Inflation Hedging and Real Assets: Are Public and Private Investments the Same? *

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Abstract

The resurgence of inflation risk has revealed stark contrasts between public and private real asset investments, particularly in infrastructure and real estate. Using granular data on 1,291 private infrastructure deals and 4,377 private real estate deals, along with private fund returns, this study delves into the differential performance of these asset classes, including an analysis of the recent inflationary period. We uncover that private real assets, especially those in opportunistic strategies, appear to have outperformed their public counterparts during the recent inflationary period. This outperformance is partially explained by sector composition but is also related to exposure to inflation and the real interest rate (r^*). Our findings add context to traditional notions of inflation hedging and a potentially unique advantage of private investments in certain macroeconomic environments.

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1 Introduction

There is a large historical body of research in finance examining the exposure of assets to various financial and economic factors. For example, the Arbitrage Pricing Theory of Ross (1976a,b) considers risk exposures to financial markets (e.g., credit spreads and the yield curve) and real economy activity, such as output and inflation, among other factors (see Roll and Ross (1980), Chen et al. (1986), and Connor and Korajczyk (1988), amongst many others). However, despite appearing in, for example, Chen et al. (1986), inflation has been largely forgotten as an asset-pricing risk factor, likely because it has been so low and stable across much of the developed world for the last thirty-plus years. For example, Table 1 shows the number of articles published in *The Journal of Finance*, by decade, that include the word inflation in the title. Since 1990, only thirteen articles mention inflation in their title compared to sixty four in the previous two decades. In addition, we could not identify any factors in the "factor zoo" (see, for example, Harvey and Liu (2019)) that explicitly represent inflation risk.

TABLE 1: "INFLATION" IN TITLES OF JOURNAL OF FINANCE ARTICLES BY DECADE

Decade	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	2020-2024
Number of Papers	29	35	4	4	2	3

With the resurgence of concerns over inflation risks within the investment management industry, a renewed focus has been on strategies to mitigate these risks. While the academic research on inflation as a risk factor largely dried up, a widely recognized approach among institutional investors involves allocating to "real" assets, including real estate, natural resources, and infrastructure investments. These assets, often incorporated into portfolios through a blend of public company equities and private funds, are traditionally employed by institutional investors as potential hedges against inflation.

To provide a specific example, the State of North Carolina Investment Fund maintains an approximate 10% allocation to assets that are "Inflation Sensitive and Diversifiers" based on an analysis that the plan's (largely pension) liabilities are tied to inflation through the wages of plan participants. Likewise, the California State Teachers Retirement System (CalSTERS) manages 21 billion USD (6.39% of portfolio AUM) allocated to "inflation sensitive" investments. CalSTERS

describes the investment opportunity set as both public and private "investment vehicles [that] will include Accounts, Commingled Funds, CoInvestments and Direct Investments as described in the Infrastructure Policy and could include other potential structures depending on the investment strategy."[1]

To explore the relationship between inflation and real assets, we leverage a unique and comprehensive dataset that spans nearly two decades and includes both public and private market returns across diverse sectors. This unprecedented access to granular data allows us to delve into the nuanced differences between public and private investments, providing insights that have been largely absent from the existing literature. Our research directly addresses two critical questions: First, can real assets, particularly private investments, serve as effective hedges against the recent resurgence of inflation? Second, what drives the stark differences in performance between public and private real assets, especially during inflationary periods? Our findings not only shed light on the important differences between private and public vehicles for real assets but also have implications for how institutional investors might rethink asset allocation in an era of renewed economic volatility.

While some assets such as Treasury Inflation Protected Securities (TIPS) are meant to directly hedge inflation, a very common inflation risk management approach is through portfolio allocations to real assets. These allocations can include commodities, but more often are heavily allocated to real assets such as infrastructure, real estate, timberland, farmland, and energy exploration and production (E&P). These assets tend to have unique risk exposures. Some, such as energy assets, did well in 2022 when global inflation spiked. However, other public real assets performed very poorly during that period. For example, the FTSE-NAREIT All Equities Real Estate Investment Trust (REIT) Total Return Index declined 25.0% in 2022, substantially more than global stock or bond markets.[2] With inflation shocks being a major driver of returns in 2022, many investors were surprised and disappointed in the performance of their real estate portfolio returns.[3]

In sharp contrast, private real estate and infrastructure investments appeared to perform better

[1]See, for example, the NCRS Quarterly Update, 2024 and the CalSTERS Inflation Sensitive Investment Policy, 2022.

[2]Specifically, in USD terms, the MSCI-ACWI Total Return Index declined 18.4% and the Bloomberg Global Aggregate Bond Total Return Index declined 16.3% in 2022.

[3]See, for example, "Pension Fund Appetite for Commercial Real Estate Is Fading Fast," by Peter Grant, The Wall Street Journal, October 25, 2022

than public market real assets over that period. In fact, private infrastructure experienced strong positive returns in 2022-2023 while public infrastructure showed negative returns. Likewise, our data (discussed in detail below) suggest that private real estate funds may have outperformed public real estate funds by as much as 10% per annnum over 2022-2023.

To scrutinize these issues, we utilize a novel dataset of private fund holdings in real estate and infrastructure funds to analyze the nature of real asset returns, with particular attention to how these assets differ from seemingly comparable public asset investments. Further, we ask whether real assets serve as effective inflation hedges during the recent spike in consumer prices. Among other findings, we show that:

- Public real assets were severely exposed to the substantial increase in real interest rates. In essence, public real assets incorporate long duration cash flows, and long-term rates increased more than expectations of higher cash flows arising from inflation. In fact, long-term inflation expectations were largely unchanged.

- Private real assets are different from public real assets and, indeed, performed better over 2022-2023. Some of the differences in performance are related to industry composition and geography of investments. However, we also find that private real assets display more near-term positive exposure to inflation because they are more likely to include service industry companies that can adjust their product prices more frequently. This means that private funds effectively incorporate shorter cash flow durations.

Our analysis builds on a small recent literature on inflation and private funds. Some recent research has examined the inflation hedging properties of stocks, currencies, commodities, REITs, and Bitcoin. For example, Salisu et al. (2020) analyze U.S. gold, stocks, and real estate, and find that stocks and, especially, real estate provide a hedge against inflation. In contrast, Fang et al. (2022) examine data through 2019 and find that conventional inflation hedges like stocks, currencies, commodities, and REITs hedge energy inflation but do not hedge core inflation (i.e., inflation measures excluding food and energy prices). Choi and Shin (2022) find that Bitcoin functions as a hedge against inflation, but declines in value during financial uncertainty shocks, limiting its value as a general safe haven. None of these studies examine private fund investments' exposure to inflation.

In fact, little research has examined private infrastructure investments at all. Inderst (2010) provides a high-level overview of infrastructure as an asset class, while Bitsch et al. (2010), Bird et al. (2014), and Ehlers (2014) look at funding, risk, return, and hedging properties. However, these papers were written at a time when infrastructure as an asset class was tiny compared to its current investible market capitalization. More recently, Haran et al. (2021) examines Preqin data and finds that infrastructure funds exhibit different performance properties compared to other private equity. On the other hand, Andonov et al. (2021), again using primarily Preqin data, find generally weak performance of private infrastructure including an average public market equivalent (PME) of 0.93, which is lower than buyout, venture, and real estate funds. Furthermore, they do not find the desired properties of private infrastructure, instead finding a risk-adjusted return using the GPME framework of Korteweg and Nagel (2016) comparable to venture capital and a market loading well above one. They conclude that closed-end private infrastructure cash flows are not much different from other private equity investments. While the preceding two papers do use more up-to-date data (up to 2019 and 2020, respectively), neither of them captures the large market fluctuations starting with the COVID-19 pandemic in 2020 nor the first major inflationary episode in decades beginning in 2021, both of which could uncover industry factor, risk factor, and return driver properties that were previously elusive due to insufficient volatility in certain market fundamentals.

The analysis of private real estate is also limited. For example, Hoesli and Oikarinen (2016) and Arnold et al. (2021) find relatively small differences between public and private real estate performance long-term, but neither paper employs data from 2020 or beyond and are therefore missing the potential effects of possibly quite important market fluctuations. Couts (2022) finds procyclical investment activity of private real estate funds that generates higher market betas. Fisher and Hartzell (2016) and Riddiough (2022) document underperformance of private real estate funds. Chin and Povala (2024) find that differences between listed and unlisted real estate fundamentals do exist but are transitory in nature, which also emphasizes the potential importance of 2020 and beyond in evaluating private real estate relative to public.

We have at least four advantages over the previous private infrastructure literature. First, we employ more recent data (up through 2023Q4) that captures a 50%+ increase in market capitalization compared to a mid-2020 cutoff. Second, having data through 2023Q4 provides variation

in many factors and drivers (e.g. inflation) that had been muted. Third, we have access to MSCI-Burgiss data, widely considered to be the most comprehensive and highest quality private investment data. Finally, we collect StepStone data on 1,291 private infrastructure deals and 4,377 private real estate deals, including entry date, exit date (when applicable), performance metrics, GICS subsectors, and investment region, allowing for a highly granular analysis.

The remainder of the paper is organized as follows: Section 2 provides a detailed description of the data. Section 3 examines the characteristics of real assets. Sections 4 and 5 examine infrastructure and real estate returns, respectively, in detail. Section 6 concludes.

2 Data

2.1 Infrastructure Data

Private market indices are from the MSCI-Burgiss Manager Universe Time Series Calculator, which gives a quarterly time series of capitalization, number of active funds, and time-weighted rates of return. Data can be filtered by asset class and region. Accordingly we look at infrastructure overall, and within sub-categories of generalist, core, value-added, and opportunistic infrastructure. We examine performance for all global funds, as well as separately for funds investing in North America (i.e. United States, Canada, or some mixture thereof) and the rest of the world (or ROW, i.e. Latin America, Europe, Middle East and Africa, Asia and Pacific, or some mixture thereof).

Infrastructure investments are defined by MSCI (2023) to be "long-life assets, properties, or other structures that provide some type of essential product or service...", and they give as examples "midstream and downstream oil and gas, power generation, transmission and distribution, telecommunication, and logistic assets." Core infrastructure investments are mature, low-risk, income-generating assets in core locations (i.e. mature and stable markets in developed regions). Value-added investments require significant capital expenditure, i.e., renovations generating returns through capital appreciation in core locations. Opportunistic investments require major development or redevelopment, generating returns through capital appreciation in non-core locations. Finally, generalist is defined as an investment "in two or more of the underlying categories within the respective classification tier and/or investments that have less capital invested in any single category."

We require at least five active funds in a calendar quarter to be included in our analysis, effectively setting the start date of each series we use. Opportunistic infrastructure has a paucity of funds when filtered to North American or ROW, so we merge opportunistic with value-added infrastructure to ensure a sufficiently long and dense time series; both capture risky assets in need of significant capital expenditures, so little granularity is lost in merging these categories.

For world data, the overall infrastructure series starts in 2000Q2, the core series starts in 2006Q4, the generalist starts in 2005Q2, and the value-added starts in 2004Q3. For North America, the overall infrastructure series starts in 2004Q2, the core series starts in 2010Q1, the generalist starts in 2005Q2, and the value-added starts in 2005Q1. And for the rest of world sample, the overall infrastructure series starts in 2006Q3, the core starts in 2010Q2, the generalist starts in 2005Q2, and the value-added starts in 2007Q4. All series end in 2023Q4.

We have also collected data from StepStone on individual private infrastructure investments covering 107 funds and 1,291 deals. We focus on large funds with more than 1 billion USD in committed capital, for vintage years 2004 through 2021. GICS sectors are missing for 226 deals, GICS subsectors are missing for 239 deals, and company regions are missing for 184 deals. We classify missing entries manually when possible, typically using Bloomberg or Crunchbase classifications, or otherwise searching for the companies with Google. The GICS classification system is fairly straightforward for infrastructure, so our classifications are unlikely to have more misspecification than those provided by StepStone. We are left with 16 deals with unspecified GICS sector, 17 with unspecified GICS subsector, and 25 with unknown geography.

