

Empirical paper

A replication of Bowman's paradox across 28 countries

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ABSTRACT

This study assessed the generalizability of Bowman's paradox across 12,235 firms from 28 countries. Cross-sectional and longitudinal relationships between risk and return provided broad support for the presence of Bowman's paradox in diverse country settings (Asia, Europe, and South Africa), except India, Japan, and South Korea, where the relationship was positive. This replication confirms that Bowman's paradox generally holds across diverse institutional and cultural settings and supports prior studies on Bowman's paradox based on US samples.

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Introduction

Risk is generally expected to be positively associated with returns. However, Bowman (1980) observed an interesting phenomenon in a sample of 387 firms from 11 industries (from 1955 to 1973) and in a sample of 1572 firms from 85 industries (from 1968 to 1976). He found a negative correlation between accounting risk and return at the industry level. This phenomenon has since been referred to as Bowman's risk paradox, or the negative correlation between accounting based performance and the variance of accounting-based performance.

Bowman's paradox is considered a phenomenon and not a theoretical framework because it is counterintuitive to the generally accepted logic in financial economics – higher risk must accompany higher returns. Since Bowman's initial findings in 1980, strategy literature has addressed Bowman's paradox in a series of studies (Andersen & Bettis, 2015; Andersen, Denrell, & Bettis, 2007; Núñez Nickel & Rodríguez, 2002). Broadly, explanations for Bowman's paradox have focused on prospect theory or behavioral theory of the firm, statistical artifacts, and good management conduct (Andersen & Bettis, 2014, page 63). Drawing on prospect theory (Kahneman & Tversky, 1979), researchers have argued that low performing firms had a negative risk–return relationship

and high performing firms had a positive risk–return relationship (Fiegenbaum & Thomas, 1988). Others have found a curvilinear relation between risk and return (Chang & Thomas, 1989). Relatedly, drawing on behavioral theory of the firm (Bromiley, 1991a), researchers have found that, when performance is below (above) aspiration levels, managers take more (less) risks, resulting in a negative (positive) cross-sectional relationship between risk and return (Bromiley, 1991b; Miller & Leiblein, 1996; Palmer & Wiseman, 1999). Others have proposed that the negative relationship is more likely among firms with high levels of unrelated diversification (Bettis & Hall, 1982; Chang & Thomas, 1989; Kim, Hwang, & Burgers, 1993), among firms with high market power who have lower variation in sales (Cool, Dierickx, and Jemison, 1989; Woo, 1987), or among firms with high risk in the previous period (Miller & Leiblein, 1996). Furthermore, as firms get closer to bankruptcy, the relationship between risk and return becomes increasingly negative (Miller & Bromiley, 1990).

Interest in Bowman's paradox has continued in recent years. Although studies have traditionally used ROA as a measure of return, For instance, Brick, Palmon, and Venezia (2015) conclude that “positive relationship between mean ROE and its standard deviation is far more likely than a negative one” (page 99). In another study, Brick, Palmon, and Venezia (2012) conclude that the risk–return relationship is positive or non-significant after adjustments to beginning of year, instead of end of year, for equity and reported net income of accruals. To resolve Bowman's paradox using computational simulations, Andersen and Bettis, 2014 find

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that “both imperfect learning and a mindless random walk can lead to the inverse longitudinal risk–return relationships observed empirically” (page 1135), and others support for a U-shaped relationship (Pan & Zhou, 2015). Recent theoretical focus include behavioral theory of the firm (Xiaodong, Fan, & Zhang, 2014), managerial myopia (Holder, Petkevich, & Moore, 2016), and adaptive systems (Song, An, Yang, & Huang, 2012). Bowman’s paradox was recently used as a backdrop to understand variations in risk preferences among female executives (Perryman, Fernando, & Tripathy, 2016).

In addition to theoretical explanations, others have pointed to potential statistical issues such as the use of accounting-based performance data (Marsh & Swanson, 1984), lack of lags (Miller & Leiblein, 1996), outliers and spurious correlation, and non-normal distribution of performance at the industry level (Henkel, 2009). A review of studies on Bowman’s risk paradox also reveals that virtually all studies have drawn on US based samples, using Compustat, Fortune 500 firms, Value line, Census of Manufacturing, Arbitron, and PIMS [except for Jegers (1991) who drew on a sample of 3250 Belgian firms] (Andersen & Bettis, 2015; Núñez Nickel & Rodriguez, 2002).

