Private Equity Fund Debt: Capital Flows, Performance, and Agency Costs*

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Abstract

A subscription line of credit (SLC) is debt issued to a private equity fund and used on a continuing basis. Using new data on U.S. buyout funds, we show that when funds use subscription lines of credit they call less capital. We find that funds using SLCs have substantial distortions in performance measures sensitive to cash flow timing. SLCs are more common among poorly performing funds and increase carried interest along both the extensive and intensive margins. These results highlight the agency costs of SLCs arising from an underlying agency conflict between fund managers and investors.

JEL Classification: E22, G23, G32

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1 Introduction

Private equity funds primarily raise capital using equity from limited partners (LPs). Many funds also use debt financing in the form of subscription lines of credit (SLCs). An SLC is debt used by a private equity fund on a continuing basis, often for several quarters.[1] This source of capital for private equity funds is substantial, with an estimated $400 billion outstanding (Flood (2017)). However, little is known about the role of SLCs in private equity. In this paper, we study how subscription lines of credit relate to private equity funds' capital flows and performance, and whether SLCs generate agency costs from an underlying agency conflict between general partners (GPs) and investors.

We use unique data on subscription lines of credit by buyout funds from Burgiss, which are linked with their transaction-level data on capital calls, distributions and valuations. These data are representative of private equity investors and cover a substantial amount of committed capital (Harris, Jenkinson, and Kaplan (2014)). We ask three questions using these detailed data on SLCs and fund cash flows. First, how do funds using subscription lines of credit deploy capital from their limited partners? Second, do subscription lines of credit distort measures of fund performance? Third, are poorly performing funds more likely to use SLCs to improve their apparent performance and do SLCs alter fund manager compensation, potentially reflecting an agency conflict between managers and investors? This paper provides the first evidence on subscription lines of credit by investigating these questions.

We start by examining how subscription lines of credit relate to capital called from limited partners. On the one hand, GPs might reduce their capital calls when using an SLC. Alternatively, managers could deploy the proceeds from an SLC alongside capital from LPs, increasing their overall investments. To evaluate how funds adjust their capital calls, we construct the cumulative equity capital that a fund has called from its limited partners in a quarter relative to its size. We find that when funds use subscription lines of credit they

[1] This differs from debt for leveraged buyouts and venture debt, as discussed in Appendix B.

call significantly less capital from LPs, representing an 11.1% decline relative to the sample standard deviation. These estimates are amplified for young funds, which we define as an age of five years or less. Additionally, we show that the delay in capital calls tends to persist throughout a fund's life. These findings highlight that general partners actively choose their fund's capital structure, which appears to vary throughout a fund's life.

By reducing the amount of time that LPs provide capital to a fund, SLCs might distort a fund's internal rate of return (IRR), the most widely used measure of fund performance (Gompers, Kaplan, and Mukharlyamov (2016)). Using data on funds' cash flows linked with their use of SLCs, we calculate a fund's IRR and what its performance would have been without a subscription line of credit. This allows us to estimate the magnitude of the change in a fund's performance related to its SLC use.

We find that the annualized IRR for funds using subscription lines of credit significantly increases by 2.6 percentage points. This represents a 9.4% increase relative to the sample standard deviation of the IRR. We examine the role of fund age and find that the effect is amplified for comparatively young funds. Further, the distortion in a fund's IRR grows as it uses more leverage.

We also evaluate the role of subscription lines of credit in the investment multiple, which is the ratio of a fund's distributions and the value of its unrealized investments to the capital received from LPs. We find that the multiple for funds using SLCs decreases by an average of 0.006. This estimate is economically small, representing a 1.2% decrease relative to the sample standard deviation of the multiple. Although the change in the investment multiple related to SLCs is larger for young and more levered funds, the magnitudes remain economically negligible. These results are consistent with a reduction in a fund's value stemming from its interest expense from using an SLC. However, the estimates are small because subscription lines of credit primarily alter the timing of a fund's cash flows and the multiple is invariant to cash flow timing.

The public market equivalent (PME) is an additional measure of fund performance

based on a market adjustment (Kaplan and Schoar (2005) and Korteweg and Nagel (2016)). It compares a private equity fund's cash flows to a similarly-timed investment in public equity markets. Following the literature, we construct a fund's PME by growing its contributions and distributions by the return on the S&P 500 to the date of the fund's last observed cash flow. Then, we calculate PME as the ratio of a fund's aggregate distributions and net asset value in the last period to its aggregate contributions. Additionally, we calculate a fund's PME as if it did not use an SLC.

We find that the public market equivalent for funds using subscription lines of credit significantly increases by 0.036. This represents an 11.0% increase relative to the sample standard deviation of PME. These associations are larger for young and more levered funds. The estimated increase in a fund's PME and IRR related to SLC use is similar in economic magnitude. In addition to the IRR, an SLC could also alter a fund's public market equivalent because it reduces the time that a fund uses capital from LPs. Since LPs focus primarily on IRR to assess performance (Gompers, Kaplan, and Mukharlyamov (2016)), GPs who distort a fund's IRR may also change the fund's PME.

Next, we study whether the use of subscription lines of credit by private equity funds exacerbates agency conflicts between fund managers and investors. General partners are concerned about their relative performance since it is an important determinant in raising follow-on funds (Harris et al. (2014)) and subsequently impacts their compensation (Chung et al. (2012)). Accordingly, poorly performing funds have an incentive to use SLCs to increase their relative performance. This might produce agency costs stemming from an underlying agency conflict between GPs, who receive the benefits of higher apparent performance, and investors. Alternatively, fund managers might also use subscription lines of credit to call capital less frequently, which could reduce the administrative burden on their LPs. However, we find that there is no relationship between a fund's SLC use and the frequency of its capital

calls.[2]

We explore these potential agency costs by studying the relationship between a fund's relative performance and its use of subscription lines of credit. We find that funds ranked in the bottom quartile of performance in a given vintage are 8.3 percentage points more likely to use an SLC. This is both statistically significant and economically large, representing a 31.2% increase relative to the proportion of funds using an SLC. We also examine the relation between poorly ranked funds and subscription lines of credit along the intensive margin. Funds using SLCs in the bottom quartile of performance increase their leverage by 3.5 percentage points, or about 36.5% of the sample standard deviation of fund leverage.

Do poorly performing funds distort their performance based on the internal rate of return? To explore this question, we examine the relation between the change in a fund's IRR associated with SLC use and its relative performance. We find that funds using SLCs in the bottom quartile of relative performance increase their annualized IRRs by an additional 3.1 percentage points compared to funds in other quartiles. Overall, these findings suggest that poorly performing funds use subscription lines of credit to boost their apparent performance based on their IRR. This evidence is consistent with an underlying agency conflict by benefiting GPs at the expense of a fund's investors.

Last, we evaluate how subscription lines of credit impact the compensation of general partners by extending the model of Metrick and Yasuda (2010). This approach develops an expected revenue model to estimate the present value of carried interest. We adapt it to allow funds to delay calling capital from limited partners by using SLCs. We find that a fund using an SLC that represents 25% of its fund size for one year increases its carried interest by 1.4% on average. This estimate grows monotonically as the SLC is utilized for a longer period and is amplified when funds are close to their hurdle rate. The model also indicates that funds using SLCs are considerably more likely to reach the hurdle rate and

[2]In a recent working paper, Schillinger, Braun, and Cornel (2020) use a simulation to argue that subscription lines of credits are used for cash management purposes. We find no support for this argument using our detailed data on SLCs and fund cash flows.

receive carried interest earlier. These results are consistent with agency conflicts between fund managers and investors driving the use of subscription lines of credit.

This paper contributes to the literature on private equity, and particularly its performance.[3] Buyout funds generally outperform public equity markets net of fees (Harris, Jenkinson, and Kaplan (2014) and Robinson and Sensoy (2016)). Risk adjustments can produce different estimates of performance for private equity funds (Korteweg and Nagel (2016), Ang et al. (2018), and Gupta and Nieuwerburgh (2019)).[4] In a related working paper, Larocque, Shivey, and Stevens (2020) explore the difference between IRRs and annualized multiple-based returns. The findings are difficult to interpret since the paper assumes that all cash flows occur at the beginning or end of a fund's life, which is key to its analysis and contrary to cash flows at private equity funds. The paper also uses self-reported data on both fund performance and SLC use, which is limited to the extensive margin. In contrast, our paper uses subscription lines of credit by funds over time linked with high-quality transaction-level cash flows to study the relation between SLCs and capital flows, performance, and agency costs.

We also add to the broader literature about how asset managers influence their apparent performance. Private equity managers obscure actual returns when raising capital (Barber and Yasuda (2017) and Brown, Gredil, and Kaplan (2019)). Further, managers of mutual funds (Carhart et al. (2002)) and hedge funds (Ben-David et al. (2013)) tend to inflate their portfolio valuations by purchasing stocks they already own to improve their apparent performance. Asset managers also appear to strategically select mismatched benchmarks to meet their performance targets (Sensoy (2009)), temporarily overstate performance (Bollen and Pool (2009)), and window dress returns (Agarwal, Gay, and Ling (2014)). Our findings contribute to this literature by providing evidence that private equity fund managers inflate their apparent performance through the use of subscription lines of credit.

[3]Kaplan and Strömberg (2009) and Kaplan and Sensoy (2015) provide overviews of the private equity literature.

[4]Korteweg (2019) reviews the literature on risk-adjusting private equity returns.