2.2 Real Estate Data

We similarly employ the MSCI-Burgiss Manager Universe time series for private real estate data, including overall private real estate, and within that sub-sectors of generalist, value-added, and opportunistic real estate. Again, we examine data for all global funds as well as separately for those within North America and the rest of the world (as defined above).

Real estate investments are defined by MSCI (2023) as investments in "properties and/or land that will be zoned for properties." Opportunistic real estate are properties requiring major development or redevelopment or are located in riskier markets. Value-added real estate are properties

that require some capital expenditures, albeit less than opportunistic, or have operational, management, or capital constraint concerns. Both opportunistic and value-added derive returns primarily through appreciation. Generalist is as defined for infrastructure. All of the real estate asset classes extend back into the 1990s, although, in practice, we primarily utilize more recent data (2000+) since we will largely be using it in conjunction with other data with shorter histories. All series end in 2023Q4.

We have also collected data from StepStone on individual private real estate investments covering 83 funds and 4,377 deals, each with more than 1 billion USD in committed capital, for vintage years 2003 through 2021. GICS sectors and geographies were missing for the overwhelming majority of deals and had to be classified manually.[4] 345 deals were unable to have their GICS sector classified, 392 were unable to have their GICS subsector classified, and 41 were unable to have their geographical region classified.[5]

3 Real Assets Characteristics

The goal of this paper is to compare public real asset returns to private real asset returns. We start by analyzing the characteristics of public real asset returns. Because the data are more readily available, we primarily focus on North America, and will often use US-specific data for macrovariables as they reflect North America generally. Accordingly, we will use "NA/US" to denote this combined region, when applicable.

3.1 Public Returns and Correlations

We use various macro factors to describe return drivers of both public and private returns. We measure inflation expectations (and changes in expectations) using TIPS 5-year breakeven rates (T5YIE on FRED). We measure real interest rates (and changes in real rates) using the yield on 5-year TIPS (DFII5 on FRED). As a proxy for the equity premium we calculate the inverse of the cyclically adjusted price-to-earnings ratio (CAPE) of Campbell and Shiller (1998) for the S&P 500.[6] We utilize the term premium on a 10-year zero-coupon bond as reported by the Federal Reserve

[4] A flowchart illustrating the decision tree used to classify GICS subsectors is shown in Figure A1.
[5] As of writing, regions for 621 deals have not yet been manually classified.
[6] Found at https://shillerdata.com/

Board of Governors (THREEFYTP10 on FRED). We use potential real GDP as reported by the Congressional Budget Office (GDPPOT on FRED) to capture long-run macro trends. The Chicago Fed National Activity Index (CFNAI on FRED) measures short-term macroeconomic fluctuations.

We start our analysis by looking at correlations between the US public equity market as a whole (MSCI USA Index), the MSCI USA Infrastructure Index (M5US0INF), and the Dow Jones U.S. Real Estate Total Return Index (DJUSRET). For real estate, the effective start of the time series are determined by the first observation available for the TIPS 5-year breakeven rate (2003Q2). For infrastructure, data begin as described above in the data section.

Table 2 shows the full-sample univariate correlations between macrovariables and public returns. The largest correlation for all series comes from changes in the equity risk premium, a sharply negative -0.873 for public overall, -0.575 for public infrastructure, and -0.780 for public real estate. This is expected since a large amount of the short-run variation in CAPE is driven by changes in equity prices. Short-run macroeconomic variation also correlates strongly with all three series, at 0.527 for public overall, 0.402 for public infrastructure, and 0.444 for public real estate. The other consistently sizeable correlation comes from the change in the 5-year TIPS breakeven at 0.545 for public overall, 0.431 for public infrastructure, and 0.317 for public real estate. These results are consistent with equities serving as a hedge against unanticipated inflation, however the lower correlations for public real assets suggest that there may not be any differentiated role for real assets. Overall correlations for public real assets tend to be similar or small in magnitude than correlations for all public equities.

TABLE 2: PUBLIC MARKET AND MACRO VARIABLE CORRELATIONS, UNITED STATES

Variable	**All Public Equities**	**Public Infrastructure**	**Public Real Estate**
5-year Breakeven	0.200	0.261	0.226
Δ 5-year Breakeven	0.543	0.428	0.320
5-year Real Rate	-0.161	-0.125	-0.106
Δ 5-year Real Rate	-0.173	-0.293	-0.175
Equity Risk Premium	-0.262	-0.182	-0.200
Δ Equity Risk Premium	-0.873	-0.573	-0.784
Term Premium	-0.070	-0.031	0.074
Long-Run Macro	0.054	-0.077	-0.085
Short-Run Macro	0.532	0.405	0.445

We also show quarterly 3-year moving correlations for each variable in Figures 1, 2, and 3. Most variables do not show any obvious trend over time, but there are apparent exceptions. For public overall, the correlation with the change in the 5-year breakeven appears to increase over time from roughly zero to sharply positive, whereas the correlation on the change in the 5-year real rate, and possibly the term premium, appears to decrease over time from roughly zero to sharply negative. The change in the 5-year breakeven also appears to increase over time for public infrastructure and possibly public real estate from roughly zero to distinctly positive, although the latter doesn't exhibit the same consistency. The correlation between the change in the 5-year real rate and public real estate investment appear to decrease starting around 2007, as well as the term premium, going from roughly zero or positive around 2007 to sharply negative by 2022. While exposures to unexpected changes in inflation and real rates have increased in recent years, the results again show that correlations are not stronger for real assets than for all public equities.

3-YEAR MOVING CORRELATIONS, US PUBLIC RETURNS AND MACROVARIABLES

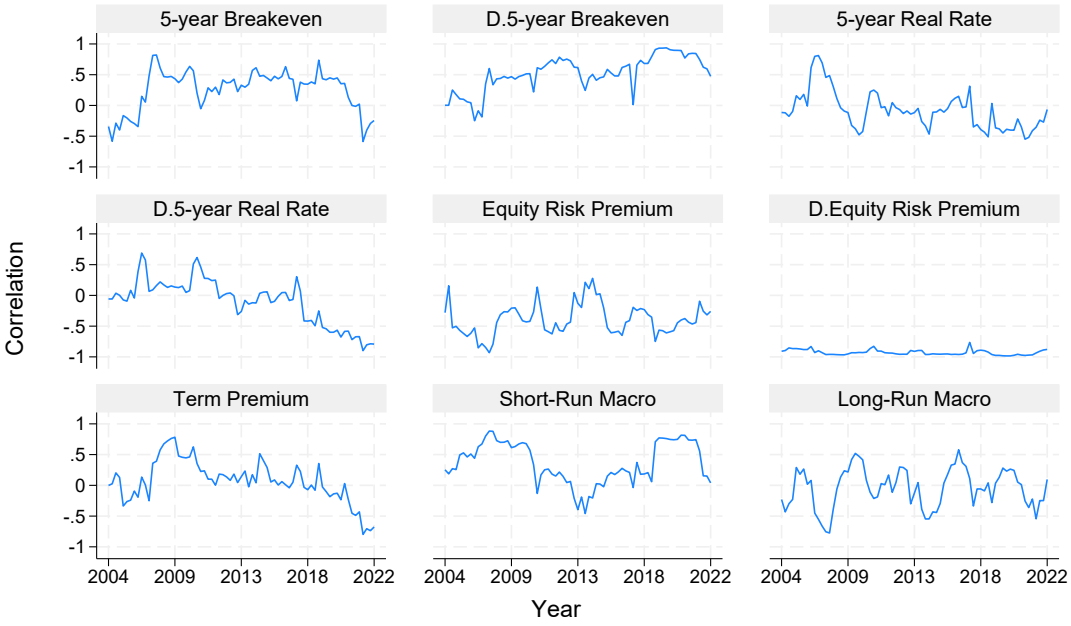

FIGURE 1: This figure shows quarterly 3-year rolling average correlations of the MSCI USA Index (public overall) returns with macrovariables.

3-YEAR MOVING CORRELATIONS, US PUBLIC INFRASTRUCTURE RETURNS AND MACROVARIABLES

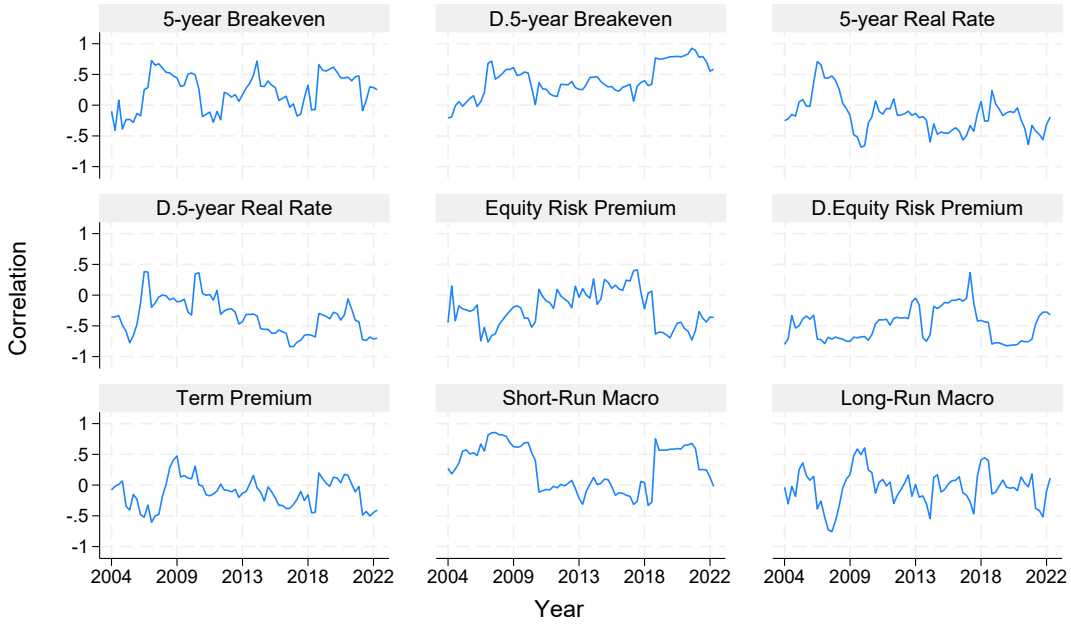

FIGURE 2: This figure shows quarterly 3-year rolling average correlations of the MSCI USA Infrastructure Index with macrovariables.

3-YEAR MOVING CORRELATIONS, US PUBLIC REAL ESTATE RETURNS AND MACROVARIABLES

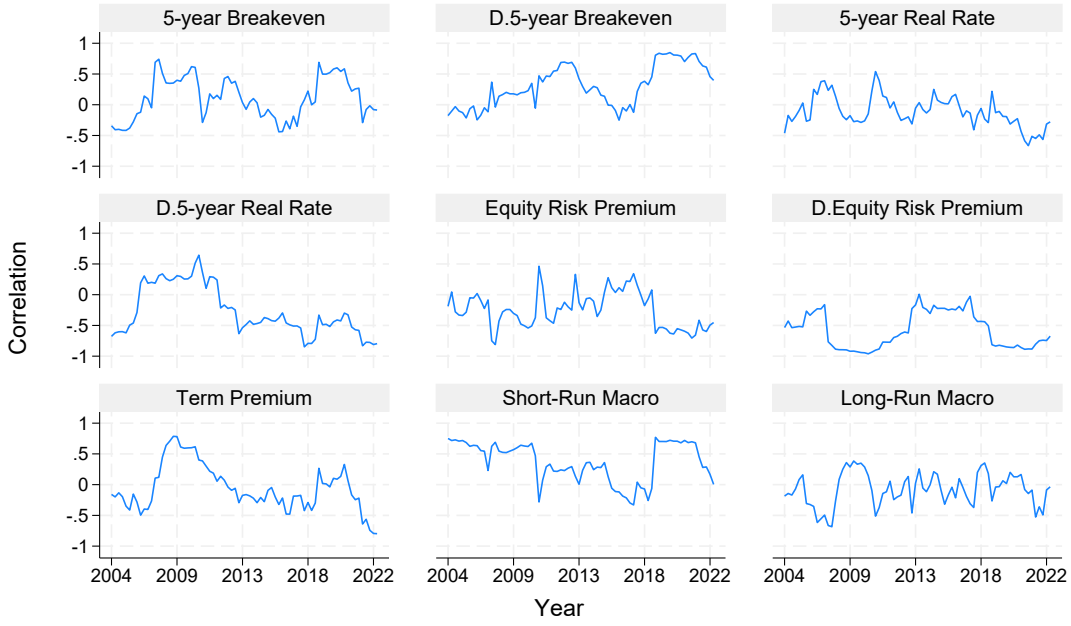

FIGURE 3: This figure shows quarterly 3-year rolling average correlations of the Dow Jones U.S. Real Estate Total Return Index returns with macrovariables.

