs is fraught with endemic agency conflicts.[3] We identify a new potentially large conflict related to the allocation of investments across funds of the same PE firm. This cost resembles the asset substitution problem, which refers to the tendency of equity-holders to increase the risk level of their investment *ex post* (Jensen and Meckling 1976). Asset sorting concerns the allocation of investments across subsidiaries, and it may or may not affect aggregate firm investment behavior.

The analysis deepens our understanding of existing business practices in the private equity industry. This industry has grown significantly over the last few decades, now raising billions of dollars per year and managing assets worth trillions of dollars. Much of the growth has been fueled by an influx of capital from public pension plans across the globe (see, e.g., Ivashina and Lerner 2018). We argue that fund-based carry creates incentives for GPs to transfer value from LPs by arranging assets strategically across funds. Some alternative contractual arrangements, such as less convex or even linear compensation contracts, could reduce these incentives, while preserving some of the productive incentives of carried interest. The interests of the LPs could be also better protected if in some cases they are provided with more discretion over the fund allocation decisions.

The paper also adds to the literature on VC compensation arrangements. Gompers and Lerner (1999a) examine GP-LP contracts in practice and find that the carried interest arrangement exhibits significant concentration at the 20% level, with some minor variations. They also document modest differences in management fees. Metrick and Yasuda (2010a) find evidence consistent with the findings of Gompers and Lerner (1999a). They further document that about

[3] See Griffin and Kruger (2003) for a recent review of the academic work on forensic finance, including private equity.

40% of VC funds in their sample use a hurdle rate, i.e., a rate of return that must be met before the GPs can receive the carried interest. Our analysis suggests that, while higher hurdle rates reduce the expected payoff to the GPs, they may not reduce the GPs' incentives for asset sorting and the resulting wealth transfer. Litvak (2009) complements these findings by showing that the rules governing when GPs receive the carried interest also matter. She documents that VCs use a number of complex distribution rules with respect to the carried interest, which vary from investor-friendly to GP-friendly. We extend this literature by showing how current VC compensation arrangements with respect to carried interest could incentivize a particular type of wealth transfer from LPs to GPs, and by estimating the approximate magnitude of such a transfer.

Our paper contributes to the literature on executive options compensation. The original motivation for option-based compensation has been to promote productive risk-taking (Bettis et al. 2010). This could be particularly beneficial in the private equity space where many of the projects are inherently risky. Executive options, however, may lead to some unintended consequences. For example, there is evidence that options create incentives for managers to manipulate reported performance (Burns and Kedia 2008; Bennett et al., 2017). Liu, Masulis, and Stanfield (2021) find that high option compensation could hurt existing customer relationships. Using standard principal-agent arguments, some authors have even suggested that the costs of option compensation far outweigh the benefits (Dittmann and Maug 2007). Our study highlights another potential cost to convex compensation structures.

The rest of the paper is organized as follows. Section 2 defines asset sorting. Sections 3 and 4 propose two tests and present the main results. Section 5 examines the importance of legal exposure, while Section 6 presents some additional results. Section 7 concludes.

2. A definition of asset sorting

Venture capital firms are financial intermediaries between large investors (such as banks, endowments, pension funds, life insurance companies, wealthy private individuals) and private enterprises (Cumming and Johan 2013). Each VC firm is structured as a limited partnership, where the general partners (GPs) raise money from investors, or the limited partners (LPs), and invest the funds in portfolio companies on their behalf. The capital committed by LPs is attached to a particular fund and is usually provided to that fund in the first three to four years of the fund's life.

The provided capital is invested in a portfolio of startups and early-stage companies where it typically takes time, often years, until LPs start receiving money back from the fund's investments. Reneging on a capital commitment already made to a VC fund is costly for the LPs, as they may face high penalties, potential litigation, and severe reputational harm in the private equity community. Limited partner stakes are illiquid since there is practically no secondary market for them. Additionally, the contract between the LPs and GPs provides the latter with substantial discretion in terms of when, how much, and in what companies to invest the fund's capital.

The compensation of GPs usually takes the form of a fixed annual fee applied to assets under management and a percentage of the profits generated, both of which are typically contracted at the fund level. The fee charged on the percentage of the profits is known as the "carried interest" (or simply the "carry") and may be subject to a contracted hurdle rate. Examining actual contracts between GPs and LPs, Gompers and Lerner (1999a) and Metrick and Yasuda (2010a) find that the

management fee is usually around 2% of assets under management and that carried interest arrangements are concentrated at 20%, with some minor variation.[4]

We define asset sorting as the strategic allocation of assets into funds in a manner that increases the GPs' payoff from carried interest. The carry received from a given fund is effectively the payoff of a call option on the value of the fund's investment portfolio. The strike price of this option is equal to the hurdle amount GPs need to deliver before receiving the carry. Using insights from option pricing theory, we know that the value of such an option increases as the volatility of the underlying portfolio also increases (Black and Scholes 1973). Although managers could use a wide set of investment characteristics to sort, and these characteristics are generally not observed by the econometrician, sorting should ultimately increase the volatility of performance across funds.

In the next two sections, we propose two empirical tests for asset sorting. The first test is agnostic with respect to the exact information GPs use to allocate investments into funds. Such information could include, for example, knowledge about the likelihood of success of each investment or knowledge about the underlying correlation structure among different investments. The second test examines sorting based on the realized performance of portfolio companies.

3. A general test of asset sorting

3.1. Hypothesis development

To develop the first testable hypothesis, we use the insight from the previous section that sorting should increase the volatility of performance across funds. We focus on investment rounds

[4] In addition to fee structure, contracts often include various covenants, such as clawback provisions, that aim at restricting the GPs' ability to expropriate the LPs (Metrick and Yasuda 2010a).

by VC firms. For each new investment, we identify all funds by the VC firm that are open at the time of the investment and that invest in the same industry and geographic location. We then estimate the variance of average fund performance using all funds by the same VC firm under two scenarios. In the first scenario, the new investment is placed in the actual fund making the new investment. We label this the *realized* scenario. Assessing the presence of asset sorting requires a benchmark, or a counterfactual. In the second scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We label this the *counterfactual* scenario.

To formalize our approach, for VC firm j making investment i at time t, let V_{jit}^{RL} be the realized variance of fund performance. To calculate V_{jit}^{RL}, suppose the VC firm manages K funds, where the realized performance of each fund k ($k = 1,\ldots,K$) is equal to X_{jitk}^{RL}. As noted above, X_{jitk}^{RL} is the weighted-average performance of all investments in fund k up to and including investment i. We then calculate V_{jit}^{RL} as:

$$V_{jit}^{RL} = \frac{1}{K}\sum_{k=1}^{K}\left(X_{jitk}^{RL} - \mu_{jit}^{RL}\right)^2, \tag{1}$$

where $\mu_{jit}^{RL} = \frac{1}{K}\sum_{k=1}^{K} X_{jitk}^{RL}$, or the average performance across all funds by firm j at the time of the new investment. We assume that average fund performance μ_{jit}^{RL} is not affected by where the new investment is allocated. As a result, V_{jit}^{RL} is an estimate of the variance of fund performance for the average fund managed by VC firm j. We calculate the counterfactual variance of performance for the average fund in a similar manner and label it V_{jit}^{CF}. We measure asset sorting

at the level of VC firm j, investment i, time t as the difference between the realized and counterfactual variances, so that:

$$ASORT_{jit} = V_{jit}^{RL} - V_{jit}^{CF}. \quad (2)$$

If VC firms make new investments without consideration of asset sorting, we expect the estimated variances to be equal under the two scenarios (i.e., $ASORT_{jit} = 0$, on average). In contrast, if VC firms strategically sort assets into portfolios to increase the variability of fund performance, we expect the estimated variance to be higher under the realized scenario relative to the counterfactual scenario (i.e., $ASORT_{jit} > 0$, on average). Thus, we propose the following testable hypothesis:

> ***Hypothesis 1 (A general test of asset sorting).*** *If VC firms allocate new investments strategically across funds in a manner that increases their carried interest, the allocation will increase the variance of fund performance.*

3.2. Data and summary statistics

Our sample is obtained from the Thomson Reuters's VentureXpert database and contains VC investments in U.S. companies during the period of 1980-2022. VentureXpert is one of the two main VC data sources available to researchers; the other is Dow Jones' VentureSource. Both databases have been validated by previous researchers against known financing rounds (see e.g., Kaplan, Strömberg, and Sensoy 2002). VentureXpert began compiling data in 1977 and is more comprehensive than VentureSource in earlier years. The VentureXpert database contains detailed information about the dates of venture financing rounds, the investors, and portfolio companies

involved, the estimated amounts invested by each fund, and the ultimate portfolio company outcome. The reinterpretation of the Employee Retirement Income Security Act (ERISA) "prudent man" standard in 1979 is widely believed to mark the beginning of the modern VC market (Gompers and Lerner 1999b, Hellmann, Lindsey, and Puri 2008). We therefore start our sample from January 1, 1980.

