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International Momentum Strategies

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ABSTRACT

International equity markets exhibit medium-term return continuation. Between 1980 and 1995 an internationally diversified portfolio of past medium-term Winners outperforms a portfolio of medium-term Losers after correcting for risk by more than 1 percent per month. Return continuation is present in all twelve sample countries and lasts on average for about one year. Return continuation is negatively related to firm size, but is not limited to small firms. The international momentum returns are correlated with those of the United States which suggests that exposure to a common factor may drive the profitability of momentum strategies.

MANY PAPERS HAVE DOCUMENTED that average stock returns are related to past performance. Jegadeesh and Titman (1993) document that over medium-term horizons performance persists: firms with high returns over the past three months to one year continue to outperform firms with low past returns over the same period. By contrast, DeBondt and Thaler (1985, 1987) document return reversals over longer horizons. Firms with poor three- to five-year past performance earn higher average returns than firms that performed well in the past. There has been an extensive literature on whether these return patterns reflect an improper response by markets to information, or whether they can be explained by market microstructure biases or by properly accounting for risk.[1] Fama and French (1996) show that long-term reversals can be consistent with a multifactor model of returns, but their model fails to explain medium-term performance continuation. Chan, Jegadeesh, and Lakonishok (1996) find that medium-term return continuation can be explained in part by underreaction to earnings information, but price momentum is not subsumed by earnings momentum.

Return reversal and continuation are only two of many patterns that empirical researchers have uncovered using substantially the same database of U.S. stocks. It can therefore not be ruled out that these apparent anomalies are simply the outcome of an elaborate data snooping process. This paper is

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[1] See for example Chan (1988), Ball and Kothari (1989), Ball, Kothari, and Shanken (1995), Conrad and Kaul (1993, 1996), Chan, Hamao, and Lakonishok (1991), Lakonishok, Schleifer, and Vishny (1994), and DeLong et al. (1990).

an attempt to address this concern by studying return patterns in an international context. Although Asness, Liew, and Stevens (1996) and Richards (1996) study return patterns across markets at the country index level, this paper primarily focuses on international return continuation within markets and across markets at the individual stock level using a sample of 2,190 stocks from 12 European countries in the period 1978 to 1995.[2] Because of the length of the sample period, the paper concentrates only on patterns in medium-term returns. The sample period partly overlaps with the United States samples of Jegadeesh and Titman (1993) and Fama and French (1996), and is thus not strictly independent because of common factors in international markets. However, return continuation in the United States does not seem to be related to common factors or conventional measures of risk. If return continuation is absent in international markets or, when present, can be rationalized using conventional measures of risk, this suggests that the U.S. experience may simply have been unusual. Return continuation that is common to many markets and cannot be accounted for by risk points either toward a more serious misspecification of commonly used asset pricing models or a general tendency of markets to underreact to information.

The main finding of the paper is that an internationally diversified relative strength portfolio that invests in medium-term Winners and sells past medium-term Losers earns approximately 1 percent per month. This momentum in returns is not limited to a particular market, but is present in all 12 markets in the sample. It holds across size deciles, although return continuation is stronger for small than large firms. The outperformance lasts for about one year, and cannot be attributed to conventional measures of risk. In fact, controlling for market risk or exposure to a size factor increases the abnormal performance of relative strength strategies. The paper, however, presents some evidence that European and U.S. momentum strategies have a common component, which suggests that exposure to a common factor may drive the profitability of momentum strategies.

The remainder of the paper is organized as follows. Section I describes the sample and documents the profitability of medium-term international momentum strategies. Section II shows that momentum is not restricted to stocks of a particular country or size category. Section III examines whether the returns to momentum strategies can be explained by conventional asset pricing models. Section IV provides conclusions.