3.2 Private Returns and Correlations

Private funds are not regularly valued in the manner that public assets are through secondary market transactions. Private fund returns rely on quarterly net asset valuations (NAVs), and consequently, the reported returns of private funds typically reflect lagged information about the funds' valuations. This lagged information introduces spurious autocorrelation in performance metrics, AKA "smoothed" returns. To estimate the true volatility of private fund returns, various unsmoothing techniques have been used in the literature. Historically, moving average methods are used for hedge funds, as in Getmansky et al. (2004),whereas autoregressive methods are used for real estate, as in Geltner (1993). We follow Couts et al. (2023) in using an AR(2) model to unsmooth private real estate and infrastructure returns though our results do not depend on what method we use.

For AR(2) unsmoothing, suppose we have a series of returns spanning $t = 0, \ldots, T$. Let r_t denote the return—typically quarterly—of a private infrastructure investment. Also let $\bar{r}$ denote the mean of r calculated having omitted $t = \{0, 1\}$. We then demean the series of returns with $t \in \{2, \ldots, T\}$ such that $R_t \equiv r_t - \bar{r}$. The AR(2) unsmoothing process is then given by

$$R_t = \phi_0 + \phi_1 R_{t-1} + \phi_2 R_{t-2} + \epsilon_t, \tag{1}$$

and the unsmoothed series of returns is then given by

$$R_t^* = \bar{r} + \frac{\epsilon_t}{1 - \phi_1 - \phi_2}, \quad \text{for } t \in \{2, \ldots, N\}, \tag{2}$$

where $R_0^* := r_0$ and $R_1^* := r_1$. This process preserves the mean of the original series but adjusts for the spurious autocorrelation; the first two returns of the unsmoothed series are set to the first two returns of the original series because the AR(2) process cannot account for R_0^* and R_1^* otherwise.

Correlations of both the original and unsmoothed infrastructure returns are shown in Table 3, where stars denote unsmoothed counterparts. We start by pointing out any difference in correlation of 0.20 or more in absolute value. First, all slices of private infrastructure returns correlate with long-run macro variation with the opposite sign of public infrastructure returns, from, on average, -0.08 with private as opposed to 0.40 for public returns. Likewise for short-run macro

variation, the public return correlation is -0.06 whereas private has an average correlation of 0.37. Second, private core, generalist, and value-added returns differ from the public return correlation with the change in the equity risk premium, with private returns averaging around -0.28 as opposed to -0.58 for public returns. Core and value-added private infrastructure returns show correlations with the change in the 5-year real rate of about 0.03 compared to the public of -0.29. Finally, core private infrastructure returns correlate with the change in the 5-year breakeven at 0.16 compared to the public at 0.43. These correlations may vary over time, however. To that end, we illustrate quarterly 3-year rolling average correlations in Figures A2, A3, A4, and A5.

TABLE 3: PRIVATE INFRASTRUCTURE AND MACRO VARIABLE CORRELATIONS, NA/US

Variable	**All**	**All***	**Core**	**Core***	**Gen**	**Gen***	**VA**	**VA***
5-year Breakeven	0.539	0.411	0.267	0.270	0.376	0.298	0.523	0.494
Δ 5-year Breakeven	0.335	0.401	0.153	0.147	0.306	0.295	0.223	0.286
5-year Real Rate	0.098	0.024	-0.100	-0.100	0.054	0.049	0.123	0.083
Δ 5-year Real Rate	-0.020	-0.107	-0.006	0.000	-0.101	-0.100	0.093	0.056
Equity Risk Premium	-0.290	-0.195	-0.094	-0.095	-0.261	-0.203	-0.215	-0.206
Δ Equity Risk Premium	-0.344	-0.366	-0.203	-0.200	-0.330	-0.301	-0.280	-0.327
Term Premium	0.163	0.108	0.075	0.077	0.004	-0.004	0.295	0.260
Short-Run Macro	0.377	0.380	0.280	0.275	0.327	0.302	0.310	0.360
Long-Run Macro	-0.194	-0.144	0.041	0.042	-0.087	-0.077	-0.164	-0.127

Table 4 shows the same set of correlations of both original and unsmoothed real estate returns. The differences between public and private real estate correlations aren't as common as they are with infrastructure. That said, public real estate returns have a correlation of 0.40 with long-run macro variation as opposed to -0.07 for private real estate. On the other hand, public real estate returns have a correlation of -0.06 with short-run macro, whereas private real estate returns have a correlation of about 0.38. Public correlation with the changes in the real rate is -0.29, whereas core generalist, and value added on average have correlations of -0.07. All other correlation differences are less than 0.20. These correlations may vary over time, however. To that end, we illustrate quarterly 3-year rolling average correlations in Figures A6, A7, A8, and A9. Overall, and especially recently, private real estate correlations with most variables have declined in magnitude. These result suggest that public and private infrastructure returns are potentially driven by different factors. A question we now examine explicitly.

TABLE 4: PRIVATE REAL ESTATE AND MACRO VARIABLE CORRELATIONS, NA/US

Variable	All	All*	Core	Core*	Gen	Gen*	VA	VA*
5-year Breakeven	0.540	0.286	0.551	0.306	0.557	0.307	0.479	0.271
Δ 5-year Breakeven	0.165	0.349	0.197	0.339	0.124	0.299	0.126	0.256
5-year Real Rate	-0.191	-0.219	-0.147	-0.177	-0.197	-0.246	-0.201	-0.197
Δ 5-year Real Rate	0.092	-0.097	0.088	-0.074	0.131	-0.073	0.079	-0.064
Equity Risk Premium	-0.562	-0.225	-0.526	-0.226	-0.595	-0.283	-0.529	-0.254
Δ Equity Risk Premium	-0.254	-0.468	-0.334	-0.461	-0.170	-0.394	-0.186	-0.352
Term Premium	-0.068	-0.016	-0.024	-0.014	-0.070	-0.037	-0.097	-0.029
Short-Run Macro	0.417	0.389	0.437	0.408	0.362	0.355	0.377	0.349
Long-Run Macro	-0.059	-0.073	-0.074	-0.067	-0.040	-0.066	-0.045	-0.062

3.3 Are Underlying Infrastructure Assets in Private Funds Different?

We next compare the characteristics of our private infrastructure dataset to those of public infrastructure as determined using the MSCI World Infrastructure Net Total Return index (M2WD0INF on Bloomberg). First, we note the difference in investment regions as shown in Table 5. Specifically, private infrastructure is more geographically diversified than the public index. The public index is comprised of more than 60% North American firms, whereas the private funds are less than 50%. Most of that difference is accounted for by investment in Europe, where the private weight is about 11% higher, specifically 24.2% public versus 34.9% private. It is also worth noting that the private dataset has 5.3% weight in Latin America versus zero weight in the public index. From this decomposition, we begin to uncover that the public indices often used to benchmark private infrastructure funds represent very different underlying assets. This is not only important for performance benchmarking but also has implications for the risk exposure comparisons that are central to this paper. We need to ensure that, when evaluating, say, relative inflation exposures, we are correctly comparing apples-to-apples.

Next, we compare GICS sector weights, shown in Table 6. As with geography, there is more diversification in the private sector relative to the public index. At the world level, the public index is heavily invested in utilities with a weight of 52.2%, whereas the private dataset has a utility weight of only 31.0%. The public index has a weight of 31.1% in communication services versus 11.6% in the private dataset. The difference in utilities and communication services is mostly accounted for by the much larger private weight in industrials, increasing from 2.1% in public to

TABLE 5: REGION-WISE PUBLIC AND PRIVATE INFRASTRUCTURE WEIGHTS

Region	Public Weight	Private Weight
North America	63.2%	49.4%
Europe	24.2%	34.9%
Asia-Australia	12.7%	8.7%
Africa	0.0%	0.2%
Latin America	0.0%	5.3%
Middle East	0.0%	1.0%

Private weights calculated relative to total amount invested USD in the entire sample.

24.2% in private funds. Private funds also have a notably higher weight in energy, with 19.1% versus 11.3% in the public index, and a smaller but still substantially larger weight in information technology, with 5.0% at the world level and compared to essentially zero in public infrastructure.

For North America / US (NA/US), the difference between utilities investment is even more stark with 60.3% in the public index versus 28.4% in private funds. The difference in energy is also large, with 12.1% in the public index versus 32.2% in private funds. The public index has 22.9% in communication services compared to just 7.7% in private funds. Most surprising is that the public index has nothing in industrials or information technology, whereas private funds have 17.7% and 7.4%, respectively.

The largest difference between world and North America private infrastructure is found in energy, which has a 32.2% weight in North America compared to 19.0% for the world. North America private funds have a weight of 17.7% in industrials compared to 24.2% in global funds. Other differences in private infrastructure weights are around 3 percentage points or less.

Because industrials are such a large proportion of, and are found almost exclusively in, private infrastructure, we break down the top 10 GICS subsectors at the world level with industrials as shown in Table 7. The largest subsectors are largely transportation related, involving marine, road, air, and rail.

To further complicate matters, sector composition is not necessarily stable over time. Figure 4 shows how the monthly percent of each GICS industry, weighted by deal size in USD, changes over time.[7] In line with the overall weights of Table 6, the weights are dominated by utilities,

[7]Weights before 2008q1 are noisy due to the small number of deals. Accordingly, we simply assume pre-2008 weights are the same as those in 2008q1. We likewise assume a constant weight for 2023q4 equal to 2023q3 since our deals-level

TABLE 6: GICS SECTOR-WISE PUBLIC AND PRIVATE INFRASTRUCTURE WEIGHTS

GICS Sector	Public (World)	Private (World)	Public (US)	Private (NA)
Utilities	52.2%	31.0%	60.3%	28.4%
Communication Services	31.1%	11.6%	22.9%	7.7%
Energy	11.3%	19.0%	12.1%	32.2%
Health Care	2.9%	2.3%	4.8%	0.5%
Industrials	2.1%	24.2%	0.0%	17.7%
Consumer Discretionary	0.4%	2.8%	0.0%	2.3%
Consumer Staples	0.0%	0.3%	0.0%	0.4%
Financials	0.0%	1.7%	0.0%	1.4%
Information Technology	0.0%	5.0%	0.0%	7.4%
Materials	0.0%	1.0%	0.0%	0.6%
Real Estate	0.0%	1.0%	0.0%	1.3%

Private weights calculated relative to total amount invested USD in the entire sample.

