# Funding Risk, Patient Capital, and the Dynamics of Hedge Fund Lockups

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**Abstract**

We exploit the fact that hedge fund lockups expire over time and use the time-series variation in a funds locked up capital to create a dynamic, fund-level proxy of funding liquidity risk. In contrast to the prior literature, our measure allows us to identify within-fund changes in funding risk, enabling us to better identify the connections between funding liquidity risk, performance, and risk-taking in the cross-section of hedge funds. We find that decreases in funding liquidity risk are associated with increases in asset liquidity risk and higher fund performance, suggesting reduced funding risk increases managerial flexibility and enables funds to better capitalize on risky mispricing. However, regardless of how much capital a fund has locked up, lockup funds outperform non-lockup funds, suggesting that a portion of the lockup premium found in the prior literature is attributable to fund fixed effects.

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# 1. Introduction

Theories of efficient capital markets hinge on the concept that mispricing will be arbitraged away by competitive traders. In practice, however, traders are constrained by funding liquidity risk, i.e., their ability to attract and retain the capital necessary to trade against risky mispricing (Shleifer and Vishny, 1997). Funding liquidity risk is a critical friction that reduces a fund manager's ability to take risks, and has wide reaching implications for not only fund performance, but also market stability and efficiency. As such, there is growing interest in understanding how funds manage funding liquidity risk and overcome limits to arbitrage by placing restrictions on investor withdrawals. For instance, there is evidence in the literature that closed-end mutual funds, which do not offer redeemable shares, are better able to invest in illiquid assets and employ risky arbitrage strategies than are open-end funds, which offer daily liquidity to their investors (Cherkes, Sagi, and Stanton, 2009; Deli and Varma, 2002; and Giannetti and Kahraman, 2014).

In addition, because of the importance of hedge funds as arbitrageurs, much attention has been paid to how withdrawal restrictions could enable hedge funds to take greater risks and capitalize on market mispricing.[1] For example, many hedge funds employ an expiring restriction called a lockup. Lockups are contractual provisions that prevent new capital from being withdrawn for an initial lockup period (typically 12 months), after which time the lockup expires and the shares become fully redeemable. Previous studies have examined the effects of having a lockup in the fund's investment contract, which is chosen at the fund's inception and is fixed through time. The evidence in this literature points to the lockup provision as a contracting tool that reduces funding liquidity risk, increases managerial flexibility, and ultimately improves fund performance by between 4-7% a year compared to hedge funds that do not impose a lockup (Aragon, 2007).

[1] See, for instance, Aragon (2007), Agarwal, Daniel, and Naik (2009), Aragon, Martin, and Shi (2014), Giannetti and Kahraman (2014), and Hombert and Thesmar (2014).

However, because the lockup provision is a static fund characteristic, the previous literature implicitly characterizes lockups as imparting a fixed effect on fund outcomes. This makes it difficult to disentangle the effects of the lockup from other time invariant omitted factors that may affect fund performance and risk characteristics. For example, it could be that higher quality managers have better bargaining power with investors and that these investors are more willing to accept a lockup provision in their contract. Thus, the observed relation between the presence of a lockup and better fund performance could reflect managerial skill (or other omitted factors) rather than the effects of reduced funding liquidity risk.

Additionally, the presence of a lockup can only be construed as a static proxy for funding liquidity risk. However, lockups expire over time, meaning that the amount of capital a hedge fund has locked up, and thus, its funding liquidity risk, is actually dynamic and varies across funds and through time as a function of lockup periods and capital flows.

In this paper, we focus on the dynamic nature of the hedge fund lockup and create a time-varying measure of capital restrictions for hedge funds. By comparing the time series of capital inflows relative to a fund's lockup period, we are able to estimate the proportion of fund capital that is restricted from withdrawals at any given time. Doing so allows us to disentangle the effects of binding share restrictions from other omitted factors and helps us to better understand the connection between funding liquidity risk, fund performance, and risk taking.

Our sample includes over 3,800 lockup funds from the union of five different hedge fund databases over the period 1994-2013. We estimate the proportion of capital locked up in each fund in each month in our sample. Far from being static, we find that the proportion of locked up capital varies considerably across funds and through time. Figure 1 shows the fraction of fund capital that is actually restricted (locked up) over the course of a fund's life. Although new lockup funds begin operations with 100% of their capital locked up, this percentage steadily declines over time. By the time a fund is five years old, the median fund will only have about 10% of its capital locked up, while a quarter of funds have less than 1% of their capital locked up. In fact, more than 70% of the average lockup fund's capital is redeemable at any given time. This raises the question as to whether the lockup premium is truly only attributable to the decreased funding risk created by binding withdrawal restrictions.

We begin by examining the relation between a locked up fund's performance and its proportion of locked up capital (henceforth referred to as *dynamic lockup*) in a regression framework. Our results indicate that a one standard deviation increase in dynamic lockup is associated with a 16 basis point (bps) increase in monthly fund returns. The difference in annual performance between a fund with zero capital under lock and a fund that is fully locked is nearly 5%. This result continues to hold after a series of robustness checks, including, removing young funds, small funds, adding delisting returns, and an alternative estimate of the fund's dynamic lockup using a duration-based approach. Collectively, our findings are consistent with the idea that funds with more protected capital have more flexibility to pursue higher expected return strategies.

Further, because the dynamic lockup measure is time varying, it enables us to employ a fund fixed effects estimator and control for time invariant factors that could also be driving the outperformance of lockup funds. After including fund fixed effects, we find that within fund variation in dynamic lockup is positively related to future performance. This means that, within a fund, decreases in funding risk (i.e., increases in locked up capital) leads to an increase in performance. This represents a major contribution to the literature, as most of what we currently know about the relation between funding risk and fund performance is derived from comparative studies of time invariant contractual designs (i.e., open versus closed-end mutual funds, lockup versus non-lockup hedge funds, etc.) or time series studies of aggregate funding conditions (such as studies of financial crises).

We also address the potential concern that because dynamic lockup is calculated from the time series of capital inflows, it is merely a proxy for other fund characteristics, such as a fund's age or size, which have been shown in the literature to be related to future hedge fund returns. In addition to controlling for these characteristics in our regressions, we also conduct the following placebo test. We randomly assign a pseudo-lockup period to non-lockup funds and calculate a placebo value of dynamic lockup using the same methodology as with the lockup funds. We then test for a difference in the relation between the dynamic lockup measure and returns for lockup funds versus non-lockup funds.

The results of this placebo test confirm that the relation between returns and dynamic lockup is significantly greater for lockup funds as compared to non-lockup funds. This differential effect for lockup funds continues to hold when we include fund fixed effects, meaning it is not driven by time invariant differences between lockup and non-lockup funds. These results support the conclusion that our measure captures the relation between returns and funding risk, and not simply other factors that contribute toward the dynamic lockup calculation.

Including non-lockup funds in our analysis reveals another interesting pattern. Controlling for the proportion of capital the fund has locked up, lockup funds still outperform non-lockup funds by 156 bps/year. This suggests that the lockup premium documented in prior literature is comprised of two components: a time varying component related to binding capital restrictions and a time invariant component related to other differences between lockup and non-lockup funds.

To better understand what is driving both components of the lockup premium, we run portfolio tests using factor models that control for common risks associated with hedge fund investment strategies. We split the sample of lockup funds into terciles of dynamic lockup, and adjust each return for the corresponding placebo fund portfolio's return. This nets out the characteristics of dynamic lockup that are unrelated to capital restrictions and allows us to identify the differences in risk-adjusted performance and risk loadings between lockup and non-lockup funds.

The portfolio tests reveal that even on a risk- and placebo-adjusted basis, funds in the top tercile of dynamic lockup outperform those in the bottom tercile, meaning that the time varying component of the lockup premium is not only driven by differences in factor risk across funds. However, only the funds in the top tercile of dynamic lockup significantly outperform placebo funds on a risk-adjusted basis. This suggests that the time invariant component of the lockup premium is driven by increased risk taking by lockup funds versus non-lockup funds. In particular, this increased risk taking appears to come in part from greater lagged market exposure, consistent with lockup funds having greater exposure to illiquid assets than non-lockup funds. Moreover, this effect is not driven by the actual degree of locked up capital. In fact, there is no difference in lagged market exposure between low and high dynamic lockup funds, suggesting that the time varying component of the lockup premium is not only driven by increased exposure to illiquid assets. Instead, the placebo-adjusted alphas we find for the high dynamic lockup funds are consistent with greater capital stability that allows funds to more effectively capitalize on mispriced securities.

We also examine hedge fund stock holdings to test whether lockup characteristics are associated with a fund's propensity to own assets that are more illiquid or have greater liquidity risk. We proxy for liquidity level with the Amihud (2002) measure of stock illiquidity and liquidity risk using the stock's beta with respect to the Pastor-Stambaugh (2003) traded liquidity factor. We find a strong positive relation between dynamic lockup and liquidity risk, even when controlling for fund fixed effects. This result is important because it provides direct evidence that increases in funding liquidity risk encourage traders to decrease their asset liquidity risk, which suggests traders at least partially understand the dangers of a liquidity spiral and try to mitigate their asset-liability mismatches. In contrast, when we examine liquidity level, we find that lockup funds own more illiquid stocks than non-lockup funds, yet this propensity to own illiquid stocks is unrelated to dynamic lockup. These results corroborate the inferences from our portfolio tests suggesting that the lockup premium is partly due to lockup funds owning more illiquid assets as in Aragon (2007), but not because their capital is restricted from withdrawals. Instead, the propensity to own more illiquid assets appears to be a fixed characteristic of lockup funds.

