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TRIVARIATE RESEARCH

HOW TO FAKE A STOCK

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RESEARCH SUMMARY AND INVESTMENT CONCLUSIONS

Background: We have been writing for several quarters about company-specific risk (CSR) and replicability – two concepts we use to assess how much of a stock's returns can be explained by macro factors, and how many stocks trade highly correlated to each other over the last year. In addition to using these concepts to guide CIOs on resource allocation, there can also be very immediate and practical implications for replication or hedging. For instance, investors could have a large position in an individual stock, and they may want to hedge out as much "macro" exposure as they can to isolate the expected alpha from their high conviction holding. With that in mind, we studied four different approaches to replication:

1) Beta: We estimate each stock's market beta over the trailing 252 days and evaluate the explanatory power for stock returns going forward.
2) Company-specific risk (CSR): We regress a stock's sensitivity to 7 factors (market beta, quality minus junk, growth minus value, 2 size factors (mega / large vs. mid, mid vs. small / micro), liquidity, and momentum) over the trailing 252 days.
3) Top 30 Equal-Weight: We create an equal-weight basket of the top 30 stocks by 252-day return correlation to the target stock. We implemented several practical considerations, i.e., liquidity, price, etc.
4) Top 30 Regression-Based: We use a partial-least squares (PLS) regression and take the first component to estimate the basket weights of the top 30 stocks by 252-day return correlation to the target stock.

Results: We can use a 30-stock basket to replicate a stock's performance far better on average than using Beta or our CSR framework. On average, there appears to be little additional benefit in hedging by using our regression-based approach, but it is slightly better and not excessively complicated to implement should an investor be so inclined. <u>Recently, no matter the metric, the US equity market has become far more macro, which is an obvious response to the tariffs.</u> Given the huge move in the market fueled by the specter of tariff relief, 56% of stocks have been highly replicable as of the end of April, up sharply from a more normal 21% at the end of February.

INVESTMENT CONCLUSIONS

Investors should be more concerned with their replication risk than their beta exposure: Replication basket models explain risk out-of-sample far better than traditional factor models. The traditional factor model can explain risk well "ex-post," but has not outperformed the simple 252-daily beta out-of-sample because a stock's factor sensitivities can change. Both our PLS regression-based, and an equally-weighted basket of the top 30 stocks by correlation to the target security replicate well for some stocks.

Methodology: Using the PLS regression-based 30 stock basket, we categorized each stock into one of three buckets based on our ability to replicate the variance of their returns: "Weak" replicability for stocks with a 2-year historical average r-squared below 0.3, "Moderate" for r-squared between 0.3 and 0.6, and "Strong" for r-squared above 0.6.

Sector / cohort results: Utilities, Real Estate, Energy, and Financials have the highest concentration of stocks with "Strong" replicability. Staples, Comm. Services, and Health Care have zero stocks with "Strong" replicability and the highest percentage of stocks with "Weak" replicability. A long-only manager should focus their time on areas where stock replication is difficult or impossible as positions in these names that turn out to be "right" will allow for separating performance from the index. Unsurprisingly, high-quality stocks and growth stocks are on average harder to replicate than value or lower quality stocks.

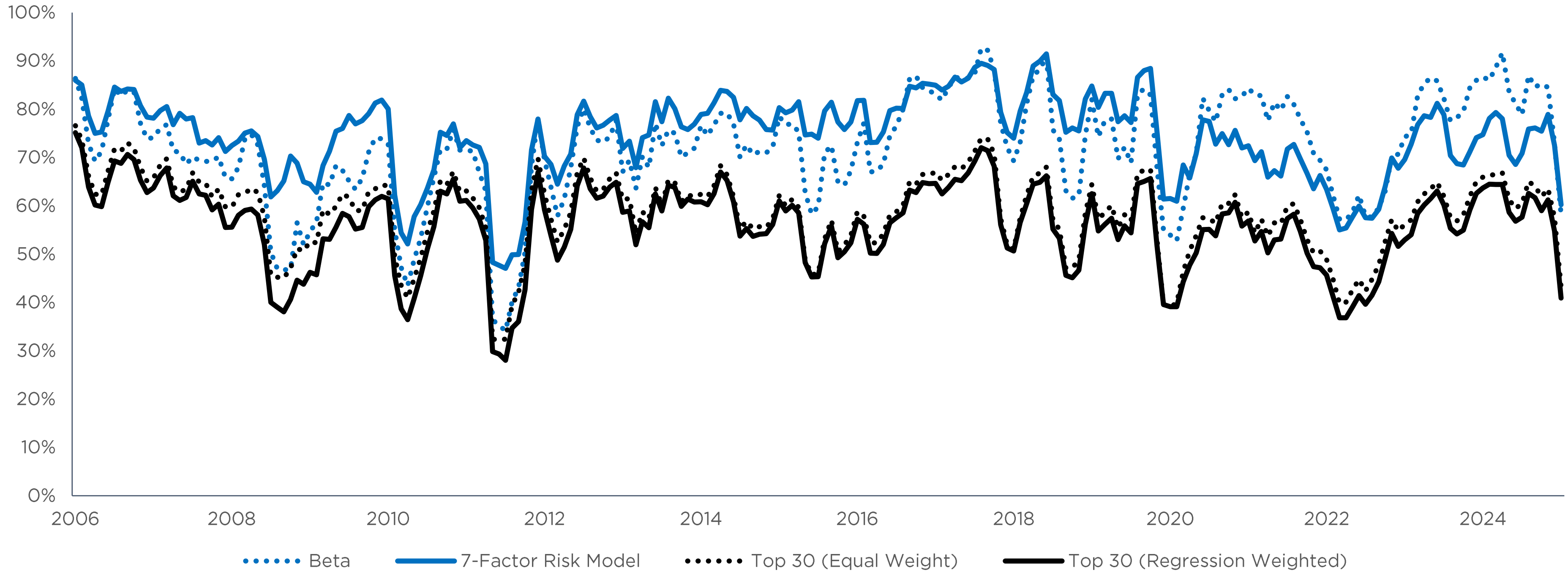
Industry results: Consumer Staples Distribution & Retail, Telecommunication Services, and Healthcare Equipment & Services stocks are on average the hardest to replicate with 30-stock baskets. Banks, Energy, and Semiconductors are the easiest to replicate.

