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# Distorting Private Equity Performance: The Rise of Fund Debt

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# Distorting Private Equity Performance: The Rise of Fund Debt\*

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## Abstract

This paper studies the emergence of debt financing by private equity funds. Using confidential data on U.S. buyout funds, we document the increasing use of subscription lines of credit (SLCs) as an additional source of capital. We find that funds using SLCs tend to reduce the amount of equity invested relative to fund size and delay capital calls. Our results suggest that the use of SLCs increases IRR-based performance by 6.1 percentage points, while multiples-based performance slightly declines. Overall, we provide the first evidence on a new source of capital in private equity and its impact on funds.

*JEL Classification:* E22, G23, G24, G32

*Keywords:* Private equity, subscription line of credit, internal rate of return, capital call

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# 1 Introduction

There has been a striking shift in raising capital from U.S. public to private equity markets over the past two decades (Doidge, Karolyi, and Stulz (2017)). With the rise of private equity funds, there has been a corresponding growth in the literature examining their effects on firms and the broader economy (Kaplan (1989), Lerner, Sorensen, and Strömberg (2011), Agrawal and Tambe (2016), and Faccio and Hsu (2017)). It is commonly assumed that private equity funds raise capital primarily through their limited partners using equity. In this paper, we document and study the emergence of a new source of capital, debt financing, by private equity funds.

It is empirically challenging to examine the sources of capital for private equity funds. First, there are limited regulatory filings for these types of funds. Private equity funds are not subject to the reporting requirements of other asset classes, such as mutual funds. Second, there could be concerns about selection and self-reporting biases. In particular, there might be an incentive for private equity funds with relatively stronger performance to select into particular datasets and, conditional on reporting, to provide inflated measures of performance. Third, there is limited data available on the sources of capital for private equity funds, in addition to reliable information on fund cash flows.

To mitigate these concerns, we use confidential data on the equity and debt raised by private equity funds, which are linked with transaction-level data on fund distributions and valuations. These data are provided by Burgiss and sourced directly from limited partners (LPs). It provides a complete and exact record of cash flows between LPs and general partners (GPs). The data are validated across limited partners for each fund and represent a substantial amount of investment from a comprehensive sample of LPs.<sup>1</sup> To our knowledge, this is the first paper with data on debt financing by private equity funds, which we refer to as subscription lines of credit (SLCs).

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<sup>1</sup>A detailed discussion of the Burgiss data is provided in Section 3, in addition to Harris, Jenkinson, and Kaplan (2014) and Kaplan and Lerner (2016).

We find that there has been a dramatic rise in the aggregate use of SLCs from 2014 to 2018. In our sample, the total amount of subscription lines of credit in 2014 (adjusted for inflation) was just \$86.1 million. The use of SLCs in the first three quarters of 2018 increased to more than \$5.3 billion. There has been a parallel increase at the fund level along both the extensive and intensive margins. We document that the number of funds using subscription lines of credit rises monotonically in our sample. We also report that the average (median) amount of SLC use jumps from \$14.4 million (\$14.6 million) in 2014 to \$74.6 million (\$19.4 million) in 2018. This evidence suggests that there has been a substantial shift in the source of financing for private equity funds and challenges the assumption that equity is the primary source of capital for these funds.

A potential issue with the contemporaneous increase in debt financing is that it might be relatively inconsequential for a particular fund. To address this concern, we examine the capital structure of private equity funds. An extensive literature studies capital structure, mainly focusing on public firms (Lemmon, Roberts, and Zender (2008)). It is our understanding that this is the first paper to detail the relative use of debt financing for private equity funds. Conditional on using a subscription line of credit, we find that the average (median) leverage of a fund increases from 11.8% (11.5%) in 2014 to 31.1% (27.5%) in 2018. This highlights that debt financing is increasing at both the fund and aggregate levels.

Subscription lines of credit could alter the amount of equity called by fund managers. On the one hand, SLCs might substitute for capital calls. Alternatively, debt financing could allow fund managers to increase the total amount of capital deployed at a particular time. We examine the equity ratio, which we define as the cumulative capital that a fund has called from its limited partners relative to its size. We find that funds using subscription lines of credit tend to deploy less equity from LPs. This association is about a 3.9% decrease after including fund age fixed effects to hold constant equity ratios for funds of the same age, in addition to vintage fixed effects to account for time-varying trends in capital calls. Additionally, private equity funds tend to primarily invest toward the beginning of a fund's

life. When restricting to funds with an age of five years or less, we report that the equity ratio decreases by 7.0%, which is a 13.5% decrease relative to the sample mean.

We also consider *when* funds using SLCs delay their capital calls. It is an empirical question about the timing of a fund’s use of subscription lines of credit. We construct fund-level variables for the age when a fund first calls 25%, 50%, and 75% of the capital available from its limited partners. We find that funds using SLCs tend to deploy capital at relatively later ages at the 25% and 50% thresholds. This change is about a 2.5 month average delay in calling capital at the 25% cutoff, which increases to a 4.2 month delay at the 50% threshold. Taken together, this suggests that subscription lines of credit allow funds to delay capital towards the beginning to middle of their investment period.

The delay in capital calls associated with SLCs raises the prospect that the internal rate of return (IRR), which is a key performance metric for private equity funds, might also vary with SLC use. To build intuition, consider two funds that are identical in all respects, except that one fund delays its third year capital call by one year through the use of an SLC. Since capital calls represent negative cash flows in the calculation of its IRR, the fund using the subscription line of credit will push its year three negative cash flow further into the future, which increases its IRR.

To understand the role of SLCs on a fund’s IRR-based performance, we calculate the difference between the IRR using a fund’s observed cash flows and the IRR based on the assumption that capital calls substitute for SLC use, which we term a fund’s “synthetic” IRR. For example, suppose that a fund in its second year called \$100 million of capital from its LPs and used \$10 million from a subscription line of credit. The synthetic IRR is the fund’s IRR calculated as if the fund had instead called \$110 million of capital from its LPs and did not use an SLC. All other cash flows remain unaltered. Subsequently, the difference in IRRs is the change based on a fund’s SLC use.

We find that IRR-based performance for funds using subscription lines of credit increases by 6.1 percentage points. This is relative to the internal rate of return as if the fund

did not use an SLC. This result is statistically significant at the 1% level and economically meaningful, representing a 25.0% increase relative to the sample mean of a fund’s IRR based on its observed cash flows. This association is driven by comparatively young funds, which is consistent with the notion that SLCs have a larger impact on IRR-based performance when a fund is young. Additionally, the relationship increases in a fund’s leverage, suggesting that the distortion in IRRs is heightened as the use of debt financing rises.

In our final set of analyses, we evaluate the role of subscription lines of credit on multiples-based performance. We focus on the ratio of total value to paid-in capital (TVPI). Total value is the sum of a fund’s distributions to LPs during its life plus its net asset value (NAV) for the last observation in the sample. Paid-in capital is the sum of a fund’s capital calls from its limited partners throughout its life. Similar to the analysis on IRR-based performance, we construct the difference between the TVPI using a fund’s observed cash flows and the TVPI based on the assumption that total value increases by four percent of a fund’s average SLC use over its observed life, which we refer to as a fund’s “synthetic” TVPI. This alternative measure of a fund’s TVPI accounts for the decrease in a fund’s total value by paying interest expenses and fees from using a subscription line of credit.

We estimate that multiples-based performance for funds using SLCs decreases a fund’s TVPI by an average of 0.006. This is statistically significant at the 1% level and represents a 0.4% decrease relative to the sample mean of TVPI. It is consistent with a reduction in fund value stemming from its payments of interest expenses and fees from using a subscription line of credit. This estimate is economically small compared to the change in IRR-based performance associated with SLC use by private equity funds. Corresponding to the analysis on IRRs, we find that the decline in TVPI is substantially larger for younger funds, which is when SLCs can have a larger impact on a fund’s cash flows. Further, we report that TVPI tends to decrease as a fund’s leverage increases.

Taken together, we provide novel evidence on the rise of a new source of capital for private equity funds. First, we document that these funds increasingly use subscription lines

of credit. Second, we find that funds using SLCs often reduce the relative amount of equity deployed and delay capital calls, particularly near the middle of a fund’s investment period. Third, we study the role of subscription lines of credit in distorting a fund’s performance. We find that SLC use is associated with a substantial rise in a fund’s IRR and a modest decrease in a fund’s multiples-based performance using TVPI.