We use VentureXpert to identify each VC fund making the investment. We exclude funds where VentureXpert indicates that the VC fund is "unspecified" in the name of the fund and funds where the time between the first and last investments is more than 12 years. Our starting sample contains 78,061 investments by VC firms between 1980 and 2022. We use this sample to determine the date of each fund's first and last investments.

In Figure 1, we plot the number of investments conditional on when the investment is made relative to each fund's first investment. As the figure shows, the majority of investments are made within the first several years after a fund opens. For example, 69,514 investments (or 89.1% of all investments) are made within five years while 75,237 investments (or 96.4% of all investments) are made within seven years of each fund's first investment.

[Insert Figure 1 about here]

Table 1 presents the annual number of investments, total invested amounts, number of VC funds, number of VC firms, and number of portfolio companies.[5] Examining the table, we note the rapid expansion of the industry since the 1979 ERISA regulatory change. The table also illustrates the well-documented fluctuations due to "hot" and "cold" markets that characterize the VC industry. In our sample, there are 1,815 investments in the average year with annual invested

[5] To adjust for inflation, all dollar amounts are expressed in 2024 U.S. dollars using the GDP implicit price deflator from the Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/GDPDEF).

amount at $33.97 billion in 2024 US dollars. Furthermore, our sample contains 339 VC firms and 480 funds investing in 1,072 companies per year, on average.

[Insert Table 1 around here]

An important aspect of our analysis is the presence of VC firms that manage multiple funds at the same time. To examine the importance of multiple-fund VC firms, in Figure 2 we plot by year the number of investments and dollar amounts invested by single-fund and multi-fund VC firms. A VC firm is classified as single-fund if no other fund is open at the time of the investment and as multi-fund if at least one other fund is open at the time of the investment. We consider a fund to be open from the date of its first investment to the date of its last investment based on our data. In our sample of 78,061 investment, 32,567 investments are made by single-fund VC firms and 45,494 investments are made by multi-fund VC firms. The importance of multi-fund VC firms is evident throughout the entire sample period and is consistent with prior studies (e.g., Metrick and Yasuda 2010b).

Most VC firms tend to have several funds operating in any given year so that multi-fund firms are common in the VC industry. They account for a large fraction of the number of investments and dollar amount invested in the VC industry. In addition, the market share of multi-fund VC firms tends to increase in hot periods and decrease in cold periods, which suggests that, when demand by investors is high, it is relatively easier for an established VC firm to start a new fund than for a new VC firm to enter the market.

[Insert Figure 2 around here]

We focus our analysis on VC firms that manage at least two funds at the same time, which allows us to examine the presence of asset sorting. For our final sample, we keep only new investments where the VC firm has at least one other fund that is open at the time of the investment.

To further ensure that other contemporaneous funds invest in similar companies, we keep only funds that invests in companies in the same geographic region and the same industry as the new investment. We define geographic regions using the ten Standard Federal Regions in the U.S. established by the Office of Management and Budget (OMB) and industries at the Minor Industry Group level based on the industry classifications provided by VentureExpert. Appendix A provides the list of geographic regions and industries in our sample. We further require each fund to have at least one prior investment. As we explain in the following section, this condition is necessary for us to measure the counterfactual variance of performance for the average fund in a given VC firm as well as the quality of investments in each fund. The resulting sample contains 37,689 investments over the 1980-2022 period.

We measure investment success using data on whether the company experiences an IPO or an acquisition in the future. Fund performance at the time of the new investment is then calculated as the value-weighted average success of all investments up to and including the new investment. An investment is classified as successful (success=1) if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful (success=0). As noted above, for the *realized* and *counterfactual* scenarios, we calculate the variance of fund performance across all funds within the same VC firm. To allow companies some time to mature, we restrict the sample in this section to 33,636 investments between 1980 and 2017.

Table 2, Panel A, presents summary statistics for the resulting sample. When making a new investment, the average VC firm in our sample has already 1.6 other contemporaneous funds. The average fund making the new investment holds 16.5 companies in its portfolio at the time of the investment. Other contemporaneous funds hold a similar number of companies, at 16.7, on average. The average investment is around $17.1 million in 2024 USD, and around 41.0% of all

investments result in an IPO or an acquisition, which in our subsequent analysis use as a measure of success.

[Insert Table 2 around here]

We use Form ADV filings to determine whether the VC firm files with the Securities and Exchange Commission (SEC). To construct this variable, we first search for CRD numbers for each of the VC firms in our sample (https://adviserinfo.sec.gov/). We then use the matched CRD numbers to compare them against a list of all Form ADV filers to the SEC, where filings data are from January 2000 to December 2023. A VC firm is classified as a filer at the time of the new investment if the firm files Form ADV with the SEC in the year before and year after the investment. Otherwise, the firm is classified as a non-SEC-filer at the time of the investment. VC firms are classified as filers for around 9.0% of all investments.

For some of our subsequent analysis, we examine how asset sorting depends on VC firm activity prior to each investment. To measure VC firm activity, we use each VC firm's number of investments over the prior one year. VC firms have made around 17.2 investments over the prior one year, on average.

3.3. Empirical findings

The test of Hypothesis 1 is presented in Table 3. We find that the estimated variance of performance equals 222.4 basis points under the realized scenario. The variance drops to 215.9 basis points under the counterfactual scenario. The difference of 6.5 basis points is highly statistically significant (at the 0.001 level) and indicates that, under the realized scenario, the variance of fund performance is around 3.0% higher than under the counterfactual scenario (6.5/215.9).

[Insert Table 3 around here]

A potential limitation of the above analysis is that our measure of company success is based on each company's exit outcome: IPO, acquisition, or neither. Most standard VC databases do not disclose the pre- and post-money valuation of the portfolio companies after each round. The only information available is the investment amount in each round and the VCs participating in each round. While these limitations may introduce noise in our, we do not expect them to bias our findings.

3.4. The effect of asset sorting on the carry

In this section, we provide estimates of the effect of asset sorting on the carry received by the general partners. As discussed above, most standard VC databases do not disclose the pre- and post-money valuation of the portfolio companies after each round. In addition, the data does not provide information on management fees, carried interest, and investor hurdle rates at the fund level. The only information available is the investment amount in each round, the exit outcome of each portfolio company (IPO, acquisition, or neither), and the VCs participating in each round. To estimate the effect of asset sorting on the carry, we first define fund k 's value net of management fees and investor hurdle rates as follows:

$$Z_{jkt} = \sum_{i=1}^{I} \left[a_{ijkt} x_{ijkt} M - a_{ijkt} \left(1 - \left(1 - \gamma \right)^{T} + \left(1 + r \right)^{T} \right) \right]. \tag{3}$$

In the above equation, Z_{jkt} is the time t value of VC fund k managed by VC firm j, where this value is net of management fees γ and investor hurdle rate r. We let a_{ijkt} equal the investment amount in company i by fund k and VC firm j up to and including time t. We further let x_{ijkt} be an indicator variable equal to 1 if the company has a successful exit and 0

otherwise. A company is classified as successful if it goes public or is acquired in the future; otherwise, the company is classified as unsuccessful. We assume successful companies increase the initial investment by a multiple of M, $M > 0$, whereas unsuccessful companies result in a total loss of the initial investment. The parameter T measures the time to exit from an investment in years.

To measure the amount attributable to carried interest for each VC firm at time t, we use the following equation:

$$Y_{jt} = \theta \sum_{k=1}^{K} \max\left[Z_{jkt}, 0\right]. \tag{4}$$

In this equation, θ is the carried interest, which we assume is equal across all funds. For the rest of the analysis, we assume that $\gamma = 2\%$ and that $T = 5$ years. As baseline assumptions, we further let $M = 5$, $r = 8\%$, and $\theta = 20\%$.[6] We then evaluate the effect of asset sorting on the carry under several different assumptions for M, r, and θ.

For each new investment by a VC firm, we identify all funds of the VC firm that are open at the time of the investment. We consider a fund to be open from the date of its first investment to the date of its last investment in our data. We then estimate a hypothetical carried interest the VC firm would collect from all open funds under the two scenarios discussed in the previous section. In the realized scenario, the new investment is placed in the actual fund making the investment; we label the estimated carried interest as Y_{jt}^{RL}. In the counterfactual scenario, the new investment is placed in another open fund of the same VC firm; we label the estimated carried

[6] We calibrate the baseline assumptions to obtain an annual limited partner return close to the 14% size-weighted median return of VC funds reported in Table 2 of Kaplan and Schoar (2005).

interest as Y_{jt}^{CF}. If the VC firm has several other open funds, we sequentially place the new investment in each of these funds and average the estimated carry across all such cases.

To estimate the effect of asset sorting on the carry for VC firm j making an investment at time t, we use the difference in the VC firm's carried interest between the two scenarios:

$$\Delta CARRY_{jt} = Y_{jt}^{RL} - Y_{jt}^{CF}. \quad (5)$$

For ease of interpretation, we express this effect as a percent of the amount of the new investment. Because assets under management (AUM) of a given fund are a cumulative of all investments by that fund, the estimated percentage effect of asset sorting on the carry can be interpreted as a percent of total AUM.