Stock level: We can provide information on every US stock – is it strongly, moderately, or weakly replicable with a 30-stock practical basket. On Slide 10 we show stocks that are easy to replicate, primarily consisting of Banks, Energy, and Homebuilders. On Slide 11 we show stocks that are difficult to replicate – THESE ARE STOCKS WHERE FUNDAMENTAL ANALYSTS SHOULD TRY TO HAVE A VIEW VS. THE BENCHWEIGHT – because if they are ultimately right, they will separate from the index. Example stocks of how the replication works are Lam Research (Ticker: LRCX) on Slide 12, U.S. Bancorp (Ticker: USB) on Slide 13, and Walmart (Ticker: WMT) on Slide 14.

STOCK-BASED REPLICATION BEATS FACTOR-BASED REPLICATION

Unsurprisingly, we can use a 30-stock basket to replicate a stock's performance far better on average than using Beta, or our CSR framework. If you have a stock you want to hedge and can't use options, using a 30-stock replication basket might be a reasonable approach for some stocks. On average, there appears to be little additional benefit in hedging by using our regression-based approach to identifying and setting the weights for a 30-stock replication basket relative to doing a simple equal-weight, but it is slightly better and not excessively complicated to implement should an investor be so inclined. Recently, no matter what the metric, the US equity market has become far more macro, which is an obvious response to the tariffs.

Average Company-Specific Risk for 3-Month Periods Following Replication Basket Creation
Top 1,500 US Equities by Liquidity
Through End-April, 2025