This paper contributes to the growing literature on private equity markets, particularly regarding performance.<sup>2</sup> Moskowitz and Vissing-Jørgensen (2002) document that private equity investment is highly concentrated, yet does not outperform public equity markets, which they refer to as the “private equity premium puzzle.” Kaplan and Schoar (2005) find that performance at buyout funds is persistent, although somewhat lower than returns on the S&P 500 after fees. Phalippou and Gottschalg (2008) also find that private equity buyout funds appear to underperform the S&P 500 net of fees. Robinson and Sensoy (2016) study the link between the comovement of public and private capital, and the liquidity of private equity. Brown, Gredil, and Kaplan (2019) find that underperforming managers tend to inflate reported returns when raising capital for follow-on funds.<sup>3</sup> We provide evidence on the emergence of debt financing by private equity funds and its relation to their performance, identifying a new challenge in comparing private equity fund performance over time.

Our paper focuses on the use of debt by private equity funds. A parallel and nascent literature studies venture debt, which is debt financing by startup firms. Hochberg, Serrano, and Ziedonis (2018) study lending to startup firms and the use of patents as collateral. De Rassenfosse and Fischer (2016) examine venture debt and also find that patents are significantly related to receiving debt financing. González-Uribe and Mann (2017) use contract-level data on venture loans and report that debt is repaid using equity from later rounds. Davis, Morse, and Wang (2018) study how venture debt affects firm-level outcomes.

We also contribute to the literature on how asset managers influence the measure-

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<sup>2</sup>Kaplan and Strömberg (2009) provide an overview of the private equity literature.

<sup>3</sup>Cochrane (2005), Groh and Gottschalg (2006), Cao and Lerner (2009), and Guo, Hotchkiss, and Song (2011), among others, provide additional insights on performance of venture capital and private equity.

ment of their performance. Carhart et al. (2002) find that mutual fund managers inflate their quarter-end portfolio valuations through purchases of stocks they already own to improve their reported performance. Ben-David et al. (2013) report evidence of similar behavior among hedge funds. Sensoy (2009) shows that mutual fund managers strategically select mismatched benchmarks to facilitate meeting their performance targets. Bollen and Pool (2009) document a discontinuity in the distribution of hedge fund returns attributable to temporary overstatements of performance. In related work, Agarwal, Gay, and Ling (2014) provide a rationale for window dressing by asset managers. In this paper, we present evidence consistent with the notion that private equity fund managers inflate their perceived performance through the use of subscription lines of credit.

## 2 Subscription Lines of Credit

A key feature of the private equity market is its reliance on equity financing from limited partners. In this paper, we document and study the emergence of a new source of financing: subscription lines of credit. Section 2.1 provides the institutional details of subscription lines of credit (SLCs). Section 2.2 examines a hypothetical example of how subscription lines of credit can alter a fund's performance measured using its internal rate of return.

### 2.1 Institutional Details

Figure 1 illustrates the typical structure of a private equity firm managing several private equity funds. The private equity firm at the top of this figure is connected to its two private equity funds. In the middle of this figure, we highlight that a private equity fund raises equity capital through commitments by limited partners (LPs) at the beginning of the fund's life. As deals in portfolio companies are closed by the fund, the general partners (GPs) will draw down these commitments using capital calls. The middle of this figure also



highlights that SLCs can be used by a fund as an alternative source of capital. SLCs are a form of debt financing originated by banks. Additional details are provided below. A portfolio company is at the bottom of this figure. Portfolio companies raise equity and debt capital from several sources, including private equity funds and banks.

The focus of our paper is exclusively on subscription lines of credit for private equity funds, which is a recently emerging form of debt financing. SLCs are distinct and different from debt financing at either the level of the portfolio company or private equity firm. To our knowledge, this is the first paper to systematically study the use of debt capital by private equity funds.

Next, we provide institutional details about subscription lines of credit, including the typical type of debt contract, pricing, maturity, collateral, and covenants.<sup>4</sup> First, SLCs can be either a revolving line of credit or a term loan. Similar to other forms of debt financing, banks sometimes syndicate subscription lines of credit. Second, the interest rate for an SLC is typically based on LIBOR plus a spread. In addition to the interest expense, an SLC tends to include an upfront fee. Third, the maturity of a subscription line of credit often ranges from several months to several years. At maturity, there might be the opportunity for the contract to be renewed. Fourth, an important feature of SLCs is that unfunded capital commitments from limited partners serve as collateral. Lastly, SLCs may include a range of covenants. A typical example relates to the ratio of total unfunded commitments to the fund's total debt. Anecdotal evidence suggests that a private equity fund has never defaulted on an SLC.

Why do private equity funds use subscription lines of credit, and what frictions might arise from this form of financing? One of the main explanations for the rise of SLCs is the ability for fund managers to adjust the timing of capital calls or to prepay distributions prior to an anticipated successful exit (Institutional Limited Partners Association (2017)). There

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<sup>4</sup>This information is drawn from Institutional Limited Partners Association (2017), Beekman, Bowman, and Brown (2014), Flood (2017), Petkanics, Pirraglia, and Oberdorf III (2018), and conversations with industry participants.

are several reasons GPs might prefer to change the timing of a capital call. First, there might be a lag between an investment opportunity and the disbursement of capital from LPs. Private equity funds could use an SLC to maintain a cash buffer to invest immediately in a deal. Second, LPs might prefer for funds to call capital at a relatively lower frequency than for each deal. For example, if it is costly to disburse capital each time a deal is closed, an LP might prefer to provide capital on a quarterly basis.

The use of a subscription line of credit could also alter the perceived performance and fees generated for GPs. In particular, by shortening the period of outflows, or negative cash flows, performance measured using the internal rate of return (IRR), a widespread metric in private equity markets, can be inflated. If investors do not understand how SLCs adjust IRR-based performance, then a private equity firm could potentially raise additional capital for future funds using the relatively higher measure of performance. Additionally, the use of a subscription line of credit might increase the fees from carried interest. Since an SLC could increase a private equity fund's IRR, it may become more likely for the fund to reach its hurdle rate. Taken together, these reasons provide GPs with a strong incentive to use SLCs.

Limited partners might also prefer for private equity funds to use subscription lines of credit. Some LPs, such as those at endowments, are compensated based on the returns they generate for their investors. The benchmark for these returns may be based on a fund's IRR. If an SLC increases a fund's IRR, then it may also increase compensation for the fund's LPs. These LPs have an incentive to encourage GPs' use of subscription lines of credit (Flood (2017)).

## **2.2 SLCs and Fund Performance: An Example**

This section provides a hypothetical example of how subscription lines of credit can distort IRR-based performance, and how this distortion varies over the life of a fund. As highlighted in the previous section, one of the key features of an SLC is the opportunity it

offers to defer capital calls. We posit a hypothetical, yet realistic, set of net cash flows, which we define as distributions to LPs minus capital called from LPs, over a fund's life. Figure 2 illustrates these net cash flows, which are plotted by the dotted line against the right axis. For example, the fund's net cash flow at age four is \$100 million. This may represent a \$100 million capital call netted against a \$200 million distribution from a successful early investment. The dashed line, plotted against the left axis, represents the IRR of 27.8% at fund liquidation, which occurs at age 10 in this example.

Next, we determine the change in the fund's IRR when it uses a subscription line of credit. The solid line, also plotted against the left axis, represents the IRRs at fund liquidation associated with the use of a \$100 million SLC at various fund ages. For example, if an SLC is only used at age four, we increase the net cash flow in that year from \$100 million to \$200 million. Conceptually, this represents the fund's use of an SLC instead of a capital call of \$100 million. The fund's IRR at liquidation rises substantially when it uses an SLC at age four, increasing from 27.8% to 30.3%.

More generally, the figure demonstrates that SLCs inflate IRRs at fund liquidation and that this distortion is larger when subscription lines of credit are used relatively earlier in the life of a fund. The average (median) age that a fund uses an SLC in our sample is 3.2 (2) years. This intuition will guide our empirical analysis on the change in IRR-based performance when funds use subscription lines of credit.

### 3 Data

We use data on subscription lines of credit provided by Burgiss. Fund managers typically provide details about their use of subscription lines of credit in the quarterly financial reports provided to their limited partners. Accordingly, the data are available at a quarterly frequency. The source of these confidential data is LPs' use of Burgiss' record-keeping and performance monitoring services. The data on subscription lines of credit is supplemented by

Burgiss with transactions-level data on capital calls, distributions and valuations, in addition to fund characteristics.

