A New Method to Estimate Risk and Return of Commercial Real Estate Assets from Cash Flows: The Case of Open-End (Diversified) Core Private Equity Real Estate Funds

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Abstract

This paper builds on existing methods to estimate abnormal performance of real estate assets from cash flows to strengthen the position that open-end core real estate funds earn high (albeit levered) returns. It proposes that we can use the presence of detailed cash flows histories from the date of asset purchase (inception date) to the date of sale (liquidation date) plus the actual sale price for the transaction as well as appraised market values during the interim to determine a value for the Jensen's alpha and beta for each investment made by an open-end core real estate fund. It is examined how these Jensen's alphas are affected by (i) the rate of return from sector leverage, (ii) the rate of return from incremental leverage, and (iii) the rate of return from excess risk taking, and how the Jensen's alphas which we estimate may be expected to overstate the "true" deal-level alpha. We offer an explanation of this puzzle which hinges on the observation that institutional investors prefer diversification over concentration of ownership because of their concern with minimizing portfolio risk.

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1 Introduction

This paper builds on, and borrows from, Driessen, Lin, and Phalippou (2012), hereinafter referred to as DLP. The DLP paper examines the performance of the private equity-backed venture-capital (VC) funds and buyout funds (BO). The topic of performance of private equity funds is not new, and the academic literature is vast.[1] DLP's approach to the problem is based on internal rates of return at the fund level. In the funds analyzed, DLP report an average (value-weighted) internal rate of return (IRR) at the aggregate fund-level of 14.3%. These IRRs are the rates that make the net present value (NPV) for each fund zero, or, equivalently, these IRRs are the discount rates of a standard market model, and they depend on two unknown parameters, α (abnormal performance) and β (risk exposure). However, as DLP point out (p. 516), "With a single (IRR) equation and 2 unknowns, we cannot solve for α and β." In this case, another equation or an assumption about α and β is required in order to determine the two unknowns. What should this be? DLP chose to assume that there is a common parametric structure for α and β across similar funds. DLP group funds based on their starting year (or vintage year) and within each vintage year into two-by-two matrices, with focus (EU/US) and size axes. Their method, then, looks for values of α and β that bring all the NPVs across identical funds as close as possible to zero.

Our approach to determine α and β bears resemblance to, but is different from the one taken by DLP. Instead of assuming there is a common parametric structure for α and β across identical funds, we assume there is a common parametric structure for α and β across different horizons (as an independence argument might suggest). Given this assumption, we use the presence of detailed cash flows histories from the date of purchase (inception date) to the date of sale (liquidation date) plus the actual sale price for the transaction as well as appraised market values during the interim to determine a value for α and β for each investment. We then take special effort to relate our estimates of α to abnormal returns as calculated by Acharya, Gottschalg, Hahn, and Kehoe (2013), hereinafter referred to as AGHK. Estimates

[1] Jensen (1989) did some of the seminal work in this field. His analysis suggests that private equity funds create significant value-added through high leverage and powerful incentives. Subsequent work – e.g., by Hellmann and Puri (2000), Kortum and Lerner (2000), Mollica and Zingales (2007), and Chemmanur, Krishnan, and Nandy (2008) – reach a similar conclusion that private equity groups seem to add value to the companies in which they invest. Kaplan and Schoar (2005) report persistence in fund performance, i.e., fund that outperform the industry are likely to outperform with their next fund.

of α (with and sometimes without adjusting for risk) are widely used in practice to measure how well a fund manager does compared to the market or benchmark index. In contrast, the calculations in AGHK provide us with a measure of how much an investor in a private equity fund actually earns relative to what the investor would have earned from a sector benchmark, referred to as a deal-level alpha. The deal-level alphas in AGHK are measured in terms of IRRs (which is the most commonly used performance measure for private equity markets). These deal-level alphas can be calculated at any stage of a fund's life.[2] This study documents that α overstates, or mismeasures, the deal-level alpha, and that the overstatement, or mismeasurement, of the deal-level alpha is due to the use of financial leverage (which fund managers need or choose to take). Our explanation for why this disparity exists is that the use of financial leverage enables the fund manager to diversify its portfolio and reduce risk, which is traded off against the higher α and greater incentive compensation.

In this paper we apply our model to the case of open-end core private-equity funds (OECFs) and try to answer five specific questions. (1) Are the returns to private equity real estate investments made by OECFs large? (2) Do these returns represent value created by the fund advisor, over and above the value created by the quoted sector peers (i.e., all core real estate funds)? (3) What measures of α and β are consistent with these returns? (4) How do the values of α and β compare with the true abnormal performance measured at the deal-level? (5) How does leverage affect the values of α and β? Even though we study OECFs, the five questions we deal with are of general interest. Our discussions highlight how private equity fund managers use leverage both to take advantage of more investment opportunities and to increase the values of α and β.

The remainder of the paper proceeds as follows. Section 2 provides an overview of OECFs. Section 3 describes the methodology for calculating values of α and β. Section 4 presents the data used. In Section 5, we link deal-level alphas to the values of α and β. Section 6 concludes.

[2] AGHK reach the conclusion that private equity fund managers (especially those private equity managers with experience to better understand VC outcomes) do add value in relatively large private equity transactions involving equity securities in operating companies that are not publicly-traded on a stock exchange. Deals in AGHK's sample have an average, gross IRR of 56.1% and a cash multiple of 4.4, with large values on the right tail. Deals in AGHK's sample are drawn from Western Europe with a vintage year between 1991 and 2007.

2 The Case of OECFs

In the present paper we study OECFs, which are an especially interesting case for three reasons. First, one of the pluses of OECFs, as far as private equity real estate funds are concerned, is that they can be well diversified by property type and geography. It is possible for property type and geographic diversification to reduce the variance of a portfolio's return and to reduce its mean return as well. At least since Firstenberg, Ross, and Zisler (1988), real estate economists have questioned whether geography, specifically metropolitan areas, or property type diversification matters more for mean-variance diversification. Admittedly, there is evidence on both sides which suggests that the answer may not be found in terms of black or white but in shades of grey. There is also evidence to suggest that not all OECFs are created equal and that smaller funds, in particular, are less diversified and have returns with a greater amount of idiosyncratic volatility than larger funds. In other words, real estate diversification requires substantial capital (see Fairchild, MacKinnon, and Rodrigues (2011)). A similar conclusion can be found in the work of Fisher and Goetzmann (2005). This work takes a rather different approach to the subject of real estate diversification. Instead of comparing costs and benefits of real estate diversification using holding period returns, Fisher and Goetzmann (2005) focus on an active real estate fund manager's ability to meet an IRR-based benchmark and the cross-sectional volatility of IRRs for a portfolio. Their sample includes performance data on all properties owned or managed by a variety of investment managers – from open-end funds to closed-end funds – from the last quarter of 1977 through second quarter 2004. Fisher and Goetzmann (2005) find significant reductions in the cross-sectional dispersion of IRRs in a property portfolio, but only in a large portfolio (i.e., portfolios of 100 properties).

Second, OECFs are more flexible and liquid than closed-end funds. An OECF is one that can redeem its shares quarterly at net asset value (NAV) per share. Most OECF also offer their shares continuously at NAV per share. Many would argue that the buying or redeeming of shares directly through the fund – especially at the first sign of trouble – represents a socially efficient way to address moral hazard in managerial incentives and/or asymmetric information. Others would argue that the buying or redeeming of shares can lead to too much open-ending or liquidating. This open-ending creates an underinvestment problem according to which OECFs may reject positive net present value (NPV) investments that are hard to convert into cash quickly and for which fair market value is uncertain. As a result, while OECFs may represent a safer choice than closed-end funds, closed-end funds may offer certain opportunities which might produce a better return (see Stein (2005)). The suggested shortening of the evaluation period for OECFs on the other hand may reduce the fund's exposure to asset price shocks.

