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Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole

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ABSTRACT

We examine whether macroeconomic risk can explain momentum profits internationally. Neither an unconditional model based on the Chen, Roll, and Ross (1986) factors nor a conditional forecasting model based on lagged instruments provides any evidence that macroeconomic risk variables can explain momentum. In addition, momentum profits around the world are economically large and statistically reliable in both good and bad economic states. Further, these momentum profits reverse over 1- to 5-year horizons, an action inconsistent with existing risk-based explanations of momentum.

THE PHENOMENON OF MOMENTUM, continuation of the direction of prior stock returns, has proved to be a challenge to financial economists. The simple investing strategy of buying prior winners and selling short prior losers appears significantly profitable both statistically and economically. Indeed, a growing body of both theoretical and empirical literature has examined several possible explanations, among them data mining, behavioral patterns, and risk.

On the available evidence, data mining is an unlikely explanation. Since the Jegadeesh and Titman (1993) study of U.S. stock returns, "out-of-sample" evidence of momentum has amassed both geographically and temporally. As shown in studies by Rouwenhorst (1998, 1999) and Chui, Titman, and Wei (2000), momentum is economically large in many European markets, small but positive in many emerging markets, and, furthermore, present in at least five Asian markets. In the time dimension, Jegadeesh and Titman (2001) show that momentum remains large even subsequent to the period covered by the 1993 study.

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Behavioral patterns underlie the models according to Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), and Hong and Stein (1999), who focus on imperfect formation and revision of investor expectations in response to new information. Tantalizing, yet inconclusive, evidence related to these models lies in the discovery that momentum profits are associated with several characteristics not typically associated with priced risk in standard models of expected returns. For instance, Chan, Jegadeesh, and Lakonishok (1996) show that return momentum coexists with earnings momentum. Lee and Swaminathan (2000) document that momentum is more prevalent in stocks with high turnover. Hong, Lim, and Stein (2000) find that small firms with low analyst coverage have more momentum. Grinblatt and Moskowitz (2003) discover that momentum is more prevalent for small firms with few institutional owners, growth firms, and firms with high volume. Moskowitz and Grinblatt (1999) demonstrate that industry momentum is large, which Hou (2001) argues is due to slow information diffusion within industries.

What kind(s) of risk might be driving momentum? Jegadeesh and Titman (1993) show that momentum is not driven by market risk. Fama and French (1996) demonstrate that their unconditional three-factor model cannot explain momentum either. Measuring conditional exposure to three-factor risk, as in Grundy and Martin (2001), only serves to deepen the momentum puzzle. Conrad and Kaul (1998) conjecture that cross-sectional dispersion in expected returns can explain momentum, but the effect of such dispersion is not strong enough to fully explain observed momentum. Jegadeesh and Titman (2001) present evidence that U.S. momentum returns quickly dissipate after the investment period, a finding difficult to reconcile with standard notions of priced financial risk. However, Chordia and Shivakumar (2002) investigate the one-step-ahead forecasts obtained by projecting momentum profits onto lagged macroeconomic variables and conclude that U.S. momentum profits are completely explainable using these forecasts.

Formal models offer further intuition for explanations of momentum based on economic risk factors that affect firm investment life cycles and growth rates. In the model of Berk, Green, and Naik (1999), a firm's value depends on interest rates as well as the number of and systematic risk of its existing projects. Slow turnover in the firm's project portfolio leads to persistence in both the firm's asset base and its systematic risk, all of which makes expected returns positively correlated with lagged expected returns. Simulations from the calibrated model produce momentum profits of roughly the magnitude observed in the United States, but at slightly longer horizons. Interesting intuition is also found in the model of Johnson (2002). Here, momentum arises from a positive relation between expected returns and firm growth rates. In effect, a firm with an extreme realized return is experiencing a highly persistent shock to the dividend growth rate, which in turn changes future expected returns in the same direction. Calibration of this partial equilibrium model produces momentum profits that can decline rapidly (as observed empirically), but remain positive at longer horizons.

The principal goal of this study is to investigate exhaustively on a global basis the relation between momentum returns and macroeconomic risk. In addition, we analyze whether international evidence on the dissipation of these profits is consistent with risk-based or behavioral models of momentum. We carefully build upon the literature studying the relation between stock returns and macroeconomic risk through the use of the widely cited unconditional approach of Chen, Roll, and Ross (1986). We also examine whether the conditional macroeconomic risk argument of Chordia and Shivakumar (2002) is robust internationally. Further, we document whether international momentum profits extinguish slowly, as predicted by many risk-based explanations, or reverse sign completely, consistent with several behavioral explanations.

Our results, in brief, are as follows. Momentum portfolio profits are large and positive abroad, and only weakly comove among 40 countries, whether within regions or across continents. These findings support the notion that if macroeconomic risk is driving momentum, then it should be largely country specific. In the 17 markets where we have such data, momentum profits bear basically no statistically or economically significant relation to the Chen et al. (1986) macroeconomic factors. Additionally, the forecasting model proposed by Chordia and Shivakumar (2002) generates global momentum forecasts that are unrelated to observed momentum profits. We also tabulate international momentum profits in both good and bad business cycle states; our finding of positive profits in both sorts of economies is incompatible with momentum being a reward for priced business cycle risk. Finally, we show strong international evidence of rapid reversals of momentum profits, a finding incompatible with existing risk-based explanations of momentum.

The remainder of the study proceeds in the following manner. Section I describes the data, documents momentum profitability, and shows interregional and intraregional links among the momentum portfolio profits of different countries. Section II examines the international relation between momentum and macroeconomic risk using the leading unconditional and conditional approaches. Section III demonstrates around the world the relation between momentum profits and economic states as classified by GDP growth and market movements. Behavioral and risk explanations are disentangled in Section IV, and Section V concludes.

I. Momentum Within and Between Countries

A. Data and Methodology

U.S. monthly stock return data include common shares of all NYSE- and AMEX-listed firms available from CRSP. For non-U.S. data, we select countries from Datastream International that have at least 50 stocks. Thus, in addtion to U.S. stocks, all available stocks from these 39 countries are used.[1] Whenever country market indices are needed, we use the Datastream value-weighted market index, if available; otherwise, we use the International Finance Corporation (IFC) index.

[1] Real estate trusts and investment companies are excluded. To control for delisting bias, we include both currently listed and delisted firms.

Table I displays starting dates for each country. U.S. data are available from 1926. For 10 markets, coverage begins in 1975. By January 1990 there are 23 countries available, and all countries except Egypt have coverage by February 1995. The sample ends in December 2000 for all countries except Peru and Argentina, which end in June 1999 and August 2000, respectively.

Table I also reports the number of firms available in January 1990 (or the first available month for countries with coverage beginning after 1990). Note that the United States is not the only highly populated market—in January 1990, Japan, the United Kingdom, and Canada have 1,898, 1,404, and 843 firms, respectively. The regional totals are 280, 1,233, 4,780, and 4,054 for Africa, Americas excluding the United States, Asia, and Europe as of January 1990 or the first available date for which a country has data.

Any momentum strategy consists of a ranking period, over which winners and losers are determined, and an investment period, over which winners are held and losers sold short. We follow the most widely reported results focusing on use of a 6-month ranking period over which raw total returns determine winner or loser status. We use a 6-month investment period with equal weights, and the investment rule is followed every month such that equally weighted momentum strategies of six varying vintages are simultaneously in effect at all times.

Our international strategies examine the top (winner) and bottom (loser) 20% of stock returns because some countries simply do not have enough stocks to allow for use of the more common top and bottom decile designations. To avoid microstructure distortions, we generally focus on results using the common practice of skipping a month between portfolio ranking and investment periods. Thus, for each month t, the portfolio held during the investment period, months t to $t+5$, is determined by performance over the ranking period, months $t-7$ to $t-2$.[2]

B. Momentum Profits by Country and Region

Table I displays average winner minus loser profits for each country in local currency. In Panel A, we report figures for momentum portfolios formed with a 1-month gap between the portfolio ranking and investment period. Table I shows that the winner minus loser portfolios are largely profitable on average around the world, with Asian countries displaying the weakest momentum profits. Both African countries, 5 of 6 American countries, 10 of the 14 Asian countries, and 14 of the 17 European countries display positive mean momentum profits over the period. To allow for noisiness of individual country data, we also report regional averages where the time series for each region is formed as the equally weighted average of all countries in the region.

The average monthly momentum profit is 1.63, 0.78, 0.32, and 0.77 in Africa, Americas (excluding the United States), Asia, and Europe, respectively. The

[2] Nevertheless, to examine the importance of skipping a month and for comparison with some studies that do not skip a month (e.g., Moskowitz and Grinblatt (1999) and Chordia and Shivakumar (2002)), we also recalculate our key results for momentum strategies where the portfolio investment period, t to $t+5$, immediately follows the 6-month ranking period, $t-6$ to $t-1$.

Table I

Momentum Profits by Country and Region

For each month t, stocks in each country are ranked into quintile groups based on their performance over the 6 months $t-7 \ldots t-2$. The momentum strategy buys the winner quintile and sells short the loser quintile and holds these positions for the 6 months, $t \ldots t+5$. A time series for each region is constructed from the monthly equally weighted average of all countries in the region. Panel A reports average momentum profits (WML), and returns in excess of the local market index separately for winners and losers. Begin dates t are as shown. The ending date is December 2000, except June 1999 for Peru and August 2000 for Argentina. Number of stocks is for the first portfolio available in or after January 1990. Panel B shows regional summary results using the period $t-6 \ldots t-1$ for ranking stocks.

			Momentum Profits		Returns vs. Local Market			
Region/Country	Begin	No. Stocks	WML	t	Winner	t	Loser	t
Panel A: Ranking Period is $t-7 \ldots t-1$								
Egypt	9705	54	0.24	(0.25)	– 0.72	(– 0.88)	– 0.95	(– 1.00)
South Africa	9009	226	1.82	(4.00)	1.77	(4.30)	– 0.04	(– 0.09)
Africa	9009	280	1.63	(3.89)	1.52	(3.73)	– 0.12	(– 0.27)
Argentina	9404	66	1.00	(1.42)	0.15	(0.23)	– 0.85	(– 0.91)
Brazil	9408	87	0.74	(0.75)	1.90	(2.16)	1.17	(0.98)
Canada	7508	843	0.52	(1.73)	1.25	(4.78)	0.73	(1.92)
Chile	9003	92	1.12	(3.13)	0.64	(1.86)	– 0.48	(– 1.36)
Mexico	9205	74	1.21	(1.76)	0.35	(0.84)	– 0.85	(– 1.32)
Peru	9502	71	0.03	(0.01)	2.33	(1.38)	2.30	(1.47)
Americas (ex. U.S.)	7508	1,233	0.78	(3.13)	1.13	(5.19)	0.35	(1.30)
Australia	7508	509	0.43	(1.15)	1.49	(4.43)	1.06	(2.67)
China	9406	253	– 0.01	(– 0.02)	– 0.10	(– 0.11)	– 0.09	(– 0.10)
Hong Kong	8402	179	0.41	(0.97)	0.25	(0.52)	– 0.15	(– 0.26)
India	9009	375	0.80	(1.74)	0.79	(1.56)	– 0.02	(– 0.02)
Indonesia	9012	97	– 1.00	(– 1.16)	0.99	(1.19)	1.99	(1.49)
Japan	7508	1,898	0.02	(0.10)	0.09	(0.50)	0.07	(0.25)
Malaysia	8609	190	0.18	(0.34)	0.37	(0.90)	0.19	(0.30)
New Zealand	8809	80	1.33	(2.66)	1.42	(3.88)	0.08	(0.16)
Pakistan	9303	117	– 0.30	(– 0.41)	0.42	(0.60)	0.72	(0.78)

Table I
(continued)