TABLE 7: WORLD INDUSTRIALS INFRASTRUCTURE GICS SUBSECTORS WEIGHTS

GICS Subsector	Number	Weight
Marine Ports and Services	42	3.3%
Environmental and Facilities Services	52	3.3%
Highways and Railtracks	59	3.2%
Airport Services	27	3.2%
Rail Transportation	14	1.9%
Construction and Engineering	48	1.9%
Diversified Support Services	23	1.6%
Data Processing and Outsourced Services	9	1.4%
Marine Transportation	16	1.3%
Passenger Ground Transportation	7	0.7%

Private weights calculated relative to total amount invested USD in the entire sample.

energy, and industrials. Starting in 2004, utilities account for over 40% and fall to under 30% by 2023. Likewise, industrials account for under 30% of investments, but fall to less than 20% by 2023. Energy has the most interesting path, starting at about 15%, peaking at around 45% in the mid-2010s before falling to around 30% by 2023.

GICS Sector Share of North America Private Infrastructure Investment Over Time

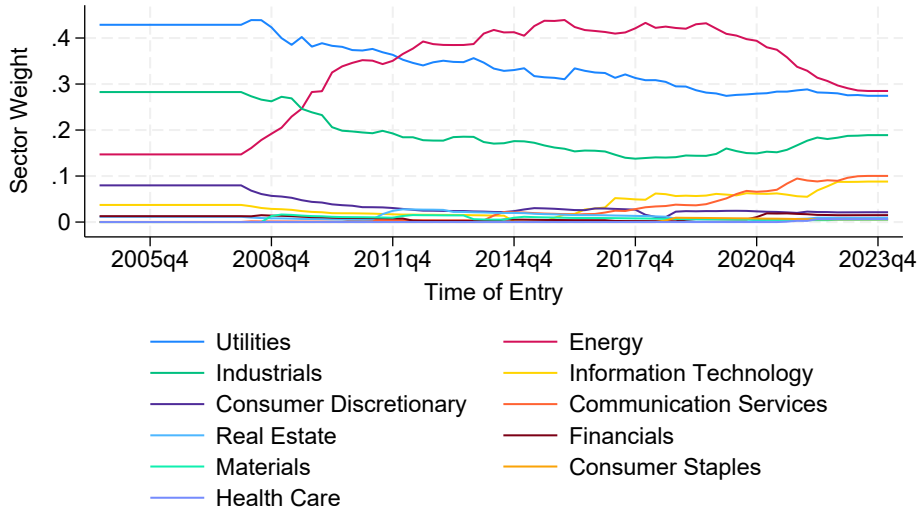

Figure 4: This figure shows the weight in US private infrastructure investment of each GICS sector by investment amount in USD for each month. Source: StepStone.

Taken together, in order to assess the differences in inflation, and other factor, risk exposures across public and private infrastructure funds, we have to account for the fact that the public indices represent a very different set of investments.

3.4 Are Underlying Real Estate Assets in Private Funds Different?

We next compare the characteristics of our private real estate dataset to public real estate as measured by the MSCI World Real Estate Index (MXWO0RE on Bloomberg). Table 8 shows the differences in investments by region. As with infrastructure, we uncover that private investments are more geographically diversified than the public index. On the other hand, the public index reflects a greater than 20% weight in Asia-Australia, whereas the associated private fund weight is under 10%.

data ends at 2023q3.

TABLE 8: REGION-WISE PUBLIC AND PRIVATE REAL ESTATE WEIGHTS

Region	Public Weight	Private Weight
North America	72.3%	53.3%
Europe		22.9%
Asia-Australia	20.7%	9.6%
Not Yet Classified		7.9%
Unknown		5.9%
Latin America		0.7%
Middle East		0.1%

Private weights calculated relative to total amount invested USD in the entire sample.

GICS subsector weights are shown in Table 9. One of the most substantial differences between the public index and the private funds is the large public weight in telecom tower REITs, at around 12-13%, as opposed to practically zero weight for private real estate funds. Another substantial difference is the larger weights in private office REITs, around 14-17%, compared to low single digits for the public index. An important difference lies in real estate development; whereas the weight of public U.S. firms is almost zero, the private fund NA weight is over 10%. Another substantial difference is in hotels and resorts, REIT or otherwise, which have very little U.S. weight—less than 1% combined—compared to around 17% for private fund NA weights. Data center REITs are favored in public investment at around 9%, compared to a little under 1% in private real estate.

The temporal change in private real estate sector weights is shown in Figure 5. Starting in 2004, office REITs dominated private real estate investment at almost 50%, but by 2023 fall to around 10%. On a smaller scale, hotels and resorts (REITs and non-REITS) combined for around 30% in 2004, but fall to under 20% by 2023. On the other hand, diversified real estate activities grew from under 10% to around 25% by 2023. Residential REITs exhibit noticeable growth from almost nothing in 2004 to over 10% by 2023.

4 Explaining Public vs Private Infrastructure Returns

In this section, we use a more rigorous return decomposition framework to explain the differences between public and private asset investments.

TABLE 9: GICS SUBSECTOR-WISE PUBLIC AND PRIVATE REAL ESTATE WEIGHTS

GICS Sector	Public (World)	Private (World)	Public (US)	Private (NA)
Industrial REITs	12.1%	6.8%	12.2%	7.0%
Telecom Tower REITs	11.9%	0.0%	13.2%	0.0%
Retail REITs	11.3%	5.5%	11.8%	6.7%
Data Center REITs	8.5%	0.7%	9.3%	0.9%
Diversified Real Estate Activities	7.8%	17.6%	0.0%	9.4%
Multi-Family Residential REITs	7.5%	8.0%	8.4%	11.4%
Health Care REITs	5.9%	2.1%	10.9%	3.5%
Real Estate Services	5.1%	0.3%	6.8%	0.5%
Real Estate Operating Companies	4.9%	2.7%	0.0%	3.9%
Self-Storage REITs	4.9%	0.6%	7.1%	0.8%
Other Specialized REITs	4.6%	0.9%	6.6%	1.2%
Office REITs		13.5%	2.3%	15.4%
Unknown		10.1%	0.0%	0.6%
Real Estate Development		8.2%	0.2%	10.9%
Hotel & Resort REITs		7.5%	0.9%	11.2%
Diversified REITs		5.7%	1.0%	6.0%
Hotels, Resorts & Cruise Lines		3.7%	0.0%	5.1%
Single-Family Residential REITs		2.1%	0.0%	2.6%
Timber REITs		0.0%	2.3%	0.0%
Mortgage REITs		0.1%	2.4%	0.2%

Private weights calculated relative to total amount invested USD in the entire sample.

GICS SECTOR SHARE OF NORTH AMERICA PRIVATE REAL ESTATE INVESTMENT OVER TIME

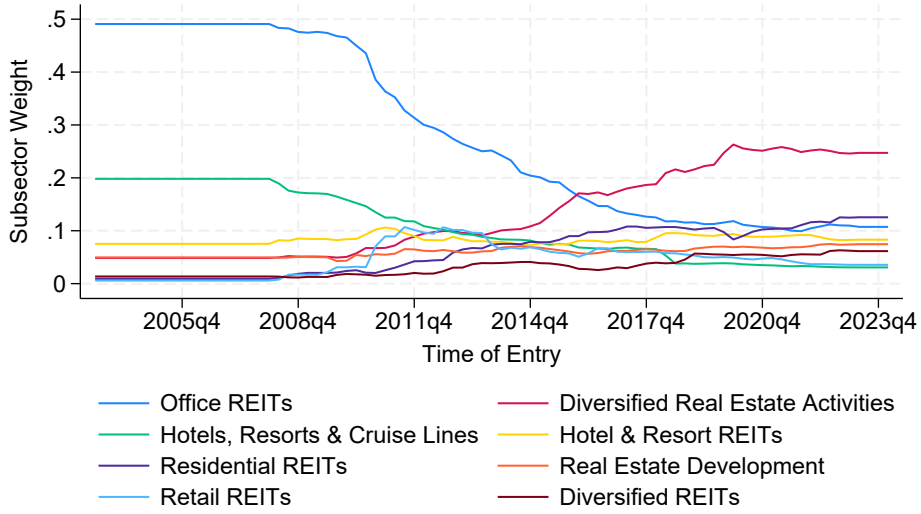

FIGURE 5: This figure shows the weight in North America private real estate investment of each GICS sector by investment amount in USD for each month. Source: StepStone.

4.1 Infrastructure Industry Composition and Returns

Different types of infrastructure investments can have very different proprieties, including return exposures to varying economic conditions. We can use MSCI-Burgiss Manager Universe data to dissect private infrastructure performance by core, generalist, and value-added/opportunistic investments. (We remind the reader that we merge opportunistic with value-added infrastructure to ensure a sufficiently long and dense time series; both capture risky assets needing significant capital expenditures, so little granularity is lost.) Table 10 shows returns across different periods. Generalist infrastructure funds have provided the most consistently high returns, around 11.3%, annualized from 2005-2023 on a pooled basis. Furthermore, generalists are the primary driver of overall private infrastructure returns as well, constituting 33% and 39% of all private infrastructure by market capitalization from 2005-2023. Over that entire period, the overall private infrastructure return was 10.3%. As discussed below, returns of private infrastructure funds in recent sub-periods, specifically 2020-2021 and 2022-2023, have been uniformly positive and, in most cases, very strong in the 8-15% annualized range. The exception is value-added and opportunistic, which had a relatively low return of 2.8% in the 2020-2021 sub-period.

TABLE 10: US/NA PRIVATE INFRASTRUCTURE RETURNS

Asset Tier	**2005-2023**	**2005-2019**	**2020-2021**	**2022-2023**
Core	7.6%	7.1%	9.3%	8.7%
Generalist	11.5%	11.3%	15.2%	9.5%
Value Added/Opp	8.2%	8.5%	2.4%	12.6%
All	10.5%	10.5%	10.3%	10.3%

Source: MSCI-Burgiss. Returns are annualized.

We tabulate the return difference between North American private infrastructure and the MSCI North America public index back to 2005 and report the results in the first three rows of Table 11. As noted previously, the private infrastructure return from 2005-2023 was 10.3%, and from 2022-2023 was 9.5%. By contrast, the public index return from 2005-2023 was 7.2% and was 2.4% in 2022-2023. Over the entire sample, the difference in returns between private and public infrastructure investment is 3.1 percentage points, and that difference appears to grow over time, reaching 7.2% in 2022-2023.

As noted above, private infrastructure substantially differs in subsector composition from the

public infrastructure index. We estimate the return difference that can be attributed to this difference by creating an alternative public-market index, comprised of public stocks but weighted by quarterly private infrastructure subsector weights. We call this the *matched GICS* public index. Public index data is created using individual firm returns data from CRSP merged with with the GICS subsectors from Compustat data. The CRSP/Compustat data is filtered to consist of ordinary shares of companies incorporated in the U.S. and listed on the NYSE, AMEX, or NASDAQ. CRSP returns are value-weighted within each subsector and quarter. By equating subsector weights across public and private indices, we can estimate how much of the return difference is driven by subsector differences and how much is left to be explained.

The matched GICS public index is reported in the fourth row of Table 11. From 2005-2019, the public infrastructure index outperformed the matched GICS index by 2.4% (8.4% minus 6.0%), suggesting that subsector effects over this period did not drive the outperformance of private infrastructure funds, but possibly despite them. However, in 2020-2021, the differences change dramatically: the public infrastructure return falls to 3.6%, and the difference between private and public infrastructure increases to 6.7%, whereas the difference between private and matched GICS public infrastructure decreases to -3.0%. In other words, the events of 2020-2021 emphasize the role of subsector, pulling private and public further apart but private and matched GICS public closer together (as compared to the previous 15 years). From 2022-2023 the gap between private and public returns widens even further, but the difference between the public and matched GICS public more closely resemble that seen in 2005-2019. Taken together, these results show that cyclical return properties of infrastructure investments depend critically on what industries (and individual investments) are considered infrastructure.