The above discussion suggests that despite focus on mostly US based samples and correcting for statistical artifacts, Bowman’s paradox continues to be supported in studies over the years. However, to extend the validity of this phenomenon, whether the relationship can be replicated in a cross-country context is essential to further build this framework.

The strategic management literature increasingly seeks to improve generalizability of management phenomena and scholars have called for a greater need for replication in different contexts (Harzing & Harzing, 2016; Hubbard, Vetter, & Little, 1998). Testing Bowman’s risk paradox in a cross-country context is theoretically important and practically relevant as risk preferences, the mainstay of prospect theory and behavioral theory of the firm, are known to be culture specific or influenced by institutional factors (Rieger, Wang, & Hens, 2014). As risk–return relationship is influenced by cross-country differences, Bowman’s risk paradox could vary across countries. Indeed, if Bowman’s paradox were inconsistent across different countries, future research could further explore boundary conditions based on variations in cultural and institutional factors. In contrast, if the relationship were less variable across countries, firm- or industry-specific effects would be stronger in driving the relationship, and culture and institutional factors would be less influential. The proposed framework could help practitioners further understand the drivers of risk–return relationship.

This study assesses the generalizability of Bowman’s risk paradox through a replication across 28 countries. It attempts to increase generalizability of the past findings by: (a) replicating past findings for US firms using a different time period (1998–2012); (b) generalizing Bowman’s paradox by drawing on a sample 12,235 firms from 28 countries (excluding the US) from 1998 to 2012; (c) assessing robustness of findings by using proposed corrections of statistical artifacts by using lags, and splitting firms above and below median industry performance; and (d) correcting for potential spuriousness due to right skewness in performance of firms in the industry as recommended by Henkel (2009). Overall, our study contributes to the literature at the intersection between strategy and international business management by replicating the generalizability of Bowman’s paradox in different countries around the world.

Background on Bowman’s risk paradox

Investors require higher returns for undertaking higher levels of risk. Unlike investors who can generally mitigate financial

risk through diversification, firm managers must manage multiple forms of business risks that cannot be diversified easily. Considering a broader set of risks, Miller and Bromiley (1990) propose three types of risks – income stream risk, stock returns risk, and strategic risk. Although the three forms of risks are interrelated, managers are concerned about long-term strategic risk and variations in income over time. As investors can diversify stock return risk, stock return risk may not fully capture the total risk faced by the firm. Due to variegated notions of both income and strategic risks, literature on Bowman’s paradox has proposed a variety of accounting-based measures of performance and alternate specifications of variation in accounting-based measures of performance. Studies have found broad support for a negative relationship between cross-sectional accounting performance and variance of performance (Andersen & Bettis, 2015; Núñez Nickel & Rodriguez, 2002).

To provide a theoretical lens to explain the negative association between risk and return, scholars have drawn on prospect theory (Fiegenbaum & Thomas, 1988; Kahneman & Tversky, 1979) and behavioral theory of the firm (Bromiley, 1991b). Through the lens of behavioral theory of the firm, managers undertake more risk when performance is below aspiration, and they take low risk when performance is above aspirations. Due to contemporaneous association between risk-taking and low performance, contemporaneous relationship could be negative; as lower performance and higher risk are observed in cross-sectional accounting data, or lagging effects of risk and performance would continue in the short-term in longitudinal accounting data. Through the lens of prospect theory (Kahneman & Tversky, 1979), studies have argued that managers in low performing firms face negatively framed prospects and are thus more likely to undertake high risk. In contrast, managers in high performing firms face positively framed prospects and take low risk, resulting in negative correlation between high performance and low risk. Thus, prospect theory and behavioral theory of the firm provide possible explanations for the negative relationship between risk and return. Comeig, Holt, and Jaramillo-Gutiérrez (2015) further elucidate the joint mechanisms of prospect theory and behavioral theory of the firm in the context of Bowman’s risk paradox by identifying reference points (of relative performance) and probability weights (of payoffs from risk). That is, when performance is below aspirations, decisions are framed negatively and managers undertake more risk. In evaluating such risky actions, managers underweigh downside of lower payoffs from increased risk. Similarly, when performance is above aspirations, managers undertake lower risk and assign low probability to higher payoff and thereby avoid risky actions.¹

In addition, studies have shown that the negative relationship is also driven by adaptation capabilities, nature of diversification, distance from bankruptcy, and market power. Firms with high adaptation capabilities realize higher returns despite taking lower risks (Andersen et al., 2007). Adaptation capabilities allow firms to meet challenges of the changing environment, thus lowering variance in performance. Firms with high levels of unrelated diversification have lower variation in returns, and thus have negative correlation between variance in performance and mean performance (Chang & Thomas, 1989). As higher market power is negatively related to variance in performance, the negative risk–return relationship is likely to be higher in such firms. Finally, firms closer to bankruptcy could also have a negative risk–return relationship.