I. Returns of Relative Strength Portfolios

The sample consists of monthly total returns in local currency for 2,190 firms from 12 European countries from 1978 through 1995: Austria (60 firms), Belgium (127), Denmark (60), France (427), Germany (228), Italy (223), The Netherlands (101), Norway (71), Spain (111), Sweden (134), Switzerland (154), and the United Kingdom (494). The sample covers 60 to 90 percent of each

[2] Foerster, Prihar, and Schmitz (1995) provide evidence on momentum strategies in the Canadian market.

country's market capitalization.[3] All returns are converted to deutsche marks (DM) using exchange rate information taken from the *Financial Times*.

The relative strength portfolios are constructed as in Jegadeesh and Titman (1993). At the end of each month, all stocks with a return history of at least 12 months are ranked into deciles based on their past J-month return (J equals 3, 6, 9, or 12) and assigned to one of ten relative strength portfolios (1 equals lowest past performance, or "Loser", 10 equals highest past performance, or "Winner"). These portfolios are equally weighted at formation, and held for K subsequent months (K equals 3, 6, 9, or 12 months) during which time they are not rebalanced.[4] The holding period exceeds the interval over which return information is available (monthly), which creates an overlap in the holding period returns. The paper follows Jegadeesh and Titman (1993) who report the monthly average return of K strategies, each starting one month apart. This is equivalent to a composite portfolio in which each month $1/K$ of the holdings are revised. For example, toward the end of month t the $J = 6$, $K = 3$ portfolio of Winners consists of three parts: a position carried over from an investment of one DM at the end of month $t - 3$ in the 10 percent of firms with highest prior six-month performance as of $t - 3$, and two similar positions resulting from a DM invested in the top-performing firms at the end of months $t - 2$ and $t - 1$. At the end of month t, the first of these holdings will be liquidated and replaced with a unit DM investment in the stocks with highest six-month performance as of time t.

Table I presents the average monthly returns on these composite portfolio strategies from 1980 to 1995.[5] Panel A shows that an equally weighted portfolio formed from the stocks in the bottom decile of previous three-month performance returns 1.16 percent per month, 0.70 percent less than the top decile portfolio, which returns 1.87 percent. For the three-month holding period ($K = 3$), the excess return from buying Winners and selling Losers increases with the length of the return interval used for ranking (J). Irrespective of the interval used for ranking, average returns tend to fall for longer holding periods. For each of the ranking and holding periods, however, past Winners outperformed past Losers by about 1 percent per month. The returns range from 0.64 to 1.35 percent per month earned by portfolios based on 12-month ranked returns held for 12 and 3 months respectively. All excess returns in Panel A are significant at the 5 percent level.

The portfolios in Panel A are formed at the end of the performance ranking period. Because bid-ask bounce can attenuate the continuation effect, Panel B reports the average returns if the portfolio formation is delayed relative to

[3] Although the sample is not comprehensive, and is biased to the larger firms in each market, there is no selection bias in the sense that the data are not backfilled.

[4] An exception arises when a stock is delisted. In that case the liquidating proceeds are invested in the value-weighted Morgan Stanley Capital International (MSCI) index of the 12 countries in the sample. The conclusions of the paper are unchanged if the proceeds are reinvested in the remaining stocks in the same decile portfolio.

[5] Return data are available from 1978, but two years are lost due to performance ranking: the $J = 12$, $K = 12$ strategy consists in part of positions taken 12 months ago based on prior 12-month performance.

Table I

Returns of Relative Strength Portfolios

At the end of each month all stocks are ranked in ascending order based on previous J-month performance. The stocks in the bottom decile (lowest previous performance) are assigned to the Loser portfolio, those in the top decile to the Winner portfolio. The portfolios are initially equally weighted and held for K months. The table gives the average monthly buy-and-hold returns on these portfolios for the period 1980 to 1995. In Panel A the portfolios are formed immediately after ranking, in Panel B the portfolio formation occurs one month after the ranking takes place. t-stat is the average return divided by its standard error.