Why would lockup funds own more illiquid assets even if their capital is unrestricted? We argue that the lockup provision may screen for patient investors, and/or create various incentives for investors to remain patient with their capital, even after their lockup expires. For instance, holders of unlocked shares can withdraw at will, but they know that any investments they make in the future will revert to locked-up status. This effectively raises the shadow cost of redeeming unlocked lockup shares. Consequently, the greater risk taking by lockup funds could be due to their having a more stable capital base, beyond that which is induced by the binding restrictions of the lockup. To test this conjecture, we examine the flow pattern of lockup funds versus non-lockup funds, and find that even after controlling for the proportion of locked-up capital, lockup funds have lower outflows and lower outflow volatility than non-lockup funds. This is consistent with patient behavior by lockup investors, and suggests the lockup provision's contribution to capital stability goes beyond merely the strict prohibition of withdrawals.

## 2. Contribution Relative to Prior Literature

Our work contributes to the growing literature that examines how funding risk affects asset manager performance and risk taking. Agarwal, Daniel, and Naik (2009) argue that hedge funds with redemption restrictions have more flexibility to pursue risky arbitrage opportunities, and find that hedge fund performance is positively related to redemption restrictions. Similarly, Hombert and Thesmar (2014) argue that funds will choose to have more stable capital when they plan to engage in riskier strategies, and find that following low past performance, funds with greater share restrictions and lower flow-performance sensitivity subsequently earn higher returns. Giannetti and Kahraman (2014) find that closed-end mutual funds and hedge funds with greater share restrictions are better able to trade against mispricing than unrestricted funds. Franzoni and Plazzi (2015) find that a hedge fund's ability to provide liquidity is particularly sensitive to funding conditions, but that redemption restrictions mitigate the impact of market-wide funding shocks risk on hedge fund liquidity provision. Collectively, these papers support the idea that redemption restrictions reduce funding risk, which in turn increases a fund's ability to capture higher returns from risky strategies. However, because they focus on static restrictions, these papers do not disentangle the differential effects of time varying capital restrictiveness from the other omitted differences between restricted and unrestricted funds. Our results support this prior work by showing that even within funds, increases in capital restrictiveness lead to increased fund performance.

In addition, our work contributes to the literature concerning the premium of lockup funds. Aragon (2007) finds that funds that institute a lockup earn a substantial premium of between 4-7% over other hedge funds, and he connects this premium to the lockup fund's ability to more efficiently manage illiquid investments that carry higher returns. Subsequent work has shown that lockup funds are more likely to trade against mispriced securities and provide liquidity than non-lockup funds (Giannetti and Kahraman, 2014; Aragon, Martin, and Shi, 2014), which points to other sources of the lockup premium. By constructing a dynamic measure of locked up capital, we are better able to identify the role that binding capital restrictions play in determining the outperformance of lockup funds, while holding constant omitted fixed effects that may be correlated with the presence of the lockup. Though we find that binding capital restrictions do lead to higher performance, they are not the only factor that differentiates funds with from those without a lockup. Our results suggest that funding risk may also be partially mitigated by simply having a lockup provision in the fund's contract, which can lead to the formation of a more stable capital base.

Our work is also relevant to the debate about the optimal structure of redemption rights in the asset management industry. Fama and Jensen (1983) argue that demand deposits reduce agency problems and improve fund governance because investors can vote with their feet. However, the dark side of unrestricted redemptions is that it hinders managerial flexibility to pursue higher expected return investments (Shleifer and Vishny, 1997). As a result, Stein

(2005) argues that competitive pressures to remain open-end lead to an inefficiently low supply of closed-end managers that are free to engage in risky arbitrage, stabilize prices, and contribute to market efficiency. Though the debate concerning redemption rights often centers on the extremes of open- versus closed-end funds, the heterogeneous structure that has emerged in the hedge fund industry may be a more suitable solution to the problem of excessive open-endedness. In addition to directly restricting investor redemptions, our finding of the lockup fixed effect, i.e., that investors behave more patiently with unlocked shares than they do with shares in unrestricted funds, suggests that funds can also combat limits to arbitrage by creating contract mechanisms that screen for and incentivize more patient capital.

## 3. Data and Methodology

The hedge fund data in our paper comes from the union of five hedge fund databases: Lipper TASS, BarclayHedge, HFR, Eureka, and Morningstar. Our sample period covers 1994-2013. We follow Joenväärä, Kosowski, and Tolonen (2012) and merge the databases together to remove duplicate funds and share classes through a name matching and returns correlation algorithm. Because each hedge fund database categorizes investment strategies differently, we use the style-correspondence created by Joenväärä et al. (2012) to condense the investment strategy space to 13 different strategies.[2]

We remove funds of funds and non-US dollar denominated share classes. Our final sample contains 13,959 hedge funds with a total of 795,447 monthly return observations. Of these, 3,809 funds (about 29.2% of fund-months) have a lockup in their contract with an average length of 12.5 months.

Insert Table 1 Here

[2]The 13 strategies are: CTAs, Emerging Markets, Event Driven, Fund of Funds, Global Macro, Long Only, Long/Short, Market Neutral, Multi-Strategy, Relative Value, Sector, Short Bias, and Others.

In Table 1, we present summary statistics for both our full sample (Panel A) and for just those funds with a lockup provision in their contract (Panel B). We note that funds with a lockup have higher average monthly returns than the full sample, which is consistent with prior literature. Interestingly, lockup funds also have more share restrictions beyond just the lockup, with longer redemption notice periods and redemption frequencies than non-lockup funds. This is consistent with the findings in Aiken, Clifford, and Ellis (2015), who argue that different share restrictions can serve a complementary role in hedge fund contracting. However, it is important to point out that, like the lockup, these restrictions are also fixed-contract provisions that are essentially time invariant.[3] As such, we control for these restrictions in our tests to ensure that we are isolating the specific effects of the lockup.

## *3.1. Dynamic Lockup Measure*

A primary innovation in this paper is that we create a dynamic measure of restricted capital that takes into account the flow history of the fund to estimate the amount of capital under lockup. This approach differs from the previous literature that relies on a static indicator of the presence of a lockup provision in the fund's contract. For each fund that has a lockup provision, we calculate the fund's dynamic lockup, which captures the percent of assets the fund has under lockup at a given point of time. We calculate dynamic lockup in the following way. We begin by assuming that a lockup fund's capital is fully locked up at the fund's inception (i.e., dynamic lockup = 100%). This new fund is fully locked up until the lockup period ends. For example, if a fund had a 12 month lockup and received no additional investments, the fund would have a dynamic lockup = 100% for months 1 through 12. In month 13, the lockup period would have expired, and the fund would become fully unlocked

[3] Our database is formed from snapshots of the commercial databases collected in 2013, and thus the contractual terms we can observe truly are fixed through time. It is common in the hedge fund literature to assume these provisions remain fixed in reality, and there is evidence that supports this view (e.g., Aragon, 2007). Funds can change share restrictions through time, though this happens very infrequently (Hong, 2014).

(i.e., dynamic lockup = 0%). We treat any additional capital inflows the fund receives as new investments subject to the same 12 month lockup period. We track the timing and size of each inflow to create the following asset weighted percentage of locked up capital for each $fund_i$:

$$Dynamic\ Lockup_{i,t} = \frac{\sum_{j=1}^{L}(flow_{i,t-L+j} * \prod_{k=j+1}^{L}(1 + r_{i,t-L+k}))}{AUM_{i,t}} \tag{1}$$

where $flow_t$ is the positive net flow received by the fund at the end of each $quarter_t$, $r_t$ is the return in quarter t, $L$ is the length of lockup period measured in quarters, and $AUM_t$ is the assets under management for the fund. As gross inflows and outflows are not available in the data, we proxy for the size of new investments (gross inflows) with net capital inflows each month. To the extent that some inflows are masked by countervailing outflows, our dynamic lockup measure would understate the true proportion of locked up capital. Because the lockup only binds once for each new investment, we exclude negative net flows from the calculation based on the assumption that outflows can only come from unlocked capital, which is treated the same regardless of its vintage in the fund.

We find that, on average, only 29% of lockup funds' assets are restricted over our sample period. There is a great deal of variation across funds, however, as the 25th percentile of dynamic lockup is only 1.1%, meaning that in over a quarter of our sample, lockup funds have almost no capital locked up. On the other hand, a fund in the 90th percentile fully locked. A static lockup measure, such as a lockup indicator, is unable to capture this fact, and would treat both the fully locked and unlocked funds the same. The goal of this paper is to use this variation to explore how the amount of restricted capital within a fund affects their returns, as well as the sources of these returns.

