

Deconstructing the Denominator Effect

INVESTMENT INSIGHT | PORTFOLIO SOLUTIONS GROUP | 2023

Key Takeaways

- The downturn in markets last year ushered in a host of challenges for investors. Key among them has been portfolio imbalances resulting from the falling prices for publicly-traded securities and the increase in relative exposures to private assets, the so called “denominator effect.”
- We analyzed five key contributors that led to an upturn in challenges related to the “denominator effect” for investors in 2022 and found private equity (PE) outperformance preceding the 2022 correction, the impact of lagged PE performance and a higher weight than the target allocation at the end of 2021 (or overallocation) to be the most significant.
- Compared to previous crises, the major differentiator last year was the starting point in which investors carried higher allocations than target going into the crisis. Other less impactful variations included a larger lag in PE performance during the trough quarter and differing trends for net PE flows (capital distributions and contributions). In contrast, the public markets drawdown and the outperformance of PE relative to public equity did not differ materially from the Global Financial Crisis (GFC).
- We expect the final impact on 2022 PE allocations to be mostly muted compared to 2021, and the “denominator effect” may even prove short-lived, which, in our view, **suggests that investors should approach portfolio rebalancing differently, possibly temporarily relaxing target allocation guidelines and becoming slightly more opportunistic on new commitments.**
- Investors might have an asymmetric risk profile in trying to reduce this overallocation, as reducing or stopping new commitments, or more drastic measures like secondary sales, can be potentially more damaging than a continued overallocation. This can potentially lead to costly sacrifices in vintage diversification, missed opportunities in post-crisis strong vintages, risks of underweighting (if markets bounce back) and possibly crystallizing losses if investors resort to secondary divestments.

AUTHORS

PORTFOLIO SOLUTIONS GROUP

Specialists in designing and managing custom multi-asset, multi-manager investment solutions that span from broadly diversified to focused portfolios. The team's expertise lies in partnering with institutional and high net worth investors to understand their unique needs and crafting solutions to help them achieve their overall investment objectives.

Introduction

Negative performance across public markets in 2022 caused private market investors to experience an expansion in their illiquid exposure as a proportion of overall assets. As a result, they must now reconsider the appropriate level of new private commitments. Given the prevalent use of exposure limits by asset class, this has been all the more true.

The “denominator effect,” as this set of patterns is commonly known, has forced dramatic action in the form of reduction and suspensions to new commitments and even to the use of secondary sales as investors seek to limit growing overallocations to private markets. According to a recent Collier Capital investors’ survey, up to 42% of investors, or 65% of investors with AUM above \$20 billion, will likely reduce PE commitments due to the denominator effect.¹

As investors wrestle with the denominator effect and contemplate remediation, it is important to understand the various reasons driving apparent overallocations. In this paper, we deconstruct the causes of the denominator effect to gain insight into how investors understand and respond to these incidents. If the primary drivers are expected to be temporary in nature, or even illusory, investors may opt to forgo adjustments to the commitment plan, to the extent possible. If the primary drivers are expected to have a long-term impact on asset allocation, however, then adjustments to the commitment plans might be warranted.

We identified the following factors contributing to the denominator effect:

- 1. PUBLIC MARKET DOWNSIDE STRESS AND VOLATILITY:** The magnitude of the stress to public markets and the associated volatility can impact the *denominator*.
- 2. LAGGED EFFECT OF PE VALUATIONS:** The lag and smoothing effect in the performance of private markets can affect the *numerator*.
- 3. RELATIVE PERFORMANCE:** In relative terms, outperformance of private over public markets can impact the *numerator*.
- 4. NET CAPITAL FLOWS:** Distributions and capital calls to PE play an important role in the value of the *numerator*.
- 5. ALLOCATIONS RELATIVE TO TARGET:** The starting point and the gap in investors’ allocation to target can compound the denominator effect.

We recognize that circumstances vary between investor types and asset classes. However, in order to perform a data-rich analysis, we have focused on PE allocations across U.S. public

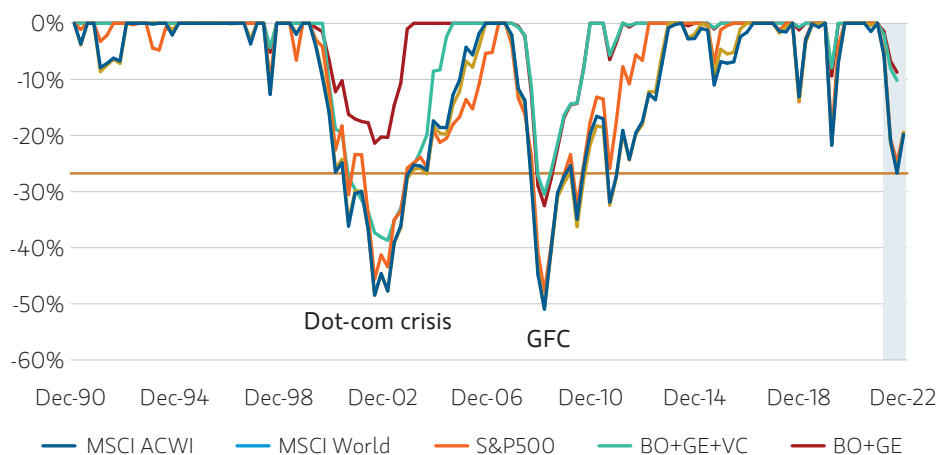
pension plans, given the availability of data and the close comparisons that can be drawn between public and private equity markets.

Analysis

1. PUBLIC MARKET DOWNSIDE STRESS AND VOLATILITY

Putting the 2022 drawdown into the context of the past 30 years is important for understanding the extent of the sell-off in public and private markets. To this end, we first performed a drawdown comparison. As can be seen in *Display 1*, the magnitude of the 2022 public equity sell-off is significant and is only behind the dot-com crisis and GFC in terms of scale over this observation period. Associated to these periods of sell-off there is a natural increase in volatility in the public markets. As such, the target ranges of the different asset classes could be tested more often than usual, but in certain cases it might be only a transitory situation.

DISPLAY 1
Max Drawdown



Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of December 31, 2022.

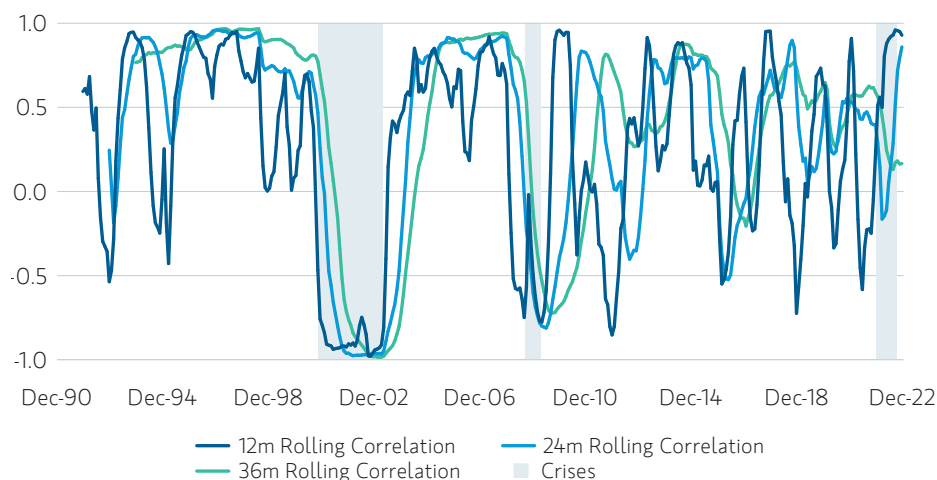
Note: BO+GE+VC is a Cambridge Associate benchmark for private markets that includes buyouts (BO), growth equity (GE) and venture capital (VC). BO+GE is a narrower index, excluding venture capital.

