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Momentum in Japan
The Exception that Proves the Rule

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Abstract

Momentum strategies have been notable successes in most places researchers have looked. One glaring exception is Japan. There, trying to pick stocks based on price momentum has made no money for near 30 years. This failure has led some to call into question momentum's viability, suggesting that perhaps momentum's success elsewhere may be the result of data mining. We reject that interpretation. We argue that because value and momentum strategies are strongly negatively correlated, they need to be studied as a system. In this context we show that the results in Japan are perfectly consistent with value and momentum working everywhere at similar levels and are entirely within the range of statistical noise. Going further, viewed as a system with value strategies, either through ex post optimizations or through Fama-French 3-factor model intercepts, we show momentum strategies are actually a success in Japan. In sum, we find the Japanese momentum results supportive, not contrary, to the idea that momentum is a strong ex ante efficacious strategy around the world. In other words, the Japanese momentum results don't worry us at all. They are the exception that proves the rule.

Introduction

Since their power for choosing U.S. stocks was documented in the early to mid-1990s (Jegadeesh and Titman [1993], Asness [1994]) the success of momentum strategies has become one of the strongest empirical regularities in finance. Momentum has joined size (Banz [1981]) and value (Rosenberg, Reid, and Lanstein [1995], Fama and French [1992, 1993, 1996], Lakonishok, Shleifer, and Vishny [1994]) as one of the "big three" anomalies or risk factors of modern investing

Any empirically successful trading strategy, meaning one that has produced significant positive returns in the past, may be the result of one of three explanations. It may be the result of 1) exposure to a priced risk, 2) some market inefficiency, or, 3) simple data mining. While journals are full of debate over the first two possibilities, it is the third we are concerned with here, in particular as it might apply to momentum. One can never fully eliminate the chance that any empirical result is caused by random fluctuation uncovered by motivated researchers. But, one can progressively minimize this worry with successful out-of-sample tests. Momentum and value have survived such tests handily. In the ensuing near two decades since they first came to the forefront of finance, both value and momentum strategies have shown consistent out-of-sample success when examined across geography, asset class and security type, and time (an eclectic subset of work includes Asness, Liew, and Stevens [1997], Fama and French [1998], Asness, Moskowitz, and Pedersen [2010], De Groot, Pang, and Swinkels [2010], Blitz and Van Vliet [2008], and Okunev and White [2001]).

However, there is one very notable exception. Quite a few authors have noted that momentum is an empirical failure for stock selection in Japan (Asness, Moskowitz, and Pedersen [2010], Fama and French [2010], Griffin, Ji, and Martin [2003], Rouwenhorst [1998]). In both academic and practitioner circles this result causes quite a bit of angst as many worry about how large a blow this is to our overall confidence in momentum strategies.

This paper examines this failure of momentum in Japan and asks the very basic question, do we care? That is, how damaging are the Japanese findings to a belief that

momentum strategies have a healthy ex ante positive expected return outside and inside Japan? Does this documented exception prove the rule or blow it out of the water?

Our central finding is that the results in Japan are no blow to believers in momentum, not even a glancing one. In fact we argue they are ultimately supportive. First we document and confirm the basic finding – value and momentum work everywhere save for momentum in Japan. Next, we show that given the success of both value and momentum strategies around the world (we limit ourselves to value and momentum based stock selection in four major developed regions), the ex ante chance one strategy in one region has delivered poor results, akin to those for momentum in Japan, is quite high. In other words, the true p-value of the Japanese findings is unimpressive.[2]

Furthermore, because value and momentum are negatively correlated, we argue that it is difficult or even unproductive to study one without including the other. These two factors are best studied as a system. In this context, we find that, an ex post Sharpe ratio optimizer that can invest in value and momentum would still invest heavily in the Japanese momentum strategy. Following this we explore further the intuition behind the importance of the negative correlation between value and momentum. Finally, using a 3-factor model, we find that momentum in Japan is actually a success (significant positive intercept).

In sum, we find the univariate failure of momentum in only Japan to be anything but a blow. The global results for momentum, particular when considered as a system with the well known value effect, are powerful, and almost unscathed by the oft noted weak results in Japan.