Finally, our paper is related to the literature on agency conflicts between fund managers and investors. The financial structure of private equity funds appears to minimize these conflicts (Axelson, Strömberg, and Weisbach (2009)). However, agency costs are not completely dissipated because information asymmetry persists between fund managers and investors (Jensen and Meckling (1976)). Robinson and Sensoy (2013) find evidence of agency frictions based on the distribution behavior of private equity funds. Additionally, agency conflicts also exist between venture capital funds and limited partners during fundraising (Chakraborty and Ewens (2017)). Our results complement these findings by highlighting how poorly performing buyout funds are more likely to use subscription lines of credit, which also increases manager compensation through carried interest.

2 Subscription Lines of Credit

In this section, we provide a detailed description of subscription lines of credit. Section 2.1 offers institutional features of SLCs. Section 2.2 examines a hypothetical example about how SLCs can alter a fund's capital flows and performance.

2.1 Institutional Context

Subscription lines of credit are debt issued to a private equity fund and utilized on a continuing basis. SLCs are distinct from debt financing at the level of either the portfolio company or the private equity firm. In this paper, we focus exclusively on subscription lines of credit used by private equity funds. This is the first paper to systematically study this source of capital.

Figure 1 illustrates the typical structure of a private equity firm and one of its private equity funds. The private equity firm at the top of this figure is connected to its private equity fund. 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, general partners (GPs) will draw down these commitments using capital calls. The middle of this figure also highlights that subscription lines of credit can be used by a fund as an alternative source of capital. Since an SLC is debt issued to a fund and used on a continuing basis, it differs from debt for leveraged buyouts and venture debt, which are discussed in Appendix B. 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.

Next, we provide institutional details about subscription lines of credit, including the typical type of debt contract, pricing, maturity, collateral, and covenants.[5] 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 often based on LIBOR plus a spread. In addition to the interest expense, an SLC might include an upfront fee. Throughout the paper, we refer to interest on SLCs and related fees as interest expense. Interest expense is paid by the fund. Since SLCs are mainly used during a fund's investment period, we assume in our analysis that the interest expense is paid with contributions from LPs. 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.[6] Unfunded capital commitments are the portion of committed capital that has not been called yet. Last, SLCs may include a range of covenants. An example of a covenant is a limit on the ratio of unfunded capital commitments to the fund's total debt. Anecdotal evidence suggests private equity funds rarely default on their SLCs.[7]

Why do private equity funds use subscription lines of credit, and what frictions might

[5]This information is drawn from Institutional Limited Partners Association (2017), Beekman, Bowman, and Brown (2014), Flood (2017), Petkanics, Pirraglia, and Oberdorf III (2018), and discussions with industry participants.

[6]Limited partner agreements allow private equity funds to use capital commitments as collateral.

[7]An exception is the default by Abraaj Holdings on its credit line in 2018, as described in Kerr and Sender (2018).

arise from this form of financing? One of the main explanations for the use of SLCs is the ability for fund managers to reduce the frequency of capital calls. If it is administratively costly to disburse capital each time a deal is closed, limited partners might prefer to provide capital less often. Alternatively, the use of a subscription line of credit could alter a fund's apparent performance and the compensation generated for its GPs. In particular, by shortening the period of outflows, or negative cash flows, performance measures sensitive to cash flow timing might increase. SLCs could also generate agency costs because of an underlying agency conflict between managers and investors.

2.2 SLCs, Cash Flows, and Fund Performance: An Example

This section provides a hypothetical example illustrating how subscription lines of credit can alter a fund's cash flows and impact its apparent performance. First, we explain how an SLC changes a fund's gross and net cash flows. Then, we describe how SLC use distorts fund performance.

To illustrate how an SLC might change a private equity fund's cash flows, we construct a hypothetical, yet realistic, example. Suppose a fund operates for 10 years and, as a base case, does not use an SLC. Additionally, assume that it raised $500 million in committed capital. Table A1 provides the cash inflows from LPs to this fund and cash outflows from the fund to LPs in columns 1 and 2, respectively. Cash inflows, or contributions, are initially large, as the fund calls committed capital to invest in portfolio companies. In contrast, the fund's cash outflows, or distributions, ramp up over its life, as some portfolio companies achieve successful exits, such as through acquisitions or initial public offerings. The fund's net cash flows in each year, in column 3, are simply the sum of its contributions and distributions.

Next, we consider how these cash flows change if the same fund uses a subscription line of credit. Specifically, we assume that the fund borrows $100 million using an SLC with an annual 4% interest expense over the course of year two. Column 4 indicates that $100 million is received by the fund in year two, which is repaid the following year. The fund

uses the SLC to delay calling some of the capital it would have raised in year two until year three. Consequently, contributions are reduced by $100 million in year two and increase by $100 million in year three. The 4% interest rate leads to a $4 million interest expense at the SLC's maturity, which is recorded in column 5. Since funds tend to use SLCs during the investment period, we assume that interest expense is paid using contributions. Column 6 reports the outflows when the fund uses an SLC, including both the altered contributions and the interest expense. The distributions of the fund are the same when it uses an SLC, as indicated by column 7. Column 8 is the net cash flow of the fund when it uses an SLC. This example demonstrates that the SLC impacts net cash flows in years two and three. In particular, the net cash flow in year two rises by $100 million from −$150 million to −$50 million, while the net cash flow in year three declines by $104 million from −$125 million to −$229 million. Figure 2 plots the effect of the SLC on fund contributions for this example.

The use of an SLC by a private equity fund results in two changes. First, when a fund uses an SLC, its contemporaneous net cash flows increase. By shifting cash inflows later in a fund's life, the fund's IRR increases. Second, net cash flows aggregated over the life of the fund are reduced by the interest expense. This has a relatively small and negative impact on a fund's IRR. In this example, the IRR increases by one percentage point. The interest expense also decreases a fund's investment multiple. An SLC can alter a fund's PME by shortening the time that capital is called from LPs. The PME might also change if SLC use varies with S&P 500 returns. In our sample, the average (median) age when a fund first utilizes an SLC is 14 (11) quarters. This motivates us to replicate our key analyses on a sample limited to young funds.

3 Data and Descriptive Statistics

We describe the data on subscription lines of credit since this is the first paper to use these data. Fund managers provide details about their use of subscription lines of credit in the

quarterly financial reports sent 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.[8] The data on subscription lines of credit is supplemented by Burgiss with transaction-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 alternative 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, of which 60% is from pensions and 20% is from endowments (Harris, Jenkinson, and Kaplan (2014)).[9]

We link data on subscription lines of credit with high-quality transaction-level cash flows at buyout funds.[10] Following the literature, we restrict our sample to funds with a geographical focus in North America and start with vintages in 1993 (Harris, Jenkinson, and Kaplan (2014)). To calculate performance measures, the last vintage in our sample is 2016. To avoid potentially disclosing confidential information, our analyses primarily focus on SLC data from 2014Q2 to 2019Q1.

Table 1 contains descriptive statistics for subscription lines of credit based on funds using SLCs in our sample. Observations are at the fund level. We define $SLC\,amount$ as the average SLC amount when a fund uses an SLC. The average is about \$61 million and the median is nearly \$17 million. There is also substantial variation in the size of subscription lines of credit, as the standard deviation of $SLC\,amount$ is \$160 million. Among funds using SLCs, the average fund size, as measured by total committed capital, exceeds \$1.2 billion,

[8]Data on subscription lines of credit are generally based on information from the balance sheet in a quarterly report. Each report is manually reviewed for details about a fund's liabilities.

[9]Burgiss data currently represent more than \$7.3 billion in committed capital for private capital markets, with about \$4.5 billion in buyout and venture capital. Kaplan and Lerner (2016) provides further details about the Burgiss data. Brown et al. (2015) compares the main commercial sources of private equity data.

[10]We focus on buyout funds because data on venture capital funds are not available.

with a median of $450 million. *Leverage* is defined as the ratio of a fund's average SLC amount to its average cumulative capital called, where each average is calculated over the fund's life. The mean value of this variable is 5.8%. Finally, the average age of a fund is 23.4 quarters.

Table 2 contains summary statistics for the other variables analyzed in this paper. Panel A details the sample on capital calls, where the unit of observation is at the fund-quarter level. The mean of *Equity called*, which is defined as the cumulative capital called in a quarter relative to a fund's size, is about 85%. This ratio drops to 56.1% for funds whose age is five years or less. To mitigate the influence of outliers, we winsorize this variable at the 1% level in each tail. Funds using subscription lines of credit represent about 30% of this sample. The ratio of a fund's SLC amount to the fund's size, *SLC ratio*, averages 60 basis points. We use Age_{25}, Age_{50}, and Age_{75} to denote the age in quarters when a fund deploys more than 25%, 50%, and 75% of its capital from its limited partners, respectively. We also winsorize each of these variables at the 1% level in each tail. The average age when a fund deploys 50% of its capital from its limited partners is 9.6 quarters.

Panel B provides fund-level summary statistics on performance measures for private equity funds that use a subscription line of credit. We calculate a fund's IRR using its net cash flows at a quarterly frequency, since the SLC data is provided each quarter. The quarterly IRR for private equity funds using SLCs is 2.8%, on average. If we assume that capital calls substitute for SLCs in the same quarter, then the quarterly IRR decreases to 2.1%. We refer to this performance measure as *Unlevered IRR*. The investment multiple, which we refer to as *Multiple*, averages about 1.45. We similarly construct *Unlevered multiple* by assuming that capital is called from LPs rather than using subscription lines of credit, which is only larger than *Multiple* due to the absence of interest expenses.[11] Last, we measure performance using the public market equivalent, PME, as developed by Kaplan

[11] Our baseline analyses assume that the quarterly interest expense is 1% of a fund's outstanding SLCs at the end of the previous quarter. We verify the robustness of our findings to alternative interest expenses in Section 5.4.

and Schoar (2005). The average PME is 1.13. Its unlevered analog, $Unlevered\,PME$, is somewhat lower.