In addition to the theoretical explanations, several studies attribute the negative relationship to statistical artifacts. First, prior studies have often measured risk contemporaneously with returns.

¹ We thank an anonymous reviewer for this suggestion.

Table 1
Basis of replication.

Issue	Criticisms	Addressed in current replication
Past studies have almost exclusively relied on US firms	Limited generalizability of Bowman's paradox across countries	<ul style="list-style-type: none"> • Compustat Global data representing 12,235 firms from 28 countries from years 1998 to 2012 • Replication of US firms using a different time period – 1998–2012
Risk and return measured cross-sectionally	Lagged values could affect direction of risk–return relationships	The relationship is tested using lags in a longitudinal setting (Anderson and Bettis, 2014).
Prospect theory and Behavioral theory explanations	Based on (Anderson et al., 2007), median split of the sample helps control for it.	Robustness of relationship is tested using full-, below-, and above-median effects.
Time periods affect risk–return relationship	Past work found different relationships when using different time periods	Robustness of relationship is tested using: <ul style="list-style-type: none"> • three-time periods for contemporaneous outcomes: 1998–2002; 2003–2007; 2008–2012 and • two-time periods for longitudinal outcomes: from 1998 to 2007 and from 2003 to 2012
Correction for spurious effects (Henkel, 2009)	Due to skewness in performance, risk–return correlations could be spurious in cross-section.	Included Henkel's (2009) spuriousness correction approach.

As mean return and variance in return are derived from the same underlying distribution of returns, the negative correlation may not be based on a theoretically meaningful relationship but on statistical artifacts resulting from model specification. However, Bowman's risk paradox is robust under lagged models (Andersen & Bettis, 2015) or under alternate measures of risk (based on survey questionnaire or managerial risk aversion coefficient obtained from utility function) or prospective and non-accounting measure of ex-ante level of risk – variability in stock analyst forecasts (for a review refer to Núñez Nickel & Rodriguez, 2002).

Second, others indicate that managers take multifaceted and multi-contextual view of risk. Managers focus more on downside risk than on upside risk and therefore their assessment of risk must be distinct from the theoretically espoused understanding of risk. However, studies using alternate measures of risk have found support for Bowman's paradox (Núñez Nickel & Rodriguez, 2002).

Third, and more importantly, critics have highlighted the endogenous relationship between return and variance in returns, non-normality in distribution of returns (Marsh & Swanson, 1984), and choice of aggregation periods (Ruefli & Wiggins, 1994; Ruefli, 1990, 1991). While studies have relied on shorter time periods to lower effects of non-stationarity in returns, estimates from such specifications are sensitive to outliers.

Finally, focusing on different time periods to understand the risk–return relationship could also bias the findings (Bromiley, 1991a). Furthermore, due to different strategic and competitive goals over the life-cycle of a firm, and changing industry characteristics over time could influence risk–return relationship. Therefore, relying on longitudinal samples or lowering survivor bias could help provide more robust inferences. As an example of where longitudinal data with industry controls could offer different inferences, Henkel (2009) shows that the negative correlation could be an artifact of right skewness in distribution of return among firms in the industry, and proposed a methodology to correct for such spuriousness.

Overall, past research has proposed different theoretical rationales for explaining the negative correlations, or has suggested that negative correlation could be an artifact of sampling criteria or statistical artifacts in measurement and analyses.

The need for replication

We undertake the replication with multiple objectives in mind. First, most studies on Bowman's risk paradox have drawn on US firms. We do not know whether Bowman's paradox is generalizable across different countries. It is possible that different country – and country × industry-specific unobserved heterogeneity could show a positive, negative, or non-significant association. Therefore, the

primary aim of this study is to replicate Bowman's paradox in firms across 28 countries (excluding US firms).

