AN EMERGING MARKETS ANALYSIS *of the Piotroski F-score*

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This paper examines whether the F-score signal developed by Piotroski (2000) can discriminate between high- and low-return stocks in emerging markets. It shows that there is a meaningful premium attached to high F-score stocks which is unrelated to the size, value and momentum premiums. This suggests that the usual explanation for the power of the F-score (i.e. investor neglect of high F-score stocks) is incomplete because big cap and high-momentum stocks are typically the most heavily scrutinised stocks in the market.

The F-score is a measure of financial strength and is a composite of nine financial items. A stock is assigned a binary score for each item and the nine scores are then summed to give the F-score for the stock, ranging between zero and nine. The items together with their desired properties are: (i) positive profitability; (ii) increase in profitability; (iii) positive cash flow; (iv) negative accruals; (v) increase in profit margin; (vi) increase in asset turnover; (vii) decrease in leverage; (viii) increase in financial liquidity; and (ix) no issuance of new equity.

Piotroski found that in the US between 1976 and 1996, for the 20 per cent of stocks with the highest book-to-price ratio (deep value stocks), high F-score stocks outperformed all stocks by 7.5 per cent p.a. The effect was most pronounced for small stocks with low share turnover and no analyst coverage, consistent with the F-score being most effective for stocks for which the market is slow to incorporate relevant financial information. Deep-value stocks are typically neglected by analysts and investors and thus likely to impound new information more slowly. Indeed, Piotroski shows high F-score stocks tend to experience large positive reactions to subsequent earnings announcements.[1]

We do not restrict attention to deep value stocks in our analysis since emerging markets are likely to be slower to price in new information for all stocks. The finding by Mohr (2012) that the F-score effectively discriminates between high- and low-return stocks among growth stocks provides additional justification for broadening the analysis to include all stocks. We estimate the premium to high F-score stocks and examine whether the premium is robust to controls for size, value and momentum effects.

As analyst coverage (controlling for size) is lower in emerging markets (Griffin et al. 2010), it is plausible that emerging markets may be slower to price in new information than developed markets. Indeed, a range of studies provide evidence in this direction, some based on the relative success of traditional alpha signals (Griffin et al. 2010; Harvey 1995) and others looking the existence of serial correlation and information leakage (Rouwenhorst 1998; Bhattacharya et al. 2000; Van der Hart et al. 2003). The lower informational efficiency of emerging markets could plausibly result in the F-score having even more power in emerging markets than developed markets.

Previous studies using financial statement analysis to separate winners from losers have either focused on developed markets (Piotroski (2000) and Mohanram (2005) look at the US; Mohr (2012) examines the Eurozone) or subsets of the global emerging markets universe (Tantipanichkul (2011) studies Thailand; Galdi and Broedel Lopes (2009) focus on Brazil; Kang and Ding (2005) study Asia ex Japan). Here we examine the effectiveness of the F-score signal across all countries in the MSCI Emerging Markets Index. Adopting this broader global context is important given that many institutional investors access emerging markets only through global mandates.

Data and methodology

Our analysis employs start-of-month data spanning the period January 2000 to December 2011. The universe is the MSCI Emerging Markets Index. The sample contains 667 stocks in January 2000, 805 stocks in December 2011 and 99,658 stock-date observations in total. All portfolio average excess returns are equal-weighted.

Portfolios are formed monthly starting January 2000 and ending July 2011 for six-month holds and January 2011 for 12-month holds. The excess return for a stock is calculated as the total return for the stock less the accumulation index return for the country/region to which the stock is assigned. Similarly, when conditioning returns on size, value and momentum, we sort stocks based on their ranking relative to other stocks in the same country/region to which the stock is assigned — thus, the resulting portfolios are country-neutral. The only countries examined in isolation are those which contain many stocks and have a large market capitalisation. All other countries are aggregated into geographic groupings. See Table 1.