4 Capital Calls

In this section, we study the link between the use of subscription lines of credit by private equity funds and equity from limited partners. Section 4.1 examines how SLCs relate to the amount of equity used by a fund. Section 4.2 investigates the association between SLC use and the frequency of capital calls. Section 4.3 explores the relationship between subscription lines of credit and the timing of capital calls.

4.1 Equity Called

Subscription lines of credit provide managers of private equity funds with an additional source of capital. On the one hand, SLCs might substitute for capital calls. Alternatively, SLCs might allow fund managers to increase the overall amount of capital deployed at a given time.

To study the amount of equity called by a fund, we construct a panel of fund-quarter observations. We define *Equity called* as the ratio of the cumulative capital that fund i has called in quarter t to the fund's size. SLC is an indicator variable 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:

$$Equity\,called_{it} = \beta \times SLC_i + \alpha_a + \alpha_v + \varepsilon_{it}. \tag{1}$$

The coefficient of interest, β, is the association between the equity called by a fund in a particular quarter and whether it uses a subscription line of credit. We denote fund age and vintage fixed effects by α_a and α_v, respectively. Standard errors are clustered by fund.

Funds do not randomly use subscription lines of credit. Accordingly, while we provide the first evidence about the role of SLCs in private equity, we do not interpret these estimates as causal. We retain this interpretation for all specifications in the paper.

Panel A of Table 3 reports the findings for the full sample. In column 1, we include fund age fixed effects because there is variation in when a fund calls capital over its life. We find that funds using SLCs call proportionally 2.5 percentage points less equity than funds that do not use SLCs. This represents a 8.4% decrease compared to the sample standard deviation. We also include vintage fixed effects, in addition to fund age fixed effects, in column 2. The vintage fixed effects account for time-varying trends in capital call activity potentially associated with the private equity cycle or macroeconomic fluctuations.[12] We find that the proportion of equity called by funds using SLCs decreases by 3.3 percentage points. The magnitude of the estimate is similar to column 1, which suggests that the decline in equity called by funds using SLCs is not driven by their vintage year.

Since private equity funds mainly invest toward the beginning of their life, Panel B of Table 3 restricts the sample to young funds, which we define as a fund age of five years or less. In column 1, we find that young funds using subscription lines of credit tend to use 8.2 percentage points less equity relative to fund size. This estimate is more than three times larger than the estimate in column 1 of Panel A, which is consistent with funds using SLCs to delay capital calls primarily when they are young. Column 2 includes both fund age fixed effects and vintage fixed effects. The economic magnitude and statistical significance are quite similar to column 1. This result again suggests that the decrease in equity called by funds using SLCs is not related to their vintage year.

Overall, the results in Table 3 indicate that funds using subscription lines of credit call less capital from limited partners. The estimates above examine the extensive margin of SLC use. In Table A2, we repeat these specifications based on the intensive margin of SLC use and find similar results.

[12] Gompers and Lerner (2004) and Robinson and Sensoy (2016) provide an overview of cyclicality in private equity and venture capital.

4.2 Frequency of Capital Calls

Next, we examine the association between a fund's use of subscription lines of credit and the frequency with which GPs call capital from their limited partners. LPs could prefer the reduced administrative burden of less frequent capital calls. Based on a simulation, Schillinger, Braun, and Cornel (2020) argue that SLCs are used primarily for this cash flow management purpose.

We use our detailed data on SLCs to study the association between SLC use and the frequency of capital calls. We re-estimate equation 1 and replace the outcome variable with *Number capital calls*, which is defined as the number of times that a fund calls capital from its limited partners in a given quarter. To mitigate the influence of outliers, we winsorize this variable at the 1% level in each tail. Panel A of Table A3 reports the results for the full sample. We find that the relation between SLCs and the number of capital calls by a fund's managers is economically negligible and statistically insignificant. The estimates are similar when we examine young funds in Panel B of Table A3.

These results do not support the hypothesis that funds use SLCs for cash flow management. In Section 6, we discuss and present evidence instead linking funds' use of SLCs to agency conflicts between funds' managers and investors.

4.3 Timing of Capital Calls

This subsection studies the relation between a private equity fund's use of SLCs and the timing of its capital calls. We define Age_{25} as a fund's age in quarters when it has first called more than 25% of committed capital from its limited partners. We analogously define Age_{50} and Age_{75} as the age when a fund has called more than 50% and 75%, respectively, of committed capital from its LPs.[13] We estimate the following fund-level specification using

[13]Note this requires that a fund called at least 25%, 50%, or 75% of committed capital from its LPs for the respective variable to be defined.

ordinary least squares:

$$Age_{ic} = \beta \times SLC_i + \alpha_v + \varepsilon_{ic}, \tag{2}$$

where the subscript c, which is 25, 50, or 75, indexes the fraction of capital that the fund has called. The coefficient β represents the difference in fund age when more than c% of committed capital is called for funds with SLCs compared to those funds not using SLCs. We include vintage fixed effects to absorb time-invariant heterogeneity by vintage, including potential correlation between the emergence of subscription lines of credit and the private equity cycle. Standard errors are robust.

Table 4 reports the estimates of the relation between a fund's use of SLCs and the timing of its capital calls. In column 1, we find that funds using SLCs tend to be about 0.8 quarters older when they call 25% of their capital, which is a 23.7% increase compared to the sample standard deviation. In column 2, we focus on Age_{50} and report that funds using SLCs are nearly 1.4 quarters older when they have called 50% of their capital. This estimate is almost two times larger relative to the estimate in column 1 and corresponds to an increase in age of about 33.8% compared to the sample standard deviation. Finally, in column 3, we find that funds using SLCs are approximately 1.6 quarters older when they have called 75% of their capital. This estimate again increases relative to the preceding columns.

Taken together, these results highlight that debt financing by private equity funds is linked to the timing of capital deployment from limited partners. They motivate our analysis of the connection between subscription lines of credit and fund performance, which can be impacted by cash flow timing. The findings illustrate that GPs make active capital structure decisions for their funds and this capital structure appears to vary over the course of a fund's life.

5 Performance

This section examines the role of subscription lines of credit in performance measures for private equity funds. Section 5.1 studies the change in a fund's internal rate of return related to using an SLC. Sections 5.2 and 5.3 examine the association between SLC use and a fund's multiples- and market-based performance, respectively. Section 5.4 assesses the robustness of these results to alternative assumptions about the interest expense for subscription lines of credit.

5.1 Internal Rate of Return

The internal rate of return is a key performance measure for private equity funds (Gompers, Kaplan, and Mukharlyamov (2016)), despite its numerous and well-known flaws (Phalippou and Gottschalg (2008) and Phalippou (2008)). Subscription lines of credit alter the timing of cash flows for a fund by delaying its capital calls, as shown in Section 4. By changing the timing of cash flows, a fund using a subscription line of credit may have a substantially higher IRR. This subsection evaluates the change in a fund's IRR associated with using an SLC.

We use transaction-level data on funds' cash flows at a quarterly frequency. For each fund, we calculate two measures of its IRR.[14] First, we calculate its IRR based on the cash flows observed in the data, which we refer to as IRR. Second, we calculate its IRR assuming that the fund would have called capital from its limited partners in the same amount and the same quarter instead of using a subscription line of credit, which we term $Unlevered\ IRR$. We also adjust the fund's cash flows for interest expense on its SLC. We assume that interest expense is 1% per quarter, which is paid based on a fund's outstanding subscription line of

[14] If the sum of the net cash flows is greater than zero, we define the IRR as the smallest positive root. If the sum of the net cash flows is less than zero, we set the IRR to the largest negative root. If the sum of the net cash flows is zero, we define the IRR to be zero. If these conditions are not satisfied for a fund's net cash flows or if the IRR is less than -100%, we set the IRR to missing.

credit in the previous quarter.[15] We define the adjustment in IRR due to an SLC, ΔIRR, as the IRR based on the observed cash flows less $Unlevered\,IRR$. We winsorize ΔIRR at the 1% level in each tail to mitigate the influence of outliers.

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:[16]

$$\Delta IRR_i = \alpha + \beta \times X_i + \varepsilon_i, \tag{3}$$

where X_i is either $Young\ fund$, which is an indicator variable equaling one if a fund's age is five years or less, or $Leverage$, which is the ratio of a fund's average SLC amount to the average amount of capital called. The analysis is performed at the fund level, and the sample is restricted to funds using SLCs. The constant term, α, represents the average difference between a fund's IRR and its $Unlevered\,IRR$. Standard errors are robust.

First, we examine the average change in a fund's IRR when it uses a subscription line of credit. In column 1 of Table 5, we find that SLC use is associated with a 65 basis point increase in quarterly IRR, which annualizes to 2.6 percentage points.[17] This value is statistically significant at the 1% level. The estimate represents a 9.4% increase relative to the sample standard deviation of IRR.

Next, we explore how the association between a fund's SLC use and its IRR varies with fund age. We extend the specification by including $Young\ fund$ as a covariate in equation 3. Column 2 reports that the estimate of α drops to 13 basis points and is statistically significant. This suggests the IRRs of older funds using SLCs tend to be inflated, but that the magnitude is lower compared to the estimate in column 1. Additionally, we find that the effect is amplified for young funds, inflating annual IRRs by an average of 4.3 percentage

[15] In Section 5.4, we show that our results are robust to interest expenses of 0.5% or 1.5%, in addition to a time-varying interest expense of LIBOR plus 50 basis points.

[16] We do not include vintage fixed effects because the outcome is the difference between two measures of IRR for the same fund. Additionally, in the presence of fixed effects, the change in a fund's IRR associated with using an SLC, which is estimated by the constant term, is inherently difficult to interpret.