Second, past studies have found different relationships based on different specifications of time periods used to analyze the data. To address this issue, we also conduct a split sample analysis by including different periods for generalizing cross-sectional (1998–2002; 2003–2007; 2008–2012) and lagged relationship (1998–2007; 2007–2012).

A criticism of studies on Bowman's risk paradox is the contemporaneous measurement of risk. Based on Andersen and Bettis (2015), we also test for longitudinal relationship between risk and return. Moreover, as most US based studies of Bowman's paradox have relied on samples of US firms from 1970s to mid-1990s, we also replicate these findings using US firms from a more recent time period – from 1998 to 2012.

Third, to assess generalizability of prospect theory or behavioral theory of the firm explanations, following Andersen et al. (2007), we test for differences in correlation for firms with performance below and above median industry performance.

Fourth, in response to Henkel (2009) call for correction for potential spuriousness in risk–return correlation driven by skewness in performance of firms in the industry, we include correction for spuriousness.

Table 1 provides a summary of theoretical and empirical issues incorporated from past work into this replication study.

Sample description

To replicate the testing of Bowman risk paradox in non-US sample, we obtained data from Global COMPUSTAT, which provides data items similar to the North American COMPUSTAT. In their review of the literature, Núñez Nickel and Rodriguez (2002) identify ROA and ROE as widely used outcome measures (as reviewed in Table 2 of their article). However, as equity levels are subject to different regulations in different countries and firms use different policies to value equity, we use ROA that is subject to lesser biases on differences in equity valuation practices in cross-country settings. Following previous studies (Andersen et al., 2007; Fiegenbaum & Thomas, 1988; Henkel, 2009; Núñez Nickel & Rodriguez, 2002), we used return on asset (ROA) as the measure for firm performance and to ensure reliability of aggregated correlations we only included industries with more than 25 firms in the sample.

We focused on a 15-year period from 1998 to 2012. This allows us to calculate three concurrent risk–return relationship (consecutive 5-year periods: 1998–2002; 2003–2007; 2008–2012) and two sets of longitudinal risk–return relationship (the first ten year period from 1998 to 2007 and the second ten year period from 2003

Table 2
Empirically observed cross-sectional risk–return relationship for non-US sample.

