



EYE ON THE MARKET | SPECIAL EDITION

# The Lion in Winter

From 1930 to 2010, there were six extended periods of small cap outperformance as it dominated large cap over that entire period. But since 2010, small cap sits alongside value stocks and non-US stocks in the unholy trinity of underperforming portfolio strategies. While poor profit fundamentals argue against a prolonged period of outperformance vs large cap, small cap stocks are at their cheapest levels in the 21st century with potential market and political catalysts in their favor. First, a few words on the CrowdStrike outage.

---

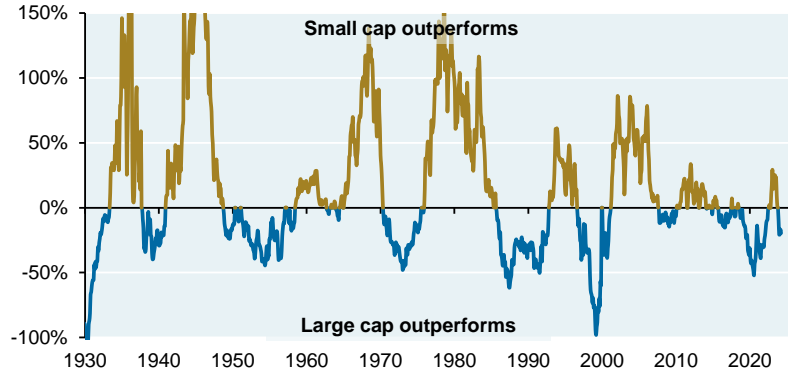
By **Michael Cembalest** | Chairman of Market and Investment Strategy for J.P. Morgan Asset & Wealth Management

### The Lion in Winter: small cap underperformance and potential catalysts; the CrowdStrike outage

You should forgive asset allocators for mistakenly assuming in 2010 that US small cap would outperform US large cap in their capital markets projections. From 1930-2010, the “small cap anomaly” yielded tremendous outperformance as shown in the first chart. There were six small cap outperformance eras during that period, the most recent of which occurred over 15 years ago.

#### Small cap vs large cap index returns

3 year rolling out (under) performance of small cap vs large cap

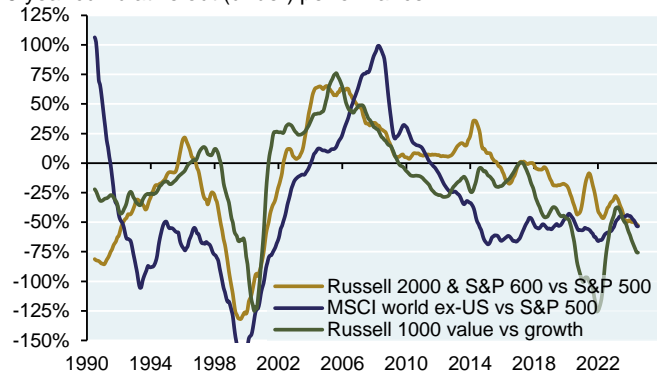


Source: SBBI Ibbotson, JPMAM, July 2024

**The unholy trinity.** Since 2010, small cap has been one of the big three underperforming portfolio strategies alongside large cap value vs growth and non-US stocks vs the US. All three out of favor strategies are at their cheapest levels in 20 years, but for good reason: weaker earnings growth than US large cap growth.

#### The Big Three: relative underperformance

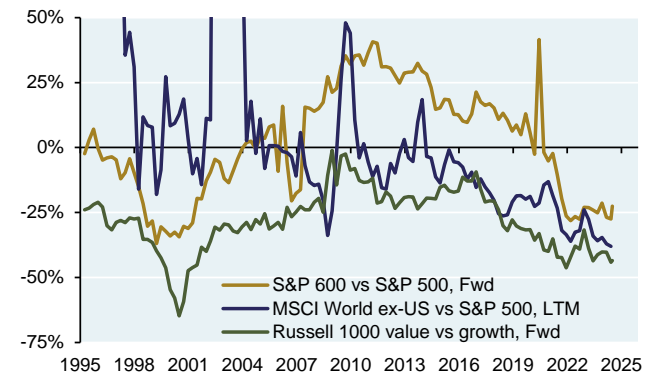
5 year cumulative out (under) performance



Source: Bloomberg, JPMAM, July 22, 2024

#### The Big Three: relative valuations

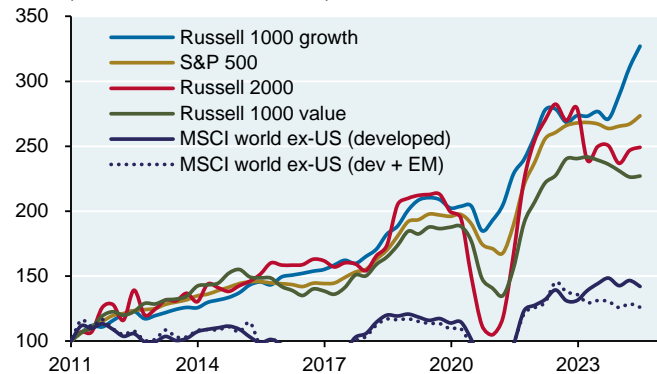
Relative P/E premium (discount)



Source: Bloomberg, JPMAM, July 22, 2024. Fwd = 12 mo forward, LTM = last 12 mo

#### Earnings growth

Index (100= December 31, 2010)



Source: Bloomberg, JPMAM, Q2 2024

**American exceptionalism:** as shown on the left, non-US stocks (proxied by the MSCI World ex-US index) have been an earnings wasteland over the last decade whether we include emerging countries or not. Of the three underperforming strategies, I see better prospects for US small cap than the other two.

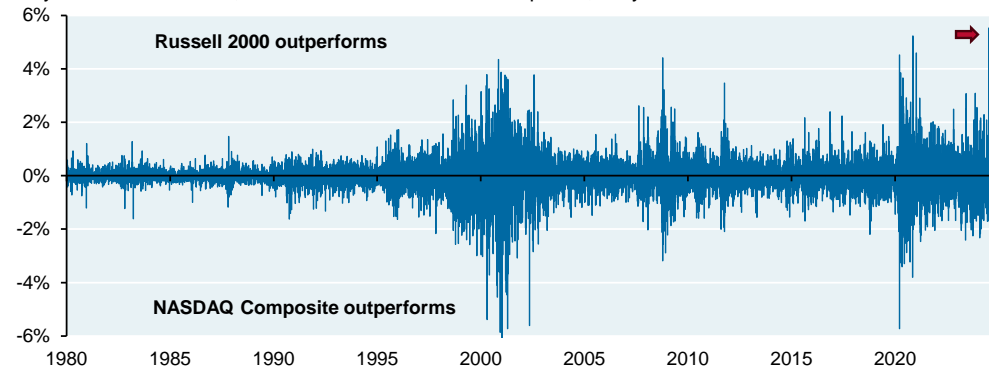
**The Lion in Winter, 1968.** A precursor to Game of Thrones intrigue: Henry II of England (Peter O’Toole) attempts to establish a line of succession with his three sons and his imprisoned wife Eleanor of Aquitaine during a Christmas family gathering in the year 1183 AD.

**Everything eventually has a price.** After the soft June CPI report, the NASDAQ fell by 2% and the Russell 2000 Small Cap Index rose by 3.6%, the largest single day outperformance by small cap in over 40 years. It was just one day and may reflect unwinding of very entrenched positions at a time of a massive valuation gap. Poor small cap fundamentals (particularly portfolios that look like the Russell 2000) may prevent small cap from mounting its seventh sustained period of outperformance, but for diversified investors thinking about small cap stocks, today’s valuations offer the cheapest entry point in the 21<sup>st</sup> century.