¹ Collier Capital. ‘Global Private Equity Barometer Winter 2022-23.’ As of December 7, 2022.

Secondly, we looked at the interaction of the different public markets, most notably fixed income with public equities. Compared to previous corrections, the unique combination of fixed income and equity underperforming concurrently was an important difference in 2022 and led to a stronger denominator effect than would be implied by a drop in equities alone. Correlation trends in *Display 2* illustrate this clearly. As can be seen, fixed income did not provide the negative correlation benefit in this stressed period due to the strong inflationary environment, which led central banks to aggressively tighten monetary policy.

We show three scenarios (the first during the GFC, the second during the GFC but with 2021 allocations and the third during 2022) to illustrate, all else being equal, the impact of the denominator effect for a pension plan's typical asset allocation. We can see how, based on the median asset allocation (held constant using 2021 data for comparison purposes),

DISPLAY 2
MSCI ACWI vs Bloomberg Global Aggregate Total Return USD Hedged



Source: Bloomberg, as of December 31, 2022.

the 2022 scenario had a similar denominator effect to 2008 (*Display 3*), as fixed income did not act as a diversifier and decreased in value together with public equities.

2. LAGGED EFFECT OF PE VALUATIONS

Considering different PE drawdowns, the current event is still limited. In fact, according to data from Cambridge

Associates, the 2022 PE drawdown, as of Q3, was only 10% versus 33% during the GFC. An interesting consideration is to understand the historical lag and smoothing effect between public and private markets to infer the potential maximum private drawdown and how far we currently are from it. To start, we looked at several metrics including:

DISPLAY 3
The 2022 Scenario Had a Similar Denominator Effect to 2008

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
2007 Starting Allocation	60.0%	22.5%	5.0%	1.0%	5.0%	5.0%	1.5%
2008 Return	-42.1%	5.6%	-21.4%	-35.6%	-6.5%	-27.1%	3.1%
2009 Resulting Allocation	47.6%	32.6%	5.4%	0.9%	6.4%	5.0%	2.1%
	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
2007 Starting Allocation (Based on 2021 Allocations)	50.0%	20.0%	10.0%	2.5%	5.0%	10.0%	2.5%
2008 Return	-42.1%	5.6%	-21.4%	-35.6%	-6.5%	-27.1%	3.1%
2009 Resulting Allocation	39.1%	28.5%	10.6%	2.2%	6.3%	9.8%	3.5%
	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
2021 Starting Allocation	50.0%	20.0%	10.0%	2.5%	5.0%	10.0%	2.5%
2022 Return	-19.5%	-11.2%	-5.2%	16.1%	3.9%	-12.3%*	2.5%
2022 Resulting Allocation	46.3%	20.4%	10.9%	3.3%	6.0%	10.1%	2.9%

Source: Cambridge Associates, as of September 30, 2022 (*Q4 22 estimated performance equal to Q3 22); Bloomberg, as of December 31, 2022.

Note: Data includes over 200 public pension plans from the public plan data website (<https://publicplansdata.org/>). Performance: Equity – MSCI World, Fixed Income – Bloomberg Global Agg. USD Hedged, Alt/HF – HFRI Fund of Funds Composite, Commodity – Bloomberg Commodity PE – CA Benchmarks Buyout + Growth Equity + Venture Capital, Cash/Other – Libor USD3M).

- TIME TO TROUGH:** Historically, during crises PE has reached the trough in the same quarter as public markets (Q1 2003 and Q1 2009) and rebounded in the same quarter.
- SIMPLE DRAWDOWN RATIOS:** The maximum drawdown ratio in the trough quarter of private to public was as high as 81% during the dot-com crisis, and 60% during the GFC, so if we apply the latter to the Q3 2022 public drawdown of 27%, we should expect a PE drawdown of 16%. As of Q3, the 10% drawdown implies a ratio of 38%.
- BETA IN NEGATIVE MARKETS:** We also analyzed over 30 years of data for beta trends in down markets, which revealed similar ratios to the above at 0.7 (for comparison, the rolling one-year beta to Q3 was 0.5). Using a beta of 0.7, we would have experienced a PE drawdown of 19%. Looking at the Q4 public rebound, the MSCI ACWI finished the year with a 20% drawdown. If this ratio were to hold true, we would expect PE marks at the end of the year to be down roughly 14%, so another 4% lower than current valuations.

This means that this component of the denominator effect is likely to be temporary or illusory and is overstating current overallocations.

3. RELATIVE PERFORMANCE: PRIVATE VS PUBLIC EQUITY

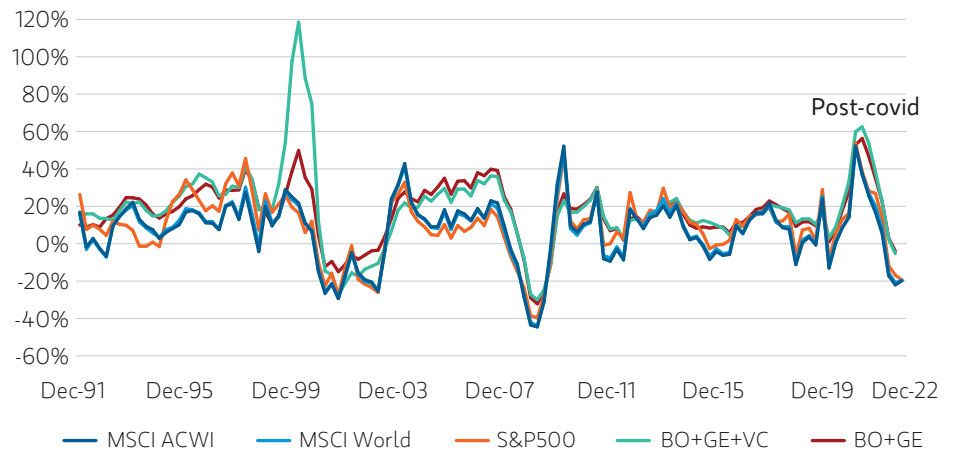
When looking at PE NAV growth, we have to disaggregate between two components: 1) PE performance, and 2) PE net capital flows versus history. In this section, we start by looking at the relative performance versus public markets to understand the dynamics between the numerator and denominator.

We consider the relative outperformance of PE versus public markets to see if this time the magnitude was different, therefore amplifying the denominator effect and potentially warranting lower PE commitments. We consider relative performance before, during and after the correction.