TABLE 11: US/NA PRIVATE VERSUS PUBLIC INFRASTRUCTURE RETURNS

	2005-2023	**2005-2019**	**2020-2021**	**2022-2023**
Private	10.5%	10.5%	10.3%	10.3%
Public	6.9%	8.4%	3.6%	-0.7%
Private - Public	3.6%	2.1%	6.7%	11.0%
Public (Matched GICS)	7.0%	6.0%	13.0%	8.0%
Private - Public (Matched GICS)	3.9%	4.9%	-3.0%	2.7%

Source: MSCI-Burgiss, MSCI, StepStone, CRSP, Compustat. Returns are annualized.

We further highlight the differences in returns during the 2020-2023 period by plotting all three

indices (each normalized to 100 in 2005Q1) in Figure 6. The subsector differences appear to have little effect on returns until around 2015 when the matched GICS index abruptly falls below the public index, but then the two remain roughly parallel again until around 2021 when the matched GICS public index exhibits a sustained increase in performance to close the gap by 2023. Indeed, the only prolonged and sizeable difference in the direction of public and matched GICS public indices begins in 2021. Despite its disruptions, there is no prolonged difference to be observed during the 2007-2008 Great Financial Crisis. These results suggest that macroeconomic conditions particular to 2021-2022 are of interest. Of course, one potential factor is the emergence of the first period of substantial widespread inflation in decades.

PRIVATE VERSUS PUBLIC US/NA INFRASTRUCTURE INDICES, 2005-2023

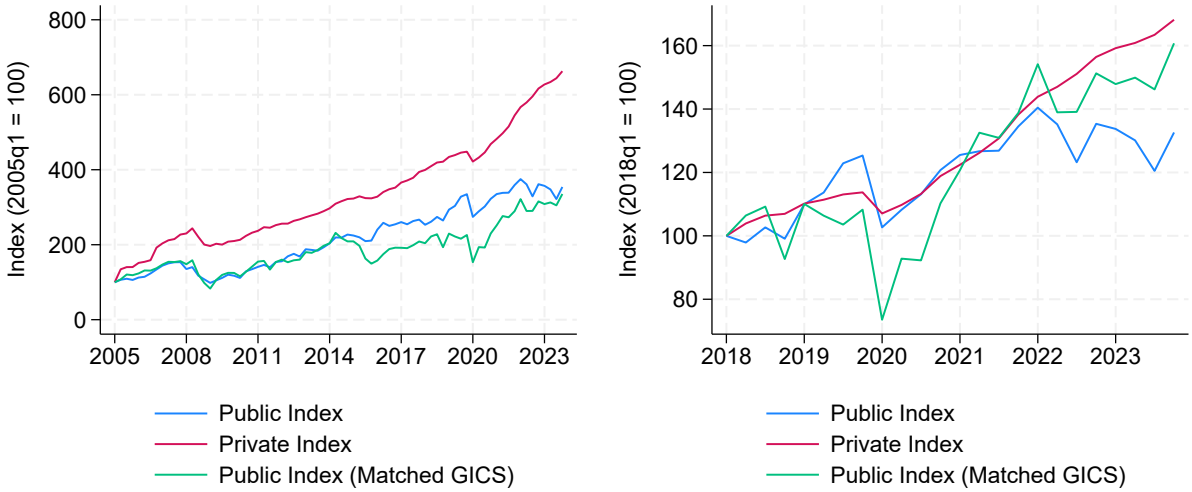

FIGURE 6: Source: MSCI-Burgiss, MSCI, StepStone, CRSP, Compustat.

We conclude this section by noting that the differences in subsector weights between public and private infrastructure investment can explain some but not all differences in returns. Our next step is to seek additional explanations by analyzing risk factors and return drivers.

4.2 Infrastructure Risk Factors

In this subsection, we employ a linear regression model to analyze risk factors among U.S. infrastructure returns. We begin by examining the five factors from Fama and French (2015): small minus big (SMB), high minus low (HML), robust minus weak (RMW), conservative minus aggressive (CMA), and market excess return (MKTRF). The dependent variables in the regressions are

the quarterly returns above the risk-free rate for private funds (pooled) from MSCI-Burgiss and the US public infrastructure index returns from MSCI (M5US0INF on Bloomberg). We also include an autoregressive term in the regression, and standard errors are Newey-West HAC-robust with one lag. Because private returns are often smoothed, we use a 1-step AR(2) unsmoothing process on private fund returns to better capture private return volatility.

TABLE 12: US/NA INFRASTRUCTURE RISK FACTORS

	Public	All	Core	VA/Opp	Gen	Matched Public
MKTRF	0.580***	0.298***	0.070	0.152***	0.339**	0.900***
SMB	−0.122	0.069	−0.002	0.173	−0.125	0.296
HML	−0.112	−0.005	0.239**	0.074	−0.122	0.157
RMW	0.234	0.098	0.117	0.279**	−0.101	0.138
CMA	0.592***	0.018	−0.277*	−0.102	0.179	0.183
AR(1)	−0.008	0.008	0.034	0.114	−0.035	−0.113
Constant	−0.000	0.015*	0.014***	0.008*	0.019	−0.002
N	78	78	55	75	74	77
Adj R-sq	0.525	0.074	0.086	0.152	−0.002	0.687

1 autoregressive term and Newey-West HAC-robust standard errors with 1 lag.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The regression results are shown in Table 12. Public index returns are strongly correlated to risk factors overall, as evidenced by the adjusted R-squared of 0.525. In contrast, the adjusted R-squared's of private returns range from −.002 to 0.152. Interestingly, core infrastructure is the only class not to have a significant loading on the market factor and also has a statistically significant quarterly alpha (5.7% annualized). Value-added/opportunistic also has a positive alpha of 3.2% (at the 90% confidence level). Public infrastructure returns show a relatively strong and statistically significant loading on market returns of 0.580, whereas all private infrastructure is about half that at 0.298. Generalist funds have a similar estimated market beta of 0.339. Market risk loadings for value-added/opportunistic is relatively low (0.152) but statistically greater than zero. Core infrastructure has an insignificant exposure to the market factor. None of the estimated exposures to other Fama-French risk factors consistently differ from zero. The last column of Table 12 reports results from a similar regression with the public index matching private market subsectors. In this case, the estimated market beta jumps to 0.900, suggesting that this public index has systematic risk much closer to the overall market. Similarly, the adjusted R-squared increases to 0.687.

Overall, the findings of this section suggest that private infrastructure funds have seemingly low exposure to commonly used equity risk factors. In addition, core and value-added/opportunistic strategies appear to have generated significantly positive risk-adjusted returns over our sample period.

4.3 Infrastructure Return Drivers

In this subsection, we employ a linear regression model to explain the drivers of U.S. infrastructure returns. Echoing Chin and Povala (2024), we consider inflation and cash flow news as persistent drivers, interest rates, and risk premia as transitory drivers and exploit these differences to infer longer-term return properties. The dependent variable in the regressions will be quarterly returns (unsmoothed via AR(2) process) above the risk-free rate, with private returns from MSCI-Burgiss and public returns as described in subsection 3.1. Each regression includes one autoregressive term and Newey-West HAC-robust standard errors with one lag.

The results are shown in Table 13. Note that the R-squared for the matched public index is again the highest. In contrast, core infrastructure has little apparent relationship with any of the included return drivers with an adjusted R-squared of only 0.028, and the other private returns all have a noticeably lower adjusted R-squared as well.

TABLE 13: US/NA INFRASTRUCTURE RETURN DRIVERS

	Public	All	Core	VA/Opp	Gen	Matched Public
5-year Breakeven	2.518	3.632**	2.126	2.131*	4.160**	5.344**
D.5-year Breakeven	0.210	2.383	−4.264	−0.119	2.881	3.293
5-year Real Rate	−0.118	0.527	−0.640	−0.403	2.030	−0.611
D.5-year Real Rate	−3.168	−0.191	−1.177	−0.138	−0.231	−2.094
Equity Risk Premium	0.346	−0.216	−0.393	−0.119	−0.813	1.558
D.Equity Risk Premium	−7.658***	−3.016**	−3.661*	−1.441	−3.819**	−14.532***
Term Premium	−3.122	−3.104	1.233	2.551	−8.896	−0.335
Long-Run Macro	−0.007*	−0.011	−0.001	−0.001	−0.019	−0.001
Short-Run Macro	0.014	0.018	0.013**	0.011	0.025	0.026***
AR(1)	−0.110	−0.189*	−0.049	−0.075	−0.236**	−0.220***
Constant	0.101	0.183	0.013	0.002	0.367	−0.118
N	78	78	55	75	74	77
Adj R-sq	0.423	0.275	0.028	0.212	0.186	0.722

1 autoregressive term and Newey-West HAC-robust standard errors with 1 lag.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Most importantly, we see that the public infrastructure index has no exposure to either the level of expected inflation or changes in expected inflation. In contrast, the returns of private funds (All), particularly value-added/opportunistic and generalist funds, are significantly positively related to the level of expected inflation. Both public and private infrastructure funds are negatively related to changes in the equity risk premium, but the exposures are much larger for public infrastructure. Value-added/opportunistic funds do not have a significant relation to changes in the equity risk premium. Few other factors are statistically different from zero in any of the regressions.

When we look at the GICS-matched public index, we find return drivers that are similar in sign to the public index but typically larger in magnitude. Most interestingly, the matched public index has a positive and significant exposure to the expected inflation level even when the regular public index does not.

These findings suggest that private infrastructure funds, and value-added/opportunistic funds in particular, have returns that are positively correlated with the level of inflation. The results with the subsector-matched public index suggest that at least some of this difference is being driven by differences in sector composition. In addition, private infrastructure funds have less exposure than public infrastructure funds to changes in the real interest rate (though none of the exposures are significantly different from zero).

4.4 Decomposing Infrastructure Return Differences

We finish this section by conducting a return decomposition that helps uncover the drivers of the difference between public and private infrastructure returns. As a first step, we regress the public index returns on the privately weighted public index returns; since the unshared element of the two is the GICS subsector difference (the sub-industry weights), the residuals capture the variation between the two driven by compositional effects. As a second step, we create a new time series that shows the difference between private and public returns at each period. We then use the return difference time series as the dependent variable to evaluate the explanatory impacts of subsectors, risk factors, and other return drivers using general dominance analysis of Budescu

(1993) and Luchman (2024).[8]

The relative importance of each set of explanatory variables—sector composition, risk factors, and return drivers—is shown in Table 14. The results vary heavily depending on the asset tier, both in total and in the relative weights in each set of variables. Altogether, sector composition, risk factors, and return drivers can explain 80.4% of the return difference between public and core private infrastructure returns, 66.0% of the return difference between public and value-added/opportunistic private infrastructure returns, and 26.5% of the difference between public and generalist private infrastructure returns. The large explanatory power for core infrastructure is consistently distributed across the set of regressors. However, the large allocations for risk factors (29.6%) and return drivers (24.8%) indicate that private core infrastructure funds posses risk and return characteristics that are more closely aligned with public markets. Risk factors andd return drivers explain less of the differences for value-added/opportunistic and generalist funds. Across all private funds, just 33.0% of the difference between public and private infrastructure returns are explained by risk factors and return drivers which is consistent with there being potentially large diversification benefits from private (especially non-core) infrastructure funds.

TABLE 14: US/NA PUBLIC VS PRIVATE INFRASTRUCTURE RETURN DIFFERENCE DECOMPOSITION

Asset Tier	Obs	Composition	Risk Factors	Return Drivers	Total
Core	55	26.0%	29.6%	24.8%	80.4%
VA/Opp	75	27.8%	17.3%	20.8%	66.0%
Generalist	74	3.8%	11.7%	11.0%	26.5%
All Private Infra	78	12.4%	11.3%	9.3%	33.0%

Taken together, our analysis of infrastructure returns unveils a disconnect between public and private markets, particularly in their response to market conditions during the recent inflationary period.. While public infrastructure investments faltered, private infrastructure funds showed greater resilience. Their ability to adjust dynamically to economic shifts enabled them to weather the inflation storm and thrive in it. Investors may need to reassess their strategies and embrace the more flexible, inflation-resilient opportunities within the private infrastructure sector.