[17] Note that the R^2 is necessarily zero for this specification since it does not include any covariates.

points. This estimate represents a 15.5% increase compared to the sample standard deviation of IRR.

Finally, we include *Leverage* as a covariate, instead of $Young\ fund$. In column 3, we find that funds using relatively more leverage significantly increase their IRRs. A one standard deviation increase in leverage is related to a 15.4% increase in a fund's IRR relative to the sample standard deviation of IRR. The constant term in this specification is nearly zero. It is inherently difficult to interpret since the coefficient corresponds to a value of zero for *Leverage*, although the sample is conditioned on SLC use.

In a related working paper, Larocque, Shivey, and Stevens (2020) study the difference between private equity funds' IRRs and their annualized multiple-based returns, and construct a "gap" between these measures. Their multiple-based return assumes that a fund invests all of its committed capital at the start of its life and only distributes capital at the end of its life. This assumption is inconsistent with cash flows at private equity funds and changes the gap. The authors find no relation between SLC use and their performance gap. There are several possible explanations for the lack of a relation. First, they use data from Preqin, which is self-reported and hence subject to well-established accuracy concerns (Kaplan and Lerner (2016)). Second, their data only indicate whether a fund uses an SLC, and not its variation over time. Third, they estimate fund life for more than half of their sample, which is used to calculate annualized multiple-based returns when cash flow data are not available. In contrast, we use high-quality and verified data on transaction-level cash flows linked to a fund's quarterly use of SLCs, allowing us to reliably estimate the relation between subscription lines of credit and specific measures of performance.

5.2 Investment Multiple

An additional measure of performance for private equity funds is based on capital distributed to limited partners and the value of a fund's unrealized investments relative to capital provided by LPs, which is referred to as a fund's investment multiple. Since

subscription lines of credit alter a fund's cash flows, the use of an SLC by a fund might change its multiple. Specifically, a subscription line of credit might lower a fund's investment multiple since the interest expense for an SLC is paid with contributions from LPs.

For each fund using a subscription line of credit in our sample, we calculate the following two multiples. We define $Multiple$ as the ratio of 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. Next, we calculate a multiple based on the assumption that capital calls substitute for subscription lines of credit. We continue to assume that interest expense is 1% per quarter based on a fund's outstanding SLC in the previous quarter. We construct $Unleveredmultiple$ by assuming the paid-in capital is reduced by the interest expense for an SLC. We define $\Delta Multiple$ as $Multiple$ less $Unleveredmultiple$, and winsorize this difference at the 1% level in each tail to mitigate the influence of outliers. As in Section 5.1, we estimate equation 3 to evaluate the association between SLC use and the change in a fund's investment multiple.

In column 1 of Panel A in Table 6, we report that a fund's multiple, on average, significantly decreases by 0.006, which is consistent with the notion that interest expense for an SLC reduces fund value and subsequently reduces its investment multiple. This represents a 1.2% decrease relative to the sample standard deviation of $Multiple$. Compared to the 9.4% increase in IRR for funds using SLCs, the decrease in a fund's multiple is economically small.

We examine the importance of fund age in column 2. We find that the multiple significantly declines by 0.004 for relatively old funds, which is somewhat smaller than the average estimate in column 1. Additionally, we report that the multiple significantly decreases by a further 0.004 for young funds.

Last, in column 3, we study the role of fund leverage in multiples-based performance.

Recall that *Leverage* is the ratio of a fund's average SLC amount to the average amount of capital called. We find that a one standard deviation increase in leverage is associated with a 1.4% decrease in a fund's multiple compared to the sample standard deviation of $Multiple$. The constant remains negative, but, as in the case of IRR, it is difficult to interpret since the sample is conditioned on SLC use and the constant corresponds to *Leverage* of zero.

5.3 Public Market Equivalent

A final common measure of private equity performance is the public market equivalent, which can adjust for market risk (Kaplan and Schoar (2005) and Korteweg and Nagel (2016)). Intuitively, PME compares a private equity investment to a similarly timed investment in the S&P 500. We track each fund's contributions by LPs and distributions to LPs, allowing these cash flows to grow at the same rate as the S&P 500. Then, we divide the aggregate value of the fund's distributions and its net asset value (if applicable) by the aggregate value of its contributions. A PME greater than one suggests that a fund has outperformed public markets, while a PME less than one implies it has underperformed.

We calculate two measures of the PME for each fund in our sample. We define PME as the public market equivalent based on the observed cash flows and valuation. We also repeat this calculation and adjust fund contributions to account for SLC use and the associated interest expense, which we define as $UnleveredPME$. ΔPME is defined as PME less $Unlevered\,PME$. To mitigate the influence of outliers, we winsorize this variable at the 1% threshold in each tail. As in Sections 5.1 and 5.2, we estimate equation 3 to evaluate the association between SLC use and ΔPME.

In Panel B of Table 6, column 1 indicates that SLC use is associated with a significant increase of 0.036 in PME, which represents an 11.0% increase relative to the standard deviation of PME. In column 2, we find that PME significantly increases by 0.014 for relatively old funds. For comparatively young funds, PME significantly rises by a further 0.045. In column 3, we evaluate whether the adjustment in PME is related to fund leverage, which is

the ratio of a fund's average SLC amount to the average amount of capital called. We find that a one standard deviation increase in leverage is associated with a 15.5% increase in a fund's public market equivalent compared to the standard deviation of PME. The constant remains difficult to interpret, since the sample is conditional on using an SLC.

The change in a fund's PME related to using subscription lines of credit is economically similar to the association between SLCs and a fund's IRR. Since SLCs delay a fund's capital calls, their use can alter a fund's PME by reducing the time that a fund uses capital from LPs. Additionally, PME might be impacted if SLC use varies with S&P 500 returns. Since LPs primarily assess fund performance using IRR (Gompers, Kaplan, and Mukharlyamov (2016)), fund managers have an incentive to distort performance based on IRR, which in turn may also change a fund's PME.

Taken together, Sections 5.1-5.3 provide strong evidence demonstrating the importance of subscription lines of credit in the performance of private equity funds. We find that SLCs are related to increases in performance measures that are sensitive to cash flow timing, which include a fund's IRR and PME. We also show that the association between SLC use and the investment multiple is negligible. These results suggest that a fund might be motivated to use SLCs to distort its apparent performance.

5.4 Robustness

We extend the analysis in this section by examining the robustness of the performance results to different assumptions about the interest expense for subscription lines of credit. The preceding analyses assumes that the interest expense for an SLC is 1% per quarter. We evaluate the sensitivity of our results to a lower fixed quarterly rate of 0.5%, a higher fixed quarterly rate of 1.5%, and a time-varying quarterly rate of LIBOR plus 50 basis points.[18]

In Table 7, we present the results from this sensitivity analysis for each of the perfor-

[18]LIBOR at a daily frequency ranges from 0.5% to 3.1% over the sample period. We average LIBOR within a quarter and convert it to a quarterly rate.

mance measures. Each specification estimates the baseline result using equation 3, omitting the covariates. In Panel A, we find that, using alternative assumptions for the interest expense, the change in a fund's quarterly IRR is quite similar to the baseline estimate of 65 basis points and remains statistically significant at 1% level. In Panel B, we explore the role of different interest expenses in a fund's investment multiple. We show that the association between a fund's use of an SLC and its multiple continues to be economically small, while the estimates are still highly statistically significant. In Panel C, we consider the sensitivity of a fund's public market equivalent to alternative SLC interest expenses. Compared to the baseline estimate of 0.036, we find that the change in a fund's PME is nearly the same.

Overall, the performance results are highly robust across a variety of alternative interest expense assumptions. This implies that our findings are primarily driven by the changes in the timing of a fund's cash flows due to a subscription line of credit.

6 Agency Costs

This section examines the agency costs that may arise due to private equity funds' use of subscription lines of credit. Section 6.1 studies the relationship between funds' relative performance and the use of SLCs. Section 6.2 uses a model to estimate the impact of subscription lines of credit on GP compensation through carried interest.

6.1 Relative Performance and Subscription Lines of Credit

Fund managers are commonly evaluated based on their performance compared to other funds of the same vintage. This provides a benchmark to measure a fund's performance relative to the economic conditions in the year when the fund raised its capital commitments. Managers are concerned about their relative performance because it strongly relates to their ability to raise follow-on funds (Harris et al. (2014)) and accordingly impacts compensation over their career (Chung et al. (2012)). Consequently, poorly performing funds have an

incentive to boost their relative performance by using a subscription line of credit. This incentive reflects an agency conflict, since GPs benefit from the distorted relative performance and investors bear the cost.

To examine the use of SLCs by poorly performing funds, we estimate the following fund-level specification using ordinary least squares:

$$SLC_i = \alpha + \beta \times Quartile_{4,i} + \varepsilon_i, \tag{4}$$

where $Quartile_4$ is an indicator variable equaling one if a fund's $Unlevered\,IRR$ is in the bottom quartile relative to funds in the same vintage. We focus on a fund's $Unlevered\,IRR$ for two reasons. First, Gompers, Kaplan, and Mukharlyamov (2016) find that most LPs evaluate fund performance using IRR. Second, we find in Section 5.1 that the use of subscription lines of credit by GPs distorts their internal rate of return. The coefficient β is the association between whether a fund uses an SLC and the fund being ranked in the bottom quartile of performance.[19] Standard errors are robust.

Panel A of Table 8 examines the likelihood that funds in the bottom quartile of relative performance use subscription lines of credit. In column 1, we find that the lowest performing funds are significantly more likely to use an SLC. Specifically, a fund in the bottom quartile is 8.3 percentage points more likely to have a subscription line of credit compared to funds in other quartiles. This estimate is economically large, representing a 31.2% increase compared to the SLC mean of 0.266.

