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Macromomentum: Returns Predictability in International Equity Indices*

This study examines momentum and reversals in international stock market indices. We find that country stock indices exhibit momentum during the first year after the portfolio formation date and reversals during the subsequent 2 years. Positive currency momentum predicts low stock index returns in the future, thereby weakening momentum and strengthening reversals in U.S. dollar-denominated stock index returns. Cross-sectional regression tests involving individual stock indices confirm the portfolio findings. Our results are consistent with a key prediction of recent behavioral theories, that initial momentum should be accompanied by subsequent reversals.

I. Introduction

In this paper, we examine the predictions of behavioral theories that momentum should be followed by reversals, using international stock indices. Jegadeesh and Titman (1993) document a pervasive momentum effect in equity markets: past 3- to 12-month winners outperform past 3- to 12-month losers over the next 3 to 12 months. These results have been a source of great controversy in the finance literature because, taken at face value, they present a challenge to market efficiency. Recent behavioral theories (e.g., Barberis, Shleifer, and Vishny 1998; Daniel, Hirshleifer, and Subrahmanyam 1998; Hong and Stein 1999) suggest that momentum is the result of an initial underreaction to private or public news.[1] In addition, these theories

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1. In Barberis et al. (1998), investors underreact to public earnings news due to the "conservatism" bias, while in Daniel et al. (1998), investors overreact to private news and underreact to public news due to the "overconfidence" bias. Hong and Stein (1999) model the underreaction as occurring when boundedly

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provide an empirically testable prediction that momentum should be followed by reversals. The rationale behind this prediction is as follows: stock prices initially underreact to information, causing momentum as prices rise toward their fundamental value, but prices overreact and continue to rise above their fundamental value due to overoptimistic expectations about the future prospects of these stocks, which ultimately leads to reversals. Testing this prediction provides a direct way to evaluate the validity of behavioral theories. An international setting is of particular interest, since it provides important out-of-sample evidence not available in tests based on U.S. equities.[2]

We examine whether momentum in country index returns is followed by reversals using data on 38 country stock indices. Previous work on predictability in country stock indices include Asness, Liew, and Stevens (1997) and Chan, Hameed, and Tong (2000), who document momentum in country stock index returns, and Richards (1997) and Balvers, Wu, and Gilliland (2000), who provide evidence of the profitability of long-run contrarian strategies. Neither set of papers, however, examines the key prediction of behavioral theories, that initial momentum should be accompanied by subsequent reversals.[3] Our data on country stock indices is from Morgan Stanley Capital International (MSCI) and covers a 30-year period from 1970 to 1999 (see table 1 for a list of these countries).[4]

International stock indices provide a convenient case with which to test the predictions of behavioral theories out of sample, since they are relatively unaffected by the illiquidity problems that plague studies involving individual stocks. It is well established that the predictability patterns observed in U.S. equities are concentrated among low- to mid-cap stocks, low-priced stocks, and less-followed stocks (see Jegadeesh

rational agents each observe some private information but fail to extract other agents' information from prices, resulting in a gradual diffusion of information.

2. Lee and Swaminathan (2000) and Jegadeesh and Titman (2001) show that U.S. stocks exhibiting initial momentum ultimately experience reversals. Swaminathan and Lee (2002) show that stocks exhibiting postearnings announcement drift also ultimately experience reversals, especially if they have experienced a long string of positive or negative earnings news.

3. Existing empirical evidence (see DeBondt and Thaler 1985) shows that long-run contrarian strategies are also profitable (contrarian strategy forms portfolios based on past 3- to 5-year returns, while the momentum strategy forms portfolios based on past 3- to 12-month returns) in the United States, but this does not necessarily imply that momentum should be followed by reversals. This is because the two strategies (momentum and contrarian) involve different sets of securities and membership in one does not necessarily imply past or future membership in the other. Behavioral theories, however, make the unambiguous prediction that the securities exhibiting the largest momentum are the same ones that should ultimately exhibit reversals. This is a more restrictive prediction than can be inferred from the profitability of contrarian strategies.

4. Other international work that examines predictability in individual international stocks (not indices) includes Rouwenhorst (1998), who confirms the existence of momentum in European markets; Chui, Titman, and Wei (2001), who find that the profitability of momentum strategies is weaker in Asian markets; and Hong, Lee, and Swaminathan (2003), who examine the profitability of earnings momentum strategies in international markets.

TABLE 1 Descriptive Statistics on Country Stock Index Returns and Currency Returns

	Country Index Returns, US$			Country Index Returns, Local			Currency ($/Unit) Returns			
Country	Mean	SD	ρ(1)	Mean	SD	ρ(1)	Mean	SD	ρ(1)	NOBS
Argentina	.79	9.71	−10.0%	.79	9.71	−10.0%	−3.91	12.64	40.0%	71
Australia*	.97	7.26	−2.0%	1.05	6.22	1.0%	−.12	2.75	.0%	359
Austria*	.96	6.10	10.0%	.76	5.57	15.0%	.22	3.21	4.0%	359
Belgium	1.36	5.42	9.0%	1.27	4.79	16.0%	.12	3.32	.0%	359
Brazil	1.89	13.19	9.0%	6.40	17.82	33.0%	−11.04	12.07	77.0%	71
Canada*	.98	5.45	1.0%	1.04	4.94	2.0%	−.08	1.28	−6.0%	359
Chile	2.09	7.75	19.0%	2.68	7.48	20.0%	−.57	2.16	7.0%	143
Denmark*	1.27	5.42	−2.0%	1.25	5.02	10.0%	0.05	3.12	0.0%	359
Finland	2.00	8.44	10.0%	2.30	8.66	17.0%	−.23	3.32	13.0%	143
France*	1.27	6.63	7.0%	1.28	6.03	7.0%	.00	3.11	2.0%	359
Germany*	1.17	5.85	−2.0%	.95	5.26	5.0%	.24	3.24	3.0%	359
Greece	2.37	11.45	5.0%	3.05	11.54	9.0%	−.62	2.87	9.0%	143
Hong kong*	2.12	11.42	6.0%	2.17	10.92	5.0%	−.08	1.34	8.0%	359
Indonesia	1.93	17.62	13.0%	2.64	15.52	6.0%	−.68	7.93	18.0%	143
Ireland	1.24	5.75	−6.0%	1.43	5.80	15.0%	−.14	2.98	7.0%	143
Italy*	.89	7.60	6.0%	1.18	7.23	8.0%	−.27	3.02	4.0%	359
Japan*	1.33	6.62	9.0%	.91	5.44	5.0%	.41	3.41	5.0%	359
Korea	1.18	12.51	1.0%	1.24	10.46	8.0%	−.18	4.03	6.0%	143
Malaysia	1.07	10.34	11.0%	1.28	9.46	5.0%	−.22	3.84	14.0%	143
Mexico	2.60	10.74	12.0%	3.47	9.49	6.0%	−.92	3.82	9.0%	143
Morocco	1.64	4.55	32.0%	1.84	4.38	34.0%	−.19	1.77	−4.0%	59
Netherlands*	1.41	5.13	.0%	1.26	4.97	8.0%	.19	3.20	2.0%	359
New Zealand	.52	7.00	−9.0%	.66	6.44	−13.0%	−.16	2.14	5.0%	143
Norway*	1.23	7.81	11.0%	1.24	7.48	13.0%	.00	2.77	1.0%	359
Philippines	1.15	10.06	22.0%	1.55	9.20	13.0%	−.43	2.99	7.0%	143
Poland	3.43	19.42	10.0%	4.69	19.91	11.0%	−1.16	2.25	1.0%	83
Portugal	.64	6.74	2.0%	.92	6.50	13.0%	−.24	3.03	8.0%	143
Singapore	1.47	8.84	14.0%	1.27	8.45	15.0%	.18	1.62	8.0%	359
South Africa	1.22	8.23	−5.0%	1.37	6.32	−3.0%	−.21	3.79	6.0%	83