[8]The general dominance approach with p independent variables evaluates a unique regression for all $2^p - 1$ pairwise permutations of regressors, averaging the R^2 of each regressor across its set of regressions, and using the relative size of each to assign the relative contribution to the R^2 of the full multivariate model.

5 Explaining Public vs Private Real Estate Returns

5.1 Real Estate Industry Composition and Returns

Returns for private real estate in generalist, opportunistic, and value-added funds are shown in Figure 15. Unlike private infrastructure, we do not observe substantial differences between real estate asset sub-strategies. There are substantial differences over time, however: returns in 2020-2021 are around 15%, about double the average 7% return observed in the preceding 15 years. Returns fall below zero in 2022-2023.

TABLE 15: US/NA PRIVATE REAL ESTATE RETURNS

Asset Tier	2005-2023	2005-2019	2020-2021	2022-2023
Generalist	5.9%	5.6%	14.9%	-0.2%
Opportunistic	7.9%	8.3%	14.7%	-1.0%
Value Added	7.1%	7.4%	17.4%	-4.0%
All	7.2%	7.4%	15.4%	-2.1%

Source: MSCI-Burgiss. Returns are annualized.

Similar to infrastructure, we create a matched GICS public index that provides private real estate investment subsector weights to public subsector returns. A comparison of private real estate, public real estate, and returns for the matched GICS public index is shown in Table 16. For most of the sample, there is little difference in public and private returns (less than 1% across subsamples), but that changes in 2022-2023 when private returns drop by -2.1% and public returns drop by -8.4%, a 6.3% gap. On the other hand, the gap between private and matched GICS public is not much changed, illustrating the importance of sector composition. As shown in Figure 16, we again see a prolonged and sizeable difference in the direction of public (and matched GICS public) real estate indices and the private real estate index.[9]

5.2 Real Estate Risk Factors

The same risk factors and general risk model used for infrastructure are also used for real estate, which are shown in Table 17. Private returns have been unsmoothed using the AR(2) process described in subsection 3.2. The R-squared for public real estate is 0.63, which is considerably

[9]Some of the gap is related to NAV smoothing of private fund indices which is also visible around the global financial crisis in 2008-2009.

TABLE 16: NORTH AMERICA PRIVATE VERSUS PUBLIC REAL ESTATE RETURNS

	2005-2023	2005-2019	2020-2021	2022-2023
Private	7.2%	7.4%	15.4%	-2.1%
Public	6.4%	7.5%	14.7%	-8.4%
Private - Public	0.7%	-0.1%	0.7%	6.3%
Public (Matched GICS)	6%	7%	13%	-5%
Private - Public (Matched GICS)	1.2%	0.9%	2.2%	2.6%

Source: MSCI-Burgiss, MSCI, StepStone, CRSP, Compustat. Returns are annualized.

PRIVATE VERSUS PUBLIC US/NA REAL ESTATE INDICES, 2005-2023

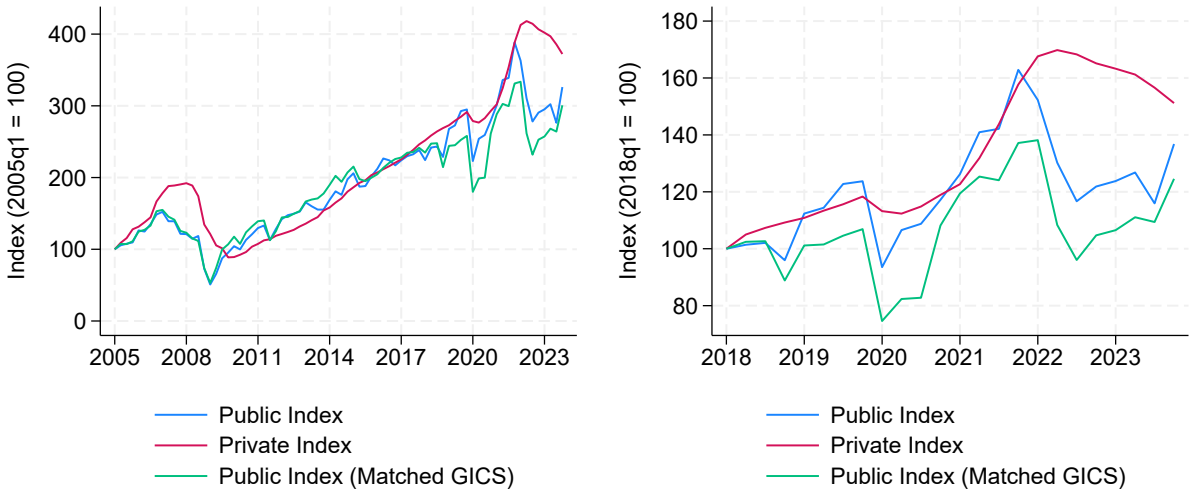

FIGURE 7: Source: MSCI-Burgiss, MSCI, StepStone, CRSP, Compustat.

higher than that of private real estate, which ranges from 0.11 to 0.21 suggesting a high level of idiosyncratic returns for private real estate. All series have factor loadings on excess returns at the 5% significance level except for value-added, which is only significant at the 10% level. The public market loading (i.e., market β) is 0.977 suggesting that public real estate comoves closely with the broader public market. The market exposure of private real estate funds varies based on sub-strategy. The index of all private real estate has a high β of 0.86 close to the β of opportunistic funds of 0.87 compared. Market betas for value-added and generalists funds are quite a bit lower, 0.55 and 0.68, respectively. Interestingly, almost none of the other factors are important for either public or private real estate (the only exceptions are RMW for opportunistic funds at the 10% level and HML for GICS-matched public returns at the 1% level). Alphas (constant term) are statistically zero across each return series.

TABLE 17: US/NA REAL ESTATE RISK FACTORS

	Public	All	Opp	VA	Gen	Matched Public
MKTRF	0.977***	0.861**	0.866***	0.548*	0.684***	1.040***
SMB	−0.002	−0.593	−0.564	−0.485	−0.498	0.231
HML	0.396	0.333	0.291	0.305	0.311	0.510***
RMW	−0.008	−0.854	−0.790*	−0.815	−0.527	−0.105
CMA	−0.007	0.010	0.130	−0.142	0.113	−0.067
AR(1)	0.016	0.083	0.017	0.068	0.068	0.034
Constant	−0.002	0.003	0.006	0.009	0.000	−0.004
N	78	78	78	78	78	78
Adj R-sq	0.626	0.210	0.202	0.106	0.205	0.782

1 autoregressive term and Newey-West HAC-robust standard errors with 1 lag.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.3 Real Estate Return Drivers

We utilize the same return driver model used for infrastructure for real estate. The model estimation results are shown in Table 18. Private returns have been unsmoothed using the AR(2) process described in subsection 3.2. As was the case for the risk factor model, the R-squared of 0.69 for public returns is considerably higher than those of private returns, which span a relatively narrow window from 0.22 to 0.31. Exposure to the level of expected inflation (5-year breakeven rate) is positive, but only significant at the 10% level, for the public real estate index and oppor-

tunistic private funds. The largest difference between public and private returns comes from the change in the 5-year breakeven inflation rate where public returns have a statistically significant *negative* coefficient of -9.8, whereas no private coefficient has a magnitude in excess of 1.5 (and none are statistically significant). A similar but slightly less pronounced pattern can be seen with the change in the 5-year real rate, with the public highly statistically significant coefficient of -7.9 compared to private coefficients no larger than unity in magnitude along with an absence of statistical significance. These results suggest that public real estate is not a good hedge for inflation. It is harder to interpret the results for private funds with respect to inflation with the weak exposure to expected (breakeven) inflation and real rates.

The other noticeable difference comes from the change in the equity risk premium with a highly statistically significant coefficient of -26.1 for public real estate compared to statistically significant but much lower coefficients of -15.3 and -14.8 for all private and opportunistic private, whereas value-added and generalist are no lower than -10.0 and have no statistical significance.

TABLE 18: US/NA REAL ESTATE RETURN DRIVERS

	Public	All	Opp	VA	Gen	Matched Public
5-year Breakeven	3.045*	3.804	5.744*	2.119	3.213	2.816
D.5-year Breakeven	−9.799***	−0.858	−1.032	−1.408	−1.233	−4.151
5-year Real Rate	−1.235	−3.150	−1.718	−3.067	−4.078***	−0.545
D.5-year Real Rate	−7.903***	−0.736	0.466	−0.369	−0.055	−4.629**
Equity Risk Premium	0.482	−2.586	−0.900	−4.392	−5.055*	1.660
D.Equity Risk Premium	−26.134***	−15.339**	−14.824**	−8.516	−9.507	−27.093***
Term Premium	3.357	−3.397	−7.343	−2.125	−1.067	1.154
Long-Run Macro	0.000	−0.024	−0.023*	−0.025*	−0.024**	0.000
Short-Run Macro	0.018	0.034	0.041	0.031	0.016	0.015
AR(1)	−0.035	−0.153	−0.183	−0.200	−0.254	0.018
Constant	−0.069	0.519	0.417	0.639*	0.620**	−0.108
N	80	80	80	80	80	80
Adj R-sq	0.691	0.295	0.296	0.220	0.310	0.710

1 autoregressive term and Newey-West HAC-robust standard errors with 1 lag.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.4 Decomposing Real Estate Return Differences

We again utilize general dominance analysis to assess the contribution of each set of factors—composition, risk, and other return drivers—to the difference between public and private real estate returns. Compared to infrastructure, the explanatory power is low. The highest level of explained variation is for generalist real estate returns differences at 36.9%, most of which comes from observed return drivers. The fraction of value-added real estate fund return differences explained is similar, albeit with more explained by risk factors and less explained by return drivers. Overall real estate and opportunistic return differences are very similar with around 28% explained with 14% from return drivers and 10 percentage points from risk factors.

TABLE 19: US/NA PUBLIC VS PRIVATE RETURN DIFFERENCE DECOMPOSITION

Asset Tier	Observations	Composition	Risk Factors	Return Drivers	Total
Opportunistic	78	3.6%	10.4%	14.9%	28.8%
Value Added	78	5.2%	15.2%	15.9%	36.3%
Generalist	78	7.2%	9.6%	20.0%	36.9%
All Private RE	78	3.9%	9.7%	14.2%	27.8%

Taken together, our analysis of real estate returns exposes a critical vulnerability in traditional investment strategies that rely on public real estate as a hedge against inflation. Despite results in prior research, our findings reveal that private real estate investments have slightly outperformed public markets over the full 2005-2023 period but this outperformance grew during the 2022-2023 inflationary period. Whether these difference persist once private real estate funds exit from current investments is an open question. However, our results, at a minimum, challenge the conventional wisdom that public assets can serve as reliable inflation hedges.

6 Conclusion

This paper presents a preliminary analysis of the differential performance of public and private real assets, focusing on their effectiveness as inflation hedges. Our findings indicate that private real assets have demonstrated superior performance on average compared to their public counterparts during the recent inflationary period. This outperformance is, in part, attributed to differences in sector composition, but also to the inherent differences in risk exposures and return

drivers of private assets.

In examining the important differences between private and seemingly comparable public real asset vehicles, our paper suggests that private assets may offer unique risk exposures that can provide diversification benefits. By highlighting the importance of cash flow duration and the ability to adjust product pricing, we contribute to a deeper understanding of the role of private investments in institutional portfolios. As this is a preliminary analysis, further research is needed to characterize these findings fully.