**One more thing on small cap, related to politics.** Trump has mentioned the possibility of higher tariffs on China and the rest of the world (which typically hurts large cap stocks the most), while Vance has said positive things about Lina Khan’s FTC (despite her department losing almost all antitrust cases it brings). If a second Trump administration raises tariffs and ratchets up antitrust enforcement of large cap tech stocks, that could be a small cap relative value catalyst, albeit at a time of possibly declining overall US equity markets. Before we begin, a few words on the CrowdStrike outage given its breadth, and what it tells us about cybersecurity in 2024.

**Small cap vs NASDAQ daily returns**

Daily excess total return, Russell 2000 - NASDAQ Composite, daily



Source: Bloomberg, JPMAM, July 21, 2024

Michael Cembalest  
JP Morgan Asset Management

**Table of Contents**

**The CrowdStrike outage** .....3

**[1] US small cap: much lower profitability and more rate exposure than large cap** .....4

**[2] Small cap indexes: S&P 600 vs Russell 2000** .....5

**[3] Zeroing in on root causes: the performance gap between large cap and small cap US tech stocks** .....6

**[4] How cheap is US small cap now? Very, using three different measures** .....7

**[5] While US small cap lagged US large cap, it outperformed vs the rest of the world**.....8

**[6] Recent small cap underperformance vs large cap mostly a developed market phenomenon** .....8

**[7] Can manager outperformance make up for small cap underperformance vs large cap?**.....9

**[8] Wrapping up: small cap data sources and small cap performance around recessions** .....10

## The CrowdStrike outage

**It was an adventure wrapping this piece up last Friday given systems outages caused by CrowdStrike's botched software update.** One cybersecurity firm observed that "CrowdStrike has done more to disrupt global business than all ransomware operators combined", while a former FBI counterintelligence agent cited CrowdStrike's "severe failure of quality control". Some more information from behind the scenes<sup>1</sup>:

- *It's all about "kernel" access.* The kernel refers to the core of an operating system and differs from "user space" in one very important regard. Once kernel access is granted to a software program, it can generally operate without restrictions, and if the program crashes it brings the computer down with it. Software operating in user space can crash without terminating the computer's ability to function
- *In Windows, cybersecurity software typically gets priority access to the kernel.* This dates back to the mid-2000's when Symantec and McAfee pressured Microsoft to allow them access to the kernel (rather than Microsoft being able to restrict cybersecurity tasks to its own cyber-program PatchGuard)
- *Microsoft requires software drivers operating in its kernel to receive a Windows Hardware Quality Labs certification after extensive testing, but CrowdStrike appears to have developed a workaround to bypass this with respect to certain updates of its driver.* CrowdStrike creates dynamic definition files that its software uses that do not require certification each time they're updated. Instead of just pointing to filenames, these definition files can also contain executable code. As a result, something like a null pointer reference in such files or inadequate parameter validation could crash the computer given its use by a kernel function
- *CrowdStrike's error sounds kind of shocking when explained in simple English:* CrowdStrike created a faulty driver definition file, failed to test it properly and then rolled it out to their entire client base in one fell swoop rather than rolling it out in batches. The result: 8 million (!!) crashed computers worldwide
- *Why weren't Apple or Linux computers affected?* Both operating systems prevent third party developers from having access to kernel space. It's that simple
- *I don't understand what the FTC's Lina Khan is talking about.* Khan's conclusion from the outage was that "concentration creates fragile systems". That's bizarre, since it was Microsoft's decision to open up the kernel to third party developers that is the root cause here. It's also bizarre since CrowdStrike only operates on 1% of all Windows PCs, which is not concentrated at all. I am inclined to believe that Khan would blame the Chicago Bears missed double-doink field goal in its 2018 wild card game on market concentration
- *There was evidence well before last week that something was amiss with CrowdStrike's Falcon Sensor software updates.* The enterprise software company Red Hat reported in June that CrowdStrike's updates were crashing Linux machines, creating "kernel panics" that are similar to Microsoft's "blue screen of death"
- *This kind of thing has happened before.* In 2010, CrowdStrike's CEO was the CTO at McAfee when it published an update that mistakenly labeled a legitimate Windows file as infected. This error paralyzed computers at hospitals, schools and gov't agencies. McAfee lost 40% of its market cap that day and sent ~4,000 employees on planes to help affected customers recover
- *Competitors go for the jugular after a mistake.* After the gov't released a report in 2023 chiding Microsoft for a "cascade of security failures," CrowdStrike's CEO used it as an opportunity to bash Microsoft in an appeal for new customers, citing "a crisis of confidence among security and IT teams within the Microsoft security customer base". What goes around...

**CrowdStrike stock price**



Source: Bloomberg, JPMAM, July 23, 2024

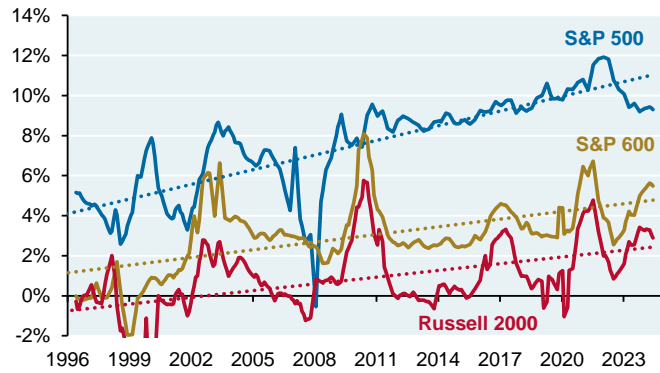
<sup>1</sup> Sources: Bloomberg, Stratechery, Register.com, Dave Plummer (ex-Microsoft, creator of Task Manager)

**[1] US small cap: much lower profitability and more rate exposure than large cap**

Relative to US large cap, US small cap stocks have (a) lower free cash flow margins, (b) a lot more companies with negative earnings, (c) lower return on invested capital<sup>2</sup>, (d) more floating rate debt, (e) higher debt to cash flow ratios, (f) higher interest expense to cash flow and (g) ~70% of debt falling due in the next 5 years compared to 45% for large cap. These are depressing metrics if you’re looking to find value in US small cap.

**Free cash flow margin: large cap vs small cap**

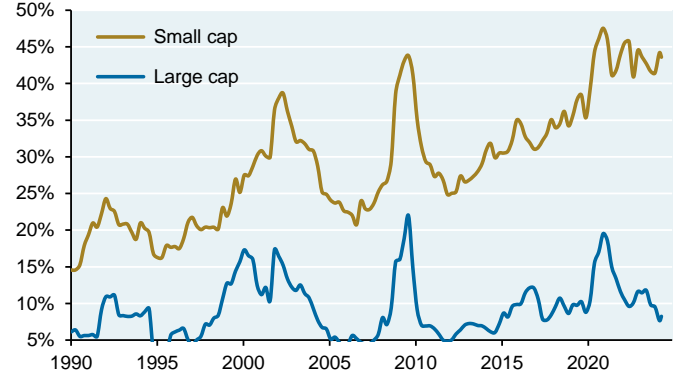
Free cash flow margin, 3 month smoothing



Source: Bloomberg, JPMAM, June 2024

**Companies with negative earnings by size**

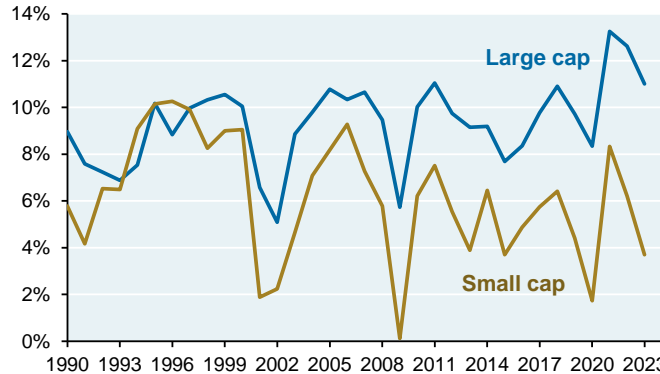
% of companies with negative LTM earnings



Source: Factset, JPMAM, May 15, 2024.