I. Data Description

Factor construction and data sources follow Asness, Moskowitz, and Pedersen (2010). International equity returns are from DataStream and are aggregated across four regions: the U.S., U.K., Europe (excluding U.K.), and Japan. We choose these four

[2] The p-value in this case is the probability we would find Japanese momentum to be as bad, or worse, than we do if the true mean return for momentum in Japan was similar to that found ex post in other countries. 5% or lower is a commonly used level where something is called "significant."

regions to be economically meaningful (as opposed to, say, having each non-U.K. European country enter separately). The data cover the 29½ year period July 1981 to December 2010, the longest period over which we have both value and momentum for all four regions. More detail on the source of these returns and their construction can be found in Asness, Moskowitz, and Pedersen (2010).

We obtain the value and momentum portfolios in each of these markets as done by Asness, Moskowitz, and Pedersen (2010), who each month divide each market's stocks into three equal groups based on value or momentum rankings, where momentum is defined as the past 12-month return on each security, skipping the most recent month's return, and value is defined as book-to-market equity where book is updated with a six month lag to ensure the data would be available for construction, and market is current price at the month's start.[3,4] Security returns are then value-weighted within each group. The spread in returns between the portfolios representing the top and bottom third of securities capture the value and momentum premia within each market and asset class.

We restrict our universe to the top 90% of market capitalization in each of the four markets. This is a fairly conservative large capitalization restriction. For example, in the U.S. for December 2010 we have 707 firms in our sample – firmly in between the large cap Russell 1000 and the very large cap S&P 500. We use value weighting and a large cap universe to ensure that implementation drags on our gross of trading cost results are as small as possible. In fact, our size restrictions would allow the reasonable use of equal weight portfolios held long and short. We view the equal weight results as a robustness check and they confirm (at higher individual Sharpe ratios for each strategy) all the results of this paper. Table 1 reports the number of stocks, and various other statistics, for the four regions in our sample at the end of our sample period.

[3] Asness and Frazzini [2011] study the difference between using updated market price to calculate book-to-market ratios versus using a lagged price that matches the timing of the book data. Versions of value that lag price, like Fama and French's HML, look more like 80% value and 20% momentum than they do like pure value. Thus, if you use the lagged value measures, it is harder to see the importance of adding some momentum to value in Japan, because the lagged value measures already did so. The key simulation result in this paper, that the true p-value of momentum's "failure" in Japan is not impressive, is not affected by this choice.

[4] We do lag the price by one day to avoid loading on the short-term contrarian strategy that is possibly an artifact of the bid-ask spread. Also, for the three-factor regressions reported later in Table 7 we tested explicitly adding the one month contrarian strategy to each regression and found the results essentially unchanged.

Table 1
Statistics for Sample End of 2010

	Number Stocks	Average Size (mm)	Value Wgt. Size (mm)	Minimum Size (mm)
USA	707	15,900	76,162	2,407
UK	115	19,517	87,028	2,382
Europe	395	13,940	51,839	1,891
Japan	554	5,098	24,837	636

We are left with eight key series that form the core of our paper: the returns to a large capitalization liquid dollar-balanced long-short value strategy (or factor) within each of the four regions, and the returns to a similarly constructed momentum strategy (or factor) within each of the four regions, all monthly from July 1981 through December 2010.

II. The Basic Evidence

Let's start with the value strategy. The next table details the results to the value long/short strategy in each of the four regions, and in the "All" region that puts equal dollars (rebalanced monthly) in each of the four. We report the average annualized returns, annualized standard deviations, Sharpe ratios achieved, and the t-statistics associated with those Sharpe ratios.

Table 2
Value Strategy Results
July 1981 - December 2010

	USA	UK	Europe	Japan	All
Average Return	1.8%	5.1%	3.9%	10.5%	5.3%
Standard Deviation	12.7%	13.5%	11.2%	14.7%	9.3%
Sharpe ratio	0.14	0.38	0.35	0.71	0.57
T-statistic	0.78	2.07	1.90	3.87	3.12

Basically, value has worked around the world. It's not statistically significant on its own in the USA, and is borderline in Europe.[5] However, the "All" region turns in a very strong 0.57 Sharpe / 3.12 t-statistic, though not as good as value achieved individually in Japan (this strong result for value in Japan will be important later in this paper). Now let's examine the momentum strategy.