There are several notable features of the data from Burgiss relative to existing data sources. First, the data are a complete and exact record of cash flows between LPs and general partners derived from the reporting and accounting systems of LPs. Second, Burgiss validates information across LPs in the same fund, which addresses a common concern about reporting bias. Finally, the data comprise a substantial amount of investment in private equity from a comprehensive sample of LPs. Harris, Jenkinson, and Kaplan (2014) is the first paper to use Burgiss and report that it represents over \$1 trillion in committed capital, of which 60% is from pensions and 20% is from endowments. Kaplan and Lerner (2016) provide additional details about Burgiss data. Brown et al. (2017) compare private equity performance using data from the four main commercial sources. We are the first paper, to our knowledge, to use data on subscription lines of credit linked with high-quality transaction-level cash flows at private equity funds.

Our analysis uses an initial set of data on subscription lines of credit used by buyout funds. Following the literature, we restrict our sample to funds with a geographical focus in North America (Harris, Jenkinson, and Kaplan (2014)). Starting in 2014, a sufficient number of observations on SLCs is available to avoid potentially disclosing confidential information. The end of the sample is currently the third quarter of 2018. Due to these sample limitations, our analyses will primarily focus on data from 2014 to 2018.

Table 1 provides summary statistics for the samples analyzed in this paper. Panel A details the sample on capital calls. The average  $FundSize_i$  is just over \$1.2 billion, with a median size of \$500 million. The mean  $EquityRatio_{it}$ , which represents cumulative capital called in a year relative to a fund's size, is about 83.7%. This ratio drops to 51.7% for funds with a vintage year of 2014 or later. Subscription lines of credit are used in about 7.8% of fund-years in this sample. The average age that a fund deploys 50% of its capital from limited partners,  $Age_{i,50}$ , is 3.4 years.

Panel B provides summary statistics on performance measures for private equity funds using subscription lines of credit. This sample focuses on those funds with nonmissing data for all performance measures. We report that the internal rate of return for private equity funds using SLCs is 24.4%, on average. If we assume that capital calls substitute for SLCs in the same year, then the IRR decreases to 18.3%. We refer to this measure as the *SyntheticIRR<sub>i</sub>*. The average ratio of total value to paid-in capital (*TVPI<sub>i</sub>*) is slightly more than 1.4. If we assume that capital calls are used rather than subscription lines of credit, then the total value would increase since there would be no interest expense or fees. This measure is referred to as the *SyntheticTVPI<sub>i</sub>*. We assume that interest expenses and fees are four percent of a fund’s average outstanding SLCs each year. This measure is 1.43, on average, in our sample.

## 4 Capital Structure of Private Equity Funds

This section documents the use of subscription lines of credit by private equity funds. Section 4.1 details the increasing aggregate amount of SLCs. Section 4.2 examines the use of subscription lines of credit relative to the capital deployed in a particular year.

### 4.1 Aggregate Debt Use

This is the first paper to study the use of subscription lines of credit at the fund level and over time. To understand the temporal change in SLCs and to reduce seasonal variation, we compute the average outstanding amount of a fund’s subscription line of credit during the year. Summary statistics are based on these fund-year observations. Subscription lines of credit are adjusted for inflation and represent 2018 dollars.

Table 2 provides summary statistics on subscription lines of credit from 2014 to 2018. We find that the number of funds using subscription lines of credit rises monotonically from 6 funds in 2014 to 72 funds in 2018. Additionally, we report that the average amount of SLC

use jumps from \$14.4 million in 2014 to \$74.6 million in 2018. The median use of SLCs by a fund increases from \$14.6 million in 2014 to \$19.4 million in 2018. The fact that the median SLC is substantially lower than the average from 2015 to 2018 indicates the distribution of SLC use for these years is skewed to the right.

Taken together, these findings imply that the use of subscription lines of credit is increasing on both the extensive and intensive margins. This suggests that there is a substantial shift in the source of financing for private equity funds and challenges the notion that equity is the primary source of capital in private equity markets.

The last column of Table 2 details the total use of SLCs in a particular year. At the beginning of the sample in 2014, total SLC use was relatively limited at \$86.1 million. It has increased dramatically every year in our sample. The use of subscription lines of credit in the first three quarters of 2018 exceeds \$5.3 billion. This represents a substantial increase over the past five years. Figure 3 plots the total value of subscription lines of credit outstanding by year. The increased use of subscription lines of credit each year is particularly striking since we do not yet observe the full sample of funds with SLCs in the Burgiss data.

## 4.2 Debt and Equity

This subsection explores the extent of debt financing used by private equity funds relative to the total capital deployed. In contrast to the aggregate focus in Section 4.1, this analysis focuses on the leverage of a fund in a particular year.

We define leverage for fund  $i$  in year  $t$  as the ratio of its SLC use to the total capital invested, which includes subscription lines of credit and capital called from a fund's limited partners:

$$Leverage_{it} = \frac{SLC_{it}}{SLC_{it} + CapCall_{it}} \quad (1)$$

As above, we calculate  $SLC_{it}$  as the average of a fund's SLC use during a year. Additionally,  $CapCall_{it}$  is the sum of capital called from LPs by fund  $i$  in year  $t$ .

Table 3 provides summary statistics for  $Leverage_{it}$ . We find that the average amount of debt used by private equity funds rises from 11.8% in 2014 to 31.1% in 2018, representing a 2.6-fold increase. The median rises at a similar pace, from 11.5% in 2014 to 27.5% in 2018. In contrast to the summary statistics on SLC amounts, this suggests that the distribution of  $Leverage_{it}$  is not skewed. Since the sample is the same as Table 2, the number of funds is also identical, increasing from 6 funds in 2014 to 72 funds in 2018.

In Figure 4, we plot average and median fund leverage from 2014 to 2018, revealing a similar pattern for both statistics over time. Overall, we find that private equity funds are increasingly relying on debt. Importantly, this is not due to a change in the number of funds using SLCs. Rather, this represents an increased reliance on debt via subscription lines of credit, and highlights the leveraging of private equity funds.

## 5 Capital Calls

In this section, we study the relation between the use of subscription lines of credit by a private equity fund and equity provided by limited partners. Section 5.1 examines how debt influences the relative amount of equity used by a fund. Section 5.2 explores the link between the timing of capital calls and a fund's use of debt.

### 5.1 Equity Ratio

Subscription lines of credit provide managers of private equity funds with short-term debt financing. This source of capital could alter the amount of equity called by fund managers. On the one hand, SLCs might substitute for capital calls. On the other hand, SLCs might allow fund managers to increase the overall amount of capital deployed at a given time.

To study the relative amount of equity called by a fund, we construct a panel of fund-year observations. We define  $EquityRatio_{it}$  as the ratio of the cumulative capital that

fund  $i$  has called in year  $t$  divided by the fund’s size. To mitigate the influence of outliers, we winsorize  $EquityRatio_{it}$  at the 1% level in each tail. The independent variable is  $SLC_i$ , which is an indicator equaling one if fund  $i$  uses a subscription line of credit at any point during its life. We estimate the following ordinary least squares regression:

$$EquityRatio_{it} = \beta \times SLC_i + \alpha_a + \alpha_v + \varepsilon_{it} \quad (2)$$

The coefficient of interest,  $\beta$ , is the association between the equity ratio of a fund in a particular year and its use of a subscription line of credit. We include fund age fixed effects,  $\alpha_a$ , and vintage fixed effects,  $\alpha_v$ . Standard errors are clustered by fund.

Panel A of Table 4 reports the findings for the full sample, which includes fund-year observations for all fund ages. As seen in Column 1, we find that funds using SLCs tend to have called a statistically significant lower proportion of their capital. This relation between SLCs and capital deployed could be due to the recent emergence of subscription lines of credit. Funds using SLCs are younger and, therefore, have had less time to call capital. To address this concern, we include fund age fixed effects to hold constant equity ratios for funds of the same age. In Column 2, we find that funds using SLCs tend to call 3.5% less equity relative to their size than funds that do not use SLCs, which represents a roughly 4.2% decrease compared to the sample mean. The estimate is statistically significant at the 10% level. This suggests that the estimate in Column 1 is comparatively large due to the recent emergence of SLCs.

We include vintage fixed effects, in addition to fund age fixed effects, in Column 3. The vintage fixed effects account for time-varying trends in capital call activity potentially associated with the private equity cycle or macroeconomic trends.<sup>5</sup> We find that the proportion of equity for funds using SLCs decreases by 3.9%, which is statistically significant at the 5% level. The magnitude of the estimate is similar to Column 2, which implies that

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<sup>5</sup>For an overview of cyclical in venture capital and private equity, see Gompers and Lerner (2004) and Robinson and Sensoy (2016).



the decline in equity ratios by funds using SLCs is not driven by their vintage year.