We augment equation 4 by adding $Quartile_2$ and $Quartile_3$, which are indicator variables equaling one if a fund is in the second or third quartiles of relative performance in the same vintage, respectively. Column 2 reports that there is a large increase in the probability of using an SLC for funds in the bottom and third quartiles. Specifically, we find that funds in quartiles four and three are 12.0 percentage points and 7.8 percentage points

[19]The estimate of β in equation 4 is *ex-ante* unknown. For example, if funds with high relative performance tend to use SLCs, the estimate of β would be negative.

more likely to use an SLC, respectively. Since the top quartile is omitted, these coefficients are relative to the likelihood of using an SLC for funds in the best performing quartile. Overall, these results suggest that GPs with poor relative performance are substantially more likely to use a subscription line of credit. This is consistent with the notion that these low ranked funds use SLCs to boost their apparent performance.

In Panel B of Table 8, we consider how a fund's relative performance influences its use of SLCs on the intensive margin. Specifically, we change the outcome variable in equation 4 to *Leverage*, which is the ratio of a fund's average SLC use to its average cumulative capital called. Since we focus on the intensive margin, the sample is restricted to funds that use an SLC. In column 1, we report that leverage significantly increases by 3.5 percentage points for funds in the bottom quartile of performance compared to funds in other quartiles. This represents an economically large increase of 36.5% in fund leverage relative to the sample standard deviation. Column 2 adds $Quartile_2$ and $Quartile_3$ to the intensive margin specification. We find that the effect is concentrated in the bottom quartile and is nearly the same as the estimate in column 1.

Last, we examine whether the change in a fund's IRR due to an SLC, ΔIRR, is correlated with a fund's relative performance. In Section 5.1, we find that a fund using a subscription line of credit increases its quarterly IRR by an average of 65 basis points. We re-estimate equation 4 and use ΔIRR as the dependent variable. In column 1 of Table 9, we find that the quarterly IRR significantly increases by an additional 76 basis points for a fund using an SLC in the bottom quartile of relative performance. This represents an 11.0% increase relative to the sample standard deviation of IRR. In column 2, we incorporate additional quartiles and continue to find that there is a significantly stronger association between IRR-based performance and SLC use for funds in the bottom quartile. Overall, these results suggest that the lowest ranked funds use SLCs to distort their apparent performance.

The relationship between SLCs and relative fund performance might weaken as more

funds adopt their use. In an extreme scenario where all funds use SLCs, there might be no association between SLC use and performance rank, as all funds' performance may be similarly distorted. Only some funds in our sample use subscription lines of credit, implying that a fund may improve its relative performance by using an SLC.

The results in this section suggest that general partners of poorly performing funds increase their use of SLCs along both the extensive and intensive margins. The worst performing funds also have the largest improvements in their apparent performance related to using SLCs. This is consistent with the notion that SLC use reflects an agency conflict between funds' GPs and investors. Next, we consider how SLCs might change GP compensation.

6.2 Carried Interest

General partners of buyout funds primarily receive compensation through management fees and carried interest.[20] Management fees are based on committed capital, while carried interest allows GPs to participate in the returns of the funds. Carried interest represents a substantial portion of expected compensation and is generally received by fund managers after a particular rate of return, commonly referred to as the hurdle rate, is reached (Metrick and Yasuda (2010)). The return provided to LPs is calculated over the period that capital is used by GPs. In Section 4.1, we find that funds using subscription lines of credit delay calling capital from their limited partners, rather than scaling up investment activity. As a result, fund managers can use an SLC to increase their carried interest by shortening the time they deploy LPs' capital. In addition to the interest expense associated with an SLC, investors bear the cost of managers using a subscription line of credit through its impact on carried interest, representing an agency cost.

Since the data provided by Burgiss are net of fees and do not contain information

[20] A growing literature examines manager compensation at private equity funds (Gompers and Lerner (1999), Metrick and Yasuda (2010), and Robinson and Sensoy (2013)).

about fund compensation, we model how subscription lines of credit impact carried interest by adapting the model of Metrick and Yasuda (2010). This approach develops an expected revenue model to study the present value of carried interest and management fees, in addition to transaction fees and monitoring fees from portfolio companies. We focus on modeling carried interest, since SLCs plausibly do not alter any of these fees.[21] Using an options framework, the model simulates a geometric Brownian motion for each investment of a buyout fund. The exit times for the investments are based on an exponential distribution. The simulation is parameterized following Metrick and Yasuda (2010). We extend this model by assuming that a subscription line of credit delays the deployment of a portion of capital from a fund's limited partners for various amounts of time, which we describe below. When the fund uses an SLC, it also incurs an interest expense of 1% per quarter. Additional details are provided in Appendix C.

Table 10 summarizes the output of 100,000 simulations from the model for different SLC lengths. We define:

$$Carry\,change = \frac{Carried\,interest_{SLC} - Carried\,interest_{No\,SLC}}{Carried\,interest_{No\,SLC}}, \tag{5}$$

where $Carried interest_{SLC}$ is the present value of the aggregate carried interest when a fund uses an SLC and, similarly, $Carried\,interest_{No\,SLC}$ is the present value of the aggregate carried interest when a fund does not use an SLC. Intuitively, this represents the proportional change in carried interest that results from using a subscription line of credit. Since the distribution contains outliers, we winsorize it at the 1% level in each tail. In column 1, we find that when a fund uses an SLC that is 25% of its fund size for one year, *Carry change* increases by 1.4% on average. The estimated change increases to 3.0% if a fund uses an SLC for two years, 5.1% if a fund uses an SLC for three years, and 7.1% if a fund uses an SLC for four years. This highlights that the impact of an SLC monotonically increases in its length.

[21] Management fees are based on fund size. Transaction fees and monitoring fees are paid by the portfolio companies.

The next two columns of Table 10 report the average change in carried interest based on a simulated fund's distance from the hurdle rate. Column 2 provides the estimates for the mean change in carried interest for simulated funds close to the hurdle rate, which is defined as the bottom quartile of the distribution of carried interest when a fund does not use an SLC. As expected, we find that the increase in carried interest due to subscription lines of credit is amplified when a fund is relatively close to the hurdle rate, increasing by more than three times the average estimate in column 1. Column 3 lists the estimates for funds comparatively far from the hurdle rate, which is defined as the top quartile of the distribution of carried interest when a fund does not use an SLC. We find that these model estimates are substantially lower compared to those in column 1.

Column 4 examines the difference between the first quarter when GPs receive carried interest if a fund uses an SLC and if it does not use an SLC, which we refer to as *Early carry*. We find that GPs tend to receive carried interest earlier when the fund uses a subscription line of credit. The estimates increase monotonically in the SLC's length.

Last, column 5 details the probability that a fund's managers only receive carried interest when the fund uses a subscription line of credit. We define this variable as *Hurdle reached*. We find that 0.6% of funds' managers receive carried interest only when they use an SLC lasting for one year. These estimates increase considerably with the length of an SLC, rising to 1.5%, 3.3%, and 5.5% if funds use an SLC for two, three, and four years, respectively.

Overall, we find that subscription lines of credit increase a fund's carried interest along both the intensive and extensive margins. This provides an incentive for fund managers to deploy SLCs, particularly if they anticipate that their returns could be close to the hurdle rate. When considered in combination with greater SLC use among funds in the bottom quartile of relative performance, the use of subscription lines of credit appears consistent with an underlying agency conflict between funds' managers and investors.

7 Conclusion

This paper provides the first evidence about the use of subscription lines of credit by private equity funds. We find that funds using SLCs tend to delay calling capital from their limited partners and that this delay occurs throughout a fund's life. Contrary to common explanations for using subscription lines of credit, we find no evidence that funds using SLCs call capital less frequently. We also study the relation between funds' use of SLCs and common measures of their performance. We find that a fund's internal rate of return increases when it uses a subscription line of credit. Since SLCs alter the timing of a fund's cash flows, they also tend to increase its public market equivalent, while there is little change in a fund's investment multiple. Further, we examine the role of SLCs in an agency conflict between funds' managers and investors. We find that poorly performing funds are significantly more likely to use SLCs along the extensive and intensive margins, which tends to boost their apparent performance. Using an expected revenue model, we show that subscription lines of credit increase carried interest and the likelihood of a fund reaching its hurdle rate.

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 associated trade-offs merit further study. Second, performance distortions due to SLC use might impact capital flows from other asset classes into private equity. The extent and importance of this potential capital reallocation remains an open question. Third, the use of SLCs by private equity funds has not resulted in substantial defaults yet. During an economic downturn, banks originating SLCs might be unwilling or unable to roll them over. An unanswered question is whether future defaults on subscription lines of credit will be systemically disruptive.

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Figure 1: Private Equity Structure

This figure displays a private equity firm connected to one of its 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. A portfolio company, which is at the bottom of this figure, raises equity and debt capital from several sources, including private equity funds and banks.