Region/Country	Begin	No. Stocks	Momentum Profits: WML	Momentum Profits: t	Returns vs. Local Market: Winner	t	Loser	t
Philippines	9306	63	1.17	(0.89)	1.43	(1.46)	0.26	(0.21)
Singapore	8309	112	0.10	(0.25)	0.27	(0.96)	0.17	(0.35)
South Korea	8710	588	– 0.76	(– 0.80)	– 0.21	(– 0.32)	0.54	(0.47)
Taiwan	8908	164	0.01	(0.02)	– 0.59	(– 1.01)	– 0.60	(– 0.81)
Thailand	8709	155	0.17	(0.25)	0.63	(0.92)	0.46	(0.59)
Asia	7508	4,780	0.32	(1.64)	0.74	(5.10)	0.42	(2.01)
Asia (ex. Japan)	7508	2,882	0.40	(1.35)	1.08	(5.16)	0.68	(2.43)
Austria	8902	51	0.70	(2.06)	0.23	(1.01)	– 0.47	(– 1.38)
Belgium	7508	129	1.12	(5.67)	0.39	(2.56)	– 0.73	(– 3.74)
Denmark	8812	153	0.92	(2.83)	0.26	(0.84)	– 0.66	(– 1.55)
Finland	9307	54	0.50	(1.13)	– 1.19	(– 1.92)	– 1.69	(– 2.24)
France	7508	571	0.79	(3.82)	0.57	(3.36)	– 0.22	(– 0.87)
Germany	7508	502	0.69	(4.57)	0.17	(1.16)	– 0.51	(– 2.61)
Greece	9002	62	1.61	(2.36)	1.46	(1.62)	– 0.14	(– 0.17)
Ireland	9003	55	1.23	(2.29)	0.22	(0.50)	– 1.01	(– 1.65)
Italy	7508	184	0.86	(3.79)	0.43	(2.41)	– 0.43	(– 1.83)
Netherlands	7508	197	1.16	(4.97)	0.42	(2.14)	– 0.73	(– 2.56)
Norway	8206	88	1.11	(2.54)	0.88	(2.29)	– 0.23	(– 0.48)
Portugal	9002	89	– 0.63	(– 1.06)	0.27	(0.69)	0.90	(1.41)
Spain	8711	100	0.32	(0.64)	– 0.07	(– 0.26)	– 0.39	(– 0.76)
Sweden	8406	160	– 0.01	(– 0.02)	– 0.05	(– 0.18)	– 0.05	(– 0.10)
Switzerland	7508	183	0.95	(5.17)	0.44	(2.35)	– 0.51	(– 2.51)
Turkey	8809	72	– 1.50	(– 2.20)	0.61	(0.80)	2.11	(2.30)
UK	7508	1,404	1.03	(6.14)	0.76	(3.56)	– 0.27	(– 1.13)
Europe	7508	4,054	0.77	(8.15)	0.45	(4.74)	– 0.32	(– 2.43)
U.S.	2,608	1,930	0.59	(3.32)	0.66	(5.95)	0.07	(0.34)

Developed (ex. U.S.)	7508	7,452	0.73	(7.04)	0.54	(5.74)	− 0.18	(− 1.40)
Developed	2608	9,382	0.51	(3.09)	0.65	(6.69)	0.14	(0.74)
Emerging	8609	2895	0.27	(1.21)	0.59	(2.88)	0.32	(1.17)
World (ex. U.S.)	7508	10,347	0.65	(6.90)	0.60	(6.87)	− 0.05	(− 0.44)
World	2608	12,277	0.49	(2.95)	0.67	(6.94)	0.19	(0.98)
Panel B: Ranking Period is $t-6\ldots t-1$								
Africa	9008	286	1.42	(3.36)	1.58	(3.81)	0.16	(0.37)
Americas (ex. U.S.)	7507	1,234	0.50	(1.89)	1.07	(4.74)	0.57	(2.09)
Asia	7507	4,768	0.13	(0.64)	0.69	(4.64)	0.55	(2.59)
Asia (ex. Japan)	7507	2,870	0.20	(0.66)	1.03	(4.75)	0.83	(2.94)
Europe	7507	4,058	0.70	(6.86)	0.43	(4.47)	− 0.27	(− 2.04)
U.S.	2607	1,930	0.31	(1.68)	0.53	(5.08)	0.22	(1.06)
Developed (ex. U.S.)	7507	7,456	0.64	(5.77)	0.53	(5.38)	− 0.12	(− 0.87)
Developed	2607	9,386	0.29	(1.66)	0.56	(5.99)	0.27	(1.37)
Emerging	8608	2890	− 0.01	(− 0.02)	0.50	(2.49)	0.51	(1.84)
World (ex. U.S.)	7507	10,346	0.53	(5.09)	0.57	(6.38)	0.04	(0.36)
World	2607	12,276	0.25	(1.44)	0.57	(6.23)	0.32	(1.66)

profits are highly significant in all regions except for Asia. Excluding Japan from the Asian index does not dramatically alter profits.[3] It is interesting to note that the momentum profits for Asia are decidedly weaker than those around the world, particularly for Europe. The average monthly momentum profit for Europe is 0.77% (about 9.24% per year), which is slightly less than the average monthly "country neutral" momentum profit found in Europe by Rouwenhorst (1998) of 0.93% per month. Similar to Rouwenhorst (1999) we find weaker momentum profits for emerging markets. The average momentum profit for all non-U.S. developed markets is 0.73% per month or 8.74% per year compared to a statistically insignificant 0.27% per month or 3.24% per year for emerging markets.

We also report in Table I separate winner and loser profits in excess of the local market index, to get a broad sense of whether profits primarily arise from winner or loser portfolios. In many countries, both winners and losers outperform the local market index, most likely due to higher expected returns for the small stocks prevalent in both winner and loser portfolios. In Europe, however, loser portfolios tend to underperform the market as a whole.[4]

Panel B reports results for momentum strategies where the investment period, t to $t+5$, directly follows the ranking period, $t-6$ to $t-1$. As expected, these momentum profits are smaller than those skipping a month. The average monthly momentum profits are 1.42%, 0.50%, 0.13%, and 0.70% in Africa, the Americas (excluding the United States), Asia, and Europe, respectively. Still, these measurements are statistically significant in all regions except Asia. In sum, momentum profits are generally quite economically important and statistically significant around the world. We now investigate the interrelations of momentum profits across countries.

C. Correlations

If momentum profits arise due to systematic risk and markets are integrated, then one ought to expect high correlations among returns to momentum strategies in various countries. Panel A of Table II examines the correlations of the winner minus loser momentum profits across markets. We start by examining momentum profits within regions. Because the United States and Japan are the largest two markets in the world and have received considerable attention, we exclude them from their regional averages and examine these markets as if they were their own regions. For region A comprising n_A markets, there are $\binom{n_A}{2}$ correlations between markets. The average correlation of momentum profits

[3] Our findings for Asian stocks are not directly comparable to those in Chui et al. (2000), a study examining seven Asian countries using both PACAP and Datastream data, and hence having more coverage in periods prior to our Datastream sample. Nevertheless, they report an average momentum profit for Asia of 0.329, which is extremely close to our average for Asia of 0.32.

[4] Another interesting question is whether momentum profits have extinguished internationally, especially due to the widespread attention such strategies have received since Jegadeesh and Titman (1993)—their original sample ended in 1989. For a subsample beginning January 1990, the average monthly momentum profits are 0.42%, 0.02%, and 0.61% per month in the Americas, Asia, and Europe, respectively. The average monthly momentum profit for developed markets is 0.59% or 7.08% per year. No extinction since 1990 is found.

Table II

Intraregional and Interregional Correlation of Momentum Profits and Markets

Panel A reports the correlation of raw momentum profits. Panel B reports the correlation of market indices. Three kinds of correlations are reported in each panel:

1. Intraregional correlations. For region A with n_A countries, there are $\binom{n_A}{2}$ correlations. Regional averages are shown in the top portion of each panel.
2. Interregional correlations by country pair. For region A with n_A countries and region B with n_B countries, there are $\binom{[n_A+n_B]}{2}$ correlations to consider. We break these down as follows: The $[\binom{n_A}{2}+\binom{n_B}{2}]$ intraregional correlations are ignored, and the remaining $\left\{\binom{[n_A+n_B]}{2} - [\binom{n_A}{2}+\binom{n_B}{2}]\right\}$ correlations are averaged to form the upper triangle in each panel.
3. Interregional correlations by regional indices. The time series for each region is formed as the equally weighted average of the momentum profits of all countries in the region. These regional average time series are then paired and the correlations thereof form the lower triangle in each panel.

	Africa	Americas (ex. U.S.)	Asian (ex. Japan)	Europe	Japan	U.S.
Panel A: Correlation of Momentum Profits						
Intraregional Average	0.012	0.077	0.106	0.088		
		0.071				
Interregional						
Africa		0.036	– 0.056	0.011	– 0.056	– 0.109
Americas (ex. U.S.)	– 0.005		0.047	0.001	0.070	0.080
Asia (ex. Japan)	– 0.100	0.398		0.027	0.041	0.088
Europe	0.113	0.038	0.169		0.107	0.139
Japan	– 0.029	0.050	– 0.018	0.220		0.050
U.S.	– 0.132	0.251	0.211	0.328	0.050	
Average of upper triangle:	0.032					
Average of lower triangle:	0.103					
Panel B: Correlation of Market Indices						
Intraregional Average	0.376	0.532	0.306	0.479		
		0.423				
Interregional						
Africa		0.366	0.254	0.261	0.256	0.274
Americas (ex. U.S.)	0.478		0.333	0.379	0.357	0.483
Asia (ex. Japan)	0.522	0.587		0.306	0.253	0.341
Europe	0.463	0.561	0.554		0.324	0.435
Japan	0.352	0.325	0.325	0.431		0.336
U.S.	0.298	0.691	0.523	0.590	0.336	
Average of upper triangle:	0.331					
Average of lower triangle:	0.469					

between pairs of markets within a particular region is 0.012 in Africa, 0.077 in the Americas, 0.106 in Asia, and 0.088 in Europe. Within regions, there is only weak evidence to suggest common sources of momentum profitability.

We then examine the correlations of momentum profits *across* regions using two methodologies. First, we consider the average pairwise correlation of countries of one region with those in another region. Second, we calculate directly the correlations between one region's time series of momentum profits and another's.

In the upper diagonal of the correlation matrix in Panel A of Table II are the average interregional pairwise correlations of country-specific momentum profits. For region A containing n_A countries and region B with n_B countries, there are $\binom{[n_A+n_B]}{2}$ correlations to consider. We break these down as follows: the $[\binom{n_A}{2} + \binom{n_B}{2}]$ intraregional correlations are ignored (i.e., they contribute instead to the top portion of Panel A), and the remaining $\left\{\binom{[n_A+n_B]}{2} - \left[\binom{n_A}{2} + \binom{n_B}{2}\right]\right\}$ correlations are averaged to form the upper triangle in each panel. The highest average correlation of 0.139 is between the United States and countries in Europe. The average of all the correlations in the upper diagonal of Panel A is only 0.032.[5]

We next turn to correlations between pairs of regional momentum indices. Regional average time series are paired and the correlations thereof form the lower triangle in Panel A. These correlations are somewhat higher than those in the upper triangle. The correlations between momentum profits in the United States and the regional indices are −0.132, 0.251, 0.211, 0.328, and 0.050 for the African, American (excluding the United States), Asian (excluding Japan), European, and Japanese momentum indices respectively. The average of all regional index correlation pairs is 0.103.

To gauge the relative importance of these correlations in momentum profits, we show in Panel B the correlations between market indices over the same time period. Correlations between market indices can be indicative of common sources of systematic risk. As before, the upper diagonal of the correlation matrix reports the average country correlations across regions, while the lower diagonal reports the average correlations of regional indices that are calculated as equally weighted averages of local market indices (similar to momentum indices). The correlations in Panel B, with an average of 0.331 in the upper diagonal and 0.469 in the lower diagonal, are much higher than those in Panel A. Market indices *are* subject to many common shocks across countries, whereas there is much less evidence of comovements in momentum profits.

To summarize, the low intraregional and interregional correlations of momentum profits indicate that momentum is not likely driven by a global risk factor. In our subsequent empirical work we focus on the importance of local risk factors.

[5] These low correlations are nevertheless likely overstated. Even though momentum profits derive from a long and a short portfolio for each market, they possess significant market beta and thus are not "country neutral." To see this, suppose the overall stock market's movement is large and positive over the 6-month momentum portfolio ranking period. Winner portfolios then have a higher proportion of high beta stocks and loser portfolios obtain disproportionately many low beta stocks. Overall, the winner minus loser portfolio will bear a significant positive market beta (for specifics, see, e.g., Chopra, Lakonishok, Ritter (1992) for a reversal study, or Grundy and Martin (2001) for a momentum study). We also compute the correlations of market risk-adjusted momentum profits across countries, and they are, in general, lower than the correlations of raw momentum profits in Panel A.

II. Macroeconomic Risk Models and Momentum Profits

If momentum strategies around the world earn positive expected returns due to their exposure to macroeconomic risk variables, then country-specific macroeconomic factors should do well in capturing variation in momentum profits. Measurement of the variation in stock prices due to macroeconomic risks is a heavily researched area that continues to generate considerable debate. The literature can generally be divided into conditional and unconditional approaches.[6] To measure macroeconomic variation in momentum profits in each country, we utilize a leading approach from each camp: An unconditional test based on the method of Chen et al. (1986), and a conditional application shown to explain momentum profits based on the method of Chordia and Shivakumar (2002).