PRE-2022: We analyzed rolling 12-month returns for PE and observed markedly strong performance post-

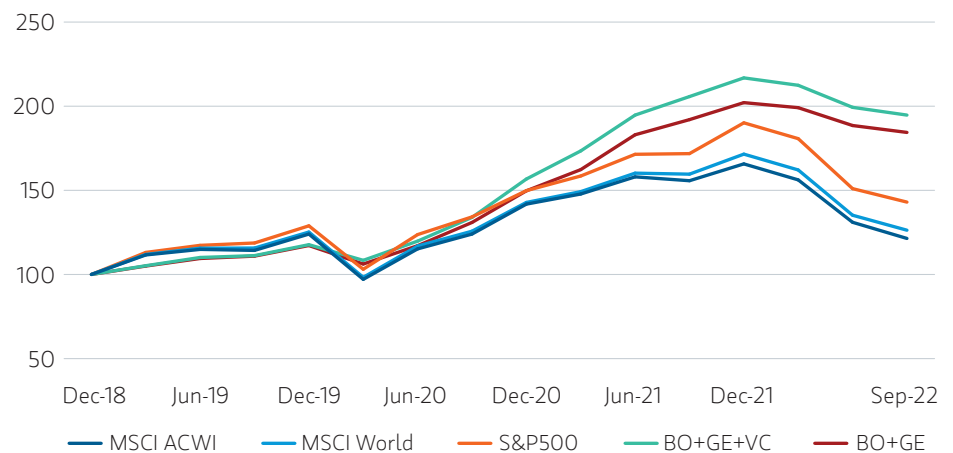
COVID—60% at the peak (*Display 4*), the second-highest ever for all PE including venture capital (VC) and the highest ever for PE excluding VC. Consequently, the numerator for investors in their private markets asset allocation increased significantly. Extending our analysis to include pre-COVID performance from January 2019 to date, we see PE's performance was extremely strong, with capital growth doubling (*Display 5*). Public market

DISPLAY 4
12m Rolling Return



Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of December 31, 2022.
Note: BO+GE+VC is a Cambridge Associate benchmark for private markets that includes buyouts (BO), growth equity (GE) and venture capital (VC). BO+GE is a narrower index, excluding venture capital.

DISPLAY 5
NAV Growth



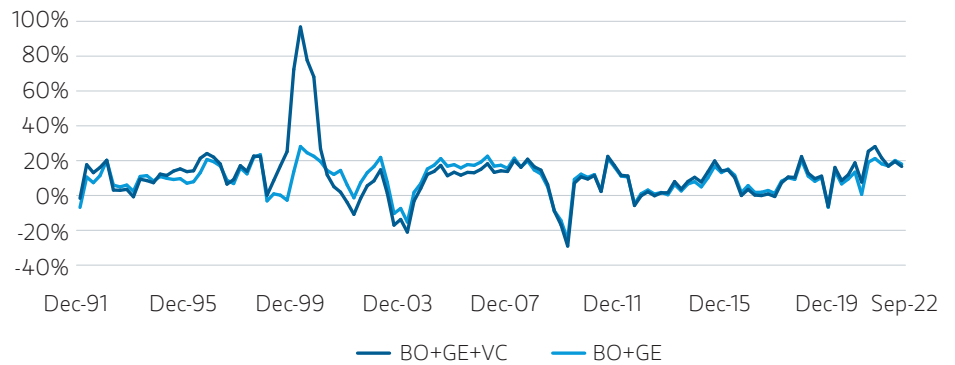
Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of September 30, 2022.

performance was also strong, but when looking at PE outperformance on a rolling 12-month period versus MSCI ACWI, we can observe that post-COVID it reached one of the maximums (circa 28%). However, this is in line with certain historical periods like pre-GFC (*Display 6*).

2022 CORRECTION: By observing different market selloffs on a rolling 12-month basis and calculating the outperformance when the MSCI ACWI was down 10%, 15% and 20%, we see that the 2022 outperformance was not stronger than previous periods (*Display 7*). In absolute terms, the outperformance during 2022 was very similar to the start of GFC period (*Display 6*).

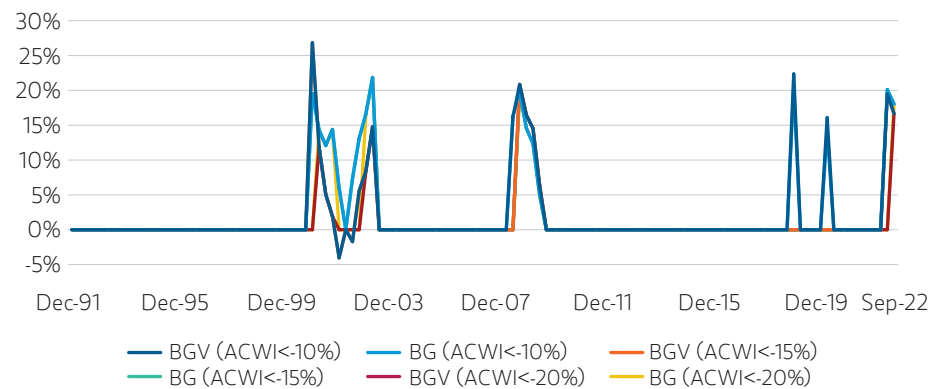
POST-CRISIS: We also looked at the outperformance during the maximum drawdown rather than the rolling 12-month return and confirmed that these outperformance periods post-crisis can last for an extended period (*Display 8*).

DISPLAY 6
Outperformance 12m Rolling Return vs MSCI ACWI



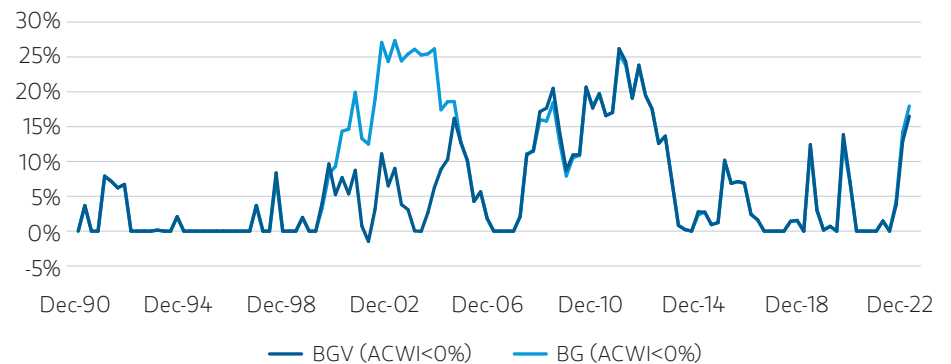
Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of September 30, 2022.

DISPLAY 7
Outperformance of 12m Rolling Return in Down MSCI ACWI



Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of December 31, 2022.
Note: BGV is the Cambridge Associates benchmark covering Buyout, Growth Equity and Venture Capital, while BG includes only Buyout and Growth Equity.

DISPLAY 8
Outperformance of Max Drawdown vs MSCI ACWI



Source: Cambridge Associates, as of September 30, 2022; Bloomberg, as of December 31, 2022.

