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Cross-country determinants of market efficiency: A technical analysis perspective☆

Jiali Fang [a,*], Ben Jacobsen [b]

[a] School of Economics and Finance, Massey University, Auckland, New Zealand
[b] TIAS Business School, the Netherlands

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ABSTRACT

This study examines the relative impact of seven factors, including herding, sentiments, and institutional quality, on varying levels of weak form market efficiency across 50 stock markets. The analysis focuses on the profitability of technical analysis trading strategies to address issues with other (statistical) market efficiency measures related to information and transaction costs (Griffin et al., 2010). Proxies for herding, institutional quality, and equity market development consistently emerge as the most significant cross-country determinants of relative market efficiency. In contrast, proxies for fractionalization, chaos, and investor protection play comparatively weaker roles. We also find no clear link between market efficiency and sentiment proxies.

1. Introduction

This study uses cross-country variation in technical analysis portfolio returns as proxies for differences in weak form market efficiency. The portfolios are constructed based on the 26 technical analysis trading rules used in Brock et al. (1992). By examining these portfolio returns, we address issues associated with other (statistical) market efficiency measures regarding information and transaction costs (Griffin et al., 2010). We then evaluate the impact of international differences on portfolio returns using various proxies (discussed below) on the following seven factors: herding, investor sentiment, institutional quality, market development, investor protection, chaos (degree of nonlinearities in stock market indices), and societal fractionalization.

Fig. 1 plots the simple equal-weighted raw returns of the 26 technical analysis trading strategies against composite proxies for the seven factors to illustrate the main findings. The composite proxies are constructed using principal component analysis (PCA). We use the R^2 and the slope of the estimated regressions of technical analysis returns on the composite proxies as rough indicators. We find that technical analysis performs better in countries where investors exhibit higher herding behavior, stock market development is lower, and institutional quality is poorer. R^2 values are 23 %, 42 %, and 43 %, with slopes significantly positive, negative, and negative, respectively. To a lesser extent, technical analysis performs better in countries where investor protection is weaker, societal fractionalization is lower, and stock return series are more chaotic. The associated R^2 values are 15 %, 18 %, and 22 %, with slopes significantly negative, negative, and positive, respectively. However, sentiment does not significantly impact technical analysis returns and exhibits low explanatory power with an R^2 of 6 % and an insignificant slope.

We confirm the results using the following estimation methods: monthly cross-country panel data regressions, different risk corrections, and alternative portfolio construction methods with and without transaction costs. The results remain robust when we control for various macroeconomic variables or country and year fixed effects, and across alternative models including two-stage least squares regressions. We analyze the proxies individually and collectively while demonstrating that they Granger cause the cross-country differences in technical trading profits. We find that herding, institutional quality, and equity market development are the most influential cross-country determinants

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* Corresponding author.
E-mail address: j.fang@massey.ac.nz (J. Fang).

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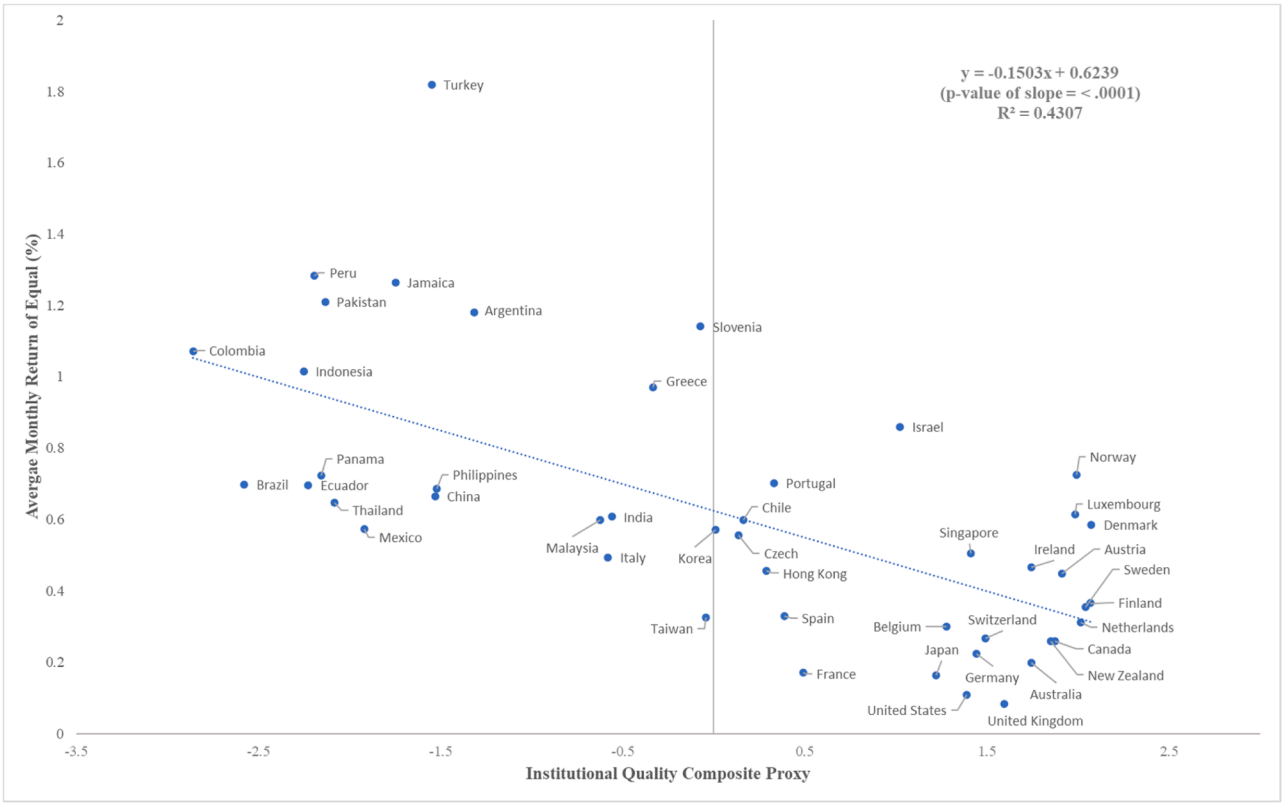
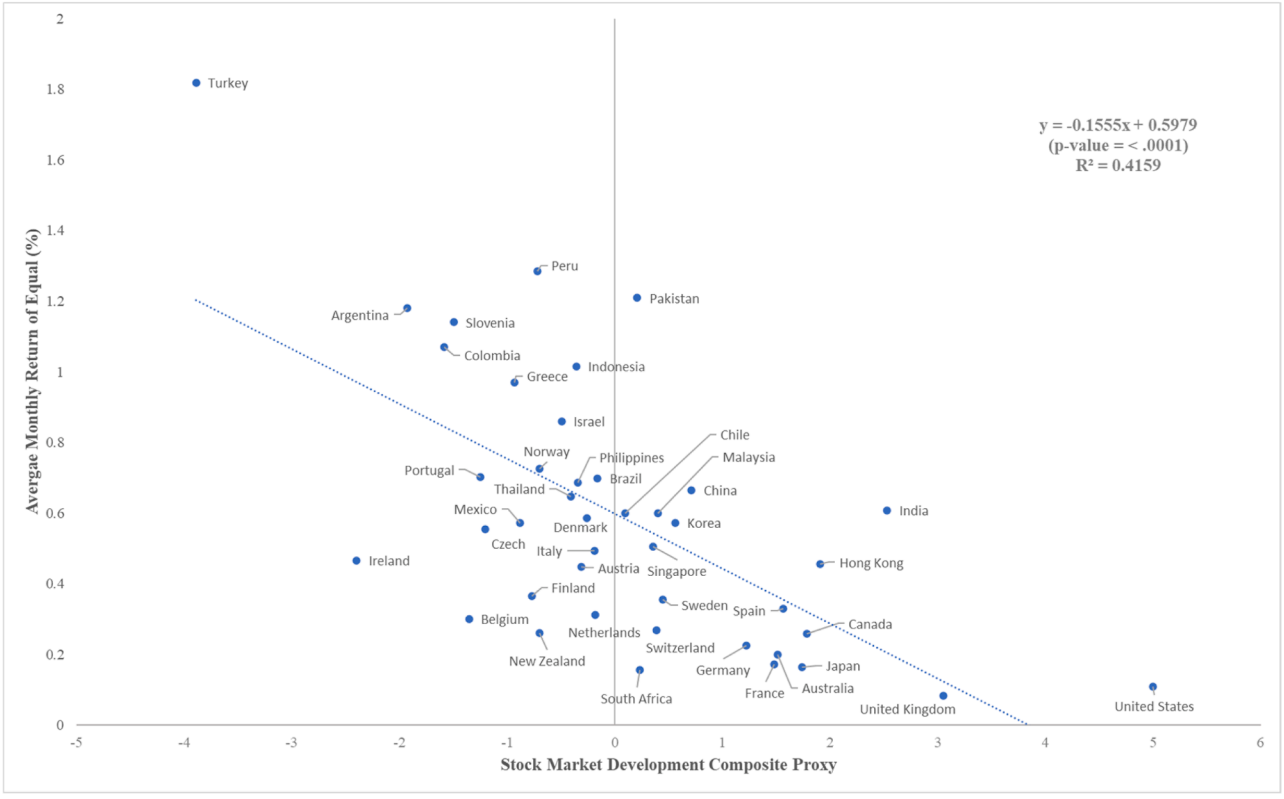
Fig. 1. Average monthly technical trading profits versus market efficiency determinants.





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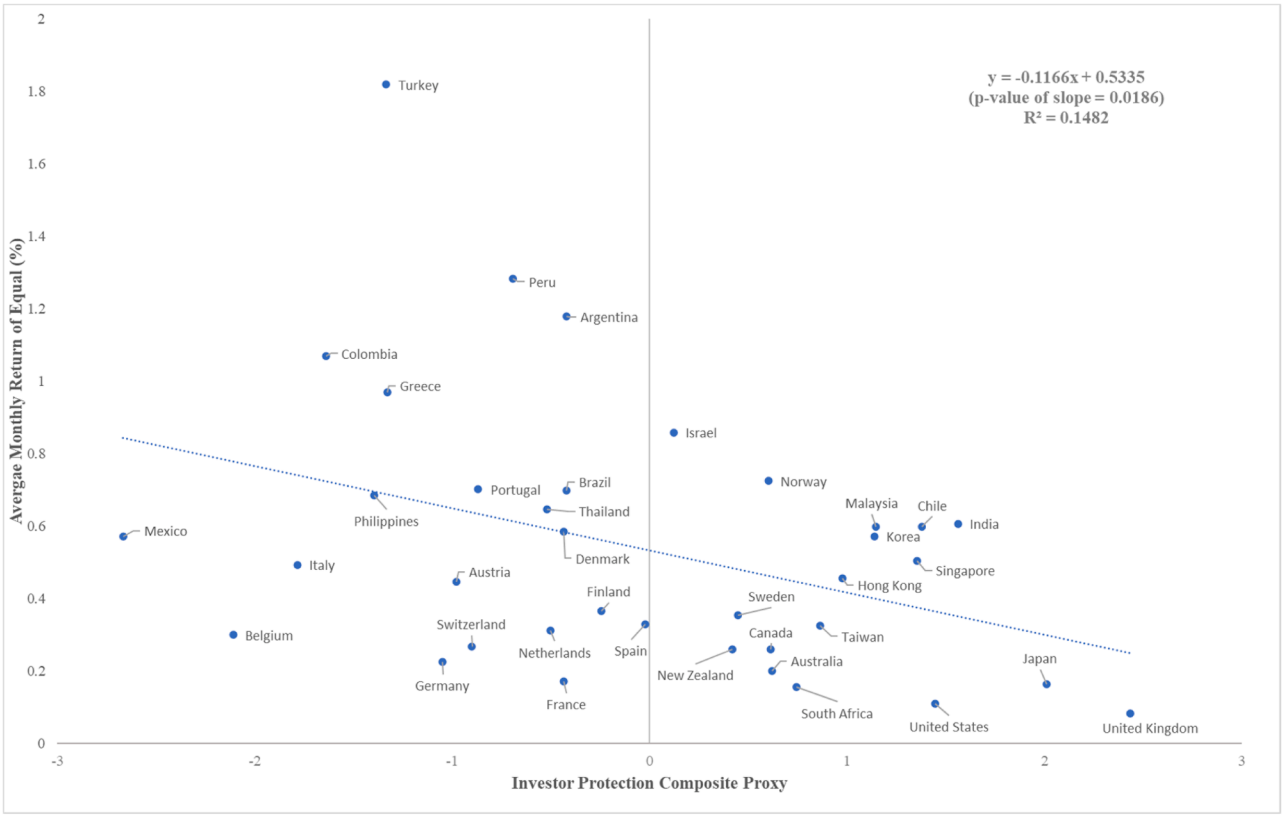

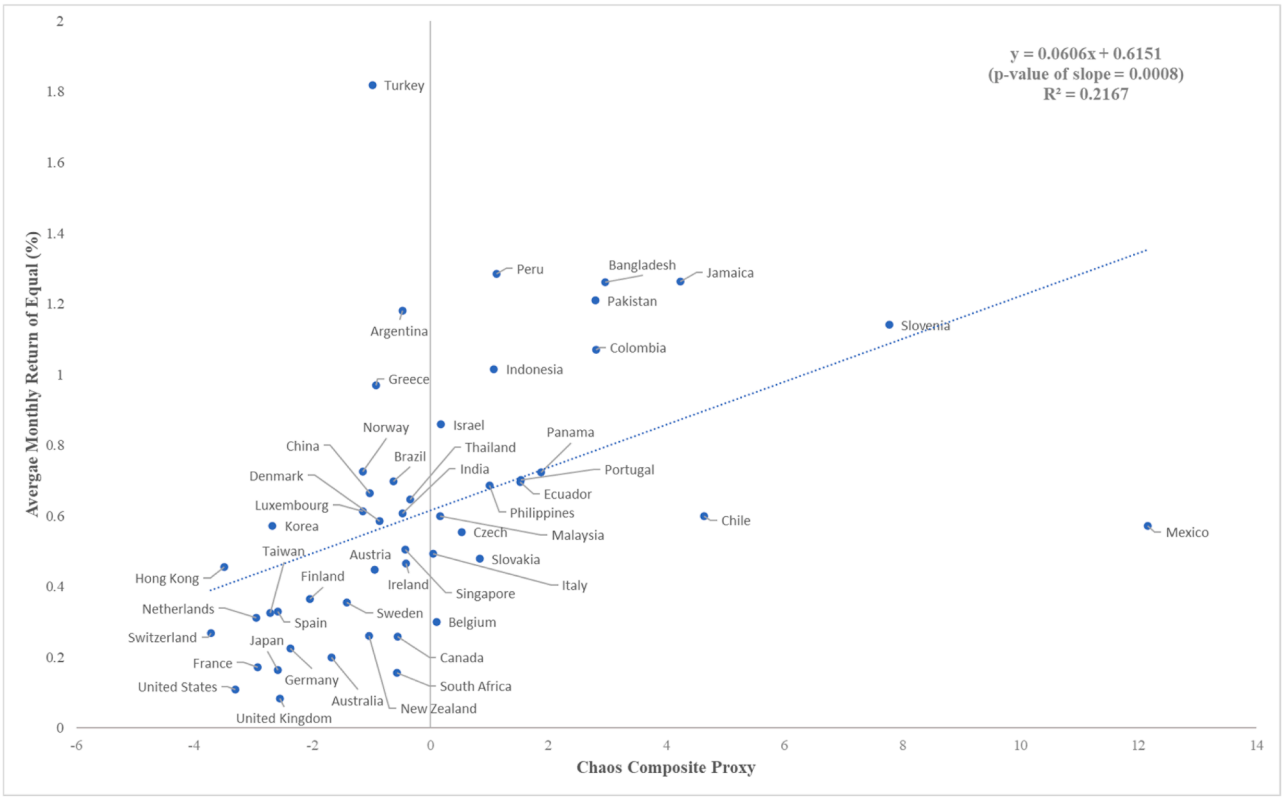

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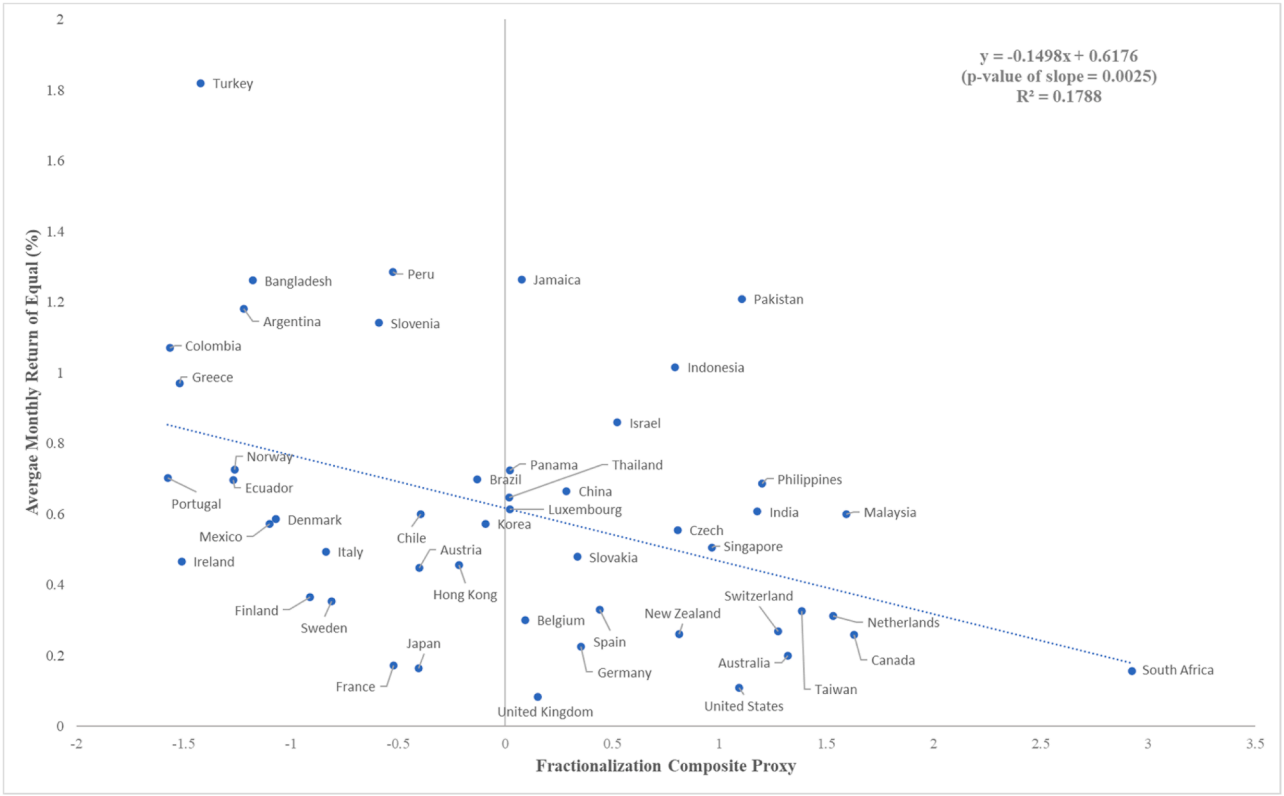

Fig. 1. (*continued*).

of relative market efficiency across all approaches. At the same time, fractionalization, chaos, and investor protection play relatively minor roles, and sentiment shows no clear effect.[1]

For each of the 50 markets in the sample, the basic portfolio (Fig. 1) is an equal-weighted mix of the 26 individual trading strategies (Brock et al., 1992) based on daily data from 1994 to 2018. We construct three additional portfolios for each country based on the same individual trading strategies. The portfolios represent a blend of returns from technical trading rules to mitigate the risk of idiosyncratic spurious results arising from specific rules. They serve as broad indicators of weak form market efficiency. Two of the additional portfolios aggregate signals of individual rules and trade based on the dominant buy or sell signal. Following Brock et al. (1992) we construct the portfolios with and without a holding period requirement. The final portfolio adds trading costs to the "full" portfolio with the holding period requirement. We adopt Fong et al.'s (2017) approach to estimate average monthly transaction costs in each market and factor in time-varying transaction costs based on data from 92,809 individual stocks. Griffin et al. (2010) find that trading strategies to test market efficiency are advantageous compared to traditional statistical measures (e.g., autocorrelations and variance ratios) because they can incorporate trading costs. The authors suggest that differences in information and information processing costs can also impact market efficiency measures (Griffin et al., 2010). Therefore, comparing market efficiency levels should rely on widely accessible and immediate information while considering transaction costs. Hence, the net profits from applying technical analysis on market indices, which are easily and freely observable, may serve as reliable proxies to compare levels of weak form market efficiency across countries.

