B. Size-Neutral Relative Strength Strategies

The unrestricted and country-neutral relative strength strategies in Table II and in Panel A of Table III are not size-neutral in two respects. First, Loser firms are on average smaller than firms in the Winner decile. Because Winners are on average larger than Losers, a size effect may attenuate the Winner − Loser effect. Second, both Winners and Losers are smaller than the average firm in the sample. This raises the question whether the continuation effect is only limited to smaller stocks.

To control for size I first sort all stocks based on size (market equity), and within each size decile on past six-month return. The Loser portfolio contains the 10 percent of firms with the lowest previous performance from each size decile; the firms with the highest past return in each size decile end up in the Winner portfolio. Both the Winner and the Loser portfolios will therefore contain the same number of stocks from each size decile, and are in that sense approximately size-neutral. Panel B of Table III shows that after controlling for size, past Winners significantly outperform past Losers by 1.17 percent per month ($t = 4.30$). Moreover, return continuation exists in all size deciles and is not limited to small stocks. However, there is a negative relation between firm size and the excess return of the relative strength portfolios. Winners from the smallest size decile outperform the Losers on average by 1.45 percent per month, with a standard deviation of 5.88 percent. The excess return in the largest size decile is on average 0.73 percent per month with standard deviation of 4.73 percent. The conclusion from Panel B is that the continuation effect is not merely a reflection of firm size. Although the continuation effect is stronger for smaller firms, past Winners outperform Losers in every size category.

C. Size-Country-Neutral Relative Strength Portfolios

Although return continuation is present in many countries and across size deciles, country membership and size are not independent. The country-specific relative strength portfolios take significant size bets, and the size-sorted relative strength portfolios take significant country bets. This section explores the effectiveness of relative strength strategies that avoid taking significant country and size positions, in order to separate the influence of size and country membership.

The number of sample firms is not sufficient to construct 10 relative strength portfolios for each size decile in every country, but a coarser sort can provide information about the influence of size independent of country. Size-country-neutral portfolios are formed by first sorting stocks by country into three size groups: small (bottom 30 percent), medium (middle 40 percent), and large (top 30 percent). Within each size-country group, stocks are ranked into deciles based on past six-month performance. The size-country-neutral Loser (Winner) portfolio contains the stocks from the lowest (highest) past performance decile from each of the 36 country-size groups. Panel C of Table III shows that an internationally diversified portfolio of Winners that controls for country and size has outperformed Losers by 0.85 percent per

month ($t = 5.32$). The performance cannot be attributed to a particular geographical market. The size-neutral W − L excess returns are significantly different from zero in the three largest markets in the sample (France, Germany, and the United Kingdom) and comparable to the excess return on a size-country-neutral W − L portfolio constructed of stocks from the other 9 markets.

Although Winners outperform Losers in each of the three size categories, the excess return on the country-neutral W − L portfolio of small stocks is about twice as large as the excess return on the W − L portfolio of large stocks.[12] Interestingly, the country-neutral W − L strategy of stocks from the middle 40 percent of the size distribution has on average earned 0.92 percent per month, which is not significantly different from the 0.85 percent earned on the overall size-country-neutral strategy ($t = 0.91$). Thus, the conclusion is that although return continuation varies by country and size, profitability of international relative strength strategies does not require investors to take significant size or country positions.

III. Risk-Adjusted Returns

A. Adjustment for Market and Size Factors

Panel A of Table IV confirms that the excess return on the unrestricted relative strength strategy cannot be accounted for by a simple adjustment for beta-risk, because the betas of the Winner and Loser portfolios are very similar. The alphas of Losers and Winners are −0.27 percent ($t = -1.05$) and 0.88 percent ($t = 4.53$) per month respectively, and their difference of 1.14 percent ($t = 3.94$) is highly significant. Allowing for exposure to size, as measured by an international version of Fama and French's (1996) SMB factor, increases the risk-adjusted return to 1.46 percent per month ($t = 5.05$). Similarly to the U.S. experience, Losers are on average smaller than Winners and load more on the international SMB factor.[13] The size-country-neutral W − L portfolio, however, shows a similar negative size exposure. Unreported results show that all 10 size-sorted W − L portfolios summarized in Panel B of Table III have negative loadings on the international SMB portfolio. It suggests that Losers behave more like small stocks than Winners irrespective of size. The overall conclusion from Table IV is that a risk adjustment for market and size makes the continuation effect appear more at odds with the joint hypothesis of market efficiency and the two-factor model.