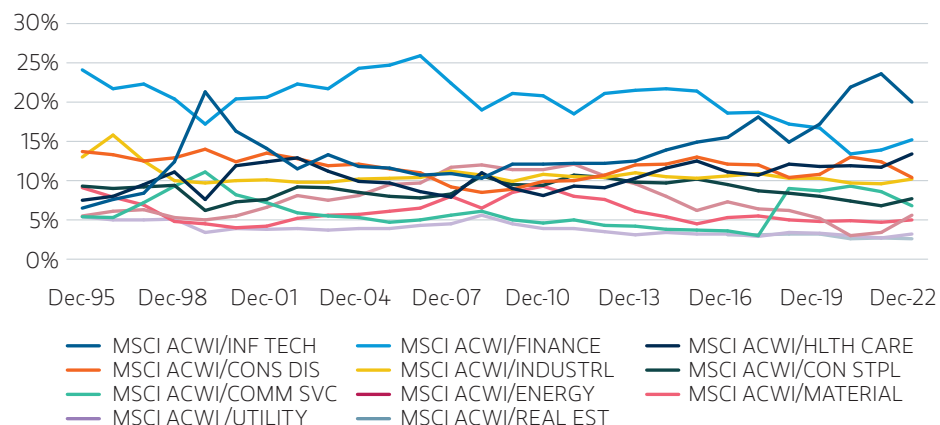
As an extension, given the PE outperformance associated with corrections, we considered the magnitude and persistency of the outperformance in 2022 and beyond in the context of the uneven earnings environment across countries and sectors. We therefore considered key sector/country weights for PE and public markets, such as technology and the U.S., but no significant under/overweight was found to exist at the macro level (Displays 9 to 12). However, we acknowledge there are likely to be differences in sub-sector exposures, for example PE's relatively high concentration in software, which might have contributed to the outperformance.

We observed how long periods of outperformance have not been uncommon either before, during and after a crisis. Outperformance of private markets could well continue in recovering markets in 2023-2024 and could justify investors taking action through lower commitments. However, we will explore below how target allocations, distributions and contributions also play a key role in the balance of the denominator effect.

4. NET CAPITAL FLOWS IN PRIVATE EQUITY

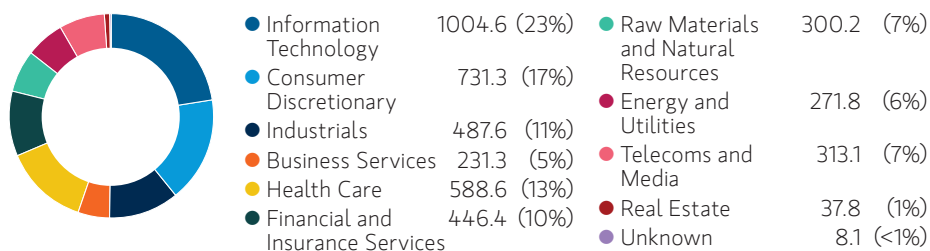
The second component in PE NAV growth includes net capital flows. This component is particularly relevant in private markets, as investors typically use historical capital call and distribution rates to determine their assumptions regarding future cash flows (arguably, this is the most important input in commitment planning). Whenever there is a large misalignment in capital called or distributed versus history, this can have an impact on the *numerator*.

DISPLAY 9 MSCI ACWI Sector Weights



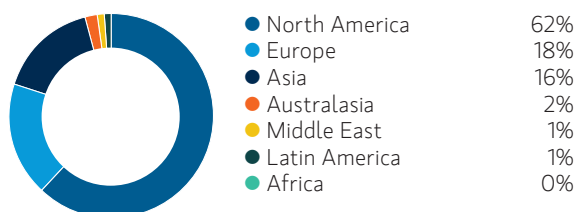
Source: Bloomberg, as of December 31, 2022.

DISPLAY 10 Aggregate Buyout Deals (\$bn) Last 5 Years



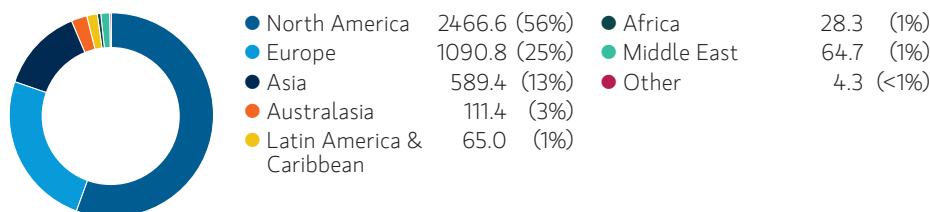
Source: Preqin, as of December 31, 2022.

DISPLAY 11 MSCI ACWI Geographical Split December 31, 2022



Source: Bloomberg, as of December 31, 2022.

DISPLAY 12 Aggregate Buyout Deals (\$bn) Last 5 Years



Source: Preqin, as of December 31, 2022.

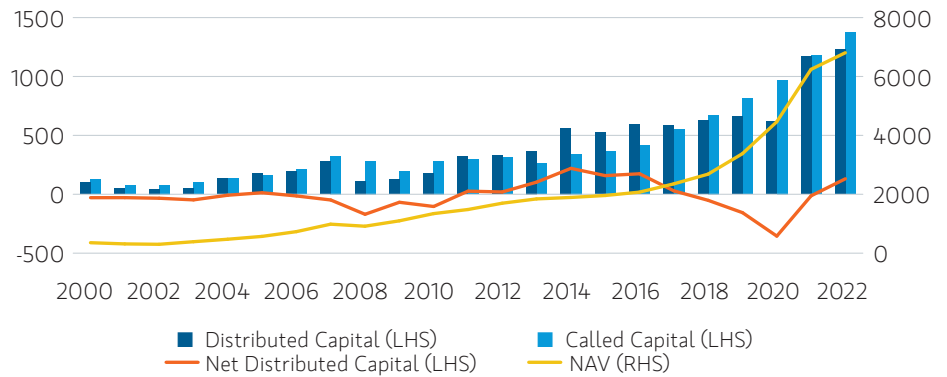
In *Display 13*, we can observe record absolute levels of called capital. Relative levels, however, increased only modestly when adjusted for rises in market capitalization (“market cap”) in public markets (*Display 14*). The larger absolute proportion of capital called is in part explained by a significant increase in the public market cap. Such rises impact private market commitment decisions, as the valuation expansion complicates the maintenance of desired portfolio allocations. However, in analyzing called capital as a percentage of NAV, a measure that provides insight into annual NAV changes (excluding performance seen above), we see levels decreasing over the past three years (*Display 15*).

Next, we consider the impact of distributions on the numerator. While distributions have been trending higher in U.S. dollar terms, they have been gradually decreasing since 2016 as a percentage of NAV (*Display 15*). In fact, they potentially sit below levels forecast by investors that relied on historical data (21% on average versus NAV). This could be considered as another factor that has contributed to an elevated numerator versus expectation. However, it is important to look at the net flows (called capital–distributed capital) to have the full picture. We calculated the net flow as a percentage of NAV to observe, all else being equal, the impact on investors’ NAV. We conclude that in the last three years the net flows have not particularly impacted investors’ allocations.