This study considers seven possible determinants of market efficiency to explain cross-country variation in technical analysis profitability. The first determinant, herding behavior, can shift prices away from their fundamental values, resulting in inefficiencies (Avery and Zemsky, 1998; Beckmann et al., 2008; Bikhchandani et al., 1998; Cipriani and Guarino, 2014). We use herding proxies including individualism/collectivism indices from seminal cultural studies such as Hofstede (2001), the Global Leadership and Organizational Behavior Effectiveness (GLOBE) project (House et al., 2004; Schwartz, 1999). Sentiment is our second determinant. De Long et al. (1990a, 1990b) find that noise traders' irrational beliefs or sentiments can cause inefficiencies by pushing asset prices away from their fundamental values. Following Schmeling (2009) and Wang et al. (2021), we employ consumer and business confidence indices as sentiment proxies in an international context.

Following Bekaert et al. (2011a), the third set of proxies of institutional quality are derived from the International Country Risk Guide (ICRG), which quantifies a country's political risk, corruption levels, and law and order. Fourth, more developed equity markets are likely more efficient. As such, we measure stock market development based on total stock market capitalization (scaled by GDP), liquidity (total value of stocks traded as a percentage of GDP), turnover (market dollar trading volume scaled by market capitalization), number of listed companies, stock market age, cash flow growth volatility, and stock market concentration (measured using the industry Herfindahl–Hirschman index). Fifth, we adopt La Porta et al.'s (1998) proxies to capture country-level investor protection, insider trading restrictions, ownership concentration, and accounting disclosure standards.

The sixth factor is the degree of chaos in stock returns. Stock return nonlinearities may lead to higher technical analysis predictability (Clyde and Osler, 1997). Thus, we use 11 statistics (e.g., BDS statistics

[1] The main findings also hold when examining individual technical analysis strategies, employing long-only strategies (to mitigate arbitrage limits), using dollar returns relative to a world index, utilizing different market indices from various sources, estimating transaction costs using alternative methods, and assessing the market timing ability of these rules. Additionally, we validate the results based on an alternative sample period: the initial 20 years of each market once they started trading or once daily data were available.

following Brock et al. (1996)) to capture the degree of chaos. The seventh and final determinant is fractionalization, the degree of diversity or division of a country's population along ethnic, linguistic, or religious lines (Alesina et al., 2003). Highly fractionalized societies may lead to smaller in-group networks, greater distrust among different groups, and lower homogeneity in local social structures (Postelnicu and Hermes, 2018). This can increase political risks (Annett, 2001) and negatively impact growth and market efficiency. However, fractionalization can also relate positively to market efficiency; individuals from varying homogeneous groups are more likely to herd in a less fractionalized society due to a lower probability of conflict and a higher probability of social cooperation (Lindner and Strulik, 2008). Furthermore, Alesina et al. (2003) suggest that religious fractionalization could inversely relate to political risk by promoting a culture of tolerance and compromise, especially if different groups have a history of peaceful coexistence, share common interests, or face external threats. Therefore, although there is no clear a priori relationship between fractionalization and relative market efficiency, the results of this study suggest that high fractionalization improves market efficiency.

We conduct pairwise interaction tests to examine the relative significance of cross-country determinants. Each regression includes two determinants along with their interaction term. We examine all possible pairwise combinations of the determinants. Although the individual impacts of herding, institutional quality, equity market development, and investor protection remain substantial and consistent after considering other determinants, our findings indicate that their combined effects with other factors may amplify or offset their individual impacts. For instance, the positive effect of herding on technical analysis profitability becomes prominent in contexts of lower institutional quality and less developed equity markets. In contrast, the inverse relation between institutional quality and technical analysis profits can weaken with improved stock market development, better investor protection and increased fractionalization. Notably, chaos and fractionalization exhibit decreased impact when other factors are considered, and sentiment consistently demonstrate a weak impact.

Additionally, we conduct supplementary tests using all seven determinants collectively. Tests include model selection based on adjusted R^2, holdout tests using root mean square error (RMSE), stepwise regressions which add regressors in order of importance, and Autometrics, an automatic model selection method (Bekaert et al., 2011b; Griffin et al., 2010). These tests consistently yield robust and corroborative results.

The study makes several contributions. First, to our knowledge, it is the first study to evaluate the factors contributing to or undermining weak form market efficiency while considering information and transaction costs. Ülkü and Prodan (2013) also examine factors affecting technical analysis results across countries. However, they focus on short-term strategies before transaction costs and primarily consider macroeconomic and statistical factors within a relatively small sample (379 observations). Second, this study explores market efficiency determinants beyond the traditional "developed versus emerging markets" paradigm. After accounting for transaction costs, this paradigm appears less distinct based on our findings that show positive risk-adjusted profits of technical analysis in "developed" markets such as Italy, Denmark, Luxembourg, and Austria but not in "emerging" markets such as Brazil, India, or Indonesia.

Third, this study identifies the dominant market efficiency drivers. Market inefficiencies may persist over time as some determinants change only gradually (e.g., cultural factors such as herding or fractionalization). In contrast, structural shifts could diminish inefficiencies linked to time-varying factors (e.g., institutional quality). Finally, the results provide insight into potentially profitable opportunities using technical analysis. Contrary to studies suggesting diminishing return predictability over time, technical analysis strategies continue to yield profits in several countries even after factoring in transaction costs. This may not be surprising as some of the market efficiency determinants we uncover may only evolve gradually.

2. Cross-Country determinants and data[2]

2.1. Herding

In addition to academic studies that examine the impact of herding on financial market prices (e.g., Scharfstein and Stein 1990), several technical analysis handbooks (Kahn, 2010; Kirkpatrick and Dahlquist, 2010) suggest that herding may cause prices to shift away from their fundamental values and follow trends, thereby becoming more predictable. Based on the above, this study uses seven well-known proxies to measure investors' herd-like behavior across countries: (1) the Hofstede (2001) individualism index; (2) the updated individualism index (Beugelsdijk et al., 2015); (3) three indices from the Schwartz Value Survey (Schwartz, 1999), including affective autonomy, intellectual autonomy, and embeddedness; and (4) two GLOBE in-group collectivism indices (House et al., 2004).

2.2. Sentiment

Behavioral feedback models (De Long et al., 1990a, 1990b) suggest that noise traders may affect prices while causing trends based on irrational beliefs or sentiments. Although several sentiment indices have been proposed, international-level data are limited. We use two proxies to measure monthly cross-country differences in sentiment: the Consumer Confidence Index and the Business Confidence Index (Schmeling, 2009). However, these proxies are available for a maximum of 35 countries in our sample due to data limitations. To ensure robustness, we examine 12 alternative sentiment proxies commonly used in studies examining single countries (Bekaert et al., 2022) or shorter, more recent samples (Wang et al., 2021). Alternative proxies include time-series-only proxies primarily measuring U.S. sentiment (such as, the CBOE Volatility Index (VIX), Baker and Wurgler's (2006) sentiment indices, Bekaert et al.'s (2022) risk aversion and uncertainty indices, the State Street global investor confidence index, and the Sentix Eurozone investor sentiment index). Additionally, we include panel proxies that are available for a limited number of countries (such as the Directorate General for Economic and Financial Affairs (DG-ECFIN) of the European Commission sentiment indices and Refinitiv/Ipsos primary consumer sentiment indices). Finally, we also examine possibly noisy proxies that often contain information beyond sentiment, such as stock market volatility, which also proxies for market risk, and correlation with world markets, relating to market segmentation.

2.3. Institutional quality

Following Bekaert et al. (2011a), we use three measures from the ICRG to evaluate institutional quality. First, we employ the ICRG law and order proxy to determine the significance of the legal system, which directly relates to corporate governance. Second, we analyze the ICRG investment profile index, which measures the risk and attractiveness of investing in a country based on three subcomponents: contract validity, repatriation, and payment delays. Third, we create an aggregate institutional quality index by combining three ICRG political risk proxies: law and order, bureaucratic quality, and corruption.

2.4. Equity market development

Korajczyk (1996) and Levine and Zervos (1996) indicate that less developed stock markets present more arbitrage opportunities, suggesting lower market efficiency due to reduced information quality, higher information costs, lower investor sophistication, and increased

[2] We present all measures and data more extensively in Appendix A

risk. Developed stock markets are generally more active, and stock prices typically reflect available information in active markets more accurately. As such, we include several proxies to assess stock market activity such as total market capitalization (as a percentage of GDP), liquidity (total value of stocks traded as a percentage of GDP), turnover (market dollar trading volume divided by market capitalization), and the total number of listed companies.

Furthermore, we use the age of stock market to proxy for market development. This is measured by the year of study minus the year when stock market data became available in the Global Financial Data. Benefiting from a longer history, older markets generally have more accessible information, possibly resulting in decreased technical analysis profitability (Shynkevich, 2012; Zhang, 2006). Additionally, markets with lower earnings uncertainty and lower concentration (or higher firm visibility) are more likely to exhibit greater information quantity and quality. Following Minton and Schrand (1999), Jiang et al. (2005), and Zhang (2006), we measure earnings uncertainty by volatility of market index cash flow growth rates. We measure market concentration based on the Herfindahl–Hirschman index following Morck et al. (2000).

2.5. Investor protection

La Porta et al. (1998) propose various metrics to assess firm information asymmetry by evaluating the extent of protection provided to investors, including outsiders, such as shareholders or creditors, against insiders such as managers or controlling shareholders. Information asymmetry significantly affects the informativeness of stock prices. La Porta et al. (2000, 2002) provide empirical evidence to show that the legal protection of creditors and shareholders directly impacts corporate governance and firm valuation. As such, we use five investor protection measures based on La Porta et al. (1998): creditor rights, anti-director rights, accounting standards, ownership concentration, and insider trading indices.

2.6. Chaos theory

Clyde and Osler (1997) and Surajaras et al. (2019) suggest that chaotic series are more amenable to technical analysis, particularly in predicting short-term price behavior. They demonstrate that methods such as charting (head-and-shoulders) may offer comparable results to non-linear forecasting in this context. To measure chaos, we utilize 11 distinct proxies derived from the Hurst exponent (Hurst, 1951), corrected Hurst exponent (Annis and Lloyd, 1976), maximum Lyapunov exponent (Wolf et al., 1985; Yadav et al., 1999), and the BDS statistic (Brock et al., 1996), along with variations of these measures as proposed in the existing literature. Higher values across these proxies indicate greater chaos, implying a positive relation between technical analysis profitability and chaos proxies.

2.7. Fractionalization

Alesina et al. (2003) introduce three measures to evaluate fractionalization at the country level. Their measures capture how individuals within a population are divided into different groups based on ethnicity, language, and religion. These measures have been widely used in various studies (Sturm and De Haan, 2015; Cline et al., 2021; Kanagaretnam et al., 2022). As previously discussed, societal fractionalization can impact technical analysis profitability through a positive or negative relation with political risk or a negative relation with herding. The relation between technical analysis profitability and fractionalization could manifest in either direction when considered collectively.

2.8. Other data

Stock market and risk-free rate data are from the Global Financial Data database.[3] We include all markets with daily aggregate stock market index data available for 24 years from March 1994 to March 2018, totaling 50 markets. The cross-country variables are elicited from various sources. A detailed description of the data is presented in Appendix A.

3. Methodology

3.1. Technical analysis strategies

We construct portfolios based on Brock et al.'s (1992) 26 popular technical trading rules. These rules, extensively studied, are chosen to mitigate potential data snooping and publication bias. The 26 trading rules comprise three categories: (1) variable-length moving average (VMA) rules, (2) fixed-length moving average (FMA) rules, and (3) trading range break (TRB) rules. VMA rules include short- and long-term moving averages of underlying prices. Buy (sell) signals are generated when the short-term moving average crosses above (below) the long-term moving average. We analyze five VMA rules: (1,50), (1150), (5150), (1200), and (2200). The parameters denote the time frames in days for short- and long-term moving averages. Additionally, we introduce a version of these rules with a 1 % filter (the percentage difference between the short-term and long-term moving averages) to reduce whipsaws in prices. These are labeled as (1,50,0.01), (1150,0.01), (5150,0.01), (1200,0.01), and (2200,0.01), respectively, resulting in a total of 10 VMA rules. The holding period after trading on signals is flexible. We hold the current buy (sell) position until a different sell (buy) trading signal is generated.

FMA rules resemble VMA rules but differ as trade signals occur only during a crossover of short- and long-term moving averages. FMA rules rely on a fixed holding period of 10 days. With identical short- and long-term moving average windows and price filter settings in the VMA rules, we derive 10 FMA rules. TRB rules employ support and resistance parameters derived from periodic price extremes. These rules generate buy (sell) signals when current prices exceed (fall below) resistance (support). We use three time frames (1,50), (1150), and (1200) to define the price extremes, with corresponding versions using a 1 % filter as (1,50,0.01), (1150,0.01), and (1200,0.01), yielding six TRB rules in total. The TRB rules require a fixed holding period of 10 days.

For all technical rules, we execute buy and sell actions based on signals and invest in risk-free assets when no technical trade signal is present. Next, we construct four composite technical trading strategies to aggregate the average performance of technical analysis from the 26 rules to simplify and mitigate noise from individual strategies. The first strategy, *Equal*, represents the equal-weighted return of all 26 strategies. The second strategy, *Composite*, generates a single composite buy/sell/risk-free signal on each trading day when most of the 26 individual trading strategies generate this signal. For example, we count the total number of buy/sell/risk-free signals generated by the 26 individual trading strategies for each trading day. If the number of buy signals is greater than both the number of sell signals and the number of risk-free signals, *Composite* would trade on a buy signal. The third strategy, *CompFixed*, extends this strategy by imposing a fixed 10-day holding period filter (as in the original FMA and TRB individual rules) once a composite trading signal is generated. The final portfolio considered is *CompFixedNet*, adds trading costs to the *CompFixed* portfolio. We present the results of these four portfolios in the following analysis, but the individual strategy results are highly consistent and reported in Online Appendix A.

[3] The Global Financial Data indices allow us to include several countries with the longest possible sample period. Nevertheless, our results remain similar if we use MSCI or Datastream stock market indices.

3.2. Profitability of technical trading rules

We calculate the monthly returns of each technical trading strategy k. For each day d in month t, we long (short) sell the market index when there are technical buy (sell) trading signals and invest in risk-free assets when there is no signal in day d-1. Next, we integrate all daily returns in a month to obtain the monthly raw returns generated by each trading strategy in each country j, denoted as r^p_{kjt}.

We also calculate risk-adjusted returns for each strategy to account for general cross-country differences in risk captured by the Fama and French (1993, 1996) factors SMB_{jt},HML_{jt}, and MOM_{jt}. Since many fundamental analysis strategies are related to these factors, controlling for them allows for a general comparison of technical analysis profitability to a broad range of passive and active trading strategies. We run the following regression for each strategy k in each country[4]:

$$r^p_{kjt} - r^f_{jt} = \alpha_{kj} + \beta 1_{kj} MRP_{jt} + \beta 2_{kj} SMB_{jt} + \beta 3_{kj} HML_{jt} + \beta 4_{kj} MOM_{jt} + \mu_{kjt}, \quad (1)$$

where for each country j at month t, r^f_{jt} represents the monthly risk-free rates and r^m_{jt} represents the monthly returns of the local market index. MRP_{jt} (equals to $r^m_{jt} - r^f_{jt}$) is the market risk premium, and μ_{kjt} represents the residual term. Therefore, α_{kj} represents the risk-adjusted return for country j over the entire sample period for strategy k. We further test the spread between returns conditional on the buy and sell signals and the market timing ability of the technical trading rules, as shown in Online Appendix C.

3.3. Transaction costs

We apply the *FHT* method (Fong et al., 2017) to examine the profitability of technical analysis net of transaction costs. This is considered one of the best liquidity proxies in international research. Specifically, we estimate the monthly transaction costs for stock s in country j at month t by running the following model:

$$FHT_{sjt} = 2\sigma_{sjt} N^{-1}\left(1 + Zeros_{sjt}\right), \quad (2)$$

where N^{-1} represents the inverse function of the cumulative normal distribution. σ_{sjt} is the standard deviation of non-zero returns of stock s in month t. $Zeros_{sjt}$ equals the number of days with zero returns divided by the total number of days in month t for stock s.

First, we calculate the monthly transaction costs for each stock in each country. Next, we take the average of all the stocks in each country for each month to derive the monthly transaction costs at the country level. In the *FHT* approach, we assume that a zero return is the outcome of the actual return being between the upper bound given by the transaction cost for buying, and the lower bound given by the transaction cost for selling. Therefore, a greater proportion of zero returns indicates wider bounds. Hence, there is a wider spread (i.e., transaction costs) when the volatility of the actual return distribution is constant.

We collect the daily prices of all stocks in the U.S. and Canada from Compustat North America and Compstat Global for all other countries. Appendix B presents the number of stocks for each country and the estimated monthly transaction costs. The average one-way transaction cost across all countries in this sample is 0.024. It is consistent with the global average effective and quoted spreads of 0.019 and 0.024, respectively, from 1996 to 2014 (Fong et al., 2017). Transaction costs are higher in countries such as Ecuador, Venezuela, and Slovakia, aligning with our expectations. We deduct monthly round-trip transaction costs from *CompFixed* each time the technical analysis strategy indicates a position change (e.g., long to short or short to holding risk-free assets) to calculate *CompFixedNet*.

We also combine the actual transaction costs reported by Angelidis and Tessaromatis (2017) and Domowitz et al. (2001) and use them as a robustness check for the main results. Transaction costs under this method tend to be higher than *FHT* costs due to the high level of transaction costs in the first half of the sample period. However, this does not affect the overall results, as shown in Appendix B.

3.4. Cross-Country analysis of technical trading profits

We run the regression in Eq. (3) to conduct the cross-country analysis of technical trading profits for each strategy k. We follow the Fama–MacBeth statistical procedure and correct for cross-sectional correlation in standard errors. This procedure estimates the regression coefficients for each month (i.e., each cross-section) of the sample, generating a time series of estimates for each coefficient. For each coefficient, we take the time-series estimate average and calculate the adjusted t-statistics by measuring the sampling errors based on the standard deviations of the cross-sectional regression estimates. Standard errors are adjusted for heteroskedasticity and autocorrelation (Newey and West, 1994).[5]

$$r^p_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}, \quad (3)$$

where r^p_{kjt} represents the monthly returns from technical trading strategy k for country j at month t. X_{jt} represents the different cross-country determinants of technical analysis profitability. MRP_{jt} (equal to $r^m_{jt} - r^f_{jt}$) is the market risk premium. SMB_{jt}, HML_{jt}, and MOM_{jt} are Fama and French (1993, 1996) factors. They are controlled for in all the cross-country regressions. $Controls_{jt}$ captures the additional macroeconomic risk factors and other controls added to the model from Section 6 onwards, and ε_{kjt} is the residual term. We use a 5 % significance level throughout.

4. Technical trading profits

Panel A of Table 1 presents the average monthly raw returns for the four technical analysis portfolios for each stock market. *Equal*, *Composite*, and *CompFixed* produce significantly positive average monthly returns of 0.67 %, 0.55 %, and 0.63 % in 42, 37, and 32 markets, respectively. *Equal*, which represents the average returns of the 26 original technical analysis strategies of Brock et al. (1992), exhibits the highest returns. *Composite* and *CompFixed* perform similarly to *Equal*, confirming that they are good proxies for evaluating the overall performance of various technical analysis strategies. The returns on *CompFixed* are higher than those of *Composite*. This finding supports Brock et al.'s (1992) argument that applying price and holding period filters can reduce noise and whipsaws in underlying prices. Finally, *CompFixedNet*'s average monthly return is 0.59 %. The results suggest that technical analysis generates positive and significant returns in 30 of the 50 stock markets, even after accounting for transaction costs.