[12] These size results are stronger than Jegadeesh and Titman (1993) and Asness (1995) find for the United States, where relative strength portfolios of medium-sized firms outperform both small and large firms.

[13] The SMB portfolio is constructed by sorting the sample firms by country on size in each month. Firms smaller than the median size in a country are assigned to the internationally diversified S portfolio, the largest 50 percent to the B portfolio. SMB is the excess return of S minus B. The average return and standard deviation of the international SMB portfolio are 0.29 and 1.16 percent per month from 1980 through 1995.

Table IV

Risk-Adjusted Excess Returns

The table gives the results from regressing the monthly returns of Loser and Winner portfolios in excess of the deutsche mark risk free rate on the excess return on the value weighted Morgan Stanley Capital International index of the twelve sample countries over the deutsche mark risk free rate, $R_{m,t} - r_{f,t}$, and the excess return on an internationally diversified portfolio of small stocks over a portfolio of large stocks, SMB_t:

$$R_{i,t} - r_{f,t} = \alpha + \beta[R_{m,t} - r_{f,t}] + \gamma \text{SMB}_t + e_{i,t}.$$

SMB is constructed by ranking all stocks in each country in ascending order on market equity. The stocks below the median size in a country end up in the international portfolio of S, the stocks above the median in B. The relative strength portfolios in Panel A are formed based on past performance only, the Winner and Loser portfolios in Panel B are constrained to have a similar size and country composition. R^2 is the coefficient of determination adjusted for degrees of freedom and $t(\cdot)$ is the coefficient divided by its standard error.

Portfolio	α	$t(\alpha)$	β	$t(\beta)$	γ	$t(\gamma)$	R^2
			Panel A: Unrestricted Relative Strength Portfolios				
Loser	−0.0027	−1.05	1.00	17.77			0.62
Winner	0.0088	4.53	1.02	23.76			0.75
Winner–Loser	0.0114	3.94	0.02	0.33			0.00
Loser	−0.0090	−4.52	1.08	25.10	2.00	12.01	0.78
Winner	0.0056	3.09	1.06	26.95	1.00	6.56	0.79
Winner–Loser	0.0146	5.05	−0.02	−0.30	−1.00	−4.13	0.07
			Panel B: Size-Country-Neutral Relative Strength Portfolios				
Loser	−0.0027	−1.58	0.98	25.4			0.77
Winner	0.0062	4.81	0.92	32.12			0.84
Winner–Loser	0.0089	5.55	−0.06	−1.73			0.01
Loser	−0.0074	−5.81	1.04	37.57	1.47	13.79	0.89
Winner	0.0036	3.18	0.95	38.66	0.81	8.59	0.89
Winner–Loser	0.0110	7.00	−0.09	−2.57	−0.65	−4.98	0.12

$R_i = \alpha_i + \beta_i R_{MSCI} + \varepsilon_i$

Chan (1988) and DeBondt and Thaler (1987) find that abnormal returns associated with long-term return reversal strategies disappear once betas are allowed to vary with market conditions. For the continuation effect to be consistent with market-dependent betas requires that Losers have a higher beta in down markets than Winners, and a lower beta in up markets. Table V shows that empirically the opposite is true. Although the betas do vary with market conditions, Losers uniformly have a higher beta in up markets and a lower beta in down markets than Winners, which makes the alphas appear more anomalous. As a consequence, the beta of the W − L excess returns are significantly negative in up markets and positive in down markets. The resulting alphas are 1.41 and 1.99 percent per month respectively for the size-country-neutral and the unrestricted W − L portfolios.

Table V

Market Dependent Risk-Adjusted Returns

The table gives the results from regressing the monthly returns of Loser and Winner portfolios in excess of the deutsche mark risk free rate on the excess return on the value weighted Morgan Stanley Capital International (MSCI) index of the twelve sample countries, $R_{m,t}$:

$$R_{i,t} - r_{f,t} = \alpha + \beta^{+}D_t[R_{m,t} - r_{f,t}] + \beta^{-}(1 - D_t)[R_{m,t} - r_{f,t}] + e_{i,t}.$$

D_t is a dummy variable that is one if the MSCI return is positive in month t and zero otherwise. The relative strength portfolios in Panel A are formed based on past performance only, the Winner and Loser portfolios in Panel B are constrained to have a similar size and country composition. R^2 is the coefficient of determination adjusted for degrees of freedom, and $t(\cdot)$ is the coefficient divided by its standard error.