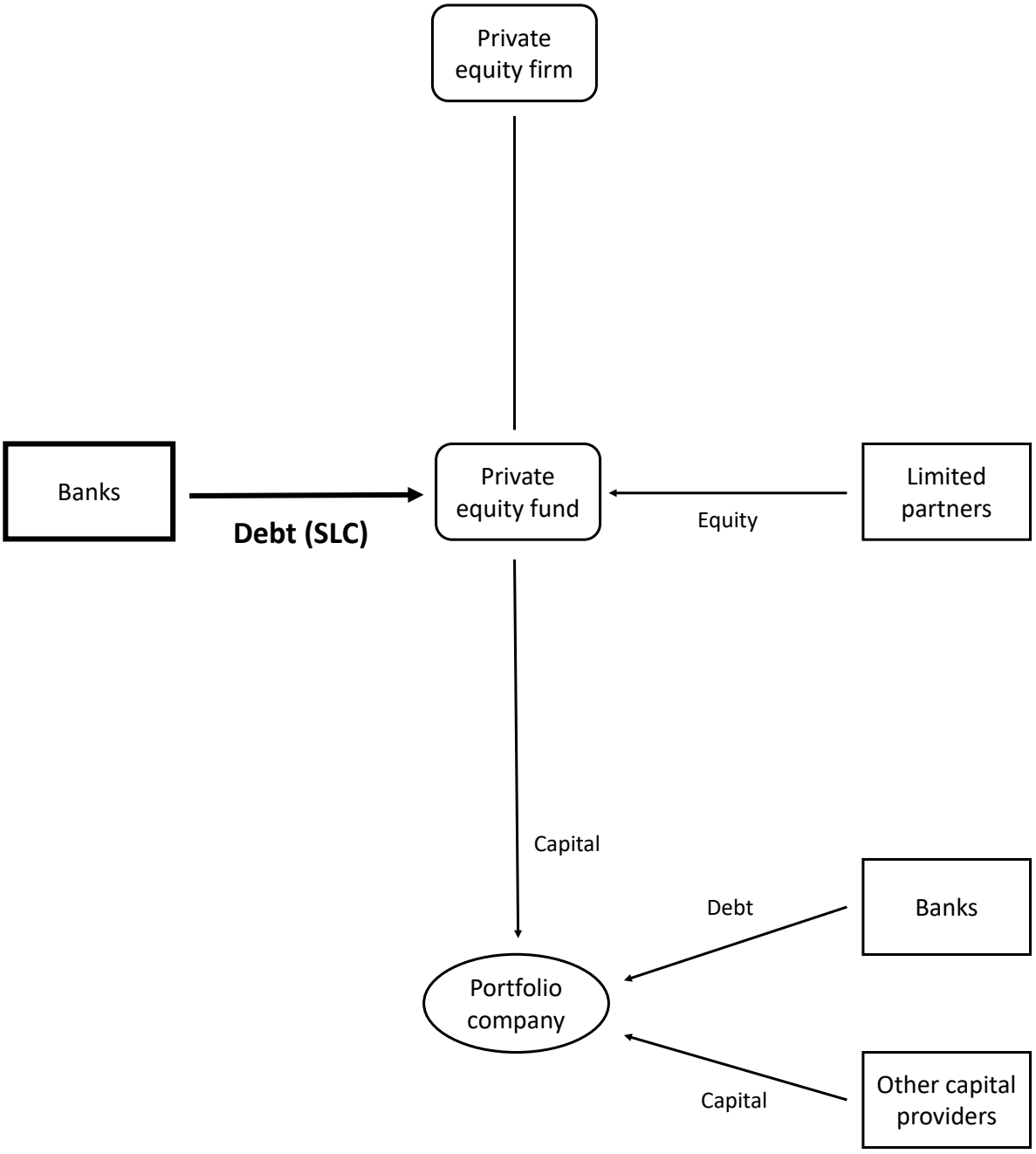

Figure 2: Effect of Hypothetical SLC Use on Fund Cash Flows

This figure illustrates the effect of a subscription line of credit on a hypothetical fund's cash inflows (contributions) over its life of 10 years. The cash flows underlying these lines are presented in Table A1. The dashed line plots limited partner contributions to the fund in the absence of an SLC. The solid line plots contributions of an otherwise identical fund that uses a $100 million SLC in year two for one year with a 4% annual interest expense.

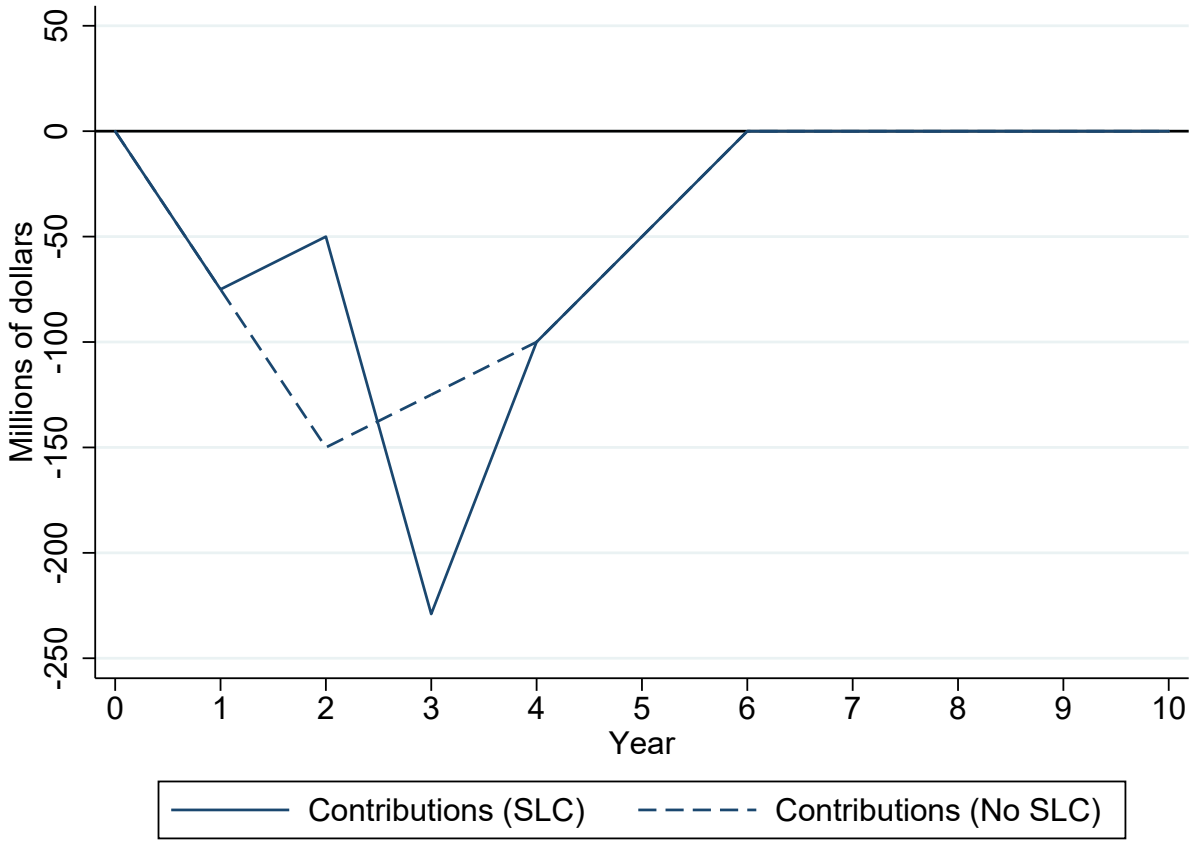

Table 1: Subscription Lines of Credits

This table provides summary statistics for subscription lines of credit at the fund level. The sample includes funds using an SLC at any point during their lives. *SLC amount* is the average amount ($ million) of a subscription line of credit in a quarter. *Fund size* is the total committed capital of a fund in millions of dollars. *Leverage* is the ratio of a fund's average SLC use to its average cumulative capital invested, where each average is calculated over the fund's life. *SLC length* is the number of quarters that a fund has an SLC outstanding. *Fund age* is the number of quarters since a fund's first capital call. *Young fund* is an indicator variable equaling one if a fund's age is five years or less.

Variable	Number of Observations	Mean	Median	Standard Deviation
SLC amount ($ million)	258	61.3	16.9	160.0
Fund size ($ million)	258	1,260	450	2,280
Leverage	258	0.058	0.018	0.096
SLC length (quarters)	258	6.171	6.000	4.035
Fund age (quarters)	258	23.4	21.0	11.4
Young fund	258	0.488	0.000	0.501

Table 2: Descriptive Statistics

This table provides descriptive statistics on capital calls in Panel A and on performance in Panel B. *Equity called* is the ratio of the cumulative capital that a fund has called in a particular quarter divided by the fund's size. *Number capital calls* is the number of times that a fund calls capital from its limited partners in a given quarter. SLC is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life. *SLC ratio* is the ratio of the average amount ($ million) of an SLC in a quarter to the total committed capital of a fund ($ million). Age_c is defined as a fund's age when it has first called more than c% of committed capital from its limited partners. IRR is the internal rate of return of a fund based on its observed cash flows. $Unlevered\,IRR$ is the internal rate of return of a fund based on the assumption that capital calls substitute for SLC use and the associated interest expense. $Multiple$ is the ratio of a fund's total value to paid-in capital. The total value of a fund is constructed by summing a fund's distributions to investors throughout its life and adding the fund's 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. $Unlevered\,multiple$ modifies the calculation of $Multiple$ by assuming that paid-in capital is reduced by the interest expense of a fund's SLC. PME is the public market equivalent based on the observed cash flows and valuations. $Unlevered\,PME$ is the public market equivalent based on the adjusted cash flows to account for SLC use and its associated interest expense.