Panel B of Table 1 presents the estimated average risk-adjusted returns for each market using regression (1). *Equal* produces significantly positive risk-adjusted returns in 22 markets. Similarly, the risk-

[4] We obtain the data for the Fama and French factors from Kenneth French's data library. We use country-specific factors whenever they are available. For countries that have no data available directly, we use regional factors (e.g., Fama and French European Factors) if the country is included in the construction. Otherwise, we use the Fama and French Developed Factors or Fama and French Emerging Factors, accordingly. In addition, we also calculate Jensen's alpha for each strategy, which does not require data on the risk factors. The results are presented in Online Appendix A. Our results are similar.

[5] Cochrane (2009) presents additional details regarding the Fama–MacBeth cross-sectional regression procedure. Our methodology is similar to Chui et al. (2010).

Table 1
Technical analysis strategy returns in international stock markets.

Country	Panel A: Raw Return				Panel B: Four Factor Alpha			
	Equal (%)	Composite (%)	CompFixed (%)	CompFixedNet (%)	Equal (%)	Composite (%)	CompFixed (%)	CompFixedNet (%)
Argentina	1.18***	1.34***	1.41***	1.38***	0.30***	0.61***	0.74***	0.71***
Australia	0.20**	0.24***	0.17**	0.14*	−0.11	−0.04	−0.11	−0.15*
Austria	0.45***	0.15	0.33***	0.30**	0.40***	0.10*	0.32***	0.29***
Bangladesh	1.26***	0.86***	1.09***	1.04***	0.83***	0.47*	0.62***	0.57***
Belgium	0.30**	0.22***	0.20	0.16	0.07	0.11***	0.02	−0.02
Brazil	0.70***	1.17***	1.02***	0.96***	−0.45**	0.10	−0.13	−0.19
Canada	0.26**	0.14**	0.17	0.14	−0.01	−0.05	0.00	−0.02
Chile	0.60***	0.45***	0.56***	0.54***	0.27***	0.18***	0.27***	0.25***
China	0.66***	0.33***	0.76***	0.75***	0.45*	0.08	0.52***	0.51***
Colombia	1.07***	1.31***	1.07***	1.04***	0.19**	0.61***	0.19*	0.16
Czech	0.55***	0.47***	0.45**	0.43**	0.35***	0.31***	0.25**	0.23**
Denmark	0.58***	0.19***	0.41***	0.39***	0.38***	0.06*	0.34***	0.32***
Ecuador	0.70***	0.54***	0.65***	0.54**	0.03	−0.05	0.01	−0.11
Finland	0.37*	0.36***	0.28	0.26	−0.09	0.23**	−0.15*	−0.17**
France	0.17	0.09	0.08	0.05	−0.12	−0.08	−0.12*	−0.15**
Germany	0.22	0.05	0.08	0.03	−0.08	−0.06	−0.12*	−0.17**
Greece	0.97***	0.80***	0.74***	0.70***	0.48***	0.41***	0.29**	0.25*
Hong Kong	0.46***	0.12	0.34*	0.32*	0.22***	−0.13	0.13	0.11
India	0.61***	0.62***	0.53***	0.51***	−0.02	0.13*	−0.10	−0.12
Indonesia	1.02***	1.02***	1.03***	0.96***	0.06	0.35**	0.18	0.12
Ireland	0.47***	0.27***	0.13	0.10	0.19	0.06*	−0.16**	−0.19**
Israel	0.86***	0.71***	0.83***	0.80***	0.26	0.13**	0.24***	0.21***
Italy	0.49***	0.40***	0.46**	0.45**	0.18*	0.19***	0.26***	0.25***
Jamaica	1.26***	1.30***	1.56***	1.52***	0.49***	0.57***	0.97***	0.94***
Japan	0.16	−0.09	−0.03	−0.04	0.06	−0.13***	−0.11	−0.12
Korea	0.57***	0.34***	0.20	0.19	0.26*	0.06	−0.01	−0.02
Luxembourg	0.61***	0.39***	0.58***	0.57***	0.44***	0.29***	0.46***	0.44***
Malaysia	0.60***	0.49***	0.37*	0.35*	0.21**	0.27*	0.02	0.00
Mexico	0.57***	0.74***	0.93***	0.91***	−0.26**	0.10**	0.13***	0.11***
New Zealand	0.26***	0.17***	0.24**	0.21**	0.02	−0.08	0.04	0.01
Netherlands	0.31**	0.06	0.23	0.21	0.05	−0.08**	0.02	0.00
Norway	0.73***	0.27***	0.45***	0.42***	0.37***	0.01	0.24**	0.21*
Pakistan	1.21***	1.16***	1.31***	1.28***	0.72***	0.80***	0.97***	0.94***
Panama	0.72***	0.22***	0.48***	0.45***	0.52***	0.00	0.32***	0.29***
Peru	1.28***	0.98***	1.09***	1.05***	0.88***	0.60***	0.66***	0.61***
Philippines	0.69***	0.60***	0.36**	0.30*	0.23***	0.26	0.06	0.00
Portugal	0.70***	0.36***	0.46***	0.41***	0.44***	0.13	0.17	0.12
South Africa	0.16	0.11	−0.05	−0.09	−0.08	0.05	−0.17	−0.21*
Singapore	0.50***	0.37***	0.35**	0.31**	0.23***	0.12	0.04	0.00
Slovakia	0.48***	0.39***	0.75***	0.68***	0.15	0.05	0.24	0.17
Slovenia	1.14***	1.09***	1.01***	0.95***	0.55	0.54**	0.43**	0.37*
Spain	0.33**	0.12*	0.27	0.26	0.06	−0.11**	0.02	0.00
Sweden	0.35**	0.06	0.21	0.19	0.01	−0.10***	−0.06	−0.08
Switzerland	0.27**	0.12*	0.08	0.07	0.10	0.08	−0.02	−0.03
Taiwan	0.32*	0.10	0.18	0.17	0.15**	−0.06	0.11**	0.11**
Thailand	0.65***	0.48***	0.57**	0.54**	0.25**	0.21	0.12	0.09
Turkey	1.82***	2.04***	2.38***	2.34***	−0.16	0.25	0.55	0.52
United Kingdom	0.08	0.07	0.05	0.03	−0.23***	−0.17***	−0.19***	−0.22***
United States	0.11	−0.03	−0.04	−0.05	−0.05	−0.20***	−0.14**	−0.16**
Venezuela	3.65***	3.99***	4.67***	4.50***	2.72**	3.21**	3.89**	3.71**
Average	0.67	0.55	0.63	0.59	0.24	0.21	0.25	0.21
Std	0.57	0.67	0.75	0.73	0.45	0.49	0.60	0.58
No. of positive returns (significant at 5 %)	42	37	32	30	22	17	20	17

This table reports the returns for four technical trading strategies—*Equal, Composite, CompFixed*, and *CompFixedNet*—in 50 international stock markets during the period 1994:03–2018:03. Panel A presents the monthly returns denoted as r^{p}_{kjt} of the technical analysis strategies. For each strategy k, we long (short sell) the market index when a buy (sell) signal is generated; we invest in risk-free assets when there is no signal. Panel B estimates the risk-adjusted returns for the strategies by running the regression $r^{p}_{kjt} - r^{f}_{jt} = \alpha_{kj} + \beta 1_{kj} MRP_{jt} + \beta 2_{kj} SMB_{jt} + \beta 3_{kj} HML_{jt} + \beta 4_{kj} MOM_{jt} + \mu_{kjt}$, where, for each country j at month t, r^{f}_{jt} represents the monthly risk-free rates. MRP_{jt} is the market risk premium, and μ_{kjt} is the residual term. Therefore, α_{kj} measures risk-adjusted returns for country j after controlling for Fama and French risk factors. We indicate results that are statistically significant at the 1 %, 5 %, and 10 % levels, with ***, **, and *, respectively.

adjusted returns of *Composite* and *CompFixed* are significantly positive in 17 and 20 markets, respectively. Furthermore, *CompFixedNet* generates significantly positive returns in 17 markets, indicating that the risk-adjusted profitability of *CompFixed* remains similar after deducting transaction costs.

Mature markets such as the U.S. and U.K. show insignificant or even negative returns for technical analysis strategies, reflecting weak form market efficiency. Furthermore, investors might not discover technical analysis profitability in major emerging markets such as India and Brazil. However, technical analysis is highly profitable in rising markets such as China and Pakistan, as well as in some developed markets like

Table 2
Cross-country analysis of technical analysis profitability - composite proxies.

Variables	Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries	% of variations explained
	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2		
Herding	0.87***	5.58	0.4068	1.24***	5.29	0.1978	1.14***	4.89	0.1612	1.11***	4.80	0.1594	38	65.15 %
Sentiment	−0.22	−0.76	0.3972	−0.51**	−2.15	0.1760	−0.71*	−1.75	0.1452	−0.71*	−1.80	0.1420	30	75.87 %
Institutional quality	−1.31***	−5.98	0.4127	−1.68***	−8.25	0.2130	−1.77***	−5.78	0.1770	−1.68***	−5.47	0.1751	47	91.49 %
Stock market charactertiscs	−1.20***	−6.83	0.4116	−1.57***	−7.85	0.1989	−1.56***	−5.47	0.1597	−1.52***	−5.28	0.1579	43	35.44 %
Investor protection	−0.84***	−5.39	0.4103	−1.15***	−7.62	0.1685	−1.20***	−5.33	0.1430	−1.18***	−5.19	0.1418	37	38.70 %
Chaos	0.41***	3.28	0.3762	0.51***	3.80	0.1967	0.58***	3.02	0.1587	0.56***	2.96	0.1570	50	62.20 %
Fractionalization	−0.67***	−4.03	0.3701	−0.60***	−4.42	0.1944	−0.90***	−3.99	0.1578	−0.90***	−4.04	0.1560	50	52.79 %

This table presents the cross-country results of the regression model $r^p_{kjt} = \beta0_k + \beta1_k X_{jt} + \beta2_k MRP_{jt} + \beta3_k SMB_{jt} + \beta4_k HML_{jt} + \beta5_k MOM_{jt} + \beta6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the composite proxies using PCA for herding, investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. We run the regression for each composite proxy separately for the four technical trading strategies *Equal*, *Composite*, *CompFixed*, and *CompFixedNet*. The table reports the $\beta1_k$ estimates, the associated *t*-statistics and adjusted R^2. We also report the number of countries included in each regression based on data availability. The last column presents the percentage of variations in the individual proxies explained by the composite proxies. The sample period is from 1994:03 to 2018:03. The regressions are based on the Fama–MacBeth statistical procedure, which corrects for cross-sectional correlation in standard errors. Newey–West standard errors are used to calculate the regression estimates. We indicate results that are statistically significant at the 1 %, 5 %, and 10 % levels, with ***, **, and *, respectively.

Denmark, Italy, Norway, and Taiwan. This suggests that the simple classification of developed versus developing economies is insufficient to predict the success of technical analysis strategies or market efficiency.[6]

5. Cross-country determinants of technical analysis profitability

To determine the joint direction and strength of the relation between technical analysis returns and the seven determinants of market efficiency, we create a composite measure for each determinant using PCA. This approach reduces potential noise and measurement errors in the individual proxies. We run the regression in Eq. (3) for each composite proxy. Table 2 presents the regression coefficients and *t*-statistics for the four composite technical trading strategies, and the percentage of common variations in the individual proxies explained by the composite measures is presented in the last column. The individual proxy results are presented in Appendix C for brevity.

The composite measures identify a large percentage of the common variations in the individual proxies, with 65.15 % for herding, 75.87 % for sentiment, 91.49 % for institutional quality, 35.44 % for stock market characteristics, 38.7 % for investor protection, 62.20 % for chaos, and 52.79 % for fractionalization, confirming the composite measures' validity. Based on the composite measures, we find the relevance across all determinants in predicting the profitability of technical analysis with sentiment being the only exception. The results are robust across all four technical analysis portfolios.

Specifically, herding positively correlates with the profitability of technical trading strategies across countries. Regarding economic significance, each unit increase in the composite herding measure (maximum = 2.84 for Indonesia and minimum = −3.52 for Sweden), leads to a 0.087 percentage point increase in the monthly profit of *Equal*. The composite proxy of sentiment displays weak significance at best.[7]

Regarding institutional quality and stock market characteristics, the composite scores range from 2.07 (Denmark) to −2.86 (Colombia) and from 5.00 (the U.S.) to −3.89 (Turkey), respectively. Each unit increase in the composite score is associated with a respective decrease of 0.13 and 0.12 percentage points in the monthly profit of *Equal*. The results indicate that higher institutional quality implies greater market efficiency. We also find that when markets are more developed in terms of having more listed companies, bigger capitalization, higher turnover

[6] The Online Appendix C shows the results of the additional tests on the profitability of technical analysis strategies we conducted. We firstly examine whether the average spread between returns conditional on the buy and the sell signals is significantly positive. Brock et al. (1992) suggest a positive spread indicates profitability of technical analysis. Second, we examine the Henriksson and Merton (1981) market timing ability of the technical analysis strategies. The results of these tests confirm the mixed profitability of technical analysis across markets. Moreover, using the actual transaction cost proxy (Appendix B) to calculate *CompFixedNet*, we find significantly positive profitability in 27 markets. We also calculate the round-trip break-even transaction cost for *CompFixedNet* by dividing the average monthly returns by the average number of trading signals per month. The findings indicate the average break-even cost is 84 bps, which is larger than commonly used benchmarks of previous studies. Technical trading strategies' profitability is unlikely to be fully explained by higher transaction costs that prevent arbitrage opportunities. Finally, we replicate the tests in Table 1 for buy-only and sell-only strategies separately (Online Appendix D). We find that technical analysis profitability primarily comes from buy signals. This finding further mitigates the concerns regarding whether limits to arbitrage (Shleifer and Vishny, 1997) or short sales constraints can hinder technical analysis profitability.

[7] In Online Appendix E, we show that the results based on individual sentiment proxies are still weak and mixed. Moreover, we use 12 alternative sentiment proxies to verify the role of sentiment. The results from this wider range of proxies still indicate that sentiment may exhibit some relationship with technical trading profits, but it remains unclear whether technical analysis profits are higher in high, or low, sentiment periods.

Table 3
Subsample analysis and alternative models.

Variables	Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries
	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	
Panel A1: GNI developed markets subsample analysis													
Herding	1.16***	4.50	0.4149	1.52***	4.42	0.2142	1.43***	4.21	0.2016	1.49***	4.37	0.1734	34
Sentiment	−0.18	−0.65	0.4128	−0.41*	−1.77	0.1817	−0.41*	−1.83	0.1743	−0.44	−1.13	0.1420	29
Institutional quality	−1.24***	−5.07	0.4455	−1.68***	−7.68	0.2364	−1.46***	−6.32	0.2225	−1.71***	−5.06	0.1938	29
Stock market charactertiscs	−1.27***	−7.18	0.4221	−1.73***	−8.75	0.1992	−1.62***	−8.14	0.1921	−1.77***	−6.02	0.1639	38
Investor protection	−0.69***	−4.19	0.4117	−1.13***	−7.11	0.1794	−1.08***	−6.63	0.1731	−1.21***	−4.83	0.1584	33
Chaos	0.41***	3.00	0.3973	0.43***	3.21	0.2082	0.37***	2.79	0.1952	0.57***	2.60	0.1635	42
Fractionalization	−0.58***	−3.94	0.3863	−0.80***	−6.13	0.2019	−0.79***	−6.10	0.1891	−0.86***	−4.07	0.1589	42
Panel A2: GNI developing markets subsample analysis													
Herding	0.40	0.35	0.3434	2.97***	3.31	0.1144	3.31***	4.34	0.1039	0.90	0.45	0.1424	8
Sentiment	*(not enough sample to run regressions, no result available)*												2
Institutional quality	−2.10***	−3.13	0.3555	−1.84**	−2.42	0.1199	−1.38*	−1.81	0.1231	−2.48**	−2.28	0.1415	10
Stock market charactertiscs	−0.72	−0.70	0.4521	4.95	1.41	0.0224	4.61	1.39	0.0332	2.58	0.69	0.1373	8
Investor protection	0.17	0.12	0.4994	−1.71	−1.64	0.1566	−1.65	−1.58	0.1523	−2.00	−0.81	0.1191	5
Chaos	0.33	1.18	0.3718	0.89**	2.39	0.1542	0.94**	2.52	0.1515	0.48	1.21	0.1659	13
Fractionalization	−0.72	−1.54	0.3851	0.95*	1.69	0.1364	0.97*	1.71	0.1297	−0.53	−0.89	0.1372	13
Panel B1: HDI developed markets subsample analysis													
Herding	0.63***	3.89	0.4684	0.71***	5.63	0.1856	0.50***	4.15	0.1812	0.48***	4.05	0.1796	28
Sentiment	0.11	0.34	0.4674	−0.01	−0.02	0.2063	−0.06	−0.13	0.1849	−0.05	−0.12	0.1819	25
Institutional quality	−0.89***	−2.74	0.4621	−1.44***	−3.88	0.1620	−0.84*	−1.87	0.1581	−0.84*	−1.87	0.1554	33
Stock market charactertiscs	−0.79***	−5.22	0.4617	−1.05***	−6.56	0.1620	−0.95***	−4.40	0.1662	−0.92***	−4.26	0.1630	31
Investor protection	−0.41**	−2.18	0.4694	−0.57***	−3.98	0.1696	−0.58**	−2.22	0.1765	−0.56**	−2.15	0.1749	29
Chaos	0.31**	2.08	0.4461	0.35**	2.30	0.1757	0.30	1.44	0.1652	0.28	1.37	0.1629	34
Fractionalization	0.02	0.11	0.4282	−0.04	−0.30	0.1488	0.35	1.52	0.1461	0.35	1.54	0.1442	35
Panel B2: HDI developing markets subsample analysis													
Herding	0.83	1.43	0.3860	1.67**	2.44	0.1907	2.58***	3.18	0.1594	2.48***	3.10	0.1587	20
Sentiment	1.56	1.14	0.4000	−2.36	−1.28	0.0943	0.47	0.15	0.1246	0.43	0.13	0.1221	13
Institutional quality	−2.41***	−4.86	0.4173	−2.94***	−5.69	0.2064	−4.49***	−6.17	0.1983	−4.23***	−5.83	0.1969	23
Stock market charactertiscs	−2.03***	−3.06	0.4655	−2.41***	−4.70	0.2131	−2.77***	−3.63	0.1825	−2.73***	−3.55	0.1821	20
Investor protection	−1.10***	−3.53	0.4187	−1.75***	−6.34	0.1240	−2.26***	−5.57	0.1149	−2.25***	−5.53	0.1142	5
Chaos	0.36*	1.72	0.3810	0.46**	2.45	0.1940	0.48	1.56	0.1716	0.47	1.57	0.1712	29
Fractionalization	−1.54***	−5.31	0.3797	−1.39***	−5.51	0.1962	−2.61***	−7.14	0.1775	−2.59***	−7.16	0.1774	29
Panel C: Fixed effects models													
Herding	19.14***	4.61	0.0629	20.54***	4.57	0.0891	25.21***	4.50	0.0557	24.14***	4.34	0.0539	38
Sentiment	−0.39	−1.40	0.0863	−0.46***	−2.58	0.0220	−0.27	−0.81	0.0305	−0.27	−0.84	0.0308	30
Institutional quality	−2.46***	−2.99	0.0635	−1.64**	−2.51	0.0466	−2.11**	−2.11	0.0336	−1.96**	−1.97	0.0327	47
Stock market charactertiscs	−0.81*	−1.66	0.0703	−1.52***	−4.44	0.0413	−1.29**	−2.27	0.0315	−1.24**	−2.20	0.0314	43
Investor protection	−3.21***	−3.61	0.0485	−4.45***	−8.53	0.0639	−4.54***	−4.44	0.0332	−4.50***	−4.42	0.0334	37
Chaos	0.16*	1.69	0.0826	0.16*	1.71	0.0836	0.07***	4.22	0.0517	0.07***	2.70	0.0503	50
Fractionalization	34.22***	4.79	0.0605	35.97***	4.79	0.0972	45.35***	4.59	0.0541	43.34***	4.41	0.0525	50
Panel D: Stage 2 results of 2SLS													
Herding	1.29***	7.23	0.0443	1.66***	11.75	0.0560	1.69***	7.81	0.0268	1.65***	7.66	0.0265	37
Sentiment	−12.33*	−1.93	0.0286	11.73**	2.41	0.0114	4.28	0.63	0.0134	4.24	0.63	0.0405	30
Institutional quality	−1.42***	−4.69	0.0311	−1.63***	−6.80	0.0237	−1.74***	−4.76	0.0123	−1.71***	−4.71	0.0123	47
Stock market charactertiscs	−6.76***	−10.34	0.0398	−7.49***	−15.73	0.0254	−8.08***	−10.67	0.0212	−8.07***	−10.69	0.0215	43
Investor protection	−8.73***	−5.37	0.0676	−9.20***	−7.27	0.0721	−14.16***	−6.99	0.0486	−14.20***	−7.01	0.0487	37
Fractionalization	−2.76***	−4.39	0.0258	−3.34***	−7.29	0.0053	−4.17***	−5.63	0.0105	−4.19***	−5.67	0.0108	47

Panels A and B present the subsample analysis results for developed and developing economies. We classify developed versus developing economies using Gross National Income (GNI) in Panel A and the Human Development Index (HDI) in Panel B; both classifications use panel data. For each subsample, we present the cross-

country results of the regression model $r^{p}_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^{p}_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the composite proxies using PCA for herding, investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. We run the regression for each composite proxy separately for the four technical trading strategies *Equal, Composite, CompFixed,* and *CompFixedNet*. The table reports the $\beta 1_k$estimates, the associated *t*-statistics, and adjusted R^2. We also report the number of countries included in each regression based on data availability. The sample period is from 1994:03 to 2018:03. The regressions are based on the Fama–MacBeth statistical procedure with Newey–West standard errors, which corrects for cross-sectional correlation in standard errors. Panel C presents the same regression model results for the entire sample. Instead of the Fama–MacBeth statistical procedure, we use OLS with country and year fixed effects for panel determinants (i.e., sentiment, institutional quality, stock market characteristics, and chaos) and OLS with country fixed effects for the cross-sectional determinants (i.e., herding, investor protection, and fractionalization). Panel D presents the second stage results by applying 2SLS. Robust standard errors are applied. The results are marked with ***, **, and * if statistically significant at the 1 %, 5 %, and 10 % levels, respectively.

and liquidity, and greater age, information is more likely to be rapidly reflected in stock prices and markets become more efficient.