# 4. Dynamic Lockups and Fund Returns

We start by investigating how the returns of funds with lockup provisions vary as their amount of restricted capital increases. As discussed, previous work has focused on the average differences between funds with a closed structure and those that choose to allow investors to withdraw their capital. However, our dynamic lockup measure allows us to study within-fund variation in returns for funds with a lockup feature and learn the effect of an incremental change in the amount of capital locked up. This allows us to more closely identify the link between changes in funding risk and asset manager performance.

### 4.1. Multivariate Regression

We begin by estimating a pooled, monthly return regression, where we restrict our sample to just those hedge funds that use a lockup. These results are presented in Table 2. Our regression model is given in equation (2) as,

$$Return_{i,t+1} = \alpha + \beta \times Dynamic\ Lockup_{i,t} + \gamma \times Controls_{i,t} + \theta_i + \tau_t + \epsilon_{i,t} \tag{2}$$

where the dependent variable, $Return_{i,t+1}$, is the fund's return in the subsequent month t+1 and the variable of interest, $Dynamic\ Lockup_{i,t}$, is the percentage of the fund's capital under contractual lockup in month t.

$Controls_{i,t}$ is a vectors of time-varying controls, including the fund's past performance, flow, age, and size, as well as time-invariant controls, including the fund's minimum investment, fees and other capital restriction features, such as redemption frequency and notice period. All continuous variables are normalized to mean of zero and a standard deviation of one. The unit of observation is a fund-month and we include time fixed effects in all models. Standard errors are clustered at the fund-level. In Models 1-3, $\theta_i$ includes style fixed effects. In Models 4-6, $\theta_i$ includes fund-level fixed effects.

Insert Table 2 Here

We find that the amount of restricted capital (*Dynamic Lockup*) is positively related to future fund returns in all model specifications. In Model 1, we find that a one standard deviation increase in *Dynamic Lockup* is associated with a 16 bps/month (t-statistic of 10.68) increase in the fund's performance. In Model 2, where we control for fund characteristics shown to be related to fund performance, we again find a positive and significant relation between dynamic lockup and future fund performance. For example, a one standard deviation increase in *Dynamic Lockup* is associated with an 8 bps increase in monthly returns ($t$-statistic of 5.05).

One of the advantages of our dynamic lockup measure is its time-varying nature for a given fund. As such, in Models 3 and 4 we perform similar tests but include fund-level fixed effects to control for unobservable, time-invariant fund characteristics that may be related to the performance of lockup funds. In doing so, we find that an increase in the amount of stable capital leads to better performance.[4] For example, within a given fund, a one standard deviation increase in dynamic lockup leads to a 7 bps/month increase in average returns (Model 4). Overall, this result is consistent with a greater degree of asset stability (i.e. a reduction in funding risk) allowing managers to pursue strategies with greater expected returns. We argue this is an important finding given the lack of within-fund evidence in the prior literature of a link between funding liquidity risk and performance.

## *4.2. Robustness*

We test the robustness of this result in Table 3 by both restricting our sample and altering our definition of dynamic lockup. In order to ensure that our results are not driven by known hedge fund data issues, we remove young funds (less a year since inception), small funds (funds that never manage more than $20MM in assets during their history), and include a delisting return of -50% when a fund leaves the database. As an alternative to the percentage of assets locked up, we also define dynamic lockup as a duration measure. We use this alternative definition in order to verify that our results are not dependent on the exact specification for restricted capital. This approach addresses the limitation that the percent lockup (equation 1) will be the same for a fund with 6 month lockup and a two year

[4] If we exclude the lagged dependent variable in Model 4 of Table 2, our inferences are unchanged.

lockup, ceteris paribus. We define duration in this context as the length of time in months that the fund's assets will remain under lockup, or:

$$Duration_{i,t} = \frac{\sum_{j=1}^{L}(j * flow_{i,t-L+j} * \prod_{k=j+1}^{L}(1 + r_{i,t-L+k}))}{AUM_{i,t}} \quad (3)$$

where $flow_t$ is the positive net flow received by the fund at the end of each quarter, $r_t$ is the gross return in quarter t, $l$ is the length of lockup period measured in quarters, and $AUM_t$ is the assets under management for the fund.

[Insert Table 3 Here]

In Table 3, Panel A we include style fixed effects, while in Panel B we include fund fixed effects. The same set of control variables as in Model 2 of Table 2 are included, but omitted for brevity. Our result remains, as dynamic lockup is positive and statistically significant across each robustness check. Amongst funds with a lockup provision, those with less fragile capital structures and more restricted assets under management have greater returns. In Section 5, we explore the return difference between locked and unlocked funds by including the full sample of hedge funds in our sample.

## 5. Locked Up Funds vs. Non-Locked Up Funds

In this section, we include all non-lockup funds in our analysis. We do this for two reasons. First, we wish to place our results within the prior literature by comparing the performance of lockup and non-lockup funds. Doing so allows us to understand if the return differences found in Section 3 are driven entirely by our dynamic measure, or if there is a residual, fixed difference between lockup and non-lockup funds. However, including funds without a lockup in our sample also serves as a robustness check for our dynamic lockup measure. Our measure is created using the past flow history of the fund and will mechanically be related to the age, size, and net inflows of the fund. Because these factors have been shown to predict hedge fund performance, one concern could be that our dynamic lockup measure is simply a proxy for these factors. Aggarwal and Jorion (2010), for example, find that young funds outperform older funds. Using our measure, younger funds will have larger dynamic lockup estimates, as much of their initial capital will still be locked. Though we control for these factors in our regression, the effects may be nonlinear.

### *5.1. Correlation of Dynamic Lockup and Fund Characteristics*

To better see this issue, in Table 4, we sort funds into terciles each month based on the fund's dynamic lockup. We report average assets under management (AUM), age, returns (%), and flows (%) across the terciles. As a reminder, one of the starkest findings in our paper is the variation in locked up capital across funds. As we see from Table 4, the lowest tercile of funds in our sample have almost none (1.62%) of their assets restricted, while funds in the highest tercile have almost three-quarters (74.87%) of their capital under lock. However, we also find that our measure of locked up capital is related to other fund characteristics known to be related to future performance. For example, funds in the top tercile of dynamic lockup are younger, have higher returns, and greater inflows.

[Insert Table 4 Here]

### *5.2. Placebo Approach*

To mitigate concern that our dynamic lockup measure is a proxy for funding liquidity risk and is not solely a proxy for other fund characteristics, we use a placebo approach and randomly assign a lockup period to funds with no lockup in their contract. By year of fund founding, we obtain the frequency distribution of lockup periods for lockup funds and apply the distribution to non-lockup funds founded in the same year. In 2000, for example, 76% of the lockup funds in our sample have a one-year lockup period. Accordingly, we randomly choose 76% of the non-lockup funds in 2000 and assign them a one-year lockup.

We repeat the process for the rest of the non-lockup funds. For each of the pseudo-lockup funds, we calculate a placebo version of the dynamic lockup (*Placebo Lockup*) measured as the percentage of capital that would be restricted had they instituted their assigned pseudo-lockup, as given in equation (1). By construction, the placebo lockup that we calculate for non-lockup funds will also reflect any potential bias related to age, size, or recent inflows introduced by the dynamic lockup calculation. Thus, by including both *Dynamic Lockup* and *Placebo Lockup* in the same regression we can net out these biases.

By pooling all funds and using a similar regression framework, we can estimate how capital stability affects fund returns both within lockup funds and between lockup and non-lockup funds. Table 5 reports regression results for monthly hedge fund returns on the lockup indicator (*Lockup Dummy*), our dynamic lockup measure for lockup funds (*Dynamic Lockup*), and the placebo measure (*Placebo Lockup*). As discussed, both non-lockup and lockup funds are included when estimating *Placebo Lockup*, but the *Dynamic Lockup* term estimates the additional return that lockup funds receive as their proportion of restricted capital increases. The indicator, *Lockup Dummy*, captures any incremental return received by lockup funds that is not captured by the dynamic measure. Model 1 includes only these three variables, while Model 2 contains the same controls as our main specification in Table 2 (Model 2). Model 3 includes fund-level fixed effects. Because *Lockup Dummy* is time invariant it is dropped from this model. Time fixed effects are included in all models and standard errors are clustered at the fund-level.

[Insert Table 5 Here]

In Models 1 and 2, both *Lockup Dummy* and *Dynamic Lockup* are positive and statistically significant. The former suggests that funds with a lockup have greater returns than funds without a lockup (Aragon, 2007), while the latter suggests that lockup funds earn more as the amount of capital under lockup increases. In Model 1, *Placebo Lockup* is positive and statistically significant, indicating that increasing the amount of capital under lockup is associated with positive returns, even if the fund is part of the placebo group that does not actually have a lockup in their contract. This suggests that a portion of the *Dynamic Lockup* premium is due to fund characteristics, such as size and age, associated with both more restricted capital and higher returns.

However, when the full set of controls is included in Model 2, *Placebo Lockup* is no longer statistically significant, while *Lockup Dummy* and *Dynamic Lockup* remain so. In other words, after controlling for fund characteristics, only those funds with an actual lockup have higher returns as the amount of restricted capital within the fund increases, supporting our claim of a causal link between a reduction in funding risk and higher returns.