TABLE 1: Country groupings

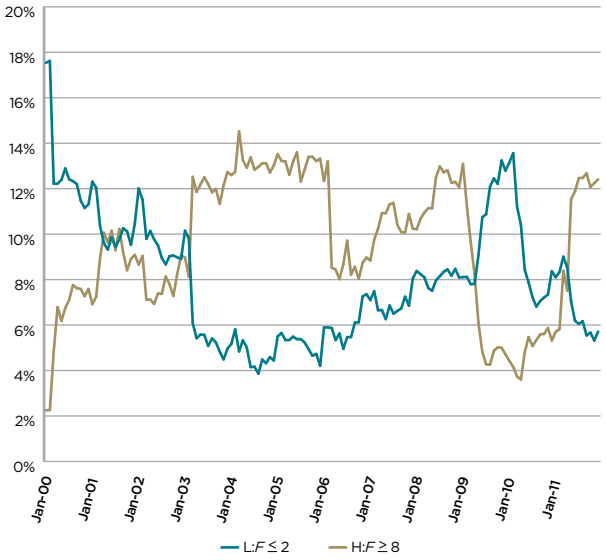
Grouping	Constituents
SE Asia	Indonesia, Malaysia, Philippines and Thailand
Latin America ex Brazil	Chile, Colombia, Mexico, Peru
E Europe and N Africa	Czech Republic, Egypt, Hungary, Morocco, Poland, Russia, Turkey
Individual countries	Brazil, China, India, Korea, South Africa, Taiwan

The F-score is defined in Table A.1 in the Appendix. Observations of F-scores between 4 and 7 (inclusive) account for 75 per cent of our data sample, while only 13 per cent are associated with the extreme scores of 0, 1, 8 or 9. There is little year-to-year variation in the average F-score, with the annual equal-weighted average F-score across all stocks remaining within the range of 4.89 to 5.66. The average F-score reached its lowest points in the years 2000, 2009 and 2010, periods of weak economic growth. There is also little variation across countries, with the country average F-score ranging from 5.05 (South Africa) to 5.50 (Latin America ex Brazil).

The F-score does not vary greatly with the value- or momentum-rank of stocks. The equal-weighted average F-score for the bottom 50 per cent of stocks ranked on the book-to-price (BP) ratio (i.e. the most expensive stocks) is only 0.11 lower than for the top 50 per cent of stocks. The difference in the average F-score between high and low (six-month) momentum stocks is only slightly higher at 0.21.

We compare the equal-weighted excess returns of high F-score stocks (F ≥ 8, denoted H) to that of low F-score stocks (F ≤ 2, denoted L).[2] These two bins contain on average 9.5 per cent and 8.0 per cent, respectively, of the available stocks at each date — the time variation in the number of stocks in the two bins is shown in Figure 1. These cut-offs ensure that while comparing stocks at the tails of the F-score distribution, there are sufficient observations in each bin to ensure the results are statistically meaningful.

FIGURE 1: Time variation in the sample sizes of the high (H) and low (L) bins



Results

The premium to high F-score stocks

Among deep value stocks, those in the H bin generate a premium relative to all deep value stocks. Table 2 shows that for stocks in the top 20 per cent of value as ranked by BP, this premium is 3.51 per cent p.a. (2.06 per cent p.a.) for the six-month (12-month) holding period — the associated *t*-statistics for these estimates are shown in parentheses. This is lower than the 7.5 per cent premium observed by Piotroski, but still economically meaningful and statistically significant in the case of the six-month holding period. Table 2 also shows that this premium varies with value, being negative for stocks in the lowest 20 per cent of value and positive but small for the middle 60 per cent of stocks as ranked by BP. The finding of a negative premium for growth stocks points to a difference between emerging and developed market stocks — Mohr (2012) found a positive premium for growth stocks in Europe.

TABLE 2: Premium of high F-score stocks relative to all stocks within each value tier

	High F-score ($F \geq 8$) stocks – all ($F \geq 0$) stocks return differential (% p.a.)	
BP rank	Six-month hold	12-month hold
Bottom 20% (expensive)	-1.07 (1.28)	-1.53 (1.67)
Middle 60%	0.83 (1.79)	0.84 (1.54)
Top 20% (cheap)	3.51[a] (3.58)	2.06 (1.53)

[a] Statistically significant at p = 0.01 level.

Using the entire data sample (not just value stocks), we find that stocks in the H bin generate a higher average return than stocks in the L bin for holding periods of six and 12 months, confirming the existence of a broad-based premium to high F-score stocks. Table 3 shows that this H−L premium is substantial, similar and statistically significant for the two holding periods, being 4.10 per cent p.a. for the six-month holding period and 4.36 per cent p.a. for the 12-month holding period.

TABLE 3: Annualised excess return of high (H) and low (L) F-score stocks

	EW average excess return (% p.a.)	
F-score	Six-month hold	12-month hold
H: F ≥ 8	3.33[a] (9.37)	3.41[a] (7.96)
L: F ≤ 2	-0.77 (1.54)	-0.95 (1.75)
H−L premium	4.10[a] (6.77)	4.36[a] (6.31)

[a] Statistically significant at p = 0.01 level.