Third, a common assumption is that OECFs provide broad market exposure to real estate and employ low leverage. However, Fairchild, MacKinnon, and Rodrigues (2011) state (p. 66) that OECFs have, because of their leverage, an aggressive exposure to the broad commercial real estate market. Fairchild, MacKinnon, and Rodrigues (2011) provide an initial, descriptive look at the characteristics of OECFs. Their sample includes a total of 16 different OECFs in the US over the period 1999-2010. Fairchild, MacKinnon, and Rodrigues (2011) report the leverage levels of these funds over time. Over the 1999-2010 period the mean leverage level increases from 20% in 1999 to roughly 30% in 2010. This increase in mean leverage levels appears to result, in part, from an increase in the use of debt financing in 2007 and partly from a decline in property values starting in 2008 but reversing in 2010. The point is that the degree of leverage is not zero but is not inconsequential either.

Table 1 shows a detailed summary of total real estate assets under management by fund type for the period 1978-2015. The unit of observation is the property. The data are from the National Council of Real Estate Investment Fiduciaries (NCREIF), which is an association of institutional real estate professionals who share a common interest in the performance assessment of investments in private equity real estate. At the end of 2015, open-end funds (with core and non-core real estate investment strategies) held over 4,700 properties, valued at $296 billion, across four major property types, with a small residual of other (including hotels and self-storage). By contrast, closed-end funds held only 787 properties, valued at $35 billion. Other funds (dominated by separate accounts) held over 3,800 properties, valued at $211 billion. Thus, open-end funds account for 50 percent of all properties held, and 55 percent of the value of assets under management (which provides a good reason to examine the case of OECFs).

Figure 1 draws attention to the pattern of holdings in open-end funds for the years 1978-2015. The quantity plotted is the percent of the total assets under management held by open-end funds to the total assets held by all plan sponsors over the period 1978-2015. Figure 1 shows that in 1982 the fraction of total assets under management held by open-end funds to total assets held by all plan sponsors was 34 percent and decreased to 15 percent in 1994.[3] For the years afterwards, the fraction of total assets under management held by open-end funds to total assets held by all plan sponsors increases from 15 percent in 1994 to 47 percent in 2007 and to 55 percent in 2015.

The above highlights how dominant OECFs have become in the U.S. in recent years. Interestingly, at the same time actual allocations to real estate in institutional investment portfolios have increased as well, from about 3 percent in 1995 to 8.8 percent in 2013, and to about 9.6 percent (target level) in 2015 (see Funk (2015)). The immediate conclusion which follows from this observation is that, with more and more wealth being allocated to illiquid asset classes such as real estate, portfolio positions in these asset classes become less desirable with size and, therefore, more and more wealth moves freely into OECFs searching for greater liquidity and high returns, if indeed that would be possible. At the theoretical level, many works suggest the same conclusion to meet liquidity needs (see, e.g., Longstaff (2009)). Facts like these, and their implications, make this study a valuable contribution to the private equity literature.

3 Estimating Abnormal Performance

To understand the basic idea for estimating abnormal performance (and how this abnormal performance measure relates to the calculations in AGHK), suppose that every fund manager reports property-level operating income and expenses and market value data to an association of institutional real estate professionals each quarter. Following Jensen's (1968) original time-series regression

[3] On the basis of the information in Table 1, it is clear that the decline in the fraction of total assets under management held by open-end funds to the total assets held by all pension sponsors in the 1982-1994 period was commensurate with a shift to closed-end funds and direct investing (i.e., separate accounts). The increase in the fraction of total assets under held by open-end funds from 1979 to 1982 provide at least a partial explanation for the shift to closed-end funds and direct investing. The high inflation of the late 1970s and early 1980s turned pension fund executives' attention toward real estate investing and encouraged investors to invest in open-end funds, and as a result, commercial real estate prices rose and yields on the investments declined. However, as yields on the investments declined, many investors wanted out of open-end funds so they could invest directly (and a few wanted to step back and see which way real estate investing was likely to move, and as a result, for example, total assets held by all pension sponsors fell slightly from $42 billion in 1993 to $41 billion in 1994, see Table 1).

approach, it would always be possible in this setting to use the Sharpe-Lintner CAPM approach to estimate the abnormal performance (or α) and risk (or β). That is, as has become standard practice to evaluate and pay fund managers in relation to the performance of their peers, one could estimate Jensen's alpha based on the following market model:

$$(1) \quad R_{it} - r_{ft} = \alpha_i + \beta_i\left[R_{mt} - r_{ft}\right] + \varepsilon_{it}$$

where R_{it} is the holding period rate of return on project i in month t, R_{mt} is the benchmark rate of return (in this case either the NPI property return index or the ODCE return index) in month t, r_{ft+k} is the risk-free rate, and ε_{it} is a random error term. β_i is a parameter that measures the sensitivity of R_{it} to the benchmark (market) index. α_i is the alpha index (i.e., Jensen's alpha) and gives a measure of the performance of the fund manager in relation to one's peers (and in relation to the risk of the property, β_i).[4]

However, what we want is not an α and β that is consistent with a times-series of estimated holding period returns (and whether the fund manager is able to outperform the benchmark (market) index), but an α and β that is consistent with the fund's internal (or realized) return on investment. Once we have that as a foundation, we can use the methodology in AGHK to calculate a more meaningful abnormal performance measure for deals of private equity funds, one that is based on using IRR instead of holding period returns. We can then proceed to compare these two values and so decide whether the α suggested herein exhibits more extreme means and variances than the true deal-level alphas suggested by AGHK. But large and more variable measures of α – when they occur – would suggest that OECF fund managers may, in actual practice, be overcompensated for the value-added they create at the deal level.

To begin, let us specify the (unlevered) internal rate of return, R_i, for an arbitrary property investment i to be

$$(2) \quad V_{it} - \left[\frac{CF_{it+1}}{(1+R_i)} + \frac{CF_{it+2}}{(1+R_i)^2} + \cdots + \frac{CF_{it+n_i} + V_{it+n_i}}{(1+R_i)^{n_i}}\right] = 0$$

[4]There is somewhat of an over-emphasis on risk in this description of how fund managers are evaluated, considering that most fund managers are evaluated in practice in relation to the performance of their peers without adjusting for β_i. Nonetheless, we shall assume for present purposes that fund managers are evaluated based on the α_i they are able to generate (adjusting for β_i), since this is the way fund managers should, in theory, be evaluated.

where CF_{it+k} represents the before-tax cash flows to property i in period $t+k$, V_{it+k} represents the market price of the property in period $t+k$, and n_i is the length of the holding period, and t is the date at which the holding period starts.

Next, following DLP, we can use (1) to rewrite the discount rate in period $t+k$ as equal to $R_{it+k} = \alpha_i + r_{ft+k} + \beta_i[R_{mt+k} - r_{ft+k}]$, where β_i is the property's (unlevered) beta (which, as estimated by the security market line, shows the systematic risk of the property). If R_i in period $t+k$ is replaced in equation (2) by $R_{it+k} = \alpha_i + r_{ft+k} + \beta_i[R_{mt+k} - r_{ft+k}]$, the resulting modification of equation (2) is

$$(3) \quad V_{it} - \left[\frac{CF_{it+1}}{(1+\alpha_i + r_{ft+1} + \beta_i[R_{mt+1} - r_{ft+1}])} + \frac{CF_{it+2}}{(1+\alpha_i + r_{ft+1} + \beta_i[R_{mt+1} - r_{ft+1}])(1+\alpha_i + r_{ft+2} + \beta_i[R_{mt+2} - r_{ft+2}])} + \cdots + \frac{CF_{it+n_i} + V_{it+n_i}}{\prod_{k=1}^{n_i}(1+\alpha_i + r_{ft+k} + \beta_i[R_{mt+k} - r_{ft+k}])}\right] = 0$$

This equation rests on the assumption that value-added skills (i.e., a large positive α_i) will result in a high return on investment. Private equity real estate funds generally try to add value by improving the physical, financial, and/or operational characteristics (through operational expertise) of a property. These value-increasing actions are not necessarily mutually exclusive, but, if successful, they tend to result in improved cash flow and profitability (i.e., larger values of CF_{it+k}). Holding V_{it} and β_i constant, improved cash flows and profitability imply an increase in R_i in terms of equation (2) and a large positive α_i in terms of equation (3). The empirical problem is how to estimate α_i and β_i from the available data, given values of V_{it}, $CF_{it+1}, CF_{it+2}, \ldots, CF_{it+n_i}$, and V_{it+n_i}. Since equation (3) is a single equation with two unknowns, α_i and β_i, the problem resists solution.