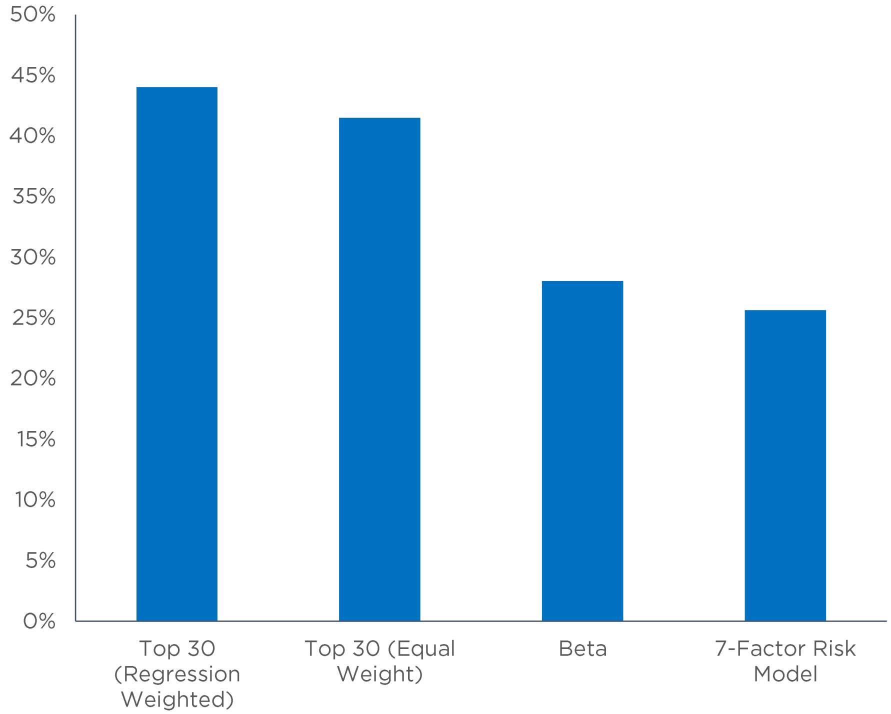


Source: Trivariate Research

REPLICATION RISK MATTERS MORE THAN BETA EXPOSURE

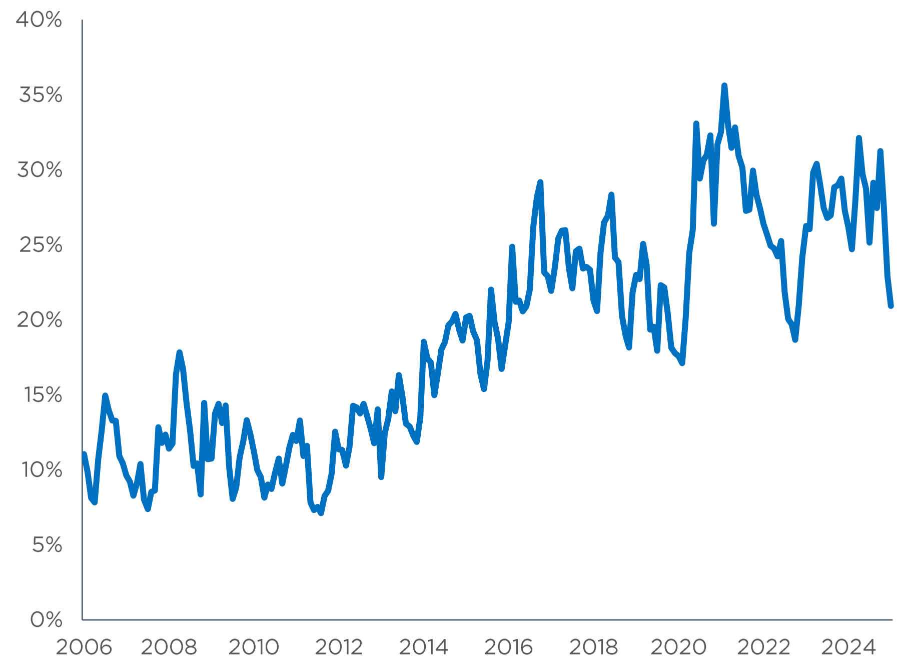
Replication basket models explain risk out-of-sample far better than traditional factor models (left). The traditional factor model can explain risk well "ex-post," but has not outperformed the simple 252-daily beta out-of-sample because a stock's factor sensitivities can change. The regression weights from our practical replication model are close to equal weight, and so an equally-weighted basket of the top 30 stocks by correlation to the target security performs similarly. The variance explained by the replication model vs. beta has increased over time (right). Prior to 2012, the replication model explained ~10% more variance than beta, but over the last five years, the replication model has explained ~20-30% more variance. <u>Investors should be more concerned with their replication risk than their beta exposure.</u>

Average Out-of-Sample R-Squared for Several Risk Models Through End-April, 2025



Source: Trivariate Research

Spread of Replication Model vs. Beta % of Variance Explained (R-Squared) Rolling 3-Month Out-of-Sample Periods Through End-April, 2025

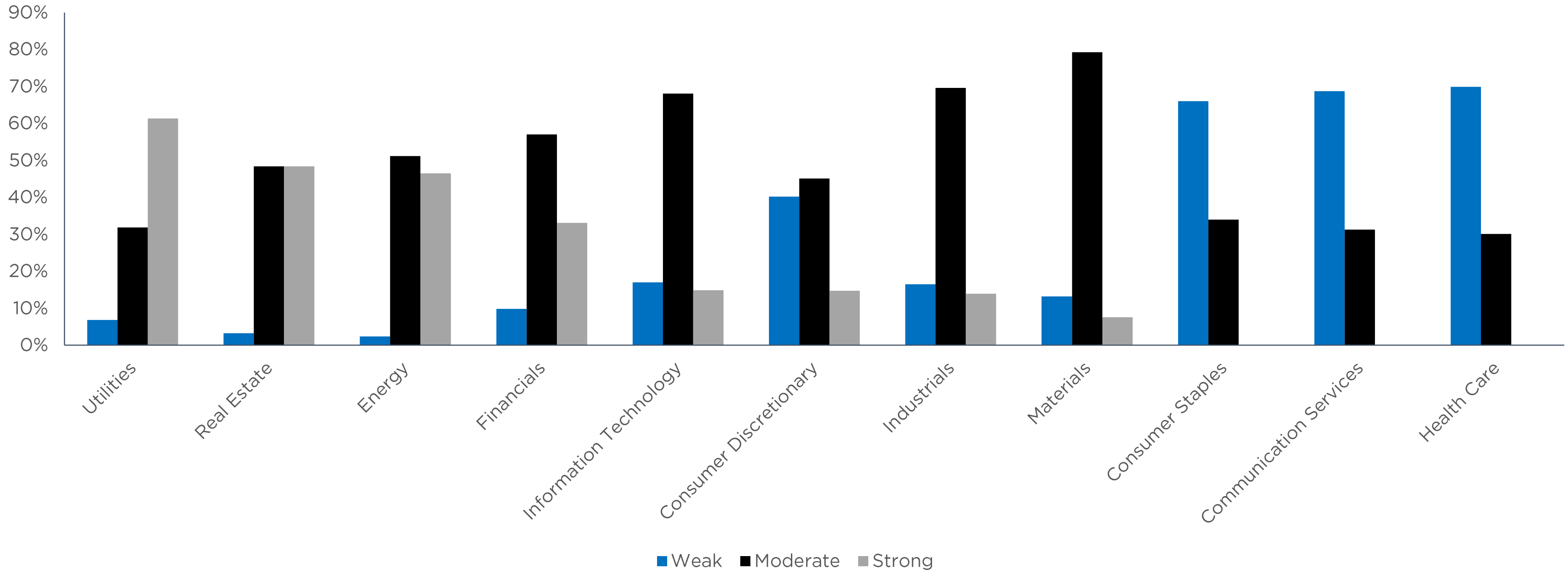


Source: Trivariate Research

UTES, REAL ESTATE, ENERGY, AND FINANCIALS ARE MOST REPLICABLE

Using the PLS regression-based 30 stock basket, we categorized each stock into one of three buckets based on our ability to replicate the variance of their returns: "Weak" replicability for stocks with a 2-year historical average r-squared below 0.3, "Moderate" for r-squared between 0.3 and 0.6, and "Strong" for r-squared above 0.6. Below we show the percentage of stocks in each replicability bucket by sector. Utilities, Real Estate, Energy, and Financials have the highest concentration of stocks with "Strong" replicability. Staples, Comm. Services, and Health Care have zero stocks with "Strong" replicability and the highest percentage of stocks with "Weak" replicability. A long-only manager should focus his or her time on areas where stock replication is difficult or impossible as positions in these names that turn out to be "right" will allow for separating performance from the index.