A. Unconditional Tests

Chen et al. (1986) were the first to seriously propose and examine a set of macroeconomic factors that might affect stock returns. Using the Fama and MacBeth (1973) methodology and size portfolios, Chen et al. conclude that unexpected inflation (*UI*), changes in expected inflation (*DEI*), term spread (*UTS*), changes in industrial production (*MP*), and default risk premium (*URP*) are significant for pricing. While the Chen et al. model has been superseded by the three-factor model of Fama and French (1993) in the pricing of size and book-to-market effects,[7] the model represents a common starting point to examine whether momentum is sensitive to macroeconomic variables. If momentum profits are driven by unconditional macroeconomic risk, then momentum profits should exhibit significant sensitivity to the factors proposed by Chen et al.

A.1. Data and Methodology

For each country, we construct four of the Chen et al. (1986) factors using monthly data: unexpected inflation (*UI*), changes in expected inflation (*DEI*), term spread (*UTS*), and changes in industrial production (*MP*).[8] To estimate the

[6] Examples of unconditional approaches are Chan, Chen, and Hsieh (1985), Chen et al. (1986), and, more recently, Liew and Vassalou (2000) and Griffin (2002). Examples of the voluminous literature modeling time variation in returns related to macroeconomic variables include Gibbons and Ferson (1985), Fama and French (1989), Harvey (1989), and Ferson and Harvey (1991).

[7] Fama and French (1993) show that their three-factor model explains size and book-to-market equity effects in stock returns better than the Chen et al. factors. However, Fama and French (1996) demonstrate that the three-factor model fails to explain momentum profits. We "complete the circuit" here by applying the Chen et al. factors to explain momentum profits.

[8] Bond markets outside the United States are generally not well enough developed at the low quality end of the credit spectrum to give an accurate default premium factor. International macroeconomic data are from the OECD. The factor *UTS* is constructed as the yield on a more than 10-year maturity government bond minus the 3-month T-bill rate. The factor *MP* is the log difference in seasonally adjusted industrial production. Inflation is computed as the log relative of the consumer price index, and expected and unexpected inflation are calculated following Fama and Gibbons (1984).

sensitivity of momentum profits to the factors, we fit the following regression for each country j where at least 3 years of data exist:

$$WML_{j,t} = \alpha_j + \beta_{UI,j}UI_{j,t} + \beta_{DEI,j}DEI_{j,t} + \beta_{UTS,j}UTS_{j,t} + \beta_{MP,j}MP_{j,t} + \varepsilon_{j,t}. \quad (1)$$

Estimates of expected momentum profits take the form

$$E[WML_{j,t}] = \hat{\beta}_{UI,j}\hat{\gamma}_{UI,j,t} + \hat{\beta}_{DEI,j}\hat{\gamma}_{DEI,j,t} + \hat{\beta}_{UTS,j}\hat{\gamma}_{UTS,j,t} + \hat{\beta}_{MP,j}\hat{\gamma}_{MP,j,t}, \quad (2)$$

where $\hat{\beta}_{k,j}$ is the sensitivity estimate for factor k in country j from fitting model (1), and $\hat{\gamma}_{k,j,t}$ is the estimated risk premium associated with factor k in country j in month t. The risk premia $\hat{\gamma}_{k,j,t}$ must be estimated before calculating (2). Following Chen et al. (1986), we estimate these risk premia for each country j by using the Fama and MacBeth (1973) technique on a set of country j portfolios chosen for a wide spread in expected returns.[9] If the Chen et al. factors suffice for explaining momentum, then the difference between the actual momentum profits and the estimated expected momentum profits should be zero.

A.2. Results and Analysis

Because industrial production data are unavailable before 1990, Panel A of Table III reports the results of a restricted model where $\beta_{MP,j} = 0$. For each country, the table reports factor sensitivity estimates [columns *UI*, *DEI*, and *UTS*], associated t-statistics [columns $t(UI)$, $t(DEI)$, and $t(UTS)$], the adjusted R^2 obtained estimating (1), the average observed momentum profit (column *WML*), the average estimated expected profit [column $E[WML]$, obtained from (2)], and associated t-statistics for differences [column $t(DIFF)$].

In Panel A, 8 of 51 factor sensitivity estimates are statistically significant at the 5% level. The average adjusted R^2 across all countries is 0.012, a very poor fit compared to the R^2 values of 0.75 and 0.86 reported by Fama and French (1996) for explaining the variation in loser and winner decile portfolios, respectively, with their three-factor model.

If the model captures time-series variation in momentum profits, the average expected momentum profit (column $E[WML]$) should be close to the average observed momentum profit (column *WML*). Instead, the average expected momentum profit is -0.03% over all countries while the average observed momentum profit is 0.67%. The difference, 0.70%, is strongly statistically significant. More-

[9] Where possible (United States, United Kingdom, and Japan), this set is the 25 portfolios resulting from five-way size and book-to-market sorts of all available stocks. In all other countries, this set is the nine portfolios resulting from three-way size and book-to-market sorts. For each portfolio p in country j, we estimate model (1) for the time series of returns $r_{p,j,t}$. The factor sensitivities $\hat{\beta}_{k,p,j}$ are then used to fit the cross-sectional regression once for each month t:

$$r_{p,j,t} = \alpha_{j,t} + \gamma_{UI,j,t}\hat{\beta}_{UI,p,j} + \gamma_{DEI,j,t}\hat{\beta}_{DEI,p,j} + \gamma_{UTS,j,t}\hat{\beta}_{UTS,p,j} + \gamma_{MP,j,t}\hat{\beta}_{MP,j,t} + \varepsilon_{p,j,t}$$

which gives the estimated $\hat{\gamma}_{k,j,t}$ needed in (2). For robustness we also calculate (2) under the restriction of no time variation in risk premia, that is, $\hat{\gamma}_{k,j,t} = \hat{\gamma}_{k,j}$, its time series average; this makes no difference in the results.

Table III
Momentum Profits and the Chen, Roll, and Ross Factors

For each month t, stocks in each country j are ranked into quintile groups based on their performance over the 6 months $t-7 \ldots t-2$. The momentum strategy buys the winner quintile and sells short the loser quintile and holds these positions for the 6 months $t \ldots t+5$. Momentum returns, $WML_{j,t}$, are regressed on country j's Chen et al. (1986) factors—unexpected inflation (UI), change in expected inflation (DEI), term premium (UTS), and growth of industrial production (MP):

$$WML_{j,t} = \alpha_j + \beta_{UI,j}UI_{j,t} + \beta_{DEI,j}DEI_{j,t} + \beta_{UTS,j}UTS_{j,t} + \beta_{MP,j}MP_{j,t} + \varepsilon_{j,t}.$$

At least 3 years of data are required for the regression. Panel A omits MP (i.e., $\beta_{MP}=0$). Coefficient estimates are shown for each country, together with the associated t-statistic and adjusted R^2. Starting months t are as reported; all regressions end in December 2000 except Austria, France, Germany, Italy, Netherlands, and Spain, which end in December 1998 (Panels A, B), and Mexico and Greece, which end in November 2000 (Panel B). Regional results are averages of the constituent countries. Expected momentum profits take the following form:

$$E[WML_{j,t}] = \hat{\beta}_{UI,j}\hat{\gamma}_{UI,j,t} + \hat{\beta}_{DEI,j}\hat{\gamma}_{DEI,j,t} + \hat{\beta}_{UTS,j}\hat{\gamma}_{UTS,j,t} + \hat{\beta}_{MP,j}\hat{\gamma}_{MP,j,t},$$

where $\hat{\beta}_{k,j}$ is the sensitivity estimate for factor k in country j, and $\hat{\gamma}_{k,j,t}$ is the risk premium estimate (from Fama-MacBeth regressions on size and book-to-market portfolios) associated with factor k in country j in month t. For comparison, observed momentum profits WML are shown together with the associated t-statistic for the difference from E[WML].

Region/Country	Begin	UI	t(UI)	DEI	t(DEI)	UTS	t(UTS)	MP	t(MP)	Adj. R^2	WML	E[WML]	t(DIFF)
						Panel A: Three Factors							
Canada	7508	0.01	(0.36)	−0.01	(−0.87)	−0.85	(−0.44)			−0.006	0.30	−0.37	(1.71)
Mexico	9205	−0.77	(−2.56)	0.63	(2.88)	−0.25	(−0.35)			0.060	0.36	0.53	(−0.06)
Americas (ex. U.S.)	7508	−0.38		0.31		−0.55				0.027	0.09	−0.27	(0.88)
Japan	8901	0.00	(−0.04)	0.01	(1.24)	0.93	(0.24)			−0.003	−0.27	0.14	(−1.30)
South Korea	9104	−0.01	(−0.19)	0.01	(0.42)	−0.73	(−0.09)			−0.025	−0.99	0.03	(−0.78)
Asia	8901	0.00		0.01		0.10				−0.014	−0.57	0.08	(−1.14)
Austria	9001	−0.03	(−2.18)	0.03	(3.45)	−1.50	(−0.57)			0.078	0.74	0.03	(0.93)
Denmark	8812	0.01	(0.69)	0.00	(−0.44)	1.69	(0.92)			−0.009	1.09	−0.18	(2.98)
France	7508	0.02	(0.87)	0.00	(−0.05)	3.08	(1.72)			0.004	0.81	0.13	(2.07)
Germany	9001	0.00	(−0.23)	0.02	(1.78)	3.92	(2.06)			0.054	0.84	0.09	(1.58)
Greece	9706	0.02	(1.53)	−0.01	(−0.85)	4.69	(0.56)			−0.004	1.79	1.08	(0.34)
Italy	9103	−0.01	(−0.17)	0.00	(−0.14)	6.70	(1.61)			−0.002	0.23	−0.11	(0.68)
Netherlands	8604	0.01	(1.07)	−0.02	(−1.66)	4.77	(1.47)			0.011	1.16	−0.24	(2.62)
Norway	8501	0.05	(2.28)	−0.03	(−2.10)	2.32	(0.64)			0.016	0.38	−0.93	(1.98)
Spain	8711	0.02	(0.85)	−0.01	(−0.34)	1.01	(0.19)			−0.016	0.05	−0.04	(0.14)

Table III

(continued)