Table 3
Momentum Strategy Results
July 1981 - December 2010

	USA	UK	Europe	Japan	All
Average Return	3.7%	8.3%	7.4%	0.7%	5.0%
Standard Deviation	16.6%	17.2%	15.3%	20.2%	13.2%
Sharpe ratio	0.22	0.48	0.48	0.03	0.38
T-statistic	1.21	2.63	2.62	0.19	2.06

All the momentum strategies are positive. But, momentum in Japan is far and away the weak sibling. It achieves a Sharpe ratio of effectively zero for 29½ years.[6] The "All" region survives its exposure to weak Japan with a Sharpe of 0.38 and a t-statistic of 2.06 (note this includes and survives some very poor results for momentum in the spring of 2009).

Essentially, this flat result in Japan is what many have noted as the "failure of the momentum strategy in Japan", and has caused much hand-wringing in quantitative finance circles. Interestingly, value and momentum in the USA, over the large cap value

[5] Keep in mind, to be conservative, we use a very large cap formulation where many anomalies are known to be weaker. See Israel and Moskowitz (2011) for further discussion of these results, analyzing both value and momentum among different size stocks.

[6] For comparison with another study, Fama and French (2010) Table 1 presents the results for momentum in Japan over only big cap stocks (the analogy to what we do here). They find a t-statistic of 0.32 over 239 months. That translates to a Sharpe ratio of 0.07 versus our 0.03. The time periods and construction methods aren't precisely the same, but the similarity in result is comforting.

weighted portfolios we study, are better but also unimpressive viewed alone. But, they are not as bad as momentum in Japan, and have not attracted nearly the same attention.[7]

As a final preliminary, in each of the above regions we look at a portfolio that invests 50% in that country's value long/short strategy, and 50% in that country's momentum long/short strategy rebalanced to 50/50 monthly (note, momentum has a long history of realizing higher volatility per dollar than value, therefore ex post, and perhaps predictably ex ante, this portfolio is actually slightly more momentum than value).

Table 4
50/50 Value/Momentum Strategy Results
July 1981 - December 2010

	USA	UK	Europe	Japan	All
Average Return	2.8%	6.7%	5.7%	5.6%	5.2%
Standard Deviation	6.8%	8.0%	6.9%	8.6%	5.2%
Sharpe ratio	0.40	0.84	0.82	0.65	1.01
T-statistic	2.19	4.56	4.46	3.54	5.46

Each region turns in a statistically significant performance when we examine a portfolio of value and momentum, including Japan (in fact it's considerably better than the USA). The "All" region is particularly strong as, of course, it's diversifying by value versus momentum and by region. In particular, note that even though Japan has 50% of its dollars, and more than half its ex post risk (again, Tables 2 and 3 show that the univariate volatility of Japan's momentum strategy is considerably higher than its value strategy) in the 0.03 Sharpe momentum strategy, its 50/50 Sharpe ratio is quite strong.

[7] This is also, perhaps, due to value and momentum's testability and success over a longer period in the USA, and the fact that Fama and French's HML includes both smaller stocks and a bit of the momentum strategy (again see Asness and Frazzini [2011]) as compared to our value strategy that uses up-to-date unlagged price. Fama and French's HML is a 0.42 Sharpe over this same period, but that averages value's performance among large and small stocks. Among large-cap stocks, like we use in this paper (similar though not precisely the same cut), Fama and French's data actually yields a Sharpe of only 0.10 for value over this period, but 0.65 for small stocks. In a bivariate regression of this paper's USA value strategy on the Fama-French large-cap and small-cap value strategy separately, you get a 0.87 coefficient and a 17.7 t-stat on the Fama-French large-cap value strategy, and 0.05 and a 1.0 t-stat on the Fama-French small-cap value strategy. In other words, as a reasonableness check, our results look a heck of lot like the Fama-French large cap value strategy, which also looks weak but positive over this period.