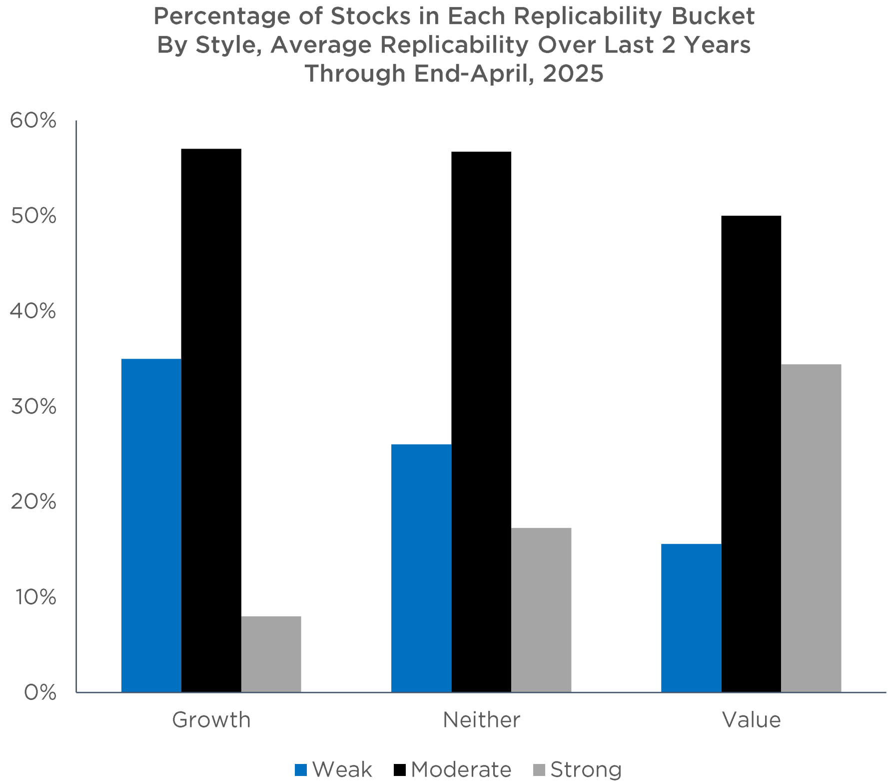
Percentage of Stocks in Each Replicability Bucket
By Sector, Average Replicability Over Last 2 Years
Through End-April, 2025



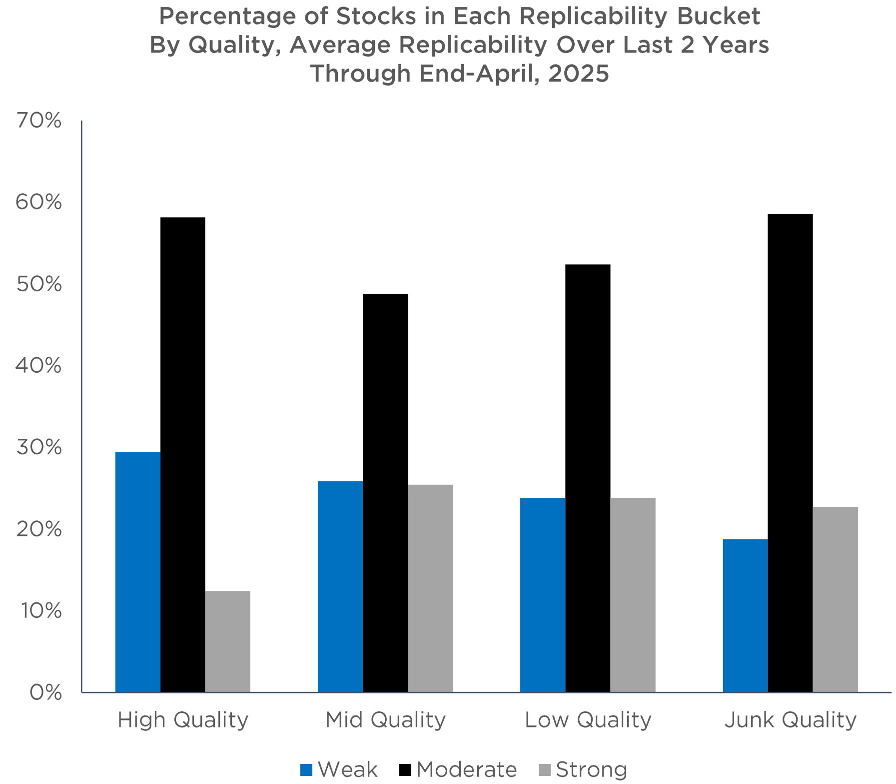
Source: Trivariate Research

GROWTH AND HIGH-QUALITY STOCKS ARE HARDER TO REPLICATE

Based on the sector data, it is not surprising that growth stocks are generally more challenging to replicate than value stocks (left). We can only use 30-stock baskets to strongly replicate about 1 in 12 growth stocks, whereas we can strongly replicate more than 1 out of 3 among the value universe. Replicability by quality bucket doesn't seem to matter much (right), except for on the margin high quality businesses are harder to strongly replicate. This makes sense because something about what makes them high quality is likely not an attribute of a broad range of stocks.