**Aggregate ROIC for US large and small cap stocks**

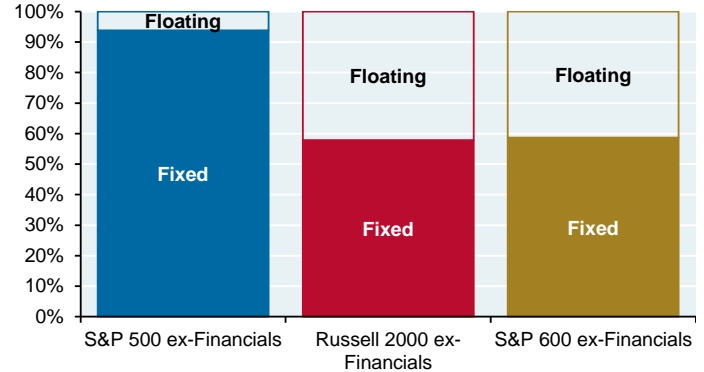
Percent, Return On Invested Capital



Source: "Stock Market Concentration", Morgan Stanley, June 4, 2024

**Fixed vs floating rate debt**

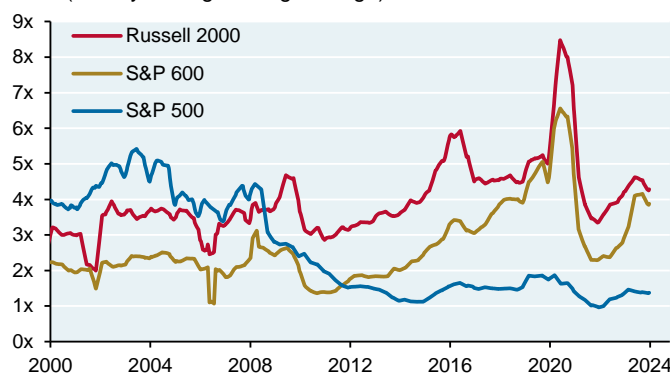
Share of debt



Source: Bloomberg, JPMAM July 8, 2024

**Net debt to EBITDA for small and large cap companies**

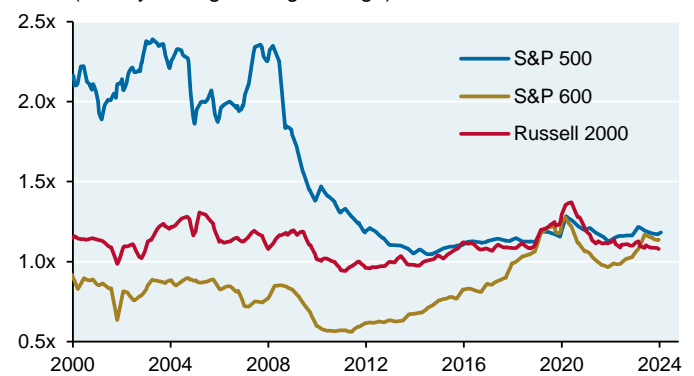
Ratio (90-day trailing moving average)



Source: Bloomberg, JPMAM, July 7, 2024

**Total debt to equity for small and large cap companies**

Ratio (90-day trailing moving average)

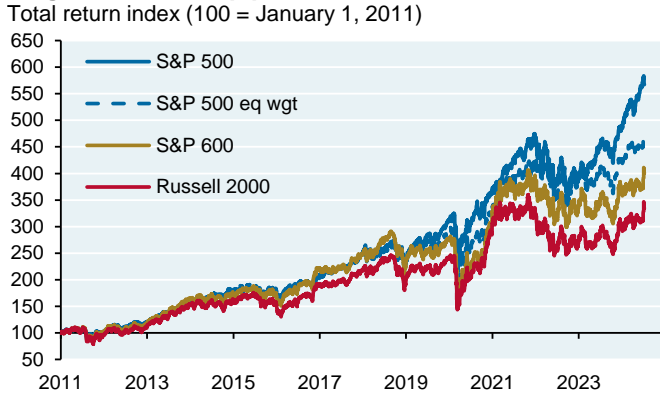


Source: Bloomberg, JPMAM, July 7, 2024

<sup>2</sup> ROIC = net operating profit after taxes divided by equity and interest-bearing debt (efficiency of debt and equity to generate profits); EBITDA = earnings before interest, taxes, depreciation and amortization

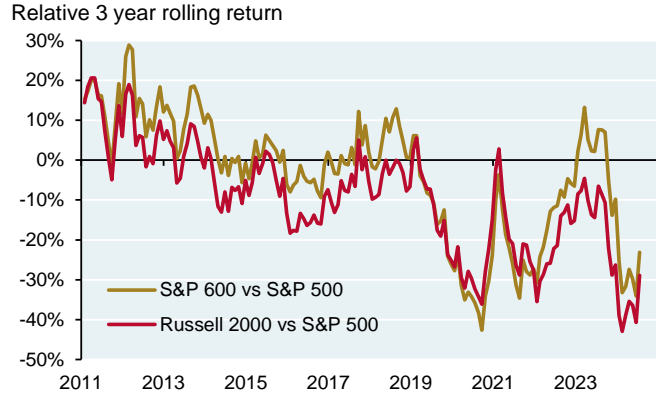
The next two charts illustrate small cap underperformance on a cumulative and rolling basis since Dec 2010. We use the Russell 2000 and the S&P 600 as US small cap proxies, which we explain next.

**Large and small cap performance since 2011**



Source: Bloomberg, JPMAM, July 21, 2024

**Rolling small cap performance vs large cap**



Source: Bloomberg, JPMAM, July 19, 2024

**[2] Small cap indexes: S&P 600 vs Russell 2000**

Small cap stocks are a small part of US market capitalization. Even at their peak, small caps stocks represented only 4.5% of the S&P 1500; currently, they're just 2.5%. The S&P 600 and Russell 2000 are the most commonly used US small cap benchmarks.

The S&P 600 is rebalanced quarterly and is a higher quality index. To be added, a company's most recent earnings and its trailing four quarters of earnings must be positive at time of inclusion, and the stock must meet certain turnover criteria. The Russell 2000 includes small-cap stocks based solely on market cap (no earnings or turnover criteria) and is rebalanced annually.

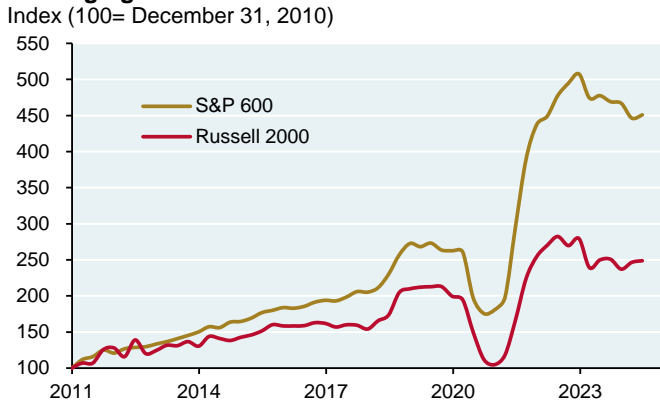
Key differences:

- Share of index with negative net income over the last 12 months: S&P 600 23%, Russell 2000 42%
- Median market cap: S&P 600 \$1.8 bn, Russell 2000 \$925 mm
- S&P 600 trades at cheaper valuations than the Russell 2000 (P/Book, EV/EBITDA, P/CF, P/E)
- S&P 600 stocks have generated faster earnings growth than the Russell 2000 (see below)