		Panel A				Panel B			
		Holding Period (K)				Holding Period (K)			
Ranking Period (J)	Portfolio	3	6	9	12	3	6	9	12
3	Loser	0.0116	0.0104	0.0108	0.0109	0.0077	0.0087	0.0094	0.0105
	Winner	0.0187	0.0192	0.0190	0.0191	0.0185	0.0191	0.0190	0.0184
	Winner − Loser	0.0070	0.0088	0.0082	0.0082	0.0109	0.0105	0.0095	0.0079
	(t-stat)	(2.59)	(3.86)	(4.08)	(4.56)	(4.29)	(4.74)	(4.99)	(4.64)
6	Loser	0.0095	0.0090	0.0092	0.0104	0.0072	0.0076	0.0088	0.0106
	Winner	0.0208	0.0206	0.0204	0.0195	0.0204	0.0205	0.0200	0.0187
	Winner − Loser	0.0113	0.0116	0.0112	0.0091	0.0131	0.0128	0.0112	0.0081
	(t-stat)	(3.60)	(4.02)	(4.35)	(3.94)	(4.27)	(4.59)	(4.50)	(3.62)
9	Loser	0.0088	0.0083	0.0097	0.0111	0.0064	0.0077	0.0095	0.0114
	Winner	0.0212	0.0213	0.0204	0.0193	0.0209	0.0207	0.0197	0.0184
	Winner − Loser	0.0124	0.0129	0.0107	0.0082	0.0145	0.0130	0.0102	0.0070
	(t-stat)	(3.71)	(4.19)	(3.78)	(3.19)	(4.50)	(4.36)	(3.77)	(2.83)
12	Loser	0.0084	0.0094	0.0108	0.0121	0.0077	0.0093	0.0110	0.0125
	Winner	0.0219	0.0209	0.0197	0.0185	0.0208	0.0198	0.0188	0.0176
	Winner − Loser	0.0135	0.0115	0.0089	0.0064	0.0131	0.0105	0.0078	0.0051
	(t-stat)	(3.97)	(3.66)	(3.07)	(2.40)	(4.03)	(3.48)	(2.80)	(1.98)

the ranking by one month. For the shorter ranking and holding intervals, delaying the portfolio formation indeed increases the payoff to buying Winners and selling Losers. This increase is primarily due to a lower return to the Loser portfolio.

Bid-ask bounce can also affect the measurement of the holding period returns. Blume and Stambaugh (1983) show that long-term performance measures, obtained by averaging short-term returns over time, will be biased upward due to measurement error in the returns and bid-ask bounce. This bias affects the apparent profitability of momentum strategies because Losers are on average smaller than Winners.[6] In addition to the average monthly return on K-month strategies given in Table I, I also compute the average K-month holding period returns on the various strategies, and find the results to be very similar.

The remainder of the paper will concentrate on portfolios formed on the basis of six-month ranked returns, formed at the end of the ranking period and held for six months. Table II presents the summary statistics for the 10 decile portfolios of this strategy. The Average Return column shows that the average performance of the decile portfolios is monotonically increasing in previous six-month return. Higher past six-month return is on average associated with stronger future six-month performance. An F-test strongly rejects the equality of average returns of the relative strength portfolios. The next column of Table II shows that the standard deviation of the decile portfolios is u-shaped. The Winner and Loser portfolios have standard deviations that are 30 and 40 percent higher than the portfolios in the middle deciles. All else equal, stocks with higher standard deviations are more likely to show unusual performance, and past unusual performance is cross-sectionally correlated with volatility. The standard deviation of the excess return of Winners over Losers is about 4 percent per month, which is similar to the volatility of a long position in the middle decile portfolios. This indicates that an "unrestricted" international momentum portfolio may not be well-diversified. The MSCI β column shows that the excess return of Winners over Losers is unlikely to be explained by its covariance with the market. The sample average excess return on the market is about 0.6 percent per month. For market risk to explain a continuation effect of 1.2 percent per month would require, loosely speaking and ignoring standard errors, that the beta of Winners exceeds the beta of Losers by about two. Instead, both betas with respect to the value-weighted Morgan Stanley Capital International (MSCI) index are close to unity, and the beta of the excess return of Winners over Losers is insignificantly different from zero.[7] The last column of Panel A reveals two interesting characteristics of the relative strength portfolios. First, the average size of the Losers is smaller than the average size

[6] For example, Conrad and Kaul (1993) and Ball, Kothari, and Wasley (1995) show that this bias overstates the profitability of contrarian strategies.