Typically, a private equity fund invests in portfolio companies toward the beginning of its life. This suggests that SLCs might be used primarily by relatively young funds. Panel B of Table 4 restricts the sample to young funds, which we define as a fund age of five years or less. In Column 1, we re-estimate the specification from Panel A. We find that young funds using subscription lines of credit tend to use 11.1% less equity relative to fund size, which is statistically significant at the 1% level. Compared to the sample mean, this is a 21.5% decrease in the proportion of equity deployed by fund managers. Since recently observed funds are more likely to use SLCs and have deployed relatively less capital, the lower magnitude relative to the corresponding estimate in Panel A is expected. Equivalently, restricting the sample to young funds mitigates the influence of the recent emergence of SLCs.

Column 2 includes fund age fixed effects and reports that the equity ratio for funds using subscription lines of credit is, on average, 6.5% lower than funds not using debt financing. This estimate is statistically significant at the 1% level and nearly twice the magnitude of the estimate in Column 2 of Panel A. This is consistent with reports that funds use SLCs to delay capital calls primarily when they are young.

Finally, in Column 3 of Panel B, we include both fund age fixed effects and vintage fixed effects. The economic magnitude and statistical significance are quite similar to Column 2. This suggests that the association is not strongly related to a fund's vintage year.

## 5.2 Timing of Capital Calls

This subsection studies the relation between a private equity fund's use of subscription lines of credit and the timing of capital calls. Building on the previous findings, we explore how SLCs potentially shift the distribution of capital calls. For example, a fund using an SLC could delay calling its initial capital. Alternatively, it may prefer to delay capital called later in its life. The issue of timing of capital calls is an open empirical question.

To answer this question, we define  $Age_{i,25}$  as fund  $i$ 's age when it has first called more

than 25% of its capital from its limited partners. We analogously define  $Age_{i,50}$  and  $Age_{i,75}$  as the age when fund  $i$  called more than 50% and 75%, respectively, of its capital from its LPs.<sup>6</sup> We estimate the following specification using ordinary least squares:

$$Age_{i,c} = \beta \times SLC_i + \alpha_v + \varepsilon_i, \quad (3)$$

The subscript  $c$ , which equals 25, 50 or 75, indexes the fraction of capital that the fund has called. The coefficient of interest,  $\beta$ , represents the change in fund age, in years, for funds with SLCs compared to those funds not using SLCs when more than  $c\%$  capital is called from LPs. All specifications include vintage fixed effects, which are discussed below. Standard errors are robust.

We include vintage fixed effects to account for the possibility that the emergence of subscription lines of credit is correlated with the private equity cycle, which in turn may relate to the rate at which a fund calls its capital. For example, if funds of more recent vintages called their capital relatively quickly in response to especially strong investment opportunities, the association between  $SLC_i$  (which equals one more often for funds of recent vintages) and  $Age_{i,25}$  may be biased downward. Including vintage fixed effects accounts for this concern.

Table 5 reports the estimates of the relation between a fund's use of SLCs and the timing of its capital calls. Based on Column 1, we find that funds using SLCs tend to be about 2.5 months older when they call 25% of their capital. This estimate is statistically significant at the 10% level. It is about 9.5% of the sample average age when a fund has raised 25% of its capital. This is a moderate shift in the timing of a fund's capital calls.

In Column 2, we focus on  $Age_{i,50}$ , which is a fund's age when it has called 50% of its capital. We report that funds using SLCs are about 4.2 months older when they have called 50% of their capital. This effect represents a nearly 70% increase from the estimate in

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<sup>6</sup>Note this requires that a fund called at least 25%, 50% or 75% of its capital for the respective variable to be defined.

Column 1 and is highly statistically significant. It corresponds to an increase in age of almost 10.3%. Finally, in Column 3, we consider a fund’s age when it has called 75% of its capital,  $Age_{i,75}$ . The estimate is attenuated and is not statistically significant at conventional levels.

Figure 5 demonstrates when funds tend to delay capital calls. For each fund, we calculate the fraction of capital a fund has called through a given age divided by the fund’s respective size. The *horizontal* distance between the plotted lines represents the difference in the average timing of capital calls between funds with and without SLCs. The gap is largest in the center part of the figure (corresponding to fund ages between roughly 3 and 4 years) and smaller for relatively younger and older funds.

Taken together, this provides the first evidence that debt financing by private equity is linked to the timing of capital deployment by limited partners. Our findings suggest that, on average, funds using subscription lines of credit tend to delay “median” capital calls relatively more than early or late capital calls. This constitutes one of our systematic findings about the rise of a new source of capital by private equity funds.

## 6 Performance

This section examines the role of subscription lines of credit in adjusting performance measures for private equity funds. Section 6.1 studies the change in a fund’s internal rate of return by using an SLC. Section 6.2 examines the association between a fund’s multiples-based performance and use of a subscription line of credit.

### 6.1 IRR-Based Performance

In practice, the internal rate of return (IRR) is a key performance metric for private equity funds, despite its numerous and well-known flaws (Phalippou (2008)). A subscription line of credit could alter the timing of cash flows for a fund by delaying capital calls, as detailed in Section 5. By changing the timing of cash flows, a fund using a subscription line

of credit may have a substantially higher IRR, given the exact same set of investments in portfolio companies. This subsection evaluates the adjustment to a fund’s IRR by using a subscription line of credit.

Using the transaction-level data on a fund’s cash flows, we aggregate the data to an annual frequency for each fund in the sample. For each fund, we calculate two measures of its IRR. First, we calculate its IRR based on the cash flows observed in the data. Second, we calculate its IRR assuming that the fund would have called capital from its limited partners in exactly the same amount and the same year instead of using a subscription line of credit. We define the IRR difference,  $IRR_i^{Diff}$ , as the difference between the IRR based on the observed cash flows,  $IRR_i$ , and the IRR based on the assumption that capital calls substitute for SLC use,  $SyntheticIRR_i$ .

To study whether a fund’s internal rate of return changes with its use of a subscription line of credit, we estimate the following specification using ordinary least squares:

$$IRR_i^{Diff} = \alpha + \beta \times X_i + \varepsilon_i, \tag{4}$$

where  $X_i$  is either  $YoungFund_i$ , which is an indicator variable equaling one if the vintage year of a fund is 2014 or later, or  $Leverage_i$ , which is the ratio of a fund’s SLC use to the total capital invested. The unit of observation is a fund, and the sample is restricted to funds using SLCs. The intercept term,  $\alpha$ , represents the average difference between a fund’s IRR and its respective synthetic IRR. The covariates are discussed further below. Standard errors are robust.

In Column 1 of Table 6, we estimate the average difference of internal rates of return for funds using subscription lines of credit,  $IRR_i^{Diff}$ . We find that funds using SLCs, on average, have IRRs that are 6.1 percentage points higher. This coefficient is statistically significant at the 1% level. It is also economically meaningful, representing a 25.0% increase relative to the sample mean of a fund’s IRR based on the observed cash flows.

The effect of subscription lines of credit on a fund’s IRR tends to vary with its age, as illustrated for a hypothetical set of net cash flows in Figure 2. We extend the specification by including  $YoungFund_i$  as a covariate in equation 4. Column 2 reports that the estimate of  $\alpha$  drops to 0.7 percentage points and remains statistically significant at the 1% level. This suggests the IRRs of relatively older funds using SLCs tend to be inflated, but the magnitude is much lower compared to the estimate in Column 1. Additionally, we find that the effect is amplified for young funds, inflating IRRs by an average of 9.7 percentage points. This estimate is highly statistically significant and represents a 39.8% increase relative to the average IRR based on observed cash flows. It is also consistent with the hypothetical example illustrated in Figure 2.

Finally, we include  $Leverage_i$  as a covariate, instead of  $YoungFund_i$ . As in Section 4.2, we define  $Leverage_i$  as the ratio of a fund’s SLC use to its total capital invested, which includes subscription lines of credit and capital called from a fund’s limited partners. This variable is based on all available observations for a particular fund. Column 3 finds that the intercept term is statistically indistinguishable from zero and small in magnitude. This suggests that, as a fund’s leverage approaches zero and it does not rely on using a subscription line of credit, its IRR is not altered. We report that the coefficient on  $Leverage_i$  is 0.5, which is statistically significant at the 1% level. This represents an increase in a fund’s IRR of 4.3 percentage points, relative to the sample mean of leverage.

## 6.2 Multiples-Based Performance

An alternative measure of performance for private equity funds is based on capital distributed to investors relative to capital provided by limited partners. In this subsection, we focus on a particular multiple, the ratio of total value to paid-in capital (TVPI). Since subscription lines of credit change the timing of a fund’s cash flows, the use of an SLC by a fund might adjust its TVPI. Specifically, holding all else constant, a subscription line of credit might lower a fund’s TVPI since the interest and fees for an SLC would lower the

total amount of capital returned to investors.