Sweden	8612	– 0.02	(– 1.69)	0.03	(2.65)	0.23	(0.08)			0.024	0.18	0.63	(– 0.57)
Switzerland	7508	0.00	(0.03)	0.00	(– 0.46)	– 0.89	(– 0.70)			– 0.007	1.27	– 0.01	(3.77)
UK	7804	0.01	(0.84)	0.01	(1.09)	– 2.10	(– 1.83)			0.023	1.17	– 0.96	(8.16)
Europe	7508	0.01		0.00		1.99				0.014	0.90	– 0.17	(5.63)
U.S.	6005	0.03	(1.88)	– 0.01	(– 0.48)	– 0.95	(– 0.62)			0.005	0.86	0.04	(3.89)
World (ex. U.S.)	7508	– 0.04		0.04		1.44				0.012	0.72	– 0.09	(4.54)
World	6005	– 0.04		0.04		1.30				0.012	0.67	– 0.03	(4.45)
Panel B: Four Factors Over Shorter Time Series													
Canada	9202	0.01	(0.36)	– 0.02	(– 0.70)	1.84	(0.33)	– 0.59	– (0.89)	– 0.026	0.30	– 0.26	(0.93)
Mexico	9205	– 0.84	(– 2.77)	0.66	(3.00)	– 0.21	(– 0.31)	0.37	(1.44)	0.069	0.36	– 2.51	(2.07)
Americas (ex. U.S.)	9202	– 0.41		0.32		0.81		– 0.11		0.021	– 0.14	– 0.60	(0.76)
Japan	9502	0.01	(0.49)	0.01	(0.34)	– 3.01	(– 0.23)	0.36	(1.10)	– 0.019	– 0.08	0.13	(– 0.43)
South Korea	9104	– 0.01	(– 0.33)	0.01	(0.29)	0.26	(0.03)	– 0.65	– (1.29)	– 0.019	– 0.99	– 1.67	(0.60)
Asia	9104	0.00		0.01		– 1.38		– 0.15		– 0.019	– 0.73	– 0.99	(0.35)
Austria	9002	– 0.02	(– 2.09)	0.03	(3.58)	– 0.07	(– 0.03)	– 0.37	– (2.35)	0.116	0.74	– 0.88	(2.08)
Denmark	9002	0.00	(– 0.21)	0.00	(– 0.15)	2.18	(1.19)	– 0.03	– (0.23)	– 0.019	1.09	0.06	(2.76)
France	9002	0.03	(1.09)	– 0.01	(– 0.28)	4.62	(1.91)	– 0.16	– (1.43)	0.027	0.54	– 0.20	(1.89)
Germany	9102	– 0.01	(– 0.50)	0.02	(2.24)	4.94	(2.57)	– 0.59	– (2.52)	0.124	0.87	0.70	(0.35)
Greece	9706	0.02	(1.53)	– 0.01	(– 0.69)	5.11	(0.58)	– 0.55	– (0.77)	– 0.018	1.73	3.52	(– 0.94)
Italy	9502	– 0.06	(– 0.80)	0.01	(0.25)	14.45	(1.48)	0.00	(0.01)	– 0.027	– 0.10	– 0.10	(0.00)
Netherlands	9002	0.00	(0.20)	– 0.01	(– 0.68)	4.76	(1.32)	0.21	(1.20)	– 0.001	1.39	– 0.10	(2.13)
Norway	9002	0.02	(0.84)	– 0.01	(– 0.76)	6.81	(1.88)	0.07	(0.43)	0.007	0.38	0.35	(0.03)
Spain	9002	0.04	(1.05)	– 0.01	(– 0.38)	– 1.31	(– 0.22)	0.00	(0.00)	– 0.026	0.05	– 0.04	(0.13)
Sweden	9002	– 0.02	(– 1.62)	0.03	(2.70)	0.28	(0.08)	– 0.09	– (0.38)	0.026	0.08	1.39	(– 1.09)
Switzerland	9004	0.00	(– 0.06)	0.00	(– 0.22)	0.94	(0.34)	0.26	(1.58)	– 0.004	1.23	– 0.13	(3.44)
U.K.	9402	– 0.01	(– 0.59)	0.02	(1.88)	1.63	(0.58)	– 0.57	– (0.88)	0.013	1.31	– 1.20	(3.50)
Europe	9002	0.00		0.01		3.69		– 0.15		0.018	0.67	0.33	(1.29)
U.S.	9002	0.04	(1.29)	0.00	(– 0.12)	– 8.96	(– 2.34)	0.24	(0.33)	0.033	0.92	0.43	(0.47)
World (ex. U.S.)	9002	– 0.05		0.04		2.70		– 0.15		0.014	0.44	0.06	(1.62)
World	9002	– 0.05		0.04		2.01		– 0.12		0.015	0.49	0.18	(1.23)

over, $E[WML]$ is fairly evenly distributed around 0 across countries, which is not consistent with the momentum strategy bearing a positive risk premium.[10]

Panel B shows the performance of the model with the monthly industrial production growth factor (*MP*) included but over the consequently shorter sample periods. Including *MP* does not help the performance of the model. Coefficient estimates for the *MP* factor are negative and significant in two countries, indicating that momentum strategies are less risky as industrial production grows. Across all countries, the average adjusted R^2 is 0.015. The estimated $E[WML]$ is volatile across countries and averages a statistically insignificant 0.18%. Because of the shorter time period, significance is reduced. Nevertheless, differences between estimated expected profits and observed profits are significant in six countries.[11] The evidence here indicates that momentum profits cannot be explained by the Chen et al. factors.

B. Conditional Tests

Conditional model performance often bears scant relation to a model's unconditional performance. On U.S. data, Chordia and Shivakumar (2002) use a conditional forecasting model where historical momentum profits are projected onto lagged values of the following instruments: *DIV* (the market dividend yield), *TERM* (the difference between average yield on Treasury bonds with greater than 10 years to maturity and the 3-month T-bill yield), *YLD* (the 3-month T-bill yield), and *DEF* (the difference between the average yield of AAA and BBB-or-lower-rated bonds). After estimating the regression over the prior 60 months, the projection gives rise to a one-period out-of-sample forecast, which, in turn, is used to explain momentum profits in the current month. Chordia and Shivakumar find that these forecasted momentum profits are on average positive and can more than explain the average premium to stock return momentum.

While we do not find any evidence that unconditional models can explain momentum profits worldwide, Chordia and Shivakumar show that their conditional forecasting model can capture momentum profits in the United States quite nicely.[12] We proceed to adapt the Chordia and Shivakumar approach to the global data.

[10] Results could vary depending on the particular implementation of the factor sensitivity estimation performed in (1) and the expected return calculation (2). As a partial check, we also estimate (1) using rolling regressions over 5-year windows, rather than using one fixed regression over the whole sample period as above. Using this approach, the average adjusted R^2 across all countries is 0.014 and the average expected monthly momentum profit generated from the model is -0.42%.

[11] In further results, omitted for conciseness, we also investigate the model on a global basis by applying U.S. factors as regressors for momentum profits globally. Such a setting is justified if markets are integrated and global factors are market capitalization weighted (the United States is often up to 50% of world market capitalization). U.S. economic factors do no better than home country macroeconomic factors in explaining momentum profits worldwide.

[12] Another application of the conditional approach is in Wu (2002), a study that reports that incorporating market-wide conditioning information into the Fama and French (1993) three-factor model explains momentum in the United States.

B.1. Forecasting Model

For each stock i in each country j for each month t, we estimate the following rolling regression over the period $\tau = t-60\ldots t-1$:

$$r_{i,j,\tau} = \alpha_{i,j,t} + \beta_{DIV,i,j,t} DIV_{j,\tau-1} + \beta_{TERM,i,j,t} TERM_{j,\tau-1} + \beta_{YLD,i,j,t} YLD_{j,\tau-1} + \varepsilon_{i,j,\tau}. \quad (3)$$

This estimation procedure is identical to that in Chordia and Shivakumar (2002) for U.S. data, except that we exclude the *DEF* (credit quality spread) instrument because bond markets outside the United States are generally not well enough developed at the low quality end of the credit spectrum. Before proceeding internationally, in unreported results we replicate key results from Tables IV, VI, and VII of Chordia and Shivakumar (2002), omitting *DEF*, and find that the omission does not affect any of the inferences. Also, the MSCI dividend yield series begins in December 1988 and runs until December 2000. Hence, for specifications including *DIV*, our forecasted return series starts in 1991 for non-U.S. countries, since we require at least two years of data to estimate parameters for individual stocks.

B.2. Model Performance

Perhaps the strongest support for the forecasting model based on (3) is its performance in U.S. tests sorting individual stocks as shown in Table VII of Chordia and Shivakumar (2002). The question addressed by such tests is: Which is the better predictor of future returns of momentum stocks, the model-predicted returns or the past raw returns themselves? If it is the former, then the model provides evidence of an ability to capture common variation in momentum returns due to the factors. If instead, after having taken account of model-predicted returns, past raw returns can still predict future differences in returns, then the model is not explaining momentum.

In Table IV, we adapt this methodology to perform these sorts in the 16 sample countries having enough stocks to allow for a three-by-three sort with at least 10 stocks per resulting portfolio. The predicted return for stock i, in country j in month t, results from compounding the one-step-ahead fitted values from the six most recent estimations (months $t-6\ldots t-1$) of (3). In Panel A, stocks in each country j in each month t are first sorted into momentum tercile groups (M_{hi}, M_{md}, M_{lo}) based on their raw returns over the 6 months $t-6\ldots t-1$ (i.e., no month skipped between ranking and investing). Stocks in each tercile are then sorted into subterciles (P_{hi}, P_{md}, P_{lo}) based on predicted returns. The sorts result in nine equally weighted portfolios, whose average monthly return over the period $t\ldots t+5$ is then computed.

The left-hand side of the table reports differences, over the period $t\ldots t+5$, in subtercile portfolio average monthly returns, $P_{\mathrm{hi}} - P_{\mathrm{lo}}$. The first column shows this difference for the low-momentum tercile, the second column for the middle-momentum tercile, and the third column for the high-momentum tercile. To illustrate, stocks within the Canadian low-momentum group (column M_{lo}) show a

Table IV

Holding Period Returns for Portfolios Ranked by Raw Returns and Predicted Returns

For each month t, each stock i in each country j is regressed on country j macroeconomic instruments over the period $\tau = t-60 \ldots t-1$:

$$r_{i,j,\tau} = \alpha_{i,j,t} + \beta_{DIV,i,j,t} DIV_{j,\tau-1} + \beta_{TERM,i,j,t} TERM_{j,\tau-1} + \beta_{YLD,i,j,t} YLD_{j,\tau-1} + \varepsilon_{i,j,\tau}.$$

The predicted return for stock i for month t results from compounding the one-step-ahead fitted values from the six most recent regressions (months $t-6 \ldots t-1$). At least 24 observations are required for each regression. In Panel A, stocks in each country j are first sorted into tercile groups (M_{hi}, M_{md}, M_{lo}) based on their raw returns over the 6 months $t-6 \ldots t-1$. Stocks in each tercile are then sorted into subterciles (P_{hi}, P_{md}, P_{lo}) based on their predicted returns. This results in nine equally weighted portfolios, whose average monthly returns over the period $t \ldots t+5$ are then computed. The left-hand side of the table reports, within each momentum tercile, differences in subtercile returns $P_{hi} - P_{lo}$. The first column shows this difference for the low-momentum tercile, the second column for the middle-momentum tercile, and the third column for the high-momentum tercile. The average of these three differences is also reported. Associated t-statistics are in parentheses. The right-hand side of the table reports, for each predicted return subtercile type, differences in momentum portfolio returns $M_{hi} - M_{lo}$. In Panels B and D, the portfolio formation sorts are interchanged: Stocks are sorted first into terciles by predicted returns, then into subterciles by raw returns. In Panels C and D, the sorting of stocks uses the period $t-7 \ldots t-2$ instead of $t-6 \ldots t-1$. All regional averages begin July 1991.

	Model Sort Power ($P_{hi} - P_{lo}$) within Momentum Groups								Momentum Sort Power ($M_{hi} - M_{lo}$) within Model Groups							
	$P_{hi} - P_{lo}$								$M_{hi} - M_{lo}$							
Country	M_{lo}	M_{md}	M_{hi}	Avg	t(lo)	t(md)	t(hi)	t(Avg)	P_{lo}	P_{md}	P_{hi}	Avg	t(lo)	t(md)	t(hi)	t(Avg)
Panel A: Sample First by Past Raw Returns $t-6 \ldots t-1$ and Then by Predicted Returns																
Canada	– 0.28	0.22	0.66	0.20	(– 0.56)	(0.72)	(1.54)	(0.66)	– 0.71	0.96	0.23	0.16	(– 1.11)	(2.00)	(0.47)	(0.35)
Australia	– 0.13	– 0.04	– 0.42	– 0.20	(– 0.28)	(– 0.13)	(– 1.00)	(– 0.62)	0.27	0.51	– 0.03	0.25	(0.52)	(1.11)	(– 0.06)	(0.60)
Japan	– 0.33	– 0.17	0.01	– 0.16	(– 1.50)	(– 0.82)	(0.05)	(– 0.80)	– 0.70	– 0.61	– 0.36	– 0.56	(– 1.65)	(– 1.62)	(– 0.85)	(– 1.41)
New Zealand	– 0.48	0.96	1.00	0.49	(– 0.56)	(1.41)	(0.86)	(0.77)	– 1.09	– 0.20	0.40	– 0.30	(– 0.99)	(– 0.21)	(0.35)	(– 0.36)
Asia	– 0.15	– 0.03	– 0.11	– 0.10	(– 0.56)	(– 0.21)	(– 0.42)	(– 0.52)	– 0.27	– 0.05	– 0.23	– 0.18	(– 0.79)	(– 0.16)	(– 0.65)	(– 0.63)
Belgium	– 0.46	0.50	0.42	0.15	(– 0.90)	(1.68)	(1.15)	(0.57)	0.28	0.66	1.16	0.70	(0.53)	(2.19)	(2.80)	(2.40)
Denmark	0.42	– 0.26	– 0.23	– 0.02	(1.26)	(– 0.61)	(– 0.87)	(– 0.09)	1.02	0.58	0.36	0.65	(2.53)	(1.77)	(1.21)	(2.35)
France	0.20	0.25	0.58	0.34	(0.52)	(1.02)	(2.28)	(1.44)	– 0.01	0.49	0.37	0.28	(– 0.03)	(1.60)	(1.28)	(1.00)
Germany	– 0.15	0.05	0.57	0.16	(– 0.38)	(0.28)	(2.25)	(0.75)	0.20	0.59	0.92	0.57	(0.52)	(2.13)	(3.52)	(2.33)
Italy	0.32	0.30	0.05	0.23	(0.50)	(0.80)	(0.13)	(0.63)	– 0.01	– 0.60	– 0.28	– 0.29	(– 0.01)	(– 0.86)	(– 0.47)	(– 0.57)
Netherlands	– 0.01	– 0.04	0.71	0.22	(– 0.01)	(– 0.15)	(2.00)	(0.72)	0.96	0.99	1.68	1.21	(1.18)	(3.27)	(5.04)	(3.54)