TABLE 1 ***(Continued)***

	Country Index Returns, US$			Country Index Returns, Local			Currency ($/Unit) Returns			
Country	Mean	SD	ρ(1)	Mean	SD	ρ(1)	Mean	SD	ρ(1)	NOBS
Spain*	1.09	6.53	8.0%	1.30	6.05	13.0%	−.19	2.97	6.0%	359
Sweden*	1.55	6.39	3.0%	1.68	6.28	12.0%	−.10	2.90	10.0%	359
Switzerland*	1.25	5.49	4.0%	.95	4.98	6.0%	.34	3.56	7.0%	359
Taiwan	1.65	12.52	11.0%	1.67	12.10	11.0%	−.06	1.56	8.0%	143
Thailand	.99	12.10	18.0%	1.23	11.60	10.0%	−.25	3.58	23.0%	143
Turkey	2.58	17.67	16.0%	7.01	17.63	10.0%	−4.19	3.59	37.0%	143
United Kingdom*	1.30	6.92	8.0%	1.38	6.25	10.0%	−.07	3.00	8.0%	359
United States*	1.13	4.41	.0%	1.13	4.41	.0%	.00	.00	.0%	359
Venezuela	1.61	16.12	−25.0%	3.93	15.34	−15.0%	−2.11	7.33	−3.0%	83
Mean	1.46	8.98	5.9%	1.90	8.57	8.7%	−.70	3.57	9.2%	

Note.—This table provides descriptive statistics of the return data obtained from Morgan Stanley Capital International used in this study. *Mean* refers to the average monthly returns in percent. *SD* refers to the standard deviation of monthly returns in percent. ρ(1) represents the first-order autocorrelation in monthly returns. *NOBS* represents the number of monthly observations. The sample period is January 1970 to December 1999. The ending date for all countries with a shorter time period is December 1999. The columns titled *Country Index Returns, US$* provides summary statistics for country stock index returns measured in U.S. dollars. The columns titled *Country Index Returns, Local* provides summary statistics for country stock index returns measured in their own currencies. The columns titled *Currency ($/ Unit) Returns* provides summary statistics for currency returns (rate of change of the price of foreign currency in U.S. dollars).

* These are the developed countries used in Richards (1997).

and Titman 1993 and Hong, Lim, and Stein 2000). In contrast, MSCI country indices represent the largest and the most frequently traded securities of any stock market. MSCI uses a bottom-up approach that picks stocks with the largest market cap and most liquidity in each industry group to construct its country index. In fact, the stated objective of MSCI in constructing these indices is investability from the perspective of international institutional investors. As a result, the stocks in these indices represent those that are the most widely followed by the investment community and those for which most information is available within any stock market. We refer to momentum strategies involving the international stock indices as *macromomentum* strategies to emphasize that these strategies involve country-level indices rather than individual firms.

The key findings are as follows. Momentum and reversals in international equity market returns (measured in U.S. dollars) are related in the manner predicted by the behavioral models, just as in U.S. equities. Thus, past 6-month winners (country stock indices earning the highest returns) outperform past 6-month losers (country stock indices earning the lowest returns) over the next 3 to 12 months but underperform past losers over the subsequent 2 years. To ensure that these results are not driven by the developing country stock indices in our sample, which might be considered less liquid, we also performed all of our tests using only developed countries and obtained similar results. The profits of country index momentum strategies are also robust to risk adjustments based on an international two-factor model that controls for market and currency risks.

We also find that positive currency momentum predicts low stock index returns in the future. This result is not just an emerging market phenomenon but is prevalent even in a sample containing only developed countries. We find that this negative relationship between past currency returns and future stock returns weakens momentum and strengthens reversals in U.S.-dollar-denominated momentum strategies. Consequently, we find that the profitability of macromomentum strategies can be significantly improved by forming momentum portfolios based on past equity-index returns measured in local currencies rather than in U.S. dollars. Cross-sectional regression tests involving stock index returns and currency returns confirm the portfolio findings.

Our finding that momentum in country stock indices turns into reversals is consistent with a key prediction of behavioral theories. This is encouraging for the behavioral asset pricing literature, since the objective is to build parsimonious models of investor behavior that are applicable in several security market contexts. Our results, in general, do not support pure transaction cost explanations of momentum. This is because momentum and reversals are also observed among country stock indices made up of the most actively traded stocks in a stock market. The evidence that initial momentum turns into subsequent reversals is also

inconsistent with risk-based explanations of momentum, which cannot explain why the "riskier" positive momentum securities would underperform "less risky" negative momentum securities after the first year.

The rest of the paper proceeds as follows. Section II discusses data, reports the returns earned by macromomentum portfolio strategies, and tests whether momentum turns into reversals using cross-sectional Fama-MacBeth regression tests. Section III computes components of macromomentum profits, provides subperiod results, and discusses the findings of cross-sectional regression tests involving international stock index returns and currency returns. Section IV concludes the paper.

II. Macromomentum Strategies

A. Data

The data on equity market returns and exchange rates were obtained from the Morgan Stanley Capital International Web site: http://www.mscidata.com/mstool/index.htm.[5] The equity market returns and exchange rates are updated monthly and available from January 1970 to December 1999. Using monthly returns should minimize any concerns about nonsynchronous trading that might affect returns computed in different time zones.

It is useful to define the following terms before we proceed further:

U.S. dollar returns refers to the rate of return earned by a country's stock index/equity market in U.S. dollars.
Local returns or *local currency returns* refers to the rate of return earned by a country's stock index/equity market in the local currency.
Currency returns refers to the rate of change of spot exchange rates expressed in $/foreign currency. A positive return represents the depreciation of U.S. dollars and a negative return represents the appreciation of U.S. dollars against the foreign currency.

Columns 2 to 4 of table 1 provide descriptive statistics on the U.S. dollar returns of the stock indices of the 38 countries in this study. The average return across all countries is about 1.5% a month, and the average first-order autocorrelation is about 6%. Columns 5 to 7 provide descriptive statistics on the returns of the stock indices in their respective currencies. The average return in local currencies across all countries is about 1.9% a month, and the average first-order autocorrelation is about 9%. The average return in local currencies is higher because

5. The Web site provides the *MSCI Methodology Book,* which lists in detail the criteria used by MSCI to construct its stock indices.

the currencies (mostly developing countries), on average, depreciated against the U.S. dollar over this period. The positive autocorrelations in country index returns are consistent with momentum in equity market returns.

Columns 8 to 10 provide descriptive statistics for the currency returns (rate of change of exchange rates) of the 38 countries. The currencies, on average, depreciated by 0.7% against the U.S. dollar over this period. The average first-order monthly autocorrelation across currencies is about 9.2%, indicating that there is some momentum in currency returns as well. Asterisks in table 1 mark the 16 developed countries that we use to examine the robustness of our findings. These are the same countries used in Richards (1997).