DLP ingeniously suggested considering least squares optimization applied to NPVs, bringing all the NPVs as close as possible to zero for a cross section of N portfolios of funds. However, to estimate their model DLP were forced to assume that there is a common parametric structure for α_i and β_i across portfolios. We propose a similar but different least squares optimization technique, one which does not constrain α_i and β_i to have a common parametric structure across investments. More specifically, we solve the least squares optimization

$$\text{(4)} \qquad \min_{\alpha_i,\beta_i} \sum_{j=1}^{n_i} \left[NPV_{ij}(\alpha_i, \beta_i)\right]^2$$

where

$$\text{(5)} \quad NPV_{ij}(\alpha_i, \beta_i) = V_{it} - \left[\sum_{k=1}^{j} \frac{CF_{it+k}}{\prod_{k=1}^{j}\left(1 + \alpha_i + r_{ft+k} + \beta_i\left[R_{mt+k} - r_{ft+k}\right]\right)} + \frac{V_{it+j}}{\prod_{k=1}^{j}\left(1 + \alpha_i + r_{ft+k} + \beta_i\left[R_{mt+k} - r_{ft+k}\right]\right)}\right]$$

where $NPV_{ij}(\alpha_i, \beta_i)$ is the NPV of the cash flows on property i by year j since investment. We can estimate α_i and β_i for each individual property in our sample in this way since we have (quarterly) data on V_{it+j} for $j = 1,2, \ldots, n_i$. The chosen values of α_i and β_i will yield an average "dynamic IRR" that will not be exactly equal to the static IRR as defined in equation (2) (due in part to the complex relation between NPV and the discount rates and partly due to idiosyncratic shocks to V_{it+k}), but nonetheless should be very close. Thus, one can think of our estimates of α_i and β_i as being asymptotically consistent estimators. Essentially, if the values of α_i and β_i that make the NPVs across the N overlapping holding periods closest to zero are high, then the observed values of CF_{it+k} and V_{it+k} in equation (5) must be high. But if CF_{it+k} and V_{it+k} are high, the investment should have a high static IRR (so high estimates of α_i and β_i are consistent with high static IRRs in equation (2)).

In solving the above least squares optimization for $NPV_{ij}(\alpha_i, \beta_i)$, we measure CF_{it+k} on a quarterly basis as net operating before debt service, less capital expenditures, plus all cash proceeds from partial sales. We measure V_{it+j} using the quarterly market value reported to NCREIF in period $t + k$ for all $k < n_i$ and the actual sales price (net of selling expenses) in period $t + n_i$ when the property is sold. Finally, we convert all values of α_i to annual equivalents.

We compare α_i with results in AGHK to ask the questions "Are α_i and deal-level alpha different?" and to define the true value-added from an investment. The latter is defined as:

(6) $\alpha_i^* = R_i - R_m$

where R_i is the unlevered (internal rate of return) return on property i and R_m is the benchmark return.

Continuing with the comparison between Jensen's α in equation (3) and the true deal-level alphas suggested by AGHK, we can rewrite (6) as:

(7) $\alpha_i^* = (R_i^L - R_m) - (R_i^L - R_i)$

where R_i^L is the levered property return for property i, $R_i^L - R_m$ is the deal's outperformance relative to the benchmark index (without adjusting for risk), and $R_i^L - R_i$ is the total leverage effect.

The next step in the comparison is to relate the total leverage effect of the deal to the deal's financial leverage. Following Hamada (1972), the total leverage of the deal can be written as:

(8) $R_i^L - R_i = (R_i - R_{Di})(D/E)_i$

where R_{Di} is the cost of debt capital for property i and $(D/E)_i$ is the debt-to-equity ratio for property i. It further follows from the derivations in Hamada (1972) that $R_i^L = [\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)] + (R_m)$, where α_i^L is the levered Jensen's alpha on the property measured in relation to the benchmark and $\beta_i^L = \beta_i(1 + D/E_i)$.

Next, substituting (8) in (7), it follows that

(9) $\alpha_i^* = (R_i^L - R_m) - (R_i - R_{Di})(D/E)_i$

Next, substitute for D/E_i in terms of incremental leverage:

(10) $D/E_i = D/E_{Si} + (D/E_i - D/E_{Si})$

where D/E_{Si} captures leverage inherent in the sector and $(D/E_i - D/E_{Si})$ measures the incremental leverage beyond the sector. Then (9) becomes

(11) $\alpha_i^* = (R_i^L - R_m) - (R_i - R_{Di})(D/E)_{Si} - (R_i - R_{Di})(D/E_i - D/E_{Si})$

Finally, substituting the definition of R_i^L from above into (11), we have

(12) $$[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)] = \alpha_i^* + (R_i - R_{Di})(D/E)_{Si} + (R_i - R_{Di})(D/E_i - D/E_{Si}) - R_m[\beta_i(1 + D/E_i) - 1]$$

Here $[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)]$, which is Jensen's alpha adjusted for leverage, is decomposed into the following four components: α_i^*, which is the true deal-level alpha, $(R_i - R_{Di})(D/E)_{Si}$, which is the return from sector leverage, and $(R_i - R_{Di})(D/E_i - D/E_{Si})$, which is the return from incremental leverage, and $R_m[\beta_i(1 + D/E_i) - 1]$, which is the return from excess risk taking.

Here we make several comments on the empirical implementation of equation (12). First, in equation (12) the Jensen's alpha adjusted for leverage generally gives us an approximate estimate of how the market evaluates OECF fund managers relative to their peers.[5] Second, in contrast, the true deal-level alphas in equation (12) give us an estimate of the overall outperformance of the property at the deal-level. Thus, equation (12) is extremely helpful in generalizing about whether fund managers are fairly compensated for the true excess returns they are generating (adjusting for risk). We hypothesize, and later show, that $[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)] > \alpha_i^*$. That is, $[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)]$ will generally exceed α_i^* if financial leverage is positive (i.e. if $(R_i - R_{Di})(D/E)_{Si} + (R_i - R_{Di})(D/E_i - D/E_{Si}) > 0$) and if risk taking is low (i.e., if $R_m[\beta_i(1 + D/E_i) - 1] < 0$, which generally will occur when β_i is low).

We stress, as the reader no doubt has already recognized, that whenever that $[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)] > \alpha_i^*$, the OECF fund manager is routinely being overcompensated for the true value-added they create at the property level. Observe, too, that allowing fund managers to be compensated on the basis of $[\alpha_i^L - R_{Di}(\beta_i(1 + D/E_i) - 1)]$ rather than α_i^* gives fund managers an incentive to take on financial risk to increase returns. This incentive is perverse, because there is little one can do to get rid of the fund manager's desire to take on financial risk in this situation. Fund managers will take on financial leverage (especially when they are making investments in core properties with relatively stable cash flows) because of their compensation structure, no matter what. In addition, it should be noted that the use of nonrecourse debt secured by the property provides only a further incentive in this situation to take on financial risk, if private equity real estate fund managers ever needed one, because nonrecourse debt is one for which the fund manager is not personally liable; upon default the

[5] Only approximate because most fund managers are evaluated in practice in relation to the performance of their peers without adjusting for leverage or beta β_i.

lender can look only to the property securing the debt for satisfaction. Thus, by defaulting and walking away from the property when the value of the mortgage becomes greater than the value of the property, the fund manager is able to limit any downside exposure (something private equity real estate fund managers can do so more than private equity buyout funds or venture capital funds, or even growth equity funds, given the nature of their underlying assets).