Panel A: Capital Calls

Variable	Number of Observations	Mean	Median	Standard Deviation
Equity called	15,606	0.851	0.952	0.296
Equity called for young funds	5,278	0.561	0.561	0.308
Number capital calls	15,606	0.871	0.000	1.264
Number capital calls for young funds	5,278	1.477	1.000	1.454
SLC	15,606	0.301	0.000	0.459
SLC ratio	15,606	0.006	0.000	0.027
Age_{25}	891	4.912	5.000	3.172
Age_{50}	866	9.643	10.000	4.099
Age_{75}	793	14.406	14.000	5.313

Panel B: Performance

Variable	Number of Observations	Mean	Median	Standard Deviation
IRR	258	0.028	0.035	0.069
Unlevered IRR	258	0.021	0.031	0.074
Multiple	258	1.445	1.409	0.487
Unlevered multiple	258	1.451	1.412	0.489
PME	258	1.131	1.124	0.328
Unlevered PME	258	1.094	1.075	0.329

Table 3: Subscription Lines of Credit and Capital Calls

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 *Equity called*, which is the ratio of the cumulative capital that a fund has called in a particular quarter divided by the fund's size. *SLC* 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

Dependent variable	Equity called	
	(1)	(2)
SLC	-0.025^{*}	-0.033^{**}
	(0.015)	(0.015)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.693	0.700
Observations	15,606	15,606

Panel B: Young Funds

Dependent variable	Equity called	
	(1)	(2)
SLC	-0.082^{***}	-0.092^{***}
	(0.020)	(0.021)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.556	0.569
Observations	5,278	5,278

Table 4: Timing of Capital Calls

This table examines the association between a fund's subscription lines of credit and the timing of its capital calls. Age_c is defined as a fund's age in quarters when it has first called more than c% of committed capital from its limited partners. SLC 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_{25}	Age_{50}	Age_{75}
	(1)	(2)	(3)
SLC	0.752^{**}	1.385^{***}	1.631^{***}
	(0.294)	(0.369)	(0.446)
Vintage fixed effects	Yes	Yes	Yes
R^2	0.066	0.093	0.163
Observations	891	866	793

Table 5: Internal Rate of Return

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 is ΔIRR, which is the quarterly IRR based on the observed cash flows less the unlevered quarterly IRR based on the assumption that capital calls substitute for SLC use and the associated interest expense. $Young\ fund$ is an indicator variable equaling one if a fund's age is five years or less. $Leverage$ is the ratio of a fund's average SLC use to its average cumulative capital invested, where each average is calculated over the fund's life. Standard errors are robust.

Dependent variable	ΔIRR		
	(1)	(2)	(3)
Constant	0.0065^{***}	0.0013^{***}	0.0001
	(0.0009)	(0.0004)	(0.0005)
Young fund		0.0107^{***}	
		(0.0016)	
Leverage			0.1109^{***}
			(0.0101)
R^2	0.0000	0.1472	0.5864
Observations	258	258	258

Table 6: Investment Multiple and Public Market Equivalent

This table examines the relation between a fund's use of a subscription line of credit and other performance measures. Panel A studies investment multiples, which is the ratio of a fund's total value to its paid-in capital. Panel B explores the adjustment to a fund's public market equivalent performance. The outcome variable in Panel A is $\Delta Multiple$, which is the investment multiple based on the observed cash flows and valuation less the unlevered multiple based on the assumption that paid-in capital is reduced by the interest expense for a fund's SLC. The outcome variable in Panel B is ΔPME, which is the PME based on the observed cash flows and valuation less the unlevered PME based on the adjusted cash flows to account for SLC use and the associated interest expense. $Young\ fund$ is an indicator variable equaling one if a fund's age is five years or less. *Leverage* is the ratio of a fund's average SLC use to its average cumulative capital invested, where each average is calculated over the fund's life. Standard errors are robust.

Panel A: Investment Multiple

Dependent variable	$\Delta Multiple$		
	(1)	(2)	(3)
Constant	-0.0060^{***}	-0.0038^{***}	-0.0019^{***}
	(0.0005)	(0.0006)	(0.0003)
Young Fund		-0.0043^{***}	
		(0.0010)	
Leverage			-0.0693^{***}
			(0.0048)
R^2	0.0000	0.0656	0.6220
Observations	258	258	258

Panel B: Public Market Equivalent

Dependent variable	ΔPME		
	(1)	(2)	(3)
Constant	0.0360^{***}	0.0142^{***}	0.0054^{***}
	(0.0041)	(0.0038)	(0.0020)
Young fund		0.0445^{***}	
		(0.0079)	
Leverage			0.5285^{***}
			(0.0392)
R^2	0.0000	0.1136	0.5939
Observations	258	258	258

Table 7: Robustness

This table examines the robustness of the performance results to alternative interest expenses on subscription lines of credit. Panels A, B, and C focus on ΔIRR, $\Delta Multiple$, and ΔPME, respectively. Columns 1, 2, and 3 re-estimate equation 3 without controls and set the quarterly SLC interest expense to 0.5%, 1.5%, or LIBOR plus 50 basis points, respectively. Standard errors are robust.

Panel A: Internal Rate of Return

Interest expense	0.5%	1.5%	LIBOR + 50bps
	(1)	(2)	(3)
Constant	0.0068^{***}	0.0062^{***}	0.0065^{***}
	(0.0009)	(0.0008)	(0.0009)
Observations	258	258	258

Panel B: Investment Multiple

Interest expense	0.5%	1.5%	LIBOR + 50bps
	(1)	(2)	(3)
Constant	-0.0030^{***}	-0.0090^{***}	-0.0060^{***}
	(0.0003)	(0.0008)	(0.0005)
Observations	258	258	258

Panel C: Public Market Equivalent

Interest expense	0.5%	1.5%	LIBOR + 50bps
	(1)	(2)	(3)
Constant	0.0378^{***}	0.0341^{***}	0.0359^{***}
	(0.0042)	(0.0040)	(0.0041)
Observations	258	258	258

Table 8: Relative Performance and Subscription Lines of Credit

This table presents results on the association between funds' relative performance and their use of subscription lines of credit. In Panel A, the outcome variable is SLC, which is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life. In Panel B, the outcome variable is *Leverage*, which is the ratio of a fund's average SLC use to its average cumulative capital invested, where each average is calculated over the fund's life. $Quartile_4$ is an indicator variable equaling one if a fund's $Unlevered\,IRR$ falls in the bottom quartile relative to funds in the same vintage. $Unlevered\,IRR$ is the internal rate of return for a fund based on the assumption that capital calls substitute for SLC use. $Quartile_3$ and $Quartile_2$ are defined analogously. Standard errors are robust.

Panel A: Extensive Margin

Dependent variable	SLC	
	(1)	(2)
Quartile_4 (Lowest)	0.083^{**}	0.120^{***}
	(0.033)	(0.039)
Quartile_3		0.078^{**}
		(0.038)
Quartile_2		0.030
		(0.038)
R^2	0.007	0.011
Observations	1,018	1,018

Panel B: Intensive Margin

Dependent variable	Leverage	
	(1)	(2)
Quartile_4 (Lowest)	0.035^{**}	0.034^{*}
	(0.016)	(0.018)
Quartile_3		0.001
		(0.014)
Quartile_2		-0.006
		(0.013)
R^2	0.028	0.029
Observations	258	258

Table 9: Fund Quartile and Performance Distortions

This table presents the relation between a fund's relative performance and its ΔIRR. ΔIRR is the quarterly IRR based on the observed cash flows less the unlevered quarterly IRR based on the assumption that capital calls substitute for SLC use and the associated interest expense. $Quartile_4$ is an indicator variable equaling one if a fund's $Unlevered\ IRR$ falls in the bottom quartile relative to funds in the same vintage. $Quartile_3$ and $Quartile_2$ are defined analogously. Standard errors are robust.

Dependent variable	ΔIRR	
	(1)	(2)
Quartile_4 (Lowest)	0.0076^{***}	0.0079^{***}
	(0.0025)	(0.0026)
Quartile_3		0.0011
		(0.0016)
Quartile_2		-0.0004
		(0.0013)
Constant	0.0043^{***}	0.0040^{***}
	(0.0007)	(0.0009)
R^2	0.061	0.063
Observations	258	258

Table 10: Subscription Lines of Credit and Carried Interest

This table examines how subscription lines of credit impact carried interest. The reported model estimates are based on an extended version of the expected revenue model in Metrick and Yasuda (2010). *Length* is the number of quarters that a fund uses an SLC. *Carry change* is carried interest when a fund uses an SLC less carried interest when a fund does not use an SLC relative to carried interest when a fund does not use an SLC. Column 2 provides the estimates for *Carry change* for simulated funds close to the hurdle rate, which is defined as the bottom quartile of the distribution of carried interest when a fund does not use an SLC. Similarly, column 3 details the estimates for *Carry change* for simulated funds far from the hurdle rate, which is defined as the top quartile of the distribution of carried interest when a fund does not use an SLC. *Early carry* is the difference between the first quarter when GPs receive carried interest if a fund uses an SLC and if it does not use an SLC. *Hurdle reached* is the probability that a fund's managers receive carried interest when they would not receive carried interest without an SLC.

Length (quarters)	Carry change	Carry change (hurdle close)	Carry change (hurdle distant)	Early carry (quarters)	Hurdle reached
	(1)	(2)	(3)	(4)	(5)
4	1.4%	4.9%	0.1%	0.2	0.6%
6	2.1%	7.6%	0.1%	0.3	1.0%
8	3.0%	10.4%	0.2%	0.6	1.5%
10	4.1%	13.8%	0.3%	1.0	2.3%
12	5.1%	16.7%	0.5%	1.5	3.3%
14	6.1%	19.5%	0.6%	2.0	4.3%
16	7.1%	22.8%	0.7%	2.3	5.5%

Table A1: Effect of Hypothetical SLC Use on Fund Cash Flows

This table presents hypothetical gross cash flows in millions of dollars for a fund that operates for 10 years. In columns 1 to 3, cash inflows (contributions), cash outflows (distributions), and net cash flows, respectively, are provided for a fund that does not use a subscription line of credit. In columns 4 to 8, SLC amount, SLC interest expense, cash inflows, cash outflows, and net cash flows, respectively, are listed for the same fund that also uses a $100 million SLC with a 4% annual interest expense during year two. Numbers in bold highlight the cash flows that are changed when the fund uses a subscription line of credit. Figure 2 plots the cash inflows in this table.