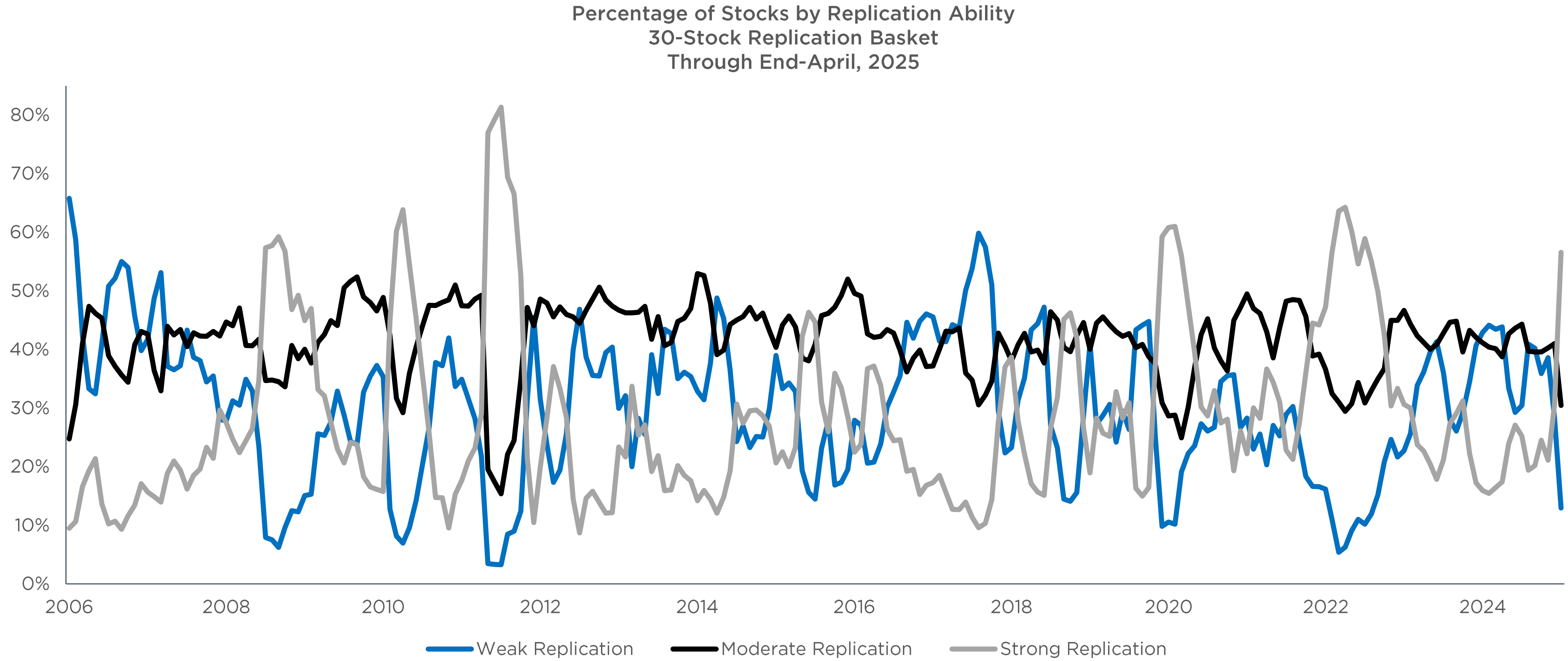
Source: Trivariate Research



Source: Trivariate Research

56% OF STOCKS WERE STRONGLY REPLICABLE OVER LAST 3 MONTHS

Given the huge move in the market fueled by the specter of tariff relief, we have now had more strongly replicable stocks than normal, and the fifth most in 20 years. In fact, 56% of stocks were highly replicable in the three-month period of February to April, up sharply from a more normal 21% for the December to February period.



Source: Trivariate Research

BANKS, ENERGY, AND SEMIS ARE THE EASIEST TO REPLICATE

At the Industry Group level, Consumer Staples Distribution & Retail, Telecommunication Services, and Healthcare Equipment & Services stocks are on average the hardest to replicate with 30-stock baskets.   Banks, Energy, and Semiconductors are the easiest to replicate.

Company-Specific Risk of Stock Replication Model by Industry Group
As of End-April, 2025