In Table 4, we provide estimates of the effect of asset sorting on the carry under a range of assumptions about the multiple of successful investments (M), the hurdle rate of limited partners (r), and the carried interest of general partners (θ). We find that the effect of asset sorting on the carry is positive and statistically significant (at the 0.01 level) under the full range of assumptions. For instance, at the baseline assumptions of $M = 5$, $r = 8\%$, and $\theta = 20\%$, the asset sorting increases the carry by around 1.05% of AUM. Reducing the multiple to three or increasing it to seven leads to estimates that range from around 0.86% to 1.09% of AUM.

[Insert Table 4 around here]

Higher hurdle rates and carried interest tend to increase the effect of asset sorting on the carry. For instance, at $M = 5$, the highest incremental carry occurs when the hurdle rate is 15% and when the carried interest is 25%, in which case asset sorting increases the carry by 1.60% of AUM.

The overall findings presented in this section indicate that the general partners in VC funds experience a significant increase in the carry due to asset sorting. This increase in the carry is statistically and economically significant under several assumptions of the carry percentage, hurdle rates, and investment performance.

4. A performance-based test of asset sorting

4.1. Hypothesis development

To develop the second testable hypothesis, we consider cases in which there is available information about the performance of existing investments and the performance of the new investment. We again use insights from option pricing theory, which shows that the value of a call option increases with the value of the underlying asset at an increasing rate. As a result, the VC firm has an incentive to place well-performing investments in well-performing funds, all else equal.[7]

In effect, by separating well-performing investments from other investments, the GPs increase the expected carry by reducing the probability that losses in some of the investments may offset profits in the other investments. A portfolio of well-performing investments is already likely to generate carried interest so that placing a well-performing investment in that portfolio will further increase the amount from the carry. In contrast, a portfolio of poorly-performing

[7] Mathematically, let $C\left(v_P\right)$ be the value of the carry, where v_P is the value of the underlying portfolio. Let $v_P = wv_E + \left(1-w\right)v_N$, where v_E is the value of the existing investments, v_N is the value of the new investment, and w is the weight of the existing investments $\left(0 \le w \le 1\right)$. Based on option pricing theory, we know that $\partial^2 C \big/ \partial v_P^2 > 0$. As a result $\partial^2 C \big/ \partial v_E \partial v_N = w\left(1-w\right)\partial^2 C \big/ \partial v_P^2 > 0$, all else equal.

investments has a high probability of an overall loss. Placing a well-performing investment in such a portfolio would mean that at least some of the profits from the new investment would be used to offset losses in the rest of the portfolio, thus reducing the expected carry. Based on these ideas, we propose the following hypothesis:

> ***Hypothesis 2 (A performance-based test of asset sorting).*** *If VC firms allocate new investments strategically across funds in a manner that increases their carried interest, new investment rounds in a company that is performing well are likely to be allocated to funds that are also performing well.*

Hypothesis 2 is a joint hypothesis. Lack of empirical evidence to support this hypothesis may mean that VC firms do not actively sort investments in a manner that increases the carried interest. However, lack of evidence may also mean that VC firms actively sort investments in a manner that increases the carried interest but that such sorting is not based on observed performance.

4.2. Data and summary statistics

To test Hypothesis 2, we focus on new investments for which at least one open fund of the VC firm has a prior investment in the company (an invested fund) and at least one open fund does not have a prior investment in the company (a non-invested fund). The resulting sample contains 30,374 investments with data for both the invested and the non-invested funds. We then examine the VC firm's choice to place the new investment in a non-invested fund rather than in an invested fund (fund switching).

We construct measures of performance both for the company receiving the new round and each fund (invested or non-invested). To measure company performance, we use the total number of investment rounds in the company by any VC firm prior to the date of the new investment. Multiple investment rounds in a company indicates that VC firms believe the company is performing well and is likely to have a successful outcome, such as an IPO or an acquisition.[8] We measure fund performance as the number of prior rounds in the average company in the fund's portfolio at the time of the new investment.

In addition to the variables measuring investment and fund performance, we also construct variables that measure the time since the invested fund has last invested in the same company and the number of prior rounds in this company by the fund. We also measure the age of the invested and non-invested funds and the number of companies in these funds.

Summary statistics for this sample are presented in Table 2, Panel B. Around 10.0% of all investments are placed in a non-invested fund rather than in an invested fund, which indicates that VC firms are relatively unlikely to switch funds when investing in the same company. The invested fund has provided 2.0 rounds of financing the same company and the last round is around 1.3 years prior to the current investment. Invested funds have around 20.8 companies in their portfolio, on average, and are 4.0 years old since their first investment. Non-invested funds have around 15.8 companies in their portfolio, on average, and are 4.2 years old. The company receiving the new investment has received around 3.5 prior financing rounds, on average. The average performance of invested and non-invested funds, as measured by the average number of prior rounds of their portfolio companies, is similar at 3.6 and 3.7 rounds.

[8] Using our sample, we verify that companies with more rounds of financing are more likely to experience a favorable outcome, i.e., an IPO or an acquisition.

4.3. Empirical findings

For the first test of Hypothesis 2, we examine how multi-fund VC firms select which fund will undertake a given investment. To that end, we estimate linear regression models in which the dependent variable equals 1 if the new investment is undertaken by a non-invested fund and 0 if the investment is undertaken by an invested fund (i.e, a fund switch).[9] As an explanatory variable of main interest, we use an interaction term between the performance of the non-invested fund and the performance of the new investment. The regression models also control for the standalone variables measuring company and non-invested fund performance as well as the time since the invested fund has last invested in the same company, the number of prior rounds in the company by the invested fund, and the age and the number of companies in both the invested and the non-invested funds.

The estimates from these regressions are reported in Table 5. In support of Hypothesis 2, we find that the interaction term between the performance of the non-invested fund and the performance of the new investment is positive in both models. In model 1, the estimate is 0.45 and is significant at the 0.01 level. In model 2, where we also control for interaction effects between company performance and the rest of the explanatory variables, the estimate is again 0.45 and is again significant at the 0.01 level. These estimates suggest that a fund switch is more likely if both the investment and the non-invested fund are performing well.

[Insert Table 6 around here]

Examining the rest of the explanatory variables, we find that the likelihood that an investment is placed in a non-invested fund decreases with the performance of the invested fund,

[9] We find similar results if we use logistic regressions.

the number of rounds in the company by the invested fund, the number of companies in the invested fund, and the age of the non-invested fund. This likelihood increases with the time since the last round by the invested fund in the company, the number of companies in the non-invested fund and the age of the invested fund.

4.4. The effect of performance-based asset sorting on the carry

Below, we provide estimates of the effect on the carry received by GPs due to sorting investments in well-performing companies into well-performing funds. To do that, we replicate our analysis from Section 3.3 while focusing on a subsample of investments where both the company obtaining the new investment and the fund investing in the company have above-median performance. The sample now contains 10,151 investments where the number of rounds in the company is greater than 2.0 (the median for this sample) and the average number of rounds in companies held by the investing fund is greater than 2.9 (the median).

As in Section 3.3, estimates of the effect of asset sorting on the carry are obtained under different assumptions about the multiple of successful investments (M), the hurdle rate (r), and the carried interest (θ). The estimates are presented in Table 7.

[Insert Table 7 around here]

We find that sorting well-performing investments into well-performing funds significantly increases the carry under the full range of assumptions. For instance, at the baseline assumptions of $M = 5$, $r = 8\%$, and $\theta = 20\%$, the effect of asset sorting on the carry is around 1.30% of AUM (significant at the 0.01 level). Reducing the multiple to three or increasing it to seven leads to estimates that range from around 0.82% to 1.29% of AUM, where both estimates are significant at the 0.01 level. As in our prior analysis, higher hurdle rates and carried interest tend to increase

the effect of asset sorting on the carry. For instance, at $M = 5$, the highest estimate occurs when the hurdle rate is 15% and when the carried interest is 25%, in which case the effect of asset sorting on the carry is 1.70% of AUM (significant at the 0.01 level).

The overall findings presented in this section provide further support to the idea that sorting based on performance leads to an increase in the carry received by the general partners of VC firms. This increase in the carry is statistically and economically significant under several assumptions of the carry percentage, hurdle rates, and investment performance.

5. Asset sorting and legal exposure

Our findings up to this point provide strong evidence that asset sorting benefits the GPs. However, it is possible that GPs do not deliberately arrange investments across funds with the intent to increase carried interest. While it is generally difficult to prove intent, if asset sorting is opportunistic, then it should be less pronounced for firms with greater legal exposure. To generate variation in legal exposure, we use VC firms' filing status with the SEC, where some firms file Form ADV with the SEC while others do not. SEC filers are subject to greater regulatory scrutiny by the Division of Examinations of the Commission.[10]

The requirements for SEC filing of Form ADV vary greatly across states. For example, certain states, such as Florida, Georgia, and Illinois, provide exemptions if a firm has fewer than a given number of clients (15, 6, and 5 respectively, within our sample period). Other states may trigger such exemptions for smaller firms (e.g., California and New York). To control for the wide differences in state-level rules, we implement a difference-in-differences approach using firm fixed effects.