[7] Allowing for a delayed market response due to nonsynchronous trading does not change these conclusions.

Table II

Returns of Relative Strength Decile Portfolios

At the end of each month all stocks are ranked in ascending order based on previous six-month performance. The stocks in the bottom decile (lowest previous performance) are assigned to the Loser portfolio, those in the top decile to the Winner portfolio. The portfolios are initially equally weighted and held for six months. The table gives the average monthly buy-and-hold returns and standard deviations of the 10 portfolios for the period 1980 to 1995. The Morgan Stanley Capital International (MSCI) β is the beta of the decile portfolio computed relative to the value-weighted MSCI index of the 12 countries in the sample. The average size is the average natural logarithm of the market value of equity of the stocks in the portfolio, computed in deutsche marks. The F-statistic tests for equality of average returns of the 10 relative strength portfolios.

Prior Return Decile	Average Return	Standard Deviation	MSCI β	Average Size
Loser	0.0090	0.0564	1.00	5.55
2	0.0096	0.0459	0.89	6.01
3	0.0101	0.0420	0.85	6.19
4	0.0112	0.0402	0.83	6.29
5	0.0114	0.0398	0.84	6.36
6	0.0125	0.0403	0.86	6.40
7	0.0135	0.0414	0.89	6.44
8	0.0144	0.0431	0.91	6.43
9	0.0165	0.0450	0.93	6.41
Winner	0.0206	0.0527	1.02	6.22
Winner − Loser	0.0116	0.0397	0.02	
(t-stat)	(4.02)			
$F = 3.58$ (p-value < 0.001)				

of the Winners.[8] Although Section III of the paper deals with risk-adjustment in more detail, the fact that average returns are negatively related to firm size suggests that size as a risk factor cannot explain the continuation effect. Second, both Winners and Losers are on average smaller than the average firm in the sample. This suggests that implementation of the Winners − Losers (W − L) strategy may be difficult because it predominantly requires positions in small stocks. The next section shows, however, that this is not the case.

II. Relative Strength Strategies That Control for Country and Size

The relative strength portfolios in the previous section combine stocks from 12 national markets, some of which are larger in size than others. More than half of the 2,190 stocks in the sample are from the United Kingdom (494), France

[8] This size differential is in part a manifestation of the continuation effect, because the $J = 6, K = 6$ relative strength portfolios at time t contain positions taken at time $t - 6$. Of two firms that have equal size but different past performance at time $t - 6$, the firm with higher past returns will at time t on average be larger than the firm with lower past returns because performance persists.

(427), or Germany (228). The average market capitalization of these firms is larger than that of firms in the smaller European markets. This raises three questions about the source and the pervasiveness of the continuation effect. First, the continuation effect may be confined to only a subset of the 12 markets: either the three largest markets, which contribute the majority of sample firms, or alternatively the smaller European markets, which contain relatively many small and thinly traded issues. Second, no restrictions have been placed on the geographical composition of the relative strength portfolios and the country weights vary over time. The continuation effect may therefore in part be due to country momentum. It is interesting therefore to see to what extent the continuation effect holds in individual countries, and is present in relative strength portfolios that are country-neutral. Finally, because both the Winner and Loser portfolios in Table II are tilted toward small stocks, I will examine the influence of firm size on the returns to relative strength strategies. As pointed out before, country membership and firm size are not independent, and I also present results for portfolios that are both size- and country-neutral.

A. Relative Strength Portfolios by Country

Return decompositions by Heston and Rouwenhorst (1994) and Griffin and Karolyi (1996) show the presence of large country-specific factors in international stock returns. Large country-specific shocks can potentially lead to poor international diversification of the relative strength portfolios. For example, a strong performance of German stocks relative to other markets will subsequently cause the Winner portfolio to be overweighted in Germany relative to the European equally weighted index. Similarly, the Loser portfolio will be tilted toward stocks from markets with poor past performance. One possible explanation for return continuation is that country-specific market performance persists (Asness et al. (1996), Richards (1996)). However, if return continuation is primarily due to country momentum, controlling for the geographical composition of relative strength portfolios should significantly reduce the average payoffs to buying Winners and selling Losers. If on the other hand medium-term persistence reflects idiosyncratic firm performance, return continuation will remain present in country-neutral relative strength portfolios as well.