(*continued*)

Table IV
(continued)

Norway	0.28	0.53	0.86	0.56	(0.35)	(1.09)	(1.41)	(1.18)	−0.30	1.03	0.28	0.34	(−0.32)	(1.45)	(0.36)	(0.52)
Spain	−1.23	0.55	0.86	0.06	(−1.08)	(1.13)	(1.86)	(0.11)	−1.26	0.82	0.83	0.13	(−1.09)	(1.45)	(1.85)	(0.24)
Sweden	−0.67	−0.10	0.13	−0.21	(−0.86)	(−0.22)	(0.31)	(−0.49)	−0.48	−0.78	0.32	−0.32	(−0.67)	(−1.52)	(0.63)	(−0.69)
Switzerland	0.34	0.40	1.30	0.68	(0.73)	(1.86)	(3.27)	(2.70)	0.56	0.75	1.52	0.95	(1.31)	(2.39)	(3.19)	(3.08)
U.K.	−0.58	0.39	0.75	0.19	(−1.89)	(2.10)	(3.04)	(0.93)	0.08	0.97	1.41	0.82	(0.24)	(3.70)	(4.09)	(3.00)
Europe	−0.19	0.16	0.58	0.18	(−0.84)	(0.97)	(2.98)	(1.17)	0.10	0.48	0.87	0.48	(0.45)	(2.74)	(4.17)	(2.81)
U.S.	0.29	0.27	0.36	0.31	(1.90)	(2.98)	(3.42)	(3.13)	0.26	0.21	0.33	0.27	(1.17)	(1.22)	(1.99)	(1.52)
World (ex. U.S.)	−0.22	0.13	0.45	0.12	(−1.25)	(1.08)	(2.74)	(0.97)	−0.06	0.40	0.60	0.32	(−0.29)	(2.57)	(3.22)	(1.95)
World	−0.23	0.12	0.45	0.12	(−1.34)	(1.06)	(2.77)	(0.96)	−0.07	0.38	0.60	0.30	(−0.36)	(2.46)	(3.20)	(1.87)
Panel B: Sample Sorted First by Predicted Returns and Then by Raw Returns $t-6\ldots t-1$																
Canada	−0.08	0.52	0.82	0.42	(−0.13)	(1.22)	(1.83)	(1.13)	−0.57	0.46	0.32	0.07	(−0.89)	(1.22)	(0.64)	(0.17)
Australia	−0.28	−0.01	−0.24	−0.18	(−0.65)	(−0.03)	(−0.53)	(−0.51)	0.22	0.23	0.27	0.24	(0.47)	(0.58)	(0.55)	(0.64)
Japan	−0.51	−0.31	−0.04	−0.29	(−1.95)	(−1.24)	(−0.15)	(−1.20)	−0.67	−0.59	−0.21	−0.49	(−1.56)	(−1.64)	(−0.51)	(−1.27)
New Zealand	−0.73	0.70	1.64	0.54	(−0.65)	(0.76)	(1.59)	(0.81)	−1.82	−0.05	0.54	−0.44	(−1.48)	(−0.05)	(0.48)	(−0.56)
Asia	−0.37	−0.10	−0.00	−0.16	(−1.35)	(−0.47)	(−0.00)	(−0.78)	−0.31	−0.23	0.06	−0.16	(−0.96)	(−0.80)	(0.19)	(−0.61)
Belgium	−0.29	0.60	0.74	0.35	(−0.59)	(1.88)	(2.05)	(1.25)	−0.03	0.55	1.00	0.51	(−0.05)	(2.12)	(2.59)	(1.79)
Denmark	0.42	0.14	−0.19	0.12	(1.02)	(0.48)	(−0.54)	(0.46)	1.00	0.62	0.40	0.67	(2.16)	(2.48)	(1.33)	(2.54)
France	0.13	0.30	0.78	0.40	(0.32)	(1.01)	(3.01)	(1.46)	−0.21	0.47	0.44	0.23	(−0.48)	(2.28)	(1.66)	(0.97)
Germany	0.09	0.18	0.58	0.28	(0.23)	(0.63)	(2.17)	(1.11)	0.42	0.39	0.91	0.58	(1.11)	(1.86)	(3.97)	(2.76)
Italy	−0.12	−0.30	0.33	−0.03	(−0.15)	(−0.58)	(0.79)	(−0.07)	−0.53	−0.26	−0.08	−0.29	(−0.63)	(−0.63)	(−0.14)	(−0.60)
Netherlands	0.25	0.41	0.98	0.55	(0.32)	(1.47)	(2.72)	(1.63)	0.95	0.71	1.68	1.11	(1.18)	(2.99)	(5.49)	(3.48)
Norway	−0.01	0.61	1.40	0.67	(−0.01)	(1.13)	(2.11)	(1.14)	−0.44	0.22	0.96	0.25	(−0.48)	(0.32)	(1.40)	(0.41)
Spain	−1.01	0.31	0.89	0.06	(−0.87)	(0.54)	(1.81)	(0.10)	−1.21	0.42	0.69	−0.03	(−1.05)	(0.80)	(1.69)	(−0.07)
Sweden	−1.12	−0.35	0.05	−0.47	(−1.32)	(−0.70)	(0.11)	(−0.92)	−0.63	−0.19	0.54	−0.09	(−0.94)	(−0.40)	(1.14)	(−0.23)
Switzerland	0.53	0.91	1.35	0.93	(1.12)	(2.93)	(3.26)	(3.08)	0.38	0.54	1.20	0.71	(0.89)	(2.30)	(2.75)	(2.66)
U.K.	−0.17	0.38	1.00	0.40	(−0.51)	(1.69)	(3.34)	(1.68)	−0.02	0.75	1.15	0.63	(−0.06)	(3.37)	(3.51)	(2.57)
Europe	−0.17	0.25	0.69	0.26	(−0.70)	(1.30)	(3.12)	(1.36)	0.01	0.39	0.87	0.42	(0.06)	(2.70)	(4.72)	(2.90)
U.S.	0.34	0.34	0.39	0.35	(1.92)	(2.55)	(3.04)	(2.72)	0.23	0.09	0.28	0.20	(1.12)	(0.67)	(1.86)	(1.31)

World (ex . U.S.)	−0.22	0.19	0.57	0.18	(−1.14)	(1.29)	(3.18)	(1.22)	−0.13	0.28	0.66	0.27	(−0.63)	(2.14)	(3.80)	(1.89)
World	−0.23	0.18	0.57	0.17	(−1.23)	(1.25)	(3.20)	(1.19)	−0.14	0.27	0.66	0.26	(−0.68)	(2.09)	(3.77)	(1.82)
Panel C: Sample Sorted First by Past Raw Returns $t-7\ldots t-2$ and Then by Predicted Return																
Asia	−0.31	−0.15	−0.24	−0.23	(−1.28)	(−0.89)	(−0.94)	(−1.33)	0.00	0.01	0.07	0.03	(0.01)	(0.02)	(0.23)	(0.10)
Europe	−0.25	0.03	0.44	0.08	(−1.12)	(0.19)	(2.34)	(0.50)	0.15	0.52	0.84	0.50	(0.65)	(3.24)	(4.55)	(3.26)
U.S.	0.21	0.17	0.23	0.20	(1.42)	(1.88)	(2.10)	(2.04)	0.47	0.38	0.48	0.44	(2.32)	(2.32)	(3.09)	(2.72)
World (ex. U.S.)	−0.30	0.01	0.31	0.01	(−1.76)	(0.05)	(1.96)	(0.05)	0.03	0.43	0.64	0.37	(0.13)	(2.92)	(3.85)	(2.49)
World	−0.28	0.01	0.32	0.02	(−1.65)	(0.11)	(2.06)	(0.18)	0.05	0.44	0.65	0.38	(0.24)	(3.01)	(3.94)	(2.59)
Panel D: Sample Sorted First by Predicted Returns and Then by Raw Returns $t-7\ldots t-2$																
Asia	−0.40	−0.02	−0.16	−0.19	(−1.57)	(−0.09)	(−0.64)	(−0.99)	−0.03	−0.08	0.21	0.04	(−0.10)	(−0.32)	(0.71)	(0.15)
Europe	−0.12	0.13	0.52	0.17	(−0.53)	(0.69)	(2.39)	(0.95)	0.19	0.43	0.83	0.48	(0.90)	(3.28)	(5.02)	(3.75)
U.S.	0.34	0.26	0.28	0.30	(2.00)	(2.04)	(2.20)	(2.30)	0.49	0.27	0.43	0.40	(2.63)	(2.02)	(3.07)	(2.83)
World (ex. U.S.)	−0.20	0.08	0.40	0.09	(−1.06)	(0.54)	(2.24)	(0.65)	0.08	0.33	0.67	0.36	(0.42)	(2.69)	(4.43)	(2.84)
World	−0.17	0.08	0.41	0.11	(−0.95)	(0.59)	(2.36)	(0.76)	0.11	0.34	0.69	0.38	(0.54)	(2.77)	(4.52)	(2.93)

-0.28% difference in future performance between stocks having highest versus lowest model-predicted returns. This is not consistent with the model exhibiting predictive power over and above momentum; if the model "works," then the numbers on the left-hand side of the table should all be positive and significant. Overall, in the world excluding the United States, the difference in future performance between high- and low-predicted return groups is -0.22 in the low-momentum group, 0.13 in the medium-momentum group, and a statistically significant 0.45 in the high-momentum group. Only in the high-momentum group does the model exhibit significant extra predictive power. Looking country by country, only in Switzerland and the United States is the average $P_{\text{hi}} - P_{\text{lo}}$ significantly positive.

The right-hand side of the table reports, for each model-predicted return subtercile type ($P_{\text{hi}} - P_{\text{md}}$, P_{lo}), differences in momentum portfolio returns $M_{\text{hi}} - M_{\text{lo}}$. Overall, in the world excluding the United States, the difference in future performance between high- and low-momentum groups is -0.06 in the low-predicted return group, a statistically significant 0.40 in the medium-predicted return group, and a statistically significant 0.60 in the high-predicted return group. Only in the low-predicted return group does momentum fail to exhibit significant extra predictive power. The average $M_{\text{hi}} - M_{\text{lo}}$ is significantly positive in six countries.

In Panel B, the portfolio formation sorts are interchanged in order to maximize dispersion in expected returns due to predicted returns: Stocks are sorted first into terciles by predicted returns, then into subterciles by raw returns. The results are very similar to Panel A. On the left-hand side, only in the high-momentum group does the model exhibit significant extra predictive power.[13] Looking country by country, again in Switzerland and the United States, the average $P_{\text{hi}} - P_{\text{lo}}$ is significantly positive, at 0.93 and 0.35, respectively. On the right-hand side of the table, only in the low-predicted return group does momentum fail to exhibit significant extra predictive power. Looking country by country, the average $M_{\text{hi}} - M_{\text{lo}}$ is significantly positive in five countries.

An important concern is that measurement of momentum is obfuscated by microstructure effects when the portfolio formation rule omits skipping a month between ranking and investing. Therefore, in Panels C and D, the sorting of stocks uses the period $t-7 \ldots t-2$ instead of $t-6 \ldots t-1$. The effect of the rest month comes across clearly; skipping a month increases the predictive power of momentum relative to that of the model. The average difference in future performance between high- and low-predicted return groups, $P_{\text{hi}} - P_{\text{lo}}$, is a statistically insignificant 0.02 and 0.11 in Panels C and D, respectively, for the world. In contrast, the difference in future performance between high- and low-momentum

[13] The regressions (3) are estimated over the ranking period $t-6 \ldots t-1$, potentially letting predicted returns proxy for past returns. To check, we replicate Table IV where the model is estimated only over the pre-ranking period $t-60 \ldots t-7$. In these results, the $P_{\text{hi}} - P_{\text{lo}}$ values for the world excluding the United States are insignificant and close to zero within the high-momentum group and negative in the other two groups.