B. Returns from Macromomentum Portfolio Strategies

The momentum strategies are implemented as follows. At the beginning of each month from January 1970 to December 1999, we formed quintile portfolios based on the preceding 6-month returns (measured either in U.S. dollars or the local currency) of all country stock indices available at the beginning of the month. P1 is the losing portfolio, consisting of countries with the lowest returns over the previous six months, P5 is the winning portfolio, consisting of countries with the highest returns over the previous 6 months, and P3 is the portfolio with no momentum. Table 2 reports the average returns (in U.S. dollars or in the local currency) in percentage earned by these portfolios over the next 4 quarters and the subsequent 2 years. $K = 1, 2, 3,$ or 4 refers to quarters 1 through 4.

Since the strategy uses overlapping monthly observations, the holding period returns are autocorrelated up to the degree of the overlap. The quarterly returns are autocorrelated up to 2 lags and the annual returns up to 11 lags. Therefore, the asymptotic Z-statistics (reported in parentheses) are computed using the Hansen and Hodrick (1980) and Newey and West (1987) (henceforth, simply Hansen-Hodrick/Newey-West) autocorrelation correction with the appropriate lags. Table 2 also reports the average monthly return (past return) earned by these portfolios during the preceding 6 months, which is the sorting period.

Panel A of table 2 reports returns from strategies based on the cross section of all 38 countries and panel B reports returns from strategies based only on the cross section of 16 developed countries. Each panel reports returns of macromomentum portfolios in two forms. First, we report returns that would be earned by an investor who forms momentum portfolios based on past U.S. dollar returns (past returns in U.S.$ and future returns in U.S.$). The holding period returns represent returns in U.S. dollars. Next, we report future U.S. dollar returns of portfolios formed on the basis of past local currency returns of country stock indices (past returns in local currency and future returns in U.S.$). This strategy is equivalent to an investor forming portfolios based on past

TABLE 2 Returns from Macromomentum Strategies

Portfolio	Return	$K = 1$	$K = 2$	$K = 3$	$K = 4$	Year 1	Year 2	Year 3
Panel A. All Countries								
Past returns in U.S.$ and future returns in U.S.$								
P1	−2.17	3.34	2.36	2.85	4.32	14.67	20.12	18.11
		(3.26)	(2.63)	(2.98)	(3.78)	(3.68)	(5.49)	(4.17)
P3	1.22	3.95	4.16	4.29	4.14	18.34	17.62	15.43
		(5.64)	(5.84)	(6.09)	(5.33)	(5.67)	(5.11)	(4.86)
P5	5.01	6.30	6.43	4.77	2.93	22.32	13.34	12.33
		(6.03)	(6.41)	(5.03)	(2.63)	(4.89)	(3.30)	(3.85)
P5−P1		2.97	4.07	1.92	−1.39	7.65	−6.78	−5.77
		(2.72)	(4.08)	(2.10)	(−1.53)	(2.18)	(−2.09)	(−1.96)
Past returns in local currency and future returns in U.S.$								
P1	−1.74	3.21	2.04	2.14	3.91	12.72	17.75	17.96
		(3.26)	(2.25)	(2.27)	(3.59)	(3.23)	(5.09)	(4.41)
P3	1.16	3.66	4.00	4.34	4.10	17.41	17.96	16.31
		(5.22)	(5.87)	(6.25)	(5.69)	(5.82)	(5.21)	(5.16)
P5	5.25	6.49	6.79	5.22	3.73	24.63	15.55	11.94
		(6.16)	(6.63)	(5.48)	(3.08)	(5.13)	(3.61)	(3.66)
P5−P1		3.28	4.75	3.08	−.18	11.92	−2.20	−6.02
		(3.11)	(4.87)	(3.39)	(−.17)	(3.24)	(−.62)	(−2.10)
Panel B. Developed Countries								
Past returns in U.S.$ and future returns in U.S.$								
P1	−1.22	2.88	2.44	2.99	4.20	13.78	17.53	17.73
		(4.06)	(3.49)	(3.94)	(4.38)	(4.20)	(5.33)	(4.19)
P3	1.80	3.93	4.33	4.24	4.52	18.73	16.92	14.57
		(6.12)	(6.89)	(6.57)	(5.92)	(6.33)	(4.92)	(4.64)
P4	3.91	5.58	5.29	4.65	3.19	20.03	14.70	12.74
		(6.60)	(6.82)	(6.12)	(3.61)	(5.56)	(4.02)	(3.86)
P4−P1		2.70	2.85	1.66	−1.02	6.25	−2.83	−5.00
		(3.80)	(4.54)	(2.67)	(−1.59)	(3.67)	(−1.05)	(−2.23)
Past returns in local currency and future returns in U.S.$								
P1	−1.01	3.04	2.10	2.45	3.81	12.41	17.06	17.94
		(4.36)	(2.92)	(3.25)	(4.16)	(3.62)	(5.38)	(4.52)
P3	1.66	3.91	4.34	4.44	4.42	18.80	17.14	15.85
		(6.10)	(6.74)	(6.77)	(6.14)	(6.39)	(5.10)	(4.81)
P4	3.74	5.88	5.64	4.83	3.56	21.55	15.59	11.95
		(6.94)	(7.26)	(6.35)	(3.82)	(5.89)	(4.10)	(3.59)
P4−P1		2.84	3.54	2.38	−.24	9.15	−1.47	−5.99
		(4.20)	(5.55)	(3.90)	(−.37)	(4.73)	(−.53)	(−2.60)

NOTE.—This table summarizes results from price momentum portfolio strategies using monthly equity market returns for 38 countries from 1970 to 1999. Panel A reports returns from strategies based on all 38 countries in the sample. Panel B reports returns based only on 16 developing countries (see Richards 1997). Each month from January 1970, all available country indices are sorted based on their previous 6-month returns and divided into five equally weighted portfolios. P1 represents the losing portfolio with the lowest returns and P5 represents the winning portfolio with the highest returns during the previous 6 months. The compounded returns from these portfolios over the next 4 quarters and next 3 years are presented. Each panel presents results both in U.S. dollars and local currency. $K = 1, 2, 3$, and 4 are the next 4 quarter returns. Return represents average monthly return over the past 6 months. The numbers in parentheses are Newey-West and Hansen-Hodrick autocorrelation corrected t-statistics. The number of lags used in the autocorrelation correction are 2 for quarterly returns and 11 for annual returns.

local returns and then converting the future returns to U.S dollars at the spot exchange rates.