Country-neutral relative strength portfolios are formed by ranking stocks into deciles based on past performance relative only to stocks from the same local market. The 10 percent of stocks from each country with lowest past six-month return are assigned to the Loser portfolio, the top 10 percent to the Winner portfolio. Except for integer constraints, the resulting decile portfolios are well-diversified in the sense that they have the same country allocation, and are country-neutral relative to the equally weighted index of the 12 countries in the sample.[9] Panel A of Table III shows that controlling for country composition only slightly reduces the average excess return of

[9] This is only approximately true. The relative strength portfolios consist of K separate holdings, and each of these K positions is only country-neutral at origination. Because the positions are not rebalanced over time they lose their equal weighting in subsequent periods, due to performance differences and as securities are added to (or removed from) the sample.

Table III

Returns of Relative Strength Portfolios that Control for Country and Size

At the end of each month all stocks are ranked in ascending order based on previous six-month performance, relative to other stocks in its country (Panel A), size decile (Panel B), or size-country group (Panel C). The bottom decile of stocks are assigned to the Loser (L) portfolio, the top decile to the Winner (W) portfolio. The portfolios are initially equally weighted and held for six months. Each panel gives the average monthly buy-and-hold return and standard deviation of an internationally diversified relative strength portfolio and its components for the period 1980 to 1995. The W − L excess returns for Austria, Denmark, and Norway in Panel A are based on Winner and Loser quintile portfolios due the small number of firms in the sample. The size assignments in Panel C correspond to the ranking of stocks in each country on size relative to other stocks in that country: small (bottom 30 percent), medium (middle 40 percent), and large (top 30 percent). t(mean) is the mean divided by its standard error.

Portfolio	Mean	Std. Dev.	t(mean)
Panel A: Country-Neutral Momentum Strategies			
All stocks (country-neutral)	0.0093	0.0239	5.36
By country:			
Austria	0.0080	0.0498	2.23
Belgium	0.0110	0.0444	3.42
Denmark	0.0109	0.0478	3.16
France	0.0097	0.0496	2.72
Germany	0.0072	0.0395	2.52
Italy	0.0093	0.0508	2.53
Netherlands	0.0126	0.0497	3.51
Norway	0.0099	0.0658	2.09
Spain	0.0132	0.0801	2.28
Sweden	0.0016	0.0632	0.36
Switzerland	0.0064	0.0428	2.08
United Kingdom	0.0089	0.0408	3.02
Panel B: Size-Neutral Momentum Strategies			
All stocks (size-neutral)	0.0117	0.0376	4.30
By size decile:			
Smallest	0.0145	0.0588	3.42
2	0.0165	0.0542	4.21
3	0.0130	0.0495	3.64
4	0.0156	0.0455	4.75
5	0.0120	0.0409	4.04
6	0.0100	0.0453	3.04
7	0.0084	0.0463	2.51
8	0.0089	0.0451	2.73
9	0.0102	0.0479	2.96
Largest	0.0073	0.0473	2.13

Table III—*Continued*

Portfolio	Mean	Std. Dev.	*t*(mean)
Panel C: Size-Country-Neutral Momentum Strategies			
All stocks (size-country-neutral)	0.0085	0.0221	5.32
Size-neutral country portfolios:			
France	0.0099	0.0463	2.94
Germany	0.0065	0.0373	2.40
UK	0.0087	0.0363	3.31
Other	0.0087	0.0236	5.07
Country-neutral size portfolios:			
Small	0.0105	0.0304	4.79
Medium	0.0092	0.0249	5.09
Large	0.0055	0.0216	3.51

Winners over Losers (W − L) from 1.16 to 0.93 percent per month. This suggests that country momentum is relatively unimportant for explaining the continuation effect.[10] The better diversification of the country-neutral relative strength portfolios lowers the standard deviations of both the Winner and Loser portfolios and increases their correlation from 0.74 to 0.88. As a result, the standard deviation of the excess return falls from 3.97 to 2.39 percent per month, and the significance of the average excess return increases ($t = 5.36$).