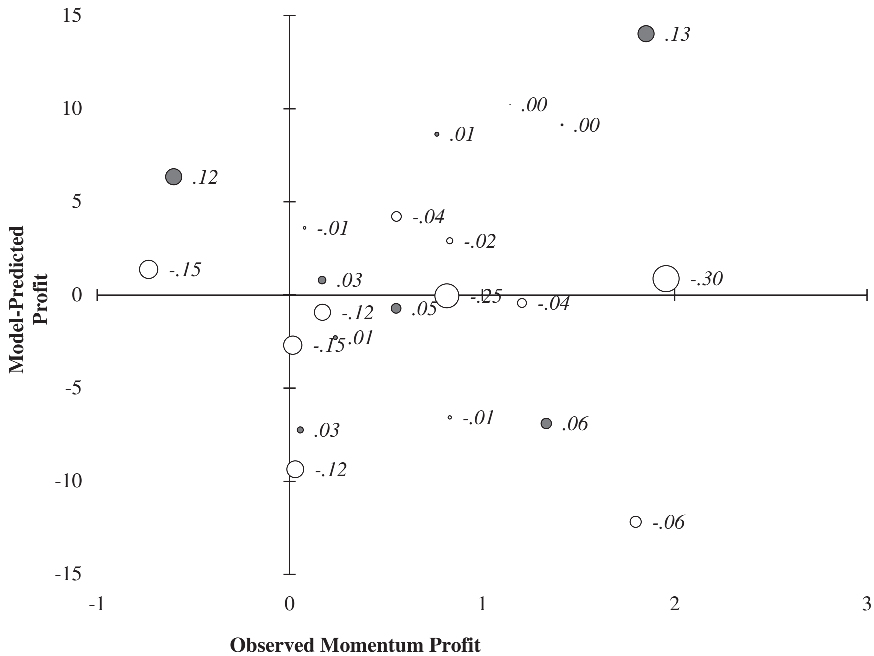

Figure 1. **Model performance across countries.** For each month t, stocks in each country j are ranked into quantile groups based on their performance over the 6 months $t-6 \ldots t-1$. The momentum strategy buys the winner quantile portfolio, and sells short the loser quantile portfolio, and holds these positions for the 6 months $t \ldots t+5$. At least 10 stocks are required for each portfolio. Where possible (Japan, United States, United Kingdom), winner and loser deciles are used; other countries use quintiles. Momentum returns $WML_{j,t}$, are regressed on country j's macroeconomic instruments over the period $\tau = t-60 \ldots t-1$ (at least 12 observations required):

$$WML_{j,\tau} = \alpha_{j,t} + \beta_{DIV,j,t} DIV_{j,\tau-1} + \beta_{TERM,j,t} TERM_{j,\tau-1} + \beta_{YLD,j,t} YLD_{j,\tau-1} + \varepsilon_{j,\tau}.$$

Each country j appears once on the graph. On the x-axis, the average realized WML for each country j is plotted. On the y-axis, the average model-predicted momentum profit for each country j is plotted. The size of each plotted circle is proportional to the correlation between observed momentum profits $WML_{j,t}$ and the model-predicted momentum profits for country j. The circles are dark when the correlation is positive and clear when negative. Correlation coefficients are shown in italics next to each circle.

groups, $M_{\text{hi}} - M_{\text{lo}}$, is economically large and significant in Panels C and D globally (0.38 and 0.38).

We also apply the conditional forecasting model to momentum portfolios in a similar manner as previously discussed for individual stocks. We compute predicted returns from the model and compare these to observed momentum returns in each country. Figure 1 scatterplots this relation. Each country appears as a circle whose size corresponds to the correlation between model-generated momentum profits and observed momentum profits. If the model works, then the countries should cluster in the first and third quadrants, and the computed correlation coefficients should be positive. Instead, there is essentially no relation between model-generated profits and actual profits. Model-generated profits are negative in more markets than they are positive. The correlation coefficients are positive for 8, zero for 2 (to two decimal places), and negative for 12 markets. The average correlation coefficient between the two series across countries is -0.04.

C. Summary

Macroeconomic factor models seem to be of paltry help in understanding international momentum profits. Unconditional tests fail to find U.S. or international evidence of a relation between the Chen et al. (1986) factors and momentum profits. The predictive power of the conditional macroeconomic forecasting model is hard to discern outside the United States, vis-à-vis momentum. Next, we investigate, in a model-free setting, the relation between momentum profits and macroeconomic risk.

III. Momentum and Economic States

Another manner of analyzing the influence of macroeconomic risk is to examine the returns to a portfolio strategy during good and bad economic states. If a strategy is risky, then there should be at least some states of the world (those where investors have high marginal utility) in which the strategy underperforms. In a manner similar to the analysis of value and growth strategies in Lakonishok, Shleifer, and Vishny (1994), we examine the profitability of momentum strategies during periods of positive and negative economic growth and market returns. Evidence that momentum strategies earn negative (positive) returns during poor (strong) economic states would support the view that momentum is driven by macroeconomic risk. Chordia and Shivakumar (2002) provide such evidence based on the relation between the business cycle state and momentum in the United States.

A. Momentum and GDP Growth

We examine momentum profits in the 22 markets for which the OECD provides GDP data. Whenever available, we use seasonally adjusted real GDP.[14] Table V displays regional average momentum profits in states of positive and negative GDP growth as well as in quartiles of GDP growth. If momentum were related to economic distress risk, one might expect to see negative momentum profits when that risk is realized—that is, in periods of low or negative GDP growth.

Instead, the monthly momentum profits are 1.18%, 0.11%, and 0.28% in the Americas (excluding the United States), Asia, and Europe in periods of negative GDP growth and 0.61%, 0.14%, and 0.76% in periods of positive GDP growth. Regional momentum profits are not statistically significant in the periods of negative GDP growth, but this is not surprising given that GDP growth is positive

[14] This index (VIXOBSA) uses a 1995 base year and is seasonally adjusted. For Korea and Turkey, no volume index is available; therefore, we use the nominal GDP series instead.

Table V

Momentum Investing and Macroeconomic States

For each month t, stocks in each country are ranked into quintile groups based on their performance over the 6 months $t-7 \ldots t-2$. The momentum strategy buys the winner quintile and sells short the loser quintile and holds these positions for the 6 months $t-1 \ldots t+5$. Panel A reports regional summary results of monthly momentum profits, WML, in different economic states based on quarterly real GDP growth. On the left are results in negative and positive GDP growth states, respectively. On the right are averages based on quartiles of GDP growth. Panel B shows analogous results using value-weighted local stock market index returns as the state variable.

Panel A: GDP Growth States

		$GDP<0$		$GDP>0$		Lowest		2		3		Highest	
Region/Country	Begin	WML	t	WML	t	WML	t	WML	t	WML	t	WML	t
Americas (ex. U.S.)	7508	1.18	(1.53)	0.61	(1.98)	0.41	(0.68)	0.66	(1.13)	0.93	(1.89)	0.76	(1.26)
Asia	7508	0.11	(0.21)	0.14	(0.50)	0.20	(0.41)	0.39	(1.07)	−0.45	−(0.80)	0.62	(1.63)
Asia (ex. Japan)	7508	0.26	(0.39)	0.20	(0.56)	0.36	(0.57)	0.43	(0.95)	−0.36	−(0.50)	0.84	(1.49)
Europe	7508	0.28	(1.22)	0.76	(8.22)	0.64	(3.18)	0.53	(3.09)	0.80	(5.28)	0.69	(3.95)
U.S.	6004	0.31	(0.38)	0.92	(5.58)	0.90	(1.92)	1.58	(5.80)	0.25	(0.69)	0.65	(2.27)
Developed (ex. U.S.)	7508	0.59	(3.09)	0.74	(8.73)	0.56	(3.20)	0.73	(4.94)	0.76	(5.16)	0.79	(5.21)
Developed	6004	0.56	(2.99)	0.76	(9.95)	0.61	(3.69)	0.83	(6.18)	0.70	(5.13)	0.77	(5.64)
Emerging	8503	−0.92	−(1.18)	−0.41	−(0.89)	0.18	(0.22)	−0.90	−(1.37)	−1.05	−(1.16)	−0.09	−(0.14)
World (ex. U.S.)	7508	0.32	(1.49)	0.61	(6.56)	0.52	(2.83)	0.51	(3.28)	0.50	(2.77)	0.69	(4.42)
World	6004	0.32	(1.54)	0.64	(7.67)	0.56	(3.30)	0.62	(4.36)	0.48	(2.86)	0.68	(4.85)

Panel B: Aggregate Stock Market States

		$r_{vw}<0$		$r_{vw}>0$		Lowest		2		3		Highest	
Region/Country	Begin	WML	t	WML	t	WML	t	WML	t	WML	t	WML	t
Africa	9009	1.55	(2.73)	1.28	(2.13)	0.78	(0.96)	3.13	(4.57)	1.21	(1.92)	−0.07	−(0.05)
Americas (ex. U.S.)	7508	0.76	(2.15)	0.76	(2.02)	0.72	(1.59)	1.06	(2.28)	0.41	(0.68)	0.85	(1.51)
Asia	7508	0.55	(3.07)	−0.10	−(0.44)	0.25	(1.04)	0.91	(3.95)	0.44	(2.01)	−0.88	−(1.89)
Asia (ex. Japan)	7508	0.61	(3.08)	−0.11	−(0.42)	0.28	(1.07)	1.04	(4.07)	0.46	(1.86)	−0.97	−(1.82)
Europe	7508	0.68	(6.00)	0.76	(7.03)	0.43	(2.93)	0.87	(6.32)	0.79	(5.33)	0.81	(4.15)
U.S.	2608	1.04	(4.95)	0.32	(1.26)	1.23	(4.55)	0.99	(4.39)	1.24	(6.30)	−1.11	−(1.96)
Developed (ex. U.S.)	7508	0.72	(7.36)	0.71	(7.50)	0.62	(4.81)	0.84	(7.02)	0.69	(5.61)	0.69	(3.99)
Developed	2608	0.77	(8.66)	0.64	(7.23)	0.72	(6.21)	0.86	(8.10)	0.77	(7.14)	0.41	(2.36)
Emerging	8609	0.56	(2.73)	−0.01	−(0.02)	−0.02	−(0.07)	1.26	(4.53)	0.53	(1.72)	−0.79	−(1.55)
World (ex. U.S.)	7508	0.66	(6.91)	0.50	(4.79)	0.41	(3.28)	0.97	(8.09)	0.64	(5.04)	0.24	(1.19)
World	2608	0.70	(7.93)	0.48	(4.94)	0.51	(4.42)	0.97	(8.91)	0.71	(6.15)	0.08	(0.43)

over most available sample periods. Underlying these averages, during periods of negative GDP growth, momentum profits are actually positive in 17 of the 22 markets. For developed markets (excluding the United States), the average momentum profit is a statistically significant 0.59% during negative GDP growth months as compared to 0.74% during positive GDP growth months.

Petkova and Zhang (2002) argue that classifying months according to ex post realized economic growth might obfuscate this issue since a risky stock should earn low returns during brief periods of unexpectedly high risk, but not during periods of high expected risk. They reason that unexpected poor economic news is more likely to arrive early in a recession period, and find that the value strategies analyzed in Lakonishok et al. (1994) generally experience negative returns during the first half of recessions. To further examine the timing of momentum profits in poor economic climates, we calculate each country's momentum profits during the first half of all periods of negative GDP growth and find that the average momentum profits are a statistically significant 1.24% in the United States and 0.26% in the non-U.S. markets.

We also examine momentum profits classified into four "regimes" of low to high real GDP growth. From lowest to highest GDP growth quartiles, the average monthly momentum profits in developed markets excluding the United States are 0.56%, 0.73%, 0.76%, and 0.79%, respectively. Momentum profits seem to be slightly higher in periods of large GDP growth, but, importantly, they are large and positive during all regimes.[15] U.S. momentum profits are also positive in periods of both up and down GDP growth and across all four GDP growth states. This pattern appears completely at odds with results reported in Table II of Chordia and Shivakumar (2002), where U.S. momentum profits are 0.53 during expansions and -0.72 during contractions. The difference, however, can be attributed to their study not skipping a month between ranking and investment periods and to the NBER classification of economic states.[16]

B. Momentum and Aggregate Stock Market Movements

We also examine risk related to economic states classified by aggregate stock market movements, since these are a forward-looking assessment of economy-

[15] To further investigate any relation between momentum and GDP growth, we estimate regressions of GDP growth in each country on contemporaneous and up to five lags of monthly momentum. The regressions show a mostly statistically and economically insignificant relation between momentum profits and future GDP growth. These findings are consistent with Liew and Vassalou (2000), who report that international size and book-to-market factors are related to future GDP growth but a momentum factor is not. In G7 countries, our findings for various economic states differ from Bacmann, Dubois, and Isakov (2001).