[10] See, for example, https://www.sec.gov/about/divisions-offices/division-examinations.

We present several regression models that examine how legal exposure affects asset sorting. As a dependent variable, we use our general measure of asset sorting. To measure the level of legal exposure, we use SEC filing status of the VC firm around each new investment. Specifically, SEC filing status is equal to 1 if the VC firm files Form ADV in the year before and the year after the investment and is equal to 0 otherwise. As mentioned above, all models include VC firm fixed effects, which allows us to obtain a difference-in-differences estimate for the SEC filing variable. The estimates from these regressions are presented in Table 7.

[Insert Table 7 around here]

We find that the estimated coefficient on the SEC filing variable is negative in all models. The coefficient is significant at the 0.05 level in model 1 and at the 0.01 level in models 2 and 3. When we examine the estimate in model 3, for example, we find that our sorting measure is lower by 11.17 basis points for SEC-filing VC firms relative to non-SEC-filing VC firms. The overall findings presented in this section are consistent with the idea that VC firms facing greater legal exposure are less likely to sort assets in a manner that increases the carry.

At the end, we note that VC firms that file Part 2 of Form ADV usually discuss potential conflicts of interest that may arise from the nature of the carry and from the simultaneous management of multiple investment vehicles. Such discussions occur under item 6 (Performance-Based Fees and Side-By-Side Management). Moreover, such discussions are usually accompanied by written commitment by the VC firm to resolve such conflicts in a fair manner. As an illustration, Appendix B provides excerpts from several filings.

6. Additional results

6.1. Asset sorting and investment performance

Asset sorting may not be a zero-sum game if it increases the aggregate value of portfolio companies. If fund-based carry creates stronger incentives for the GPs to monitor the companies in their portfolios, fund-based compensation could create value for investors net of the wealth transfer to the GPs. There is evidence that specialization improves the performance of private equity firms (Gompers, Kovner, and Lerner 2009; Spaenjers and Steiner 2021; Brown, Fei, and Robinson 2023). If asset sorting increases specialization, then the benefits of specialization could offset the costs of asset sorting.

A closer examination of the above possibility, however, suggests that the potential benefits of asset sorting are unlikely to offset completely the associated costs for investors. First, rent-seeking activity is likely to crowd out productive effort (Murphy, Shleifer, and Vishny 1993). If the GPs can transfer wealth from the LPs without costly monitoring, they would always choose to do so. Second, even if investments are placed in multiple funds, the GPs' overall portfolio remains diversified across a large and diverse pool of companies. Lopez-de-Silanes, Phalippou, and Gottschalg (2015) present evidence for diseconomies of scale in the PE industry. Mechanically grouping investments across different funds, while directly impacting the GPs' compensation, need not improve their ability to monitor the underlying companies.[11]

To examine the question of whether asset sorting improves the performance of investments, we estimate regression models in which the dependent variable is the future performance of each

[11] Prior studies have shown that the level of monitoring that GPs provide depends on company characteristics, the degree of moral hazard and agency problems between VCs and entrepreneurs, and the ease of access to a company (Gompers 1995; Bernstein, Giroud, and Townsend 2016). The structuring of investments across funds is unlikely to affect these characteristics, or the outlook of a particular portfolio company.

new investment. The explanatory variable of main interest is our measure of asset sorting averaged at the level of the VC firm over the prior one year.[12] The estimates are presented in Table 8.

[Insert Table 8 around here]

We find that asset sorting is not significantly related to investment performance in any of the three specifications. For example, the estimated coefficient on the asset sorting variable in model 1 is equal to 30.96 with a *t*-statistic of 0.51. We find similarly insignificant relations between asset sorting and investment performance in the rest of the models. In model 3, for example, we control for VC firm fixed effects, which should capture potential reputation effects on company performance (Sørensen 2007; Nahata 2008). We again find an insignificant relation between asset sorting and investment success. Examining the rest of the explanatory variables, the findings show that investments of larger funds are more likely to experience a favorable outcome, such as an IPO or an acquisition. Overall, the findings presented in this section do not provide evidence that asset sorting improves investment performance.

6.2. Asset sorting in hot vs. cold markets

In this section, we examine how asset sorting depends on the conditions of the private equity market. To that end, we estimate regression models in which the dependent variable is our measure of asset sorting: the difference between the realized and counterfactual variances of fund performance. To measure recent market activity of each VC firm, we use the number of investments by the VC firm over the prior one year. The findings are presented in Table 9.

[Insert Table 9 around here]

[12] We find similar results using data over the prior three year or the prior five years.

We find that asset sorting is less pronounced when VC firms are experiencing active periods. For instance, examining the estimate in Table 9, model 2, we find that the coefficient on the number of investments by the VC firm over the prior one year is negative and significant at the 0.05 level. Interpreting the estimate of -0.13, a one standard deviation increase in the number of investments by the VC firm over the prior one year leads to a reduction in the measure of asset sorting by around 1.96 (-0.13×15.09) basis points. When compared to the average excess variance of fund performance of 6.59 basis points, this effect amounts to an increase of around 30%.

Overall, the results presented in this section show that asset sorting is less pronounced in periods when VC firms experience higher investment activity than in periods when VC firms experience lower investment activity. One possible interpretation of the findings is that VC firms resort to asset sorting in cold markets because their incentives to do so are relatively higher in such markets due to the lower expected payoffs from managing their portfolios.

7. Conclusion

The compensation of the general partners in many private equity firms is linked to the performance of the individual funds in their portfolio rather than the aggregate performance of the firm. We argue that this compensation structure, together with the practice of managing multiple simultaneous funds, provides incentives for the general partners to arrange assets across funds in a manner that maximizes the value of their call option-like contracts. Indeed, our empirical analysis finds that new investments are sorted into funds in a way that increases the variability of performance across funds by the same VC firm, which in turn increases the expected carry of the GPs. Our estimates suggest that asset sorting leads to a substantial increase in the carry, by around one percent of invested amounts.

We argue that the observed asset sorting constitutes an agency cost that leads to a wealth transfer from the limited partners to the general partners. First, finance theory suggests that market participants should not seek compensation for idiosyncratic risk, especially when this risk could be diversified away. By contracting at the level of individual funds, GPs effectively diversifying some of the fund-specific risk by managing multiple funds. Second, asset sorting does not appear to improve investment performance. Third, asset sorting is less (more) pronounced when the GPs face higher (lower) legal exposure. Fourth, conversations with industry professionals confirm that funds are created "pro forma" and that all profits are distributed "upstairs."

Who bears the agency cost of asset sorting? If investors fully understand and internalize the agency costs of asset sorting, then they will demand compensation for it. If investors do not fully internalize the agency costs, then they will bear part of the cost. Our analysis and anecdotal evidence suggest that asset sorting is not well understood and/or internalized by the LPs. The inherent complexity of the private equity industry works against LPs' recognizing asset sorting. Moreover, the governance of some LPs may be poor, which could result in lack of attention to asset sorting. For example, Atanasov et al. (2019) show that public pension funds, a key LP in the private equity industry, are three times more likely to invest in new funds of VCs that have suffered reputational damage than other LPs. As another example, Jackson, Ling, and Naranjo (2023) provide evidence that agency frictions within pension fund LPs influence GPs of private equity commercial real estate funds to artificially boost and smooth interim reported returns.

Agency problems are often complex and difficult to solve (Jensen and Meckling 1976). A possible solution to the asset sorting problem, especially when the private equity firm is managing multiple portfolios, could be to compensate the GPs with a less convex or even linear contract, such as equity in the underlying fund. Another possible solution could be to assign carried interest

to the aggregate portfolio of the PE firm. Individual funds could still exist and be marketed to investors. The second arrangement resembles the corporate business model.

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Appendix A

This appendix provides the list of geographic regions (Table A.1) and industries (Table A.2) for the sample of VC 78,061 investments between 1980 and 2022. We define geographic regions using the ten Standard Federal Regions in the U.S. established by the Office of Management and Budget (OMB). We define industries at the Minor Industry Group level based on the industry classifications provided by VentureExpert.