Similarly, when the investor protection composite score increases by one (maximum = 2.44 for the U.K. and minimum = −2.67 for Mexico), the monthly profit of *Equal* decreases by 0.084 percentage points. If the composite score of chaos (maximum = 12.15 for Mexico and minimum = −3.72 for Switzerland) increases by one, the monthly profit of *Equal* increases by 0.041 percentage points. Furthermore, we find a strong positive correlation between technical analysis profitability and the degree of chaos in stock returns.

Finally, for fractionalization (maximum = 2.93 for South Africa and minimum = −1.57 for Portugal), the monthly profit of *Equal* decreases by 0.067 percentage points when the composite score increases by one. This finding suggests that fractionalization is negatively correlated with market efficiency.

6. Further analysis

We perform four robustness tests based on the composite proxies for each market efficiency determinant to tackle potential endogeneity and address the possibility of omitted variable bias, multicollinearity, and measurement errors.

6.1. Subsample analysis: developed versus developing economies

The first test checks whether the main results explain the degree of market efficiency within developing or developed economies separately. We replicate the analysis in Section 5 in the developed and developing economy subsamples by using two classifications: Gross National Income (GNI) from the World Bank and the Human Development Index (HDI) from the United Nations, both of which are reported annually.[8] The results are presented in Panels A and B of Table 3, respectively.

The main results remain consistent in the developed markets subsample. Specifically, the cross-country determinants explain the variation in market efficiency among economically developed markets such as the U.S. and Western Europe, under both the HDI and the GNI methods. The results also largely hold in developing markets based on the HDI method, which generates a similar number of developed and developing countries. However, the results are weaker under the GNI method, likely due to the fewer developing countries classified. This finding suggests stronger influence of market efficiency determinants in developed markets, and the finding may partially arise from the decreasing size of the developing markets subsample as more countries become developed. This underscores the need to examine market efficiency determinants beyond the traditional developed versus emerging market paradigm.

[8] Our definition of developed versus developing economy is panel. We obtain annual GNI and HDI data for each country and define their development status following official criteria summarized in World Bank high-income economy - Wikipedia and World Bank Group country classifications by income level for FY24 (July 1, 2023, to June 30, 2024).

6.2. Country and year fixed effects

Second, we control for country and year fixed effects in the main regressions of the panel determinants (i.e., sentiment, institutional quality, stock market characteristics, and chaos). For the cross-sectional determinants (i.e., herding, investor protection, and fractionalization), we control for country fixed effects. The fixed effects models determine whether the results remain stable after controlling for unobservable factors from country or year variations overall (e.g., changes in government policies and country-wide reforms). The results are presented in Panel C of Table 3. The findings indicate that except for sentiment, all other cross-country determinants remain significant in predicting differences in cross-country technical analysis profitability.

6.3. Two-stage least squares regressions (2SLS)

The third test employs a 2SLS methodology to address possible issues such as reverse causality or omitted variable biases. We employ instrumental variables and apply 2SLS for six market efficiency determinants (we do not include chaos as it is a statistical property inherent in the return-generating process). Following Cline et al. (2021), historical disease prevalence is the instrumental variable used for herding. Disease prevalence positively correlates with herding as people tend to seek larger social units while discounting individual rights to combat contagious diseases (Thornhill and Fincher, 2014). Specifically, we obtain data from Murray and Schaller (2010), who use old epidemiological atlases to rate the prevalence of nine infectious diseases in a region, including leishmanias, schistosomes, trypanosomes, leprosy, malaria, typhus, filariae, dengue, and tuberculosis.

Regarding sentiment, similar to the issue of finding suitable sentiment proxies on a cross-country level as discussed in Section 2.2, finding a suitable instrument can be limited by data availability. Nevertheless, literature documents weather conditions relate to investor sentiment (Hirshleifer and Shumway, 2003; Saunders, 1993). Schmittmann et al. (2015) find higher investor sentiment during days with higher temperatures. On this basis, we use each country's average monthly temperature as the instrument for sentiment. Regarding institutional quality, the instrument is the share of the population of European descent, following Ashraf and Galor (2013). Putterman and Weil (2010) and Easterly and Levine (2016) indicate that colonization patterns have enduring effects on economic and financial development because colonizers elicit growth-promoting characteristics, such as institutions, human capital, technology, international market connections, and cultural norms.

We use the average internet subscription per 100 people in each country as the instrument for its equity market development and information environment. A higher internet subscription rate positively relates to financial inclusion (Sarma and Pais, 2011), stock market participation, and portfolio diversification decisions (Hvide et al., 2022), as it eases information gathering and reduces uncertainty in an equity market. Moreover, most countries have typically adopted their legal systems involuntarily (i.e., exogenously) through conquest or colonization. La Porta et al. (2008) find that common law countries exhibit the strongest protection for outside investors. Therefore, this study employs whether a country adopts English common law as the

Table 4
Individual regression results for macroeconomic control variables.

Variables	Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries
	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	
Key macroeconomic strength													
(1) GDP per capita in thousands	−0.12***	−4.60	0.2674	−0.18***	−3.18	0.1144	−0.18***	−3.65	0.1097	−0.17***	−3.60	0.1083	49
(2) inflation	0.59***	4.78	0.2889	0.71***	8.05	0.1803	0.93***	6.58	0.1468	0.91***	6.66	0.1450	48
(3) unemployment	0.07	1.11	0.2650	0.14	1.27	0.1068	0.04	0.42	0.0932	0.03	0.35	0.0923	49
(4) change of exchange rate (against US dollar)	0.60**	2.11	0.3395	0.95***	2.83	0.1758	0.52	1.53	0.1587	0.48	1.48	0.1576	41
Openness of economy													
(1) Fernandez et al. (2016) capital account openness (*−1)	−3.92***	−4.49	0.2853	−6.89***	−10.40	0.1194	−6.00***	−8.18	0.1142	−5.84***	−5.91	0.1130	47
(2) trade/GDP in thousands	−0.01***	−2.64	0.2598	−0.01***	−5.20	0.0934	−0.01***	−9.44	0.0997	−0.01***	−9.19	0.0987	49
(3) foreign direct investment inflow	−0.10**	−2.31	0.2612	−0.15**	−2.17	0.0917	−0.12**	−2.14	0.0993	−0.12**	−2.39	0.0983	49
(4) foreign direct investment outflow	−0.16***	−2.94	0.2589	−0.32**	−2.19	0.0958	−0.28**	−2.55	0.1013	−0.27***	−2.88	0.1003	49
Fundamental growth													
(1) secondary school enrolment in thousands	−0.52	−0.06	0.2710	−2.18	−0.28	0.0853	1.17	0.16	0.0971	2.05	0.28	0.0965	49
(2) log life expectancy	−34.44***	−8.04	0.2813	−51.89***	−7.83	0.1444	−50.32***	−7.41	0.1224	−49.08***	−7.25	0.1209	49
(3) population growth	1.73***	7.96	0.2890	2.17***	3.96	0.1418	2.29***	5.56	0.1203	2.22***	5.17	0.1190	49
(4) log geographical land area	−0.04***	−5.91	0.3548	−0.06	−0.79	0.1868	−0.22*	−1.95	0.1513	−0.22*	−1.87	0.1499	49
World economic growth													
(1) GDP per capita world in thousands	−0.86***	−6.16	0.0298	−0.97***	−9.85	0.0290	−1.07***	−6.71	0.0156	−1.09***	−6.91	0.0159	50
(2) MSCI world index return	−117.63***	−6.49	0.0479	−68.26***	−4.05	0.0384	−131.78***	−6.09	0.0315	−129.55***	−6.03	0.0310	50
More controls													
(1) develped economy dummy - World Bank Gross National Income classification	−0.74	−1.12	0.3704	0.27	0.40	0.1932	1.01	1.04	0.1608	1.10	1.13	0.1594	49
(2) develped economy dummy - United Nation Human Development Index classification	−3.36***	−3.97	0.3695	−2.74***	−3.33	0.1904	−3.65***	−2.93	0.1544	−3.41***	−2.74	0.1526	49
(3) private credit by deposit money banks/GDP	−0.03***	−5.16	0.3531	−0.05***	−9.36	0.1831	−0.05***	−7.25	0.1444	−0.05***	−6.96	0.1424	49
(4) NBER business cycle	5.82***	10.03	0.0373	3.81***	9.41	0.0340	4.99***	7.54	0.0193	5.10***	7.73	0.0194	50
(5) January dummy	4.23***	3.40	0.0306	1.10	1.24	0.0287	4.09***	2.96	0.0160	3.84***	2.78	0.0159	50

This table reports the cross-country results of the regression model $r^{p}_{kjt} = \beta 0_k + \beta 1_k Controls_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^{p}_{Kjt} represents the monthly returns of technical trading strategy k. $Controls_{jt}$ represents the various individual macroeconomic and control variables. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. We run the regression for each individual variable separately for the four technical trading strategies *Equal, Composite, CompFixed,* and *CompFixedNet*. The table reports the $\beta 1_k$ estimates, the associated *t*-statistics, and adjusted R^2. We also report the number of countries included in each regression based on data availability (last column). The sample period is from 1994:03 to 2018:03. We run the regression using the Fama–MacBeth statistical procedure, which corrects for cross-sectional correlation in standard errors. Newey–West standard errors are used to calculate the regression estimates. The results are marked with ***, **, and * if statistically significant at the 1 %, 5 %, and 10 % levels, respectively.

instrument for investor protection. Finally, we rely on the genetic distance index of Spolaore and Wacziarg (2009) for the instrument of fractionalization, accounting for the general relatedness of populations in a country. This is based on the notion that smaller genetic distance is associated with less cultural divergence.[9]

We run 2SLS for each market efficiency determinant separately and present the results in Panel D of Table 3. The results confirm the predictive ability of herding, stock market development, institutional quality, investor protection, and fractionalization for technical analysis profitability. However, the results on sentiment remain weak with a mixed sign.[10]

6.4. Macroeconomic control variables

To ensure that the results do not simply reflect differences in these countries' general economies, we use an approach similar to Section 5 to run regressions of technical analysis profitability on a wide range of macroeconomic factors (Table 4). Generally, we find higher technical analysis profitability in countries with weaker economies, characterized by lower GDP per capita, higher inflation, higher unemployment, and greater exchange rate fluctuations. Technical analysis profitability also relates negatively to economic openness. A less open capital account as defined by Fernández et al.'s (2016) capital control restriction index, lower weighting of trade as a percentage of GDP, and lower foreign direct investment inflows and outflows scaled by GDP all lead to higher technical analysis profitability. Regarding country-level fundamental growth, technical analysis profitability is higher in countries with a less educated population measured based on secondary school enrolment following Kaniel et al. (2012). Technical analysis profitability associates positively with life expectancy, population growth, and land resources measured by the logarithm of the geographical size of each country. Moreover, the level of technical trading profits is also negatively associated with world economic growth, measured by the world GDP per capita and MSCI world index return. Finally, most technical trading strategies generate higher profits in January, during recessions (NBER definition), and when there are fewer retail investors (measured as private credit by deposit money banks scaled by GDP).

The results regarding developed versus developing economies based on World Bank classification are noteworthy. This panel measure relies on annual GNI per capita. We find no significant difference in market efficiency as measured by the technical analysis portfolio returns between developed and developing economies.

Next, we add macroeconomic control variables by group to the cross-country analysis based on composite proxies of the determinants and 2SLS.[11] Related to Section 6.3, this enables us to reduce the risk of violating the exclusion restriction. The results are presented in Table 5. We find that the predictive ability of herding, investor protection, chaos, stock market development, institutional quality, and fractionalization remains remarkably strong. However, the sentiment results become insignificant in all cases where macroeconomic control variables are considered.

6.5. Additional robustness checks

We perform several robustness checks using an alternative approach, the Wald test, to examine the joint significance of all individual proxies for each determinant. This allows us to mitigate possible loss of information while constructing the composite proxies. The results are presented in Appendix E for brevity, and the key findings are summarized in the current section. First, we test the joint significance of the individual proxies for each determinant. The Wald test results significantly reject the null hypothesis that cross-country differences in market efficiency determinants do not jointly predict technical trading profits. Second, we use an alternative sample comprising the first 20 years of each stock market since trading began (or since data became available). This enables us to calculate technical analysis profitability and re-examine the role of herding and fractionalization in the new sample. Previous studies document that cultural variables persist over time (Fernández et al., 1997; Merritt, 2000). By holding the information environment roughly equal for each market (assuming markets go through similar developmental stages in their first 20 years), we double-check whether herding and fractionalization hold independently. Although not a perfect test, the results support the relevance of herding and fractionalization. Furthermore, we confirm the relation between technical analysis profits and stock market development by documenting higher technical analysis profitability in the earlier sample when markets are less developed, as shown in Online Appendix F.

Third, we confirm the cross-country results by examining the timing ability of technical analysis rather than profits. Finally, we examine whether the panel market efficiency determinants (i.e., sentiment, chaos, institutional quality, and equity market development) Granger-cause technical analysis profits. The results support all determinants except sentiment.[12]

7. Relative importance of the determinants

This section describes how we combine the determinants to examine their relative importance.

7.1. Pairwise correlation and interaction tests

First, the pairwise Pearson's correlation coefficients indicate high correlation coefficients of 0.5968 between investor protection and institutional quality and 0.6319 between investor protection and equity market development. This is unsurprising since these three determinants examine the information environment from varying perspectives. Similarly, we observe high correlations of 0.3045 between fractionalization and herding and −0.3071 between fractionalization and institutional quality. The correlations motivate a nuanced comparison of the factors' impacts. The full correlation matrix is presented in Appendix F.

Next, we conduct pairwise interaction tests to examine the relative significance of cross-country determinants. Each regression includes two determinants along with their interaction term. We examine all possible pairwise combinations of the determinants. We document two main findings. First, the standalone explanatory power of herding, institu-

[9] We present three sets of statistics to verify our instruments in Appendix D. First, Pearson's correlation coefficients are statistically significant between all pairs of the instrument and the instrumented variables. Second, in the first stage regressions, all our instruments significantly predict the instrumented variables. Third, the Stage 1 F-statistics are significant in all cases.

[10] In unreported results, we also employ an alternative genetic distance index based on ethnic composition as of 1500 and an alternative disease prevalence index using seven diseases following Spolaore and Wacziarg (2009) and Murray and Schaller (2010), respectively, as additional instruments for fractionalization and herding. For information environment of the stock market, we also perform 2SLS with the average phone subscription per 100 people as an alternative instrument. The results are all highly consistent.

[11] To address possible overfitting problems due to the large number of proxies, we add the control variables to the regression by group.

[12] The Online Appendix E presents additional robustness check results that employ a wide range of alternative proxies for the main market efficiency determinants. These include updated and extended cultural value indices, an alternative framework measuring international country-level geopolitical risks (World Governance Indices), and various additional sentiment proxies. Generally, the results all support our main findings. In unreported results, we conduct further robustness checks. We confirm our main findings by dividing the sample into two equal parts and using the MSCI world index as the benchmark to calculate risk-adjusted returns. We also construct composite strategies within the VMA, FMA, and TRB families separately, and find similar results. The results also remain robust while employing double-clustered standard errors.

Table 5
2SLS with macroeconomic control variables.

		Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries
Variables	Control variables	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	
Herding	key macro strength	0.65**	2.36	0.0398	0.43**	2.34	0.0657	0.66**	2.08	0.0274	0.64**	2.04	0.0269	33
	openness of economy	1.09***	4.37	0.0369	1.27***	7.05	0.0276	1.41***	4.76	0.0169	1.39***	4.68	0.0167	37
	fundamental growth	0.36*	1.70	0.0388	0.53***	3.50	0.0204	0.51**	2.03	0.0157	0.50**	1.99	0.0157	37
	world economic growth and cycles	1.26***	7.21	0.0673	1.64***	11.93	0.0627	1.67***	7.89	0.0434	1.63***	7.73	0.0427	37
	more controls	0.94***	4.70	0.0486	1.06***	7.45	0.0485	1.20***	5.09	0.0283	1.18***	5.00	0.0280	37
Sentiment	key macro strength	−38.96	−0.75	0.0075	44.86	0.79	0.0005	34.24	0.66	0.0032	33.90	0.66	0.0034	26
	openness of economy	−17.99	−1.04	0.0326	15.57	1.15	0.0033	25.05	1.09	0.0078	24.40	1.08	0.0081	28
	fundamental growth	−10.94	−1.01	0.0430	15.14	1.56	0.0022	16.14	1.17	0.0119	16.14	1.17	0.0123	30
	world economic growth and cycles	−29.12	−1.10	0.0241	56.35	1.26	−0.0002	40.65	1.11	0.0076	39.11	1.10	0.0081	30
	more controls	−4.00	−0.32	0.0716	33.99	1.52	0.0018	38.27	1.38	0.0075	36.58	1.37	0.0080	30
Institutional quality	key macro strength	−1.44***	−3.49	0.0437	−0.98***	−3.54	0.0723	−1.31***	−2.78	0.0328	−1.29***	−2.74	0.0321	33
	openness of economy	−1.35***	−4.27	0.0326	−1.47***	−6.37	0.0227	−0.90***	−4.28	0.0147	−1.58***	−4.24	0.0146	36
	fundamental growth	−1.40***	−3.80	0.0426	0.15	0.51	0.0357	0.11	0.31	0.0224	0.12	0.35	0.0224	36
	world economic growth and cycles	−1.72***	−7.75	0.0629	−2.15***	−12.08	0.0494	−2.23***	−8.28	0.0391	−2.17***	−8.07	0.0386	37
	more controls	−1.16***	−4.57	0.0468	−1.42***	−7.49	0.0402	−1.55***	−5.09	0.0268	−1.51***	−4.99	0.0265	36
Stock market characteristics	key macro strength	−5.79***	−5.51	0.0439	−3.62***	−5.34	0.0499	−4.35***	−3.71	0.0255	−4.36***	−3.73	0.0254	35
	openness of economy	−6.66***	−8.45	0.0418	−6.80***	−11.91	0.0267	−7.63***	−8.35	0.0207	−7.65***	−8.39	0.0210	43
	fundamental growth	−6.90***	−7.25	0.0415	−6.20***	−9.19	0.0272	−8.05***	−7.34	0.0221	−8.20***	−7.48	0.0223	43
	world economic growth and cycles	−6.83***	−7.87	0.0530	−8.18***	−12.65	0.0254	−7.87***	−7.85	0.0336	−7.80***	−7.80	0.0337	43
	more controls	−4.88***	−7.12	0.0521	−4.92***	−7.22	0.0373	−4.13***	−3.75	0.0284	−4.18***	−3.80	0.0285	43
Investor protection	key macro strength	−2.51**	−2.30	0.0438	−2.23***	−3.21	0.0579	−2.26*	−1.85	0.0241	−2.17*	−1.78	0.0243	37
	openness of economy	−3.43***	−3.91	0.0403	−4.08***	−6.87	0.0242	−3.92***	−3.89	0.0167	−3.89***	−3.86	0.0168	44
	fundamental growth	−1.43	−1.48	0.0403	−2.75***	−4.27	0.0202	−1.88*	−1.70	0.0165	−1.83*	−1.65	0.0166	46
	world economic growth and cycles	−3.70***	−5.73	0.0550	−5.40***	−12.20	0.0311	−4.46***	−6.00	0.0358	−4.37***	−5.89	0.0358	47
	more controls	−2.48***	−3.45	0.0542	−3.62***	−7.42	0.0430	−3.12***	−3.75	0.0290	−3.07***	−3.69	0.0292	46
Fractionalization	key macro strength	−1.08**	−2.09	0.0388	−1.70***	−5.05	0.0583	−1.78***	−3.01	0.0240	−1.84***	−3.13	0.0241	38
	openness of economy	−2.86***	−3.87	0.0317	−4.27***	−8.05	0.0212	−4.80***	−5.54	0.0147	−4.79***	−5.54	0.0148	44
	fundamental growth	−4.24***	−6.46	0.0385	−4.93***	−10.46	0.0300	−5.94***	−7.73	0.0208	−6.00***	−7.82	0.0209	47
	world economic growth and cycles	−2.65***	−4.22	0.0424	−3.29***	−7.23	0.0209	−4.09***	−5.53	0.0277	−4.11***	−5.57	0.0280	47
	more controls	−1.44**	−2.23	0.0462	−0.89*	−1.92	0.0357	−1.94**	−2.55	0.0257	−2.01***	−2.65	0.0257	47

This table reports the 2SLS regression results for the model $r^p_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the composite indices of herding, investor sentiment, institutional quality, stock market development, investor protection, and fractionalization. MRP_{jt} is the market risk premium. $Controls_{jt}$ represents the various macroeconomic control variables and ε_{kjt} is the residual term. The table reports the $\beta 1_k$ estimates of the second stage results, the associated t-statistics, and adjusted R^2 for the four technical trading strategies *Equal, Composite, CompFixed,* and *CompFixedNet*. The sample period is from 1994:03 to 2018:03. The results are based on Newey–West standard errors. The results are marked with ***, **, and * if statistically significant at the 1 %, 5 %, and 10 % levels, respectively.

Table 6
Relative importance of the determinants.

Panel A: Model selection based on Fama-MacBeth adjusted R^2

	Equal adj. R^2	Composite Relative adj. R^2 Improvement	CompFixed adj. R^2	CompFixedNet Relative adj. R^2 Improvement	Average adj. R^2	Relative adj. R^2 Improvement	adj. R^2	Relative adj. R^2 Improvement	Avg adj. R^2	Avg Relative adj. R^2 Improvement
Constant + MRP + HML + SMB + WML	0.3194	–	0.0752	–	0.1127	–	0.1123	–	0.1549	–
institutional quality	0.3280	2.71 %	0.1230	14.97 %	0.1270	4.47 %	0.1263	4.38 %	0.1761	6.63 %
institutional quality + stock market char.	0.3300	0.61 %	0.1366	4.26 %	0.1298	0.87 %	0.1291	0.86 %	0.1814	1.65 %
institutional quality + stock market char. + herding	0.3303	0.10 %	0.1370	0.10 %	0.1292	−0.17 %	0.1285	−0.19 %	0.1812	−0.04 %
institutional quality + stock market char. + herding + chaos	0.3300	−0.09 %	0.1401	0.99 %	0.1301	0.28 %	0.1295	0.31 %	0.1824	0.37 %
institutional quality + stock market char. + herding + chaos + investor protection	0.3302	0.06 %	0.1440	1.20 %	0.1303	0.05 %	0.1297	0.08 %	0.1835	0.35 %
institutional quality + stock market char. + herding + chaos + investor protection + fractionalization	0.3293	−0.28 %	0.1444	0.14 %	0.1300	−0.08 %	0.1295	−0.08 %	0.1833	−0.07 %
stock market char.	0.3253	1.84 %	0.1085	10.41 %	0.1222	2.96 %	0.1216	2.89 %	0.1694	4.53 %
stock market char. + herding	0.3297	1.38 %	0.1234	4.67 %	0.1266	1.38 %	0.1258	1.32 %	0.1764	2.19 %
stock market char. + herding + chaos	0.3295	−0.05 %	0.1269	1.09 %	0.1278	0.38 %	0.1271	0.41 %	0.1778	0.46 %
stock market char. + herding + chaos + investor protection	0.3290	−0.19 %	0.1277	0.25 %	0.1268	−0.32 %	0.1262	−0.30 %	0.1774	−0.14 %
stock market char. + herding + chaos + investor protection + fractionalization	0.3280	−0.30 %	0.1278	0.04 %	0.1263	−0.15 %	0.1257	−0.14 %	0.1769	−0.14 %
herding	0.3264	2.18 %	0.1002	7.83 %	0.1208	2.53 %	0.1201	2.44 %	0.1669	3.75 %
herding + chaos	0.3264	0.00 %	0.1049	1.46 %	0.1223	0.46 %	0.1217	0.50 %	0.1688	0.60 %
herding + chaos + investor protection	0.3268	0.14 %	0.1131	2.57 %	0.1235	0.38 %	0.1229	0.37 %	0.1716	0.86 %
herding + chaos + investor protection + fractionalization	0.3263	−0.15 %	0.1147	0.52 %	0.1232	−0.10 %	0.1226	−0.09 %	0.1717	0.04 %
chaos	0.3206	0.39 %	0.0846	2.92 %	0.1162	1.07 %	0.1159	1.11 %	0.1593	1.37 %
chaos + investor protection	0.3206	−0.03 %	0.0908	1.97 %	0.1166	0.13 %	0.1163	0.14 %	0.1611	0.55 %
chaos + investor protection + fractionalization	0.3205	−0.01 %	0.0933	0.76 %	0.1169	0.09 %	0.1165	0.07 %	0.1618	0.23 %
investor protection	0.3193	−0.02 %	0.0835	2.60 %	0.1137	0.31 %	0.1133	0.31 %	0.1575	0.80 %
investor protection + fractionalization	0.3193	−0.02 %	0.0866	0.95 %	0.1146	0.28 %	0.1141	0.26 %	0.1586	0.37 %
fractionalization	0.3192	−0.05 %	0.0774	0.68 %	0.1132	0.15 %	0.1128	0.13 %	0.1556	0.23 %

Panel B: Holdout test

RMSE	Equal	Composite	CompFixed	CompFixedNet	Average	Reduction in RMSE
Constant + MRP + SMB + HML + WML (baseline model)	0.02909	0.02079	0.03383	0.03374	0.02936	–
Constant + MRP + SMB + HML + WML + institutional quality	0.02904	0.02054	0.03372	0.03363	0.02923	−0.44 %
Constant + MRP + SMB + HML + WML + stock market char.	0.02898	0.02044	0.03361	0.03352	0.02914	−0.77 %
Constant + MRP + SMB + HML + WML + herding	0.02901	0.02062	0.03375	0.03365	0.02926	−0.36 %
Constant + MRP + SMB + HML + WML + chaos	0.02909	0.02075	0.03383	0.03373	0.02935	−0.04 %
Constant + MRP + SMB + HML + WML + investor protection	0.02908	0.02073	0.03380	0.03370	0.02933	−0.12 %
Constant + MRP + SMB + HML + WML + factionalization	0.02909	0.02077	0.03383	0.03373	0.02936	−0.03 %

Panel C: Stepwise regressions

Step/Rank	Group Entered	Group Removed	No. of Vars	Partial R^2	Model R^2	C(p)	F-value	Pr > *F*
Panel C1: Equal								
1	institutional quality	NO	5	0.0054	0.0498	29.91	42.30	<0.0001
2	stock market char.	NO	6	0.0014	0.0513	20.55	11.34	0.0008
3	herding	NO	7	0.0017	0.0529	9.47	13.08	0.0003
4	fractionalization	YES	8	0.0002	0.0532	9.53	1.94	0.1641
5	chaos	YES	9	0.0002	0.0534	9.91	1.62	0.2037
6	investor protection	YES	10	0.0001	0.0535	11.00	0.91	0.3389

Panel C2: Composite								
1	institutional quality	NO	5	0.0219	0.0243	51.43	167.69	<0.0001
2	stock market char.	NO	6	0.0029	0.0272	31.22	22.14	<0.0001
3	herding	NO	7	0.0020	0.0291	17.98	15.22	<0.0001
4	chaos	NO	8	0.0014	0.0305	9.49	10.49	0.0012
5	investor protection	YES	9	0.0003	0.0308	9.13	2.36	0.1249
6	fractionalization	YES	10	0.0000	0.0308	11.00	0.13	0.7160
Panel C3: CompFixed								
1	institutional quality	NO	5	0.0062	0.0106	18.24	46.66	<0.0001
2	stock market char.	NO	6	0.0014	0.0119	10.03	10.21	0.0014
3	herding	NO	7	0.0005	0.0124	8.08	3.95	0.0469
4	chaos	YES	8	0.0002	0.0126	8.90	1.18	0.2778
5	fractionalization	YES	9	0.0002	0.0127	9.72	1.18	0.2773
6	investor protection	YES	10	0.0001	0.0128	11.00	0.72	0.3970
Panel C4: CompFixedNet								
1	institutional quality	NO	5	0.0060	0.0105	17.53	45.15	<0.0001
2	stock market char.	NO	6	0.0013	0.0117	10.04	9.49	0.0021
3	herding	NO	7	0.0005	0.0122	8.42	3.61	0.0573
4	chaos	YES	8	0.0002	0.0124	9.07	1.35	0.2449
5	fractionalization	YES	9	0.0002	0.0126	9.69	1.38	0.2400
6	investor protection	YES	10	0.0001	0.0127	11.00	0.69	0.4065
Panel C5: Average								
1	institutional quality	NO	5	0.0099	0.0238	29.28	75.45	–
2	stock market char.	NO	6	0.0018	0.0255	17.96	13.30	–
3	herding	NO	7	0.0012	0.0267	10.98	8.97	–
4.25	chaos	1 NO, 3 YES	8	0.0005	0.0272	9.34	3.66	–
5	fractionalization	YES	9	0.0002	0.0273	9.98	1.16	–
5.75	investor protection	YES	10	0.0002	0.0275	10.53	1.17	–

Panel D: Autometrics model selection					
Rank	Factors	coeff.	t-stats	p-value	Partial R^2
Panel D1: Equal					
1	stock market char.	−1.10	−4.99	0.0000	0.33 %
2	herding	1.09	5.81	0.0000	0.45 %
Panel D2: Composite					
1	stock market char.	−0.90	−5.08	0.0000	0.34 %
2	institutional quality	−0.98	−3.86	0.0001	0.20 %
3	herding	0.71	3.52	0.0004	0.17 %
4	chaos	0.38	3.23	0.0012	0.14 %
Panel D3: CompFixed					
1	stock market char.	−1.08	−3.70	0.0002	0.18 %
2	herding	0.68	2.04	0.0413	0.06 %
3	institutional quality	−0.76	−1.79	0.0742	0.04 %
Panel D4: CompFixedNet					
1	stock market char.	−1.04	−3.57	0.0004	0.17 %
2	herding	0.65	1.96	0.0506	0.05 %
3	institutional quality	−0.76	−1.81	0.0704	0.04 %

This table presents four model selection test results based on a mutual sample of 38 countries that have all data available for herding, institutional quality, stock market development, investor protection, chaos, and fractionalization from 1994:03 to 2018:03. The first test in Panel A illustrates the adjusted R^2 of competing models including different cross-country determinants of technical analysis profitability. The baseline model contains only the constant term, market risk premium, and Fama and French risk factors. We gradually add the determinants into the model and record the adjusted R^2 and its improvement from the baseline model. All other settings remain the same as in Table 4. The second test in Panel B presents the RMSE from the holdout test. We employ 80 % of the full sample as the estimation sample and apply the fitted model to the 20 % remaining "holdout sample" to predict technical analysis profitability. The test compares the predicted values with the observed values and calculates the model RMSE. Comparing the model RMSE reduction to the baseline model RMSE helps assess the model fitness. The third test in Panel C is stepwise regressions for model selection. This method includes explanatory factors in the model gradually according to their importance, measured by the factor's partial R^2, model R^2, and Mallows' C(p). Variables with weak predictive abilities are removed as new factors enter the model. We use a significance level of 5 % for factor entrance and removal. The table also reports the F-values and corresponding p-values, testing the model's joint significance. The results are presented in Panels C1 to C4 for the four composite technical analysis strategies, respectively. We aggregate the key test statistics in Panel C5 by calculating their averages over all four strategies. Panel D presents the results for the automatic model selection procedure Autometrics using the default settings (Doornik, 2009). This procedure automatically selects a set of predictors that best fit the data based on a general-to-specific (Gets) methodology. Panels D1 to D4 present the results for the four technical analysis portfolios. We report the selected factors, their coefficients, associated t-stats and partial R^2.

tional quality, and equity market development remains significant overall. Investor protection also remains significant except when equity market characteristics are considered. However, chaos, fractionalization, and, unsurprisingly, sentiment exhibit insignificant or even sign-switching results in most cases. This finding suggests their weaker explanatory power for technical analysis profitability than the other determinants. Second, we document strong interaction effects. For instance, the associated negative coefficients of −1.42, −0.47, and −0.20 for *herding* × *institutional quality*, *herding* × *stock market char.* and *herding* × *fractionalization* for *Equal* indicate that, holding everything else constant, the positive impacts of herding on the monthly returns of *Equal* decrease by −0.142, −0.047, and −0.02 percentage points when

the composite indices of institutional quality, stock market development and fractionalization increase by one, respectively. These results confirm the conjecture that investors may be more likely to herd and rely on non-fundamental information in a weak information environment.

The findings also indicate positive coefficients for *institutional quality* $\times$*stock market char*, *institutional quality* $\times$ *investor protection*, and *institutional quality* $\times$ *fractionalization*. This suggests that the negative relationship between institutional quality and market efficiency persists, as indicated by the negative coefficients of institutional quality alone. However, the relationship is moderated when other market efficiency determinants are controlled for. To illustrate, *Equal* decreases by -0.069, -0.051, and -0.22 percentage points with each unit of increase in *institutional quality* when we do not consider the impact of stock market development, investor protection, or fractionalization, respectively (i.e., when each of these factors equals 0). However, the negative impacts on *Equal* are moderated by 0.052, 0.022, and 0.03 percentage points, respectively, when the composite indices of stock market development, investor protection, and fractionalization increases by one corresponding unit. Following a similar rationale, we observe a reduced negative impact of stock market development when institutional quality and investor protection advance. Moreover, when stock market returns are more chaotic, stock market development's negative role in market efficiency enhances. The interaction effects suggest that the different determinants of market efficiency may either enhance or offset each other. We present detailed results in Appendix G.

7.2. Model selection tests

We expand the comparison to include all determinants simultaneously. To mitigate degrees of freedom and overfitting concerns, we conduct all analyses on the largest mutual sample. The sample comprises 38 countries with data for all market efficiency determinants except sentiment. Since sentiment has limited explanatory power and data for the composite proxy is only available for 30 countries, including it would significantly reduce our sample size. Moreover, to address multicollinearity, we employ four model selection tests based on various metrics, including adjusted R^2, out-of-sample tests, RMSE, and the PcGive automatic model selection process. Regardless of the test applied, the results consistently suggest that institutional quality, equity market development, and herding are more important than chaos, investor protection, and fractionalization in explaining cross-country differences in technical analysis profitability.

Following Fang et al. (2021), the first test examines the relative importance of different market efficiency determinants by computing the adjusted R^2 of competing models based on the main Fama–Macbeth regression (3). We present the adjusted R^2 for each technical analysis portfolio separately and then take average across the four portfolios. We establish a baseline adjusted R^2 for comparison based on including only MRP and Fama–French factors in the regression. Next, we add the cross-country factors in order of their adjusted R^2 (Table 2) and compute the improvements in the adjusted R^2 relative to the baseline model. The results in Panel A of Table 6 indicate that institutional quality, equity market development, and herding are the most significant factors, with average incremental adjusted R^2 values of 6.63 %, 4.53 %, and 3.75 %, respectively. These values are substantially higher than those for the other factors.

The second method is a holdout test, which involves splitting the entire sample into estimation (80 %) and test (20 %) samples to evaluate the relative importance of factors based on RMSE. We estimate regression (3) for each determinant using the estimation sample to derive the fitted model. Next, we apply the fitted models to the test sample to predict the dependent variable and calculate RMSE. We further calculate the relative improvement in RMSE compared to the baseline model, including only the MRP and Fama–French factors. The results presented in Panel B of Table 6 are highly consistent.

The third test employs stepwise regressions using a model selection process that sequentially adds explanatory variables based on their predictive abilities. An explanatory variable must be significant at the 5 % level to enter the model, whereas existing variables must remain significant at the 5 % level to be retained. The results are presented in Panel C of Table 6. The partial R^2 statistic can gauge the explanatory power of each factor, where higher partial R^2 values indicate stronger explanatory ability to prioritize variables for inclusion. The R^2 measures the overall explanatory power of the model after each factor's inclusion, calculated as the sum of individual factor partial R^2 values. Additionally, Mallows' C(p) evaluates the model fit in the context of model selection, with smaller values indicating greater precision. The joint significance of the model is assessed using model F-values. The stepwise regression results confirm the main findings.

The results also remain similar using our final model selection method, which aligns with Bekaert and Hoerova (2014) and Griffin et al. (2010). This method involves the Autometrics procedure in the PcGive (version 13) module of the econometrics software package OxMetrics (Doornik, 2009). Autometrics employs a general-to-specific (Gets) methodology to automatically select a set of predictors that best fit the data, aiming to reduce the number of predictors. We follow this procedure's default settings based on Griffin et al. (2010). The results of the four technical analysis portfolios are presented in Panels D1–D4 of Table 6, detailing the selected factors, coefficients, associated t-statistics, and partial R^2 values.

8. Conclusion

Technical analysis has long been scrutinized in academia for potentially challenging market efficiency. Previous studies yield mixed results regarding technical analysis profitability across countries. The present study reconciles these findings by examining cross-country disparities in technical analysis returns and their links to market efficiency determinants. Using data from 50 markets spanning 1994–2018, we construct portfolios to address common challenges in market efficiency tests. We find that technical analysis profitability varies significantly across countries. The proxies for herding, institutional quality, and equity market development consistently emerge as the most significant determinants of relative market efficiency. In contrast, proxies for fractionalization, chaos, and investor protection play relatively minor roles. However, the impact of investor sentiment remains unclear. The findings suggest that the conventional view of developed markets being more efficient may not fully explain cross-country differences in technical analysis profitability.