Industries (grouped by SIC)	SIC range	1998–2002				2003–2007				2008–2012			
		Correlation coefficient				Correlation coefficient				Correlation coefficient			
		Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median
Metal mining	0100–1220	536	–0.725	0.324	–0.755	480	–0.780	0.350	–0.864	400	–0.761	0.356	–0.832
Energy extraction	1311–1389	171	–0.777	0.294	–0.880	142	–0.758	0.187	–0.884	122	–0.691	0.215	–0.846
Operative builders	1531–1731	361	–0.530	0.679	–0.898	314	–0.205	0.143	–0.604	265	–0.184	0.225	–0.560
Food products	2000–2111	840	–0.139	0.328	–0.624	723	–0.259	0.407	–0.783	651	–0.466	0.354	–0.865
Textile industry	2200–2273	342	–0.435	0.388	–0.869	304	–0.263	0.324	–0.633	286	–0.531	0.334	–0.804
Apparel industry	2300–2390	196	–0.214	0.064	–0.540	168	–0.464	0.198	–0.731	139	–0.526	0.142	–0.776
Lumber & wood products	2400–2452	121	–0.539	0.752	–0.813	100	–0.558	0.154	–0.782	85	–0.840	0.410	–0.914
Household & office furniture	2510–2590	67	–0.246	–0.037	–0.540	59	–0.840	0.062	–0.964	48	–0.523	–0.150	–0.762
Paper milling & products	2600–2673	293	–0.483	0.334	–0.835	256	–0.701	0.180	–0.797	231	–0.870	0.286	–0.971
Newspaper & book publication	2711–2790	143	–0.768	0.089	–0.852	120	–0.672	0.162	–0.763	105	–0.149	0.250	–0.573
Chemical & pharmaceutical products	2800–2891	1083	–0.713	0.307	–0.772	964	–0.717	0.245	–0.795	882	–0.685	0.324	–0.781
Petroleum refining	2911–2990	105	–0.480	0.376	–0.877	94	–0.826	–0.064	–0.931	85	–0.806	0.031	–0.929
Rubber & plastic products	3011–3089	273	–0.606	0.129	–0.780	238	–0.362	0.330	–0.704	225	–0.414	0.388	–0.618
Stell works & metals	3300–3390	521	–0.381	0.314	–0.800	466	–0.202	0.475	–0.780	429	–0.798	0.326	–0.933
Fabricated metal products	3400–3490	275	–0.414	0.427	–0.858	239	–0.485	0.058	–0.716	210	–0.718	0.382	–0.933
Industrial machinery	3510–3569	547	–0.548	0.396	–0.844	463	–0.682	0.281	–0.889	414	–0.679	0.225	–0.857
Computer & office equipment	3570–3590	246	–0.656	0.278	–0.752	214	–0.853	0.143	–0.913	185	–0.705	0.092	–0.729
Electrical equipment & electronics	3600–3695	855	–0.707	0.126	–0.774	766	–0.793	0.347	–0.855	685	–0.782	0.284	–0.849
Vehicles & transportation equipment	3700–3790	431	–0.692	0.177	–0.787	382	–0.624	0.240	–0.719	360	–0.636	0.205	–0.748
Industrial instruments & equipment	3812–3873	306	–0.684	0.221	–0.718	257	–0.816	0.267	–0.847	219	–0.804	0.259	–0.826
Toys, games, sporting goods, etc.	3910–3990	133	–0.408	0.526	–0.853	115	–0.152	0.483	–0.602	102	–0.258	0.116	–0.565
Line-haul operations & trucking	4011–4213	356	–0.296	0.231	–0.605	311	–0.096	0.426	–0.507	275	–0.331	0.226	–0.681
Air transportation	4512–4522	237	–0.786	0.493	–0.862	207	–0.675	0.420	–0.842	184	–0.556	0.096	–0.719
Communication & broadcasting	4812–4899	309	–0.778	0.096	–0.844	252	–0.618	0.442	–0.824	208	–0.763	0.322	–0.892
Electric services	4911	194	–0.169	0.437	–0.615	166	–0.051	0.653	–0.495	153	0.380	0.759	–0.615
Gas transmission & distribution	4922–4991	198	–0.699	0.543	–0.885	175	–0.774	0.339	–0.930	166	–0.818	0.373	–0.910
Miscellaneous wholesaling	5000–5190	745	–0.515	0.463	–0.825	636	–0.749	0.443	–0.901	561	–0.724	0.153	–0.829
Department & variety stores	5311–5399	148	0.116	0.290	–0.141	120	–0.150	0.101	–0.611	107	–0.155	0.307	–0.664
Grocery & convenience stores	5411–5412	114	–0.410	–0.030	–0.573	86	–0.370	–0.002	–0.653	72	0.341	0.348	0.038
Apparel & clothing stores	5600–5661	134	–0.471	0.142	–0.866	106	–0.105	0.121	–0.772	88	–0.459	0.094	–0.925
Restaurants & eating places	5810–5812	113	0.162	0.416	–0.489	80	–0.218	0.282	–0.794	66	–0.051	0.322	–0.478
Miscellaneous shopping stores	5912–5990	152	–0.884	0.326	–0.929	128	–0.239	0.020	–0.775	104	–0.713	0.007	–0.931
Banking and real estate	6159–6799	63	–0.677	0.570	–0.860								
Hotels & motels	7011	178	–0.357	0.233	–0.750	146	–0.596	0.325	–0.943	134	–0.207	0.204	–0.607
Advertising & other services	7200–7363	179	–0.471	0.579	–0.787	150	–0.405	0.270	–0.818	113	–0.651	0.249	–0.861
Programming & software services	7370–7389	1005	–0.714	0.223	–0.765	812	–0.703	0.262	–0.753	617	–0.718	0.420	–0.824
Motion pictures & theaters	7812–7841	94	–0.678	0.066	–0.908	84	–0.319	0.432	–0.612	58	–0.859	0.326	–0.895
Amusement & recreation services	7900–7997	144	–0.719	0.222	–0.918	108	–0.482	0.363	–0.825	89	–0.376	0.264	–0.485
Medical & nursing services	8000–8093	75	–0.873	0.115	–0.924	62	–0.055	0.390	–0.658	53	–0.123	0.249	–0.194
Engineering & management services	8700–8744	215	–0.703	0.232	–0.810	178	–0.494	0.365	–0.709	154	–0.584	–0.106	–0.584
Corporate conglomerates	9995–9997	170	–0.879	0.363	–0.971	159	–0.772	0.584	–0.826	145	–0.856	0.381	–0.871
Mean			–0.535	0.305	–0.774		–0.497	0.280	–0.770		–0.526	0.251	–0.740

Table 3
Correction for spuriousness (Henkel, 2009) – Empirically observed cross-sectional risk–return relationship for non-US sample.