Portfolio	α	$t(\alpha)$	β^{+}	$t(\beta^{+})$	β^{-}	$t(\beta^{-})$	R^2
Panel A: Unrestricted Relative Strength Portfolios							
Loser	−0.0065	−1.69	1.13	10.24	0.90	9.58	0.62
Winner	0.0134	4.57	0.87	10.46	1.14	16.00	0.75
Winner − Loser	0.0199	4.56	−0.25	−2.04	0.24	2.26	0.02
Panel B: Size-Country-Neutral Relative Strength Portfolios							
Loser	−0.0044	−1.65	1.03	13.68	0.94	14.51	0.77
Winner	0.0098	5.05	0.80	14.52	1.01	21.43	0.85
Winner − Loser	0.0141	5.88	−0.23	−3.37	0.07	1.26	0.05

B. Relative Strength Strategies in Event Time

As noted earlier, the return on the (J,K) relative strength portfolio at time t is determined by the payoffs to K separate positions put into place at times $t - 1$ through $t - K$, with each position based on past J-month performance rankings at those times. In this Section I look at the performance of each of these components in event time: what is the average excess return on buying Winners and selling Losers ($J = 6$) in the kth month after the strategy is put into place? This provides information about the duration of the continuation effect, as well as the extent to which it is permanent.

Table VI gives the monthly average excess return (W − L) in the first two years after portfolio formation, both before and after risk adjustment. The raw excess returns are uniformly positive in the first 11 months after portfolio formation, after which time they turn negative. The risk-adjusted excess returns are significantly positive in the first 11 months after portfolio formation. There is some indication of time variation in the risk exposure of the event time portfolios, but it is not sufficient to explain the excess returns. In fact, all event time portfolios have negative loadings on the SMB factor, which tends to increase the abnormal returns relative to the raw excess returns. The sample average risk premium of SMB is 0.29 percent per month, which is about half the sample average excess return of the market factor of 0.62 percent per month. Because the absolute value of the loadings

Table VI

Relative Strength Excess Returns in Event Time

The table reports the results of regressing the monthly excess returns of a portfolio of Winners − Losers (W − L), formed by ranking stocks on six-month past performance, in the kth month after portfolio formation on the excess return on the value weighted Morgan Stanley Capital International index of the 12 sample countries over the deutsche mark risk free rate, $R_{m,t} - r_{f,t}$, and the excess return on an internationally diversified portfolio of small stocks over a portfolio of large stocks, SMB_t:

$$W_{k,t} - L_{k,t} = \alpha_k + \beta_k[R_{m,t} - r_{f,t}] + \gamma_k \text{SMB}_t + e_{k,t}.$$

R^2 is the coefficient of determination, adjusted for degrees of freedom, and $t(\cdot)$ is the point estimate divided by its standard error.

k	mean $(W_k - L_k)$	t (mean)	α_k	$t(\alpha_k)$	β_k	$t(\beta_k)$	γ_k	$t(\gamma_k)$	R^2
1	0.0072	1.94	0.0120	3.13	−0.14	−1.77	−1.14	−3.35	0.06
2	0.0136	4.07	0.0181	5.26	−0.06	−0.83	−1.14	−3.94	0.07
3	0.0153	4.60	0.0194	5.68	−0.01	−0.09	−1.11	−3.92	0.07
4	0.0125	3.84	0.0162	4.86	0.05	0.73	−1.08	−3.89	0.08
5	0.0106	3.28	0.0141	4.26	0.05	0.76	−1.02	−3.72	0.07
6	0.0127	4.10	0.0149	4.62	0.10	1.53	−0.74	−2.78	0.05
7	0.0143	4.82	0.0153	4.96	0.14	2.22	−0.49	−1.93	0.04
8	0.0102	3.52	0.0114	3.81	0.13	2.02	−0.55	−2.24	0.05
9	0.0092	3.37	0.0106	3.73	0.10	1.62	−0.54	−2.32	0.04
10	0.0062	2.45	0.0085	3.29	0.05	0.87	−0.72	−3.37	0.06
11	0.0035	1.35	0.0061	2.32	0.05	0.82	−0.84	−3.89	0.08
12	−0.0006	−0.25	0.0031	1.25	0.01	0.20	−1.07	−5.12	0.12
13	−0.0052	−2.03	−0.0019	−0.73	0.05	0.99	−1.02	−4.80	0.12
14	−0.0046	−1.68	−0.0011	−0.40	0.07	1.27	−1.10	−4.86	0.13
15	−0.0059	−2.17	−0.0027	−1.02	0.09	1.54	−1.04	−4.61	0.12
16	−0.0071	−2.58	−0.0041	−1.53	0.10	1.80	−1.03	−4.56	0.12
17	−0.0059	−2.24	−0.0036	−1.39	0.09	1.60	−0.81	−3.70	0.08
18	−0.0018	−0.73	−0.0005	−0.21	0.12	2.27	−0.61	−2.85	0.07
19	0.0010	0.41	0.0025	1.00	0.07	1.31	−0.57	−2.68	0.04
20	−0.0009	−0.38	−0.0006	−0.25	0.11	2.12	−0.29	−1.39	0.03
21	−0.0044	−1.95	−0.0038	−1.61	0.04	0.73	−0.25	−1.27	0.00
22	−0.0035	−1.60	−0.0021	−0.95	−0.04	−0.85	−0.35	−1.84	0.01
23	−0.0034	−1.50	−0.0016	−0.69	−0.05	−1.09	−0.46	−2.38	0.02
24	−0.0043	−1.80	−0.0022	−0.91	−0.06	−1.07	−0.57	−2.82	0.03