The results in table 2 document strong momentum in equity market returns up to 3 quarters after the portfolio formation date. The results are quite strong regardless of whether past returns are measured in U.S. dollars or in the local currency and whether we include or exclude developing countries. Results in panel A show that, among portfolios based on past U.S. dollar returns, winners outperform losers (P5 − P1) significantly by 1.92% to 4.07% per quarter over the next 3 quarters. During the first year after portfolio formation, the strategy earns 7.65%. In comparison, the annualized return (see column Past Return) earned by the zero-investment portfolio over the previous 6 months, which represents the portfolio formation period, is 86.2% (=12 × [5.01 − (−2.17)]). These results confirm the findings of Chan et al. (2000) using a larger sample of countries (38 in our study vs. 23 in theirs), a longer time period (we use 30 years while they use 15 years), and the MSCI data (Chan et al. use a combination of indices from the Datastream and PACAP databases).[6] We extend their findings by showing that the momentum strategies are more profitable when portfolios are based on past local currency returns (future returns are still in U.S dollars); winners outperform losers (P5 − P1) by 3.08% to 4.75% per quarter. Thus, our results suggest that a better approach to forming country momentum portfolios would be to form portfolios based on past returns measured in local currencies. This approach improves the momentum (winner minus loser) profits over the next 12 months by about 4% (11.92% vs. 7.65% in panel A and 9.15% vs. 6.25% in panel B). The superior performance of the local return strategies suggests that currency components present in strategies based on past U.S. dollar country returns tend to weaken momentum (which we discuss further in the next section).

We obtain similar results when we limit our macromomentum strategies to the sample of 16 developed countries. Given the smaller cross-section of this sample, we form four momentum portfolios rather than five. The results indicate that winners (P4) outperform losers (P1) by 1.66% to 2.85% per quarter among portfolios based on U.S. dollar returns and 2.38% to 3.54% among portfolios based on local currency returns. All differences are statistically significant. The key conclusion is that momentum in international stock indices is not solely an emerging market phenomenon nor is it driven solely by momentum in currencies (which we discuss in more detail in Section III.B).[7]

6. The magnitude of the momentum profits we report are larger than that reported by Chan et al. We discuss the sources of these differences in detail in Section III.B, using a strategy similar to theirs.

7. We find similar results for a macromomentum portfolio formed based on preceding 3-, 9-, or 12-month returns. In general, momentum dissipates faster for portfolios formed based on longer-term returns, as the reversal effects begin to set in sooner.

TABLE 3 Risk Adjusted Returns of Macromomentum Portfolios

Portfolio	a	$t(a)$	b	$t(b)$	c	$t(c)$	Adj. R^2
Panel A. All Countries							
Past returns in U.S.$ and future returns in U.S.$							
P1	−.30	−1.19	.95	9.62	−.04	−.46	42.1%
P3	.25	1.52	.82	13.42	.14	1.78	61.8%
P5	.73	2.57	.81	7.15	.20	1.06	36.3%
P5−P1	1.03	3.05	−.14	−.94	.24	1.38	.8%
Past returns in local currency and future returns in U.S.$							
P1	−.39	−1.57	.96	10.26	.02	.22	45.2%
P3	.16	1.02	.83	13.31	.14	1.60	64.4%
P5	.86	2.85	.81	6.38	.18	.87	33.4%
P5−P1	1.25	3.69	−.15	−.95	.16	.83	.4%
Panel B. Developed Countries							
Past returns in U.S.$ and future returns in U.S.$							
P1	−.22	−1.20	.85	12.77	.14	1.76	56.9%
P3	.33	2.08	.83	12.12	.15	1.83	65.2%
P4	.59	2.60	.83	8.04	.27	1.66	50.4%
P4−P1	.81	3.16	−.02	−.18	.13	.86	.0%
Past returns in local currency and future returns in U.S.$							
P1	−.25	−1.41	.86	12.53	.17	2.11	58.9%
P3	.34	2.21	.83	12.66	.15	1.76	65.1%
P4	.72	3.07	.84	7.56	.23	1.37	48.4%
P4−P1	.97	4.00	−.02	−.16	.06	.40	.0%

NOTE.—This table reports risk adjusted abnormal U.S. dollar returns for winning (P5 or P4), losing (P1), and (winner − loser) macromomentum portfolios. The portfolios are formed based on the preceding 6-month stock index returns (in U.S.$ or local currency) and held over the next 6 months. The average monthly return over the holding period is computed as the average of returns earned this month by strategies initiated at the beginning of this month and the previous 5e months (see Jegadeesh and Titman 1993). We use an international two-factor model, which uses the excess return (with respect to 1-month U.S. T-bill returns) on a value-weighted world market portfolio (r_{vwt}) of international stock indices and the return on a stock market capitalization weighted exchange rate index of G-7 countries as risk factors. The exchange rate index represents the dollar value of the currencies (other than U.S.) in G7:

$$r_t - r_{ft} = a + b(r_{\text{vwt}} - r_{ft}) + c\Delta e_t + u_t,$$

where Δe represents the rate of change of the exchange rate index; $t(a)$, $t(b)$, *and* $t(c)$ are the White-heteroscedasticity-corrected *t*-statistics corresponding to the intercept and the slope of the regression. Coefficient a is the Jensen's alpha, the risk-adjusted abnormal return. Adj. R^2 is the adjusted R-square in percent. The sample period is 1973–99, dictated by the availability of the exchange rate factor.

C. Risk-Adjusted Macromomentum Profits

Table 3 presents risk-adjusted momentum profits based on the following international two-factor model (see Ferson and Harvey 1993, 1994; Bailey and Jagtiani 1994):

$$r_t - r_{ft} = a + b(r_{\text{vwt}} - r_{ft}) + c\Delta e_t + u_t.$$

The dependent variable in this regression is the 6-month holding period return (in U.S dollars) of macromomentum portfolios formed on the basis of the preceding 6 month returns. The holding period return for

the purpose of this regression is computed as in Jegadeesh and Titman (1993), in which the average holding period return is the average of this month's return from strategies initiated at the beginning of the current month and the preceding 5 months.

The two factors on the right-hand side of the regression are (1) the market factor ($r_{vwt} - r_f$), which is the excess dollar return of value-weighted world market portfolio of international stock indices (the excess return is measured with respect to monthly returns on the 1e-month U.S. Treasury bill), and (2) the currency factor, which is the return on the stock market capitalization weighted exchange rate index of G-7 countries (other than the United States), Δe.[8] The exchange rate index represents the dollar value of the basket of currencies. An increase in the value of the index represents depreciation of the value of the dollar. The intercept a from the regression represents the risk-adjusted abnormal return and the slope coefficients b and c represent the factor loadings.

Panel A of table 3 reports results for portfolios involving all countries, and panel B reports results for portfolios involving developed countries only. Each panel reports results for portfolios formed on the basis of preceding U.S dollar return as well as preceding local currency returns. The results show that winners outperform losers on a risk-adjusted basis by 1.03% to 1.25% per month. The results, as expected, are stronger for portfolios based on preceding local returns. The t-statistics on the difference (P5 − P1) in the intercepts are significant at the 1% level. The results are equally strong among macromomentum portfolios formed using only developed country stock market indices (see panel B). The differences in market and currency betas across winning and losing portfolios are marginal at best, suggesting no significant difference in risk exposures.

An examination of the intercepts of the winning (P5) and losing (P1) portfolios reveals that most of the abnormal returns of the zero-investment portfolio are earned by the winning portfolio (P5 or P4). For instance, in panel B, the intercept on P4 for local return portfolios is 0.72% (t-statistic of 3.07), while the intercept on P1 is only −0.25% (t-statistic of −1.41). This is significant because it suggests that shorting the losing country stock indices is not essential to the success of the macromomentum strategies. Thus, short-sale constraints are unlikely to have a significant effect on the implementation of these strategies.