Industry Group	Replication Model Last 3 Months Company-Specific Risk	Replication Model Last 3 Months %ile Rank vs. History	7-Factor Model Last 3 Months Company-Specific Risk	Largest 3 Companies
Consumer Staples Distribution & Retail	67%	27%	77%	WMT, COST, KR
Telecommunication Services	66%	19%	76%	TMUS, T, VZ
Health Care Equipment & Services	65%	30%	76%	UNH, ABT, ISRG
Pharmaceuticals, Biotechnology & Life Sciences	59%	17%	73%	LLY, JNJ, ABBV
Food, Beverage & Tobacco	56%	9%	80%	KO, PM, PEP
Real Estate Management & Development	54%	40%	72%	CBRE, CSGP, Z
Media & Entertainment	52%	8%	66%	GOOGL, META, NFLX
Commercial & Professional Services	52%	15%	64%	ADP, WM, CTAS
Household & Personal Products	50%	7%	71%	PG, CL, KVUE
Consumer Discretionary Distribution & Retail	49%	11%	62%	AMZN, HD, TJX
Consumer Services	49%	10%	61%	MCD, BKNG, SBUX
Software & Services	43%	9%	55%	MSFT, ORCL, PLTR
Materials	42%	11%	60%	LIN, SHW, ECL
Utilities	40%	41%	82%	NEE, SO, DUK
Automobiles & Components	39%	9%	57%	TSLA, GM, F
Insurance	37%	14%	68%	PGR, CB, MMC
Consumer Durables & Apparel	37%	8%	63%	NKE, DHI, GRMN
Transportation	36%	4%	54%	UBER, UNP, UPS
Capital Goods	34%	7%	52%	GE, RTX, CAT
Financial Services	32%	4%	53%	BRK.B, V, MA
Equity Real Estate Investment Trusts (REITs)	31%	15%	58%	AMT, WELL, PLD
Technology Hardware & Equipment	29%	0%	44%	AAPL, CSCO, ANET
Semiconductors & Semiconductor Equipment	27%	4%	41%	NVDA, AVGO, QCOM
Energy	25%	3%	61%	XOM, CVX, COP
Banks	13%	0%	44%	JPM, BAC, WFC

Source: Trivariate Research

STOCKS THAT ARE CONSISTENTLY REPLICABLE

Several Banks, Homebuilders, and Energy stocks are consistently replicable.

Consistently Replicable Stocks
Lowest Maximum Out-of-Sample Company-Specific Risk Over Last 2 Years
End-April, 2025

Ticker	Company	Industry	Market Cap. (US$ Bil.)	2-Year Maximum OOS Company-Specific Risk	CSR Over Last 3-Months
FNB	F.N.B. Corporation	Banks	4.70	23%	4%
ASB	Associated Banc-Corp	Banks	3.60	24%	8%
ONB	Old National Bancorp	Banks	6.58	29%	7%
SSB	SouthState Corporation	Banks	8.81	29%	7%
LNT	Alliant Energy Corporation	Electric Utilities	15.67	30%	17%
WEC	WEC Energy Group, Inc.	Multi-Utilities	34.95	30%	26%
PPL	PPL Corporation	Electric Utilities	26.98	31%	14%
CFG	Citizens Financial Group, Inc.	Banks	16.15	33%	6%
FITB	Fifth Third Bancorp	Banks	23.98	34%	11%
DVN	Devon Energy Corporation	Oil, Gas & Consumable Fuels	19.56	34%	11%
PNFP	Pinnacle Financial Partners, Inc.	Banks	7.68	34%	5%
CADE	Cadence Bank	Banks	5.39	34%	14%
HWC	Hancock Whitney Corporation	Banks	4.48	35%	7%
MTB	M&T Bank Corporation	Banks	27.59	35%	7%
WTFC	Wintrust Financial Corporation	Banks	7.44	35%	8%
TMHC	Taylor Morrison Home Corporation	Household Durables	5.76	36%	25%
RF	Regions Financial Corporation	Banks	18.35	37%	7%
HBAN	Huntington Bancshares Incorporated	Banks	21.17	37%	8%
BKU	BankUnited, Inc.	Banks	2.46	37%	13%
PB	Prosperity Bancshares, Inc.	Banks	6.47	37%	12%
AEE	Ameren Corporation	Multi-Utilities	26.81	38%	15%
USB	U.S. Bancorp	Banks	62.85	39%	9%
CMS	CMS Energy Corporation	Multi-Utilities	22.03	39%	25%
TOL	Toll Brothers, Inc.	Household Durables	10.03	39%	18%
KIM	Kimco Realty Corporation	Retail REITs	13.58	39%	27%

Source: Trivariate Research

SPEND TIME ON THESE LESS REPLICABLE STOCKS

As we showed earlier, many Healthcare stocks are hard to replicate for multiple reasons such as regulatory, scientific, long development timelines, among others. Therefore, below we show mega / large cap. (left) and small / mid cap. (right) stocks outside of Healthcare that are hard to replicate with a 30-stock basket. <u>This means that if you are a good stock picker, have done fundamental work, and have a differentiated view on one of these stocks, and you are ultimately right, you will separate your performance from the index MORE.</u>

Least Replicable Mega / Large Cap. Stocks, Ex-Healthcare
End-April, 2025

Ticker	Company	Market Cap. (US$ Bil.)
WMT	Walmart Inc.	778.09
TMUS	T-Mobile US, Inc.	280.40
T	AT&T Inc.	199.32
VZ	Verizon Communications Inc.	185.77
RTX	RTX Corporation	168.50
DIS	The Walt Disney Company	164.42
MELI	MercadoLibre, Inc.	118.17
CME	CME Group Inc.	99.85
SBUX	Starbucks Corporation	90.97
CMG	Chipotle Mexican Grill, Inc.	68.07
APD	Air Products and Chemicals, Inc.	60.31
AXON	Axon Enterprise, Inc.	47.74
KR	The Kroger Co.	47.72
RBLX	Roblox Corporation	45.48
TGT	Target Corporation	43.94
CPNG	Coupang, Inc.	42.43
TTWO	Take-Two Interactive Software, Inc.	41.18
EA	Electronic Arts Inc.	37.81
GRMN	Garmin Ltd.	35.98
EBAY	eBay Inc.	31.41