5. ALLOCATIONS RELATIVE TO TARGET

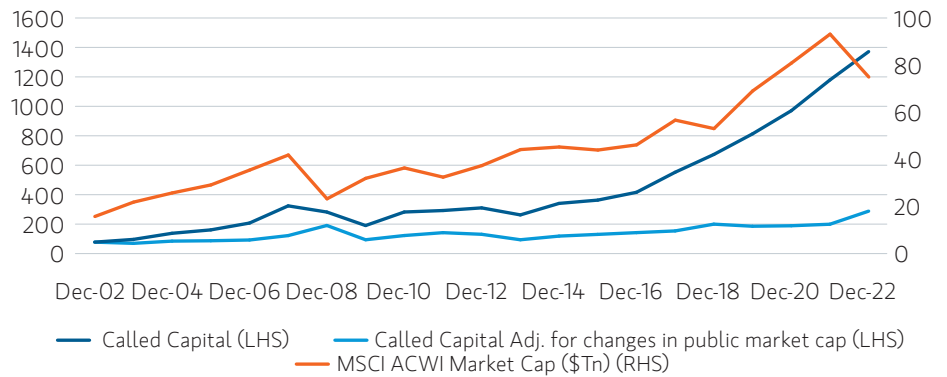
The last factor to consider for the causes of the denominator effect is the gap in investors’ private allocations relative to pre-crisis target levels. Here we focus on PE allocations across U.S. public pension plans given the availability of data. To put the 2022 denominator impact into context, we compare current allocations (i.e. the actual levels) versus targets in 2020

DISPLAY 13
PE Capital Called/Distributed (\$bn)



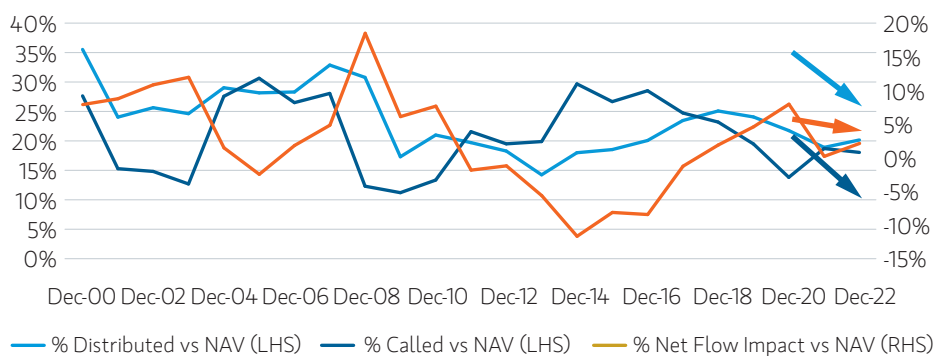
Source: Preqin, as of June 30, 2022 (H2 2022 data for called and distributed capital in line with Morgan Stanley estimates).

DISPLAY 14
PE Capital Called Adjusted (\$bn)



Source: Preqin, as of June 30, 2022 (H2 2022 data for called and distributed capital in line with Morgan Stanley estimates). Bloomberg, as of December 31, 2022.

DISPLAY 15
PE Capital Called/Distributed % NAV



Source: Preqin, as of June 30, 2022 (H2 2022 data for called and distributed capital in line with Morgan Stanley estimates).

and 2021 relative to 2006 and 2007. We then look at the crisis years, when strains from the denominator effect became most acute, i.e., 2022 and 2008.

Target allocations increased in 2021 for public pension plans by 1% (*Display 16*) against a 2% increase in 2007. The key difference in these two periods (aside from the magnitude), however, was the gap between current and target allocation levels in these years, which both preceded crises.

In 2007, the allocation gap peaked at negative 2.4% (three times higher than the prior year), which was no doubt due to that year's large target increase. One reason for the increase could be investors' need to diversify away from public risk assets in the late-cycle period (typically when forward-looking return expectations compress), as well as from the strong rolling PE performance over 2004 to 2006 (*Display 4*).

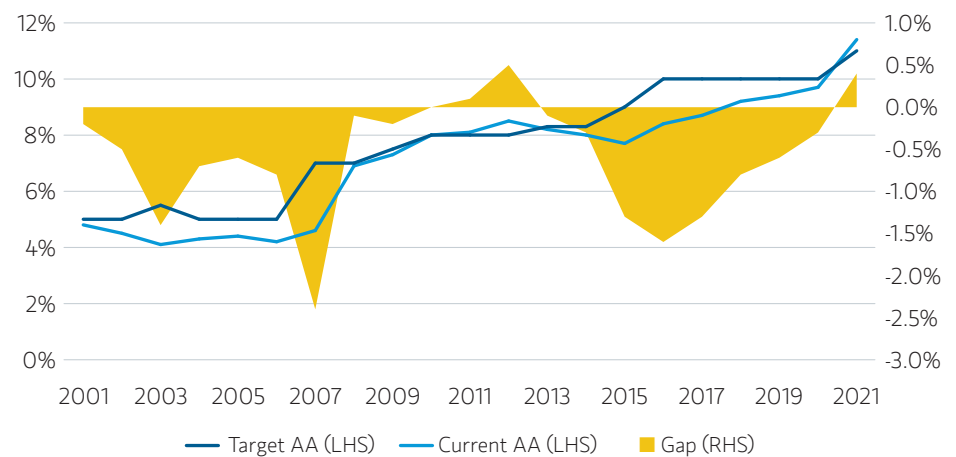
Fast-forward to 2020 and investors were much closer to target allocation levels. Thus, the more limited target increase in 2021 was not enough to offset strong numerator growth caused by robust PE outperformance, which resulted in an overallocation of 0.4% before the 2022 correction.

Focusing on the current allocations impact in 2008, we see a significant increase versus 2007 (up 2.3 percentage points from 4.6% to 6.9%). What do we attribute this 50% increase in current allocations to? Looking at the factors above, there was some smoothing effect and relative outperformance of PE versus public equity, but we think that a significant decrease in 2008 distributions compared to previous years' levels was the key driver (*Display 15*). At the same time, we do not deem the impact of public asset classes' performance alone to be a key driver, as seen in *Display 3*.

DISPLAY 16
Allocation Figures for 200 Public Pension Plans

	TARGET AA	CURRENT AA	GAP
2001	5.0%	4.8%	-0.2%
2002	5.0%	4.5%	-0.5%
2003	5.5%	4.1%	-1.4%
2004	5.0%	4.3%	-0.7%
2005	5.0%	4.4%	-0.6%
2006	5.0%	4.2%	-0.8%
2007	7.0%	4.6%	-2.4%
2008	7.0%	6.9%	-0.1%
2009	7.5%	7.3%	-0.2%
2010	8.0%	8.0%	0.0%
2011	8.0%	8.1%	0.1%
2012	8.0%	8.5%	0.5%
2013	8.3%	8.2%	-0.1%
2014	8.3%	8.0%	-0.3%
2015	9.0%	7.7%	-1.3%
2016	10.0%	8.4%	-1.6%
2017	10.0%	8.7%	-1.3%
2018	10.0%	9.2%	-0.8%
2019	10.0%	9.4%	-0.6%
2020	10.0%	9.7%	-0.3%
2021	11.0%	11.4%	0.4%

Source: Over 200 public pension plans from the public plan data website (<https://publicplansdata.org/>).