The above analysis was repeated using cut-offs of F ≥ 7 and F ≤ 3, respectively, (utilising 41 per cent of the total sample compared to 18 per cent above) to estimate the H−L premium. The resulting H−L premium was slightly higher than that shown in Table 3, being 5.28 per cent and 4.94 per cent p.a. for the six- and 12-month holding periods. In what follows, we report results only for the six-month holding period.

Despite cross-sectional variation in the H−L premium across the individual countries/regions in the emerging markets universe, Table 4 shows that the premium is positive in all countries except Brazil. The negative premium for Brazil is noteworthy given that it is one of the larger countries by market capitalisation in the emerging markets universe.

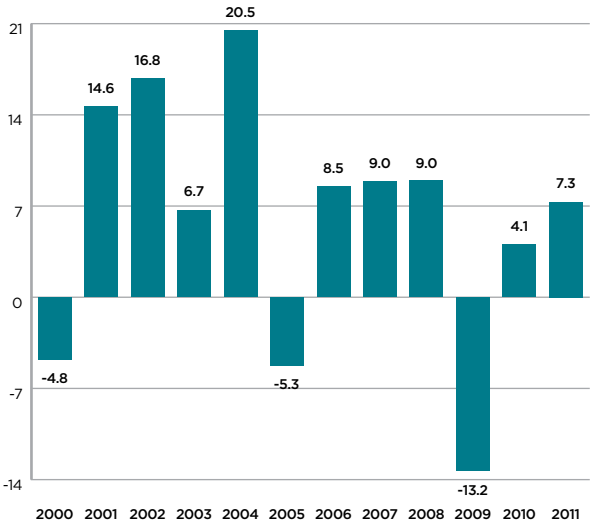
TABLE 4: The premium to high F-score stocks by country/region

Country/region	H−L premium (% pa)	*t*-statistic
Korea	6.82[b]	2.51
Taiwan	1.25	0.63
India	13.09[a]	3.89
SE Asia	14.20[a]	6.61
China	12.46[a]	4.59
E Europe and N Africa	0.90	0.39
Latin America ex Brazil	0.32	0.12
Brazil	-13.49[a]	3.60
South Africa	6.96[a]	2.57

[a] Statistically significant at p = 0.01 level.
[b] Statistically significant at p = 0.05 level.

The H−L premium displays appreciable time-series variation, although it is negative in only three of the 12 years in our sample period. Two of these years (2000 and 2009) were periods where large market swings occurred, suggesting that the F-score is a weaker signal when markets are particularly volatile.

FIGURE 2: Yearly variation in the premium to high F-score stocks



There is also variation in the contribution each of the nine F-score components makes to the overall H−L premium. Table 5 shows that the Profitability, Cash Flow, Accruals and ΔNet Capital components generate the strongest contributions while only ΔLeverage makes a negative (though small and not statistically significant) contribution to the overall H−L premium. The return differential here is the return to stocks which score 1 on the component minus the return to stocks that score 0.

TABLE 5: Component contributions to the premium to high F-score stocks

F-score component	H−L premium (% p.a.)	*t*-statistic
F_1: Profitability	3.62[a]	7.96
F_2: ΔProfitability	0.76[a]	3.19
F_3: Cash flow	4.94[a]	11.97
F_4: Accruals	2.74[a]	9.71
F_5: ΔProfit margin	1.16[a]	4.84
F_6: ΔAsset turnover	0.70[a]	2.93
F_7: ΔLeverage	-0.23	0.97
F_8: ΔLiquidity	1.34[a]	5.58
F_9: ΔNet capital	2.91[a]	11.73

[a] Statistically significant at p = 0.01 level.

It is plausible that the premium to high F-score stocks will be largest when the information contained in the financial statements is new (i.e. recently reported) as the market will have had little time to react to this data. Most stocks in the emerging markets universe have a December financial year end, meaning that new financial information generally is released in

March. The intuition above is confirmed in Table 6, with the H–L premium being larger in the March quarter than in the remaining three quarters. Moreover, the H–L premium is higher in the first half of the year than the second half, indicating that the F-score becomes a less useful signal as its informational content becomes increasingly stale.

TABLE 6: Quarterly variation in the premium to high F-score stocks

Quarter	H–L premium (% p.a.)	*t*-statistic
Jan–Mar	7.95[a]	6.13
Apr–Jun	5.49[a]	4.52
Jul–Sep	-0.18	-0.16
Oct–Dec	3.39[a]	2.72

[a] Statistically significant at p = 0.01 level.