Panel A.1: Regions

Region	States	Obs.
I	CT, ME, MA, NH, RI, VT	10,481
II	NY, NJ, PR, VI	6,052
III	DE, DC, MD, PA, VA, WV	5,318
IV	AL, FL, GA, KY, MS, NC, SC, TN	5,449
V	IL, IN, MN, MI, OH, WI	5,173
VI	AR, LA, NM, OK, TX	4,684
VII	IA, KS, MO, NE	702
VIII	CO, MT, ND, SD, UT, WY	3,269
IX	AZ, CA, HI, NV, GU, AS	33,609
X	AK, ID, OR, WA	3,324

Table A.2: Industries

Industry class	Major group	Minor group	Obs.
Information Technology	Communications and Media	Communications and Media	6,772
Information Technology	Communications and Media	Internet Specific	2,831
Information Technology	Computer Related	Computer Hardware	4,520
Information Technology	Computer Related	Computer Software and Services	21,539
Information Technology	Computer Related	Internet Specific	11,103
Information Technology	Semiconductors/Other Electronics	Semiconductors/Other Electronics	5,268
Medical/Health/Life Sci.	Biotechnology	Biotechnology	7,406
Medical/Health/Life Sci.	Medical/Health/Life Sciences	Medical/Health	10,217
Non-High Technology	Non-High Technology	Consumer Related	2,661
Non-High Technology	Non-High Technology	Industrial/Energy	2,817
Non-High Technology	Non-High Technology	Other Products	2,927

Appendix B

This appendix provides excerpts from Form ADV, Part 2A, for some VC firms discussing the conflict of interest these firms face when allocating investments across funds, specifically with respect to carried interest and increased risk. Such discussions typically occur in *Item 6. Performance-Based Fees and Side-by-Side Management*.

Example 1. Carlyle Investment Management LLC (CRD# 111128, filed on March 30, 2015)
In allocating investment opportunities, there could be incentives to favor Advisory Clients with higher potential performance fees or carried interest allocations over Advisory Clients with lower potential performance fees or carried interest allocations. [Footnote 4: For example, if one Advisory Client is in a net loss position and another Advisory Client is in a net gain position, the Advisory Client in the net loss position will either (i) not generate a carried interest from such investment, or (ii) generate less carried interest from such investment to the extent profits are required to make up for previous losses.] Additionally, as described in Item 8, carried interest allocations may create an incentive for the general partner (or similar managing fiduciary) of a Carlyle-sponsored investment vehicle advised by CIM to make riskier or more speculative investments on behalf of such investment vehicle than would be the case in the absence of this arrangement.

Example 2. WCAS Management Corporation (CRD# 155695, filed on March 30, 2015)
Each equity and subordinated debt partnership allocates to its general partner a carried interest of up to 20%. The carried interest may create an incentive for the general partner of the partnership to make more speculative investments and make different decisions regarding the timing and manner of the realization of such investments than would be made if such carried interest were not allocated to the general partner. WCAS addresses these conflicts of interest through careful review of investment opportunities by its investment professionals' full disclosure of investments to limited partners as well as investments by its general partners' employees and consultants alongside the partnerships in an effort to properly align the interests of such persons with the partnerships.

Example 3. Trilantic Capital Management LP (CRD# 152331, filed on March 30, 2015)
The funds are generally subject to a carried interest of up to 20% of profits on distributions derived from the disposition of investments. Such carried interest is generally distributed by the funds to the general partners of the funds which are related persons of TCM. Certain other clients may also be subject to a carried interest. The foregoing performance-based carried interests are generally subject to the achievement of an annual rate of return on certain amounts of unreturned capital contributions of investors (subject to certain adjustments in accordance with each client's governing documents). TCM and its related persons in their sole discretion may waive reduce or calculate differently the carried interest for certain investors of a client. Although carried interest may align TCM's and its affiliates interests with those of the clients, carried interest may also create an incentive for TCM to recommend and the general partner or managing member of each respective client to make more speculative investments and/or different decisions regarding the timing and manner of the realization of such investments than would be made if such carried interest were not allocated to the general partner. TCM seeks to address these conflicts through (i) careful review of investment opportunities by a screening committee and an investment committee, (ii) disclosure of investments to limited partners by way of written notices and quarterly reports and (iii) equity investments by a number of TCM's investment professionals directly or indirectly (through the general partners or parallel partnerships) in clients.

Example 4. Bain Capital Partners LLC (CRD# 145653, filed on March 31, 2015)
A portion of each Bain Capital Partners fund's net investment profit is allocated to the capital account of its general partner as carried interest. Each general partner of a Bain Capital Partners fund is a related person of Bain Capital Partners. Carried interest may differ from one Bain Capital Partners fund to another as well as among investors in the same Bain Capital Partners fund. The payment by Bain Capital Partners funds of carried interest at varying rates (including varying effective rates based on the past performance of a Bain Capital Partners fund) may create an incentive for Bain Capital Partners to disproportionately allocate time services or functions to Bain Capital Partners funds paying carried interest at a higher rate or allocate investment opportunities to such Bain Capital Partners

funds. Generally, and except as may be otherwise set forth in the partnership agreements of the Bain Capital Partners funds, this conflict is mitigated by (i) certain limitations on the ability of Bain Capital Partners to establish new investment funds, (ii) contractual provisions requiring certain Bain Capital Partners funds to purchase and sell investments contemporaneously and/or (iii) contractual provisions and procedures setting forth investment allocation requirements.

Example 5. Insight Venture Management LLC (CRD# 142994, filed on May 7, 2021)
The existence of the carried interest may create an incentive for a general partner to allocate attractive investments to a fund that charges a higher level of carried interest than another fund. Carried interest may also create an incentive for a general partner to make more speculative investments on behalf of a fund that it would otherwise make in the absence of such performance-based compensation. The allocation methodology between funds and their co-investment funds can generally be changed with the consents of the advisory committees of the relevant funds. Insight has established procedures to address potential conflicts in the allocation of investments among funds and between a fund and its co-investment fund and to comply with the requirements of the applicable fund limited partnership agreements.

Example 6. Stone Point Capital LLC (CRD# 156521, filed on May 13, 2022)
The carried interest creates an incentive for the firm to invest a client's capital more speculatively than would otherwise be prudent in an effort to generate higher performance-based compensation. However, this incentive is mitigated in part by the substantial financial commitment that the firm's personnel make to the affiliated funds. Additionally, the firm generally considers performance-based compensation to better align its interests with those of its investors. Additionally, the firm recognizes that some of the clients have different terms in respect of the amount or timing of fees and performance allocations, including related to waterfall conditions and other terms and that, accordingly, actual or perceived conflicts of interest will arise in allocating opportunities to between or among the clients and/or other vehicles managed advised or controlled by or otherwise related to the firm. The firm further recognizes its fiduciary duty to act in the best interests of the clients and exercises due care to ensure that investment opportunities are allocated fairly and in accordance with the terms of the applicable governing agreements, including a consideration of the investment objectives and parameters of such clients. The governing agreements typically address such matters in detail including to what extent opportunities must be allocated to a particular client, whether co-investment is permissible and whether and on what terms the firm or any of its affiliates' other investment vehicles may participate in those opportunities. Subject to compliance with those terms, and the terms of the governing agreements dealing with potential conflicts that must be reported to the relevant board of advisors or that require its consent or those of the fund investors or the client investment decisions including, allocations are made in the reasonable discretion of the firm.

Example 7. Frontenac Company LLC (CRD# 156096, filed on March 20, 2023)
The payment by the funds of carried interest can create an incentive for Frontenac to disproportionately allocate time services or functions to funds paying carried interest or allocate investment opportunities to such funds or to allocate an investment to a fund that earns a higher carried interest, if applicable. However, Frontenac believes this incentive is sufficiently mitigated due to the fact that: (i) all Frontenac funds pay carried interest, (ii) Frontenac's track record is crucial to the success of its fundraising efforts so that Frontenac is incented to do well on all deals regardless of whether the deals pay carried interest, (iii) Frontenac makes sure that its deal teams are appropriately staffed so that its people have proper time to spend on each deal and do not need to make difficult time allocation decisions, (iv) the applicable governing documents create limitations on the ability of Frontenac to establish new investment funds, (v) the funds are subject to certain contractual provisions requiring certain parallel funds to purchase and sell investments contemporaneously if they share an investment through a contemporaneous initial investment, (vi) any losses a fund sustains will reduce the general partners carried interest distribution, (vii) carried interest only has value after investors have received as distribution 100% of their capital contributions plus a preferred return related to realized investments and to fund partnership expenses paid to date including management fees, and is limited to the extent that the remaining (unrealized) investments do not pass a fair value test as prescribed by the funds governing documents and (viii) a general partner often makes a substantial commitment to a fund to invest its own capital alongside the investors. Frontenac manages multiple funds on a side-by-side basis.