Of course, in Japan, and each region, the combo strategies are benefiting from the negative correlation of value and momentum. Next we list these negative correlations (calculated using monthly returns) for each region and the combined "All" region.

Table 5
Value/Momentum Correlation
July 1981 - December 2010

USA	-0.59
UK	-0.47
Europe	-0.50
Japan	-0.55
All	-0.63

These correlations are quite negative and are clearly driving the large benefits to including both value and momentum together (the greatly superior Sharpe ratios in Table 4 to those in Tables 2 and 3).

III. Simulations

This section starts by asking a simple question, since we only observe ex post returns, what are the chances that the poor results for momentum in Japan were just bad luck? To investigate this we conduct simulations.

First we fix the variance-covariance matrix of the 8 strategies (value and momentum in each of the four regions) to match the ex post 29½ year historical realization. Then we fix the mean return for each of the eight strategies such that it yields an ex ante 0.35 Sharpe ratio. This is the average realized Sharpe ratio across the eight. We then draw 10,000 multivariate normal runs for the eight strategies over 29½ years. We will make special use of two historical Sharpe ratios. The Sharpe ratio of momentum in Japan was historically 0.03, the lowest we observed, but the Sharpe ratio of value in Japan was historically 0.71, the highest we observed.

Now, for a 0.35 Sharpe ratio strategy, viewed alone, to ex post realize a 0.03 Sharpe ratio over 29½ years is a -1.74 standard deviation event. Realizing less than or equal to a 0.03 Sharpe has a p-value of 4.1%. Even viewed alone, and ignoring the fact that it "has

not worked in Japan" but rather focusing on the statistical significance of this failure, the Japanese momentum statistical event is not particularly earth-shaking.[8]

The more relevant question is if you had eight strategies, value and momentum in all four regions, each with an ex ante Sharpe of 0.35, what are the chances that one of them would come in below a 0.03? Running this simulation, we find the answer is 26%. That is a p-value nobody would write a word about (except if you count me just now). In other words, under the hypothesis that all eight strategies are equally good, the Japanese results are not at all shocking.

Now, in a forerunner to the rest of this paper, which views value and momentum as a system, let's ask another question. We noted above that Japan's value strategy delivered the highest Sharpe historically. Since value and momentum are negatively correlated, when one is ex post high, we should expect the other to be ex post low. Running our simulations we next ask "in what fraction of our simulations do the high and low Sharpe ratios occur within the same region?" The answer is 30% of the time. If we replace our correlation matrix with a diagonal one (preserving volatility) this probability falls to 15%. Given the negative correlations of value and momentum, it is far more likely to see the high and low Sharpe ratio within one region, one in each strategy, than in different regions. This is precisely what we observe in actuality.

Finally, using our simulations one more time to argue that value and momentum are a system, and given their negative correlations must be viewed together, we ask, how often, when any region's value strategy realizes a Sharpe of greater or equal to 0.73 (Japan's historical figure), do we see a momentum Sharpe of less than or equal to 0.03? The answer is 29% of the time. Conditional on the strong value returns in Japan, the almost non-existent Japanese momentum returns are, again, very far from shocking. The puzzle of why momentum is so weak in Japan can be dismissed as random, as we did

[8] Similarly, the empirical (not simulation) t-statistic of the mean of Japanese momentum vs. the equally weighted average of the other three momentum strategies is only -1.65, and Japanese momentum vs. the equally weighted average of the other seven strategies (value and momentum) is only -1.34.

earlier, but it can also be rephrased as "why is value so strong in Japan?", as they are related questions.[9]

IV. Ex post Optimal Portfolios

Value and momentum's highly negative correlation suggests that these two factors are best studied as a system. Towards that end, let's now consider, in each region, the optimal combination of value and momentum strategies.