Source: Trivariate Research

Least Replicable Mid / Small Cap. Stocks, Ex-Healthcare
End-April, 2025

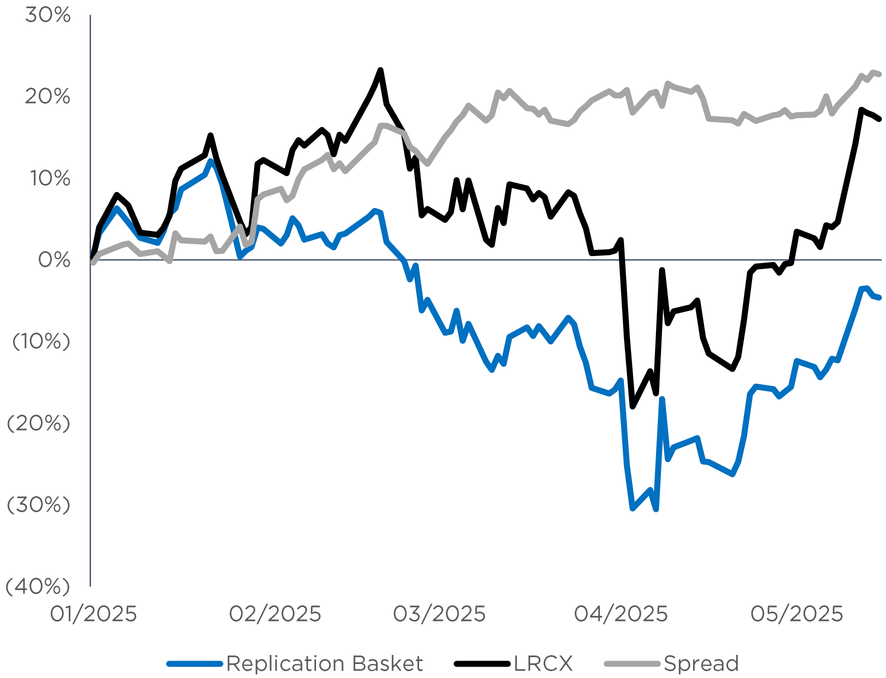
Ticker	Company	Market Cap. (US$ Bil.)
TW	Tradeweb Markets Inc.	29.51
CHKP	Check Point Software Technologies	23.79
FWONK	Formula One Group	21.89
DPZ	Domino's Pizza, Inc.	16.79
WMG	Warner Music Group Corp.	15.84
BJ	BJ's Wholesale Club Holdings, Inc.	15.48
ACI	Albertsons Companies, Inc.	12.65
JNPR	Juniper Networks, Inc.	12.14
COKE	Coca-Cola Consolidated, Inc.	11.82
MKTX	MarketAxess Holdings Inc.	8.24
HRB	H&R Block, Inc.	8.08
PLNT	Planet Fitness, Inc.	7.93
LW	Lamb Weston Holdings, Inc.	7.45
FCN	FTI Consulting, Inc.	5.60
SPR	Spirit AeroSystems Holdings, Inc.	4.22
SMPL	The Simply Good Foods Company	3.65
SAM	The Boston Beer Company, Inc.	2.68
IRDM	Iridium Communications Inc.	2.61
CCOI	Cogent Communications Holdings, Inc.	2.58
CPRI	Capri Holdings Limited	1.77

Source: Trivariate Research

REPLICATION HEDGING EXAMPLE: LAM RESEARCH (LRCX)

Lam Research (LRCX) is a perfect example of where the replication basket can add value in hedging a position. While the stock is highly replicable, it has also generated alpha above the replication basket year-to-date (left). By hedging a long LRCX position year-to-date, you would have reduced your annualized standard deviation of returns from 60% to 20%, increasing the Sharpe ratio from 1.01 to 2.86 (right). If you are a long-only investor unable to hedge a highly replicable stock, then the risk-reward for investing in replicable stocks is far worse, even if you can generate stock-specific alpha.

Cumulative Returns of LRCX and Replication Basket
Replication Basket is Rebalanced Monthly
Year-to-Date Through May 16th, 2025



Source: Trivariate Research

Performance Statistics of LRCX, Replication Basket, and Spread
Year-to-Date Through May 16th, 2025