CRediT authorship contribution statement

Jiali Fang: Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Ben Jacobsen:** Writing – review & editing, Supervision, Resources, Methodology, Formal analysis, Conceptualization.

Data availability

The authors do not have permission to share data.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jbankfin.2024.107297.

Appendix

Appendix A1. Cross-country variables description

Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
A1. Herding					
(1) individualism (Hofstede)	cross-sectional		50	Hofstede (2001)	The index measures the degree to which individuals are culturally integrated into groups, where people in more individualistic (collectivistic) cultures are less (more) likely to herd. A higher value indicates a higher degree of individualism (lower degree of collectivism).
(2) individualism (Beugelsdijk et al., (2015)	cross-sectional		50	Beugelsdijk et al. (2015)	A higher value indicates a higher degree of individualism (lower degree of collectivism). Beugelsdijk et al. (2015) replicate Hofstede's dimensions for two birth cohorts using data from the World Values Survey to address the concern that economic development results in shifts in cultural values. It incorporates values reflected in four survey questions: (1) one of my main goals in life is to make my parents proud; (2) private versus government ownership of business; (3) justifiability: homosexuality; (4) justifiability: abortion.
(3) affective autonomy (Schwartz)	cross-sectional		44	Schwartz (1999)	Schwartz (1999) argues that while the Hofstede's cultural dimensions theory remains seminal, it has used instruments not validated for cross-cultural equivalence of meaning and lacks data from important regions of the world. Schwartz (1999) offers a set of polar measures for individualism to capture the different poles of this dimension, namely autonomy-embeddedness (also referred to as autonomy-conservatism in its earlier version). A higher value indicates a higher degree of individualism (lower degree of collectivism). Affective autonomy captures the desirability of individuals independently pursuing their own positive experience (pleasure, exciting life, varied life).
(4) intellectual autonomy (Schwartz)	cross-sectional		44	Schwartz (1999)	A higher value indicates a higher degree of individualism (lower degree of collectivism). Intellectual autonomy captures the desirability of individuals independently pursuing their own ideas and intellectual directions (curiosity, broad-mindedness, creativity).
(5) embeddedness (Schwartz)	cross-sectional		44	Schwartz (1999)	A higher value indicates a higher degree of collectivism (lower degree of individualism). Embeddedness appears in situations where individuals are embedded in a collectivity and find meaning through social relationships.
(6) in-group collectivism practice (GLOBE)	cross-sectional		39	House et al. (2004)	A higher value indicates a higher degree of collectivism (lower degree of individualism). This is the cultural practice index of the collectivisim dimension. House et al. (2004) note the practice and value indices of the same cultural dimension are often negatively correlated. The authors explain that if people in practice possess a low degree of something perceived as good, its absence may lead them to value it more highly. The opposite is also true. This has been extensively discussed in the psychology literature (Venaik and Brewer, 2008). We include both the practice and the value indices for thoroughness.
(7) in-group collectivism value (GLOBE)	cross-sectional		39	House et al. (2004)	A higher value indicates a higher degree of collectivism (lower degree of individualism). This is the cultural value index (the "should be" index) of the collectivism dimension.
A2. Sentiment					
(1) Consumer Confidence Index	cross-sectional & monthly	1994:03 - 2018:03	30	OECD	A higher value indicates higher bullish consumer sentiment.
(2) Business Confidence Index	cross-sectional & monthly	1994:03 - 2018:03	35	OECD	A higher value indicates higher bullish business sentiment.
A3. Institutional quality					
(1) aggregate quality of institution index	cross-sectional & annual	1996 - 2018	47	International Country Risk Guide (ICRG)	Following Bekaert et al. (2011), the index is constructed as the sum of three ICRG indices: law and order, bureaucratic quality and corruption. A higher value indicates better institutional quality. The bureaucratic quality of a country evaluates the institutional strength and quality of the civil service, along with its degree of independence from political pressures. It also measures the ability of the bureaucracy to implement policies efficiently and transparently

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
					and to adapt to changes in government or policy. Corruption assesses the level of corruption within the political system, such as the existence of a black market, the payment of bribes, patronage networks, and nepotism. It also measures the extent to which the government has implemented anti-corruption policies and enforced the rule of law.
(2) investment profile	cross-sectional & annual	1996 - 2018	47	International Country Risk Guide (ICRG)	The index is a measure of the risk of investing in a country, based on three subcomponents: contract validity, repatriation, and payment delays. A higher value indicates better institutional quality.
(3) law and order	cross-sectional & annual	1996 - 2018	47	International Country Risk Guide (ICRG)	The law subcomponent assesses the strength and impartiality of the legal system, while the order subcomponent assesses the popular observance of the law. A higher value indicates better institutional quality.
A4. Stock market characteristics					
(1) number of listed companies	cross-sectional & annual	1994 - 2017	49	World Bank	It includes listed domestic companies and foreign companies which are exclusively listed, which shares have listed on an exchange at the end of the year. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies, such as holding companies and investment companies, regardless of their legal status, are excluded. A company with several classes of shares is counted once. Only companies admitted to listing on the exchange are included.
(2) stock market size	cross-sectional & annual	1994 - 2016	49	World Bank	Stock market size is measured by total market capitalisation of listed companies as percentage of this countries' GDP.
Variable	Type	Sample Period	No. of Countries	Source	Description
(3) stock market age	cross-sectional & annual	1994 - 2018	50	Global Financial Data	Global Financial Data provides historically extensive stock market data. We use the current year miuns the year when the stock market data becomes available in this database as a proxy for stock market age for each country. So that a higher value indicates an older market.
(4) industry concerntration	cross-sectional & monthly	1994:03 - 2018:03	49	Compustat	We calculate industry Herfindahl-Hirschman Index by first identifying the market shares of all firms operating in different industries, next we square each of the industry market shares, then sum up these squared values. The Herfindahl-Hirschman Index ranges from 0 to 1. A lower index suggests a more competitive market, while a higher index indicates a more concentrated market with fewer industries dominating.
(5) volatility of cash flow growth rates	corss-sectional & monthly	1994:03 - 2018:03	44	Datastream	For country j in year y, it is the standard deviation of this country's monthly cash flow growth rate in the sixty-month period prior to year y. The cash flow of country j in month t is the ratio between the price index of this country's Global Index and the price-to-cash flow index of the same Global Index. The growth rate in month t is computed as $\ln(cf_{jt}/cf_{jt-12})$.
(6) liquidity	cross-sectional & annual	1994 - 2017	49	World Bank	Stocks traded, total value (% of GDP)
(7) stock market turnover	corss-sectional & monthly	1994:03 - 2018:03	44	Datastream	Market turnover of country j in month t is measured as the market dollar trading volume of the Datastream Global Index of this country divided by this index's market capitalisation in month t.
A5. Investor protection					
(1) creditor rights index	cross-sectional		41	La Porta et al. (1998, 2000)	A higher value indicates better investor protection. This index considers the country restrictions, such as creditors' consent or minimum dividends to file for reorganization, secured creditors' ability to gain possession of their security once the reorganization petition has been approved (no automatic stay), secured creditors' rank in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm, and the debtor's retention of the administration of its property pending the resolution of the reorganization.
(2) anti-director rights index	cross-sectional		42	La Porta et al. (1998, 2000)	A higher value indicates better investor protection. The index considers whether a country allows shareholders to mail their proxy vote to the firms, whether shareholders are required to deposit their shares prior to the General Shareholders' meeting, whether there is cumulative voting or proportional representation of minorities in the board, whether an oppressed minorities mechanism exists, whether to call for an extraordinary shareholders' meeting less than or equal to 10 percent share is required, and whether shareholders have preemptive rights only can be waived by a shareholders' vote.
(3) concentration of ownership (*−1)	cross-sectional		41	La Porta et al. (1998, 2006)	The average percentage of common shares owned by the three largest shareholders in the 10 largest nonfinancial, privately owned domestic firms in a country. A higher value indicates more concentration.

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
(4) insider trading	cross-sectional		42	La Porta et al. (1998)	It equals one if the company law or commercial code of the country requires that ordinary shares carry one vote per share, and zero otherwise.
(5) accounting standards	cross-sectional		38	La Porta et al. (1998, 2000)	A higher value indicates better accounting disclosures. It assesses 1990 annual reports on their inclusion or omission of 90 items that fall into seven categories including general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items.
A6. Chaos					
(1) maximum Lyapunov exponent	cross-sectional & annual		50		Calculated using daily stock returns. Maximum Lyapunov exponent measures the rate at which system processes create or destroy information. A negative (positive) exponent indicates convergence (divergence and chaos).
(2) Hurst exponent	cross-sectional & annual		50		Calculated using daily stock returns. The Hurst exponent measures the long-term memory of time series by capturing the autocorrelations of the time series, and the rate at which these decrease as the lag between pairs of values increases. A Hurst exponent of 0.5 indicates characteristics consistent with the random walk theory. A Hurst exponent greater (less) than 0.5 indicates persistence and long-term memory (antipersistence).
(3) corrected Hurst exponent	cross-sectional & annual		50		Calculated using daily stock returns. A Hurst exponent of 0.5 indicates characteristics consistent with the random walk theory. A Hurst exponent greater (less) than 0.5 indicates persistence and long-term memory (antipersistence). This version of Hurst exponent is developed by Annis and Lloyd (1976) which is based on the adjusted rescaled range for independent normal summands.
(4) BDS (2,0.5)	cross-sectional & annual		50		BDS statistics, developed by Brock et al. (1996), is a test for time-based dependence in a series based on the correlation integral, measuring the probability that the system under examination has the same scaling properties as a random system. Specifically, the BDS test examines the "spatial dependence" of the underlying series embedded in m-space and calculates the dependence of the underlying series by counting "near" points which have a distance less than a given epsilon value set in terms of the standard deviation of the underlying series. Following Hsieh (1991), we pre-fit the data using GARCH (1,1) and then calculate the BDS statistics for residuals to remove linear dependence in the data before calculating the statistics. Calculated using daily stock returns, embedding dimension is 2 and epsilon value equals 0.5. Larger BDS statistics indicate higher time-based dependence.
(5) BDS (2,1)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 2 and epsilon value equals 1. Larger BDS statistics indicate higher time-based dependence.
Variable	Type	Sample Period	No. of Countries	Source	Description
(6) BDS (2,1.5)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 2 and epsilon value equals 1.5. Larger BDS statistics indicate higher time-based dependence.
(7) BDS (2,2)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 2 and epsilon value equals 2. Larger BDS statistics indicate higher time-based dependence.
(8) BDS (3,0.5)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 3 and epsilon value equals 0.5. Larger BDS statistics indicate higher time-based dependence.
(9) BDS (3,1)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 3 and epsilon value equals 1. Larger BDS statistics indicate higher time-based dependence.
(10) BDS (3,1.5)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 3 and epsilon value equals 1.5. Larger BDS statistics indicate higher time-based dependence.
(11) BDS (3,2)	cross-sectional & annual		50		Calculated using daily stock returns, embedding dimension is 3 and epsilon value equals 2. Larger BDS statistics indicate higher time-based dependence.
A7. Fractionalization					
(1) ethnic fractionalization	cross-sectional		50	Alesina et al. (2003)	A higher value indicates a higher likelihood that two randomly sampled individuals in the population belong to different ethnic groups.
(2) linguistic fractionalization	cross-sectional		50	Alesina et al. (2003)	A higher value indicates a higher likelihood that two randomly sampled individuals in the population speak different languages.
(3) religious fractionalization	cross-sectional		50	Alesina et al. (2003)	A higher value indicates a higher likelihood that two randomly sampled individuals in the population are affiliated with different religions.
A8. Alternative explanatory variables					
A8.1. Additional sentiment proxies					

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
(1) VIX	monthly	1994:03 - 2018:03		CBOE	We use the original VIX times −1, so that a higher value indicates higher bullish sentiment.
(2) Baker&Wurgler sentiment index	monthly	1994:03 - 2018:03		Baker and Wurgler (2006)	A higher value indicates higher bullish sentiment.
(3) Baker&Wurgler sentiment index (orthogonalized of macroeconomic variables)	monthly	1994:03 - 2018:03		Baker and Wurgler (2006)	A higher value indicates higher bullish sentiment.
(4) DG ECFIN sentiment index	cross-sectional & monthly	2002:01 - 2018:03	20	Datastream	Directorate General for Economic and Financial Affairs (DG ECFIN) of the European Commission sentiment indices. A higher value indicates higher bullish sentiment.
(5) Risk aversion index (Bekaert et al., (2022)	monthly	1994:03 - 2018:03		Bekaert et al. (2022)	The market-wide risk aversion index is a measure of the time-varying relative risk aversion coefficient of the representative agent in a generalized habit-like model with preference shocks, spanned by a judiciously-chosen instrument set of asset prices and risk variables.
(6) Uncertainty index (unit: monthly variance*1000, Bekaert et al. (2022))	monthly	1994:03 - 2018:03		Bekaert et al. (2022)	The index first estimates the monthly conditional variance of industrial production growth with a realistic Bad Environment-Good Environment innovation framework and a persistent conditional mean. Then it projects the monthly conditional variance onto the financial instruments used to span the risk aversion index. The fitted value is the uncertainty index.
(7) Uncertainty index (unit: annual volatility percentage, Bekaert et al. (2022))	monthly	1994:03 - 2018:03		Bekaert et al. (2022)	It multiplies the monthly variance by 120,000 and takes the square root.
(8) Sentix Euro zone investor sentiment index	monthly	2003:03 - 2018:03		Datastream	The index is a monthly survey that measures the economic outlook of investors and analysts in the Euro area. The index is based on the responses of about 2800 participants who are asked to rate the current situation and the expectations for the next six months for the Euro zone economy. The index ranges from −100 to +100, where a positive (negative) value indicates optimism (pessimism).
(9) State Street global investor confidence index	monthly	2000:03 - 2018:03		Datastream	The index is a measure of the risk appetite or confidence of institutional investors, based on their actual buying and selling patterns of these investors, rather than opinions or expectations. The greater the percentage allocation to equities, the higher the risk appetite or confidence. The index has three regional components: North America, Europe and Asia-Pacific. The index ranges from 0 to 200, with 100 as the neutral level. A higher value indicates higher bullish sentiment.
(10) Refinitiv/Ipsos primary consumer sentiment index	cross-sectional & monthly	2010:03 - 2018:03	19	Datastream	The index is a monthly survey of consumer attitudes on the current and future state of local economies, personal finance situations, savings and confidence to make large investments, conducted by Ipsos, a global market research and polling company, in 24 countries. The index ranges from 0 to 100, with 50 as the neutral level. A higher value indicates higher bullish sentiment.
(11) stock market volatility	cross-sectional & monthly	1994:03 - 2018:03	50		Volatility of daily stock index returns, calculated for each country in each month.
(12) correlation with world market	cross-sectional & monthly	1994:03 - 2018:03	50		The correlation between country index returns and returns of the world market index, computed for each country in each month.
A8.2. Additional country risk proxies:					
(1) ICRG bureaucratic quality	cross-sectional & annual	1998 - 2018	47	International Country Risk Guide (ICRG)	A higher value indicates better institutional quality. It is an assessment of the institutional strength and quality of the civil service, as well as the degree of its independence from political pressures. It also measures the ability of the bureaucracy to implement policies effectively and transparently, and to cope with changes in government or policy.
Variable	Type	Sample Period	No. of Countries	Source	Description
(2) ICRG control of corruption	cross-sectional & annual	2001 - 2018	47	International Country Risk Guide (ICRG)	A higher value indicates better institutional quality. It is an assessment of the degree of corruption within the political system, such as the existence of a black market, the payment of bribes, the patronage networks, and the nepotism. It also measures the extent to which the government has implemented anti-corruption policies and enforced the rule of law.
(3) ICRG voice and accountability	cross-sectional & annual	1996 - 2018	47	International Country Risk Guide (ICRG)	A higher value indicates better institutional quality. The index captures military in politics and democratic accountability. The military is not elected by anyone. Therefore, its involvement in politics, even at a peripheral level, is a diminution of democratic accountability.
(4) ICRG political stability and absence of violence	cross-sectional & annual	1997 - 2018	47	International Country Risk Guide (ICRG)	A higher value indicates better institutional quality. The index captures a country's government stability, and its ability to prevent internal and external threats and ethnic tensions to its authority.

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
(5) WGI quality of institutions	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	The WGI aggregate data from more than 30 think tanks, international organizations, nongovernmental organizations, and private firms across the world to measure political risks. The definition of variables are similar to that of ICRG.
(6) WGI investment profile	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
(7) WGI law and order	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
(8) WGI bureaucratic quality	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
(9) WGI control of corruption	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
(10) WGI voice and accountability	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
(11) WGI political stability and absence of violence	cross-sectional & annual	1996 - 2015	50	World Governance Indicator (WGI)	A higher value indicates better institutional quality.
Panel B: Instrumental Variables					
B1. Main Instrumental Variables					
(1) disease prevalence	cross - sectional		49	Murray and Schaler (2010)	The index uses old epidemiological atlases to rate the prevalence of nine different kinds of infectious disease in a region including leishmanias, schistosomes, trypanosomes, leprosy, malaria, typhus, filariae, dengue, and tuberculosis.
(2) average temperature	cross-sectional & monthly	1994 - 2016	48	World Bank	The average monthly temperature of a country.
(3) percentage of population with European descent	cross - sectional		50	Ashraf and Galor (2013)	
(4) internet subscription	cross-sectional & annual	1994 - 2016	49	World Bank	Fixed broadband subscriptions per 100 people.
(5) legal origin	cross - sectional		50	La Porta et al. (2008)	A binary variable capturing whether a country adopts English common law.
(6) genetic distance	cross - sectional		48	Spolaore and Wacziarg (2009)	The variance in gene frequencies across populations as a share of the population's average gene frequencies, based on ethnic composition in 1990s.
B2. Alternative Instrumental Variables					
(1) disease prevalence2	cross - sectional		49	Murray and Schaler (2010)	The index uses old epidemiological atlases to rate the prevalence of seven different kinds of infectious disease in a region including leishmanias, trypanosomes, malaria, schistosomes, filariae, spirochetes, and leprosy.
(2) phone subscription	cross-sectional & annual	1994 - 2017	49	World Bank	Fixed telephone subscriptions per 100 people.
(3) genetic distance2	cross - sectional		48	Spolaore and Wacziarg (2009)	The variance in gene frequencies across populations as a share of the population's average gene frequencies, based on ethnic composition in 1500.
Panel C: Macroeconomic Variables					
C1. Key Macroeconomic Strength					
(1) GDP per capita in thousands	cross-sectional & annual	1994 - 2017	49	World Bank	GDP per capita is in the constant 2010 U.S. dollar for all countries.
(2) inflation	cross-sectional & annual	1994 - 2017	48	World Bank	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.
(3) unemployment	cross-sectional & annual	1994 - 2017	49	World Bank	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.
(4) change of exchange rate (against US dollar)	cross-sectional & monthly	1994:03 - 2018:03	41	Datastream	In year y in country j, it is the average change of the exchange rate (local currency against U.S. dollar) in the 60-month period before year y. The value for the U.S. is zero.
C2. Openness of Economy					
(1) capital account openness	cross-sectional & annual	1995 - 2017	47	Fernandez et al. (2016)	This is the overall capital control restriction index published by Fernandez et al. (2016). This idex measures the capital control restrictions on both inflows and outflows of ten categories of assets for each country.