The above results raise the question, Why is this so? Why compensate fund managers on the basis of Jensen's alpha rather than the true deal-level alpha, and give them an incentive to take on financial risk to increase returns? Our explanation of this puzzle is that financial leverage does produce some positive benefits related to the overall risk and return at the portfolio level (which investors apparently find desirable). As one would expect, almost all of the risk in an unlevered portfolio comes from its large equity allocation to a small number of properties. In contrast, the use of leverage allows one to invest in a number of different assets with a limited amount of capital (as opposed to investing only in a small number of properties). In turn, with higher rates of diversification, investors are provided some protection against the risk of a sudden decline in the market demand for that particular property type or geographic region in which the fund manager might otherwise have specialized. To make this argument the case, one also has to argue that expected core real estate returns are such that the variance reduction benefits of diversification are not offset by lower expected returns but instead are offset by higher compensation expenses.

4 The Data

Our principal source of data is the NCREIF property database. This data set is compiled from information supplied to NCREIF from investment managers and plan sponsors who own or manage real estate in a fiduciary setting. Out of this data, NCREIF compiles an Open End Diversified Core Equity (ODCE) index. The ODCE index is an index that measures the investment returns for open-end commingled funds pursuing a core investment strategy. Core investments are an important concept in financial and real estate economics. However, there is no generally accepted way to define a core real estate investment strategy. One approach is to argue that they are not non-core (i.e., value-added and opportunistic) investments. A second approach is based on measured performance (i.e., core investments are normally underwritten to earn leveraged rates of return of 8 to 12%, while value-added and opportunistic investments are normally underwritten to earn leveraged rates of return of 12 to 18% and 18+%, respectively). A third approach is based on measured characteristics (i.e., core investments consist primarily of investments in office, retail, industrial, and apartments, with relatively stable cash flows, while value-added and opportunistic investments are exposed to a high degree of risk, as they typically involve a significant amount of "value creation" through releasing, redevelopment, or development). NCREIF chooses to do neither of these approaches, but instead divides funds into two groups based on self-reported core and non-core investment practices. While there are obvious shortcomings in using self-reported measures of investment strategies (including bias due to misclassification), there are reasons to be suspicious of more objective measures of core investment strategies as well.

Because the goal of the paper is to assess the fund performance of OECFs (including whether the α suggested herein deviates significantly from the true deal-level alphas suggested by AGHK for OECFs), it seems appropriate that the analysis should focus only on those funds included in the ODCE index. One advantage of using the funds included in the ODCE index is that it eliminates problems with non-standard reporting periods and the non-standard presenting and reporting of real estate investment returns. NCREIF requires that properties included in the NCREIF property database be valued at least quarterly, either internally or externally, using standard commercial real estate appraisal methodology. In addition, each property must be independently appraised at least once every three years. NCREIF further requires all documented income and expenses to comply with accounting standards. There are 33 OECFs included the ODCE index. These funds report on both a historical and current basis the results of their investment strategies. In Table 2, the total assets under management and the number of properties held by these funds for each year from 1978 through 2015 are shown. Also shown in Table 2 is the amount of leverage used by these funds. The total volume of assets under management starts a fairly low level – around $3.5 billion from 1978 to 1994 – and then increase rapidly to just under $159 billion in 2015 (increasing over 35-fold). As of 2015, the funds in the ODCE index account for the majority of the assets (virtually 66%, if one compares the values in Table 2 with the values reported in column 2 of Table 1) held by all open-end funds. This comparison increases our confidence that the sample truly reflects the population.

Leverage represents the deal's amount of debt financing relative to its market value. Leverage is only a small fraction of a deal's market value over the 1978 to 1994 time period, with an average leverage ratio of 1.9%. Over time, however, the amount of leverage increases to 25% in 2009, and then falls to a level around 15% (following the Great Recession), and remains at this level.

Table 3 examines the total assets under management by fund size. This table provides a different perspective from Table 2, since large funds garner an increasing fraction of the total institutional pie. Over the 1994-2015 time period, the holdings by large funds grow 4049%. In contrast, holdings by small funds increase by 2509% over this time period. In 1994, large funds represent a relatively small fraction of total assets under management, about 20%; in 2015, this fraction was 75%.

Table 4 is aimed at investigating the extent to which assets are invested in office, industrial, apartment, and retail properties. The table shows the market value of assets held by OECFs in our sample by property type. Core property includes office buildings, industrial property, residential property, and retail shopping centers. Non-core property (other than property under development) includes any other nonresidential such as hotels, hospitality, medical, self-storage, entertainment properties like theaters, golf courses, and bowling alleys, healthcare properties, pre-manufactured housing complexes, parking lots or structures, and senior living. The property under development category is self-explanatory and includes property developed ranging from core office buildings to specialized assets like healthcare properties and senior living. Non-core property plus property under development grow from $0.4 billion in 1994 to $14.2 billion in 2015 – an increase of 3698%. In 1978, the level of non-core property plus property under development was 2.5% of total assets under management. While this fraction increases to 7.3% of total assets under management in 2015 (hence, showing some investment style creep), the fraction is well below the no-more-than 20% owned restriction imposed by NCREIF for purposes of index eligibility.

Table 5 is a times series of the total assets under management for OCEFs in our sample by market type. Markets are ranked by size of institutional investment, beginning with the largest and ending with the smallest. Core markets include the top twenty largest markets for institutions investing in private equity real estate. All other investments fall into the non-core category. Whereas investments in non-core markets increase from a relatively low level of $1.2 billion in 1994 to $18.2 billion in 2015 (an increase of 1458%), investments in core markets also grow rapidly. Over this same period, investment in core markets increase by a factor of 4275% (from $4.1 billion in 1994 to $176 billion in 2015).

Figure 2 plots the fraction of the total market value of assets held in core versus non-core markets. In 1994, the faction of the total market value of assets held in core markets was 23.3%, and by 2015, this fraction decreases to about 9.4%. In other words, even though investments in non-core markets grew rapidly over this time period, the decline in the fraction of total market value of assets held in non-core markets is driven by the very rapid growth in investments in core markets. We use the distinction between core and non-core markets to control for a fund's appetite for risk taking.

4.1 Measuring Deal-Level Cash Flows

Our measure of cash flow in each quarter begins with NCREIF data item 3 (net operating income) in the NCREIF Data Collection and Reporting Procedures Manual (version 2007), which is defined as operating income (derived from adding base rent income plus contingent income plus expense reimbursement plus other operating income) less operating expense (derived from adding ground rent expense plus general administrative expense plus property management fee expense plus marketing expense plus other operating expense plus payroll and benefit expense plus professional fees expense plus property insurance expense plus real estate tax expense plus repairs and maintenance expense plus utility expense). This measure of cash flow is at the property level. We then deduct data item 10 (the total accrued interest expense for all outstanding debt on the property for the quarter), data item 11 (principal payments scheduled), data item 12 (other principal payments), and data item 5 (capital improvement total, which includes any capital improvements plus capital expenditure leasing commissions for the quarter). Next, we add data item 13 (new loan proceeds) and data item 6 (partial sales, including such items as the sale of an easement, a parcel of land, or a single building in an industrial park, etc.).

Since NCREIF strongly encourages its members to comply with standard accounting real estate reporting practices, the data items reported in the NCREIF database are generally consistent with standard accounting conventions and without regard to how profitable the investment is. These standard accounting reporting practices generally enable comparisons across different property investments and over time.

4.2 Measuring Ending Market Value

For each property for each quarter there is a value estimate (item 8) in the NCREIF database. This value estimate is supposed to represent the economic worth of property as of the end of each calendar quarter. However, in practice, this value estimate tends to reflect the value the fund manager believes is the property's fair market value. This value estimate generally comes from one of three sources, either an internal or external appraisal, or an independent appraisal using standard commercial real estate appraisal methodology.

One well-known problem with using the appraised value of the property rather than the market value of the property in equation (4) is appraisal bias. When significant, the estimates of α and β in equation (4) based on these value estimates will contain biases of generally unknown direction. To diminish the effect of appraisal bias in our analysis, we use NCREIF data item 59 (the actual sales price of the property), as opposed to the estimated value of the property, as the value of V_{it+n_i} in equation (4) in the terminal year n_i. The actual sales price will allow us to see what, if any, effect appraisal bias has on the estimates of α and β.