The remainder of Panel A gives the W − L excess returns by country. Winners have outperformed Losers in all 12 countries. In 11 countries the W − L excess return has a *t*-statistic exceeding two, including the largest markets of France, Germany, and the United Kingdom. Only in Sweden is the excess return insignificantly different from zero. The strongest continuation effect occurred in Spain, followed by The Netherlands, Belgium, and Denmark. The standard deviations of the individual country excess returns are about two to three times larger than the standard deviation of the internationally diversified momentum strategy. This implies that a large portion of the W − L excess return variance is country-specific and can be diversified internationally. The conclusion from Panel A is that return continuation is not due to country momentum. It is pervasive, and not restricted to a few individual markets.[11]

[10] This is consistent with the relatively weak momentum in country index returns reported in Richards (1996), Bekaert et al. (1996), and Ferson and Harvey (1996).

[11] I also perform a similar analysis of sector momentum, by constructing sector-neutral portfolios based on assignments to 7 broad industry groups obtained from the *Financial Times*. The returns on sector-neutral relative strength strategies were all positive, and significantly different from zero for Basic Industries, Capital Goods, Consumer Goods, and Finance. For the Energy, Transportation, and Utilities sectors, which contain relatively few stocks and hence are poorly diversified, the equality of Winner and Loser returns could not be rejected.

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

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.

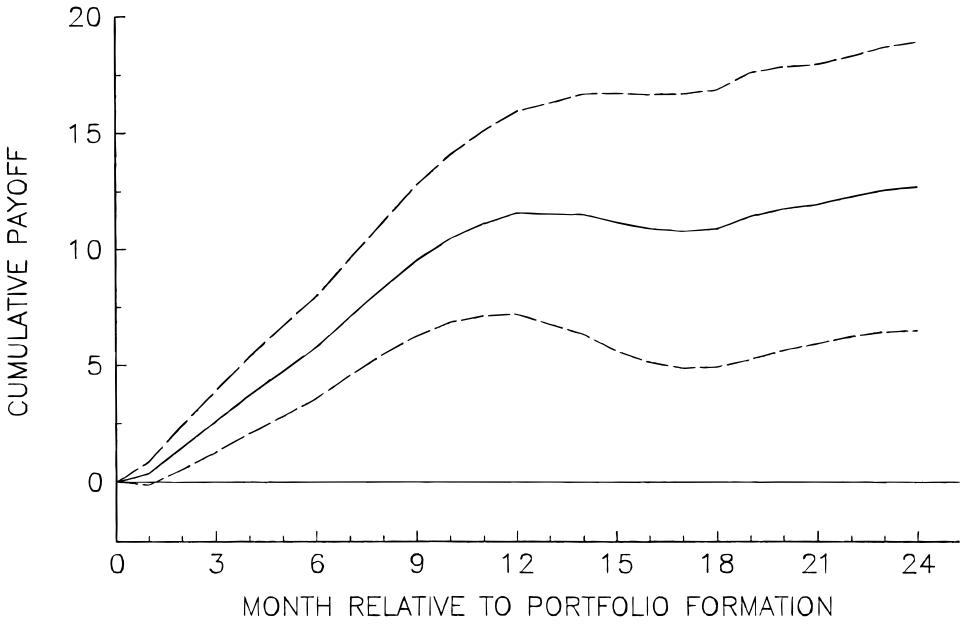

Figure 1. Cumulative payoff to momentum strategies in event time. The solid line gives the average cumulative payoff to a buy-and-hold strategy that invest a deutsche mark (DM) in a portfolio of Winners financed by a unit DM portfolio of Losers, in the kth month after portfolio formation. The payoff 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:

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

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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