Industries (grouped by SIC)	SIC range	1998–2002					2003–2007					2008–2012				
		Correlation coefficient					Correlation coefficient					Correlation coefficient				
		Sample size	Full sample	Corrected coef	Spurious effect	% of inflation	Sample size	Full sample	Corrected coef	Spurious effect	% of inflation	Sample size	Full sample	Corrected coef	Spurious effect	% of inflation
Metal mining	0100–1220	536	–0.725	–0.625	–0.100	13.84%	480	–0.780	–0.210	–0.570	73.12%	400	–0.761	–0.637	–0.124	16.33%
Energy extraction	1311–1389	171	–0.777	–0.660	–0.117	15.06%	142	–0.758	0.071	–0.829	109.43%	122	–0.691	–0.610	–0.081	11.66%
Operative builders	1531–1731	361	–0.530	–0.479	–0.051	9.58%	314	–0.205	–0.020	–0.185	90.10%	265	–0.184	–0.224	0.041	–22.27%
Food products	2000–2111	840	–0.139	–0.162	0.024	–17.04%	723	–0.259	–0.368	0.109	–42.10%	651	–0.466	–0.217	–0.249	53.42%
Textile industry	2200–2273	342	–0.435	–0.681	0.245	–56.34%	304	–0.263	–0.284	0.021	–7.87%	286	–0.531	–0.266	–0.264	49.82%
Apparel industry	2300–2390	196	–0.214	–0.160	–0.054	25.23%	168	–0.464	–0.120	–0.344	74.14%	139	–0.526	–0.142	–0.384	73.05%
Lumber & wood products	2400–2452	121	–0.539	–0.720	0.181	–33.53%	100	–0.558	–0.418	–0.140	25.16%	85	–0.840	–0.294	–0.545	64.95%
Household & office furniture	2510–2590	67	–0.246	–0.341	0.096	–38.84%	59	–0.840	–0.796	–0.044	5.28%	48	–0.523	–0.553	0.030	–5.77%
Paper milling & products	2600–2673	293	–0.483	–0.251	–0.232	48.06%	256	–0.701	–0.488	–0.213	30.33%	231	–0.870	0.053	–0.923	106.12%
Newspaper & book publication	2711–2790	143	–0.768	–0.643	–0.125	16.34%	120	–0.672	–0.570	–0.102	15.13%	105	–0.149	0.083	–0.233	155.76%
Chemical & pharmaceutical products	2800–2891	1083	–0.713	0.037	–0.750	105.18%	964	–0.717	–0.534	–0.184	25.59%	882	–0.685	–0.401	–0.284	41.51%
Petroleum refining	2911–2990	105	–0.480	–0.503	0.023	–4.84%	94	–0.826	–0.720	–0.107	12.90%	85	–0.806	–0.840	0.034	–4.16%
Rubber & plastic products	3011–3089	273	–0.606	–0.524	–0.082	13.49%	238	–0.362	–0.351	–0.011	3.14%	225	–0.414	–0.516	0.103	–24.88%
Stell works & metals	3300–3390	521	–0.381	–0.318	–0.063	16.47%	466	–0.202	–0.299	0.098	–48.49%	429	–0.798	–0.575	–0.223	27.93%
Fabricated metal products	3400–3490	275	–0.414	–0.249	–0.165	39.82%	239	–0.485	–0.505	0.021	–4.24%	210	–0.718	–0.415	–0.302	42.15%
Industrial machinery	3510–3569	547	–0.548	–0.397	–0.151	27.63%	463	–0.682	–0.457	–0.225	32.99%	414	–0.679	–0.598	–0.081	11.95%
Computer & office equipment	3570–3590	246	–0.656	–0.549	–0.107	16.29%	214	–0.853	–0.681	–0.172	20.19%	185	–0.705	–0.225	–0.480	68.03%
Electrical equipment & electronics	3600–3695	855	–0.707	–0.611	–0.096	13.55%	766	–0.793	–0.118	–0.675	85.12%	685	–0.782	0.414	–1.196	152.96%
Vehicles & transportation equipment	3700–3790	431	–0.692	–0.565	–0.127	18.35%	382	–0.624	–0.724	0.100	–16.00%	360	–0.636	–0.400	–0.237	37.20%