4.3 Measuring Deal-Level Alphas

Here we follow the approach of AGHK. We first calculate the levered IRR of deal i using the entire time series of cash flows and actual sales price for the deal, as recorded by NCREIF. All calculations run from the date of property acquisition to the date of sale. Our measure of the initial equity investment begins with NCREIF data item 7 (beginning market value) at the date of property acquisition, less data item 14 (book value of debt). We then deduct data item 20 (initial acquisition costs, which includes any additional costs related to the purchase of the property that are incurred after the acquisition date, like a legal bill or engineering bill that is received, paid and capitalized at some point after closing which is directly related to the purchase of the property, or a holdback or earnout that is funded at some point after closing). Our measure of the terminal equity value begins with NCREIF data item 60 (sales price of property, net of selling expenses), less data item 14 (book value of debt). The benchmark return for the quoted peers of the deal is taken to be the median levered IRRs for the entire NCREIF database.

For our estimate of unlevered IRRs for the deal, we use the entire time series of unlevered cash flows and actual sales price to calculate an unlevered IRR for each deal. Calculation of the benchmark return for the quoted peers of the deal is handled in a similar manner as above, except that the returns are unlevered. The resulting difference in unlevered returns for the deal and the benchmark is what AGHK call the deal-level alpha (i.e., the abnormal performance of the deal).

We use NCREIF data item 10 (interest expense) divided by data item 14 (book value of debt) to measure the cost of debt for the deal. We use the debt-to-equity ratio for the deal (where debt is measured by NCREIF data item 14, and equity is measured by NCREIF data item 7, beginning market value of the property, minus item 14, book value of debt) to measure the deal leverage. We use the median debt-to-equity ratio for the entire NCREIF database to measure the sector leverage and the resulting difference between the deal-level leverage and the sector leverage to measure the incremental leverage in the transaction.

5 The Results

The evidence from paired t-tests for the average Jensen's alpha and true deal-level alphas for the OECF funds in the ODCE index is shown in Table 6. The sample comprises 810 deals. This evidence indicates that the Jensen's alphas for OECF funds are, on average, 1.11 percentage points greater than true deal-alphas over the entire period 1978 to 2015 (see column (7) in Table 6). The mean difference between the two performance measures has a p-value of less than 0.0001. Since 0.05 indicates the formal upper limit of statistical significance, results showing a p-value of less than 0.0001 are to be taken seriously. The experimental set-up in these particular tests is extremely straightforward. The funds in the sample are all OECFs with an acknowledged core investment strategy. The observations include all types of transactions (including core and non-core investments, plus development projects) made by these funds. We limit the transactions to the sold properties that are included in the NCREIF database because we are calculating deal-level IRRs and because we want to control for appraisal bias by using the actual sales price of the property as the value of V_{it+n_i} in equation (4) in the terminal year n_i. The analysis spans the 38-year period from 1978 to 2015. The data are combined by calculating mean values using each deal as an observation. The means are compared using differences of means t-tests. When the distributions do not depart significantly from normality, which they do not do in any significant sense in our sample, parametric tests, like the t-test, can be performed to see whether this deviation is statistically significant. In fact, the paired t-test is perfect for the analysis conducted herein, and is statistically very powerful, especially considering the difference between the two performance measures will likely not be very large.

Table 6 also shows the decomposition of Jensen's alpha into to the deal-level alpha, the return from sector leverage, the return from incremental leverage, and the return from excess risk taking. These individual components are calculated at the property level following the expressions in equation (12) and manipulating them algebraically (by computing the percentages accruing to each component). The components are then averaged and the mean values thus obtained are reported in Table 6. By decomposing Jensen's alpha into these four components, we are able to report on several aspects of private equity real estate deals that are not generally available in the academic literature. Our main conclusions are:

(i) Not more than one-third of Jensen's alpha is accounted for by the true deal-level alpha (see column (3) in Table 6).

(ii) About 12.6% of Jensen's alpha comes from financial leverage, including both the return from sector leverage as well as the return from incremental leverage. The sector effects are unique because they suggest that financial leverage effects are zero at the start of the observation period, and generally increase over time with the increasing use of leverage (see Table 2). The sector leverage effect is not limited to any one fund. Instead, it generally holds for all OECF fund managers. The incremental deal leverage beyond the sector leverage suggests that there is some skewing in Jensen's alpha created by the use of financial leverage across deals. Moreover, the results suggest that the ability of OECF fund managers to create excess value is quite high, simply take on more deal-level leverage than before, and rely on debt to reach a target return.

(iii) Out of the average Jensen's alpha of 1.69% for all 810 deals, the return from excess risk accounts for 54.3%. In other words, either due to sector-picking ability or simply pure luck, the sector return from risk taking is quite significant in the sample.

One limitation in all of the above comparisons is that the research design does not control for the fact that, for example, returns for deals of different sizes may be affected by different factors. The conventional wisdom about real estate is that there is indeed higher returns on larger properties than smaller properties due in part to a risk standpoint. For portfolios with a core, diversified objective, large properties can represent a significant portion of the overall investment portfolio. Hence, the greater the portfolio's exposure to larger properties, the greater the potential for higher returns and higher Jensen's alphas (especially during a boom phase of the cycle). In the GLS model that follows, we employ property size (in gross leasable square feet), property type (core and property under development, with the left out category being non-core property), and market type (core versus non-core markets) as covariates and compare the mean difference in the two performance measures. We choose to estimate a General Least Squares (GLS) model given the degree of correlation between the explanatory variables of the regression. The GLS model provides a more stringent test of the mean differences in the Jensen's alpha and the true deal-level alpha, since we control for differences in property size and other important covariates affecting the property's inherent risk and return profile.

Table 7 presents the results of the GLS model for the difference between Jensen's alpha and the true deal-level alpha. We experimented with a few different specifications of this regression that are not reported in the table. We also control for fixed effects. The fixed effects capture differences in return characteristics across different property types (including apartment buildings, hotels, industrial properties, land, office buildings, retail shopping centers, and other (entertainment, healthcare, manufactured housing, parking, self-storage, and senior living)).

Column (1) estimates are conditional on financial leverage, core property, property under development, core market, size, and price per square foot at time of acquisition. As expected, the coefficient on financial leverage is positive and statistically significant at the 10% level, suggesting that Jensen's alpha, and its overstatement of the deal-level alpha, is due in part to the use of financial leverage (which even OECF fund managers have some, albeit limited, discretionary control over). The coefficient on core property is 11.45 and statistically significant at the 5% level, suggesting high Jensen's alphas (relative to deal-level alphas) on core property. The property under development coefficient is also positive and statistically significant, suggesting Jensen's alphas are also higher (relative to deal-level alphas) on property under development. The coefficient on property size is positive and significant, suggesting that large property size is very clearly associated with large Jensen's alphas and increasing the former should increase the latter. We also find that that price per square foot at acquisition is an important forecasting variable. The coefficient suggests that cross-sectional variation in Jensen's alpha can be very well described by price per square foot (a measure of different quality or worth).

Column (2) shows the results to be robust to including control variables like core market. These results suggest that an increase in financial leverage leads to a significant increase in the difference between Jensen's alpha and the deal-level alpha. As shown in Column (2), the coefficient on financial leverage is more precisely estimated and of a slightly higher magnitude. The coefficient on core market is positive but statistically insignificant. We can only speculate on why this effect is positive but statistically insignificant. This may happen, paradoxically, because core markets are more stable than non-core markets and more liquid, and because most institutional investors prefer more stable markets to more volatile markets. This may also happen because institutions may have better knowledge about historical return patterns in core markets and believe them to be exploitable anomalies. Another possibility is that core markets may gather greater momentum and higher returns when institutional investors move in groups, choosing to invest in the same locale at the same point in time.