D. Long-Run Reversals of Macromomentum Strategies

The results in table 2 also reveal significant reversals in the long-run (years 2 and 3 after the portfolio formation date) returns of the macromomentum portfolios. This is a direct test of one of the key predictions of

8. We have also replicated these findings using the return on the Federal Reserve's trade-weighted exchange rate index as a proxy for the currency factor, and the results are similar.

the behavioral models, that initial momentum should be followed by subsequent reversals. Among all countries (see panel A, past returns in U.S.$), the winners (P5) underperform losers (P1) in years 2 and 3 by 6% to 7%. The reversals seem to be weaker (and the momentum stronger) when portfolios are formed based on past local currency returns (see panel A, past returns in local currency and future returns in U.S.$). The reversals in year 2 are an insignificant −2.2% as opposed to the significant −6.78% in the prior case. This suggests that the reversals may be driven at least partly by currency effects, an explanation we explore in detail in the next section.

Strong reversals are also observed among winning and losing portfolios in the subsample of 16 developed countries (see panel B). Among developed countries, winners (P4) underperform losers (P1) in years 2 and 3 by 3% to 5% per year among portfolios based on past U.S. dollar returns and by 1.5% to 6% per year among portfolios based on past local currency returns. Note that the momentum is stronger in year 1 (9.15% vs. 6.25%) and the reversal is weaker in year 2 (−1.47% vs. −2.83%) when formation period returns are measured in local currencies, which again points to the importance of currency effects.

Next, we test for momentum and reversals using Fama-MacBeth cross-sectional regression tests specified as follows:

$$y_{i,t+k} = \alpha + \beta y_{i,t} + u_{i,t+k},$$

where $y_{i,t+k}$ is the future returns of country index i and $y_{i,t}$ is the preceding 6-month returns of the same country's index. The future returns are computed for the same horizons as in table 2: over the next four quarters ($K = 1, 2, 3,$ and 4) and over the next 3 years (year 1, year 2, and year 3). The cross-sectional regression is estimated each month, and the average slope coefficient and asymptotic Z-statistics are reported in table 4. Panel A reports results for all countries, and panel B reports results for developed countries. Since the regressions use overlapping monthly observations, the Z-statistics (reported in parentheses) are computed using the Hansen-Hodrick/Newey-West autocorrelation correction with 2 lags for quarterly returns and 11 lags for annual returns. The results in table 4 confirm the findings in table 2. There is strong momentum during the first 4 quarters and significant reversals in years 2 and 3. The reversals are stronger, as expected, when country index returns are measured in U.S. dollars.

Overall, the long-run results show that momentum and reversals are related in the manner predicted by behavioral asset pricing models. Countries that experience the most positive or negative momentum initially are the ones that experience the strongest reversals in the future. This evidence, however, is accompanied by the possibility that currency

TABLE 4 Cross-Sectional Regressions Involving Previous Country Stock Index Returns

Parameter	$K = 1$	$K = 2$	$K = 3$	$K = 4$	Year 1	Year 2	Year 3
Panel A. All Countries							
Returns in U.S. dollars							
$b(r)$	.407	.556	.331	−.148	1.169	−.828	−.970
	(2.79)	(4.02)	(2.53)	(−1.02)	(3.09)	(−2.18)	(−3.18)
Returns in local currency							
$b(h)$	.594	.748	.490	−.002	2.107	.016	−.251
	(4.08)	(5.29)	(4.02)	(−.02)	(5.21)	(.04)	(−.76)
Panel B. Developed Countries							
Returns in U.S. dollars							
$b(r)$	.458	.650	.386	−.112	1.399	−.430	−.705
	(3.11)	(4.46)	(3.06)	(−.78)	(3.88)	(−1.05)	(−2.17)
Returns in local currency							
$b(h)$	.539	.781	.502	−.103	1.828	−.401	−.797
	(3.57)	(5.23)	(3.76)	(−.68)	(4.47)	(−.92)	(−2.49)

NOTE.—This table reports the results from the following cross-sectional Fama-MacBeth regressions:

$$y_{t+k} = \alpha + \beta y_t + u_{t+k}.$$

At the beginning of each month, this cross-sectional regression is estimated, based on data for all available countries. The dependent variables are future equity market returns measured over four quarterly periods ($K = 1, 2, 3,$ or 4) or the next 3 annual periods (year 1, 2, or 3). The independent variable is the preceding 6-month equity market returns (in U.S. dollars [r] or local currency [h]). The table reports time-series averages of slope coefficients, and the t-statistics are reported in parentheses. Since the cross-sectional regression is estimated each month, the resulting slope coefficients are autocorrelated up to 2 lags in quarterly regressions and up to 11 lags in annual regressions. To correct for this problems, the t-statistics for the time-series means are computed using the Newey-West (1987) and Hansen-Hodrick (1980) standard error correction. Panel A reports regressions based on U.S. dollar returns of country stock indices, and panel B reports regressions based on local currency returns of country stock indices. The regressions are run using monthly data from January 1970 to June 1999.

effects play an important role in the observed reversals. Therefore, we turn to examining the role of currency effects in the profitability of macromomentum strategies.

III. Macromomentum Profits: Components and Subperiod Results

A. Components of Macromomentum

The approach we used to compute the equity and currency components of macromomentum profits is based on a zero-investment momentum portfolio involving international equity market indices. Lo and MacKinlay (1990) and Lehman (1990) consider such zero-investment strategies in examining predictability in U.S. equities; and Chan et al. (2000) use such strategies to examine predictability in international equity indices.

Consider the dollar profits earned by a zero-investment momentum portfolio of equity market indices:

$$\pi_t(j,k,l) = \sum_{i=1}^{N(t)} w_{it}(j) r_i(t+k, t+l), \tag{1}$$

where $\pi_t(j,k,l)$ represents the dollar momentum profits earned over months $t+k$ to $t+l$ in the future by a strategy initiated at the beginning of month t based on dollar returns earned by each stock index over the past j months, that is, returns over months $t-j$ to $t-1$; $w_{it}(j)$ represents the dollar amount invested in stock index i at the beginning of month t and is based on the dollar return earned by the index over the past j months; $r_i(t+k, t+l)$ represents the return earned by stock index i over months $t+k$ to $t+l$ in the future; and $N(t)$ represents the number of individual country stock indices in the zero-investment portfolio as of month t (we index the number of indices by time, since the number of stock indices grows over time in our sample).

Since the portfolio in equation (1) is a zero-investment portfolio (the weights represent long and short positions), the weights should sum to zero. If we constrain the weights on the long (or the short) side to sum to 1, then the profit from the resulting portfolio would be equivalent to the return from the winning minus the losing portfolio presented in table 2.[9] We consider a strategy in which the weights are a linear function of past dollar returns (see Lo and MacKinlay 1990 for an original exposition of this idea). This strategy, therefore, would require the arbitrageur to take a long or short position in every country's stock index. The weights are

$$w_{it}(j) = [r_i(t-j, t-1) - r_m(t-j, t-1)], \tag{2}$$

where $r_i(t-j, t-1)$ is the dollar return earned by equity market index i over the past j months, and $r_m(t-j, t-1)$ is the return earned by an equal-weighted portfolio of international equity market indices over the past j months; that is, $r_m(t-j, t-1) = [1/N(t)]\Sigma_{i=1}^{N(t)} r_i(t-j, t-1)$. The dollar momentum profits in equation (1) can now be written as follows:

$$\pi_t(j,k,l) = \sum_{i=1}^{N(t)} [r_i(t-j, t-1) - r_m(t-j, t-1)] r_i(t+k, t+l). \tag{3}$$

9. In the terminology of equation (1), the quintile portfolio zero-investment strategies in panel A of table 2 are a special case of the strategy in equation (1) with weights of $+5/N$ for the 20% of the country stock indices earning the highest return over the past j months, $-5/N$ for the 20% of the stock indices earning the lowest return over the same period, and 0 for all else. In general, if we form M momentum portfolios with an equal number of countries in each of them in month t, then the weights for stock indices in the winning and losing portfolios are respectively $+M/N$ and $-M/N$.