Source: Over 200 public pension plans from the public plan data website (<https://publicplansdata.org/>).

Denominator Effect Contribution Breakdown

We have analyzed five factors contributing to the denominator effect, such as public markets correlation, drawdown magnitude, PE outperformance, PE composition relative to public markets, PE net capital flows and investors' allocations, and have compared them across the cycle. As a final step, we undertake an empirical exercise based on available (albeit not yet full) data to evaluate each factor's impact on the 2022 denominator effect (presented in the appendix).

All five of the factors analyzed contributed to the 2022 denominator effect, albeit with varying degrees of magnitude. The main factors were outperformance in the run up to the 2022 correction, followed by lagged PE performance and investors' pre-correction overallocation. Three of these five factors have already materialized (public markets drawdown, relative outperformance and investors' starting point), while two have yet to fully be realized or recorded (lagged performance and net PE flows). If we look at the potential impact of these two factors, we see how they could slightly offset each other with the lagged effect potentially removing anywhere from 0.2% to 0.7% from current allocations and net PE flows adding around 0.2%. Therefore, we do not expect the overall overallocation amount to increase significantly in 2023, with investors likely keeping the same balance as 2022.

If we consider this on a relative basis versus history, we would argue that the key difference was a situation of overallocation before the 2022 crisis, whereas ahead of the GFC there was

a significant allocation gap. Other factors also had a marginally stronger impact than during the GFC (e.g., the bigger lag in PE performance during the trough quarter of 0.5 versus the average 0.7 beta), while others had a weaker impact (e.g., net PE flows limited effect on the denominator effect in 2022 versus a significant impact during the GFC). The impact of the public markets drawdown and the outperformance of PE relative to public markets this time are in keeping with developments during the GFC.

TAKING APPROPRIATE DECISIONS

While having private portfolios hold up well in a difficult market environment is a positive for many asset owner portfolios, it does also create a portfolio management pain point. When reflecting on the appropriate decisions to make from a portfolio construction and commitment pace perspective, it is important to consider what the risks and benefits are of a potential short/medium-term over/under-allocation.

- **Overallocation** might pose structural challenges, particularly when tight governance bars an overallocation to the asset class (perhaps due to stringent cash/liquidity needs). In such a situation, this may require a sudden stop to new commitments or even more drastic action in the form of a secondary sale. Both options are unfavorable in our view:
 - *Significantly reducing and/or stopping new commitments* could: i) Compromise the vintage diversification of the private markets program; ii) Cause investors to forgo a potentially attractive entry point for high-

quality private market assets;² and iii) Potentially result in a future under allocation that is difficult to correct.

- A *secondary sale* could require a large discount in this particular environment where investors are still waiting for the true effect of mark-to-market in PE.
- On the other hand, the *risks in accommodating this overweight* are that private markets significantly underperform post-crisis, which, as seen in the analysis above and in other research we have undertaken,³ has not been the case historically; or conversely, if they overperform, the overweight might be difficult to tame and a reduction in commitments or intervention through secondary transactions could be warranted.

- **Underallocation** risks become particularly relevant when investors are forced to chase new commitments to reach the target and accept a lower-quality threshold in the managers they onboard. Another risk is lagging peers that are at target or overweight during a period in which private markets tend to outperform. On the other hand, investors can potentially deploy more in favorable vintage years, although we believe that by the time the underweight realizes, the opportunities will be less attractive than at the onset of a post-crisis period.

Overall, we believe that investors should not ignore the bigger picture about performance by solely focusing on portfolio guidelines; the consequences of forcing a rebalancing to become neutral weight and/

² For more on this topic, see our paper "Post-Crisis Private Markets Investing."

³ Ibid.

or the consequences of becoming underweight by stopping new commitments are worse than the risks and consequences of allowing an overweight in the short-medium term and could significantly impact performance. In our view: i) There could be a transitory component of lagged valuations in the current denominator effect, which will shave off part of the overallocation when solved, and ii) The impact from net

PE flows on the numerator going forward is not expected to be particularly material.

One approach for investors with minimal overallocation could be to temporarily relax portfolio guidelines, where necessary and possible, and to become slightly more opportunistic on new commitments, accommodating what we view as a temporary overallocation to avoid compromising the vintage diversification of the

private markets program and forgoing a potentially attractive entry point for high-quality private-market GPs. **We will reassess portfolio conditions at the end of Q1/beginning of Q2 2023** when the final 2022 PE marks are released and a better picture of the PE flows is available. **Until then, any measure to correct the overallocation could be premature and adversely impact the portfolio and performance.**

Appendix

Denominator Effect Contribution Breakdown

We have analyzed five factors contributing to the denominator effect, such as public markets correlation, drawdown magnitude, PE outperformance, PE composition relative to public markets, PE net capital flows and investors' allocations, and have compared them across the cycle. As a final step, we undertake an empirical exercise based on available (albeit not yet full) data to evaluate each factor's impact on the 2022 denominator effect.

First, we must infer what the final denominator effect will be on 2022 allocations. For simplicity, we have assumed a target and current allocation to PE of 10%, equating to a 0% gap as a starting point:

PUBLIC MARKETS PERFORMANCE AND CORRELATION. As seen previously in *Display 3*, both public equity and fixed income posted negative results in 2022. On a net basis, they did not significantly impact PE positioning, as the resulting

allocation was 10.1%. In *Display 17*, we then also wanted to neutralize this positive correlation between equity and fixed income in down markets to have a neutral starting point, to see the impact if the traditional negative correlation and role of safe haven for fixed income was maintained in this correction. We have therefore attributed positive performance for 2022 using 2008 performance as a reference (+5.6%) and scaled it by the public equity drawdown in 2022 relative to 2008 (~roughly half) to get 2.3%. The resulting PE allocation would drop to 9.8%, making it an impact of -0.3% versus the base case of 10.1%.

LAGGED PE PERFORMANCE: If we assume the same Q3 performance for Q4 to estimate full-year returns for 2022, we would see a decline of 12%, which, compared to the 20% fall for public equity, is roughly 60% and in line with the lower bound of the ratios discussed above. Such performance does not impact meaningfully on allocations (*Display 3*), as, all else being equal, it only adds 0.1% to

DISPLAY 17

Public Markets Performance and Correlation

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
31/12/2021 Allocation	50.0%	20.0%	10.0%	2.5%	5.0%	10.0%	2.5%
2022 Return	-19.5%	2.3%	-5.2%	16.1%	3.9%	-12.3%*	2.5%
31/12/2022 Allocation	44.9%	22.8%	10.6%	3.2%	5.8%	9.8%	2.9%

Source: Cambridge Associates, as of September 30, 2022 (*Q4 22 estimated performance equals to Q3 22), Bloomberg, as of December 31, 2022.