on SMB is more than twice as large as the market factor loadings, the SMB factor dominates the risk correction of the raw returns. The excess returns turn negative in the second year after portfolio formation, although the abnormal returns are never significant. This does suggest, however, that part of the continuation effect may be temporary and is reversed in the second year after portfolio formation. These results are strikingly similar to the results of Jegadeesh and Titman (1993) for the U.S. market. They also report significant raw excess returns in months 2 through 10, although the return reversal for the U.S. market in the second year is somewhat less pronounced than in our European sample.

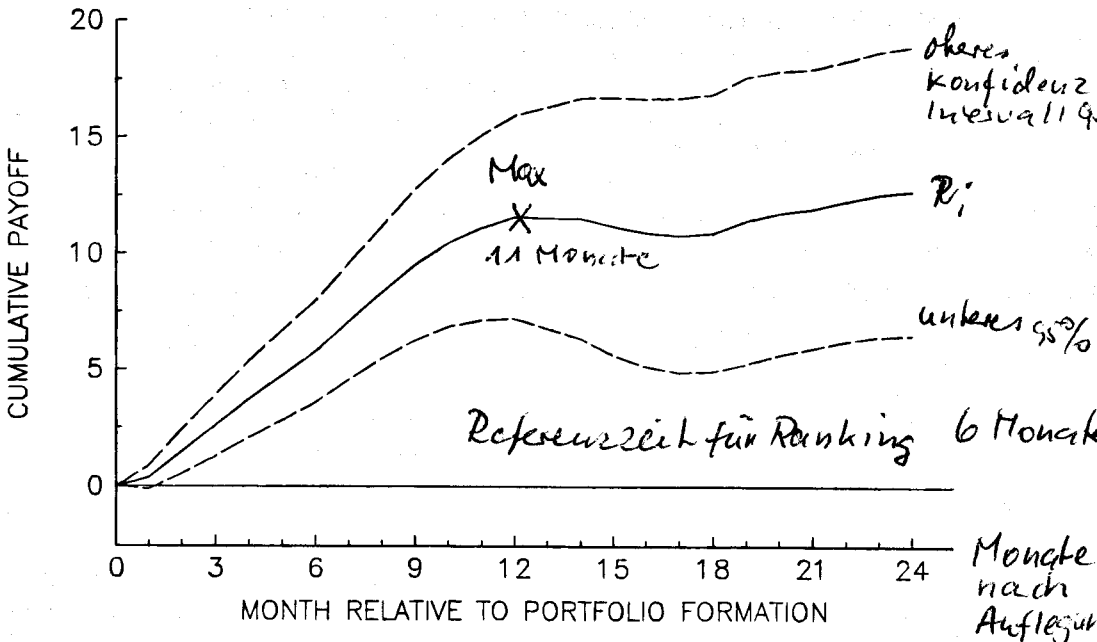

Figure 1. Cumulative payoff to momentum strategies in event time. The solid line gives the average cumulative payoff to a buy-and-hold strategy that invest a deutsche mark (DM) in a portfolio of Winners financed by a unit DM portfolio of Losers, in the kth month after portfolio formation. The payoff is measured in pfennigs (equals 0.01 DM). At the time of formation, the Winners and Losers are equally weighted portfolios constructed to be both size- and country-neutral. They contain from each of the 36 size-country groups the top and bottom decile of stocks ranked in ascending order based on past six-month return. The dashed lines give the 95 percent confidence interval of the average payoff, computed using autocorrelation consistent standard errors.