Industrial instruments & equipment	3812–3873	306	–0.684	–0.586	–0.098	14.32%	257	–0.816	–0.633	–0.184	22.52%	219	–0.804	–0.754	–0.050	6.27%
Toys, games, sporting goods, etc.	3910–3990	133	–0.408	–0.313	–0.095	23.22%	115	–0.152	0.155	–0.307	201.95%	102	–0.258	–0.420	0.162	–62.78%
Line-haul operations & trucking	4011–4213	356	–0.296	–0.466	0.170	–57.44%	311	–0.096	–0.253	0.156	–161.76%	275	–0.331	–0.169	–0.163	49.11%
Air transportation	4512–4522	237	–0.786	–0.599	–0.187	23.82%	207	–0.675	0.012	–0.687	101.82%	184	–0.556	–0.446	–0.109	19.69%
Communication & broadcasting	4812–4899	309	–0.778	–0.407	–0.371	47.70%	252	–0.618	–0.282	–0.335	54.28%	208	–0.763	–0.325	–0.438	57.42%
Electric services	4911	194	–0.169	–0.218	0.050	–29.43%	166	–0.051	0.079	–0.130	255.46%	153	0.380	0.386	–0.006	–1.66%
Gas transmission & distribution	4922–4991	198	–0.699	–0.472	–0.228	32.55%	175	–0.774	0.176	–0.950	122.68%	166	–0.818	0.841	–1.659	202.83%
Miscellaneous wholesaling	5000–5190	745	–0.515	–0.557	0.042	–8.12%	636	–0.749	–0.563	–0.185	24.76%	561	–0.724	–0.646	–0.078	10.73%
Department & variety stores	5311–5399	148	0.116	0.077	0.039	33.80%	120	–0.150	–0.061	–0.089	59.16%	107	–0.155	–0.130	–0.025	16.03%
Grocery & convenience stores	5411–5412	114	–0.410	–0.135	–0.275	67.10%	86	–0.370	–0.034	–0.336	90.77%	72	0.341	0.265	0.076	22.27%
Apparel & clothing stores	5600–5661	134	–0.471	–0.413	–0.058	12.40%	106	–0.105	0.006	–0.111	105.74%	88	–0.459	–0.510	0.050	–10.96%
Restaurants & eating places	5810–5812	113	0.162	0.191	–0.029	–18.20%	80	–0.218	–0.425	0.206	–94.54%	66	–0.051	0.133	–0.183	362.72%
Miscellaneous shopping stores	5912–5990	152	–0.884	–0.810	–0.074	8.41%	128	–0.239	0.034	–0.273	114.15%	104	–0.713	–0.824	0.111	–15.60%
Banking and real estate	6159–6799	63	–0.677	–0.362	–0.315	46.50%										
Hotels & motels	7011	178	–0.357	–0.389	0.032	–8.98%	146	–0.596	0.185	–0.781	131.00%	134	–0.207	–0.143	–0.063	30.71%
Advertising & other services	7200–7363	179	–0.471	–0.214	–0.257	54.59%	150	–0.405	–0.171	–0.234	57.68%	113	–0.651	0.120	–0.771	118.41%
Programming & software services	7370–7389	1005	–0.714	0.076	–0.790	110.58%	812	–0.703	–0.558	–0.145	20.65%	617	–0.718	–0.011	–0.707	98.44%
Motion pictures & theaters	7812–7841	94	–0.678	–0.585	–0.093	13.71%	84	–0.319	0.163	–0.481	151.00%	58	–0.859	–0.867	0.008	–0.93%
Amusement & recreation services	7900–7997	144	–0.719	–0.340	–0.379	52.67%	108	–0.482	0.029	–0.511	106.08%	89	–0.376	–0.108	–0.268	71.34%
Medical & nursing services	8000–8093	75	–0.873	0.671	–1.544	176.84%	62	–0.055	–0.138	0.083	–151.16%	53	–0.123	–0.136	0.013	–10.65%
Engineering & management services	8700–8744	215	–0.703	–0.552	–0.151	21.43%	178	–0.494	–0.185	–0.310	62.62%	154	–0.584	–0.169	–0.415	71.08%
Corporate conglomerates	9995–9997	170	–0.879	–0.207	–0.672	76.50%	159	–0.772	0.712	–1.484	192.24%	145	–0.856	–0.382	–0.474	55.38%