For each region, the table below reports the Sharpe of the value strategy, the Sharpe of putting 50% into value and 50% into momentum rebalanced monthly, the weight put in value (the weight in momentum is 100% minus the weight in value) by an optimizer tasked with maximizing realized Sharpe ratio (this is an in-sample exercise), and finally the Sharpe ratio of this ex post optimal portfolio. The All region is not ex post optimized among the regions. It's 25% in each optimal region portfolio.

Table 6
July 1981 - December 2010
Ex Post Optimal Amounts of Value and Momentum

	USA	UK	Europe	Japan	All
Sharpe ratio of Value	0.14	0.38	0.35	0.71	0.57
Sharpe ratio of 50/50	0.40	0.84	0.82	0.65	1.01
Optimal % in Value	54%	54%	55%	70%	58%
Sharpe of Optimal Portfolio	0.41	0.85	0.83	0.88	1.17

For the USA, UK, and Europe the optimal weight in value (in dollars) is between 54% and 55%. For these countries the Sharpe of the optimal portfolio is generally close to that of the 50/50 portfolio, and is more than double the Sharpe of a pure value portfolio. But what about in Japan where momentum is a much heralded failure? Here

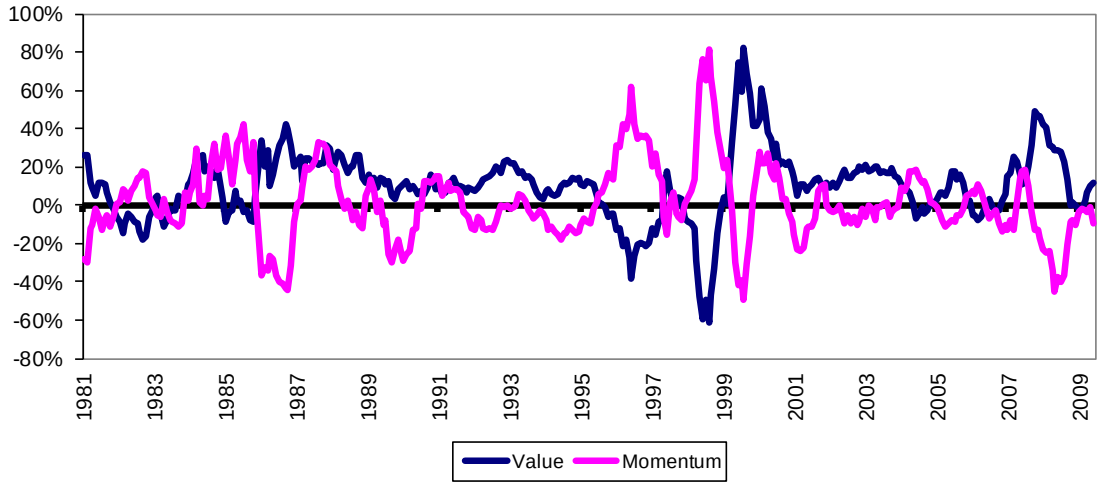
[9] Of course, we can only show that random chance is a strong possibility, we cannot dismiss causality. For example, Chui, Wei, and Titman (2000, 2008) offer explanations for momentum's weakness in Japan (and other parts of Asia) that include momentum being weaker in countries with less individualism, and momentum being weaker in civil versus common law countries.

the ex post optimal amount of value is 70%. The improvement in Sharpe is not the nearly double of our other countries, but it is non-trivial (going from 0.71 to 0.88). Even the 50/50 portfolio (in dollars) barely nudges down the Sharpe ratio from all value (from 0.71 to 0.65). 50/50 value/momentum means well more than 50% of the ex post volatility comes from momentum (as momentum has realized considerably more ex post volatility than value per dollar), in the region of the world where momentum delivers no return, and where value is the strongest in the world. And yet, even in Japan, 50/50 is almost as good as all value. An optimizer with full foresight wants to put 30% of its dollars in the "failed" Japanese momentum strategy. Some failure!