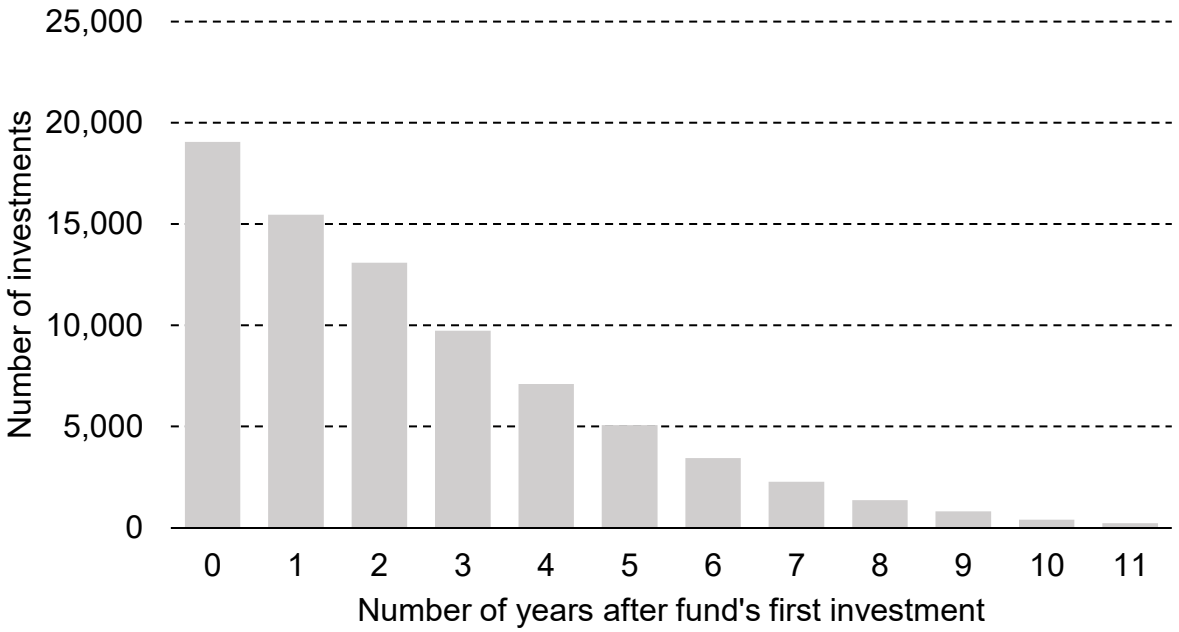


Figure 1
The figure plots the number of investments by VC funds in U.S. companies in our sample conditional on when the investment is made relative to each fund's first investment. The sample is obtained from VentureExpert and contains 78,061 investments between 1980 and 2022. The sample excludes funds where the time between the first and last investments is more than 12 years.

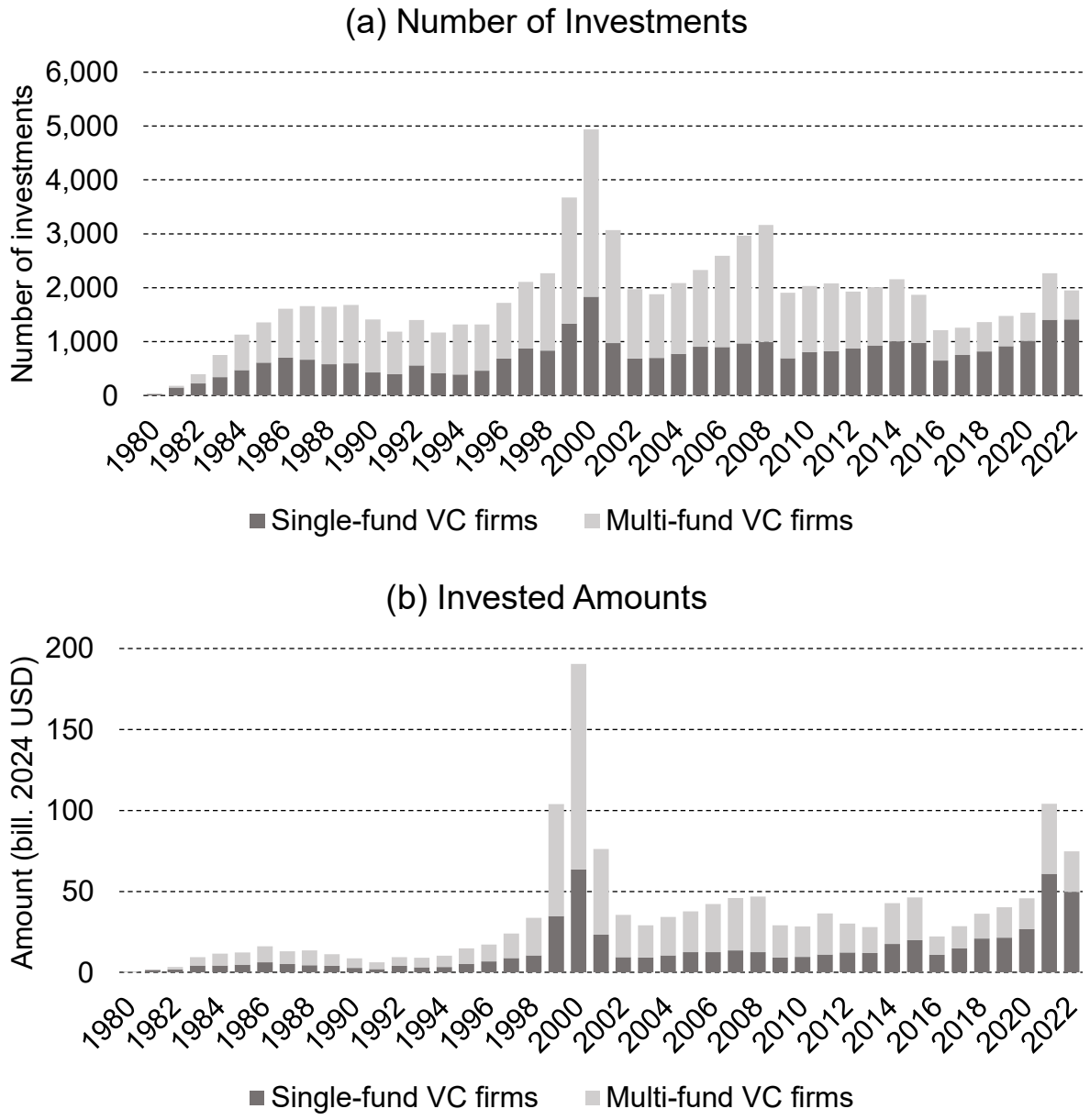


Figure 2
The figures plot (a) the number of investments and (b) investment amounts by single-fund VC firms and by multi-fund VC firms each year. The sample comes from VentureExpert and contains 78,061 investments between 1980 and 2022. The sample excludes funds where the time between the first and last investments is more than 12 years. A VC firm is classified as single-fund if no other fund is open at the time of the investment and as multi-fund if at least one other fund is open at the time of the investment. We consider a fund to be open from the date of its first investment to the date of its last investment. Overall, 32,567 investments are made by single-fund VC firms and 45,494 investments are made by multi-fund VC firms.

Table 1
VC market activity by year
The table shows the number of investments, invested amounts, number of VC firms, number of VC funds, and number of companies by year. The sample is obtained from VentureExpert and contains 78,061 investments between 1980 and 2022. The sample excludes funds where the time between the first and last investments is more than 12 years.

Year	Number of investments	Amount (bill. 2024 USD)	Number of VC firms	Number of funds	Number of companies
1980	34	0.26	17	19	28
1981	179	1.70	53	56	108
1982	397	3.36	79	96	196
1983	754	9.39	117	156	343
1984	1,129	11.51	179	242	507
1985	1,355	12.32	201	272	670
1986	1,611	16.06	204	283	751
1987	1,659	13.04	199	284	817
1988	1,651	13.65	203	309	821
1989	1,683	11.21	204	315	817
1990	1,409	8.78	182	279	658
1991	1,183	6.15	162	235	580
1992	1,400	9.51	180	260	675
1993	1,166	9.08	169	255	595
1994	1,317	10.34	181	265	623
1995	1,322	14.75	194	276	697
1996	1,720	17.26	226	332	985
1997	2,107	23.94	293	413	1,164
1998	2,271	33.65	319	459	1,299
1999	3,674	103.85	413	661	1,996
2000	4,935	190.40	519	832	2,806
2001	3,068	76.15	503	754	1,711
2002	1,972	35.59	448	666	1,142
2003	1,880	29.03	442	622	1,114
2004	2,087	34.33	456	643	1,222
2005	2,328	37.73	498	719	1,350
2006	2,591	42.10	508	772	1,511
2007	2,964	46.04	525	842	1,710
2008	3,167	46.77	537	858	1,796
2009	1,907	29.01	440	646	1,153
2010	2,033	28.36	437	632	1,267
2011	2,081	36.50	421	611	1,243
2012	1,927	30.22	419	585	1,299
2013	2,012	27.99	404	554	1,336
2014	2,158	42.66	436	595	1,484
2015	1,871	46.28	448	610	1,314
2016	1,209	22.17	335	437	943
2017	1,262	28.60	390	477	959
2018	1,361	36.33	435	551	1,031
2019	1,474	40.13	462	580	1,118
2020	1,533	45.72	482	580	1,140
2021	2,268	103.98	591	771	1,636
2022	1,952	74.71	647	821	1,478
Average	1,815	33.97	339	480	1,072

Table 2
Summary statistics

The table reports summary statistics of the sample and variables used in the analysis. The initial sample is obtained from VentureExpert and contains 78,061 investments between 1980 and 2022. The sample excludes funds where the time between the first and last investments is more than 12 years. We then keep 37,689 investments between 1980 and 2022 with available data where the VC firm has at least one other contemporaneous fund open at the time of the investment. We consider a fund to be open from the date of its first investment to the date of its last investment. A fund is classified as contemporaneous only if it invests in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We require all funds to have at least one prior investment, which allows us to construct our general measure of asset sorting (see Table 3) and to measure fund performance. For Panel A, we limit the sample to 33,636 investments between 1980 and 2017, which allows time for a future exit through an IPO or an acquisition. For Panel B, we restrict the 1980-2022 sample of 37,689 investments to cases in which at least one open fund of the VC firm has a prior investment in the company (an *invested fund*) and at least one open fund does not have a prior investment in the company (a *non-invested fund*). The resulting sample contains 30,374 investments with data for both the invested and the non-invested funds.