For each fund using a subscription line of credit in our sample, we calculate the following two measures of TVPI. The total value for a fund is constructed by summing a fund's distributions to investors throughout its life and adding a fund's net asset value (NAV) for the last observation in the sample, which incorporates the value of investments that have not been realized yet. Paid-in capital is the sum of a fund's capital calls from its limited partners throughout its life. Then, we define  $TVPI_i$  as the ratio of total value to paid-in capital for fund  $i$ . Next, we calculate a measure of TVPI that incorporates a fund's use of SLCs, which we refer to as  $SyntheticTVPI_i$ . Subscription lines of credit reduce a fund's total value based on payments for interest expenses and fees. We assume that these payments are four percent per year and that a fund's subscription line of credit has a maturity of one year. Then, we construct  $SyntheticTVPI_i$  by adding four percent of a fund's average SLC use over its observed life to its total value. Since we focus on SLCs from 2014 to 2018, it is arguably reasonable to assume that interest expenses and fees are four percent of a fund's average SLC use based on the relatively low interest rates during this period.

We define the TVPI difference,  $TVPI_i^{Diff}$ , as the TVPI based on the observed cash flows and valuations,  $TVPI_i$ , less the TVPI based on the use of capital calls instead of subscription lines of credit,  $SyntheticTVPI_i$ . Similar to Section 6.1, we estimate equation 4 to evaluate the role of SLCs on a fund's TVPI.

Column 1 of Table 7 reports that a fund's TVPI, on average, decreases by 0.006, which is statistically significant at the 1% level. This is a 0.4% decrease relative to the sample mean of  $TVPI_i$ , which is consistent with the notion that SLC expenses, including interest and fees, reduce fund value and weaken TVPI-based performance. However, compared to the 25% increase in IRR for funds using SLCs, the decrease in TVPI is economically small.

We examine the importance of fund age in Column 2. We find that TVPI declines by 0.0028 for relatively old funds, which is statistically significant at the 1% level and relatively small compared to the average estimate of  $-0.006$  in Column 1. Additionally, we report that

TVPI decreases by 0.0058 for young funds, which are funds with a vintage year of 2014 or later. This estimate remains highly statistically significant and represents a 2.1-fold larger decline compared to the estimate for relatively old funds.

Lastly, in Column 3, we study the role of fund leverage on multiples-based performance. As in Section 4.2 and Section 6.1,  $Leverage_i$  is defined as the ratio of a fund's SLC use to the total capital invested, which includes subscription lines of credit and capital called from a fund's limited partners. We find that the intercept is statistically indistinguishable from zero and relatively small in magnitude. This suggests that a fund's TVPI is not impacted when its use of a subscription line of credit is close to zero. We report that the coefficient on  $Leverage_i$  is  $-0.0550$ . This relationship is statistically significant at the 1% level. A one standard deviation increase in  $Leverage_i$  represents a decrease of 0.0057 in TVPI. This is a decrease in TVPI of 0.40% relative to the sample mean  $TVPI_i$ .

Taken together, this section provides striking evidence about the role of subscription lines of credit on the reported performance of private equity funds. We find that SLCs tend to inflate measures of performance based on IRR. At the same time, we report that SLCs weaken multiples-based performance using the TVPI. These results suggest that a potential motivation for a fund's use of SLCs is to distort measures of performance.

## 7 Conclusion

In this paper, we document the recent and dramatic rise in private equity funds' use of debt via subscription lines of credit. We report that the aggregate amount of SLCs has increased from \$86.1 million in 2014 to \$5.3 billion in the first three quarters of 2018, representing a substantial increase in the use of debt by private equity funds. Fund-level leverage has similarly increased over this period from 11.8% in 2014 to 31.1% in 2018.

Private equity funds using subscription lines of credit tend to delay the use of equity capital from limited partners. In particular, we find that capital called from LPs is delayed

during the beginning to middle of the investment period. Additionally, we study the relation between performance and the use of debt by private equity funds. We find that funds using SLCs appear to have higher IRRs when debt substitutes for capital calls. We also provide evidence that SLC use depresses multiples-based fund performance, though this effect is economically smaller.

There are several important implications of these findings, which open up future avenues for research. First, our results highlight that private equity funds make active capital structure choices. The trade-offs facing these funds merit further study. Second, subscription lines of credit might reallocate capital from other asset classes to private equity. The extent and importance of any capital reallocation remains an open question. Third, the use of debt by private equity funds has not resulted in a significant default event yet. During a financial crisis, banks originating SLCs might be unwilling or unable to rollover debt provided to private equity funds. Future research could study whether defaults on subscription lines of credit may be systemically disruptive.



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Figure 1: Private Equity Structure

This figure displays the typical structure of a private equity fund. The private equity firm at the top of this figure is connected to its two private equity funds. The middle of the figure highlights that a private equity fund raises equity capital through commitments by limited partners at the beginning of the fund's life and subscription lines of credit. Portfolio companies, at the bottom of this figure, raise equity and debt capital from several sources, including private equity funds and banks. To our knowledge, this paper is the first to study the use of debt by private equity *funds*.

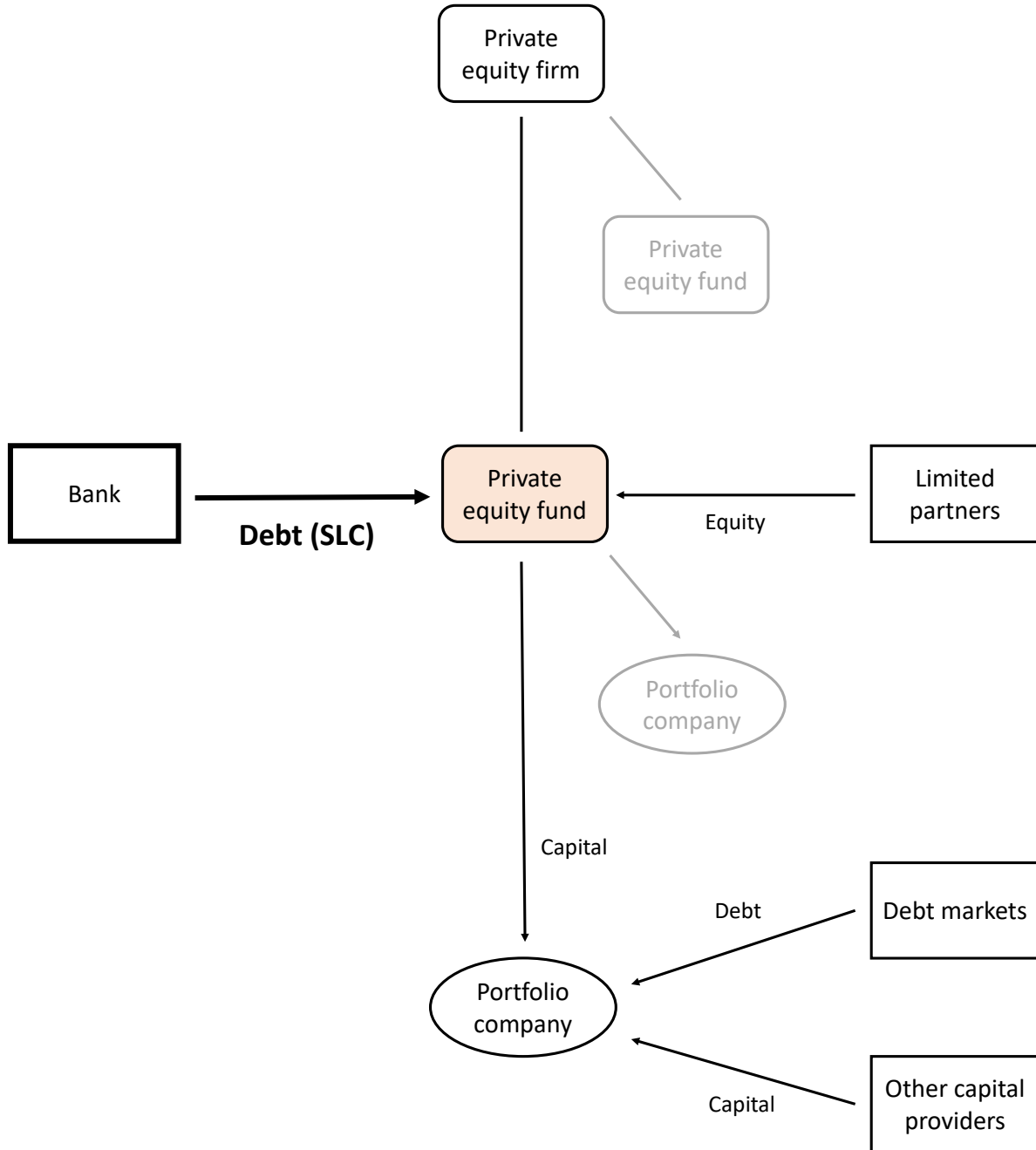


Figure 2: IRR and Subscription Lines of Credit – An Example

This figure presents the effect of subscription lines of credit use at different fund ages on the internal rate of return for a hypothetical set of cash flows. The net cash flows are plotted with the orange dotted line against the right axis. The IRR at fund liquidation associated with these cash flows is about 27.8% and is plotted with the dashed blue line against the left axis. The IRRs at fund liquidation associated with the use of a \$100 million SLC at various fund ages are plotted with the solid black line against the left axis. Specifically, the subscription line of credit increases the net cash flow by \$100 million in the year that it is used.