V. Graphically and Analytically Examining Correlations Further

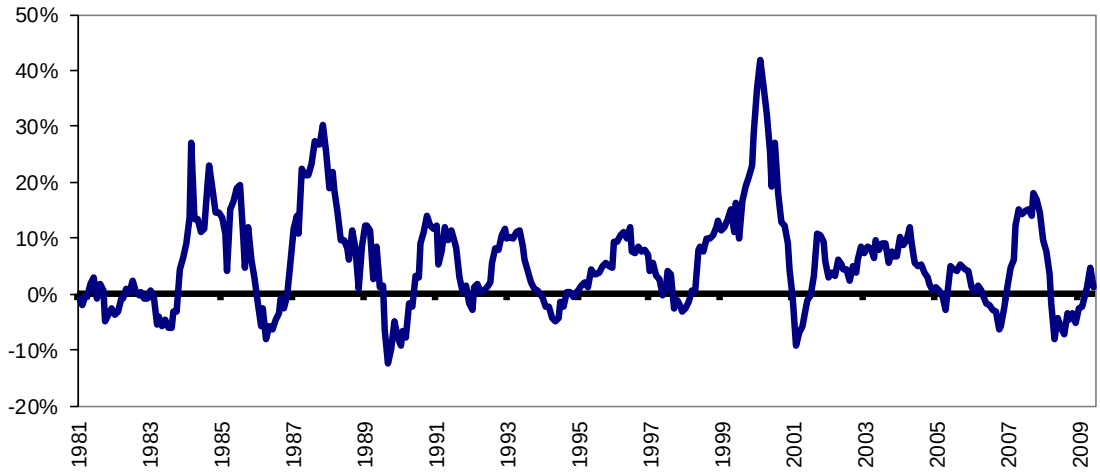
Figure 1 shows the rolling 12-month return to the Japanese value and momentum strategies:

Figure 1
Rolling 12-Month Value and Momentum in Japan



The negative correlation we saw earlier at the monthly level clearly shows up at the annual level. Now let's look at the rolling 12-month return to the 50/50 portfolio of Japanese value and momentum:

Figure 2
Rolling 12-Month 50/50 Portfolio of Value and Momentum in Japan



The worst case 12-month return for Japanese value, despite it being an excellent long-term strategy, is -61% (when looking at these large numbers recall these are additive spread returns on equity like volatility portfolios so you get some large numbers). The worst case for Japanese momentum, despite it being a lower average return and higher volatility than value, is not as bad at -49%. Of course, the real point is the 50/50 combination strategy. The worst case 12-month return for this portfolio is a comparatively tiny -13%. Of course, this is simply an illustration of the power of diversification and a -0.55 correlation, but perhaps an edifying one.

One way to view these results is that value has been on a 29½ year tear in Japan. Japanese momentum has been -0.55 correlated to value over this period. For momentum to "only" make a tiny bit of money, as opposed to losing quite a lot of money, is actually a non-trivial achievement.

It's simple to show that if you have two investment strategies with Sharpe ratios SR1 and SR2, and correlation ρ, the optimal weight in asset 1 is:

$$W1 = \frac{SR1 - \rho \times SR2}{(SR1 + SR2)(1 - \rho)}$$

Consider the simple case where SR1 is positive and SR2 = 0. Then the formula reduces to:

$$W1 = \frac{1}{(1-\rho)}$$

$$W2 = 1 - W1 = \frac{-\rho}{(1-\rho)}$$

The intuition for W2 is straightforward. Strategy 2 has a zero Sharpe ratio, so if it's also uncorrelated to the first positive Sharpe asset, it's ignored (held at zero weight). If it's positively correlated it's held short as a hedging asset (again, being positively correlated with something good, and not losing money, that is having a zero and not a negative Sharpe ratio, is an achievement under these assumptions). Finally, if negatively correlated, it's held long, again as a hedging asset. Now if ρ = -0.55, like it does for value and momentum in Japan, you get W2 = 35%. This basically reproduces our optimization results above (save for rounding and my zero assumption for SR2 here vs. the whopping historical 0.03 for Japanese momentum). To repeat, the intuition is simple. A zero Sharpe ratio does not seem that impressive, until you find that it was achieved with a -0.55 correlation to an asset with a positive Sharpe ratio. Then, it's very impressive indeed (obviously the package is more impressive the higher the positive Sharpe ratio and the more negative the correlation) as it's an excellent hedging asset for a strategy already good on its own.