Note that in equation (3), the sum of the weights of the long or the short positions would not sum to 1; in our discussion that follows, we will scale the weights to sum to 1 to be consistent with the momentum results reported in table 2.

The strategy in equation (3) is constructed from the perspective of a dollar currency investor, which involves converting foreign currency profits to U.S. dollars. This implies that the dollar profits in equation (3) contain both equity and currency components. To consider these components explicitly, let us express the dollar return earned by a country's stock index as the sum of the return earned by the country's stock index in its local currency [$h(t)$] and the rate of change in its exchange rate (we refer to this henceforth as the currency return) [e(t)], where the exchange rate is expressed as the price of foreign currency in U.S. dollars.[10] Thus, $r(t) = h(t) + e(t)$. Substitute this sum on the right-hand side of equation (3) and expand the equation into its cross products:

$$\begin{aligned}\pi_t(j,k,l) = &\sum_{i=1}^{N(t)}[h_i(t-j,t-1) - h_m(t-j,t-1)] \times h_i(t+k,t+l) \\ &+ \sum_{i=1}^{N(t)}[e_i(t-j,t-1) - e_m(t-j,t-1)] \times e_i(t+k,t+l) \\ &+ \sum_{i=1}^{N(t)}[h_i(t-j,t-1) - h_m(t-j,t-1)] \times e_i(t+k,t+l) \\ &+ \sum_{i=1}^{N(t)}[e_i(t-j,t-1) - e_m(t-j,t-1)] \times h_i(t+k,t+l). \quad (4)\end{aligned}$$

The first component on the right-hand side of equation (4) represents momentum profits due to predictability in international equity market indices. The second component represents profits due to predictability in currency returns; the third component represents profits due to cross-serial correlation between past stock index returns and future currency returns; and the fourth component represents profits due to the cross-serial correlation between past currency returns and future stock index returns.

As mentioned earlier, these profits can be arbitrarily scaled up or down by investing more or less in the zero-investment portfolios. To make the momentum profits in equation (3) comparable to the returns from the zero-investment portfolios in table 2, we scale the weights of the long and short positions in equation (3) by the total investment, $I_t(j)$, on the long

10. The sum would be exact if the returns are continuously compounded and approximate if the returns are discretely compounded. In our empirical tests reported in table 5, we use continuously compounded returns.

or the short side so that the weights on each side sum to 1. Since the long and short positions are equal in dollar amounts,

$$I_t(j) = \frac{\sum_{i=1}^{N(t)} |w_{it}(j)|}{2}. \tag{5}$$

Dividing equation (4) by $I_t(j)$ gives the dollar return of the zero-investment portfolio and its four components:

$$\begin{aligned}
\mu_t(j,k,l) &= \sum_{i=1}^{N(t)} [r_i(t-j,t-1) - r_m(t-j,t-1)] \times r_i(t+k,t+l)/I_t(j) \\
\mu_{ht}(j,k,l) &= \sum_{i=1}^{N(t)} [h_i(t-j,t-1) - h_m(t-j,t-1)] \times h_i(t+k,t+l)/I_t(j) \\
\mu_{et}(j,k,l) &= \sum_{i=1}^{N(t)} [e_i(t-j,t-1) - e_m(t-j,t-1)] \times e_i(t+k,t+l)/I_t(j) \\
\mu_{het}(j,k,l) &= \sum_{i=1}^{N(t)} [h_i(t-j,t-1) - h_m(t-j,t-1)] \times e_i(t+k,t+l)/I_t(j) \\
\mu_{eht}(j,k,l) &= \sum_{i=1}^{N(t)} [e_i(t-j,t-1) - e_m(t-j,t-1)] \times h_i(t+k,t+l)/I_t(j),
\end{aligned} \tag{6}$$

where $\mu_t(j,k,l)$ represents the dollar return earned (during months $t+k$ to $t+l$) by a zero-investment momentum portfolio (winning minus losing return) of international equity market indices constructed at time t; $\mu_{ht}(j,k,l)$ represents the component due to the predictability in country index returns (in their respective currencies); $\mu_{et}(j,k,l)$ represents the component due to predictability in currency returns; $\mu_{het}(j,k,l)$ represents the component due to predictability of currency returns by past stock index returns; and $\mu_{eht}(j,k,l)$ represents the predictability of equity market returns by past currency returns. Since $\mu_t = \mu_{ht} + \mu_{et} + \mu_{het} + \mu_{eht}$ by construction, it is easy to evaluate the relative contributions of the various components to overall momentum profits.

Equation (6) provides returns earned from a strategy initiated in a given month t. Averaging the returns over strategies initiated over all months, $t = 1, \ldots, T$ gives the average return earned by the zero-investment portfolio over the sample period. In table 5, we report the average returns earned by the macromomentum strategy and its components. The numbers reported in parentheses are Hansen-Hodrick/Newey-West autocorrelation-corrected asymptotic Z-statistics (to correct for the spurious

TABLE 5 Components of U.S. Dollar Macromomentum Portfolio Returns

Component	$K = 1$	$K = 2$	$K = 3$	$K = 4$	Year 1	Year 2	Year 3
Panel A. All Countries							
μ	2.32%	3.29%	1.53%	−1.52%	5.54%	−5.13%	−4.34%
	(2.22)	(3.67)	(1.74)	(−1.68)	(2.41)	(−2.94)	(−2.71)
μ_h	2.81%	4.23%	2.70%	.02%	9.73%	−.69%	−2.58%
	(3.12)	(5.32)	(3.60)	(.03)	(4.49)	(−.39)	(−1.75)
μ_e	.93%	.88%	.78%	.38%	2.95%	2.22%	2.37%
	(4.34)	(4.28)	(4.38)	(2.57)	(5.57)	(3.14)	(4.60)
μ_{he}	−.09%	−.40%	−.32%	−.27%	−1.13%	−1.94%	−2.85%
	(−.28)	(−1.17)	(−.90)	(−.90)	(−1.16)	(−2.45)	(−3.83)
μ_{eh}	−1.33%	−1.43%	−1.63%	−1.65%	−6.01%	−4.72%	−1.28%
	(−3.40)	(−4.55)	(−5.10)	(−5.51)	(−6.14)	(−6.20)	(−1.40)
Panel B. Developed Countries							
μ	1.62%	2.55%	1.26%	−1.12%	4.20%	−3.12%	−3.85%
	(2.12)	(3.86)	(2.15)	(−1.68)	(2.77)	(−1.97)	(−2.82)
μ_h	1.56%	2.91%	1.71%	v.67%	5.55%	−2.41%	−4.43%
	(2.25)	(4.75)	(3.00)	(−1.03)	(3.88)	(−1.56)	(−3.56)
μ_e	.13%	.30%	.24%	−.17%	.46%	−.23%	−.31%
	(.85)	(1.62)	(1.87)	(−1.06)	(1.13)	(−.63)	(−.94)
μ_{he}	.40%	.12%	.11%	.22%	.79%	.60%	−.42%
	(1.73)	(.55)	(.53)	(.98)	(1.61)	(1.33)	(−.91)
μ_{eh}	−.47%	−.78%	−.80%	−.50%	−2.60%	−1.08%	1.31%
	(−2.16)	(−3.47)	(−4.13)	(−1.94)	(−4.24)	(−1.89)	(2.71)