Similarities:

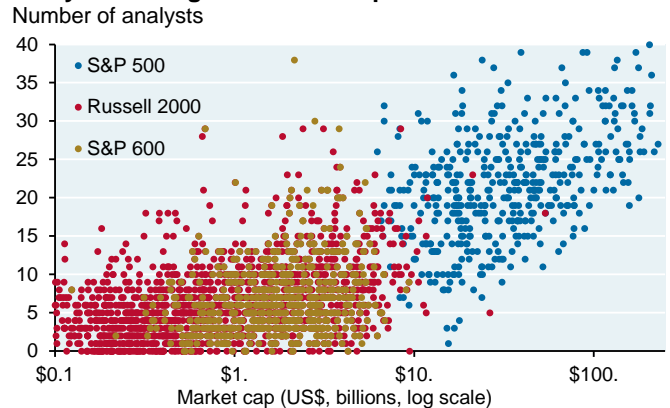
- Share of index constituents with > 100% annual turnover since 2002: S&P 600 70%, Russell 2000 67%
- Peak 50-day annualized index volatility during COVID recession: S&P 600 84%, Russell 2000 84%
- Similarly low levels of analyst coverage relative to large cap (see second chart below)

**Earnings growth**



Source: Bloomberg, JPMAM, Q2 2024

**Analyst coverage vs market capitalization**

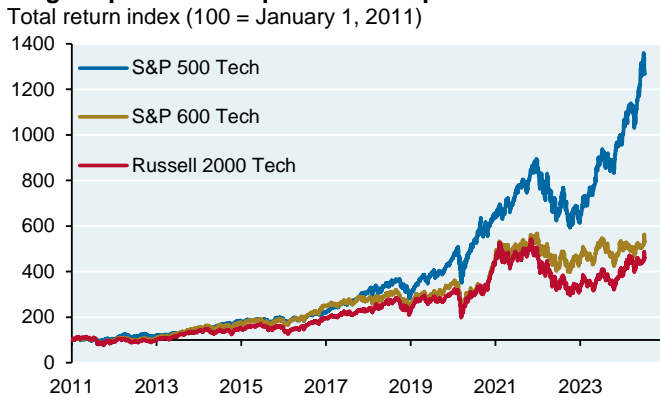


Source: Bloomberg, JPMAM, June 18, 2024

**[3] Zeroing in on root causes: the performance gap between large cap and small cap US tech stocks**

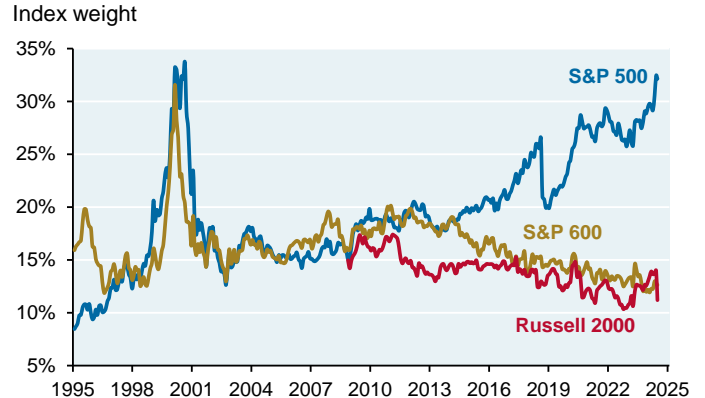
Small cap investors can blame much of their underperformance on small cap tech stocks which badly lagged large cap counterparts. Large cap tech stocks have tripled the performance of small cap tech since Dec 2010, with most of that outperformance taking place since 2019. Another way to visualize this: the declining index weight of small cap tech vs rising weights for large cap tech.

**Large cap vs small cap tech sector performance**



Source: Bloomberg, JPMAM, July 21, 2024

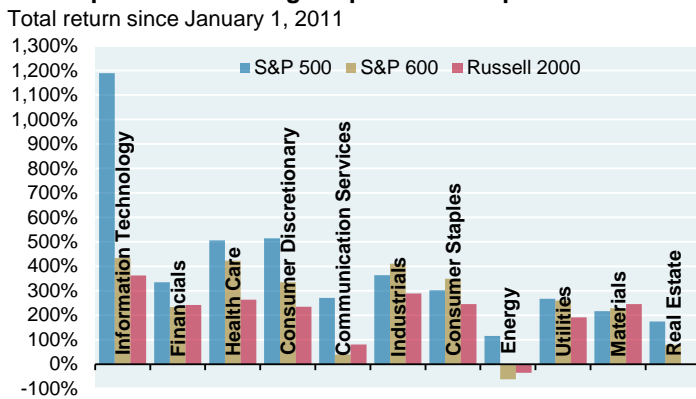
**Large cap vs small cap tech sector weights**



Source: Bloomberg, JPMAM, July 22, 2024

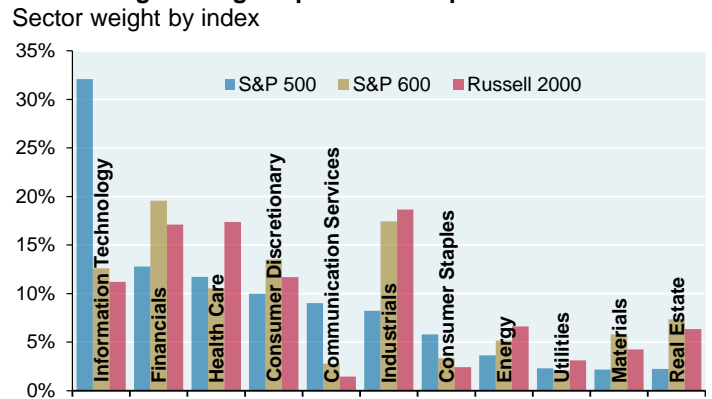
**Small cap sector underperformance does not stop at tech.** Since Dec 2010, large cap also outperformed small cap in financials, healthcare, consumer discretionary, communication services and energy. In fact, **no small cap sector meaningfully outperformed large cap since 2010**, particularly when looking at the Russell 2000 index. The next two charts show performance by sector since Dec 2010 and current sector weights.

**Sector performance: large cap vs small cap**



Source: Bloomberg, JPMAM, July 22, 2024

**Sector weights: large cap vs small cap**



Source: Bloomberg, JPMAM, July 22, 2024

**Some observers believe that underperformance of US small cap vs large cap is due to companies staying private for longer periods of time, after which they go public as mid or large companies instead of small cap.** We find some evidence for this line of reasoning as it relates to tech stocks. Median time-to-IPO for tech stocks rose from ~8 years before 2009 to ~12 years in 2021, after which IPO activity declined sharply in 2022/2023. Furthermore, the share of tech IPOs that fell into the small/micro universe were ~70% until 2017, after which they declined to ~30% [see charts on page 10]. However, while this took place in the tech sector, time-to-IPO and small cap share of IPOs were roughly unchanged when looking at all IPOs.

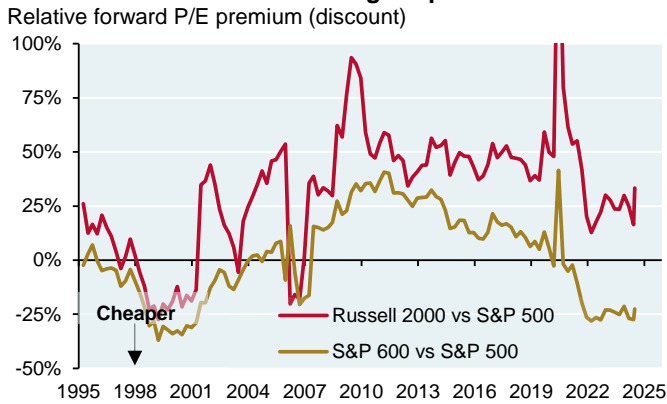
**[4] How cheap is US small cap now? Very, using three different measures**

Answering this question involves competing sources of data and approaches since there’s no one “right” answer. All three approaches discussed below indicate that small cap is at the very cheap end of its valuation range over the last 20 years. For investors that have avoided US small cap entirely, this might be an interesting entry point.