The next section makes this idea, that momentum has actually added a lot net of the highly successful Japanese value strategy, perhaps even more explicit.

VI. Three Factor Regression Intercepts

For quite a few years now, the standard way in empirical finance to evaluate historical strategy performance has been in context of a factor model. The industry-standard approach is the Fama-French 3-factor model (Fama and French [1993, 1996]), regressing the historical returns in question on the excess returns on the market, a long-short small-large factor, and a long-short value-growth factor. The loadings are interesting to discover the strategy-in-question's unconditional bets, with the intercept's

economic and statistical significance relevant to whether the strategy adds value net of these bets. Carhart [1997] adds the momentum factor of Asness [1994] to the 3-factor model, creating the well known 4-factor model, but we will not employ that here as it's precisely momentum we seek to test. Table 7 presents 3-factor results for the momentum strategy in each of the four regions regressed on market excess, small-large, and value-growth factors (we have highlighted the all-important intercepts with a box).[10,11]

Table 7
Momentum Regressed on 3-Factor Model of Market, Size, and Value
(intercept reported as annualized %)
July 1981 - December 2010

	USA	UK	Europe	Japan	All
Intercept	7.0%	11.1%	10.8%	9.3%	10.6%
T-statistic	2.83	3.88	4.33	2.98	5.40
Market Beta	-0.17	0.03	-0.06	-0.07	-0.06
T-statistic	-3.62	0.62	-1.70	-1.83	-1.78
Size Beta	0.12	-0.03	-0.14	-0.28	0.03
T-statistic	1.47	-0.43	-1.69	-3.98	0.39
Value Beta	-0.83	-0.61	-0.63	-0.70	-0.91
T-statistic	-14.39	-10.05	-9.66	-10.73	-14.55

The size of momentum's intercept in Japan is economically and statistically large (and is better than the USA's). Quite simply, viewed through the prism of modern finance, momentum has actually worked very well in Japan.

VII. Conclusion

[10] The value-growth factor is the "value" factor of this paper. The market factor is the cap weighted return on our universe of stocks (the 90% of market cap we use for this paper) over cash, and the small-large factor is constructed like momentum and value in this paper but using market capitalization at the end of the prior month (and requiring each firm to have both a value and momentum factor). Because we restrict our universe to big capitalization stocks to begin with our size factor is very weak.

[11] We are employing "local" versions of the 3-factor model. Fama and French [2010] discuss the difference between local and global models. An exception is that our "All" strategy in the far right column of table 7 is analyzed using global versions of the RHS factors (equal weighted averages of the region factors – it is not just an average of results in the table but a separate global test).

If one hypothesized that momentum has similar predictive power around the world, equal to the historical average of value and momentum over each of our four regions, then the ex post "failure" of Japanese momentum is not at all statistically impressive (a p-value of about 26%). Viewed as one of eight possibly efficacious strategies around the world, we cannot come close to rejecting that momentum's Sharpe ratio in Japan is ex ante equal to momentum and value's average Sharpe ratio everywhere.

Furthermore, our defense of momentum in Japan is not this simple citing of statistical insignificance. For the last 29½ years, a Sharpe ratio maximizing Japanese investor still would have been better off with a lot of momentum in their portfolio even with perfect foresight that momentum would be a near-zero return strategy. More importantly, we have strong evidence why momentum failed, stand-alone, in Japan. It is highly negatively correlated to the ex post very successful Japanese value strategy (though if we want a mystery we can still discuss why value is so strong in Japan – though simulations will likely again show this indistinguishable from chance).

Viewed as a system along with negatively correlated value strategies and when using a version of the Fama-French 3-factor model, we can easily reject, at standard significance levels, the hypothesis that momentum's success in Japan is the result of chance. Using the 3-factor model momentum is not simply "not a failure" in Japan, but a strong empirical success.

In other words, momentum works quite well in Japan. Everyone move along, nothing to worry about here.

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