Finally, in Model 3 we incorporate fund fixed effects to test how within-fund variation in *Dynamic Lockup* predicts future returns. We find that a one standard deviation increase in the amount of capital the fund has restricted is associated with a 6 bps/month increase in returns (t-stat=2.42). This effect is similar in magnitude to the effects found in the lockup only sample, helping to confirm that the positive association between *Dynamic Lockup* and higher future performance is due to changes in funding liquidity risk within a fund.

Interestingly, we note that despite controlling for *Dynamic Lockup* in Models 1 and 2, *Lockup Dummy* remains positive and statistically significant. This suggests that there is a positive return difference between lockup and non-lockup funds that is not explained by the amount of restricted capital and remains even if the fund has no actual assets under lockup. For example, if we take the coefficient from Model 1 of Table 5, it indicates that a fund that has had its lockup completely expire (*Dynamic Lockup* = 0%) earns a return premium of 156 bps/year when compared to a fund that is similarly completely off lockup due to never having a lockup in their contract in the first place.

[Insert Figure 2 Here]

This effect is perhaps best seen graphically. Figure 2 shows the growth of $1, starting in the beginning of our sample period, invested in three equally-weighted fund portfolios. The solid line includes all lockup funds, while the dashed line includes all funds without a lockup.

The spread between the two is the well-known result that lockup funds outperform non lockup funds. However, our dynamic lockup measure allows us to include a third portfolio (the dotted line)that shows the performance of funds with a lockup provision, but with no actual restricted capital. We rebalance this portfolio monthly, since funds can enter and leave the portfolio as their dynamic lockup changes. As the figure shows, these funds underperform the set of all lockup funds, but they still outperform funds without a lockup. This, of course, raises the question: Why do funds earn a lockup premium in the absence of locked up capital? We explore this question in the next section.

## 6. Lockup Premiums, Risk, and Patient Capital

We demonstrate that the lockup premium is a function of two separate mechanisms. One is dynamic and related to how much capital the manager has under contractual lockup. The other is time-invariant and associated with the presence of a lockup feature in the fund's contract. In this section, we ask if this return premium is related to manager skill, or if more restricted capital allows funds to take more risk. For example, perhaps managers who are able to negotiate a lockup *ex ante* are also more skilled. If this is the case, then we should observe positive alpha for managers with a lockup, independent of the percentage of capital under contractual restriction. However, perhaps limits to arbitrage are relaxed and managers are better able to engage in more complex arbitrage activities without the fear of investor outflows. In this case, estimates of alpha should increase as the percentage of capital under lockup increases. Finally, managers with less fragile capital might also earn higher returns from increased factor exposures. In this situation, lockup funds would have larger betas and these betas might increase as the amount of capital under lockup is increased.

## *6.1. Risk Models*

In Table 6, we perform calendar-time factor regressions in order to test these hypotheses. Among those funds with a lockup, we form equal-weighted monthly portfolios based upon the fund's lagged dynamic lockup tercile. Furthermore, we adjust each portfolio's return by netting out the average placebo portfolio's return in that tercile. For example, if lockup and placebo funds in the high dynamic lockup tercile share certain characteristics that are associated with higher returns (e.g. both are smaller and younger funds), then subtracting placebo returns will adjust for that source of premium. All alpha and factor betas reported in Table 6 are, therefore, in excess of what is earned by the placebo group in that tercile.

[Insert Table 6 Here]

For each tercile portfolio, we run three models. The first uses no factors and again demonstrates that fund returns increase with the amount of capital under lockup. For example, funds in the low lockup tercile earn 16 bps/month more than placebo funds in the low tercile. This difference increases monotonically, with funds in the high tercile earning 36 bps/month more. This is consistent with our findings: the fact that all funds, regardless of dynamic lockup tercile, earn a premium indicates the presence of a fixed lockup effect, while the fact that the value of the intercept is increasing in terciles suggests that higher returns are also associated with a greater amount of capital under lockup.

The second model includes the market return as a risk factor, as well as the lagged market return to account for autocorrelation in hedge fund returns (Asness et al., 2001). Autocorrelation in fund returns is often interpreted as a sign of fund exposure to illiquid assets and/or difficult-to-value securities. In this simple model, our alpha estimates are not statistically different than zero for the low and middle terciles. Estimated coefficients for the market factor are positive and statistically significant. Since fund returns are placebo adjusted, these estimates reflect the *incremental* risk taking by lockup funds over placebo funds that are in the same tercile. This suggests that the lockup fixed-effect is related to an increased ability to take risk, independent of the amount of capital locked-up.

We also note that the coefficient on lagged market returns is positive and significant in all models. This suggests that funds with a lockup own more illiquid or difficult-to-price assets with greater transactions costs than the placebo funds in their tercile. However, the factor loading does not increase when moving from the low to the high tercile, indicating that this increase in illiquid assets is independent of the amount of capital under lockup.

Finally, funds in the high tercile still have positive and statistically significant alpha estimates. While managers with a lockup take more risk, when a manager has incrementally more capital locked up, they are able to earn a return above that gained through the observed increase in market risk. With a more stable capital base, this additional alpha could be related to a reduction in the limits to arbitrage and more subsequent trading opportunities, to an omitted liquidity premium that managers can capture, or perhaps to a greater use of leverage or options (Aragon, Martin, and Shi, 2014). These findings hold when we add the six additional factors from the Fung and Hsieh (2004) model for hedge fund returns.[5] We also note that, in the Fung and Hsieh model, funds with a lockup take on more small stock risk than the placebo funds. Furthermore, the factor loading on sizespread increases as the amount of capital under lockup increases. Both facts suggest that at least a portion of the excess returns observed for lockup funds is associated with an ability to earn the size premium when capital is more stable.

## *6.2. Stock Holdings*

Why do funds with higher dynamic lockup earn higher returns? In this section, we test whether the reduction in funding liquidity risk from locked up capital can better enable

[5] The Fung and Hsieh (2004) model includes the following returns: the S&P 500 total return, a size spread return (Wilshire Small Cap 1750 - Wilshire Large Cap 750), a bond market factor (quarterly change in the 10-year constant maturity treasury yield), a credit spread factor (quarterly change in the Moody's Baa yield less the 10-year treasury constant maturity yield), and three trend-following factors for the bond market, the currency market, and the commodities market. See David Hsieh's web page at `http://faculty.fuqua.duke.edu/%7Edah7/HFRFData.htm` for a complete description.

funds to earn asset illiquidity premiums by examining the relation between a fund's dynamic lockup and the liquidity of its equity holdings.

We examine stock liquidity along two related, but distinct dimensions – liquidity level and liquidity risk. Liquidity level refers to the asset-specific liquidity of an asset, which essentially reflects the expected transactions costs of trading the asset. There is a large literature documenting an illiquidity premium as compensation for holding stocks with lower liquidity level (e.g. Amihud and Mendelson (1986) and Acharya and Pedersen (2005)). Aragon (2007) argues that the premium earned by lockup funds is related to their ability to own assets with lower liquidity level. Specifically, he argues that because lockup fund investors cannot withdraw easily, lockup funds can have a longer trading horizon. A less fragile capital structure enables these funds to hold more illiquid assets, as they can amortize their expected trading costs over a longer holding period, leading to higher realized returns.

While measures of liquidity level reflect the average cost of trading, liquidity risk measures the covariation of the stock's returns to shocks to aggregate market liquidity. Investors require a premium to hold stocks that earn lower returns when the market becomes more illiquid (e.g. Pastor and Stambaugh (2003), Acharya and Pedersen (2005), Sadka (2006)). Although assets with lower liquidity level also tend to have higher liquidity risk (Acharya and Pedersen (2005)), the two concepts are distinct, as a liquid asset can have high liquidity risk if its value is likely to drop during periods of market turmoil. Lou and Sadka (2011) point out that liquidity level can be considered a mean effect, whereas liquidity risk can be thought of as a correlation effect. Brunnermeier and Pedersen (2009) note an important interaction between market liquidity risk and funding liquidity risk, as shocks to one source of liquidity tend to negatively affect the other, causing mutually reinforcing liquidity spirals that can cause greater investor withdrawals precisely at times when market liquidity dries up. This then leads traders to sell securities in illiquid markets. Thus, holding assets with greater market liquidity risk is especially risky for funds with greater funding liquidity risk, because these funds will suffer greater asset shocks and be even more likely to be forced to sell assets into illiquid markets at fire sale prices (Teo, 2011).

We obtain hedge fund equity holdings from the Thomson-Reuters database of quarterly 13F disclosures made by hedge fund management companies to the SEC. We match the hedge fund management company names from the commercial databases to the 13F-reporting entities in the Thomson-Reuters database. Because the 13F data are reported at the management company, rather than the fund level, we aggregate time varying fund-level characteristics, including dynamic lockup, to the management company level using the asset weighted average of each fund characteristic. Though each unit of observation is a hedge fund management company-quarter, we refer to each unit of observation as a "fund" for ease of exposition. Stock characteristics come from CRSP and Compustat. We proxy for a stock's liquidity level using the Amihud (2002) price impact ratio (defined as the average of the absolute value of daily returns over daily dollar volume). To measure liquidity risk, we measure each stock's beta with respect to the Pastor Stambaugh (2003) trade liquidity factor, estimated from rolling 24-month time series regressions that also include the market, size, value, and momentum factors.