Panel A: Investments by multi-fund VC firms

Variable	Obs.	Mean	Std. dev.	1st quartile	Median	3rd quartile
Investment amount (mill. 2024 USD)	33,636	17.08	22.53	3.18	9.28	21.27
IPO/Acquisition dummy	33,636	0.41	0.49	0.00	0.00	1.00
Number of other contemporaneous funds	33,636	1.64	0.95	1.00	1.00	2.00
Number of investments by VC firm over prior one year	33,636	17.16	15.09	6.00	13.00	24.00
Number of companies in fund making the investment	33,636	16.48	12.20	7.00	14.00	23.00
Number of companies in other contemporaneous fund(s)	33,636	16.72	11.37	8.00	15.00	23.00
VC firm is an SEC-registered investment advisor dummy	33,636	0.09	0.29	0.00	0.00	0.00

Table 2 -- continued

Panel B: Fund switching sample

Variable	Obs.	Mean	Std. dev.	1st quartile	Median	3rd quartile
Investment is placed in a non-invested fund dummy	30,374	0.10	0.30	0.00	0.00	0.00
Years since the last investment in company by invested fund	30,374	1.30	1.05	0.57	1.02	1.66
Number of rounds in company by invested fund	30,374	1.99	1.31	1.00	2.00	3.00
Number of companies in invested fund	30,374	20.75	13.48	11.00	18.00	27.00
Number of companies in non-invested fund	30,374	15.84	13.62	5.00	13.00	22.00
Age of invested fund (years)	30,374	4.01	2.18	2.34	3.67	5.34
Age of non-invested fund (years)	30,374	4.21	3.05	1.38	3.92	6.66
Performance of new investment (# of rounds in company)	30,374	3.45	2.25	2.00	3.00	5.00
Performance of invested fund (average # of rounds in companies held by fund)	30,374	3.61	1.23	2.69	3.50	4.39
Performance of non-invested fund (average # of rounds in companies held by fund)	30,374	3.70	1.62	2.50	3.79	4.82

Table 3
A general test of asset sorting

The table reports estimates of the variance of fund performance within the same VC firm under two scenarios. In the first (realized) scenario, the new investment is placed in the actual fund making the investment. In the second (counterfactual) scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. To measure fund performance, each investment is classified as either successful (success=1) or unsuccessful (success=0). An investment is classified as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. Fund performance at the time of the new investment is then calculated as the value-weighted average success of all investments up to and including the new investment. For each new investment, we calculate the realized and counterfactual variance of performance across funds by the same VC firm. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average all resulting variances to obtain the counterfactual variance. The table reports the average realized variance, the average counterfactual variance, and their difference. The sample is described in Table 2 (Panel A) and contains 33,636 investments between 1980 and 2017. The reported *t*-statistic (in parentheses) is based on standard errors clustered at the year and VC firm level. *** denotes significance at the 0.01 level.

	All investments
Realized variance of fund performance (×10,000)	222.41
Counterfactual variance of fund performance (×10,000)	215.88
Difference (×10,000)	**6.54*****
t-statistic of difference	(4.48)
Obs.	33,636

Table 4
The effect of asset sorting on the carry

The table estimates the economic magnitude of asset sorting at the time of each new investment under several different assumptions about the hurdle rate, the value of a successful investment as a multiple of invested amount, and the carried interest to general partners. To do that, we estimate the carried interest the VC firm collects from all contemporaneous funds under two scenarios. In the first scenario, the new investment is placed in the actual fund making the investment. In the second scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average the estimated carried interest across all such cases. The estimated economic magnitude of asset sorting is equal to the difference in the VC firm's carried interest between the two scenarios expressed as a percentage of the amount of the new investment. To calculate the carried interest, we classify each investment as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. To calculate carried interest at the fund level, we assume that (i) unsuccessful investments result in a total loss, (ii) each investment lasts five years, and (iii) the general partners charge an annual management fee of 2%. The sample is described in Table 2 (Panel A) and contains 33,636 investments between 1980 and 2017. The reported *t*-statistics (in parentheses) are based on standard errors clustered at the year and VC firm level. *** denotes significance at the 0.01 level.

The effect of asset sorting on the carry as a percentage of investment amount

Carried interest = 20%				Multiple for successful investments = 5			
Hurdle rate	Multiple for successful investments			Hurdle rate	Carried interest		
	3	5	7		15%	20%	25%
0	0.76***	0.54***	0.72***	0	0.41***	0.54***	0.68***
	(5.12)	(3.00)	(4.08)		(3.00)	(3.00)	(3.00)
8%	0.86***	1.05***	1.09***	8%	0.79***	1.05***	1.32***
	(5.86)	(4.72)	(4.44)		(4.72)	(4.72)	(4.72)
15%	0.88***	1.28***	1.42***	15%	0.96***	1.28***	1.60***
	(5.79)	(5.02)	(4.47)		(5.02)	(5.02)	(5.02)

Table 5
Sorting good companies into good funds

The table estimates linear regression models examining whether the new investment is undertaken by a fund that does not have prior investments in the same company. We focus on investments where at least one contemporaneous fund, other than the fund making the investment, is open at the time of the investment. A fund is classified as contemporaneous only if it invests in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. We restrict the sample to cases in which at least one open fund of the VC firm has a prior investment in the company (an *invested fund*) and at least one open fund does not have a prior investment in the company (a *non-invested fund*). The dependent variable is equal to 1 if the investment is undertaken by a *non-invested fund* and 0 if the investment is undertaken by an *invested fund*. As explanatory variables, we use the performance of the non-invested fund, the performance of the new investment, and an interaction term between these two variables. Company performance is measured by the total number of investment rounds by any VC firm up to the date of the new investment. Fund performance is measured by the average performance of the companies in their portfolio at the time of the new investment. As additional explanatory variables, we include the performance of the invested fund, the number of years since the last investment in the company by the invested fund, the number of rounds in company by the invested fund, the number of companies in the invested fund and the non-invested fund, and the ages of the invested and the non-invested funds. In model 2, we also include interaction terms of these additional variables with company performance. Both models include fixed effects for the year, the VC firm, and the number of contemporaneous funds. The reported *t*-statistics (in parentheses) are based on standard errors clustered at the company × round date level. ***,**,* denote significance at the 0.01, 0.05, and 0.10 levels.

Dependent variable is whether an investment is placed in a non-invested fund (×100)		
	(1)	(2)
Performance of non-invested fund ×	**0.45*** **	**0.45*** **
Performance of new investment	**(7.50)**	**(5.09)**
Performance of non-invested fund	– 2.03***	– 2.04***
	(– 6.47)	(– 5.42)
Performance of new investment	– 1.60***	– 0.73
	(– 5.58)	(– 1.60)
Performance of invested fund	– 1.37***	– 1.20**
	(– 4.75)	(– 2.53)
Years since the last investment in the company by	1.48***	0.98**
the invested fund	(6.04)	(1.98)
Number of rounds in company by invested fund	– 0.62***	– 1.56***
	(– 3.12)	(– 3.58)
Number of companies in invested fund	– 0.06**	– 0.16***
	(– 2.51)	(– 4.15)
Number of companies in non-invested fund	0.02	0.11***
	(0.90)	(3.48)

Table 5 -- continued

Dependent variable is whether an investment is placed in a non-invested fund (×100)	(1)	(2)
Age of invested fund	0.94***	2.16***
	(5.41)	(6.55)
Age of non-invested fund	– 1.47***	– 1.66***
	(– 12.11)	(– 8.50)
Performance of invested fund ×		– 0.09
Performance of new investment		(– 0.97)
Years since the last investment in the company by		0.11
the invested fund × Performance of new investment		(1.08)
Number of rounds in company by invested fund ×		0.20***
Performance of new investment		(2.67)
Number of companies in invested fund ×		0.02***
Performance of new investment		(2.69)
Number of companies in non-invested fund ×		– 0.02***
Performance of new investment		(– 3.50)
Age of invested fund ×		– 0.28***
Performance of new investment		(– 4.45)
Age of non-invested fund ×		0.05
Performance of new investment		(1.14)
Year, VC firm, and # of contemporaneous funds *FE*	Yes	Yes
Obs.	30,374	30,374
Adjusted R-square	18.69	18.83