NOTE.—This table provides a break-up of the dollar returns (μ) of (past-momentum-weighted) macromomentum portfolio strategies (based on preceding 6-month returns) into four components: returns due to momentum in country stock returns in local currency (μ_h), returns due to momentum in currency returns (μ_e), returns due to cross-autocorrelation between past local returns and future currency returns (μ_{he}), and returns due to cross-autocorrelation between past currency returns and future local returns (μ_{eh}). The data contain monthly country stock index returns for 38 countries from 1970 to 1999. Panel A reports results from strategies based on returns of all 38 countries in the sample. Panel B reports results based only on 16 developed countries. $K = 1, 2, 3, 4$ represent returns over each of next 4 quarters. The numbers in parentheses are Newey-West/Hansen-Hodrick autocorrelation-corrected *t*-statistics. The number of lags used in the autocorrelation correction is 2 for quarterly returns and 11 for annual returns.

autocorrelation arising from the use of overlapping monthly observations). We use 2 lags to correct for the autocorrelation in quarterly returns and 11 lags to correct for the autocorrelation in annual returns.

In panel A of table 5, we report results for strategies involving all countries. In panel B, we report results for only the 16 developed countries. The results show that there is strong momentum in local currency returns of international equity markets. In year 1, the momentum in local returns (μ_h) is roughly 30% to 75% higher than the momentum in U.S. dollar returns (μ) (9.73% vs. 5.54% among all countries in panel A and 5.55% vs. 4.20% among the developed countries in panel B). The results show that the momentum in international stock indices are due to the momentum in underlying stock indices rather than just to the momentum in currencies. This is consistent with the findings in table 2, that the momentum profits in U.S. dollars are higher when past stock index returns are measured in local currencies.

The results corresponding to currency momentum in table 4, which are shown in line μ_e in panels A and B of table 5, show that the magnitude of the observed currency momentum profits for all countries is only one-fourth to one-fifth of that observed in local currencies (μ_h). This suggests that momentum in currency returns is not the primary source of the momentum in stock indices (μ).

The key findings in table 5 concern currency-stock interaction components. These interaction terms are essential to understanding the differences between the momentum and reversals in U.S. dollar returns (μ) and local currencies (μ_h). In particular, we focus on μ_{eh}, the component of momentum profits representing the average cross-serial correlation between past currency returns and future stock index returns. This correlation is significantly negative up to 2 years after the portfolio is formed, suggesting that stock prices continue to decline in response to past currency appreciation for a considerable period of time into the future. Among all countries (panel A), the cross-serial correlation components are −6.01% in year 1, −4.72% in year 2, and −1.28% in year 3. Among developed countries (panel B), the numbers are −2.60% in year 1 and −1.08% in year 2, with no further decline after year 2.[11]

The negative cross-serial correlation weakens the momentum and strengthens the reversals in dollar terms. The momentum results for years 2 and 3 bear testimony to this. In panel A, the reversals are much stronger and statistically significant when future returns are measured in U.S. dollars but are weak or nonexistent when measured in local currencies. The U.S. dollar returns in years 2 and 3 are −5.13% and −4.34%, while the local currency returns are only −0.69% and −2.58%. The results are similar in panel B.

B. Subperiod Results

The momentum profits (μ) reported in panel A of table 5 over the first 2 quarters are larger than the profits reported by Chan et al. (2000) for the same 2-quarter (26-week) holding period. Among all countries in our sample (panel A), the sum of the momentum profits over the first 2 quarters is 5.61% (=2.32% + 3.29%), while among developed countries, the number is 4.17% (=1.62% + 2.55%). In contrast, the momentum profits reported by Chan et al. for a similar strategy (see the 26-week strategy in table 2 and table 8 of their paper) are about 3% (0.1159% per week × 26 weeks) and 1.5% (0.0563% per week × 26 weeks), respectively, for all

11. One could speculate as to the possible rationale behind the lead-lag effects between the equity and the currency markets. An appreciation in the currency typically leads to the goods and services of a particular country being more expensive in world markets. This, in turn, would make the local export-oriented industries less competitive, which could cause a decline in the stock market. What is interesting about the results in table 5 is that this decline continues months after the appreciation in the currency. This is puzzling, since it appears that investors do not anticipate this effect.

and developed countries. There are several reasons for these differences. First, the sample period used in our study is January 1970 to December 1999. Chan et al. use data from January 1980 to June 1995. Second, our sample contains 38 countries (with 16 developed countries), while their sample contains 23 countries. Finally, we use the MSCI market indices in our study whereas Chan et al. use popular equity market indices obtained from the Datastream and PACAP databases.

To help reconcile our findings with that of Chan et al., we estimate (μ), the aggregate momentum profits, for the January 1970–December 1979, January 1980–June 1995, and July 1995–December 1999 subperiods. For the 23 countries covered in Chan et al., the 6-month (sum of first 2 quarters) profits for the 1970–99, 1980–95, and 1995–99 subperiods are 5.70%, 2.10%, and 20.82%, respectively; for the 17 developed countries used by Chan et al., the profits are 5.70%, 2.54%, and 10%, respectively. Note that profits during the 1980–95 subperiod are closer to the 3% (23 countries) and 1.5% (17 developed countries) profits reported for the same period by Chan et al. In comparison, the numbers for all 38 countries used in our study are 5.46%, 4.71%, and 14.27%, while for the 16 developed countries, they are 6.52%, 2.41%, and 7.95%. The key point is that the momentum strategies performed better both in the earlier subperiod and the later subperiod than in the 1980–95 subperiod. The additional differences are attributable to differences in the market indices used in the two studies and differences in the way holding-period returns are computed (average weekly returns vs. compounded quarterly returns).[12]

We also examined the sources of the large momentum profits during the 1995–99 subperiod. Among all countries and the Chan et al. 23 countries, the source of the large momentum profits (and also the gap between the all-country sample and the developed-country sample) is attributable primarily to the losers earning significant negative returns during 1996 and 1997. This is driven by the Asian financial crisis and the poor performance of the Asian stock markets (Indonesia, Korea, Malaysia, the Philippines, and Thailand) during this period. For the developed country samples, the superior performance is attributable to the performance of the winners during the bull market of the late 1990s. Not surprisingly, the performance of developed-country momentum strategies,

12. To examine the difference between the MSCI sample and the Datastream sample, we obtained from Datastream data on the indices that Chan et al. (2000) used in their study. We found significant differences between the MSCI country indices and the indices Chan et al. use. For example, the Dow 30 that Chan et al. (2000) used went from 838.74 on January 1, 1980, to 4472.75 in June 1995, representing a return of 433.65%. The U.S. MSCI index, however, went from 156.81 on January 1, 1980, to 1390.83 in June 1995, representing a return of 786.95%. The Nikkei went from 6569 on January 1, 1980 to 15594 in June 1995, while the MSCI (Japan) index went from 321.97 to 1171.28 in the same period, representing returns of 137% and 264%, respectively. The two samples are different; therefore, we would expect some difference in the results between Chan et al. (2000) and those in our paper.

while high by historical standards, is not as high as those involving the Asian countries.