	Cash flows without SLC			Cash flows with SLC				
Year	Inflows	Outflows	Net	SLC	Interest	Inflows	Outflows	Net
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	0	0	0	0	0	0	0	0
1	−75	0	−75	0	0	−75	0	−75
2	−150	0	−150	**100**	0	**−50**	0	**−50**
3	−125	0	−125	**−100**	**−4**	**−229**	0	**−229**
4	−100	50	−50	0	0	−100	50	−50
5	−50	125	75	0	0	−50	125	75
6	0	175	175	0	0	0	175	175
7	0	225	225	0	0	0	225	225
8	0	275	275	0	0	0	275	275
9	0	300	300	0	0	0	300	300
10	0	150	150	0	0	0	150	150

Table A2: Amount of Subscription Lines of Credit and Capital Calls

This table studies the association between the intensity of private equity funds' reliance on subscription lines of credit and capital called from their 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 *Equity called*, which is the ratio of the cumulative capital that a fund has called in a particular quarter divided by the fund's size. *SLC ratio* is the ratio of *SLC amount* to *Fund size*. Standard errors are clustered by fund.

Panel A: Full Sample

Dependent variable	Equity called	
	(1)	(2)
SLC ratio	-0.616^{***}	-0.769^{***}
	(0.133)	(0.135)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.695	0.702
Observations	15,606	15,606

Panel B: Young Funds

Dependent variable	Equity called	
	(1)	(2)
SLC ratio	-0.568^{***}	-0.757^{***}
	(0.151)	(0.157)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.545	0.558
Observations	5,278	5,278

Table A3: Subscription Lines of Credit and Frequency of Capital Calls

This table explores the relation between a fund's use of subscription lines of credit and the frequency of calling capital 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 *Number capital calls*, which is the number of times that a fund calls capital from its limited partners in a given quarter. *SLC* 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

Dependent variable	Number capital calls	
	(1)	(2)
SLC	0.021	0.045
	(0.081)	(0.084)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.169	0.176
Observations	15,606	15,606

Panel B: Young Funds

Dependent variable	Number capital calls	
	(1)	(2)
SLC	−0.112	−0.078
	(0.102)	(0.104)
Fund age fixed effects	Yes	Yes
Vintage fixed effects	No	Yes
R^2	0.006	0.014
Observations	5,278	5,278

Table A4: Model-Implied Estimates of IRR

This table provides the model-implied estimates of a fund's internal rate of return. IRR is the annual internal rate of return when a fund uses a subscription line of credit with an interest expense of 1% per quarter based on a fund's outstanding SLC in the previous quarter. $Unlevered\,IRR$ is the annual internal rate of return when a fund does not use an SLC. Column 3 provides the average of $Levered\,IRR$ less $Unlevered\,IRR$. Details of the model are provided in Appendix C.

Length (quarters)	IRR	Unlevered IRR	Mean Difference
	(1)	(2)	(3)
4	15.9%	15.2%	0.7%
6	16.2%	15.1%	1.1%
8	16.6%	15.2%	1.4%
10	16.9%	15.2%	1.7%
12	17.1%	15.2%	1.9%
14	17.3%	15.2%	2.1%
16	17.4%	15.1%	2.2%

Appendix A Variable Definitions

This appendix provides definitions of the variables used in the analysis.

- Age_c is defined as a fund's age in quarters when it has first called more than $c\%$ of committed capital from its limited partners.
- *Carry change* is carried interest when a fund uses an SLC less carried interest when a fund does not use an SLC relative to carried interest when a fund does not use an SLC.
- *Early carry* is the difference in the first quarter when GPs receive carried interest if a fund uses an SLC and if it does not use an SLC.
- *Equity called* is the ratio of the cumulative capital that a fund has called in a particular quarter divided by the fund's size.
- *Fund age* is the number of quarters since a fund's first capital call.
- *Fund size* is the total committed capital of a fund in millions of dollars.
- *Hurdle reached* is the probability that a fund's managers receive carried interest when they would not receive carried interest without an SLC.
- IRR is the internal rate of return for a fund based on its observed cash flows.
- ΔIRR is IRR less *Unlevered IRR*.
- *Leverage* is the ratio of a fund's average SLC amount to its average cumulative capital called, where each average is calculated over the fund's life.
- *Multiple* 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.
- $\Delta Multiple$ is *Multiple* less *Unlevered multiple*.

- *Number capital calls* is the number of times that a fund calls capital from its limited partners in a given quarter.
- PME is the public market equivalent based on the observed cash flows and valuation. Specifically, we grow fund contributions and distributions at the same rate as the return on the S&P 500. Then we divide the aggregate value of the fund's distributions and its net asset value (if applicable) by the aggregate value of its contributions.
- ΔPME is PME less $Unlevered\, PME$.
- $Quartile_4$ is an indicator variable equaling one if a fund's $Unlevered\, IRR$ falls in the bottom quartile of funds' reported IRRs in the same vintage. $Quartile_3$ and $Quartile_2$ are defined analogously.
- SLC is an indicator variable equaling one if a fund uses a subscription line of credit at any point during its life.
- $SLC\ amount$ is the average amount ($ million) of a subscription line of credit in a quarter.
- $SLC\ length$ is the number of quarters that a fund has an SLC outstanding.
- $SLC\ ratio$ is the ratio of $SLC\ amount$ to $Fund\ size$.
- $Unlevered\, IRR$ is the internal rate of return for a fund based on the assumption that fund contributions substitute for SLC use. We also adjust a fund's contributions for interest expense associated with its SLC.
- $Unlevered\ multiple$ modifies the calculation of $Multiple$ by assuming that paid-in capital is reduced by the interest expense for a fund's SLC.
- $UnleveredPME$ modifies the calculation of PME by assuming that fund contributions are adjusted to account for SLC use and the associated interest expense.
- $Vintage\ year$ is the year of a fund's first cash flow.
- $Young\ fund$ is an indicator variable equaling one if a fund's age is five years or less.

Appendix B LBO Debt and Venture Debt

This appendix compares subscription lines of credit to leveraged buyout (LBO) debt and venture debt.

Appendix B.1 LBO Debt versus SLCs

The key distinction between subscription lines of credit and debt from a leveraged buyout is the entity that is obligated to pay the debt. For an SLC, the debt is issued to a private equity fund and utilized on a continuing basis. In contrast, after an LBO transaction, a portfolio company of the private equity fund, which is the target of the LBO, is obligated to pay the LBO debt. The differences between an SLC and LBO also extend to the collateral for these different types of debt. An SLC's collateral is typically the fund's uncalled committed capital. In contrast, LBO debt is collateralized with the portfolio company's assets.

In a typical LBO, an entity (commonly referred to as a shell company) is established for legal reasons by the private equity fund issuing the LBO debt. This entity has the debt only for the brief amount of time required to complete the LBO transaction. Upon the completion of the LBO, the shell company merges with the target and the target is now obligated to pay the debt. The private equity fund retains the target's equity, since the target company is in the fund's portfolio. Müller and Panunzi (2004) provide additional details about the use of debt in an LBO.

Appendix B.2 Venture Debt versus SLCs

Venture debt refers to loans issued by banks to startups. The borrowing firms using venture debt typically do not have positive cash flows or tangible collateral. The key difference between SLCs and venture debt remains the entity that is obligated to pay the debt. SLCs are debt issued to a private equity fund and utilized throughout the fund's life. However, venture debt is issued to the startup, which pays the debt until it matures. SLCs and venture debt are generally issued by banks. The use of venture debt by a startup does not depend on whether it receives capital from private equity funds.

Appendix C Carried Interest Model

This appendix provides additional details about the carried interest model in Section 6.2, which is based on Metrick and Yasuda (2010). Following their paper, we assume that each fund size is $100 million and invests in 11 portfolio firms with equally-sized investments that occur at the beginning of a fund's life. We simulate each investment using a geometric Brownian motion and its exit times using an exponential distribution with an exit rate of 20% per year. Since we study buyout funds, we assume that the expected return is 20%, the volatility is 60%, and the pairwise correlation of each simulated fund's investments is 20%. The annual discount rate for determining the present value of carried interest is 5%. These parameters follow Metrick and Yasuda (2010).

We calculate each simulated fund's carried interest when it uses an SLC and when it does not use an SLC. We assume that the size of the SLC is $25 million and vary its length from one to four years. Following the base case in Metrick and Yasuda (2010), we use a 20% carry level, 8% annual hurdle rate with 100% catch-up, and a carry basis of committed capital. We do not include clawbacks in our model. We calculate $Levered\,IRR$ and $Unlevered\,IRR$ as defined in Section 5.1. Since the data on subscription lines of credit is quarterly, we use a quarterly frequency when we simulate the model.

Table A4 provides the model-implied estimates of a fund's internal rate of return. Column 1 lists the average IRR by SLC length. We find that the mean annual IRR when a fund uses an SLC for one year is 15.9% and rises monotonically to 17.4% when a fund uses an SLC for four years. Column 2 reports that the average $Unlevered\,IRR$ is between 15.1% and 15.2% for all SLC lengths. Since the SLC length does not impact the $Unlevered\,IRR$, it follows that the average of the simulated IRRs without an SLC should be nearly the same. Last, column 3 reports the mean of IRR less $UnleveredIRR$, which is 0.7% when a fund uses an SLC for one year and increases to 2.2% when a fund uses an SLC for four years. These model-implied estimates of how SLCs alter IRRs are broadly consistent with our findings in Section 5.1. It is important to note that these model-implied estimates might differ from the regression-based estimates since the IRRs in the model are based on a fund's entire life and the regression-based estimates include the cash flows of funds that are ongoing.