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
(2) trade/GDP in thousands	cross-sectional & annual	1994 - 2017	49	World Bank	The sum of exports and imports of goods and services measured as a share of gross domestic product.
Variable	Type	Sample Period	No. of Countries	Source	Description
(3) foreign direct investment inflow	cross-sectional & annual	1994 - 2017	49	World Bank	Foreign direct investment is the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.
(4) foreign direct investment outflow	cross-sectional & annual	1994 - 2017	49	World Bank	Foreign direct investment refers to direct investment equity flows in an economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy. Ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship. This series shows net outflows of investment from the reporting economy to the rest of the world, and is divided by GDP.
C3. Fundamental Growth					
(1) secondary school enrolment in thousands	cross-sectional & annual	1994 - 2017	49	World Bank	Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds secondary education.
(2) log life expectancy	cross-sectional & annual	1994 - 2016	49	World Bank	Log value of national average life expectancy at birth, which is the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.
(3) population growth	cross-sectional & annual	1994 - 2017	49	World Bank	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.
(4) log geographical land area	cross - sectional		49	World Bank	Log value of a country's total area in sq. km.
C4. World Economic Growth					
(1) GDP per capita world in thousands	cross-sectional & annual	1994 - 2017	50	World Bank	GDP per capita is in the constant 2010 U.S. dollar for all countries.
(2) MSCI world index return	monthly	1994:03 - 2018:03		Global Financial Data	
C5. More Controls					
(1) develped economy dummy - World Bank Gross National Income classification	cross-sectional & annual	1994 - 2018	49	World Bank	A dummy variable that equals 1(0) for developed (developing) economies.
(2) develped economy dummy - United Nation Human Development Index classification	cross-sectional & annual	1994 - 2018	49	United Nation	A dummy variable that equals 1(0) for developed (developing) economies.
(3) private credit by deposit money banks/GDP	cross-sectional & annual	1995 - 2018	49	World Bank	The financial resources provided to the private sector by domestic money banks as a share of GDP. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits.
(4) NBER business cycle	monthly	1994:03 - 2018:03		NBER	A dummy variable that equals 1(0) during economic contractions (expansions).
(5) January dummy	monthly	1994:03 - 2018:03			A dummy variable that equals 1(0) in January (other months).
Panel D: Other Cultural Dimensions					
D1. Hofstedes Cultural Variables					
(1) uncertainty avoidance	cross-sectional		50	Hofstede (2001)	A higher value indicates a higher degree of uncertainty avoidance.
(2) masculinity	cross-sectional		50	Hofstede (2001)	A higher value indicates a more feminine society.
(3) power distance	cross-sectional		50	Hofstede (2001)	A higher value indicates that hierarchy is clearly established and executed in a society. A lower value indicates that people question authority and attempt to distribute power.
(4) long-term orientation vs short-term orientation	cross-sectional		47	Hofstede (2001)	A higher value indicates a long-term oriented society which generally has a better economic development.
(5) self-indulgence vs restraint	cross-sectional		46	Hofstede (2001)	A higher value indicates a happier society that allows relatively free gratification of basic and natural human desires related to enjoying life and having fun.
D2. Schwarz Value Survey					

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Variable	Type	Sample Period	No. of Countries	Source	Description
Panel A: Main Explanatory Variables					
(1) mastery vs harmony	cross-sectional		44	Schwartz (1999)	A higher value of mastery (a lower value of harmony) indicates individuals seek success through personal action versus happy to accept their value in the world, and vice versa.
(2) hierarchy vs egalitarianism	cross-sectional		44	Schwartz (1999)	A higher value of hierarchy (a lower value of egalitarianism) indicates a higher social order, and vice versa.
D3. GLOBE Cultural Variables (each has a societal practise index and a societal value index)					
(1) assertiveness	cross-sectional		39	House et al. (2004)	A higher value indicates individuals are (and should be) more assertive, confrontational, and aggressive in their relationship with others.
(2) institutional collectivism	cross-sectional		39	House et al. (2004)	A higher value indicates organizational and societal institutional practices encourage and reward (and should encourage and reward) more collective distribution of resources and collective action.
(3) future orientation	cross-sectional		39	House et al. (2004)	A higher value indicates individuals engage (and should engage) more in future-oriented behaviors such as planning, investing in the future, and delaying gratification.
(4) gender equality	cross-sectional		39	House et al. (2004)	A higher value indicates a collective minimizes (and should minimize) gender inequality.
Variable	Type	Sample Period	No. of Countries	Source	Description
(5) humane orientation	cross-sectional		39	House et al. (2004)	A higher value indicates a collective encourages and rewards (and should encourage and reward) individuals more for being fair, altruistic, generous, caring, and kind to others.
(6) performance orientation	cross-sectional		39	House et al. (2004)	A higher value indicates a collective encourages and rewards (and should encourage and reward) group members more for performance improvement and excellence.
(7) power distance	cross-sectional		39	House et al. (2004)	A higher value indicates more acceptance for authority, power differences and status privileges.
(8) uncertainty avoidance	cross-sectional		39	House et al. (2004)	A higher value indicates greater uncertainty avoidance.
D4. Tang and Koveos (2008) Updated Hofstede's Variables					
(1) individualism	cross-sectional		43	Tang and Koveos (2008)	See Hofstede's variables for definitions.
(2) uncertainty avoidance	cross-sectional		43	Tang and Koveos (2008)	
(3) masculinity	cross-sectional		43	Tang and Koveos (2008)	
(4) power distance	cross-sectional		43	Tang and Koveos (2008)	
(5) long-term orientation vs short-term orientation	cross-sectional		36	Tang and Koveos (2008)	
D5. More Cultural Variables					
(1) religion (WVS)	cross-sectional & annual	1994 - 2014	38	World Value Survey	This variable measures the importance of religion answered by survey respondents of the World Value Survey. A lower score means religion is more important in one's life.
(2) trust (WVS)	cross-sectional & annual	1994 - 2014	39	World Value Survey	This variable measures anonymous trust, which is the percentage of World Value Survey respondents saying they trust people they meet for the first time.
(3) tightness	cross-sectional		26	Gelfand et al. (2011)	A tighter culture has many strong norms and a low tolerance of deviant behavior, in contrast a loose culture has weak social norms and a high tolerance of deviant behavior. A higher value means a tighter culture.
(4) religion (UN)	cross-sectional & annual	1996 - 2018	26	United Nation	This variable is the percentage of total population who are religious in each country.

Appendix A2. Stock index and risk-free rate data

Country	Stock Market Index	Risk-free Rates
Argentina	Buenos Aires SE General Index	Argentina Time Deposit Rate (before Sep 2012), Argentina 3-month BCRA Treasury Auction Yield
Australia	Australia ASX All-Ordinaries	Australia 3-month Treasury Bill Yield
Austria	Austria Wiener Boersekammer Share Index	Austria 3-month Time Deposit Rate
Bangladesh	Dhaka SE General Index	Bangladesh 3-month Treasury Bill Yield
Belgium	Brussels All-Share Price Index	Belgium 3-month Treasury Bill Yield
Brazil	Dow Jones Brazil Stock Index	Brazil 3-month Treasury Bill Yield
Canada	Canada S&P/TSX 300 Composite	Canada 3-month Treasury Bill Yield

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Country	Stock Market Index	Risk-free Rates
Chile	Santiago SE Indice General de Precios de Acciones	Chile 3-month Inflation Adjusted T-bill Yield (before July 1997), Chile 3-month Nominal T-bill Auction Yield
China	Shanghai SE Composite	China Time Deposit Rate (before Jan 2002), China 3 Month Repo on Treasury Bills
Colombia	Colombia IGBC General Index	Colombia 3-month Time Deposit Rate (before Jan 1998), Colombia 3-month Treasury Bill Yield
Czech	Prague SE PX Index	Czech Republic 3-month Treasury Bill Yield
Denmark	OMX Copenhagen All-Share Price Index	Denmark 3-month Treasury Bill Yield
Ecuador	Ecuador Bolsa de Valores de Guayaquil	Ecuador Sucre Time Deposit Rate (before Feb 2000), Ecuador Dollar Deposit Rate
Finland	OMX Helsinki Capped Price Index	Finland Household Deposit Rate
France	France CAC All-Tradable Index	France 3-month Treasury Bill Yield
Germany	Germany CDAX Composite Index	Germany 3-month Treasury Bill Yield
Greece	Athens SE General Index	Greece 3-month Treasury Bill Yield
Hong Kong	Hong Kong Hang Seng Composite Index	Hong Kong 3-month Treasury Bill Yield
India	Bombay SE Sensitive Index	India 3-month Treasury Bill Yield
Indonesia	Jakarta SE Composite Index	Indonesia 3-month Time Deposits
Ireland	Ireland ISEQ Overall Price Index	Ireland 3-month Treasury Bill Yield
Israel	Tel Aviv All-Share Index	Israel 3-month Treasury Bill Yield
Italy	Banca Commerciale Italiana Index	Italy 3-month Treasury Bill Yield
Jamaica	Jamaica Stock Exchange All-Share Composite Index	Jamaica 3-month Treasury Bill Yield
Japan	Nikkei 225 Stock Average	Japan 3-month Treasury Bill Yield
Korea	Korea SE Stock Price Index	South Korea 12-month Monetary Stabilization Bill
Luxembourg	Luxembourg SE LUXX Index	Luxembourg Sight Deposit Rate
Malaysia	Malaysia KLSE Composite	Malaysia 3-month T-Bill Discount Rate
Mexico	Mexico SE Indice de Precios y Cotizaciones	Mexico 3-month Cetes Yield (before June 2012), Mexico 9-month Treasury Bond Yield
New Zealand	New Zealand SE All-Share Capital Index	New Zealand 3-month Treasury Bill Yield
Netherlands	Netherlands All-Share Price Index	Netherlands 3-month Treasury Bill Yield
Norway	Oslo SE All-Share Index	Norway 3-month Treasury Bill Yield
Pakistan	Pakistan Karachi SE-100 Index	Pakistan 3-month Treasury Bill Rate
Panama	Panama Stock Exchange Index	Panama 3-month Time Deposit Rate
Peru	Lima SE General Index	Peru Time Deposit Rate
Philippines	Manila SE Composite Index	Philippines 3-month Treasury Bill Yield
Portugal	Oporto PSI-20 Index	Portugal 3-month Treasury Bill Yield
South Africa	FTSE/JSE All-Share Index	South Africa 3-month Treasury Bill Yield
Singapore	Singapore FTSE Straits-Times Index	Singapore 3-month Treasury Yield
Slovak	Bratislava SE SAX Index	Slovakia Average Deposit Rate (after Jan 2008), Slovakia 3-month T-bill Yield
Slovenia	Slovenia Bourse Index	Slovenia Demand Deposit Rate to 1 Year
Spain	Madrid SE General Index	Spain 3-month T-Bill Yield
Sweden	Sweden OMX Affärsvärldens General Index	Sweden 3-month Treasury Bill Yield
Switzerland	Switzerland Price Index	Switzerland 3-month Treasury Bill Yield
Taiwan	Taiwan SE Capitalization Weighted Index	Taiwan 3-month Treasury Bill Yield
Thailand	Thailand SET General Index	Thailand 3-month Treasury Bill Yield
Turkey	Istanbul SE IMKB-100 Price Index	Turkey 3-month Treasury Bond Yield
UK	UK FTSE All-Share Index	United Kingdom 3-month Treasury Bill Yield
US	S&P 500 Composite Price Index	USA Government 90-day T-Bills Secondary Market
Venezuela	Caracas SE General Index	Venezuela 1-month Time Deposit Rate

Appendix B. Transaction costs

Country	Panel A: FHT Method		Panel B: DGMAT Method		Panel C: Breakeven Costs
	Percent-cost	No. of stocks	Percent-cost	CompFixedNet (%)	Percent-cost
Argentina	0.0160	177	0.2744	1.31***	1.6454
Australia	0.0460	3942	0.2538	0.12	0.3621
Austria	0.0240	262	0.2173	0.26**	0.5098
Bangladesh	0.0258	392	0.4049	0.96***	1.5327
Belgium	0.0361	431	0.1510	0.15	0.3280
Brazil	0.0289	1137	0.1997	0.92***	1.2621
Canada	0.0246	6889	0.1338	0.13	0.2590
Chile	0.0167	326	0.2572	0.51***	0.8436
China	0.0081	6010	0.3102	0.66**	1.1486
Colombia	0.0202	106	0.4904	0.88***	1.3763
Czech	0.0198	375	0.4209	0.29*	0.7465
Denmark	0.0165	494	0.1785	0.35**	0.6231
Ecuador	0.0933	12	0.3128	0.53**	0.9332
Finland	0.0130	356	0.1987	0.20	0.3727
France	0.0230	2120	0.1211	0.03	0.1182
Germany	0.0296	2051	0.1274	0.03	0.1160
Greece	0.0198	472	0.3240	0.59**	1.2414
Hong Kong	0.0167	2406	0.2585	0.24	0.4847

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Country	Panel A: FHT Method		Panel B: DGMAT Method		Panel C: Breakeven Costs
	Percent-cost	No. of stocks	Percent-cost	CompFixedNet (%)	Percent-cost
India	0.0122	5483	0.0765	0.49***	0.7222
Indonesia	0.0388	930	0.4398	0.86***	1.3550
Ireland	0.0206	440	0.5970	−0.05	0.1949
Israel	0.0172	919	0.4184	0.66***	1.1129
Italy	0.0068	933	0.1458	0.42**	0.8807
Jamaica	0.0309	79	0.2918	1.46***	1.8935
Japan	0.0082	6129	0.1773	−0.10	−0.0452
Korea	0.0074	3822	0.3257	0.04	0.2902
Luxembourg	0.0134	318	0.1292	0.54***	0.8554
Malaysia	0.0197	1505	0.3814	0.23	0.6759
Mexico	0.0141	406	0.1512	0.86***	1.2241
New Zealand	0.0308	344	0.2455	0.19**	0.4544
Netherlands	0.0175	509	0.1301	0.18	0.3297
Norway	0.0225	757	0.2095	0.37**	0.5586
Pakistan	0.0221	601	0.3323	1.20***	1.5332
Panama	0.0296	4	0.2916	0.41***	0.5714
Peru	0.0252	221	0.3602	0.96***	1.4991
Philippines	0.0332	415	0.5408	0.13	0.5068
Portugal	0.0341	145	0.2987	0.37**	0.8271
South Africa	0.0382	1201	0.2149	−0.12	−0.0583
Singapore	0.0376	1087	0.3163	0.24	0.5857
Slovakia	0.0492	60	0.4280	0.56***	1.4195
Slovenia	0.0300	131	0.5841	0.84***	1.5812
Spain	0.0103	565	0.1646	0.21	0.4415
Sweden	0.0163	1730	0.1469	0.15	0.2832
Switzerland	0.0145	817	0.1586	0.03	0.1398
Taiwan	0.0058	2753	0.3001	0.06	0.2982
Thailand	0.0174	2393	0.3334	0.43*	0.8349
Turkey	0.0136	623	0.2337	2.26***	2.6833
United Kingdom	0.0246	6970	0.2069	0.01	0.1049
United States	0.0120	22,481	0.0430	−0.05	−0.0651
Venezuela	0.0666	80	0.5248	4.44***	4.4074
Average	0.0244		0.2767		0.8400

This table, in Panel A, presents the average one-way transaction cost estimated using the *FHT* methodology based on Fong et al. (2017). We analyze 50 international stock markets from 1994:03 to 2018:03. Panel A also reports the number of stocks used to estimate *FHT* in each country. Panel B presents the average one-way transaction cost of each country based on the actual trading cost reported by Domowitz et al. (2001) for the first half of our sample period, and those reported by Angelidis and Tessaromatis (2017) for the second half of the sample period. We use corresponding regional average transaction costs for countries that Domowitz et al. (2001) and Angelidis and Tessaromatis (2017) do not cover. We refer to this method as *DGMAT*. *CompFixedNe*t is estimated by deducting round-trip transaction costs. Panel C presents the round-trip break-even transaction cost for each country.

Appendix C. Cross-country analysis of technical analysis profitability–individual proxies

Variables	Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries
	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	
Panel A: Herding													
(1) individualism (Hofstede)	−0.07***	−7.12	0.3720	−0.05***	−4.44	0.1895	−0.06***	−4.40	0.1545	−0.06***	−4.14	0.1527	50
(2) individualism (Beugelsdijk et al., 2015)	−1.20***	−5.95	0.3697	−1.20***	−5.04	0.1987	−1.37***	−4.44	0.1516	−1.30***	−4.21	0.1499	50
(3) affective autonomy (Schwartz)	−3.87***	−7.37	0.3371	−5.14***	−6.35	0.1821	−5.32***	−6.78	0.1576	−5.24***	−6.70	0.1564	44
(4) intellectual autonomy (Schwartz)	−2.95***	−5.92	0.3348	−4.51***	−6.47	0.1748	−3.49***	−5.20	0.1535	−3.36***	−5.17	0.1523	44
(5) embeddedness (Schwartz)	4.31***	6.72	0.3365	6.33***	5.12	0.1810	5.38***	4.88	0.1557	5.24***	4.90	0.1544	44
(6) in-group collectivism practice (GLOBE)	2.58***	5.27	0.3308	3.38***	4.67	0.1788	3.22***	4.37	0.1522	3.13***	4.21	0.1508	39

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Variables	Equal*(10^3)			Composite*(10^3)			CompFixed*(10^3)			CompFixedNet*(10^3)			No. of Countries
	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	coeff.	t-stats	adj. R^2	
(7) in-group collectivism value (GLOBE)	2.86***	3.71	0.3260	2.87***	4.16	0.1630	3.37***	5.31	0.1472	3.26***	5.10	0.1460	39
Panel B: Sentiment													
(1) Business confidence index	0.35	1.23	0.3901	0.30	1.36	0.1972	0.22	0.63	0.1546	0.23	0.66	0.1524	35
(2) Consumer confidence index	−0.26	−1.06	0.4092	−0.39**	−2.21	0.1711	−0.48*	−1.70	0.1534	−0.49*	−1.73	0.1507	30
Panel C: Institutional quality													
(1) aggregate quality of institutions	−4.93***	−8.35	0.3340	−6.32***	−8.23	0.1719	−7.08***	−8.81	0.1469	−6.87***	−8.40	0.1450	47
(2) investment profile	−14.03***	−6.83	0.3318	−18.14***	−8.21	0.1674	−21.20***	−8.19	0.1452	−20.26***	−7.48	0.1429	47
(3) law and order	−12.92***	−7.85	0.3334	−17.03***	−7.53	0.1734	−18.63***	−8.59	0.1469	−18.06***	−8.18	0.1449	47
Panel D: Stock market characteristics													
(1) number of listed companies in thousands	−0.93***	−6.38	0.2672	−1.00***	−6.70	0.0983	−1.12***	−4.60	0.1028	−1.07***	−4.17	0.1017	49
(2) size	−0.02***	−3.01	0.2620	−0.02**	−2.38	0.0866	−0.02**	−2.47	0.1010	−0.02**	−2.46	0.1005	49
(3) age	−0.02***	−7.29	0.3693	−0.02***	−4.98	0.1882	−0.02***	−4.11	0.1539	−0.02***	−4.02	0.1521	50
(4) industry concentration	11.46***	4.76	0.3998	12.85***	5.70	0.2289	18.59***	5.84	0.1784	17.73***	5.46	0.1784	49
(5) cashflow volatility	6.66***	3.47	0.3468	13.66***	4.93	0.1844	11.43***	2.94	0.1657	10.95***	2.78	0.1646	44
(6) liquidity	−0.03***	−3.43	0.2636	−0.03**	−2.51	0.0840	−0.03***	−2.58	0.0967	−0.03**	−2.54	0.0959	49
(7) turnover	−0.01*	−1.83	0.4140	−0.02***	−4.20	0.2119	−0.01	−1.15	0.1693	−0.01	−0.94	0.1682	44
Panel E: La Porta investor protection indices													
(1) creditor rights	−0.10	−1.18	0.2801	−0.39**	−2.33	0.0623	−0.17	−1.12	0.0928	−0.19	−1.27	0.0923	41
(2) antidirector rights	−0.86***	−3.27	0.3358	−1.04***	−3.29	0.1668	−1.22***	−2.71	0.1523	−1.16**	−2.53	0.1510	42
(3) concentration of ownership (*−1)	−12.78***	−7.67	0.3490	−17.66***	−4.51	0.1862	−17.68***	−4.26	0.1591	−17.10***	−4.05	0.1579	41
(4) insider trading	0.84*	1.71	0.3339	0.97	1.13	0.1621	0.19	0.22	0.1485	0.24	0.26	0.1474	42
(5) accounting standards	−0.23***	−9.37	0.3603	−0.28***	−10.01	0.2047	−0.32***	−10.13	0.1701	−0.31***	−9.47	0.1688	38
Panel F: Chaos													
(1) maximum Lyapunov exponent	0.23*	1.79	0.3658	0.80***	5.78	0.1894	0.42**	2.46	0.1532	0.42**	2.45	0.1512	50
(2) Hurst exponent	51.43***	7.25	0.3805	53.37***	7.75	0.2084	68.29***	7.00	0.1678	68.64***	7.20	0.1663	50
(3) corrected Hurst exponent	27.90***	7.51	0.3800	22.59***	6.96	0.2034	35.69***	7.40	0.1663	35.72***	7.59	0.1646	50
(4) BDS (2,0.5)	0.43***	3.06	0.3735	0.34**	2.49	0.1941	0.40**	2.19	0.1550	0.39**	2.12	0.1533	50
(5) BDS (2,1)	0.61***	3.85	0.3740	0.56***	2.84	0.1949	0.63***	2.77	0.1553	0.61***	2.70	0.1536	50
(6) BDS (2,1.5)	0.74***	4.29	0.3752	0.74***	4.27	0.1948	0.84***	3.48	0.1558	0.81***	3.45	0.1542	50
(7) BDS (2,2)	0.55***	3.20	0.3748	0.73***	4.64	0.1934	0.79***	3.40	0.1546	0.78***	3.43	0.1529	50
(8) BDS (3,0.5)	0.37***	2.73	0.3745	0.28**	2.08	0.1958	0.36*	1.91	0.1565	0.35*	1.84	0.1549	50
(9) BDS (3,1)	0.44***	2.79	0.3734	0.51***	2.59	0.1952	0.47**	2.09	0.1565	0.44**	1.98	0.1552	50
(10) BDS (3,1.5)	0.42**	2.45	0.3749	0.61***	3.08	0.1955	0.51**	2.03	0.1566	0.48*	1.95	0.1551	50
(11) BDS (3,2)	0.20	1.11	0.3739	0.60***	3.03	0.1939	0.47*	1.83	0.1539	0.46*	1.83	0.1521	50
Panel G: Fractionalization													
(1) ethnic fractionalization	−4.47***	−7.28	0.3122	−6.57***	−4.05	0.1689	−6.29***	−4.33	0.1473	−6.00***	−4.10	0.1459	50
(2) linguistic fractionalization	−4.23***	−5.24	0.3717	−4.29***	−6.22	0.2008	−6.47***	−6.12	0.1615	−6.38***	−6.08	0.1595	50
(3) religious fractionalization	−6.23***	−6.49	0.3723	−6.44***	−6.73	0.2013	−7.24***	−5.11	0.1607	−7.04***	−4.92	0.1592	50