[16] To reconcile, we replicate Chordia and Shivakumar's findings using the NBER expansion and contraction dates. The recession return increases from -0.72 to an insignificant -0.16 monthly return upon skipping a month between the ranking and investment period. In addition, we tabulate for all countries in Table V the profits of momentum portfolios where the investment period directly follows the ranking period. The recalculated average monthly momentum profits for developed markets excluding the United States are $+0.24\%$ (although not statistically significant) during periods of negative GDP growth.

wide systematic risk. If the average premium on momentum is due to economic risk related to market movements, then momentum should earn positive returns in periods of positive market movements and negative returns during periods of negative market returns.

Panel B shows average momentum profits during periods of positive and negative market movements. The average profit to momentum strategies during down markets is 1.55, 0.76, 0.55, 0.68, and 1.04 in Africa, the Americas (excluding the United States), Asia, Europe, and the United States, respectively, as compared to 1.28, 0.76, −0.10, 0.76, and 0.32 during up markets for these regions. During periods of negative marketwide returns, momentum earns negative returns in only 5 of 40 markets. In contrast, during periods of positive market movement, momentum strategies earn negative returns in 14 markets. For all developed markets, the average momentum return in down markets is 0.77, indistinguishable from the 0.64 reached during up markets. For emerging markets, momentum profits are 0.56 during down markets and −0.01 during up markets. Momentum profits are, if anything, slightly *higher* during periods when market returns are negative.

We further examine this relation by dividing the time series of market returns within each country into four regimes based on market return quartiles. For all developed markets excluding the United States, the momentum profits are 0.62, 0.84, 0.69, and 0.69 in periods from lowest to highest quartiles of market movement. For the United States, momentum profits range from 1.23, 0.99, 1.24, and −1.11 in periods of lowest to highest market movements. While most market movements are due to their unexpected component, Petkova and Zhang (2002) argue that an analysis of realized market returns is misleading, as it contains an expected and unexpected component. A risky strategy should earn high returns during periods of high expected market returns and low unexpected market returns. To analyze the relation with expected returns, we apply a simple forecasting model based on conditional instruments,[17] and find that world momentum profits are statistically positive in periods of high and low expected market returns. Dividend yields are known to be a forecaster of expected market returns—when dividend yields are high, risk and expected returns are high and low dividend yields forecast low risk. In the highest quartile of dividend yield, world average momentum profits are a large and statistically significant positive 0.89%.

To summarize, there is no evidence that the profitability of momentum strategies is related to risk arising from macroeconomic states as proxied by GDP growth or aggregate stock market movements. We have also investigated states of industrial production growth with similar results. Taken together with the evidence that momentum profits are not related to macroeconomic variables or instruments known to forecast expected returns, we have formed a fairly exhaustive analysis of standard links to macroeconomic risk.

[17] Our model is similar to equation (3) except that the regression window starts at 3 years and widens to the full time series available.

IV. Risk and Behavioral Explanations of Momentum

Our study presents copious evidence that macroeconomic risk is not behind the momentum premium. Evidence from Jegadeesh and Titman (1993, 2001), Fama and French (1996), Rouwenhorst (1998), Grundy and Martin (2001), and others indicates that risk-based asset pricing models like the CAPM and the Fama and French (1993) three-factor model do not explain momentum returns either. The leading alternative explanation is a behavioral argument. One interesting point where behavioral and risk arguments may differ is on the issue of dissipation, that is, what happens to month t's momentum stocks *after* month $t+5$?

A. Models and Predictions

In the models of Daniel et al. (1998), Barberis et al. (1998), and Hong and Stein (1999), either behavioral biases or the interaction between groups of traders allow for initial underreaction followed by subsequent return reversals.[18] More explicitly, these models allow for a price correction stage during which month t's winners eventually reverse and start earning negative returns that may eventually bring the price below the month t level. It is important to note that because these models do not directly specify a time span for the reversals to occur, they possess something of an unfair advantage.

By contrast, the risk argument offered by Conrad and Kaul (1998) states that stocks with high past realized returns have relatively high unconditional expected returns. Since these expected returns do not vary through time, momentum profits should persist at all postformation horizons. Jegadeesh and Titman (2001) discuss in greater detail these long-run return prediction differences between the Conrad and Kaul and behavioral models and, consistent with the behavioral explanations, find evidence of reversals in U.S. return data.[19] Chordia and Shivakumar (2002) report that both U.S. preranking and postevaluation momentum profits are positive, consistent with a risk explanation. In their framework, momentum profits can dissipate as expected returns evolve through time, but they do not call for reversals at any specific horizon.

Recent risk-based models also provide predictions about dissipation of momentum profits. In the Berk et al. (1999) model, momentum profits arise because of persistent systematic risk in a firm's portfolio of projects, but these momentum returns decrease as those assets depreciate. The decrease need not stop at zero. Indeed, in their simulation results, under realistic project life and depreciation parameters, momentum strategy profits do become negative, but not until the fifth year. Other parameter choices (which they view as less probable in actual data) could produce faster dissipation.

[18] In the disposition effect model of Grinblatt and Han (2002), momentum profits increase with the proportion of investors exhibiting a tendency to sell winners and hold on to losers. This model of underreaction, but not overreaction, does allow for quick dissipation of momentum profits as the composition of trading changes; it does not call for negative cumulative profits at longer horizons.

[19] Cooper, Gutierrez, and Hameed (2001) relate the magnitude of these reversals to prior market conditions and behavioral model predictions.

In the Johnson (2002) model, momentum occurs due to growth rate shocks. A high past realized return means a firm is more likely to have a high growth rate. Because stocks with high growth rates also bear a high level of growth rate risk, stocks with high past realized stock prices earn higher future expected returns. Moreover, the model posits regime shifting in which a short-lived regime with highly persistent growth shocks (representing sudden bursts of technological disruption) alternates with a longer-lived regime in which shocks are more transitory. This innovation allows for a high past return to have an extra implication: not only whether the firm has a high growth rate, but also whether the firm is in the persistent shock regime. The ranking period length producing the highest momentum profits is the one coincident with the duration of the persistent shock regime. Momentum profits dissipate beyond the investment period, due to the decay in the growth shocks, but they are not predicted to turn negative at any horizon. Overall, the risk-based models tend to call for positive cumulative profits when month t momentum portfolios are held over even long horizons $t \ldots t+n$, whereas the behavioral models tend to allow for reversals or negative cumulative profits over horizons longer than an unspecified length. We examine n up to 60.

B. Evidence

We report in Table VI average momentum profits for our international sample in consecutive 6-month periods after the investment period: $t+6 \ldots t+11$, $t+12 \ldots t+17$, and $t+18 \ldots t+23$. Momentum profits from the investment period ($t \ldots t+5$) are also shown for comparison. Monthly average momentum portfolio returns are 0.00, -0.45, -0.49, and 0.31% in Africa, the Americas (excluding the United States), Asia (excluding Japan), and Europe, respectively, in the 6-month period from $t+6$ through $t+11$ after the investment period. From $t+12$ through $t+17$ regional momentum profits are -0.92, -1.07, -1.22, and -0.36% in Africa, the Americas (excluding the United States), Asia (excluding Japan), and Europe respectively. Regional profits are also negative in the second half of the second year after portfolio formation, months $t+18$ through $t+23$. In the United States, momentum profits are negative in the second year after portfolio formation, months $t+12$ through $t+17$ and $t+18$ through $t+23$.[20]

Longer-run performance, over horizons $t \ldots t+n$ where $1 \leq n \leq 60$, is depicted in Figure 2 by region (excluding the two-country region, Africa). Panel A shows that cumulative profits to month t momentum portfolios generally peak at a horizon of 6 to 10 months, and then an intense correction phase begins. As with the Jegadeesh and Titman (2001) findings for the United States, we document that cumulative profits become negative in the second year. Indeed, the evidence here generally shows that international momentum profits reverse more quickly and vigorously than their U.S. counterparts.

One current point of failure of behavioral models with respect to the U.S. data is on the seasonality of momentum profits. Jegadeesh and Titman (1993) and

[20] We have verified that using decile breakpoints and a $t-6 \ldots t-1$ ranking period on U.S. data gives results that are identical to Chordia and Shivakumar (2002) for the $t+6 \ldots t+11$ period.

Table VI

Momentum Portfolio Returns after Investment Periods

For each month t, stocks in each country are ranked into quintile groups based on their performance over the previous 6 months $t-7 \ldots t-2$. The momentum strategy buys the winner quintile and sells short the loser quintile. Panel A reports the average profits (WML) to the momentum portfolios in the investment period ($t \ldots t+5$), as well as in the three 6-month periods following the investment period (i.e., $t+6 \ldots t+11$, $t+12 \ldots t+17$, and $t+18 \ldots t+23$). Panels B and C report averages for January and for other months, respectively. Associated t-statistics are in parentheses.

		t to $t+5$		$t+6$ to $t+11$		$t+12$ to $t+17$		$t+18$ to $t+23$	
Region/Country	Begin	WML	t	WML	t	WML	t	WML	t
Panel A: All Months									
Egypt	9705	0.24	(0.25)	0.42	(0.44)	−1.19	(−1.31)	−0.61	(−0.63)
South Africa	9009	1.82	(4.00)	−0.11	(−0.26)	−1.05	(−2.11)	−0.62	(−1.18)
Africa	9009	1.63	(3.89)	0.00	(0.01)	−0.92	(−2.06)	−0.58	(−1.13)
Argentina	9404	1.00	(1.42)	−0.04	(−0.05)	−0.55	(−0.70)	0.29	(0.36)
Brazil	9408	0.74	(0.75)	0.55	(0.58)	−1.07	(−1.03)	−0.32	(−0.23)
Canada	7508	0.52	(1.73)	−1.01	(−3.54)	−1.55	(−5.43)	−1.00	(−3.55)
Chile	9003	1.12	(3.13)	0.12	(0.31)	−1.40	(−3.34)	−0.02	(−0.06)
Mexico	9205	1.21	(1.76)	1.39	(2.02)	1.49	(1.92)	0.56	(0.90)
Peru	9502	0.03	(0.01)	−1.43	(−0.76)	0.61	(0.32)	3.50	(1.92)
Americas (ex. U.S.)	7508	0.78	(3.13)	−0.45	(−1.79)	−1.07	(−4.21)	−0.34	(−1.51)
Australia	7508	0.43	(1.15)	−0.99	(−3.33)	−1.66	(−4.67)	−1.27	(−3.76)
China	9406	−0.01	(−0.02)	−1.00	(−1.78)	−1.30	(−2.01)	−1.26	(−2.44)
Hong Kong	8402	0.41	(0.97)	−1.45	(−3.13)	−1.50	(−3.15)	−0.30	(−0.70)
India	9009	0.80	(1.74)	0.39	(0.79)	−0.64	(−1.44)	−0.74	(−1.52)
Indonesia	9012	−1.00	(−1.16)	−1.49	(−1.61)	−1.89	(−1.54)	−1.01	(−1.72)
Japan	7508	0.02	(0.10)	−0.30	(−1.42)	−0.49	(−2.66)	−0.26	(−1.48)
Malaysia	8609	0.18	(0.34)	−0.61	(−1.38)	−1.02	(−2.64)	−0.87	(−2.40)
New Zealand	8809	1.33	(2.66)	0.21	(0.43)	−0.68	(−1.49)	0.46	(1.07)
Pakistan	9303	−0.30	(−0.41)	−0.56	(−0.63)	0.33	(0.40)	−1.03	(−1.11)
Philippines	9306	1.17	(0.89)	−0.69	(−0.53)	−2.06	(−2.07)	−0.93	(−1.05)
Singapore	8309	0.10	(0.25)	−0.13	(−0.34)	−0.57	(−1.46)	−0.11	(−0.39)
South Korea	8710	−0.76	(−0.80)	−1.39	(−1.92)	−1.12	(−2.26)	−0.15	(−0.33)
Taiwan	8908	0.01	(0.02)	0.31	(0.69)	−0.73	(−2.21)	0.36	(0.99)
Thailand	8709	0.17	(0.25)	−1.91	(−2.56)	−0.95	(−1.44)	−0.76	(−1.01)
Asia	7508	0.32	(1.64)	−0.48	(−2.91)	−0.97	(−5.12)	−0.49	(−3.54)
Asia (ex. Japan)	7508	0.40	(1.35)	−0.49	(−2.08)	−1.22	(−4.18)	−0.62	(−2.86)
Austria	8902	0.70	(2.06)	0.22	(0.67)	−0.72	(−2.47)	−0.24	(−0.87)
Belgium	7508	1.12	(5.67)	0.64	(3.22)	0.06	(0.30)	0.22	(1.19)
Denmark	8812	0.92	(2.83)	0.09	(0.31)	−0.52	(−1.70)	−0.03	(−0.09)
Finland	9307	0.50	(1.13)	0.50	(1.06)	−0.67	(−1.40)	−0.07	(−0.13)
France	7508	0.79	(3.82)	0.45	(2.67)	−0.48	(−2.75)	−0.25	(−1.44)
Germany	7508	0.69	(4.57)	0.57	(3.97)	−0.09	(−0.69)	−0.16	(−1.17)
Greece	9002	1.61	(2.36)	−0.80	(−1.07)	−1.42	(−2.10)	−1.49	(−2.61)
Ireland	9003	1.23	(2.29)	0.49	(0.75)	−0.69	(−1.05)	−0.67	(−1.00)
Italy	7508	0.86	(3.79)	0.32	(1.39)	−0.53	(−2.19)	−0.72	(−3.38)
Netherlands	7508	1.16	(4.97)	0.58	(2.71)	−0.10	(-0.51)	0.08	(0.43)