*Method 1: P/E ratio comparisons using Bloomberg and Empirical Research data*

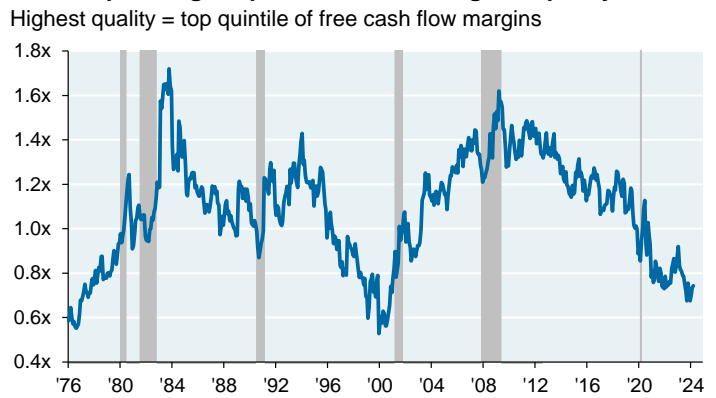
The next chart shows forward P/E ratios for small cap vs large cap using Bloomberg data. We’re puzzled since in some periods in the early 2000’s, Bloomberg shows negative earnings for the Russell 2000 Index and yet still provides a P/E ratio greater than zero, which does not make sense. Bloomberg is unwilling/unable to explain this, so we have to accept this anomaly when using their data. Separately, Empirical Research computed the relative P/E ratios of the highest quality stocks in small and large cap markets since the 1970’s, also finding a P/E discount for small cap that is close to the largest on record.

**Relative valuation: small vs large cap forward P/E ratio**



Source: Bloomberg, JPMAM, July 22, 2024

**Small cap vs large cap forward P/E for highest quality stocks**



Source: Empirical Research, June 2024

*Method 2: earnings yield comparisons from JP Morgan’s Structured Equity Group*

Earnings yield is a simple concept: it’s the inverse of a P/E ratio. The higher the earnings yield, the cheaper the stock or index. In a relative P/E chart, a discount indicates cheapness while in a relative earnings yield chart, a premium indicates cheapness. JP Morgan’s Structured Equity Group get their data from Compustat (trailing earnings) and Factset (forward earnings estimates). They “winsorize” the data (sorry) to remove outliers. As a result, their earnings yield for a small cap index will not simply be the inverse of the Bloomberg P/E ratio.

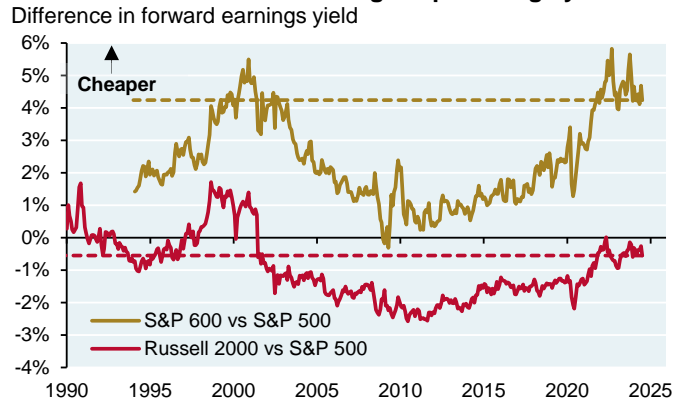
As shown below, the group’s earnings yield for small cap is close to its cheapest levels in 20 years as well, although you’ll see that small cap was even cheaper on this basis at several junctures over the last 2-3 years.

**Relative valuation: small vs large cap earnings yield**



Source: Compustat, JP Morgan Structured Equities Group, July 2024

**Relative valuation: small vs large cap earnings yield**



Source: Compustat, JP Morgan Structured Equities Group, July 2024



**Method 3: multiple valuation indicators**

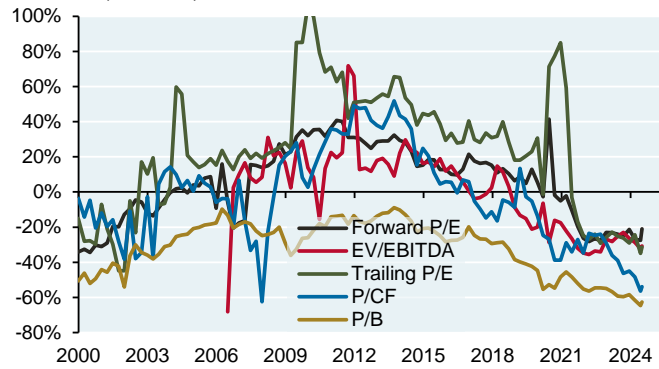
Other relative valuation approaches involve the use of multiple signals and not just price to earnings. The chart below on the left is one example, showing different valuation metrics for the S&P 600 vs the S&P 500. The signal is the same: small cap is cheap vs large cap relative to its history.

**[5] While US small cap lagged US large cap, it outperformed vs the rest of the world**

While US small cap has been disappointing vs US large cap, **it still clobbered investing outside the US**. The chart on the right compares a blend of the S&P 600 and Russell 2000 to Japan, Europe and Emerging Markets since Dec 2010. Of the three underperforming asset class categories (small cap, value and non-US), non-US stocks have experienced the worst relative performance over this time period.

**Small cap valuation measures**

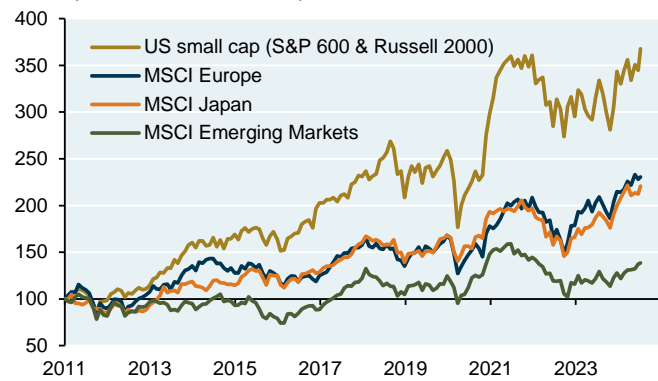
Premium (discount) of S&P 600 vs S&P 500



Source: Bloomberg, JPMAM, July 22, 2024

**US small cap performance vs international indices**

Index (100 = December 2010), US\$



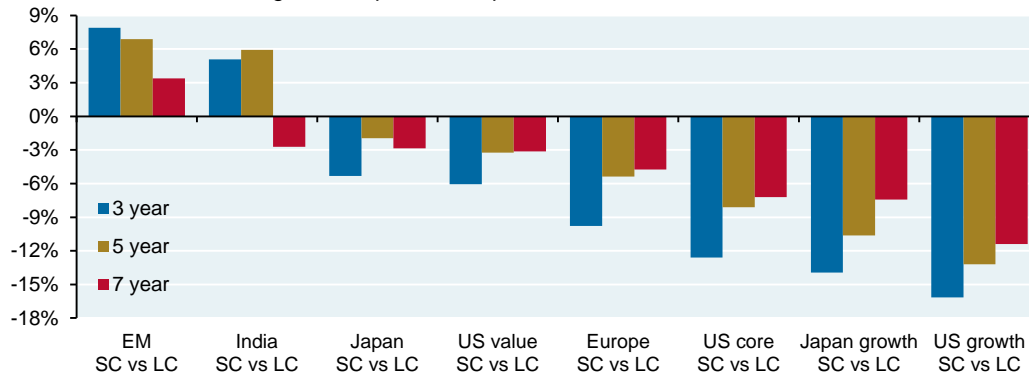
Source: Bloomberg, JPMAM, July 19, 2024

**[6] Recent small cap underperformance vs large cap mostly a developed market phenomenon**

Small cap underperformance vs large cap has been pervasive in the developed world over the last decade, but not in emerging markets. Comparing small cap to large cap performance by region requires choices regarding which indexes to use. See below for our index selections by region<sup>3</sup>.