In Table 7 we present regressions of portfolio liquidity characteristics as a function of fund lockup characteristics. We aggregate equity characteristics up to the portfolio level by measuring the percentage of the portfolio invested in stocks in the top tercile of the liquidity characteristic.[6] The sample includes the full sample of lockup and non-lockup funds and we follow the same placebo approach we used in Table 5. Each model includes the same fund-level control variables, including the placebo measure of dynamic lockup employed in Table 5 and standard errors are clustered at the management company level. For brevity, we focus on the estimate of *Lockup Dummy* and *Dynamic Lockup*.

[Insert Table 7 Here]

[6]The results are similar using other cutoffs, or if we use a value-weighted average characteristic.

We examine liquidity level in Models 1 and 2. Model 1 is estimated using OLS with time fixed effects, thus we can estimate a coefficient for both the lockup dummy and *Dynamic Lockup*. In this specification, *Dynamic Lockup* is positive, but insignificant ($t$-value=0.77), yet the lockup dummy is positive and significant at the less than 5% level. In Model 2, we repeat the analysis, but include fund fixed effects, which drops the time invariant lockup dummy from the analysis. This specification tests whether within-fund changes in funding liquidity risk, as proxied by changes in the proportion of capital that is restricted from withdrawals, is related to within-fund changes in illiquid stock holdings. We continue to find an insignificant coefficient on *Dynamic Lockup*. Together, the results in Models 1 and 2 suggest that lockup funds hold more illiquid assets on average, but do not increase their exposure to illiquid assets when they have more capital locked up. This is consistent with the lagged market beta results found in Table 6 and is counter to the notion that lockup funds earn illiquidity premiums because of their investor's inability to withdraw their capital.

We next examine liquidity risk in Models 3 and 4, using the same regression approach. Model 3 reveals an opposite pattern of results from those in Model 1, where we examined liquidity level. Liquidity risk is not related to the lockup dummy, but is instead positively and significantly related to the dynamic lockup measure. The result becomes even stronger in Model 4, when we employ the fund fixed effects estimator. Controlling for other time invariant fund characteristics, funds increase their liquidity risk as their funding liquidity risk decreases (i.e *Dynamic Lockup* increases). Thus, it appears that one driver of the excess returns of funds with greater dynamic lockups could be their increased propensity to invest in assets with greater liquidity risk and, thus, higher expected returns.

Why would *Dynamic Lockup* be related to liquidity risk and not liquidity level? We believe this asymmetric result could be due to the different nature of the two liquidity premiums. As mentioned previously, the liquidity level premium essentially comes from amortizing a large expected transaction cost. Because lockups expire, dynamic lockup represents a relatively short-term measure of binding withdrawal restrictions. For example, suppose a fund has 100% of its capital locked up for the next two months, but afterwards will revert to an unlocked fund. Buying more illiquid assets today will not necessarily be an attractive strategy for this fund, as the manager should still expect to liquidate some proportion of the illiquid assets and bear the high transactions costs in two months when the fund becomes unlocked.

On the other hand, the premium earned from holding greater liquidity risk stems from the possibility that a fund will hold the asset in a state of the world where withdrawal requests increase and market liquidity disappears at the same time. In this case, a relatively short-term withdrawal restriction could be quite effective. The same fund whose lockup is expiring in two months could hold high liquidity risk stocks this month with the knowledge that if the market experiences a shock and their assets decline in value, the fund will not be forced to sell at the bottom and get caught in a short-term loss-spiral (Brunnermeier and Pedersen, 2009) because their investors are unable to withdraw their money. Once the fund reverts to unlocked status, it can reduce its asset liquidity risk to an appropriate level given the change in its funding liquidity risk. Thus, as we explore in the next section, it could be that lockups encourage a more patient investor clientele on average, but even patient investors can become impatient during a crisis. Therefore, lockup funds can afford to take more liquidity risk when they know that their capital is restricted from withdrawals.

### *6.3. Patient Capital*

We find that funds with more capital under lockup earn higher returns than those without a stable capital base, but much of this return premium comes from an increase in the ability of the manager to take risk. Furthermore, fund managers are able to earn a risk-related premium even if very little capital is under contractual lockup. In other words, managers with a static lockup in their contract earn greater returns than managers that do not, even if their investors could withdraw their capital.

In this section, we ask if this additional return could, in part, be due to lockup funds attracting a more patient capital base. These investors, attracted to (or at least not dissuaded by) a lockup feature, might be more likely to stick with a manager and not react as quickly to poor performance. There are several reasons why funds with a lockup might either attract a more patient capital base *ex ante* or create an incentive for investors to remain in the fund. For example, the initial lockup could act as a screening device to help select investors that will remain patient even after the lockup expire, perhaps because these investors understand that earning a risk-premium entails suffering lower returns in some states of the world. The presence of a lockup also raises the cost to re-enter the fund. Investors may be less willing to pull assets if they know that any assets given back to the manager are again subject to the lockup. Finally, investors may be more patient with their own unlocked capital if they know that other investors' restricted assets are enabling all investors in the fund to earn a premium.

We test this conjecture in Table 8 by exploring how both our dynamic lockup measure and the lockup fixed-effect relate to flow levels and volatility. By including both the standalone *Lockup Dummy* and *Dynamic Lockup* measure, we are again able to separate the effects that having a contractual lockup feature, as well as actual restricted capital, have on a fund's future flows.

[Insert Table 8 Here]

The unit of observation is a fund-month. We follow the same placebo approach as in Section 5.2. In Models 1-3, the dependent variable is a fund's forward monthly netflow, inflow, and outflow, respectively, where we define a fund's inflow to be max(0, netflow) and a fund's outflow to be min(0, netflow) as in Hombert and Thesmar (2014). In Models 4-6, the dependent variable is the forward 12-month standard deviation of a fund's netflows, inflows, and outflows. We include a number of time-varying (e.g. age and AUM) and time-invariant (e.g. fees and redemption frequency) measures to control for other fund characteristics known to influence fund flows. We also include the fund's cumulative performance over the past 12 months, as well as lagged versions of the dependent variables. All models include time and style fixed effects and standard errors are clustered at the fund level.

We begin by examining the coefficients of *Dynamic Lockup* and *Lockup Dummy.* If our dynamic lockup measure has any ability to proxy for funding liquidity risk, we would expect that higher levels of restricted capital will be related to lower outflows and lower outflow volatility. Consistent with these predictions, we find that among funds with a lockup, more restricted capital (*Dynamic Lockup*) naturally leads to reduced outflows and outflow volatility. For example, from Model 3 we see that dynamic lockup is negatively related to future outflows, and in Model 6, we find that a contractual lockup reduces outflow volatility. As a point of economic reference, the average outflow in our sample is 1.83%/month and the average outflow volatility is 3.62%. Thus, a one standard deviation increase in dynamic lockup leads to a 13 bps/month, or a 7.10% decrease, in outflows and an 18 bps/month, or a 4.97% reduction in outflow volatility.

What is perhaps more interesting are the results for *Lockup Dummy.* We find that the presence of a lockup feature is associated with both lower outflows and outflow volatility. Even a lockup fund that has no actual capital under direct restraint, has a 33 bps/month, or an 18.03%, reduction in monthly outflows. The results for outflow volatility are similar. Taken together, these findings suggest that the lockup contract allows funds to retain more stable *unrestricted capital*, even after the lockup expires. This investor patience could be beneficial to both the manager and to other investors in the fund, as there is a reduced likelihood of withdrawals following poor performance, which could put further pressure on the prices of assets held by the fund.

# 7. Conclusion

Funding liquidity risk, i.e., the risk that traders will not be able to source outside funding to take advantage of attractive investment opportunities, is a central friction in models of financial market disequilibrium and limits to arbitrage. It is crucial that we understand how funding risk influences the performance and risk taking of hedge funds because of their key role as arbitrageurs that provide liquidity, price stability, and help push prices to fundamental value. In this paper, we create a novel proxy of funding liquidity risk that is both a fund-level and time-varying measure, which allows us to better identify the connection between funding liquidity risk and fund performance and risk-taking in the cross section of hedge funds.

We empirically document a strong link between a hedge fund's locked up capital and its performance and risk taking. This effect is robust to including several fund-level control variables, various hedge fund data biases, and changes in how we measure dynamic lockup. Moreover, our result holds when we include fund-fixed effects in the regressions, meaning that within-fund changes in capital restrictions are associated with improvements in fund performance.

We also find that regardless of how much capital lockup funds have restricted, they still outperform non-lockup funds by approximately 1% per year. This lockup fixed effect appears to be driven by increased risk taking by lockup funds as compared to non-lockup funds, including an increased exposure to illiquid investments. We conjecture that lockup funds take greater risk perhaps because the lockup provision screens for patient investors and incentivizes incumbent investors to be patient after the lockup expires. This allows lockup funds to retain more stable *unrestricted* capital, even after the lockup expires. Consistent with this conjecture, we find that lockup funds have lower outflows and lower outflow volatility, even after controlling for the proportion of capital that is contractually restricted. Collectively, our results suggest that funds can combat limits to arbitrage by not only directly restricting their investors' withdrawals, but also by creating mechanisms that incentivize a more patient investor base.