6 Conclusion

Measuring the extent to which private equity fund managers create value for their investors is a complicated problem, even when we narrow our focus to OECF fund managers. In a recent article, DLP demonstrate how generally to estimate a Jensen's alpha and beta for private equity fund managers from across a cross section of similar private equity funds. DLP's model is estimated by generalized method of moments. The data used are annual values of cash flows during the finite life of a fund and the final market value of the liquidated fund. The crux of DLP's methodology is to select the maximum values of Jensen's alpha and beta needed to bring the NPV of (portfolios of) funds closest to zero. This method of estimating abnormal performance is particularly useful in analyzing the performance of private equity funds at a sub-sector level of disaggregation (considering that not all private equity funds are the same).

In the present paper, we extend the DLP model so that we can estimate values of Jensen's alpha and beta for each deal rather than across a cross section of similar private equity funds. In our model, we know the cash flows that the property generates each period, the estimated sale price (and eventually the actual sale price), plus the original cost of the investment, and we know these cash flows between the inception date and the liquidation date. For each property, then, we are able to calculate a series of realized returns (i.e., IRRs) that mark the performance of the property over time. We then fit a standard market model to these data using a least squares optimization technique that best replicates the pattern of returns. This allows us to compute a Jensen's alpha and beta for each property.

These results are applied to the case of OECFs. There exists an extensive and elaborate literature on theory and empirical evidence on the performance of private equity funds. The theory of the performance of private equity fund managers developed here should of course be seen as a complement to that theory. Our estimates of Jensen's alpha suggested herein are a measure of how well a fund manager does compared to the market or benchmark index. These measures are directly comparable to the abnormal returns as calculated by AGHK since both estimates are calculated from measures of realized IRRs. The attraction of such a comparison is that the deal-level alphas in AGHK provide us with a measure of how much an investor in a private equity fund actually earns relative to what the investor would have earned from a sector benchmark. Thus, by comparing the two measures of abnormal performance, a robust estimate of whether OECF fund managers are being evaluated correctly and, hence, compensated fairly by the market for the actual deal-level alpha they are able to generate can be made.

Our estimates of Jensen's alphas suggest that the Jensen's alphas for OECF funds are, on average, 1.11 percentage points greater than true deal-alphas over the entire period 1978 to 2015. There are significant implications from our findings. In particular, the findings suggest that Jensen's alpha overstates the true performance (i.e., the deal-level alpha), and that overstatement may lead to a gross overstatement of fund fees. The explanation that we offer for this puzzle is based on the observation that institutional investors prefer diversification over concentration of ownership because of their concern with minimizing portfolio risk. Other things equal, a positive use of leverage will cause an overstatement in Jensen's alpha relative to the deal-level alpha, but it also will allow the fund manager to diversify the investment portfolio.

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Table 1: Time Series of the Total Real Estate Assets under Management by Fund Type for Entire Industry, 1978-2015

	Closed-End Funds		Open-End Funds		Other	
Year	N	Assets	N	Assets	N	Assets
1978			92	172,304,425	167	446,034,716
1979			110	233,472,332	221	699,984,147
1980	5	71,252,844	134	436,596,939	289	1,074,460,445
1981	13	213,006,551	179	774,616,657	377	1,702,241,234
1982	28	497,887,956	249	1,534,553,332	480	2,506,157,010
1983	38	790,281,666	279	1,995,842,309	661	5,507,676,834
1984	55	1,145,874,452	301	2,486,490,109	701	6,929,124,643
1985	81	1,686,396,764	326	3,263,303,444	718	8,332,439,818
1986	111	2,552,550,611	402	4,253,047,043	769	10,635,916,936
1987	134	2,939,585,923	402	5,247,226,982	841	12,510,583,864
1988	153	3,896,942,044	419	5,930,289,967	919	16,105,394,375
1989	175	4,636,455,589	400	6,216,397,259	1,064	20,293,176,655
1990	202	5,420,096,508	436	6,695,160,714	1,169	24,593,883,480
1991	223	5,696,844,340	427	7,063,918,561	1,386	26,589,494,821
1992	233	5,298,443,533	408	6,026,804,018	1,503	26,965,509,842
1993	255	5,844,247,261	459	6,097,401,247	1,467	29,742,237,859
1994	263	6,948,057,856	437	6,227,251,326	1,310	27,895,041,992
1995	273	7,687,782,309	424	6,491,632,071	1,482	29,104,878,227
1996	260	7,942,097,843	534	9,066,119,663	1,732	37,890,048,857
1997	270	8,945,965,878	628	11,119,438,571	1,838	45,384,182,641
1998	268	10,605,291,735	755	16,742,668,486	1,476	40,176,993,311
1999	282	11,230,245,753	820	21,649,766,475	1,451	43,504,990,542
2000	380	12,800,941,950	917	26,196,833,358	2,370	51,769,006,469
2001	360	11,817,624,600	990	34,087,324,845	2,618	64,291,271,813
2002	501	13,360,427,382	1,111	36,228,876,877	3,218	80,761,506,188
2003	570	14,747,262,489	1,361	44,207,077,430	3,728	86,546,148,836
2004	728	15,597,976,383	1,658	54,902,639,092	4,758	91,082,345,416
2005	888	17,412,893,516	2,353	81,163,690,937	4,623	91,174,191,707
2006	1,073	24,598,000,134	2,908	116,837,783,861	4,596	111,744,902,731
2007	1,171	38,899,912,304	3,441	157,436,889,849	4,461	136,406,381,903
2008	1,040	51,912,338,822	3,813	186,074,732,584	3,176	157,893,851,819
2009	965	33,118,912,525	3,807	140,605,263,202	3,306	131,147,630,968
2010	1,588	30,983,709,678	3,908	130,178,291,271	4,522	124,055,710,299
2011	1,504	34,283,519,003	3,807	150,848,817,521	4,477	131,257,726,032
2012	1,260	39,692,801,589	4,030	178,140,908,791	3,959	150,857,065,616
2013	1,085	37,901,391,498	4,024	193,933,937,254	3,947	168,782,867,846
2014	1,003	35,078,695,566	4,455	244,508,557,192	3,921	189,852,429,746
2015	787	35,376,943,548	4,705	296,091,770,982	3,871	211,273,213,652

The data in Table 1 relate to the total assets under management and number of properties held by all funds included in the category. These data come from the National Council of Real Estate Investment Fiduciaries (NCREIF) and represent the universe of funds investing in private equity real estate.

Table 2: Time Series of the Total Assets under Management for OCEFs included in Our Sample, 1978-2015

Year	N	Assets	Leverage (in percent)
1978	75	155,511,250	0%
1979	110	233,472,332	0%
1980	134	436,596,939	0%
1981	179	774,616,657	0%
1982	249	1,534,553,332	0%
1983	276	1,950,932,229	1%
1984	298	2,437,537,458	1%
1985	323	3,214,393,101	1%
1986	398	4,180,852,913	1%
1987	400	5,217,346,982	4%
1988	407	5,673,579,147	4%
1989	383	5,877,326,798	4%
1990	369	5,884,295,410	4%
1991	364	6,283,368,899	4%
1992	354	5,423,825,018	3%
1993	349	5,089,061,296	3%
1994	365	5,366,026,660	2%
1995	353	5,536,781,479	1%
1996	396	6,200,405,957	1%
1997	453	7,574,331,471	3%
1998	559	13,310,895,824	3%
1999	602	17,328,183,690	6%
2000	672	20,386,324,002	6%
2001	713	26,675,181,112	7%
2002	820	27,660,339,828	8%
2003	859	31,352,192,896	8%
2004	905	38,272,397,917	9%
2005	1194	55,122,624,229	10%
2006	1558	78,492,702,801	12%
2007	1809	99,671,746,796	14%
2008	2004	116,712,925,382	16%
2009	1953	87,594,213,835	25%
2010	1844	81,954,732,452	25%
2011	1976	99,311,976,545	19%
2012	2121	118,535,414,217	16%
2013	2166	131,446,144,805	13%
2014	2393	158,838,841,058	14%
2015	2572	194,215,941,407	13%

The table presents descriptive information for the sample of OECFs included in our study. The sample is all OECFs included in the NCREIF ODCE index. The data relate to the total assets under management and the number of properties held as well as the amount of leveraged used by these funds for each year from 1978 through 2015.