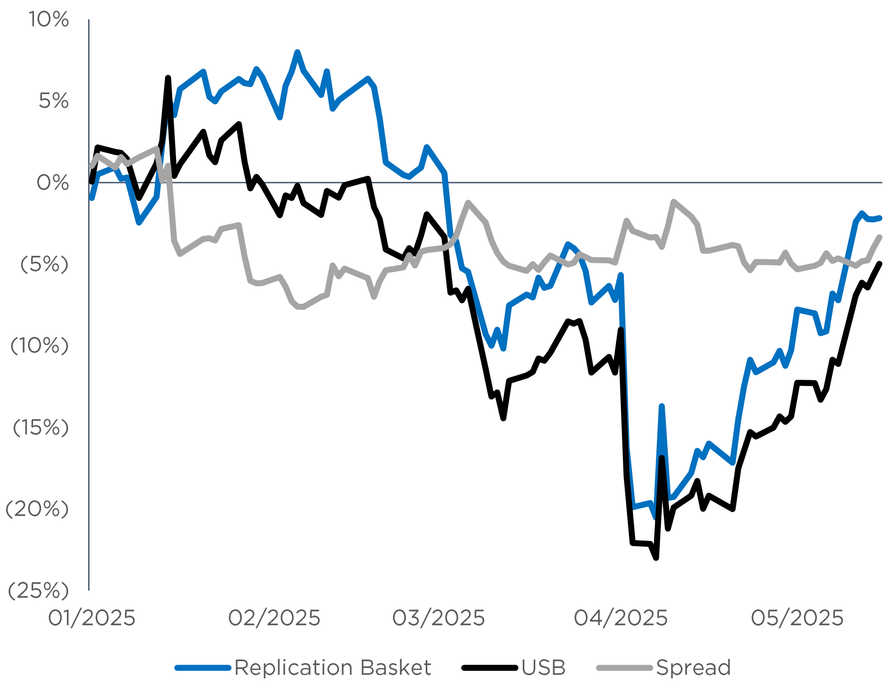
Statistic	LRCX	Replication Basket	Spread
Annualized Mean Return	60.3%	2.8%	57.5%
Annualized Standard Deviation	59%	57%	20%
Sharpe Ratio	1.01	0.05	2.86
Hit Rate	52%	52%	59%

Source: Trivariate Research

REPLICATION HEDGING EXAMPLE: U.S. BANCORP (USB)

USB is very replicable, as is the case for most Banks. Our 30-stock replication basket has performed slightly better than USB year-to-date, though quite close overall. Owning the stock and shorting the basket lost money year-to-date (left). In general, with replicable stocks like this, spreading the risk across multiple names will be better than owning a large position in one name, as the hit rate and standard deviation are also similar (right). Our judgment is that most Bank stocks should be sized by risk-minded investors, not alpha generators.

Cumulative Returns of USB and Replication Basket
Replication Basket is Rebalanced Monthly
Year-to-Date Through May 16th, 2025



Source: Trivariate Research

Performance Statistics of USB, Replication Basket, and Spread
Year-to-Date Through May 16th, 2025

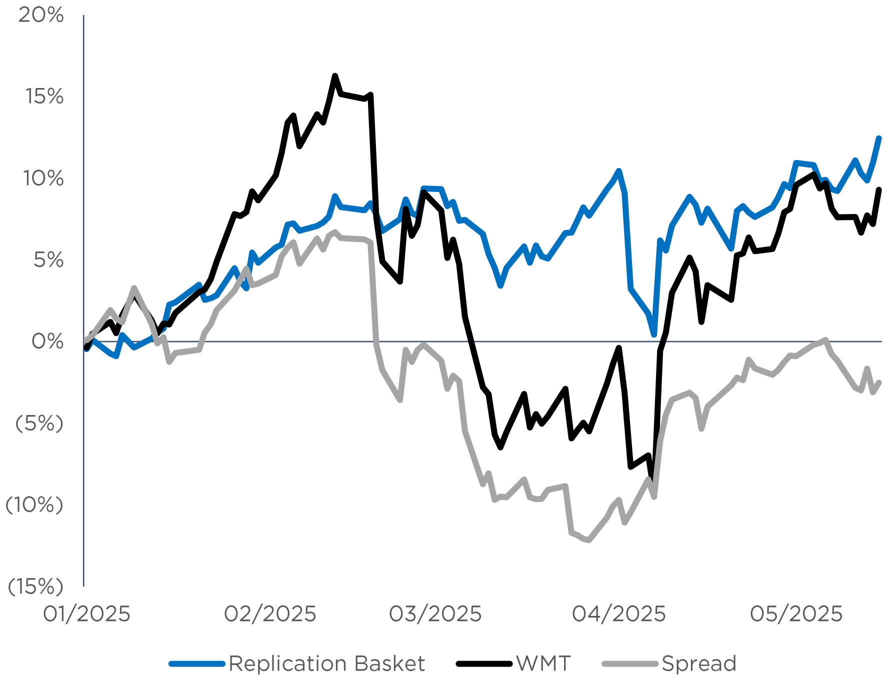
Statistic	USB	Replication Basket	Spread
Annualized Mean Return	(7.5%)	0.7%	(8.2%)
Annualized Standard Deviation	35%	36%	14%
Sharpe Ratio	(0.21)	0.02	(0.58)
Hit Rate	52%	51%	52%

Source: Trivariate Research

REPLICATION HEDGING EXAMPLE: WALMART INC. (WMT)

Walmart is a very difficult stock to replicate. The "best" 30-stock basket performs quite differently, meaning this is a very challenging position to hedge. For example, during March 2025, the basket was down while WMT was up (left). Year-to-date, the replication basket has outperformed WMT, with lower volatility, but it is not isolating WMT's returns reliably (right).

Cumulative Returns of WMT and Replication Basket
Replication Basket is Rebalanced Monthly
Year-to-Date Through May 16th, 2025



Source: Trivariate Research

Performance Statistics of WMT, Replication Basket, and Spread
Year-to-Date Through May 16th, 2025

Statistic	WMT	Replication Basket	Spread
Annualized Mean Return	29.1%	33.7%	(4.6%)
Annualized Standard Deviation	32%	19%	22%
Sharpe Ratio	0.91	1.73	(0.21)
Hit Rate	58%	54%	56%

Source: Trivariate Research

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