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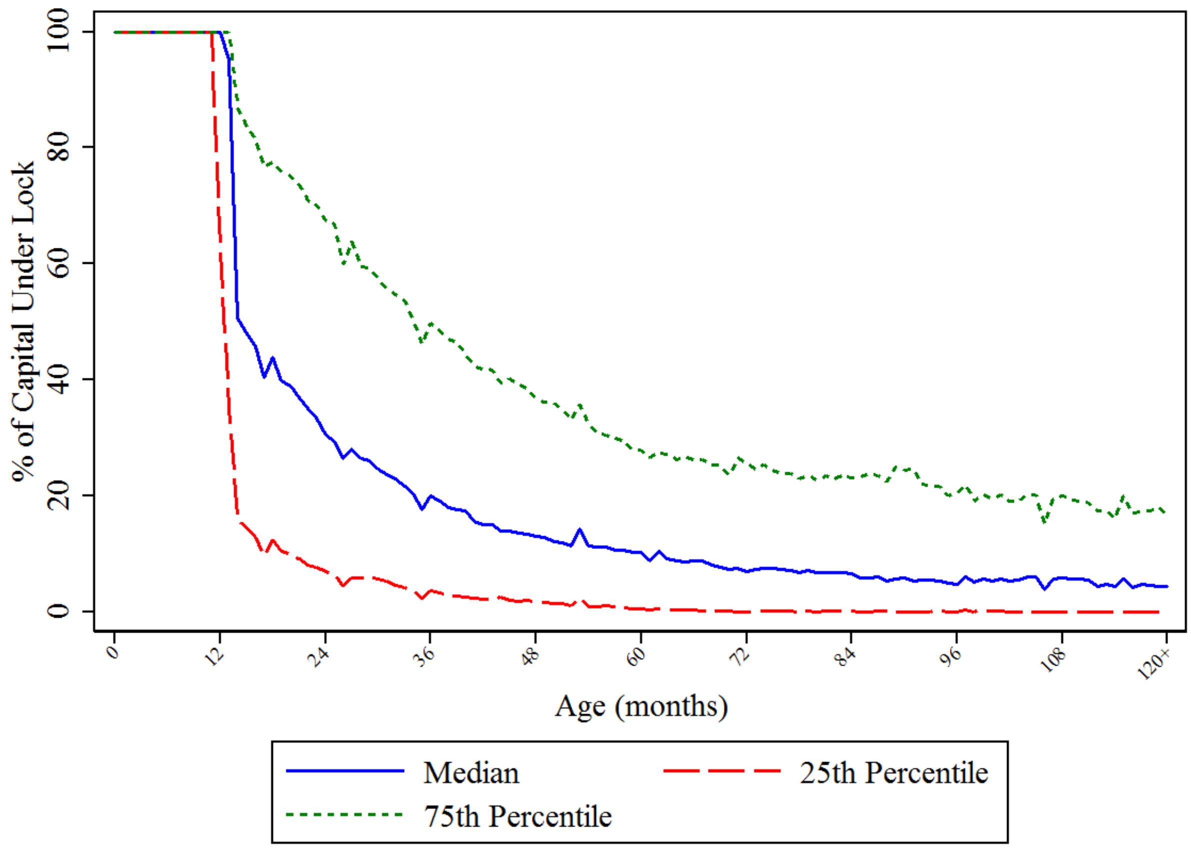


**Figure 1**
**Percentage of Capital Under Lockup by Fund Age**
Figure 1 presents the percentage of capital under lockup based on a fund's age (months). We separately report the percentage of capital under lockup for the 25th percentile, median, and 75th percentile of *Dynamic Lockup*.

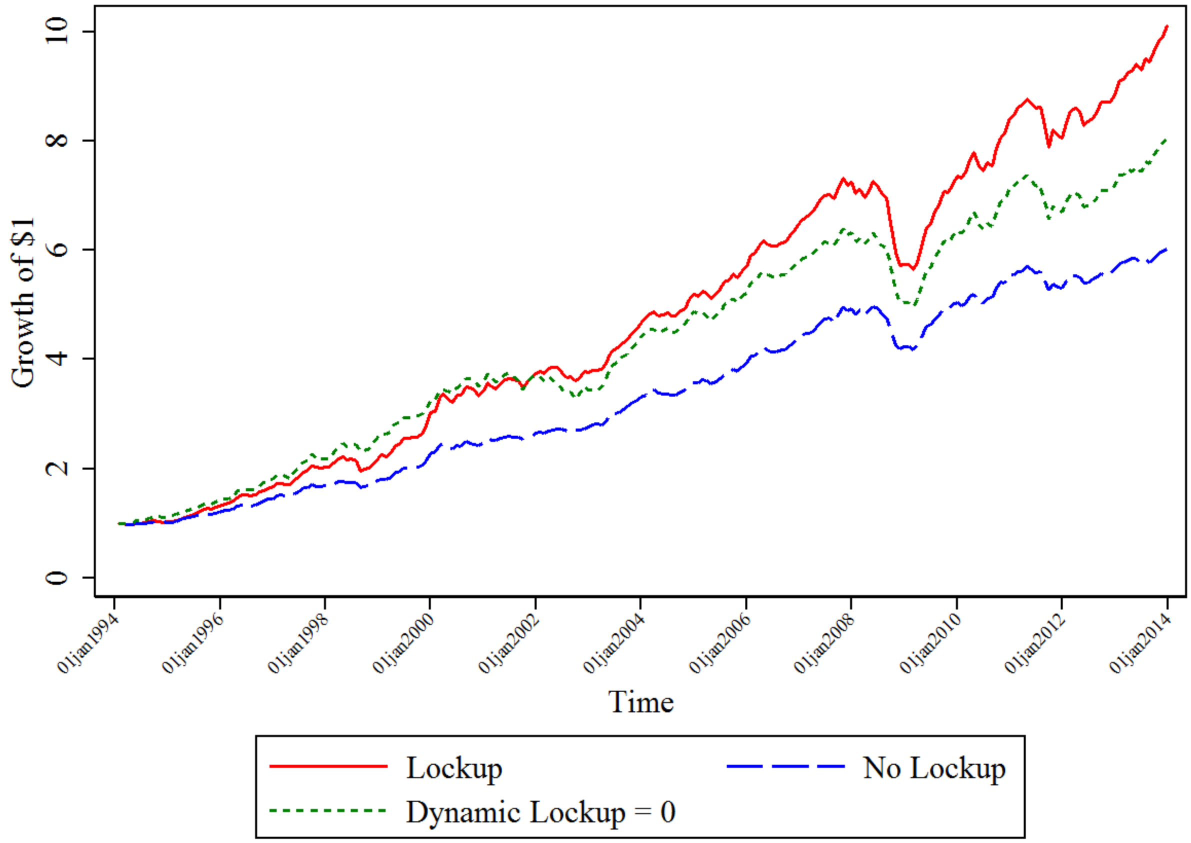


**Figure 2**
**Cumulative Performance by Lockup Characteristic**
Figure 2 shows the growth of $1 invested in three, equal-weight portfolios from 1994 (beginning of our sample) to the end of 2013. *Lockup* is the portfolio of funds that have a lockup in their contract. *No Lockup* is the portfolio of funds that do not have a lockup in their contract. *Dynamic Lockup=0* is the portfolio of funds that have a lockup in their contract, but their lagged level of dynamic lockup is zero. We rebalance this portfolio monthly.

**Table 1**
**Summary Statistics**

This table presents the summary statistics for the hedge funds in our sample. The unit of observation is a hedge fund-month. Our time-period of study is 1994-2013. In Panel A we examine the full sample of funds. In Panel B we only examine the sample of funds with a lockup. *Lockup Dummy* is an indicator variable equal to one is the fund has a lockup, and zero otherwise. *Dynamic Lockup* equals the percent of capital the fund has locked up (see equation 1). *AUM* is fund's reported assets under management at the end of each month ($ millions). *Age* measures years since fund's inception date. *Return* is the monthly return net of fee (%). *Flow* is fund's implied, monthly net flow scaled by AUM (%). *Management fee* is the annual fee charged to investors as a percent of AUM (%). *Incentive fee* is annual performance-based fee charged to investors (%). *Redemption notice* is the number of days of advance notice an investor must provide the fund to withdraw capital. *Redemption frequency* is the number of days between withdrawal periods. *Minimum Investment* is the minimum investment required to invest in the fund ($ millions). The full sample includes 13,959 funds and 795,447 fund-months.