Figure 1 presents the evolution of the cumulative payoff to buying Winners and selling Losers in event time. Both portfolios are size-country-neutral. The solid line is computed as the average difference between the K-period buy-and-hold returns of the long and short positions, and is free from the potential bias induced by summing short-term returns to obtain long-term performance measures. The dashed lines mark a 95 percent confidence interval for the average payoff, using standard errors that take into account the autocorrelation of the payoffs. The size-country-neutral relative strength strategy has on average a significantly positive payoff up to 24 months after portfolio formation. The payoff initially peaks 12 months after formation at 11.54 pfennig per DM invested in the long position, after which it stays mostly flat.

Figure 1 can also be used to assess the profitability of momentum strategy after transactions costs. Because the sample focuses on the larger and more liquid stocks in the European market, transactions costs for a single round-trip are typically below 1 percent. This would imply round-trip transactions

costs below 2 percent or about 2 pfennig for buying the Winner and selling the Loser portfolios. Figure 1 shows that the payoff to the size-country-neutral strategy significantly exceeds a 2 pfennig transaction cost for holding periods between 4 and 24 months, and transactions costs of 4 pfennig for holding periods between 7 and 24 months.

C. Are There Common Components among European and U.S. Momentum Strategies?

Part of the motivation of this paper is that a sample of international firms can provide "independent" evidence about the profitability of momentum strategies. However, the similarity between the European and U.S. findings does not directly address the question of independence. Jegadeesh and Titman (1993) conclude that the profitability of momentum strategies in the United States cannot be attributed to contemporaneous or delayed stock price responses to common factors, but is consistent with a delayed price reaction to firm-specific information. If momentum returns only reflect a delayed price response to firm-specific information, the standard deviation of international momentum strategies that simultaneously buy and sell more than 200 stocks should be very small. The fact that the country-neutral European W − L portfolio in this paper and the U.S. W − L portfolio in Jegadeesh and Titman (1993) have standard deviations of 2.4 and 3.1 percent per month indicates that both strategies are not perfectly diversified. It is therefore quite conceivable that momentum (W − L) returns have common components across markets.

A preliminary answer to this question can be obtained by examining the correlation between European and U.S. momentum returns, and evaluating the profitability of the European momentum strategy conditional on the U.S. experience.[14] The sample correlation between the country-neutral European and U.S. momentum returns, cor($W - L_{EUR}$, $W - L_{US}$), is 0.43 over the 1980 to 1995 period, indicating strong positive dependence across markets.[15] A regression of $W - L_{EUR}$ on $W - L_{US}$ can be used to evaluate the profitability of the European strategy conditional on the U.S. experience:

$$W - L_{EUR,t} = \underset{(4.04)}{0.0065} + \underset{(6.62)}{0.222}\, W - L_{US,t} + e_t, \qquad R^2 = 0.19,$$

where t-statistics are given in parentheses. Assuming joint normality, the intercept of this regression measures the average excess return of the component of the European momentum portfolio which is independent of U.S. momentum returns. Conditioning on the United States reduces the average excess return of the European momentum portfolio from 0.93 (Table III, Panel

[14] I am grateful to the referee for suggesting this point.

[15] I construct the ($J = 6$, $K = 6$) buy-and-hold U.S. momentum (W − L) portfolio using all available NYSE and AMEX firms on CRSP in the same way as the European W − L portfolio. The sample average return and standard deviation of the U.S. momentum portfolio are 1.24 and 4.65 percent per month from 1980 through 1995.

A) to 0.65 percent per month, but the high t-statistic of the intercept implies profitability of European momentum strategies that is independent of a common component with the United States. In this sense the European sample provides independent evidence of profitability of momentum strategies. Although these results can be consistent with the presence of a "momentum factor" in returns, the dependence can also be due to non-zero exposures to other common priced risk factors (such as SMB), common unpriced factors (industry factors), or a combination of both. A more detailed analysis of this issue is beyond the scope of the current paper, however, and is left for future research.

IV. Conclusions

This paper documents international return continuation in a sample of 12 European countries during the period 1980 to 1995. An internationally diversified portfolio of past Winners outperformed a portfolio of past Losers by about 1 percent per month. These relative strength strategies load negatively on conventional risk factors such as size and the market. The payoffs are therefore inconsistent with the joint hypotheses of market efficiency and commonly used asset pricing models. Return continuation is present in all countries, and holds for both large and small firms, although it is stronger for small firms than large firms. The European evidence is remarkably similar to findings for the United States by Jegadeesh and Titman (1993), and makes it unlikely that the U.S. experience was simply due to chance. Returns on European momentum portfolios are significantly correlated with relative strength strategies in the United States. Whether this correlation reflects a priced momentum factor that is common across markets remains a topic for future research.

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