Table VI

(Continued)

Norway	8206	1.11	(2.54)	− 0.06	(− 0.14)	− 0.37	(− 0.86)	− 0.40	(− 0.97)
Portugal	9002	− 0.63	(− 1.06)	− 0.35	(− 0.52)	− 0.39	(− 0.68)	− 1.47	(− 2.23)
Spain	8711	0.32	(0.64)	0.20	(0.44)	− 0.56	(− 1.19)	0.18	(0.43)
Sweden	8406	− 0.01	(− 0.02)	− 0.73	(− 1.38)	− 0.64	(− 1.31)	− 0.49	(− 1.11)
Switzerland	7508	0.95	(5.17)	0.68	(4.32)	− 0.16	(− 1.02)	0.03	(0.18)
Turkey	8809	− 1.50	(− 2.20)	− 0.46	(− 0.77)	− 0.23	(− 0.32)	− 0.59	(− 0.92)
U.K.	7508	1.03	(6.14)	0.20	(1.43)	− 0.59	(− 4.48)	− 0.25	(− 2.10)
Europe	7508	0.77	(8.15)	0.31	(3.19)	− 0.36	(− 3.72)	− 0.27	(− 3.24)
U.S.	2608	0.59	(3.32)	0.04	(0.28)	− 0.59	(− 3.81)	− 0.40	(− 2.65)
Developed (ex. U.S.)	7508	0.73	(7.04)	0.06	(0.62)	− 0.58	(− 6.29)	− 0.29	(− 3.44)
Developed	7508	0.74	(7.19)	0.08	(0.87)	− 0.56	(− 5.78)	− 0.27	(− 3.05)
Emerging	8609	0.27	(1.21)	− 0.09	(− 0.44)	− 0.65	(− 3.31)	− 0.50	(− 3.08)
World (ex. U.S.)	7508	0.65	(6.90)	0.01	(0.13)	− 0.59	(− 6.60)	− 0.32	(− 4.40)
World	7508	0.66	(7.08)	0.03	(0.39)	− 0.57	(− 6.09)	− 0.31	(− 3.79)
Panel B: January									
Africa	9101	− 0.97	(− 0.56)	− 1.79	(− 0.90)	1.77	(1.72)	0.60	(0.39)
Americas (ex. U.S.)	7601	0.58	(0.55)	− 3.06	(− 3.01)	− 4.29	(− 3.83)	− 2.10	(− 2.93)
Asia	7601	0.62	(0.91)	− 1.79	(− 3.12)	− 1.77	(− 1.52)	− 1.27	(− 1.86)
Asia (ex. Japan)	7601	1.32	(1.11)	− 2.30	(− 2.09)	− 2.56	(− 1.28)	− 1.82	(− 1.88)
Europe	7601	0.39	(1.22)	− 0.54	(− 1.55)	− 1.65	(− 3.82)	− 1.73	(− 3.99)
U.S.	2701	− 4.21	(− 6.47)	− 4.62	(− 6.32)	− 5.00	(− 6.87)	− 4.11	(− 5.40)
Developed (ex. U.S.)	7601	0.26	(0.64)	− 1.11	(− 3.08)	− 2.07	(− 4.16)	− 1.96	(− 4.13)
Developed	7601	0.03	(0.07)	− 1.51	(− 4.02)	− 2.42	(− 4.85)	− 2.43	(− 4.45)
Emerging	8701	1.01	(0.81)	− 1.51	(− 3.60)	− 1.26	(− 2.70)	− 1.16	(− 1.31)
World (ex. U.S.)	7601	0.52	(1.37)	− 1.08	(− 3.56)	− 1.81	(− 4.05)	− 1.56	(− 4.70)
World	7601	0.32	(0.86)	− 1.45	(− 4.40)	− 2.14	(− 4.75)	− 2.05	(− 4.48)
Panel C: Non-January									
Africa	9009	1.86	(4.36)	0.15	(0.36)	− 1.15	(− 2.46)	− 0.68	(− 1.25)
Americas (ex. U.S.)	7508	0.80	(3.13)	− 0.22	(− 0.87)	− 0.78	(− 3.11)	− 0.19	(− 0.80)
Asia	7508	0.29	(1.43)	− 0.36	(− 2.14)	− 0.90	(− 5.02)	− 0.43	(− 3.06)
Asia (ex. Japan)	7508	0.32	(1.04)	− 0.33	(− 1.40)	− 1.10	(− 4.16)	− 0.51	(− 2.35)
Europe	7508	0.80	(8.14)	0.38	(3.85)	− 0.25	(− 2.57)	− 0.14	(− 1.84)
U.S.	2608	1.02	(5.80)	0.46	(3.21)	− 0.19	(− 1.29)	− 0.07	(− 0.47)
Developed (ex. U.S.)	7508	0.77	(7.23)	0.16	(1.71)	− 0.45	(− 5.20)	− 0.14	(− 1.90)
Developed	7508	0.80	(7.60)	0.22	(2.45)	− 0.39	(− 4.40)	− 0.08	(− 1.08)
Emerging	8609	0.20	(0.94)	0.03	(0.16)	− 0.60	(− 2.85)	− 0.44	(− 2.79)
World (ex. U.S.)	7508	0.67	(6.81)	0.11	(1.21)	− 0.48	(− 5.59)	− 0.22	(− 3.04)
World	7508	0.70	(7.18)	0.17	(1.92)	− 0.43	(− 4.81)	− 0.15	(− 2.11)

Grinblatt and Moskowitz (2003) find that a good part of the reversals happens in January, which is not a prediction of behavioral models. A likely explanation for negative returns to momentum strategies in January reversals is that year-end

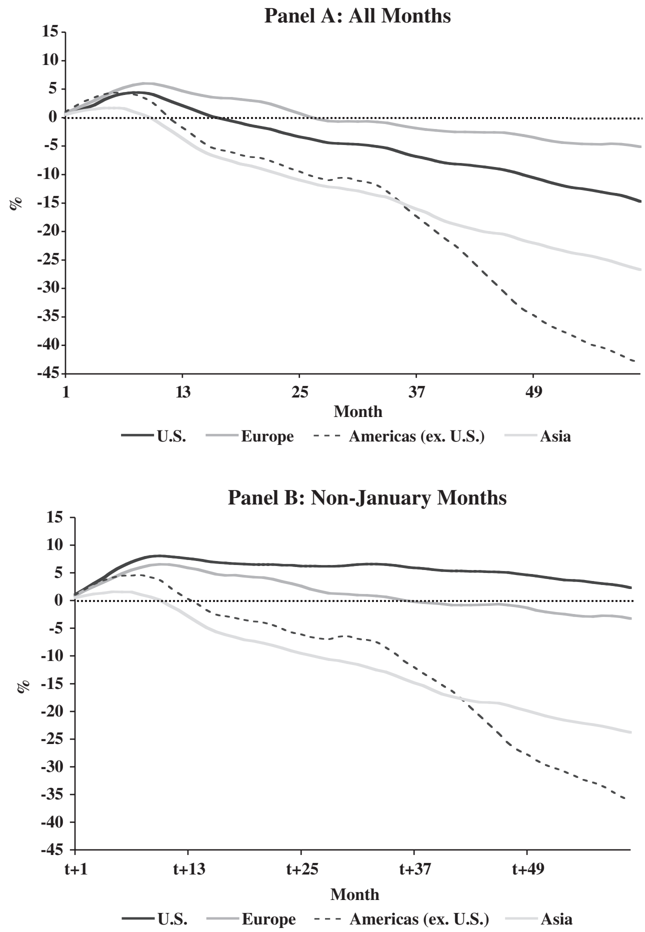

Figure 2. Cumulative performance of momentum portfolios by region. At the beginning of each month t, stocks in each country are ranked into quintiles based on their performance over the 6 months $t-7$ to $t-2$. The momentum strategy buys the winner quintile and sells short the loser quintile and holds these positions. Panel A plots regional cumulative returns for the holding period $t+1$ to $t+60$. Panel B shows only months other than January.

tax-loss selling leads to January rebounds for loser stocks. To examine whether our international reversals are concentrated in January, we break out the cumulation results between January and other months and find that a good part of the reversal effect happens in January. Indeed, Panel B of Table VI reveals that the January returns are more negative in the United States than in other regions, but the January returns are consistently negative in all regions except Africa in the $t+6 \ldots t+11$, $t+12 \ldots t+17$, and $t+18 \ldots t+23$ periods; these periods average -1.08, -1.81, and -1.56 respectively for the world (excluding the United States).

Nevertheless, the pivotal status of January in the United States is not mirrored exactly internationally. This is most clear in Panel B of Figure 2, which plots cumulated returns excluding Januaries. Here the United States looks quite different from regional results. After excluding January, U.S. momentum profits dissipate only slightly, and fail to become negative. In contrast, Europe, the Americas (excluding the United States), and Asia still have strong reversals in momentum profits that look similar to the results for all months in Panel A. This evidence of long-run reversals excluding January is inconsistent with most risk-based explanations and more compatible with behavioral explanations. Even so, it is important to note that if one believes that reversals are due to tax-loss selling and that beginning of the year effects are not January specific in some countries, our results excluding January will understate the importance of these tax-related effects.

V. Conclusion

Recent theoretical and empirical work supports the hypothesis that momentum profits are simply compensation for investors holding portfolios of high macroeconomic risk. This study comprehensively investigates the linkages between macroeconomic risk and momentum using several techniques and a large international data set covering 40 countries. We also provide new evidence on the dissipation of momentum profits. Our findings are as follows.

First, we find that momentum profits are large and have only a weak comovement among countries, whether within regions or across continents. This fact indicates that if momentum is driven by risk, the risk is largely country specific.

Second, we examine the ability of the unconditional model of Chen et al. (1986) to explain momentum profits in 17 markets. These macroeconomic factors exhibit significance neither for pricing nor in time series when applied to momentum profits in the United States or abroad.

Third, we also examine the ability of the conditional forecasting model of Chordia and Shivakumar (2002) to explain momentum profits in 16 markets. Stocks with high model-predicted returns earn future returns that are not significantly above those with low model-predicted returns. Conversely, even after controlling for variability captured by the model, winner stocks earn economically and statistically larger future returns than loser stocks internationally.

Fourth, we turn to a comparison of momentum portfolio profits across different economic climates as classified by GDP growth and aggregate stock market movements. Under both classifications, we find that international momentum profits are generally positive in all macroeconomic states. Momentum simply cannot be explained by our set of standard macroeconomic state variables. While it may be possible that momentum could be explained by macroeconomic risk of a form not tested here, it is unclear what such risk might look like or how it would behave.

Finally, we provide international evidence that momentum profits reverse quite soon after the investment period and become negative over longer horizons —a pattern consistent with predictions of some behavioral models. Reversals outside the United States are especially interesting in this regard because they are not mostly driven by negative January returns. Although the observed data are generally inconsistent with currently available risk-based models that do allow for decay in momentum profits, the comparison is in some sense unfair since no time horizon is specified in most behavioral models. We would hope to see development of more specific predictions from various behavioral models so that their performance can be assessed in future research.

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