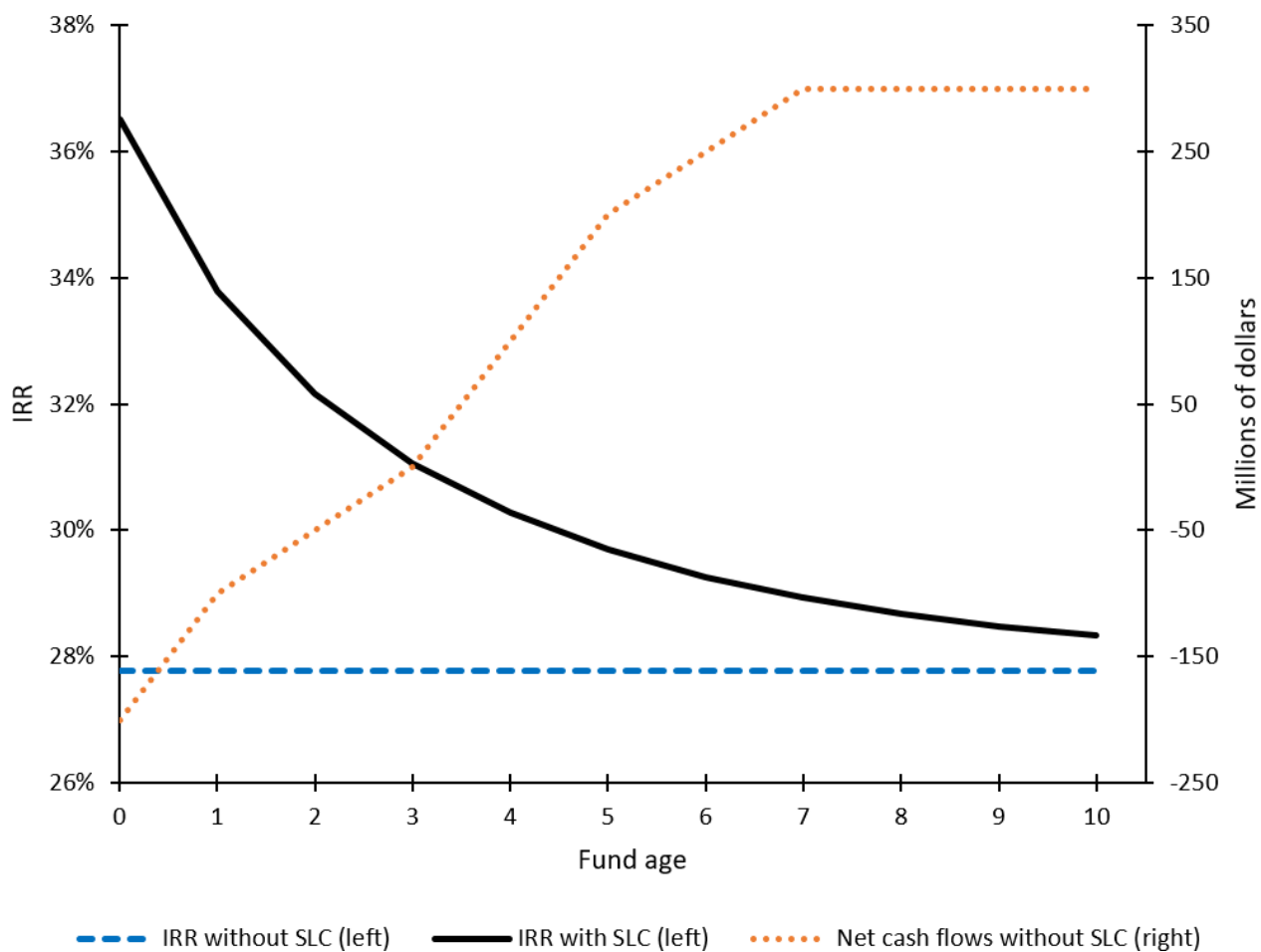


Figure 3: Subscription Lines of Credit

This figure shows aggregate use of subscription lines of credit from 2014 to 2018. The quarterly data on SLC use is averaged by fund within a year. Aggregate SLC use is adjusted for inflation and represents 2018 dollars.

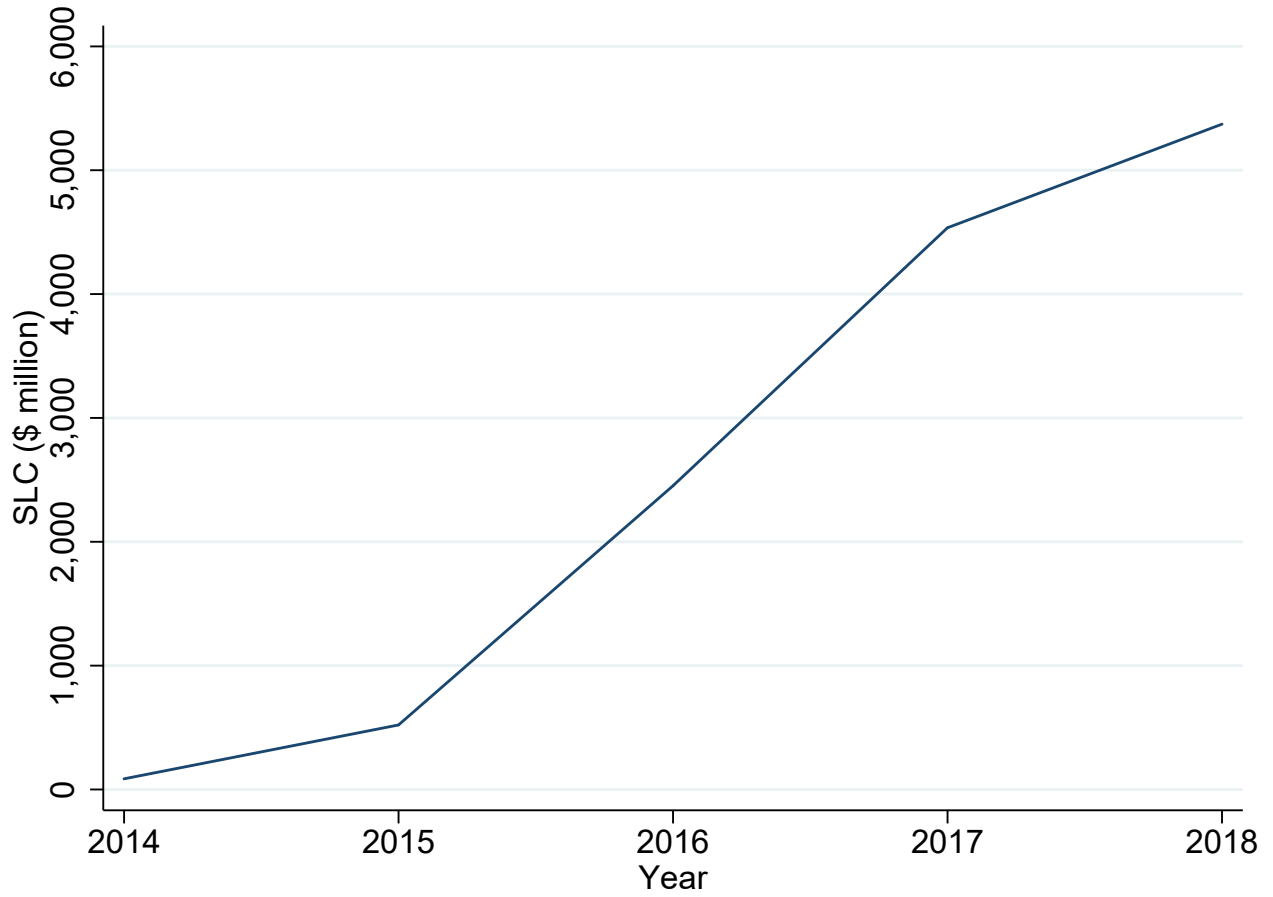


Figure 4: Leverage

This figure displays fund leverage from 2014 to 2018. Leverage is the ratio of a fund's SLC use to the total capital invested in a particular year, which includes subscription lines of credit and the total capital called from a fund's limited partners.