*Panel A: Full Sample*

| | Mean | 10th | 25th | 50th | 75th | 90th | sd |
|---|---|---|---|---|---|---|---|
| Lockup Dummy % | 29.17 | 0.00 | 0.00 | 0.00 | 100.00 | 100.00 | 45.45 |
| AUM ($MM) | 166.85 | 2.88 | 9.72 | 34.00 | 114.99 | 345.00 | 635.07 |
| Age (years) | 5.39 | 0.92 | 1.92 | 4.08 | 7.59 | 11.84 | 4.63 |
| Return % | 0.68 | -3.84 | -1.00 | 0.63 | 2.34 | 5.20 | 5.34 |
| Flow % | 1.20 | -4.98 | -0.35 | 0.00 | 1.30 | 7.96 | 10.20 |
| Management fee % | 1.48 | 1.00 | 1.00 | 1.50 | 2.00 | 2.00 | 0.62 |
| Incentive fee % | 18.13 | 10.00 | 20.00 | 20.00 | 20.00 | 20.00 | 5.93 |
| Redemption notice (days) | 36.55 | 2.00 | 15.00 | 30.00 | 45.00 | 90.00 | 34.33 |
| Redemption frequency (days) | 67.58 | 7.00 | 30.00 | 30.00 | 90.00 | 90.00 | 79.44 |
| Minimum Investment ($MM) | 1.17 | 0.10 | 0.15 | 0.50 | 1.00 | 2.00 | 3.86 |

*Panel B: Lockup Sample Only*

| | Mean | 10th | 25th | 50th | 75th | 90th | sd |
|---|---|---|---|---|---|---|---|
| Dynamic Lockup % | 29.27 | 0.00 | 1.10 | 12.72 | 47.05 | 100.00 | 35.00 |
| AUM ($MM) | 156.30 | 3.00 | 9.80 | 33.80 | 110.00 | 331.42 | 490.82 |
| Age (years) | 5.30 | 0.92 | 1.92 | 4.08 | 7.51 | 11.67 | 4.39 |
| Return % | 0.78 | -3.87 | -0.90 | 0.74 | 2.49 | 5.35 | 5.54 |
| Flow % | 1.33 | -3.44 | -0.16 | 0.00 | 1.28 | 7.24 | 9.31 |
| Management fee % | 1.40 | 1.00 | 1.00 | 1.50 | 2.00 | 2.00 | 0.49 |
| Incentive fee % | 19.18 | 17.00 | 20.00 | 20.00 | 20.00 | 20.00 | 3.98 |
| Redemption notice (days) | 52.09 | 30.00 | 30.00 | 45.00 | 60.00 | 90.00 | 42.05 |
| Redemption frequency (days) | 107.18 | 30.00 | 90.00 | 90.00 | 90.00 | 180.00 | 98.53 |
| Minimum Investment ($MM) | 1.11 | 0.10 | 0.25 | 1.00 | 1.00 | 2.00 | 1.70 |

**Table 2**
**Hedge Fund Performance and Dynamic Lockups**

We regress hedge fund returns on a dynamic measure of a hedge fund's lockup. The unit of observation is a hedge fund-month. *Dynamic Lockup* equals the percent of capital the fund has locked up (see equation 1). All control variables are defined in Table 1. All continuous control variables are normalized to mean of zero and a standard deviation of one. We include time fixed effects throughout and style/fund fixed effects where indicated. We cluster standard errors at the fund level. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Dynamic Lockup | 0.0016*** | 0.0008*** | 0.0015*** | 0.0007*** |
| | [10.678] | [5.054] | [7.814] | [3.255] |
| Flow | | 0.0009*** | | 0.0005*** |
| | | [5.954] | | [3.679] |
| Log Age | | -0.0004** | | -0.0011** |
| | | [-2.218] | | [-2.200] |
| Log AUM | | -0.0012*** | | -0.0078*** |
| | | [-6.956] | | [-17.593] |
| Lag Return | | 0.0064*** | | 0.0049*** |
| | | [15.689] | | [11.843] |
| Minimum Investment | | 0.0014*** | | |
| | | [5.732] | | |
| Management Fee | | 0.0005 | | |
| | | [1.149] | | |
| Incentive Fee | | 0.0006*** | | |
| | | [3.965] | | |
| Redemption Frequency | | 0.0001 | | |
| | | [1.265] | | |
| Redemption Notice | | -0.0000 | | |
| | | [-0.038] | | |
| Time FE | Yes | Yes | Yes | Yes |
| Style FE | Yes | Yes | - | - |
| Fund FE | - | - | Yes | Yes |
| Observations | 231,973 | 231,973 | 231,973 | 231,973 |
| R-squared | 0.166 | 0.179 | 0.192 | 0.202 |

**Table 3**

**Hedge Fund Performance and Dynamic Lockups – Robustness**

We regress hedge fund returns on a hedge fund's *Dynamic Lockup*. The unit of observation is a hedge fund-month. Model 1 of *Panel A(B)* is intended for reference and is identical to that of Model 2(4) from Table 2. In Model 2, we exclude the fund's first year of returns. In Model 3, we exclude funds that never manage more than $20 million in assets. In Model 4, we alter the dependent variable by adding a delisting return of -50% to the last month the fund reports to a databases. In Model 5, we alter our definition of dynamic lockup using a duration approach (see equation 3). All control variables are defined in Table 1. All continuous control variables are normalized to mean of zero and a standard deviation of one. In Panel A, we include time and style fixed effects in each model. In Panel B, we include time and fund fixed effects in each model. We cluster standard errors at the fund level. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

*Panel A: Style Fixed Effects*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | Baseline | Remove Young Funds | Remove Small Funds | Delisting Return | Duration Lock |
| Dynamic Lockup | 0.0008*** | 0.0003** | 0.0006*** | 0.0019*** | 0.0009*** |
| | [5.054] | [2.064] | [3.479] | [8.440] | [5.505] |
| Time FE | Yes | Yes | Yes | Yes | Yes |
| Style FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 231,973 | 204,427 | 183,697 | 231,973 | 231,973 |
| R-squared | 0.179 | 0.186 | 0.200 | 0.101 | 0.179 |

*Panel B: Fund Fixed Effects*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | Baseline | Remove Young Funds | Remove Small Funds | Delisting Return | Duration Lock |
| Dynamic Lockup | 0.0007*** | 0.0005** | 0.0004* | 0.0018*** | 0.0012*** |
| | [3.255] | [2.048] | [1.939] | [5.898] | [3.775] |
| Time FE | Yes | Yes | Yes | Yes | Yes |
| Fund FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 231,973 | 204,395 | 183,697 | 231,973 | 231,973 |
| R-squared | 0.202 | 0.210 | 0.218 | 0.136 | 0.202 |

**Table 4**
**Summary Statistics by Dynamic Lockup Tercile**

We sort funds into terciles each month based on their level of dynamic lockup. This table presents time series averages for each of these three portfolios. We only consider funds with a lockup. Our time period of study is 1994-2013. *Dynamic Lockup* is the fraction of the fund's assets that are under lockup. All other variables are defined in Table 1. We tests for differences in means between the high and low terciles. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

| | Dynamic Lockup | AUM | Age | Return % | Flow % |
|---|---|---|---|---|---|
| Low Dynamic Lockup | 1.62 | 117.1 | 6.26 | 0.82 | -1.28 |
| Mid Dynamic Lockup | 18.57 | 159.1 | 5.41 | 0.95 | 1.36 |
| High Dynamic Lockup | 74.87 | 118.3 | 2.78 | 1.16 | 4.89 |
| High - Low | 73.24*** | 1.17 | -3.48*** | 0.34*** | 6.17*** |

**Table 5**
**Hedge Fund Performance and Dynamic Lockups – Placebo Approach**

We regress hedge fund returns on a hedge fund's *Dynamic Lockup*. The unit of observation is a hedge fund-month. We randomly assign a pseudo-lockup period to non-lockup funds and calculate a placebo value of dynamic lockup using the same methodology as with the lockup funds. We then test for a difference in the relation between the dynamic lockup measure and returns for lockup funds versus non-lockup funds. In the table, *Lockup Dummy* is an indicator variable equal to one if the fund has a lockup, and zero otherwise. *Dynamic Lockup* captures the incremental effect of reduced funding liquidity risk for lockup funds. *Placebo Lockup* captures any residual effect that our methodology has in predicting future returns for both lockup and placebo funds. We include identical control variables (omitted) to those in Table 2. All control variables are defined in Table 1. All continuous control variables are normalized to mean of zero and a standard deviation of one. We include time, style and fund fixed effects where indicated. Standard errors are clustered at the fund level. t-statistics are reported in square brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 1% level, respectively.

| | 1 | 2 | 3 |
|---|---|---|---|
| Lockup Dummy | 0.0013*** | 0.0007*** | |
| | [8.081] | [3.884] | |
| Dynamic Lockup | 0.0008*** | 0.0007*** | 0.0006** |
| | [5.129] | [4.478] | [2.418] |
| Placebo Lockup | 0.0006*** | -0.0000 | 0.0001 |
| | [7.249] | [-0.343] | [1.018] |
| Controls | - | Yes | Yes |
| Time FE | Yes | Yes | Yes |
| Style FE | Yes | Yes | - |
| Fund FE | - | - | Yes |
| Observations | 795,447 | 795,447 | 795,447 |
| R-squared | 0.124 | 0.137 | 0.137 |

**Table 6**

**Dynamic Lockup Placebo-Adjusted Performance - Portfolio Approach**

This table reports factor exposures for a series of equal-weighted, placebo-adjusted portfolios. Each month, funds are sorted into terciles based on their lagged *Dynamic Lockup*. We placebo-adjust each tercile by subtracting the monthly return for the placebo portfolio (*Lockup Dummy = 0*) from the monthly return of the lockup portfolio (*Lockup Dummy = 1*). We consider raw returns, a market model (with a lagged market factor) and the Fung and Hsieh (2004) 7-factor model (with a lagged market factor). Low (high) represents smallest (highest) *Dynamic Lockup* tercile. High-Low represents a long-short portfolio that invests long in high dynamic lockup funds and short low dynamic lockup funds. ***, **, and * indicate statistical significance at the 10%, 5%, and 1% level, respectively.