The size effect

The premium to stocks with a high F-score can be attributed to the size premium only if stocks with a high F-score are on average smaller than low F-score stocks. However, our analysis shows that the opposite is true: the average MSCI Index weight of H stocks is nearly double that of L stocks (0.0019 versus 0.0010). Similarly, the average market capitalisation of H stocks is $6.68b versus $4.82b for L stocks. This also suggests that the strategy of choosing high F-score stocks is capable of being implemented in that it doesn't rely on the selection of very small stocks.[3] High F-score stocks do, however, have somewhat lower average daily liquidity than that for all stocks: $18.1m versus $26.6m.

Table 7 shows that when stocks are sorted into two size baskets (with equal numbers of names), the premium is positive and statistically significant from zero for both large and small stocks. This is consistent with the H–L premium being independent of the size effect. While a more discriminating sort could have been used (e.g. top 20 per cent of size versus bottom 20 per cent), the fact that high F-score stocks are larger than low F-score stocks suggests that the results in Table 7 would be little changed.

We show that the H–L premium is similar for large and small stocks (0.06 per cent p.a. differential is not statistically significant). This contrasts with Piotroski's finding that the premium is concentrated within small stocks.

We show that the H–L premium is similar for large and small stocks (0.06 per cent p.a. differential is not statistically significant). This contrasts with Piotroski's finding that the premium is concentrated within small stocks. Moreover, since new information generally is rapidly impounded into large cap stock prices, our findings suggest that the H–L premium in emerging markets is driven by something other than the failure to rapidly incorporate new financial information into stock prices.

TABLE 7: Impact of size on the premium to high F-score stocks

Size	H–L premium (% p.a.)
Big: top 50% by size rank	4.75[a] (6.27)
Small: bottom 50% by size rank	4.69[a] (4.98)

[a] Statistically significant at p = 0.01 level.

The value effect

We now show that the observed premium to high F-score stocks is not just the value premium in another guise. If the H–L premium is attributable to the value premium, high F-score stocks must display higher value on average than low F-score stocks. The evidence, however, is mixed and depends critically on how value is defined. The average BP ratio of high F-score stocks is actually 9 per cent lower than for low F-score stocks (0.65 v. 0.72), while the average earnings-to-price (EP) ratio of high F-score stocks is close to double that for low F-score stocks (0.088 v. 0.045). Clearly the H–L premium in Table 3 is not being driven by the classical BP value premium.

Table 8 shows that the premium to high F-score stocks exists within high-value stocks and also within low-value stocks, indicating that the H–L premium is not being driven by the value premium. The premium is higher for value stocks than for growth stocks regardless of whether value is defined by the BP or EP ratio. This difference is consistent with the results in Table 2.

TABLE 8: Impact of value on the premium to high F-score stocks

	H–L premium (% p.a.)	
Value	BP	EP
High: top 50% by value rank	4.82[a] (4.52)	4.18[a] (3.85)
Low: bottom 50% by value rank	2.27[a] (3.00)	-0.03 (0.03)

[a] Statistically significant at p = 0.01 level.

The momentum effect

The H–L premium also appears to be independent of the momentum effect. In order for the H–L premium to be explained by the momentum premium, the average momentum of high F-score stocks must be higher than for low F-score stocks. In fact, the average six-month price momentum is virtually identical for both types of stocks, while the average 12-month momentum is a statistically significant 54 per cent higher for H stocks than L stocks. So, if the H–L premium in Table 3 is driven by the

momentum premium, it is clearly unrelated to the six-month momentum premium.

As with size and value, we find that the H–L premium is independent of price momentum. Table 9 shows that the H–L premium is positive and statistically significantly different from zero for both high- and low-momentum stocks using either six-month or 12-month formation periods. The difference in the H–L premium between high- and low-momentum stocks is not statistically significant for the six-month formation period but is significant for the 12-month period. In summary, there is no evidence to suggest that the observed H–L premium is being driven by the momentum premium.