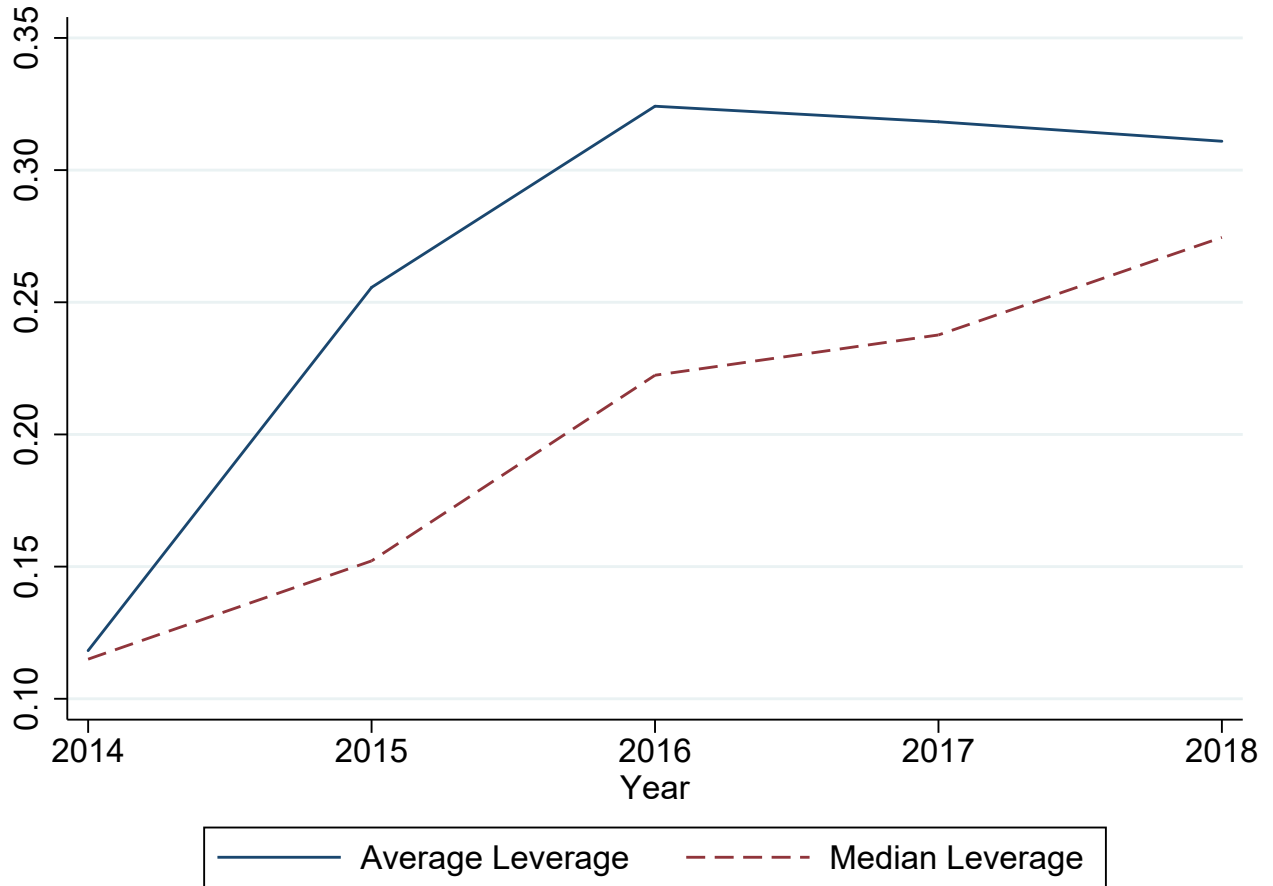


Figure 5: Capital Call Timing

This figure shows capital call timing for funds based on whether they use subscription lines of credit. The horizontal axis is demarcated by fund age, which is the number of years since a fund's first capital call. The vertical axis is the ratio of the capital called from its limited partners through a given age relative to the fund's size. The solid blue line plots the average ratio of capital called for funds using SLCs. The dashed red line plots the average ratio of capital called for funds that do not use SLCs.

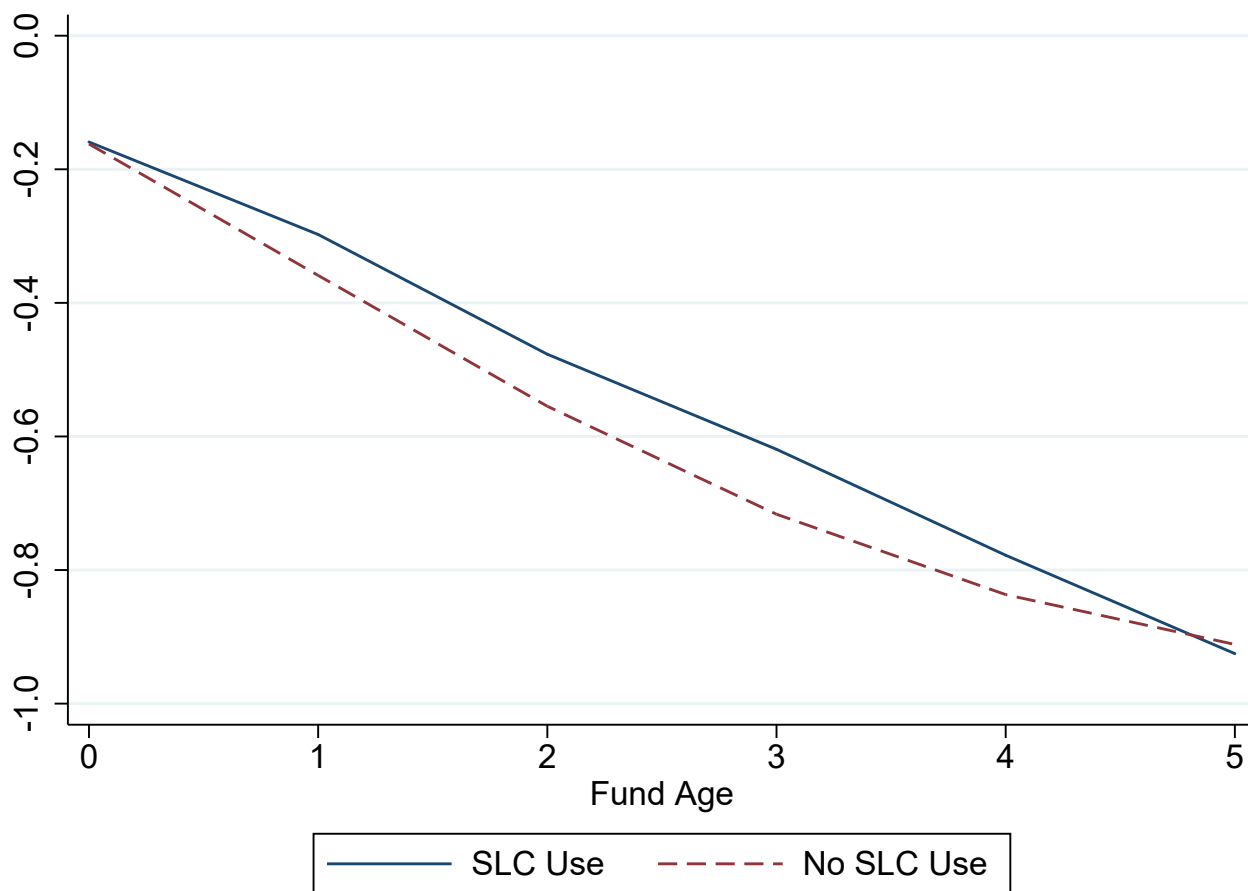




Table 1: Summary Statistics

This table provides summary statistics for the sample on capital calls in Panel A and for the sample on performance in Panel B.  $FundSize_i$  is the size of the private equity fund in millions of dollars.  $FundAge_{it}$  is the number of years since a fund's first capital call.  $EquityRatio_{it}$  is the ratio of the cumulative capital that a fund has called in a particular year divided by the fund's size.  $SLC_i$  is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life.  $Age_{i,c}$  is defined as fund  $i$ 's age when it has first called more than  $c\%$  of its capital from its limited partners.  $IRR_i$  is the internal rate of return for a fund based on its observed cash flows.  $SyntheticIRR_i$  is the internal rate of return for a fund based on the assumption that capital calls substitute for SLC use.  $TVPI_i$  is the ratio of a fund's total value to paid-in capital. The total value for a fund is constructed by summing a fund's distributions to investors throughout its life and adding a fund's net asset value (NAV) for the last observation in the sample, which incorporates the value of investments that have not been realized yet. Paid-in capital is the sum of a fund's capital calls from its limited partners throughout its life.  $SyntheticTVPI_i$  modifies the calculation of  $TVPI_i$  by assuming that total value is increased by four percent of a fund's average SLC use over its observed life.  $YoungFund_i$  is an indicator variable equaling one if the vintage year of a fund is 2014 or later.  $Leverage_i$  is the ratio of a fund's SLC use to the total capital invested.