**Small cap vs large cap returns by geography**

Percent, annualized trailing small cap out/underperformance



Source: Bloomberg, JPMAM, June 30, 2024

<sup>3</sup> **Small cap and large cap indexes used in the chart:**

- US core: Russell 2000 vs S&P 500
- US growth: Russell 2000 Growth vs Russell 1000 Growth
- US value: Russell 2000 Value vs Russell 1000 Value
- Europe: MSCI Europe Small Cap vs MSCI Europe
- Japan core: Russell/Nomura Small Cap vs MSCI Japan
- Japan growth: Russell/Nomura Small Cap Growth vs MSCI Japan
- Emerging markets: MSCI EM Small Cap vs MSCI Emerging Markets
- India: NSE Nifty Small Cap 250 vs MSCI India

**[7] Can manager outperformance make up for small cap underperformance vs large cap?**

Have small cap managers generated enough outperformance vs benchmarks to mitigate small cap underperformance vs large cap? The answers:

- For US small cap core and growth, median manager alpha was typically positive but only offset 30% or less of the associated small cap underperformance vs large cap. The presence of persistent median manager alpha in small cap may reflect a more inefficient market: ~80% of the small and mid-cap universe is either very thinly covered by research analysts or not covered at all. It may also reflect our use of the Russell 2000 benchmark while some managers construct higher quality portfolios that look more like the S&P 600
- For US small cap value, median manager alpha closed a lot more of the gap while top quartile managers closed practically all of it
- For Europe and Japan small cap core, median manager alpha was either negative or only slightly positive, offsetting no more than 15%-20% of the gap
- For India, small cap generally outperformed large cap, *and* median manager alpha was also positive; the only drawback is the limited number of small cap managers with sufficiently long performance history; note the outsized impact of our ETF adjustment on these results, explained below
- In Emerging Markets, median manager alpha was negative but there was a silver lining: EM small cap substantially outperformed EM large cap

**Adjusted for ETF fees and tracking error**

Market	3 year					5 year					7 year				
	SC-LC	# mgr	25th	50th	75th	SC-LC	# mgr	25th	50th	75th	SC-LC	# mgr	25th	50th	75th
US small cap blend	-12.6%	233	5.9%	<b>3.5%</b>	2.0%	-8.1%	218	2.9%	<b>1.3%</b>	0.2%	-7.4%	204	1.8%	<b>0.9%</b>	0.0%
US small cap growth	-16.2%	173	4.3%	<b>1.4%</b>	-2.9%	-13.2%	163	3.4%	<b>1.0%</b>	-0.2%	-11.4%	156	3.5%	<b>2.0%</b>	0.5%
US small cap value	-6.1%	154	5.5%	<b>3.6%</b>	1.9%	-1.9%	141	3.9%	<b>2.0%</b>	0.6%	-2.7%	134	2.3%	<b>1.4%</b>	0.3%
Europe small cap	-9.8%	137	0.3%	<b>-2.9%</b>	-5.7%	-3.2%	126	1.5%	<b>0.0%</b>	-2.1%	-2.9%	110	0.9%	<b>-0.2%</b>	-2.4%
Japan small cap	-5.3%	38	3.0%	<b>-4.4%</b>	-8.9%	-5.4%	34	2.3%	<b>0.0%</b>	-3.5%	-4.7%	28	2.9%	<b>0.8%</b>	-0.9%
Japan small cap growth	-13.9%	90	3.5%	<b>-0.6%</b>	-3.6%	-10.6%	84	5.0%	<b>2.2%</b>	0.7%	-7.2%	72	3.6%	<b>2.0%</b>	0.6%
India small cap	5.1%	20	6.1%	<b>5.0%</b>	2.2%	5.9%	18	7.8%	<b>5.1%</b>	4.0%	-3.1%	13	8.0%	<b>6.1%</b>	4.4%
Emerging Markets small cap	7.9%	37	0.6%	<b>-1.1%</b>	-4.0%	6.9%	38	-0.1%	<b>-1.7%</b>	-4.1%	3.4%	30	-0.2%	<b>-0.7%</b>	-1.9%

Source: Morningstar, JP Morgan Equity Research, JPMAM, June 2024

**Working with small cap manager data**

*Data source:* Morningstar, all active managers designated in one of several small cap categories. We excluded any managers with more than 35% in large cap stocks

*Multiple share classes:* most small cap managers have multiple share classes, some as many as 25. In our analysis, we chose the share class with the lowest fees (institutional share class). Using higher fee share classes would have impacted the results; in most categories, the difference between the highest and lowest fee share classes was 75-100 basis points

*Manager alpha:* Most managers have a stated benchmark. However, we use a single benchmark for each category as shown in footnote 2 irrespective of stated benchmarks. There are often multiple options to pick from; the higher the performance of a given benchmark, the lower the manager’s imputed alpha would be. For example, the trailing 5 year annualized performance of the India NSE Nifty Small Cap Index was 20.7%, while the same figure for the S&P India BSE Small Cap Index was 22.7%. For developed markets, the difference between different index options has less of an impact.

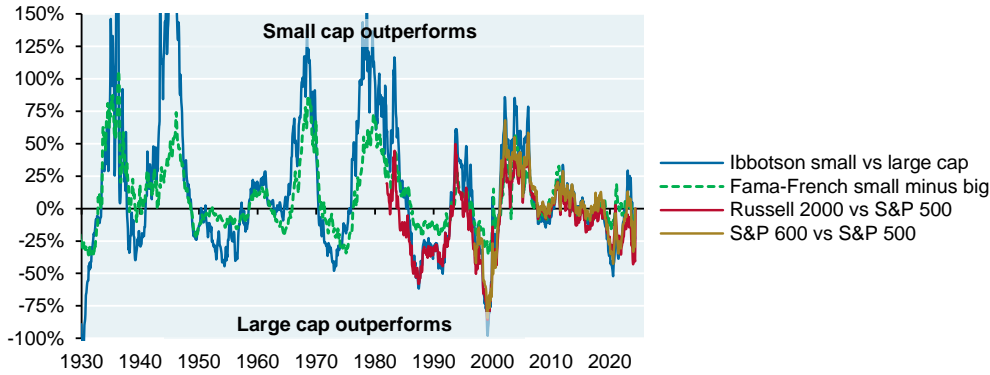
*ETF adjustments:* Benchmarks are not investible, which in essence creates an artificially high hurdle for managers. In the manager alpha analyses that I have worked on, I generally make an adjustment to reflect the cost and tracking error of investible ETFs that correspond to each benchmark. That is a fairer way to compute the opportunity cost for an investor allocating to a manager instead of a passive investible benchmark. These adjustments are negligible in the case of US small cap, and larger in the case of India. An example: over the trailing 5-year period, the India Small Cap Index returned 132% while the comparable investible ETF returned 97%, resulting in an annualized adjustment of 3.8%.

**[8] Wrapping up: small cap data sources and small cap performance around recessions**

There are several sources for historical performance of US small cap vs large cap stocks. For the chart on the first page with data back to the 1930’s, we use Ibbotson. As an alternative, we could have used Fama-French data shown in green. The results would usually have been similar with the exception of a period in the late 1940’s. Russell 2000 Index data begins in the late 1970’s, while S&P 600 data begins in the early 1990’s.