Table 6
The effect of sorting good companies into good funds on the carry

The table estimates the economic magnitude of asset sorting at the time of each new investment for a subsample of 10,151 investments where the number of rounds in the company is greater than the median and the average number of rounds in companies held by the investing fund is greater than the median. Estimates are provided under several different assumptions about the hurdle rate, the value of a successful investment as a multiple of invested amount, and the carried interest to general partners. To do that, we estimate the carried interest the VC firm collects from all contemporaneous funds under two scenarios. In the first scenario, the new investment is placed in the actual fund making the investment. In the second scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average the estimated carried interest across all such cases. The estimated economic magnitude of asset sorting is equal to the difference in the VC firm's carried interest between the two scenarios expressed as a percentage of the amount of the new investment. To calculate the carried interest, we classify each investment as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. To calculate carried interest at the fund level, we assume that (i) unsuccessful investments result in a total loss, (ii) each investment lasts five years, and (iii) the general partners charge an annual management fee of 2%. The main sample is described in Table 2 (Panel A). The reported *t*-statistics (in parentheses) are based on standard errors clustered at the year and VC firm level. *** denotes significance at the 0.01 level.

The effect of sorting good companies into good funds on the carry as a percentage of investment amount

Carried interest = 20%				Multiple for successful investments = 5			
Hurdle rate	Multiple for successful investments			Hurdle rate	Carried interest		
	3	5	7		15%	20%	25%
0	0.84***	0.53***	0.53**	0	0.40***	0.53***	0.67***
	(4.70)	(2.61)	(2.32)		(2.61)	(2.61)	(2.61)
8%	0.82***	1.30***	1.29***	8%	0.97***	1.30***	1.62***
	(4.79)	(4.75)	(4.33)		(4.75)	(4.75)	(4.75)
15%	0.79***	1.37***	1.70***	15%	1.03***	1.37***	1.72***
	(4.16)	(4.16)	(4.70)		(4.16)	(4.16)	(4.16)

Table 7
Legal exposure and asset sorting

The table estimates linear regression models examining the effect of legal exposure on asset sorting. Legal exposure is measured using SEC filing status, which is equal to 1 if the VC firm files Form ADV with the SEC in the year before and the year after the investment and is equal to 0 otherwise. As a dependent variable, we use a measure of asset sorting that compares the average variance of fund performance within the same VC firm under two scenarios. In the first (realized) scenario, the new investment is placed in the actual fund making the investment. In the second (counterfactual) scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. To measure fund performance, each investment is classified as either successful (success=1) or unsuccessful (success=0). An investment is classified as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. Fund performance at the time of the new investment is then calculated as the value-weighted average success of all investments up to and including the new investment. For each new investment, we calculate the realized and counterfactual variance of performance across funds by the same VC firm. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average all resulting variances to obtain the counterfactual variance. The measure of asset sorting is then equal to the difference between the realized and counterfactual variances of performance. As additional explanatory variables in models 2 and 3, we use the investment amount, the number of companies in the fund making the investment, and the number of companies in other contemporaneous fund(s). All models control for year and VC firm fixed effects and fixed effects for the number of contemporaneous funds. Model 3 further restricts the sample to the period from 2001 to 2022, which overlaps with available data on Form ADV filings to the SEC. The sample is described in Table 2 (Panel A). The reported *t*-statistics (in parentheses) are based on robust standard errors. $^{***, **, *}$ denote significance at the 0.01, 0.05, and 0.10 levels.

Dependent variable: Actual minus counterfactual variance of fund performance (×10,000)			
	(1)	(2)	(3)
SEC-filing VC firm	**– 9.30****	**– 12.32*****	**– 11.17*****
	(– 2.10)	**(– 2.81)**	**(– 2.45)**
Investment amount		2.18***	3.37***
(mill. 2024 USD, log)		(4.45)	(4.91)
Number of companies		0.69***	0.63***
in fund making the investment		(8.66)	(5.96)
Number of companies in other		– 1.44***	– 1.25***
contemporaneous fund(s)		(– 14.14)	(– 9.28)
Year, VC firm, and # of contemporaneous funds *FE*	Yes	Yes	Yes
Obs.	33,636	33,636	17,250
Adjusted R-square	1.67	2.94	3.66

Table 8
Asset sorting and investment performance

The table estimates linear regression models examining the relation between asset sorting and the performance of investments. As a dependent variable, we use the success of each investment. An investment is classified as successful (success=1) if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful (success=0). As an explanatory variable, we average a measure of asset sorting for the VC firm undertaking the investment over all its investments during the prior one year. The measure of asset sorting compares the variance of fund performance within the same VC firm under two scenarios. In the first (realized) scenario, the new investment is placed in the actual fund making the investment. In the second (counterfactual) scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. To measure fund performance, each investment is classified as either successful (success=1) or unsuccessful (success=0). An investment is classified as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. Fund performance at the time of the new investment is then calculated as the value-weighted average success of all investments up to and including the new investment. For each new investment, we calculate the realized and counterfactual variance of performance across funds by the same VC firm. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average all resulting variances to obtain the counterfactual variance. The measure of asset sorting is then equal to the difference between the realized and counterfactual variances of performance. Average asset sorting by the VC firm over the prior one year is available for 40,437 observations, which determines the sample size for this table. Model 2 controls the total invested amount and number of investments by the VC firm over the prior one year. Model 3 further controls for VC firm fixed effects. The reported *t*-statistics (in parentheses) are based on standard errors clustered at the VC firm level in models 1 and 2 and are based on robust standard errors in model 3. ***,**,* denote significance at the 0.01, 0.05, and 0.10 levels.

Dependent variable: Investment success (×100)			
	(1)	(2)	(3)
Average asset sorting by VC firm	**30.96**	**45.34**	**6.04**
over prior one year	**(0.51)**	**(0.80)**	**(0.14)**
Total invested amount by VC firm		5.66***	– 0.58
over prior one year (2024 USD, log)		(8.74)	(– 1.43)
Number of investments by VC firm		– 0.25***	– 0.04
over prior one year		(– 4.73)	(– 1.34)
Year *FE*	Yes	Yes	Yes
VC firm *FE*	No	No	Yes
Obs.	40,437	40,437	40,437
Adjusted R-square (%)	18.91	19.77	24.33

Table 9
Asset sorting in hot and cold markets

The table estimates linear regression models examining the effects of VC firm activity on asset sorting. As a dependent variable, we use a measure of asset sorting that compares the average variance of fund performance within the same VC firm under two scenarios. In the first (realized) scenario, the new investment is placed in the actual fund making the investment. In the second (counterfactual) scenario, the new investment is placed in another contemporaneous fund of the same VC firm. We consider other funds to be contemporaneous if they are open and invest in companies in the same geographic region and the same industry as the new investment. Appendix A provides the list of geographic regions and industries in our sample. We consider a fund to be open from the date of its first investment to the date of its last investment recorded in the data. To measure fund performance, each investment is classified as either successful (success=1) or unsuccessful (success=0). An investment is classified as successful if the company goes public or is acquired in the future; otherwise, an investment is classified as unsuccessful. Fund performance at the time of the new investment is then calculated as the value-weighted average success of all investments up to and including the new investment. For each new investment, we calculate the realized and counterfactual variance of performance across funds by the same VC firm. If the VC firm manages several other contemporaneous funds, we sequentially place the new investment in each of these funds and average all resulting variances to obtain the counterfactual variance. The measure of asset sorting is then equal to the difference between the realized and counterfactual variances of performance. We measure VC firm activity using the number of investments by the firm over the prior one year. As additional explanatory variables we use a variable that is equal to 1 if the VC firm files form ADV with SEC in the year before and the year after the investment (0 otherwise), the investment amount, the number of companies in the fund making the investment, and the number of companies in other contemporaneous fund(s). All models control for year and VC firm fixed effects and fixed effects for the number of contemporaneous funds. The sample is described in Table 2. The reported *t*-statistics (in parentheses) are based on robust standard errors. ***,**,* denote significance at the 0.01, 0.05, and 0.10 levels.

Dependent variable: Actual minus counterfactual variance of fund performance (×10,000)		
	(1)	(2)
Number of investments by VC	**– 0.25*****	**– 0.13****
firm over prior one year	**(– 3.60)**	**(– 2.07)**
SEC-filing VC firm		– 12.80***
		(– 2.90)
Investment amount		2.16***
(mill. 2024 USD, log)		(4.41)
Number of companies		0.74***
in fund making the investment		(9.24)
Number of companies in other		– 1.39***
contemporaneous fund(s)		(– 13.90)
Year, VC firm, and # of contemporaneous funds *FE*	Yes	Yes
Obs.	33,636	33,636
R-Square (%)	1.70	2.94