Table 3: Time Series of the Total Assets under Management for OCEFs included in Our Sample by Fund Size Categories, 1982-2015

	Large		Small	
Year	N	Assets	N	Assets
1982	147	1,105,381,177	102	429,172,155
1983	146	1,103,468,692	130	847,463,537
1984	143	1,279,901,906	155	1,157,635,552
1985	247	2,541,210,101	76	673,183,000
1986	311	3,369,903,045	87	810,949,868
1987	301	4,199,097,982	99	1,018,249,000
1988	289	4,401,266,240	118	1,272,312,907
1989	261	4,527,679,852	122	1,349,646,946
1990	236	4,431,369,903	133	1,452,925,507
1991	127	2,950,022,405	237	3,333,346,494
1992	117	2,467,312,000	237	2,956,513,018
1993	117	2,288,370,286	232	2,800,691,010
1994	210	3,519,834,227	155	1,846,192,433
1995	106	1,184,160,000	247	4,352,621,479
1996	116	1,322,115,000	280	4,878,290,957
1997	125	2,077,626,677	328	5,496,704,794
1998	254	5,288,772,988	305	8,022,122,836
1999	169	3,716,075,875	433	13,612,107,815
2000	311	8,021,295,675	361	12,365,028,327
2001	324	8,918,195,427	389	17,756,985,685
2002	437	9,556,087,388	383	18,104,252,440
2003	549	13,506,129,276	310	17,846,063,620
2004	606	16,813,153,083	299	21,459,244,834
2005	688	22,233,046,064	506	32,889,578,165
2006	1327	70,487,885,838	231	8,004,816,963
2007	1436	87,393,639,575	373	12,278,107,221
2008	1770	106,525,878,032	234	10,187,047,350
2009	1613	76,549,685,007	340	11,044,528,828
2010	1487	70,045,943,857	357	11,908,788,595
2011	1477	78,940,472,538	499	20,371,504,007
2012	1569	92,487,559,187	552	26,047,855,030
2013	1463	93,822,100,650	703	37,624,044,155
2014	1706	117,032,548,181	687	41,806,292,877
2015	1800	146,040,341,458	772	48,175,599,949

The sample is all OECFs included in the NCREIF ODCE index. The data relate to the total assets under management and the number of properties held by these funds for each year from 1982 through 2015. Large (small) funds are defined as funds with more than (fewer than) $100 million of assets under management.

Table 4: Time Series of the Total Assets under Management for OCEFs included in Our Sample by Property Type, 1978-2015

	Core Property		Non-Core Property Other than Property under Development		Property under Development	
	N	Assets	N	Assets	N	Assets
1978	74	151611250	1	3900000	.	.
1979	109	229347332	1	4125000	.	.
1980	132	421945939	2	14651000	.	.
1981	177	759032657	2	15584000	.	.
1982	247	1517138332	2	17415000	.	.
1983	274	1912567229	2	38365000	.	.
1984	295	2371837458	3	65700000	.	.
1985	318	3098191101	5	116202000	.	.
1986	390	4060027913	8	120825000	.	.
1987	392	5081597646	8	135749336	.	.
1988	390	5261512927	17	412066220	.	.
1989	367	5487530849	16	389795949	.	.
1990	353	5454427398	16	429868012	.	.
1991	347	5863772901	17	419595998	.	.
1992	337	5064600018	17	359225000	.	.
1993	331	4728096994	18	360964302	.	.
1994	348	4992196660	17	373830000	.	.
1995	341	4932311479	12	604470000	.	.
1996	380	5447768518	16	752637439	.	.
1997	438	7203456559	15	370874912	.	.
1998	541	12804248801	18	506647023	.	.
1999	583	16763083811	19	565099879	.	.
2000	654	19836229465	18	550094537	.	.
2001	694	25999639790	19	675541322	.	.
2002	789	26764162008	21	853105637	10	43072183
2003	794	29739429147	28	1085110842	23	527652907
2004	850	36746940252	24	1032225681	16	493231984
2005	1100	52946616929	39	1395234304	22	780772996
2006	1353	74457249491	115	3387581227	33	647872083
2007	1565	94139692492	139	3648700068	53	1883354236
2008	1779	110455000000	141	3981034668	51	2277082244
2009	1716	82166800944	144	3041982152	57	2385430739
2010	1633	77391680934	134	3198648720	54	1364402798
2011	1722	93373600954	196	5173501694	32	764873897
2012	1834	110586000000	212	6606439061	44	1342844324
2013	1834	121986000000	229	6665925140	66	2819786568
2014	1988	147139000000	284	7766523558	89	3933552694
2015	2123	180020000000	274	7887420926	109	6308870182

The sample is all OECFs included in the NCREIF ODCE index. The data relate to the total assets under management and the number of properties held by these funds for each year from 1978 through 2015. Core property includes office buildings, industrial property, residential property, and retail shopping centers. Non-core property includes any other nonresidential properties such as hotels, hospitality, medical, self-storage, etc.

Table 5: Time Series of the Total Assets under Management for OCEFs included in Our Sample by Market Type, 1978-2015

	Core Markets		Non-Core Markets	
Year	N	Assets	N	Assets
1978	59	122677250	16	32834000
1979	88	187996756	22	45475576
1980	99	302661171	35	133935768
1981	129	536253554	50	238363103
1982	172	1131486673	77	403066659
1983	191	1455458794	85	495473435
1984	205	1801059543	93	636477915
1985	231	2489423851	92	724969250
1986	287	3391242314	111	789610599
1987	296	4327281114	104	890065868
1988	303	4650087965	104	1023491182
1989	282	4799069355	101	1078257443
1990	268	4853657526	101	1030637884
1991	250	5183432739	114	1099936160
1992	241	4386440883	113	1037384135
1993	242	4151427184	107	937634112
1994	241	4116963101	124	1249063559
1995	232	4250865559	121	1285915920
1996	262	4673316329	134	1527089628
1997	309	5674842131	144	1899489340
1998	377	9950115416	182	3360780408
1999	417	12965888336	185	4362295354
2000	464	15215265318	208	5171058684
2001	508	20810921176	205	5864259936
2002	618	22080197970	202	5580141858
2003	655	25775773280	190	5576419616
2004	708	31498404029	182	6773993888
2005	929	46337262599	232	8785361630
2006	1203	66479850531	298	12012852270
2007	1392	85421872133	365	14249874663
2008	1561	100433084876	410	16279840506
2009	1520	74732862053	397	12861351782
2010	1464	70526457990	357	11428274462
2011	1580	87699725864	370	11612250681
2012	1675	105471120160	415	13064294057
2013	1744	118876968412	385	12594276301
2014	1979	145109922389	382	13728918669
2015	2092	176000334847	414	18215606560

The sample is all OECFs included in the NCREIF ODCE index. The data relate to the total assets under management and the number of properties held by these funds for each year from 1978 through 2015. Markets are ranked by size of institutional investment, beginning with the largest and ending with the smallest. Core markets include the top twenty largest markets for institutions investing in private equity real estate. All other investments fall into the non-core category.