**Small cap vs large cap index returns**

3 year rolling out (under) performance of small cap vs large cap

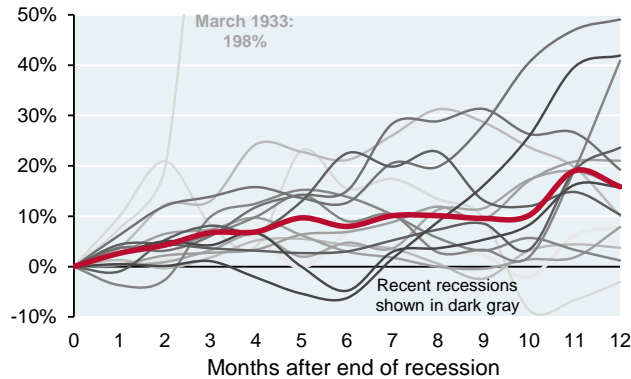


Source: SBBI Ibbotson, Fama-French Data, Bloomberg, JPMAM, July 2024

*Small cap: good early cycle asset class, bad late cycle asset class.* There’s a clear historical signal showing that small cap tends to outperform large cap following recessions (first chart). Of the 16 recessions shown, small cap outperformed in all but one. This makes sense given the much higher cyclical share of the S&P 600 (55%) compared to the S&P 500 (28%). Prior to the onset of recessions, the relative performance data is decidedly mixed: there’s a wide dispersion around the median, with no clear directional signal.

**Small cap premium following end of recession**

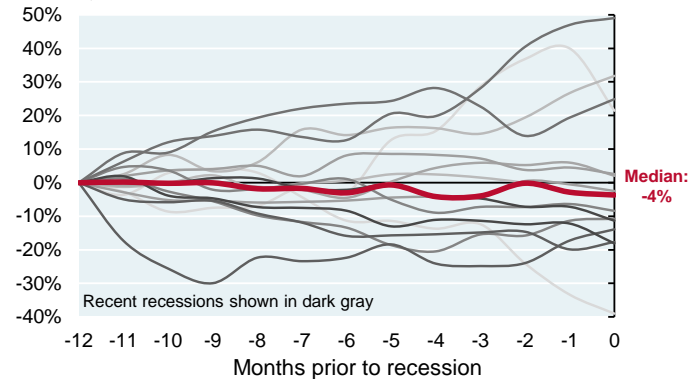
Percent, cumulative



Source: SBBI Ibbotson, JPMAM, April 2024

**Small cap premium prior to onset of recession**

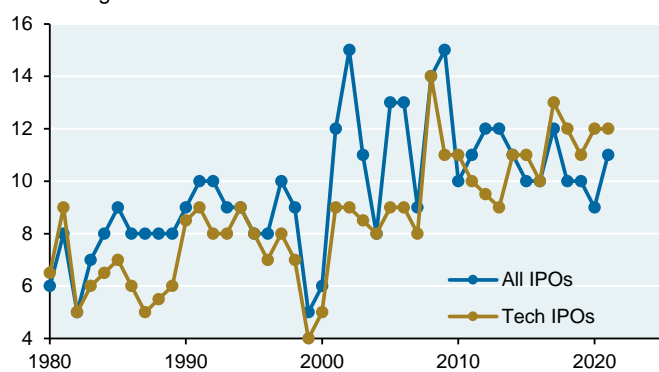
Percent, cumulative



Source: SBBI Ibbotson, JPMAM, April 2024

**Age of companies going public**

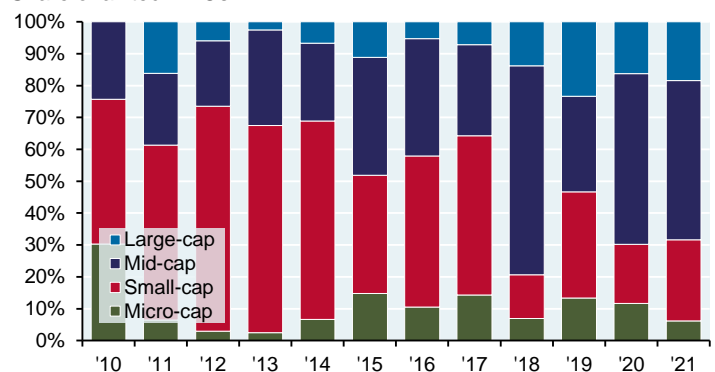
Median age



Source: Jay Ritter, University of Florida, JPMAM, 2023

**Tech IPOs by market cap at time of issuance**

Share of all tech IPOs



Source: Bloomberg, FactSet, JPMAM, 2023

**IMPORTANT INFORMATION**

This material is for information purposes only. The views, opinions, estimates and strategies expressed herein constitutes Michael Cembalest's judgment based on current market conditions and are subject to change without notice, and may differ from those expressed by other areas of JPMorgan Chase & Co. ("JPM"). **This information in no way constitutes J.P. Morgan Research and should not be treated as such.** Any companies referenced are shown for illustrative purposes only, and are not intended as a recommendation or endorsement by J.P. Morgan in this context.

**GENERAL RISKS & CONSIDERATIONS** Any views, strategies or products discussed in this material may not be appropriate for all individuals and are subject to risks. Investors may get back less than they invested, and **past performance is not a reliable indicator of future results.** Asset allocation/diversification does not guarantee a profit or protect against loss. Nothing in this material should be relied upon in isolation for the purpose of making an investment decision.

**NON-RELIANCE** Certain information contained in this material is believed to be reliable; however, JPM does not represent or warrant its accuracy, reliability or completeness, or accept any liability for any loss or damage (whether direct or indirect) arising out of the use of all or any part of this material. No representation or warranty should be made with regard to any computations, graphs, tables, diagrams or commentary in this material, which are provided for illustration/ reference purposes only. Any projected results and risks are based solely on hypothetical examples cited, and actual results and risks will vary depending on specific circumstances. Forward-looking statements should not be considered as guarantees or predictions of future events. Nothing in this document shall be construed as giving rise to any duty of care owed to, or advisory relationship with, you or any third party. Nothing in this document shall be regarded as an offer, solicitation, recommendation or advice (whether financial, accounting, legal, tax or other) given by J.P. Morgan and/or its officers or employees; J.P. Morgan and its affiliates and employees do not provide tax, legal or accounting advice. You should consult your own tax, legal and accounting advisors before engaging in any financial transactions.

**For J.P. Morgan Asset Management Clients:**

J.P. Morgan Asset Management is the brand for the asset management business of JPMorgan Chase & Co. and its affiliates worldwide.

To the extent permitted by applicable law, we may record telephone calls and monitor electronic communications to comply with our legal and regulatory obligations and internal policies. Personal data will be collected, stored and processed by J.P. Morgan Asset Management in accordance with our privacy policies at <https://am.jpmorgan.com/global/privacy>.

**ACCESSIBILITY**

For U.S. only: If you are a person with a disability and need additional support in viewing the material, please call us at 1-800-343-1113 for assistance.