Panel A: Capital Calls

Variable	Number of Observations	Mean	Median	Standard Deviation
$FundSize_i$	988	1,230.000	500.000	2,070.000
$FundAge_{it}$	4,144	8.554	8.000	5.077
$EquityRatio_{it}$	4,144	0.837	0.948	0.313
$EquityRatio_{it}$ for young funds	1,396	0.517	0.497	0.307
$SLC_i$	4,144	0.078	0.000	0.268
$Age_{i,25}$	928	2.211	2.000	0.889
$Age_{i,50}$	855	3.429	3.000	1.056
$Age_{i,75}$	770	4.709	5.000	1.348

Panel B: Performance

Variable	Number of Observations	Mean	Median	Standard Deviation
$IRR_i$	56	0.244	0.177	0.317
$SyntheticIRR_i$	56	0.183	0.151	0.225
$TVPI_i$	56	1.420	1.362	0.307
$SyntheticTVPI_i$	56	1.426	1.370	0.305
$YoungFund_i$	56	0.554	1.000	0.502
$Leverage_i$	56	0.117	0.085	0.104

Table 2: Subscription Lines of Credit

This table provides summary statistics on the use of subscription lines of credit by private equity funds from 2014 to 2018. The quarterly data on SLC use is averaged by fund within each year. Subscription lines of credit are adjusted for inflation and represent 2018 dollars.

Year	Number of Funds	Average (\$ million)	Median (\$ million)	Total (\$ million)
2014	6	14.4	14.6	86.1
2015	13	40.1	13.2	521.1
2016	33	74.3	23.7	2,452.5
2017	63	72.0	25.4	4,535.7
2018	72	74.6	19.4	5,372.3

Table 3: Leverage

This table examines leverage of private equity funds from 2014 to 2018. The quarterly data on subscription lines of credit use is averaged by fund within each year. Leverage is the ratio of a fund's SLC use to the total capital invested, which includes subscription lines of credit and capital called from a fund's limited partners.

Year	Number of Funds	Average	Median	Standard Deviation
2014	6	0.118	0.115	0.100
2015	13	0.256	0.152	0.292
2016	33	0.324	0.222	0.308
2017	63	0.318	0.238	0.272
2018	72	0.311	0.275	0.252

Table 4: Capital Calls and Debt

This table studies the relation between a fund’s use of subscription lines of credit and capital called from its limited partners. Panel A provides the estimates for the full sample. Panel B subsets to young funds, which is defined as funds with an age of five years or less. The outcome variable for each specification in this table is  $EquityRatio_{it}$ , which is the ratio of the cumulative capital that fund  $i$  has called in year  $t$  divided by the fund’s size. This variable is winsorized at the 1% level in each tail.  $SLC_i$  is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life. Standard errors are clustered by fund.

Panel A: Full Sample			
	(1)	(2)	(3)
$SLC_i$	-0.283*** (0.036)	-0.035* (0.021)	-0.039** (0.022)
Fund age fixed effects	No	Yes	Yes
Vintage fixed effects	No	No	Yes
R <sup>2</sup>	0.060	0.735	0.740
Observations	4,144	4,144	4,144
Sample mean	0.837	0.837	0.837

Panel B: Young Funds			
	(1)	(2)	(3)
$SLC_i$	-0.111*** (0.025)	-0.065*** (0.023)	-0.070*** (0.023)
Fund age fixed effects	No	Yes	Yes
Vintage fixed effects	No	No	Yes
R <sup>2</sup>	0.019	0.579	0.589
Observations	1,396	1,396	1,396
Sample mean	0.517	0.517	0.517

Table 5: Timing of Capital Calls

This table examines the relation between the use of subscription lines of credit and the timing of capital calls.  $Age_{i,c}$  is defined as fund  $i$ 's age when it has first called more than  $c\%$  of its capital from its limited partners.  $SLC_i$  is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life. Standard errors are robust.

Dependent variable	$Age_{i,25}$	$Age_{i,50}$	$Age_{i,75}$
	(1)	(2)	(3)
$SLC_i$	0.210* (0.117)	0.354*** (0.131)	0.168 (0.163)
Vintage fixed effects	Yes	Yes	Yes
R <sup>2</sup>	0.086	0.133	0.173
Observations	928	855	770
Sample mean	2.211	3.429	4.709

Table 6: IRR-Based Performance

This table studies the relation between a fund's use of a subscription line of credit and the adjustment to its internal rate of return. The outcome variable for each specification in this table is  $IRR_i^{Diff}$ , which is the IRR based on the observed cash flows less the synthetic IRR based on the assumption that capital calls substitute for SLC use.  $YoungFund_i$  is an indicator variable equaling one if the vintage year of a fund is 2014 or later.  $Leverage_i$  is the ratio of a fund's SLC use to the total capital invested. Standard errors are robust.

	(1)	(2)	(3)
Constant	0.061*** (0.018)	0.007*** (0.003)	0.002 (0.019)
$YoungFund_i$		0.097*** (0.031)	
$Leverage_i$			0.500** (0.239)
R <sup>2</sup>	0.000	0.125	0.143
Observations	56	56	56

Table 7: Multiples-Based Performance

This table examines the relation between a fund's use of a subscription line of credit and the adjustment to its total value to paid-in capital (TVPI). The outcome variable for each specification in this table is  $TVPI_i^{Diff}$ , which is the TVPI based on the observed cash flows and valuations less the synthetic TVPI based on the assumption that total value is increased by four percent of a fund's average SLC use over its observed life.  $YoungFund_i$  is an indicator variable equaling one if the vintage year of a fund is 2014 or later.  $Leverage_i$  is the ratio of a fund's SLC use to the total capital invested. Standard errors are robust.

	(1)	(2)	(3)
Constant	-0.0060*** (0.0009)	-0.0028*** (0.0009)	0.0005 (0.0006)
$YoungFund_i$		-0.0058*** (0.0016)	
$Leverage_i$			-0.0550*** (0.0075)
R <sup>2</sup>	0.000	0.179	0.689
Observations	56	56	56

## Appendix A Variable Definitions

This appendix provides definitions of the variables used in the analysis. The subscripts  $i$  and  $t$  index funds and years, respectively.

- $FundSize_i$  is the size of the private equity fund in millions of 2018 dollars.
- $FundAge_{it}$  is the number of years since a fund's first capital call.
- $Leverage_i$  is the ratio of a fund's SLC use to the total capital invested.
- $EquityRatio_{it}$  is the ratio of the cumulative capital that a fund has called in a particular year divided by the fund's size.
- $VintageYear_i$  is the first year that a fund calls capital.
- $SLC_i$  is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life.
- $Age_{i,c}$  is defined as fund  $i$ 's age when it has first called more than  $c\%$  of its capital from its limited partners.
- $IRR_i$  is the internal rate of return for a fund based on its observed cash flows.
- $SyntheticIRR_i$  is the internal rate of return for a fund based on the assumption that capital calls substitute for SLC use.
- $IRR_i^{Diff}$  is  $IRR_i$  less  $SyntheticIRR_i$ .
- $TVPI_i$  is the ratio of a fund's total value to paid-in capital. The total value for a fund is constructed by summing a fund's distributions to LPs throughout its life and adding the fund's net asset value (NAV) for the last observation in the sample, which incorporates the value of investments that have not been realized yet. Paid-in capital is the sum of the fund's capital calls from its limited partners throughout its life.
- $SyntheticTVPI_i$  modifies the calculation of  $TVPI_i$  by assuming that total value is increased by four percent of a fund's average SLC use over its observed life.



- $TVPI_i^{Diff}$  is  $TVPI_i$  less  $SyntheticTVPI_i$ .
- $YoungFund_i$  is an indicator variable equaling one if the vintage year of a fund is 2014 or later.