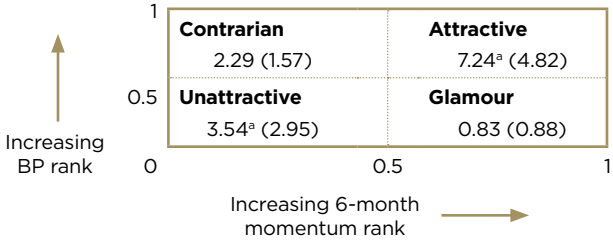
TABLE 9: Impact of momentum on the premium to high F-score stocks

	H–L premium (% p.a.)	
Momentum	**6-month momentum**	**12-month momentum**
High: top 50% by momentum rank	4.05[a] (5.10)	5.97[a] (7.67)
Low: bottom 50% by momentum rank	3.72[a] (4.05)	2.33[a] (2.57)

[a] Statistically significant at p = 0.01 level.

Figure 3 combines the insights from Tables 8 and 9, showing the tendency of high F-score stocks to outperform low F-score stocks is strongest in the high-value and high-momentum (Attractive) quadrant. Nonetheless, the average H–L premium is positive in all four quadrants.

Figure 3: The premium to high F-score stocks on the value momentum complex (% p.a.)



[a] Statistically significant at p=0.01 level

Discussion and conclusion

Our key finding is that, consistent with evidence from both developed and emerging market country studies, stocks with a high F-score earn a significant return premium over stocks with a low F-score. This positive premium is robust across both countries and time.

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Our results are consistent in key respects with the few individual emerging country studies that have been previously undertaken. Like Kang and Ding (2005) we find a positive premium in Asia and our results for Thailand are consistent with those of Tantipanichkul (2011). In contrast to the strong negative premium we observe, Galdi and Broedel Lopes (2009) find a positive premium for Brazil. However, this is driven mostly by small- and medium-sized stocks which we do not include in our analysis.

However, our results suggest the efficiency with which new information is impounded into stock prices cannot be the only source of the premium to high F-score stocks. Something other than analyst/investor neglect must explain why the H–L premium is the same for big cap and small cap stocks, and somewhat larger for high-momentum stocks than low-momentum stocks. Large cap and high-momentum stocks attract greater analyst and financial news coverage than any other part of the market. In emerging markets, a fuller explanation of the drivers of the premium to high F-score stocks is required.

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Endnotes

1 Choi and Sias (2012) provide additional evidence to support the 'slow impounding of new information' hypothesis by showing that future institutional investor demand is high for stocks with high F-scores.

2 Piotroski defines the H bin similarly ($F \geq 8$) but uses the more restrictive $F \leq 1$ definition of the L bin. Including $F = 2$ in the L bin makes the two bins better balanced in terms of the number of data points in each.

3 The average MSCI Index weight for all stocks in the sample is 0.0014 and the average market capitalisation is $5.24b.

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Appendix

The components of the F-score are detailed in Table A.1. The components F_1 to F_8 change only once per year in our monthly dataset (due to the annual frequency of the financial year-end reporting cycle) while F_9 changes every month since market capitalisation data updates daily.

Table A.1: Components of the F-score

	Name	Definition	Formula
F_1	Profitability	Net profit including extraordinary items/total assets at start of period	$F_1 = 1$ if profitability > 0, otherwise $F_1 = 0$.
F_2	ΔProfitability	Profitability in current period — profitability in one-year prior period	$F_2 = 1$ if Δprofitability > 0, otherwise $F_2 = 0$.
F_3	Cash flow	Operating cash flow/total assets	$F_3 = 1$ if cash flow > 0, otherwise $F_3 = 0$.
F_4	Accruals	Profitability — cash flow	$F_4 = 1$ if accruals < 0, otherwise $F_4 = 0$.
F_5	ΔProfit margin	Gross margin in current period — gross margin in one-year prior period	$F_5 = 1$ if Δprofit margin > 0, otherwise $F_5 = 0$.
F_6	ΔAsset turnover	Asset turnover in current period — asset turnover in one-year prior period	$F_6 = 1$ if Δasset turnover > 0, otherwise $F_6 = 0$.
F_7	ΔLeverage	(Total long term debt/total assets in current period) — (Total long term debt/total assets in one-year prior period)	$F_7 = 1$ if Δleverage < 0, otherwise $F_7 = 0$.
F_8	ΔLiquidity	(Current assets/current liabilities in current period) — (Current assets/current liabilities in one-year prior period)	$F_8 = 1$ if Δliquidity > 0, otherwise $F_8 = 0$.
F_9	ΔNet capital	Change in market cap over the prior six months — change in market cap due to the change in share price	$F_9 = 1$ if Δnet capital < 0, otherwise $F_9 = 0$.

The F-score is defined as:

$$F = \sum_{i=1}^{9} F_i$$

Thus, the F-score takes on a minimum value of 0 and a maximum value of 9.