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A Appendix

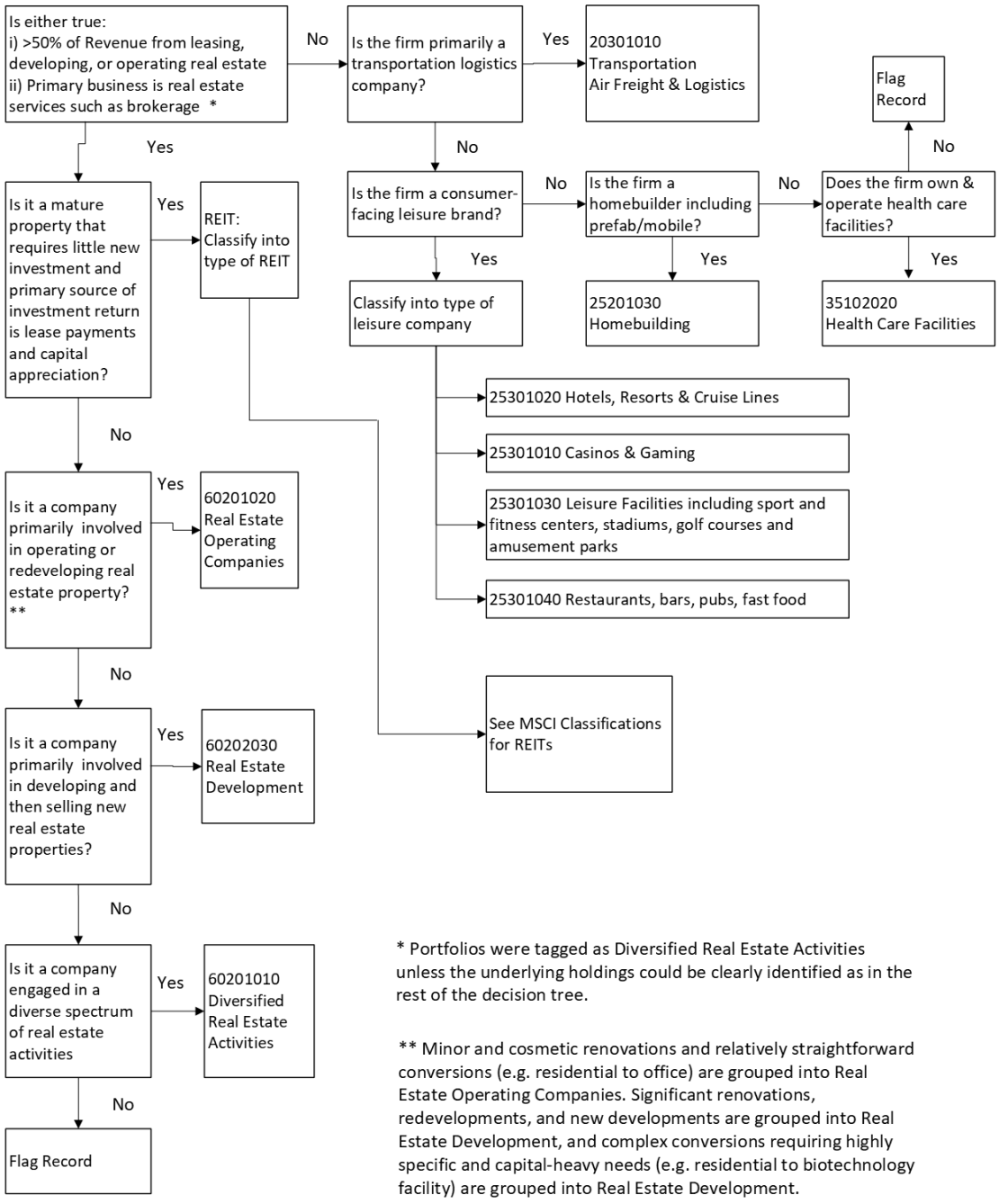

FIGURE A1: This figure shows the decision tree used to classify real estate deals into GICS sectors.

A.1 Infrastructure Moving Correlations

3-year Moving Correlations, North American Private Infrastructure Returns and Macrovariables