This table reports the cross-country results of the regression model $r^p_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the individual proxies for herding (four individualism indices and three collectivism indices), investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. We run the regression for each individual proxy separately for the four technical trading strategies Equal, Composite, CompFixed, and CompFixedNet. The table reports the $\beta 1_k$ estimates, associated t-statistics, and adjusted R^2. We also report the number of countries included in each regression based on data availability in the

final column. The sample period is from 1994:03 to 2018:03. Regressions are based on the Fama–MacBeth statistical procedure, which corrects for cross-sectional correlation in standard errors. Newey–West standard errors are used to calculate the regression estimate. The results are marked with ***, **, and * if statistically significant at the 1 %, 5 %, and 10 % levels, respectively.

Appendix D. 2SLS stage 1 results

Variables	Instrument	coeff.	t-stats	adj. R^2	F-stats	Corr	p-value
Herding	disease prevalence	2.53***	166.54	0.7274	5564.44	0.8529	<0.0001
Sentiment	average temperature	0.01***	3.80	0.0405	63.16	0.0349	0.0027
Institutional quality	% population with European descent	2.13***	71.56	0.2983	1034.56	0.5450	<0.0001
Stock market charactertiscs	internet subscription	0.02***	32.39	0.0984	215.45	0.3376	<0.0001
Investor protection	English common law adoption	5.12***	5.43	0.0314	68.41	0.0336	0.0006
Fractionalization	genetic distance	0.0008***	36.43	0.0905	266.46	0.3008	<0.0001

This table reports the 2SLS regression results for the model $r^p_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the composite indices of herding, investor sentiment, institutional quality, stock market development, investor protection, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. We report the first-stage regression coefficients and the F-statistics. In the last two columns, we provide the correlation coefficients between the instruments and the instrumented variables. The sample period is from 1994:03 to 2018:03. The results are based on Newey–West standard errors and marked with ***, **, and * to indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

Appendix E. Cross-country wald test results

	Equal			Composite			CompFixed			CompFixedNet			No. of Countries
Variables	ChiSq	Pr>ChiSq	adj. R^2	ChiSq	Pr>ChiSq	adj. R^2	ChiSq	Pr>ChiSq	adj. R^2	ChiSq	Pr>ChiSq	adj. R^2	
Panel A: Joint OLS Wald test results													
Herding	70.41***	<0.0001	0.0471	122.31***	<0.0001	0.0433	66.42***	<0.0001	0.0349	65.32***	<0.0001	0.0339	38
Sentiment	15.27***	0.0005	0.0533	4.02	0.1337	0.0036	3.20	0.2019	0.0225	2.94	0.2299	0.0225	30
Institutional quality	51.10***	<0.0001	0.0425	72.48***	<0.0001	0.0335	56.23***	<0.0001	0.0281	54.30***	<0.0001	0.0272	47
Stock market charactertiscs	96.03***	<0.0001	0.0615	167.08***	<0.0001	0.0579	99.56***	<0.0001	0.0503	97.75***	<0.0001	0.0502	43
Investor protection	63.60***	<0.0001	0.0474	179.06***	<0.0001	0.0319	75.41***	<0.0001	0.0288	72.84***	<0.0001	0.0285	37
Chaos	204.03***	<0.0001	0.0512	246.27***	<0.0001	0.0432	174.74***	<0.0001	0.0332	176.01***	<0.0001	0.0331	50
Fractionalization	75.05***	<0.0001	0.0357	104.23***	<0.0001	0.0260	72.72***	<0.0001	0.0228	69.97***	<0.0001	0.0222	50
Panel B: Herding and fractionalization - first 20 years of each stock market													
Herding	19.17**	0.0039	0.0954	60.49***	<0.0001	0.1109	22.65***	0.0009	0.0143	16.36**	0.012	0.0136	38
Fractionalization	21.78***	<0.0001	0.1094	36.26***	<0.0001	0.1673	22.68***	<0.0001	0.0260	21.98***	<0.0001	0.0249	50
Panel C: Cross-country analysis of the Henriksson and Merton market timing ability													
Herding	149.98***	<0.0001	0.0584	1270.80***	<0.0001	0.4598	479.78***	<0.0001	0.1641	490.65***	<0.0001	0.1661	38
Sentiment	2.68	0.2622	0.0036	2.88	0.2374	0.0016	0.87	0.6472	0.0019	0.82	0.6648	0.0019	30
Institutional quality	284.37***	<0.0001	0.1113	2687.50***	<0.0001	0.4657	397.95***	<0.0001	0.1805	411.92***	<0.0001	0.1821	47
Stock market charactertiscs	430.39***	<0.0001	0.1552	1747.70***	<0.0001	0.3294	516.32***	<0.0001	0.1259	496.37***	<0.0001	0.1235	43
Investor protection	536.49***	<0.0001	0.1925	1340.10***	<0.0001	0.3548	51.41***	<0.0001	0.0217	48.58***	<0.0001	0.0203	37
Chaos	135.88***	<0.0001	0.0295	415.33***	<0.0001	0.1178	89.54***	<0.0001	0.0134	87.46***	<0.0001	0.0133	50
Fractionalization	924.19***	<0.0001	0.2044	1907.00***	<0.0001	0.4013	140.52***	<0.0001	0.0528	146.28***	<0.0001	0.0547	50
Panel D: Granger causality													
Sentiment	2.43	0.2968		2.32	0.313		0.91	0.6334		0.77	0.6819		30
Institutional quality	118.19***	<0.0001		254.94***	<0.0001		165.86***	<0.0001		157.97***	<0.0001		47
Stock market charactertiscs	158.39***	<0.0001		417.46***	<0.0001		271.43***	<0.0001		270.80***	<0.0001		43
Chaos	249.35***	<0.0001		362.52***	<0.0001		268.74***	<0.0001		271.51***	<0.0001		50

This table presents the results from the robustness tests examining the combined explanatory power of individual proxies of each determinant. In Panel A, we run the OLS regression model $r^p_{kjt} = \beta 0_k + \beta 1_k X_{jt} + \beta 2_k MRP_{jt} + \beta 3_k SMB_{jt} + \beta 4_k HML_{jt} + \beta 5_k MOM_{jt} + \beta 6_k Controls_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns of technical trading strategy k. X_{jt} represents the vector of individual proxies for herding, investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. Therefore, $\beta 1_k$ is a vector of coefficients of the individual proxies for the same determinant. We use a Wald test to determine whether the individual $\beta 1_k$ are jointly equal to zero. Panel B tests whether herding and fractionalization explain the variation in technical analysis profits when using the first 20 years or each stock market as the alternative sample. Panel C uses the coefficient γ_{kj} of the Henriksson and Merton (1981) market timing test as the dependent variable to replicate the same Wald test. In Panel D, we run a Granger causality Wald test to determine whether a group of variables jointly influence the dependent variable. Specifically, the null hypothesis is that technical analysis profitability is influenced only by itself (the lagged values of the technical trading profit), and not by each group of the lagged values of the individual proxies. We compute the Granger causality test for the VAR (3) model. The autoregressive order is set as three because it exhibits the highest AIC score among

orders less than 5. We report the Chi-squared and p-values of the Wald test for the four technical trading strategies *Equal, Composite, CompFixed,* and *CompFixedNet*. We also report the number of countries included in each regression based on data availability in the final column. The sample period is from 1994:03 to 2018:03. The results are based on Newey–West standard errors.

Appendix F. Correlation matrix of cross-country determinants

	Herding	Sentiment	Institutional quality	Stock market charactertiscs	Investor protection	Chaos
Sentiment	−0.0870					
	<0.0001					
Institutional quality	−0.7186	0.0775				
	<0.0001	<0.0001				
Stock market charactertiscs	−0.2716	−0.0227	0.3041			
	<0.0001	0.1135	<0.0001			
Investor protection	−0.2331	0.0275	0.5968	0.6319		
	<0.0001	0.062	<0.0001	<0.0001		
Chaos	0.1541	0.0567	−0.1928	−0.1219	−0.1786	
	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Fractionalization	0.3045	0.0935	−0.3071	0.0665	0.0242	0.0555
	<0.0001	<0.0001	<0.0001	<0.0001	0.0336	<0.0001

This table presents the pairwise Pearson's correlation matrix and associated p-values for the composite indices of herding, investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization.

Appendix G. Interaction test results

	Equal*(10^3)		Composite*(10^3)		CompFixed*(10^3)		CompFixedNet*(10^3)		No. of Countries
	coeff.	t-stats	coeff.	t-stats	coeff.	t-stats	coeff.	t-stats	
Panel A: Herding									
herding × sentiment	0.09	0.35	−0.36**	−2.10	−0.31	−1.63	−0.33*	−1.79	28
sentiment	−1.14	−1.53	−0.59	−1.46	−0.83	−0.80	−0.82	−0.81	
herding	0.68*	1.70	0.98***	5.07	0.81**	2.44	0.78**	2.39	
herding × institutional quality	−1.42***	−4.52	−1.50***	−6.14	−2.07***	−5.47	−2.01***	−5.35	43
institutional quality	−0.71	−1.17	−1.04**	−2.20	−0.86	−1.18	−0.75	−1.04	
herding	1.08**	2.45	1.16***	3.37	1.36**	2.57	1.39***	2.64	
herding × stock market char.	−0.47***	−3.12	−0.86***	−8.16	−0.83***	−4.78	−0.81***	−4.68	43
stock market characteristics	−1.74***	−8.68	−2.55***	−18.05	−2.55***	−10.93	−2.51***	−10.78	
herding	0.79***	4.85	0.98***	8.57	0.86***	4.54	0.83***	4.43	
herding × investor protection	0.06	0.54	−0.06	−0.81	−0.02	−0.18	−0.02	−0.15	40
investor protection	−1.03***	−4.75	−1.41***	−9.58	−1.42***	−5.66	−1.38***	−5.53	
herding	1.12***	7.85	1.47***	15.22	1.31***	7.98	1.28***	7.83	
herding × chaos	0.07	0.97	−0.03	−0.49	0.07	0.75	0.07	0.73	44
chaos	−0.15	−1.06	0.39***	3.58	0.20	1.19	0.20	1.22	
herding	1.42***	8.60	1.58***	12.05	1.59***	7.97	1.56***	7.83	
herding × fractionalization	−0.20	−1.62	−0.30***	−3.09	−0.38***	−2.60	−0.38***	−2.63	44
fractionalization	−0.99***	−4.21	−0.75***	−4.04	−1.08***	−3.84	−1.09***	−3.86	
herding	1.71***	9.86	1.98***	14.48	2.08***	9.96	2.04***	9.84	
Panel B: Sentiment									
sentiment × institutional quality	0.21	1.10	0.54***	4.65	0.44**	2.47	0.45***	2.59	28
institutional quality	−0.71	−1.57	−1.23***	−5.37	−1.03**	−2.17	−1.00**	−2.11	
sentiment	−1.32*	−1.77	−0.54	−1.48	−0.82	−0.75	−0.81	−0.75	
sentiment × stock market char.	−0.61*	−1.86	0.12	0.48	−0.41*	−1.69	−0.40*	−1.71	28
stock market characteristics	−0.94***	−5.91	−1.23***	−12.17	−1.02***	−6.51	−0.97***	−6.80	
sentiment	−1.09	−1.34	−0.19	−0.49	−0.44	−0.41	−0.42	−0.39	
sentiment × investor protection	0.07	0.33	0.34*	1.82	0.23	0.88	0.22	0.84	23
investor protection	−1.03***	−5.59	−1.18***	−7.20	−1.24***	−5.29	−1.21***	−5.18	
sentiment	−1.40*	−1.72	−0.18	−0.53	−0.50	−0.42	−0.46	−0.39	
sentiment × chaos	0.32*	1.80	−0.03	−0.25	0.04	0.14	0.03	0.09	30
chaos	−0.04	−0.29	0.29***	4.60	0.18*	1.94	0.18*	1.85	
sentiment	−1.10*	−1.65	−0.46	−1.29	−0.67	−0.74	−0.65	−0.73	
sentiment × fractionalization	−0.22	−1.10	−0.32**	−2.41	−0.62***	−2.62	−0.64***	−2.68	30
fractionalization	−0.43*	−1.86	0.00	0.02	−0.25	−0.94	−0.28	−1.05	
sentiment	−1.27***	−5.19	0.54***	−3.39	−0.89***	−3.11	−0.88***	−3.06	
Panel C: Institutional quality									
institutional quality × stock market char.	0.52***	3.33	1.04***	9.39	1.05***	5.77	1.03***	5.67	42
stock market characteristics	−1.75***	−7.76	−2.54***	−15.96	−2.55***	−9.74	−2.50***	−9.58	
institutional quality	−0.69***	−3.23	−1.01***	−6.72	−0.85***	−3.46	−0.84***	−3.41	
institutional quality × investor protection	0.22	1.37	0.42***	3.97	0.46**	2.46	0.45**	2.40	36
investor protection	−1.19***	−4.53	−1.20***	−6.98	−1.55***	−5.16	−1.50***	−5.01	
institutional quality	−0.51*	−1.93	−1.11***	−6.44	−0.61**	−2.02	−0.62**	−2.06	
institutional quality × chaos	0.09	1.32	0.14***	2.64	0.08	0.98	0.08	1.01	47

(*continued on next page*)

(*continued*)

	Equal*(10^3)		Composite*(10^3)		CompFixed*(10^3)		CompFixedNet*(10^3)		No. of Countries
	coeff.	t-stats	coeff.	t-stats	coeff.	t-stats	coeff.	t-stats	
chaos	−0.06	−0.39	0.47***	4.01	0.28	1.57	0.29*	1.65	
institutional quality	−2.16***	−12.27	−2.52***	−17.92	−2.74***	−12.86	−2.64***	−12.47	
institutional quality × fractionalization	0.30**	2.01	0.51***	4.27	0.58***	3.19	0.57***	3.17	47
fractionalization	−0.71***	−2.97	−0.54***	−2.84	−0.84***	−2.93	−0.83***	−2.88	
institutional quality	−2.22***	−12.91	−2.73***	−19.90	−2.97***	−14.27	−2.87***	−13.87	
Panel D: Stock market char.									
stock market char. × investor protection	0.92***	6.66	1.37***	15.19	1.54***	9.81	1.53***	9.79	36
investor protection	−0.38	−1.45	−0.12	−0.69	−0.26	−0.88	−0.24	−0.80	
stock market characteristics	−2.19***	−8.13	−3.23***	−18.36	−3.32***	−10.84	−3.31***	−10.81	
stock market char. × chaos	−0.55***	−4.29	−0.43***	−4.70	−0.64***	−4.32	−0.63***	−4.24	43
chaos	−0.21*	−1.85	0.24***	3.01	0.11	0.86	0.12	0.92	
stock market characteristics	−2.25***	−10.31	−2.89***	−18.71	−3.01***	−11.85	−2.95***	−11.68	
stock market char. × fractionalization	0.53***	2.76	0.54***	3.99	0.69***	3.10	0.70***	3.19	43
fractionalization	−0.08	−0.38	0.36**	2.42	0.02	0.08	−0.02	−0.07	
stock market characteristics	−1.77***	−9.01	−2.56***	−18.48	−2.49***	−10.96	−2.45***	−10.79	
Panel E: Investor protection									
investor protection × fractionalization	0.02	0.11	0.01	0.07	−0.02	−0.08	−0.01	−0.06	37
fractionalization	−0.22	−1.00	0.16	1.09	−0.22	−0.87	−0.24	−0.96	
investor protection	−1.53***	−7.73	−1.96***	−15.04	−1.97***	−8.66	−1.93***	−8.50	
investor protection × chaos	0.14*	1.77	0.12**	2.36	0.13	1.44	0.13	1.43	37
chaos	−0.01	−0.07	0.44***	4.32	0.34*	1.90	0.35*	1.95	
investor protection	−1.61***	−7.84	−1.84***	−13.61	−1.90***	−8.07	−1.86***	−7.92	
Panel F: Chaos									
chaos × fractionalization	0.14	1.15	0.15	1.45	−0.05	−0.31	−0.04	−0.28	50
fractionalization	−0.12	−0.58	0.13	0.77	−0.17	−0.65	−0.18	−0.72	
chaos	0.09	0.89	0.56***	6.73	0.49***	3.92	0.49***	3.94	

This table presents the interaction test results. We run the regression model $r^p_{kjt} = \beta 0_k + \beta 1_k X1_{jt} + \beta 2_k X2_{jt} + \beta 3_k X1_{jt} \times X2_{jt} + \beta 4_k MRP_{jt} + \beta 5_k SMB_{jt} + \beta 6_k HML_{jt} + \beta 7_k MOM_{jt} + \varepsilon_{kjt}$, where, for each country j at month t, r^p_{kjt} represents the monthly returns from technical trading strategy k. $X1_{jt}$ and $X2_{jt}$ represent the composite measures for herding, investor sentiment, institutional quality, stock market development, investor protection, chaos, and fractionalization. MRP_{jt} is the market risk premium and ε_{kjt} is the residual term. $\beta 1_k$ and $\beta 2_k$ capture the effect from two different cross-country determinants separately. $\beta 3_k$ captures the interaction effect of the two determinants. We report $\beta 1_k$, $\beta 2_k$ and $\beta 3_k$ estimates and associated *t*-statistics for the technical trading strategies *Equal, Composite, CompFixed,* and *CompFixedNet*. In final column we report the number of countries included in each regression based on data availability. The sample period is from 1994:03 to 2018:03. The results are based on Newey–West standard errors.

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