C. *Lead-Lag Predictability among Stock Index Returns and Currency Returns*

In this subsection, we conduct Fama-MacBeth cross-sectional return predictability tests to examine the lead-lag interaction between past currency returns and past equity returns in predicting future equity returns. In particular, we want to test the negative relationship between past currency returns and future stock index returns in a regression and examine the role of past currency returns in explaining reversals in stock indices. The following cross-sectional regression is estimated each month from January 1970 to June 1999 using all countries available at the beginning of the month:

$$y_{t+k} = \alpha + \beta y_t + \gamma \Delta e_t + u_{t+k}, \tag{7}$$

where y_{t+k} is the equity market returns in U.S. dollars (r_{t+k}) or local currency (h_{t+k}) over the next 4 quarters or over the next 3 years, y_t is the average equity market returns in U.S. dollars or local currency over the previous 6 months, and Δe_t is the currency returns over the previous 6 months.

Table 6 reports time-series average of Fama-MacBeth cross-sectional slope coefficients. The numbers in parentheses are Newey-West/Hansen-Hodrick autocorrelation-corrected asymptotic Z-statistics. Panel A reports results from regressions based on all countries. The results show that past equity market returns predict future returns (both in U.S. dollars and local currency), with a positive sign over the next 3 quarters and a negative sign in the subsequent 2 years, even after controlling for past currency returns. The reversal effects in table 6, however, are weaker than those in table 4. This is because we explicitly control for one of the key sources of reversals in the U.S. dollar country index returns, which is the negative cross-serial correlation between past currency returns and future stock returns (see Section III.A and table 5 on the findings on μ_{eh}, the currency-stock cross-serial correlation component). This effect is captured in regression (7) by coefficient γ, which is the slope coefficient corresponding to past currency returns. As panel A of table 6 shows, this coefficient is negative and statistically significant at most horizons. Thus, explicitly controlling for this source of reversals helps to isolate the reversal effect attributable to past returns alone (see β, which is the slope coefficient on past stock returns), which still is substantial in panel A. The momentum effect, in contrast, continues to remain strong, suggesting that the profitability of momentum strategies is not affected by the cross-serial correlation. As expected, the results are weaker when we test for reversals in stock returns measured in local currencies, but the cross-serial correlation effect remains strong. The results in panel B, in general, confirm the findings in

TABLE 6 Cross-Sectional Regressions Involving Past Country Stock Index Returns and Past Currency Returns

Parameter	$K = 1$	$K = 2$	$K = 3$	$K = 4$	Year 1	Year 2	Year 3
Panel A. All Countries							
Returns in U.S. dollars							
$\beta(r)$	.477	.706	.481	−.089	1.691	−.669	−.795
	(3.00)	(4.41)	(3.40)	(−.57)	(3.42)	(−1.30)	(−1.96)
$\gamma(r)$	−1.311	−1.951	−1.400	−1.052	−7.177	−6.004	.890
	(−2.14)	(−3.03)	(−3.77)	(−2.07)	(−2.88)	(−1.65)	(.66)
Returns in local currency							
$\beta(h)$	.508	.717	.462	−.081	1.760	−.431	−.320
	(3.53)	(4.97)	(3.69)	(−.55)	(3.70)	(−.79)	(−.73)
$\gamma(h)$	−1.571	−1.769	−1.419	−1.167	−8.256	−8.075	−2.264
	(−3.26)	(−3.81)	(−4.38)	(−2.63)	(−3.52)	(−2.71)	(−1.35)
Panel B. Developed Countries							
Returns in U.S. dollars							
$\beta(r)$	.508	.809	.552	−.078	1.880	−.265	−.582
	(3.22)	(4.98)	(3.93)	(−.51)	(4.22)	(−.44)	(−1.38)
$\gamma(r)$	−1.288	−1.697	−.918	−.359	−4.870	−3.813	1.341
	(−2.15)	(−2.74)	(−2.87)	(−.76)	(−3.12)	(−1.19)	(1.11)
Returns in local currency							
$\beta(h)$	.513	.790	.523	−.115	1.835	−.356	−.466
	(3.44)	(5.11)	(4.08)	(−.78)	(3.71)	(−.60)	(−1.18)
$\gamma(h)$	−1.227	−.980	−.360	−.067	−3.130	−3.268	.719
	(−2.64)	(−2.03)	(−1.25)	(−.16)	(−3.29)	(−1.24)	(.56)

NOTE.—This table reports the results from the following cross-sectional Fama-MacBeth regressions:

$$y_{t+k} = \alpha + \beta y_t + \gamma \Delta e_t + u_{t+k}.$$

At the beginning of each month, this cross-sectional regression is estimated based on data for all available countries. The dependent variables are future equity market returns measured over 4 quarterly periods (K = 1, 2, 3, or 4) or the next 3 annual periods (year 1, 2 or 3). The independent variables are the preceding 6-month equity market returns in U.S. dollars (r) or local currency (h) and past currency returns (rate of change of exchange rates (Δe)). The table reports time-series averages of slope coefficients, and the t-statistics are reported in parentheses. Since the cross-sectional regression is estimated each month, the resulting slope coefficients are autocorrelated up to 2 lags in quarterly regressions and up to 11 lags in annual regressions. To correct for this problem, the t-statistics for the time-series means are computed using the Newey-West (1987) and Hansen-Hodrick (1980) standard error correction. Panel A reports regressions based on U.S. dollar returns of country stock indices, and panel B reports regressions based on local currency returns of country stock indices. The regressions are run using monthly data from January 1970 to June 1999.

panel A. Overall, the results in table 6 confirm the cross-serial correlation effect reported in table 5.

IV. Conclusion

International stock indices exhibit momentum and reversal patterns similar to U.S. equities. Using a sample of 38 country indices, we find that winners outperform losers in the first 3 to 12 months after portfolio formation but underperform losers in the subsequent 2 years. These results affirm a key prediction of recent behavioral theories, that initial momentum should be followed by a period of reversals as the market's

overoptimism is corrected. Our results also reveal a significant negative cross-serial correlation between past currency returns and future stock returns. This negative correlation weakens momentum and strengthens reversals in the U.S. dollar returns of country stock indices.

Our findings continue to hold in a subsample involving only developed-country stock indices, which largely comprise liquid stocks. This suggests that our results are not affected by the illiquidity problems that tend to plague studies involving individual stocks. Differences in risk do not appear to be the source of the observed momentum and reversal patterns. The differences in market betas and currency betas across winning and losing portfolios are marginal at best. It, therefore, is difficult to explain these patterns using standard risk-return asset pricing models.

Our results also have implications for international portfolio managers. At a minimum, our findings suggest that portfolio managers with investment horizons of under a year may want to take into account past positive or negative momentum in the local returns of a country index before investing in that country. To the extent that they are already investing in a country, any additional consideration of past price momentum is unlikely to add incrementally to transaction costs. Because these results are based on historical data analysis, however, there is no assurance that these patterns will repeat themselves in the future. Finally, understanding the sources for the observed momentum and reversal patterns may be a topic worthy of further research.

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