DISPLAY 18A

Lagged PE Performance

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
31/12/2021 Allocation	50.0%	20.0%	10.0%	2.5%	5.0%	10.0%	2.5%
2022 Return	-19.5%	-11.2%	-5.2%	16.1%	3.9%	-19.0%*	2.5%
31/12/2022 Allocation	46.7%	20.6%	11.0%	3.4%	6.0%	9.4%	3.0%

Source: Cambridge Associates, as of September 30, 2022 (*Q4 22 estimated performance based on the assumptions above), Bloomberg, as of December 31, 2022.

DISPLAY 18B

Lagged PE Performance

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
31/12/2021 Allocation	50.0%	20.0%	10.0%	2.5%	5.0%	10.0%	2.5%
2022 Return	-19.5%	-11.2%	-5.2%	16.1%	3.9%	-14.0%*	2.5%
31/12/2022 Allocation	46.4%	20.5%	10.9%	3.3%	6.0%	9.9%	3.0%

Source: Cambridge Associates, as of September 30, 2022 (*Q4 22 estimated performance based on the assumptions above), Bloomberg, as of December 31, 2022.

DISPLAY 19**Relative Performance**

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
31/12/2021 Allocation	50.5%	20.2%	10.1%	2.5%	5.1%	9.1%	2.5%
2022 Return	-19.5%	-11.2%	-5.2%	16.1%	3.9%	-12.3%*	2.5%
31/12/2022 Allocation	46.8%	20.6%	11.0%	3.4%	6.0%	9.2%	3.0%

Source: Cambridge Associates, as of September 30, 2022 (*Q4 22 estimated performance equals to Q3 22), Bloomberg, as of December 31, 2022.

our PE exposure. If we were to assume a delay in the Q3 impact that comes through in the audited Q4 full-year valuations, using -19% as seen above (0.7 beta on the public equity trough of -27% in Q3), the resulting allocation would drop by 0.7%, leaving a gap of -0.6% (*Display 18A*). If we use Q4 public markets as a reference point and apply a 0.7 beta, or -14% PE performance, then we would drop by 0.2%, leaving a gap of -0.1% (*Display 18B*).

RELATIVE PERFORMANCE: As we have seen, PE outperformance in the run-up to a crisis and strong outperformance during the crisis are not uncommon. The impact during the correction is already accounted for in the lagged effect above, so excluding it avoids double counting. The impact in the run-up to the correction would be difficult to quantify exactly, but a good estimate can be achieved by looking at the average PE outperformance overtime, 12%, and subtracting from this level all the outperformance during 2021. This way we are neutralizing the impact of a strong year. The rolling one-year outperformance to December 2021 was 21%. We therefore exclude 9% from the theoretical NAV of 2021 rebasing our allocations by 0.9% (based on starting 10% PE allocation) at 9.1% PE allocation. The result is that the allocation shifts from 10.1% to 9.2%, or a -0.9% impact (*Display 20*). A limitation of this approach is that valuation uplifts/performance are usually only fully recorded when an investment is sold, so the 9%

adjustment to NAV might overstate the performance impact on the unrealized portfolio.

NET PE FLOWS. We have to take a view on the capital calls and distributions for the full year of 2022. The most up-to-date data from Preqin on called capital as of H1 22 says that the capital calls were 10% of NAV. Assuming the same pace in H2 22, using observations from our managers, that would equate to 20% annualized, which is in line with average historical levels (23%) and close to 2021 (19%). Similarly for data from Preqin on distributed capital, as of H1 22 the distributions were at 12% of NAV. Assuming a 50% decrease in H2 22 versus H1, backed by observations from our managers, we would arrive at a distribution level of 18% on an annualized basis, which is slightly below 2021 levels of 19%. All else being equal in 2022 we expect slightly fewer distributions compared to 2021 and slightly more calls, therefore the impact is expected to be around 2% increase in NAV. In our example if we start with a current allocation of 10% we can estimate the effect on 2022 PE allocations to reach 10.2%.

ALLOCATIONS RELATIVE TO TARGET: In 2021, the year before the correction, investors were already overallocated by 0.4%. This is one of the key differences versus the GFC, where they were significantly underallocated in 2007. We therefore tried to neutralize this starting point by looking at the average gap over the past 20 years. This is around -0.6% and if we use it in our starting allocations, rebasing the other asset classes, we would retain a gap of -0.5% (*Display 20*).

DISPLAY 20**Allocations Relative to Target**

	EQUITY	FIXED INCOME	ALT/HF	COMMODITY	RE	PE	CASH/OTHER
31/12/2021 Allocation	50.3%	20.1%	10.1%	2.5%	5.0%	9.4%	2.5%
2022 Return	-19.5%	-11.2%	-5.2%	16.1%	3.9%	-12.3%*	2.5%
31/12/2022 Allocation	46.6%	20.6%	11.0%	3.4%	6.0%	9.5%	3.0%

Source: Cambridge Associates as of September 30, 2022 (*Q4 22 estimated performance equals to Q3 22); Bloomberg, as of December 31, 2022.

DEFINITIONS

The **MSCI ACWI Index**, MSCI's flagship global equity index, is designed to represent performance of the full opportunity set of large- and mid-cap stocks across 23 developed and 24 emerging markets. As of May 2022, it covers more than 2,933 constituents across 11 sectors and approximately 85% of the free float-adjusted market capitalization in each market.

The **MSCI World Index** captures large and mid-cap representation across 23 Developed Markets (DM) countries*. With 1,508 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

IMPORTANT INFORMATION

The views and opinions and/or analysis expressed are those of the author or the investment team as of the date of preparation of this material and are subject to change at any time without notice due to market or economic conditions and may not necessarily come to pass. Furthermore, the views will not be updated or otherwise revised to reflect information that subsequently becomes available or circumstances existing, or changes occurring, after the date of publication. The views expressed do not reflect the opinions of all investment personnel at Morgan Stanley Investment Management (MSIM) and its subsidiaries and affiliates (collectively "the Firm"), and may not be reflected in all the strategies and products that the Firm offers.

Forecasts and/or estimates provided herein are subject to change and may not actually come to pass. Information regarding expected market returns and market outlooks is based on the research, analysis and opinions of the authors or the investment team. These conclusions are speculative in nature, may not come to pass and are not intended to predict the future performance of any specific strategy or product the Firm offers. Future results may differ significantly depending on factors such as changes in securities or financial markets or general economic conditions.

This material has been prepared on the basis of publicly available information, internally developed data and other third-party sources believed to be reliable. However, no assurances are provided regarding the reliability of such information and the Firm has not sought to independently verify information taken from public and third-party sources.

This material is a general communication, which is not impartial and all information provided has been prepared solely for informational and educational purposes and does not constitute an offer or a recommendation to buy or sell any particular security or to adopt any specific investment strategy. The information herein has not been based on a consideration of any individual investor circumstances and is not investment advice, nor should it be construed in any way as tax, accounting, legal or regulatory advice. To that end, investors should seek independent legal and financial advice, including advice as to tax consequences, before making any investment decision.