| | Constant | mktrf | L.mktrf | sizespread | bondmarket | creditspread | ptfsbd | ptfsfx | ptfscom | R-squared |
|---|---|---|---|---|---|---|---|---|---|---|
| Low | 0.0016** | | | | | | | | | 0.000 |
| | [2.171] | | | | | | | | | |
| Mid | 0.0018*** | | | | | | | | | 0.000 |
| | [2.793] | | | | | | | | | |
| High | 0.0036*** | | | | | | | | | 0.000 |
| | [4.983] | | | | | | | | | |
| High - Low | 0.0020*** | | | | | | | | | 0.000 |
| | [3.360] | | | | | | | | | |
| Low | 0.0004 | 0.1340*** | 0.0428*** | | | | | | | 0.351 |
| | [0.728] | [10.298] | [3.287] | | | | | | | |
| Mid | 0.0008 | 0.1226*** | 0.0300** | | | | | | | 0.343 |
| | [1.508] | [10.381] | [2.542] | | | | | | | |
| High | 0.0023*** | 0.1530*** | 0.0416*** | | | | | | | 0.447 |
| | [4.194] | [12.800] | [3.481] | | | | | | | |
| High - Low | 0.0019*** | 0.0190 | -0.0012 | | | | | | | 0.009 |
| | [3.048] | [1.424] | [-0.087] | | | | | | | |
| Low | 0.0005 | 0.1129*** | 0.0398*** | 0.0351** | 0.7503*** | 0.6158* | -0.0040 | -0.0100*** | -0.0140*** | 0.481 |
| | [0.879] | [8.370] | [3.106] | [2.115] | [3.140] | [1.817] | [-1.028] | [-3.197] | [-3.386] | |
| Mid | 0.0009* | 0.0971*** | 0.0233** | 0.0902*** | 0.5428** | 0.4023 | -0.0032 | -0.0059** | -0.0111*** | 0.510 |
| | [1.870] | [8.225] | [2.082] | [6.203] | [2.593] | [1.355] | [-0.939] | [-2.146] | [-3.062] | |
| High | 0.0024*** | 0.1314*** | 0.0387*** | 0.0797*** | 0.2440 | 0.2537 | 0.0008 | -0.0077*** | -0.0106*** | 0.550 |
| | [4.625] | [10.520] | [3.266] | [5.186] | [1.102] | [0.808] | [0.214] | [-2.648] | [-2.751] | |
| High - Low | 0.0019*** | 0.0185 | -0.0010 | 0.0446** | -0.5064* | -0.3621 | 0.0048 | 0.0023 | 0.0035 | 0.063 |
| | [3.058] | [1.235] | [-0.073] | [2.415] | [-1.903] | [-0.959] | [1.101] | [0.668] | [0.752] | |

**Table 7**
**Stock Trading and Funding Liquidity Risk**

This table reports results from regressions of quarterly stock holdings of hedge funds as a function of lockup characteristics. The unit of observation is a fund management company-quarter. We aggregate time varying fund-level characteristics including *Dynamic Lockup* up to the management company level using the asset weighted average of each fund characteristic. We aggregate equity characteristics up to the portfolio level by measuring the percentage of the portfolio invested in stocks in the top tercile of the liquidity characteristic. We proxy for a stock's liquidity level using the Amihud (2002) price impact ratio (defined as the average of the absolute value of daily returns over daily dollar volume). To measure liquidity risk, we measure each stock's beta with respect to the Pastor Stambaugh (2003) trade liquidity factor, estimated from rolling 24-month time series regressions that also include the market, size, value, and momentum factors. Each model includes the same fund-level control variables, including the placebo measure of dynamic lockup employed in Table 5. Models 1 and 3 are regular OLS, and Models 2 and 4 include fund fixed effects. Standard errors are clustered at the fund level. *t*-statistics are reported in square brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

| | Liquidity Level | | Liquidity Risk | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Lockup Dummy | 0.0473** | | 0.0036 | |
| | [2.47] | | [0.38] | |
| Dynamic Lockup | 0.0244 | 0.0189 | 0.0303* | 0.0390*** |
| | [0.77] | [1.25] | [1.80] | [2.91] |
| Controls | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| Fund FE | - | Yes | - | Yes |
| Observations | 18,710 | 19,324 | 18,162 | 18,757 |
| R-squared | 0.111 | 0.770 | 0.022 | 0.317 |

**Table 8**
**Hedge Fund Flows and Dynamic Lockups**

We regress hedge fund flows and flow volatility on a hedge fund's *Dynamic Lockup*. The unit of observation is a hedge fund-month. In Models 1-3, the dependent variable is the fund's forward monthly netflow, inflow, and outflow, respectively. We assume a fund's inflow to be the max(0, netflow) and a fund's outflow to be the min(0, netflow). In Models 4-6, the dependent variable is the standard deviation of the fund's netflows, inflows, and outflows, respectively, over the forward 12 months. We follow the same placebo approach as in Table 5. *Lockup Dummy* is an indicator variable equal to one if the fund has a lockup, and zero otherwise. *Dynamic Lockup* captures the incremental effect of reduced funding liquidity risk for lockup funds. *Placebo Lockup* captures any residual effect that our methodology has in predicting future flows for both lockup and placebo funds. In Models 4-6, *Lag Flow Volatility* is the standard deviation of the fund's monthly flows over the past 12 months. All other control variables are defined in Table 1. All continuous control variables are normalized to a mean of zero and a standard deviation of one. We include time and style fixed effects throughout. Standard errors are clustered at the fund level. $t$-statistics are reported in square brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

| | Levels | | | Volatility | | |
|---|---|---|---|---|---|---|
| | Netflow | Inflow | Outflow | Netflow | Inflow | Outflow |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Lockup Dummy | 0.0006 | -0.0026*** | -0.0033*** | -0.0082*** | -0.0055*** | -0.0040*** |
| | [1.418] | [-6.665] | [-12.024] | [-12.103] | [-8.994] | [-9.272] |
| Dynamic Lockup | 0.0006 | -0.0007 | -0.0013*** | -0.0018*** | -0.0007 | -0.0018*** |
| | [1.091] | [-1.630] | [-4.980] | [-2.880] | [-1.298] | [-4.600] |
| Placebo Lockup | 0.0101*** | 0.0100*** | 0.0002 | 0.0010*** | 0.0035*** | 0.0021*** |
| | [33.320] | [41.157] | [1.195] | [2.625] | [9.318] | [9.631] |
| Log Age | -0.0055*** | -0.0049*** | 0.0005*** | -0.0056*** | -0.0056*** | -0.0013*** |
| | [-23.567] | [-25.261] | [3.190] | [-14.442] | [-16.374] | [-5.334] |
| Log AUM | -0.0049*** | -0.0034*** | 0.0016*** | -0.0072*** | -0.0109*** | 0.0031*** |
| | [-24.619] | [-19.321] | [12.480] | [-20.708] | [-32.941] | [15.650] |
| Minimum Investment | 0.0012*** | 0.0006*** | -0.0006*** | 0.0010*** | 0.0018*** | -0.0008*** |
| | [4.313] | [3.227] | [-4.324] | [3.149] | [4.543] | [-3.962] |
| Management Fee | -0.0010** | 0.0009** | 0.0018*** | 0.0023*** | 0.0006 | 0.0019*** |
| | [-2.307] | [2.385] | [5.774] | [2.829] | [0.957] | [3.804] |
| Incentive Fee | -0.0001 | 0.0009*** | 0.0010*** | 0.0021*** | 0.0013*** | 0.0014*** |
| | [-0.659] | [5.620] | [7.993] | [6.795] | [4.284] | [7.033] |
| Redemption Frequency | 0.0003 | -0.0012*** | -0.0015*** | -0.0026*** | -0.0018*** | -0.0013*** |
| | [1.165] | [-8.221] | [-8.490] | [-7.701] | [-6.821] | [-5.988] |
| Redemption Notification Period | 0.0006** | -0.0002 | -0.0008*** | -0.0009*** | -0.0002 | -0.0010*** |
| | [2.147] | [-1.196] | [-3.952] | [-2.848] | [-0.932] | [-3.817] |
| Annual Return | 0.0097*** | 0.0060*** | -0.0036*** | 0.0007*** | 0.0046*** | -0.0036*** |
| | [18.019] | [19.063] | [-14.267] | [2.997] | [14.314] | [-13.101] |
| Lag Flow | 0.0096*** | 0.0092*** | 0.0055*** | | | |
| | [31.908] | [36.129] | [36.442] | | | |
| Lag Flow Volatility | | | | 0.0172*** | 0.0107*** | 0.0097*** |
| | | | | [49.222] | [32.606] | [54.964] |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Style FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 629,456 | 629,456 | 629,456 | 629,456 | 629,456 | 629,456 |
| R-squared | 0.046 | 0.051 | 0.037 | 0.140 | 0.132 | 0.112 |