This communication is issued by the following entities: In the United States, by J.P. Morgan Investment Management Inc. or J.P. Morgan Alternative Asset Management, Inc., both regulated by the Securities and Exchange Commission; in Latin America, for intended recipients' use only, by local J.P. Morgan entities, as the case may be.; in Canada, for institutional clients' use only, by JPMorgan Asset Management (Canada) Inc., which is a registered Portfolio Manager and Exempt Market Dealer in all Canadian provinces and territories except the Yukon and is also registered as an Investment Fund Manager in British Columbia, Ontario, Quebec and Newfoundland and Labrador. In the United Kingdom, by JPMorgan Asset Management (UK) Limited, which is authorized and regulated by the Financial Conduct Authority; in other European jurisdictions, by JPMorgan Asset Management (Europe) S.à r.l. In Asia Pacific ("APAC"), by the following issuing entities and in the respective jurisdictions in which they are primarily regulated: JPMorgan Asset Management (Asia Pacific) Limited, or JPMorgan Funds (Asia) Limited, or JPMorgan Asset Management Real Assets (Asia) Limited, each of which is regulated by the Securities and Futures Commission of Hong Kong; JPMorgan Asset Management (Singapore) Limited (Co. Reg. No. 197601586K), which this advertisement or publication has not been reviewed by the Monetary Authority of Singapore; JPMorgan Asset Management (Taiwan) Limited; JPMorgan Asset Management (Japan) Limited, which is a member of the Investment Trusts Association, Japan, the Japan Investment Advisers Association, Type II Financial Instruments Firms Association and the Japan Securities Dealers Association and is regulated by the Financial Services Agency (registration number "Kanto Local Finance Bureau (Financial Instruments Firm) No. 330"); in Australia, to wholesale clients only as defined in section 761A and 761G of the Corporations Act 2001 (Commonwealth), by JPMorgan Asset Management (Australia) Limited (ABN 55143832080) (AFSL 376919). For all other markets in APAC, to intended recipients only.

**For J.P. Morgan Private Bank Clients:****ACCESSIBILITY**

J.P. Morgan is committed to making our products and services accessible to meet the financial services needs of all our clients. Please direct any accessibility issues to the Private Bank Client Service Center at 1-866-265-1727

**LEGAL ENTITY, BRAND & REGULATORY INFORMATION**

In the **United States**, **JPMorgan Chase Bank, N.A.** and its affiliates (collectively "JPMCB") offer investment products, which may include bank managed investment accounts and custody, as part of its trust and fiduciary services. Other investment products and services, such as brokerage and advisory accounts, are offered through **J.P. Morgan Securities LLC ("JPMS")**, a member of [FINRA](#) and [SIPC](#). JPMCB and JPMS are affiliated companies under the common control of JPM.

In **Germany**, this material is issued by **J.P. Morgan SE**, with its registered office at Taunustor 1 (TaunusTurm), 60310 Frankfurt am Main, Germany, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB). In **Luxembourg**, this material is issued by **J.P. Morgan SE – Luxembourg Branch**, with registered office at European Bank and Business Centre, 6 route de Treves, L-2633, Senningerberg, Luxembourg, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Luxembourg Branch is also supervised by the Commission de Surveillance du Secteur Financier (CSSF); registered under R.C.S Luxembourg B255938. In the **United Kingdom**, this material is issued by **J.P. Morgan SE – London Branch**, registered office at 25 Bank Street, Canary Wharf, London E14 5JP, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – London Branch is also supervised by the Financial Conduct Authority and Prudential Regulation Authority. In **Spain**, this material is distributed by **J.P. Morgan SE, Sucursal en España**, with registered office at Paseo de la Castellana, 31, 28046 Madrid, Spain, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE, Sucursal en España is also supervised by the Spanish Securities Market Commission (CNMV); registered with Bank of Spain as a branch of J.P. Morgan SE under code 1567. In **Italy**, this material is distributed by **J.P. Morgan SE – Milan Branch**, with its

registered office at Via Cordusio, n.3, Milan 20123, Italy, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Milan Branch is also supervised by Bank of Italy and the Commissione Nazionale per le Società e la Borsa (CONSOB); registered with Bank of Italy as a branch of J.P. Morgan SE under code 8076; Milan Chamber of Commerce Registered Number: REA MI 2536325. In the **Netherlands**, this material is distributed by **J.P. Morgan SE – Amsterdam Branch**, with registered office at World Trade Centre, Tower B, Strawinskylaan 1135, 1077 XX, Amsterdam, The Netherlands, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Amsterdam Branch is also supervised by De Nederlandsche Bank (DNB) and the Autoriteit Financiële Markten (AFM) in the Netherlands. Registered with the Kamer van Koophandel as a branch of J.P. Morgan SE under registration number 72610220. In **Denmark**, this material is distributed by **J.P. Morgan SE – Copenhagen Branch, filial af J.P. Morgan SE, Tyskland**, with registered office at Kalvebod Brygge 39-41, 1560 København V, Denmark, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Copenhagen Branch, filial af J.P. Morgan SE, Tyskland is also supervised by Finanstilsynet (Danish FSA) and is registered with Finanstilsynet as a branch of J.P. Morgan SE under code 29010. In **Sweden**, this material is distributed by **J.P. Morgan SE – Stockholm Bankfilial**, with registered office at Hamngatan 15, Stockholm, 11147, Sweden, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Stockholm Bankfilial is also supervised by Finansinspektionen (Swedish FSA); registered with Finansinspektionen as a branch of J.P. Morgan SE. In **Belgium**, this material is distributed by **J.P. Morgan SE – Brussels Branch** with registered office at 35 Boulevard du Régent, 1000, Brussels, Belgium, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE Brussels Branch is also supervised by the National Bank of Belgium (NBB) and the Financial Services and Markets Authority (FSMA) in Belgium; registered with the NBB under registration number 0715.622.844. In **Greece**, this material is distributed by **J.P. Morgan SE – Athens Branch**, with its registered office at 3 Haritos Street, Athens, 10675, Greece, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB); J.P. Morgan SE – Athens Branch is also supervised by Bank of Greece; registered with Bank of Greece as a branch of J.P. Morgan SE under code 124; Athens Chamber of Commerce Registered Number 158683760001; VAT Number 99676577. In **France**, this material is distributed by **J.P. Morgan SE – Paris Branch**, with its registered office at 14, Place Vendôme 75001 Paris, France, authorized by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB) under code 842 422 972; J.P. Morgan SE – Paris Branch is also supervised by the French banking authorities the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and the Autorité des Marchés Financiers (AMF). In **Switzerland**, this material is distributed by **J.P. Morgan (Suisse) SA**, with registered address at rue du Rhône, 35, 1204, Geneva, Switzerland, which is authorised and supervised by the Swiss Financial Market Supervisory Authority (FINMA) as a bank and a securities dealer in Switzerland.

In **Hong Kong**, this material is distributed by **JPMCB, Hong Kong branch**. JPMCB, Hong Kong branch is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission of Hong Kong. In Hong Ko.ng, we will cease to use your personal data for our marketing purposes without charge if you so request. In **Singapore**, this material is distributed by **JPMCB, Singapore branch**. JPMCB, Singapore branch is regulated by the Monetary Authority of Singapore. Dealing and advisory services and discretionary investment management services are provided to you by JPMCB, Hong Kong/Singapore branch (as notified to you). Banking and custody services are provided to you by JPMCB Singapore Branch. The contents of this document have not been reviewed by any regulatory authority in Hong Kong, Singapore or any other jurisdictions. You are advised to exercise caution in relation to this document. If you are in any doubt about any of the contents of this document, you should obtain independent professional advice. For materials which constitute product advertisement under the Securities and Futures Act and the Financial Advisers Act, this advertisement has not been reviewed by the Monetary Authority of Singapore. JPMorgan Chase Bank, N.A., a national banking association chartered under the laws of the United States, and as a body corporate, its shareholder's liability is limited.

With respect to countries in **Latin America**, the distribution of this material may be restricted in certain jurisdictions.

*Issued in **Australia** by JPMorgan Chase Bank, N.A. (ABN 43 074 112 011/AFS Licence No: 238367) and J.P. Morgan Securities LLC (ARBN 109293610).*

References to "J.P. Morgan" are to JPM, its subsidiaries and affiliates worldwide. "J.P. Morgan Private Bank" is the brand name for the private banking business conducted by JPM. This material is intended for your personal use and should not be circulated to or used by any other person, or duplicated for non-personal use, without our permission. If you have any questions or no longer wish to receive these communications, please contact your J.P. Morgan team.

J.P.Morgan