Charts and graphs provided herein are for illustrative purposes only. **Past performance is no guarantee of future results.**

The indexes are unmanaged and do not include any expenses, fees or sales charges. It is not possible to invest directly in an index. Any index referred to herein is the intellectual property (including registered trademarks) of the applicable licensor. Any product based on an index is in no way sponsored, endorsed, sold or promoted by the applicable licensor and it shall not have any liability with respect thereto.

This material is not a product of Morgan Stanley's Research Department and should not be regarded as a research material or a recommendation.

The Firm has not authorised financial intermediaries to use and to distribute this material, unless such use and distribution is made in accordance with applicable law and regulation. Additionally, financial intermediaries are required to satisfy themselves that the information in this material is appropriate for any person to whom they provide this material in view of that person's circumstances and purpose. The Firm shall not be liable for, and accepts no liability for, the use or misuse of this material by any such financial intermediary.

This material may be translated into other languages. Where such a translation is made this English version remains definitive. If there are any discrepancies between the English version and any version of this material in another language, the English version shall prevail.

The whole or any part of this material may not be directly or indirectly reproduced, copied, modified, used to create a derivative work, performed, displayed, published, posted, licensed, framed, distributed or transmitted or any of its contents disclosed to third parties without the Firm's express written consent. This material may not be linked to unless such hyperlink is for personal and non-commercial use. All information contained herein is proprietary and is protected under copyright and other applicable law.

DISTRIBUTION

This material is only intended for and will only be distributed to persons resident in jurisdictions where such distribution or availability would not be contrary to local laws or regulations.

MSIM, the asset management division of Morgan Stanley (NYSE: MS), and its affiliates have arrangements in place to market each other's products and services. Each MSIM affiliate is regulated as appropriate in the jurisdiction it operates. MSIM's affiliates are: Eaton Vance Management (International) Limited, Eaton Vance Advisers International Ltd, Calvert Research and Management, Eaton Vance Management, Parametric Portfolio Associates LLC, and Atlanta Capital Management LLC.

This material has been issued by any one or more of the following entities:

EMEA

This material is for Professional Clients/Accredited Investors only.

In the EU, MSIM and Eaton Vance materials are issued by MSIM Fund Management (Ireland) Limited ("FMIL"). FMIL is regulated by the Central Bank of Ireland and is incorporated in Ireland as a private company limited by shares with company registration number 616661 and has its registered address at 24-26 City Quay, Dublin 2, DO2 NY19, Ireland.

Outside the EU, MSIM materials are issued by Morgan Stanley Investment Management Limited (MSIM Ltd) is authorised and regulated by the Financial Conduct Authority. Registered in England. Registered No. 1981121. Registered Office: 25 Cabot Square, Canary Wharf, London E14 4QA.

In Switzerland, MSIM materials are issued by Morgan Stanley & Co. International plc, London (Zurich Branch) Authorised and regulated by the Eidgenössische Finanzmarktaufsicht ("FINMA"). Registered Office: Beethovenstrasse 33, 8002 Zurich, Switzerland.

Outside the US and EU, Eaton Vance materials are issued by Eaton Vance Management (International) Limited ("EVM") 125 Old Broad Street, London, EC2N 1AR, UK, which is authorised and regulated in the United Kingdom by the Financial Conduct Authority.

Italy: MSIM FMIL (Milan Branch), (Sede Secondaria di Milano) Palazzo Serbelloni Corso Venezia, 16 20121 Milano, Italy. **The Netherlands:** MSIM FMIL (Amsterdam Branch), Rembrandt Tower, 11th Floor Amstelplein 1 1096HA, Netherlands. **France:** MSIM FMIL (Paris Branch), 61 rue de Monceau 75008 Paris, France. **Spain:** MSIM FMIL (Madrid Branch), Calle Serrano 55, 28006, Madrid, Spain. **Germany:** MSIM FMIL Frankfurt Branch, Große Gallusstraße 18, 60312 Frankfurt am Main, Germany (Gattung: Zweigniederlassung (FDI) gem. § 53b KWG). **Denmark:** MSIM FMIL (Copenhagen Branch), Gorrissen Federspiel, Axel Towers, Axeltorv2, 1609 Copenhagen V, Denmark.

MIDDLE EAST

Dubai: MSIM Ltd (Representative Office, Unit Precinct 3-7th Floor-Unit 701 and 702, Level 7, Gate Precinct Building 3, Dubai International Financial Centre, Dubai, 506501, United Arab Emirates. Telephone: +97 (0)14 709 7158).

This document is distributed in the Dubai International Financial Centre by Morgan Stanley Investment Management Limited (Representative Office), an entity regulated by the Dubai Financial Services Authority ("DFSA"). It is intended for use by professional clients and market counterparties only. This document is not intended for distribution to retail clients, and retail clients should not act upon the information contained in this document.

U.S.

NOT FDIC INSURED | OFFER NO BANK GUARANTEE | MAY LOSE VALUE | NOT INSURED BY ANY FEDERAL GOVERNMENT AGENCY | NOT A DEPOSIT

ASIA PACIFIC

Hong Kong: This material is disseminated by Morgan Stanley Asia Limited for use in Hong Kong and shall only be made available to "professional investors" as defined under the Securities and Futures Ordinance of Hong Kong (Cap 571). The contents of this material have not been reviewed nor approved by any regulatory authority including the Securities and Futures Commission in Hong Kong. Accordingly, save where an exemption is available under the relevant law, this material shall not be issued, circulated, distributed, directed at, or made available to, the public in Hong Kong. **Singapore:** This material is disseminated by Morgan Stanley Investment Management Company and may not be circulated or distributed, whether directly or indirectly, to persons in Singapore other than to (i) an accredited investor (ii) an expert investor or (iii) an institutional investor as defined in Section 4A of the Securities and Futures Act, Chapter 289 of Singapore ("SFA"); or (iv) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA. This publication has not been reviewed by the Monetary Authority of Singapore. **Australia:** This material is provided by Morgan Stanley Investment Management (Australia) Pty Ltd ABN 22122040037, AFSL No. 314182 and its affiliates and does not constitute an offer of interests. Morgan Stanley Investment Management (Australia) Pty Limited arranges for MSIM affiliates to provide financial services to Australian wholesale clients. Interests will only be offered in circumstances under which no disclosure is required under the Corporations Act 2001 (Cth) (the "Corporations Act"). Any offer of interests will not purport to be an offer of interests in circumstances under which disclosure is required under the Corporations Act and will only be made to persons who qualify as a "wholesale client" (as defined in the Corporations

Act). This material will not be lodged with the Australian Securities and Investments Commission.

Japan

This material may not be circulated or distributed, whether directly or indirectly, to persons in Japan other than to (i) a professional investor as defined in Article 2 of the Financial Instruments and Exchange Act ("FIEA")

or (ii) otherwise pursuant to, and in accordance with the conditions of, any other allocable provision of the FIEA. This material is disseminated in Japan by Morgan Stanley Investment Management (Japan) Co., Ltd., Registered No. 410 (Director of Kanto Local Finance Bureau (Financial Instruments Firms)), Membership: the Japan Securities Dealers Association, The Investment Trusts Association, Japan, the Japan Investment Advisers Association and the Type II Financial Instruments Firms Association.