Figure A2

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE CORE INFRASTRUCTURE RETURNS AND MACROVARIABLES

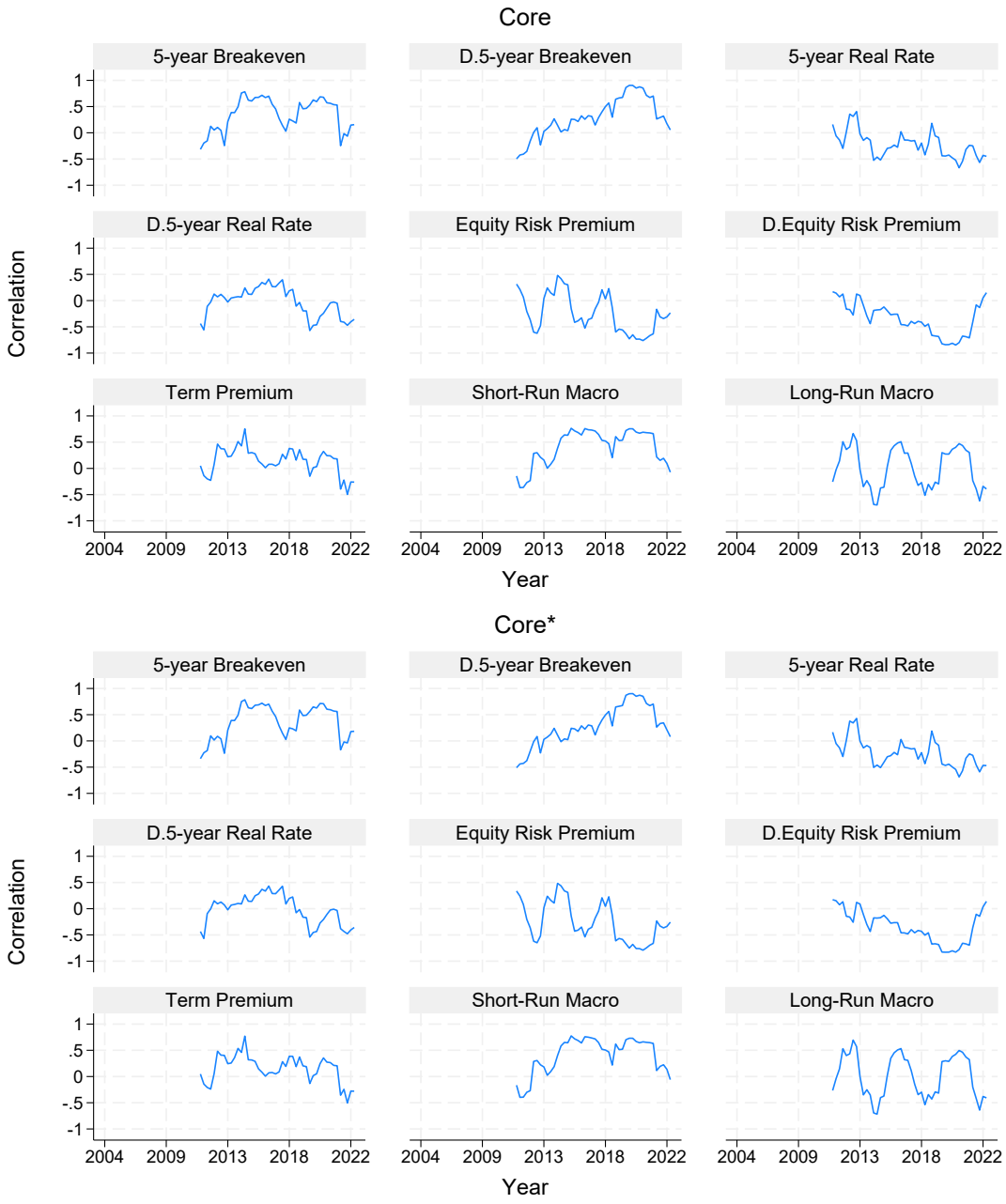

FIGURE A3

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE GENERALIST INFRASTRUCTURE RETURNS AND MACROVARIABLES

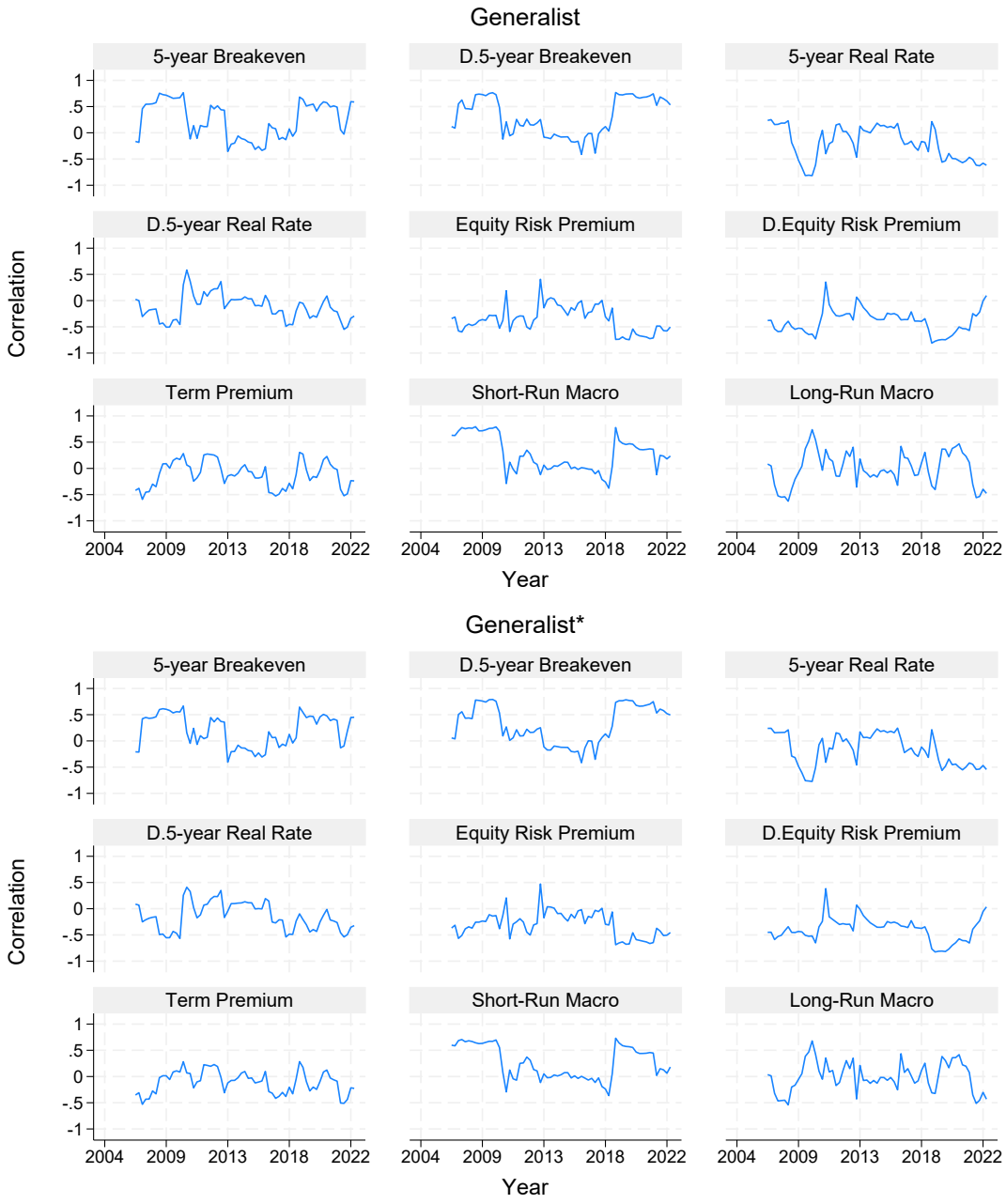

FIGURE A4

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE VALUE ADDED INFRASTRUCTURE RETURNS AND MACROVARIABLES

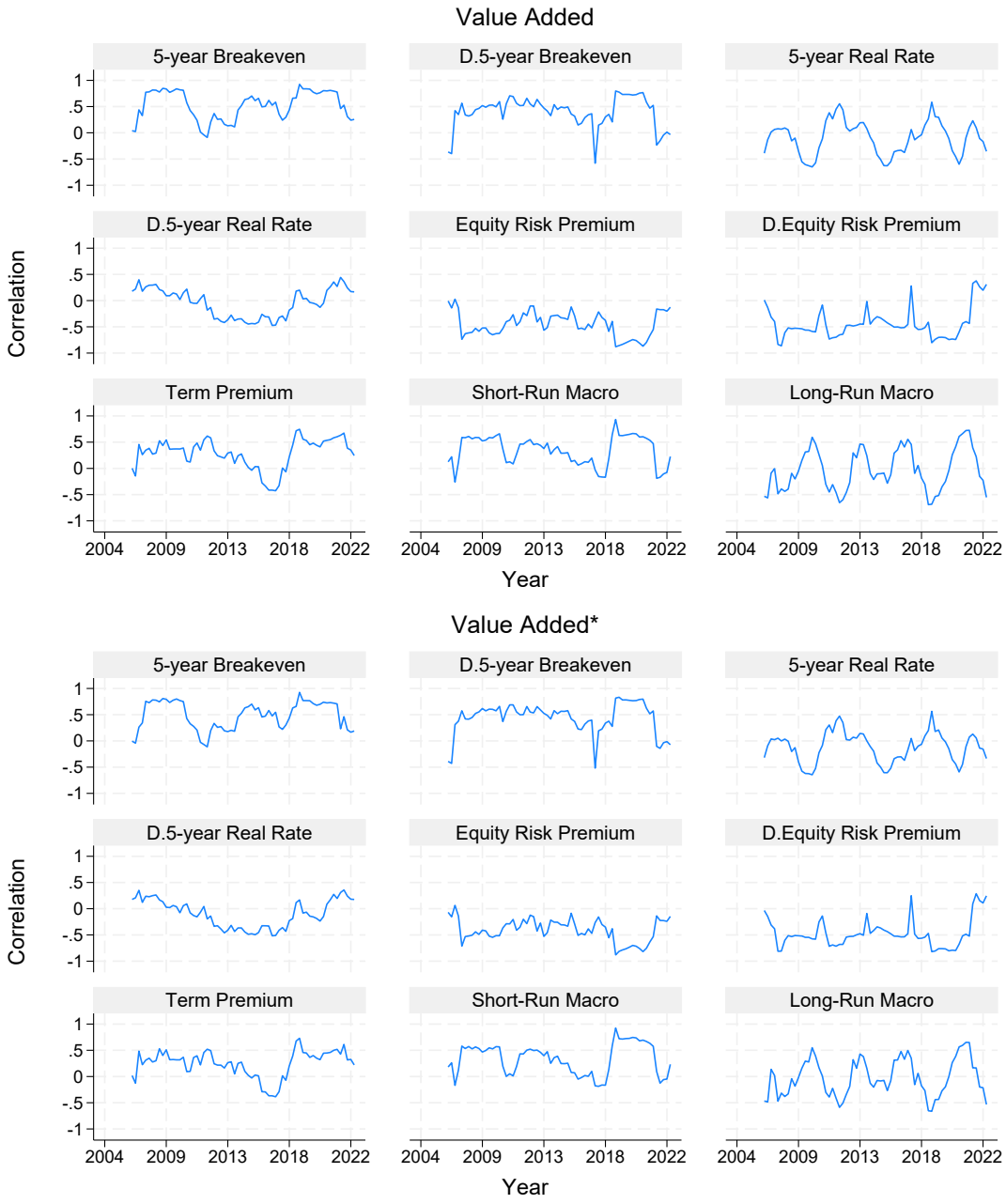

FIGURE A5

A.2 Real Estate Moving Correlations

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE REAL ESTATE RETURNS AND MACROVARIABLES

FIGURE A6

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE OPPORTUNISTIC REAL ESTATE RETURNS AND MACROVARIABLES

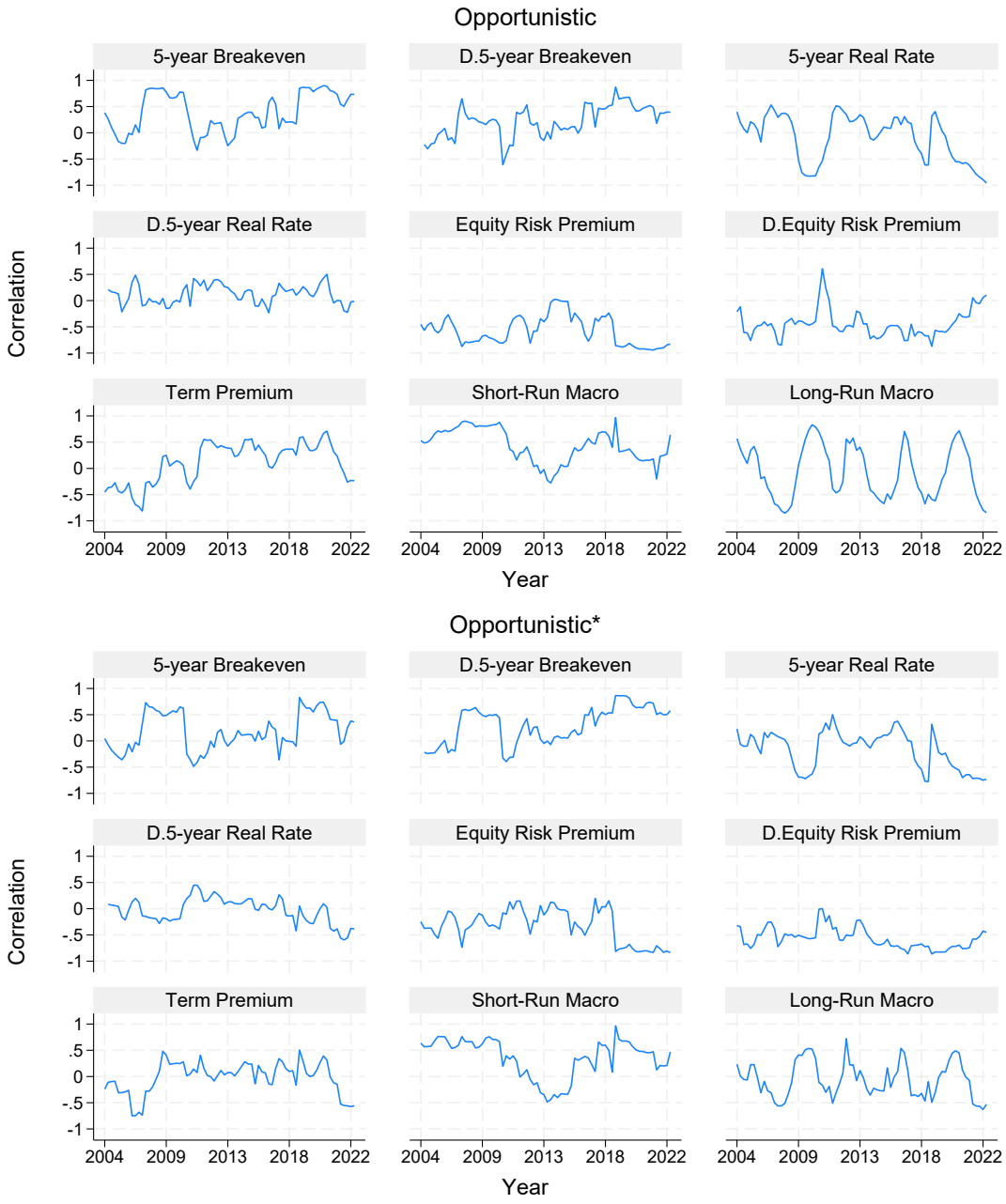

FIGURE A7

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE GENERALIST REAL ESTATE RETURNS AND MACROVARIABLES

FIGURE A8

3-YEAR MOVING CORRELATIONS, NORTH AMERICAN PRIVATE VALUE ADDED REAL ESTATE RETURNS AND MACROVARIABLES

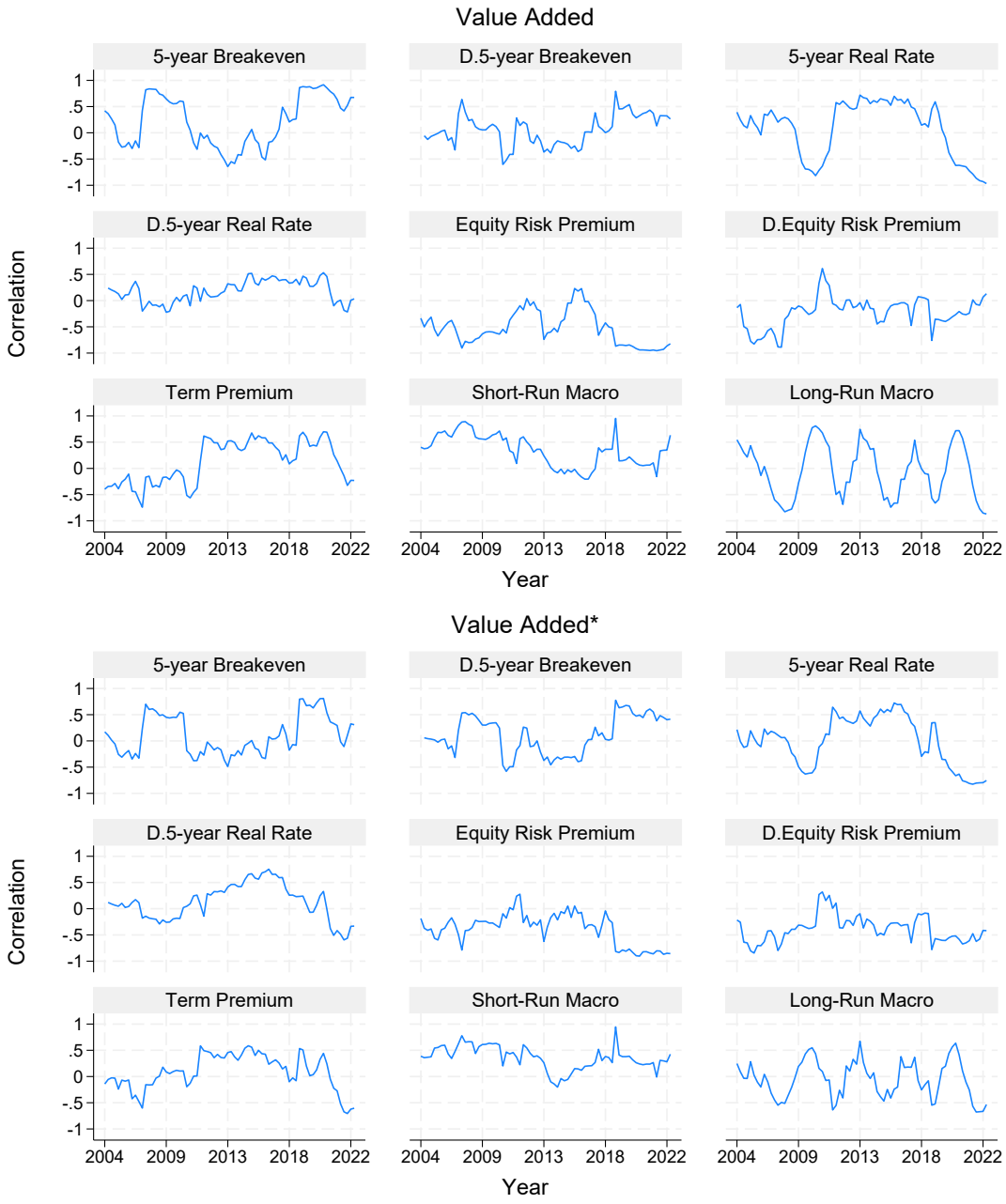

FIGURE A9