Table 6: Estimates of Jensen's Alpha of Deals and a Decomposition of Alpha for Deals in Our OECF Sample Due to Leverage and Excess Risk Taking, 1978-2015

			Decomposition of Jensen's Alpha				
	N	Jensen's Alpha	Deal-Level Alpha	Return from Sector Leverage	Return from Incremental Leverage	Return from Excess Risk Taking	Difference between Jensen's Alpha and Deal-Level Alpha
Before 1983	136	2.28	0.74	0	0.06	-1.48	1.54
			(32.5)	(0)	(2.5)	(64.9)	[4.75]
1983 - 1985	44	1.23	1.22	0	0.03	0.02	0.01
			(99.2)	(0)	(2.8)	(-2.0)	[0.02]
1986 - 1988	32	1.45	0.53	0	-0.02	-0.9	0.92
			(36.6)	(0)	(-1.2)	(62.2)	[2.54]
1989 - 1991	17	0.6	0.48	0	0	-0.12	0.12
			(80.0)	(0)	(0)	(20.0)	[0.97]
1992 - 1994	24	2.27	0.5	0	0	-1.77	1.77
			(22.0)	(0)	(0)	(78.0)	[2.39]
1995 - 1997	92	1.35	0.34	0.1	0.03	-0.88	1.01
			(25.2)	(7.2)	(2.3)	(65.3)	[2.81]
1998 - 2000	128	1.75	0.37	0.23	0.33	-0.82	1.38
			(21.1)	(13.4)	(18.8)	(46.6)	[6.15]
2001 - 2003	81	2.02	0.27	0.15	0.09	-1.51	1.75
			(13.4)	(7.4)	(4.6)	(74.7)	[5.21]
2004 - 2006	205	1.59	0.8	0.35	0.41	-0.03	0.79
			(50.3)	(22.0)	(26.0)	(1.7)	[5.09]
2007 - 2009	29	2.55	1.13	0.23	0.14	-1.05	1.42
			(44.3)	(8.9)	(5.6)	(41.3)	[3.28]
After 2009	22	1.2	-0.33	0.08	0.05	-1.4	1.53
			(-27.5)	(6.7)	(3.9)	(117.0)	[2.19]
Total	810	1.66	0.55	0.11	0.10	-0.90	1.11
			(33.1)	(6.4)	(6.2)	(54.3)	[11.32]

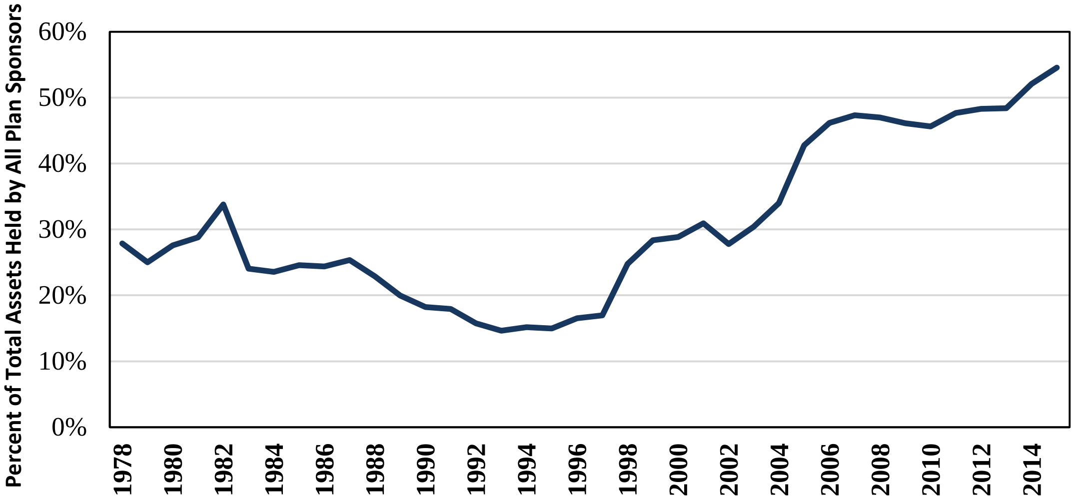
The sample is all OECFs included in the NCREIF ODCE index. The data relate to deal-level transactions initiated and sold by these funds over the period from 1978 through 2015. The data set comprises 810 deals over this time period. The table shows the year in which the OECFs in our sample acquired the property. Numbers in parentheses are the percentage decomposition derived from equation (12) and stated as a percentage of the deal's Jensen's alpha. Numbers in brackets are t-statistics.

Table 7: GLS Regressions of Difference Between Jensen's Alpha and Deal-Level Alpha

Parameter	(1)	(2)
Intercept	-10.85	-15.13
	(-3.82)	(-5.22)
Leverage	0.38	0.51
	(1.79)	(2.38)
Core Property	11.45	15.79
	(3.95)	(5.35)
Property under Development	2.58	2.71
	(8.18)	(8.69)
Core Market		0.05
		(0.57)
Size (in sqft)	1.72	2.13
	(3.96)	(4.9)
Acquisition price (per sqft)	-820.87	-865.21
	(-2.29)	(-2.44)
Fixed Effects for Specific Property Types	Yes	Yes
R-Square	0.16	0.19
Coeff Var	199.1	193.2
Root MSE	1.33	1.32

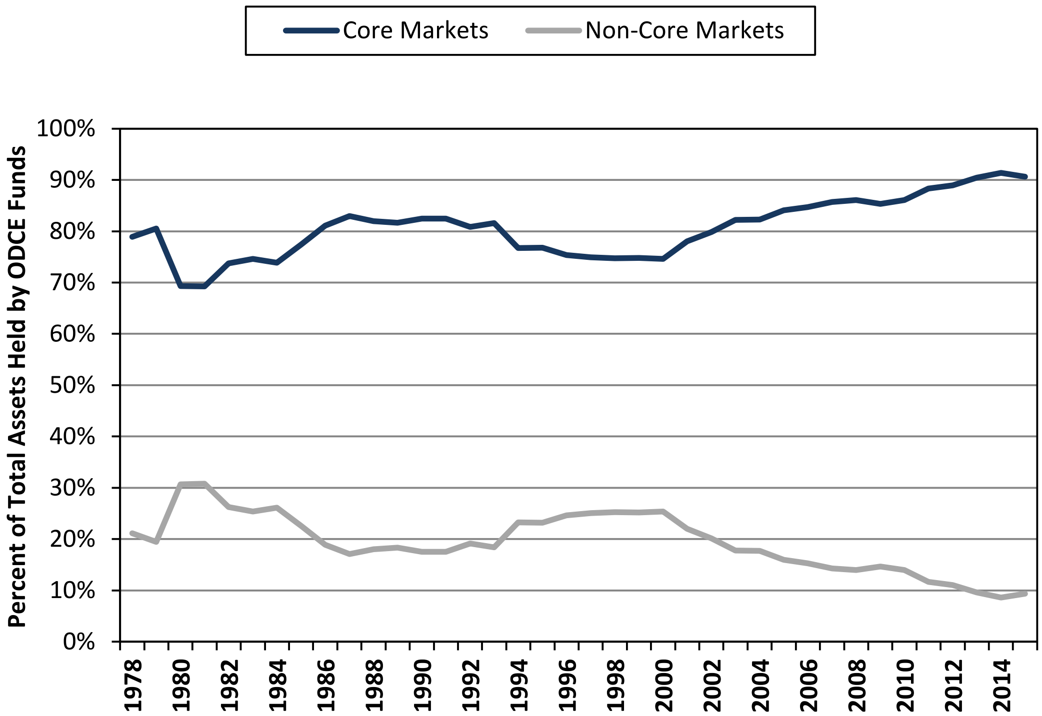
The sample is all OECFs included in the NCREIF ODCE index. The dependent variable is the difference between Jensen's alpha and the deal-level alpha on transactions initiated and sold by these funds over the period from 1978 through 2015. The data set comprises 810 deals over this time period. The table shows the GLS estimates of regressions of differences between Jensen's alpha and deal-level alpha against a variety of property characteristics including the amount of financial leverage. Numbers in parentheses are t-statistics.

Figure 1: Percent of Total Assets Under Management Held by Open-End Funds to Total Assets Held by All Funds Investing in Private Equity Real Estate, 1978-2015



The plot is the variable the percent of total assets under management held by open-end funds to total assets held by all funds investing in private equity real estate. Values of total assets under management held by open-end funds versus all other funds investing in private equity real estate are presented in Table 1. Source of data: NCREIF.

Figure 2: Percent of Total Assets Held by ODCE Funds by Market Area



The sample is all ODCE funds from 1978 through 2015. The percent of total assets held by these funds in core and non-core property markets is plotted. Source of data: NCREIF.