Table 4
Empirically observed longitudinal^a risk–return relationship for non-US sample.

Industries (grouped by SIC)	SIC range	1998–2007				2003–2012			
		Correlation coefficient				Correlation coefficient			
		Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median
Metal mining	0100–1220	480	–0.380	0.144	–0.268	397	–0.336	0.138	–0.244
Energy extraction	1311–1389	142	–0.448	–0.114	–0.368	122	–0.414	0.260	–0.359
Operative builders	1531–1731	314	–0.119	0.055	–0.235	263	–0.117	0.044	–0.459
Food products	2000–2111	723	–0.262	0.136	–0.467	643	–0.228	0.300	–0.527
Textile industry	2200–2273	304	–0.275	0.109	–0.415	275	–0.016	–0.035	–0.009
Apparel industry	2300–2390	168	–0.092	–0.077	–0.168	138	–0.161	–0.062	–0.193
Lumber & wood products	2400–2452	100	–0.516	0.435	–0.727	85	–0.361	–0.075	–0.558
Household & office furniture	2510–2590	59	–0.397	0.112	–0.593	48	–0.272	0.155	–0.665
Paper milling & products	2600–2673	256	–0.280	0.109	–0.314	229	–0.664	0.105	–0.724
Newspaper & book publication	2711–2790	120	–0.404	0.265	–0.513	104	–0.539	0.247	–0.734
Chemical & pharmaceutical products	2800–2891	964	–0.591	0.114	–0.631	872	–0.413	0.169	–0.421
Petroleum refining	2911–2990	94	–0.526	0.151	–0.611	84	–0.235	0.085	–0.223
Rubber & plastic products	3011–3089	238	–0.231	0.256	–0.320	219	–0.340	0.104	–0.506
Stell works & metals	3300–3390	466	–0.026	0.427	–0.291	426	–0.277	0.182	–0.541
Fabricated metal products	3400–3490	239	–0.266	0.037	–0.461	207	–0.415	0.063	–0.655
Industrial machinery	3510–3569	463	–0.438	0.084	–0.714	412	–0.557	0.189	–0.728
Computer & office equipment	3570–3590	214	–0.553	0.187	–0.573	185	–0.467	0.088	–0.482
Electrical equipment & electronics	3600–3695	766	–0.416	–0.031	–0.438	680	–0.438	0.053	–0.489
Vehicles & transportation equipment	3700–3790	382	–0.389	0.242	–0.421	357	–0.544	0.156	–0.709
Industrial instruments & equipment	3812–3873	257	–0.518	0.117	–0.489	219	–0.551	0.090	–0.547
Toys, games, sporting goods, etc.	3910–3990	115	–0.056	0.278	–0.320	102	–0.044	0.268	–0.187
Line-haul operations & trucking	4011–4213	311	0.011	0.152	–0.271	273	0.073	0.497	–0.255
Air transportation	4512–4522	207	–0.546	0.248	–0.691	181	–0.672	–0.067	–0.807
Communication & broadcasting	4812–4899	252	–0.283	0.006	–0.247	207	–0.375	0.566	–0.498
Electric services	4911	166	–0.179	0.164	–0.212	151	0.189	0.530	–0.306
Gas transmission & distribution	4922–4991	175	–0.431	0.634	–0.504	164	–0.431	0.282	–0.465
Miscellaneous wholesaling	5000–5190	636	–0.303	0.054	–0.382	555	–0.475	0.095	–0.512
Department & variety stores	5311–5399	120	–0.067	0.028	–0.301	105	–0.105	0.249	–0.289
Grocery & convenience stores	5411–5412	86	–0.044	0.138	–0.104	72	0.063	–0.088	–0.219
Apparel & clothing stores	5600–5661	106	–0.142	0.282	–0.502	87	–0.063	0.198	–0.088
Restaurants & eating places	5810–5812	80	–0.243	0.343	–0.539	63	–0.025	0.351	–0.273
Miscellaneous shopping stores	5912–5990	128	–0.432	0.431	–0.448	103	–0.195	0.315	–0.522
Banking and real estate	6159–6799	21	–0.584	0.827	–0.759	8	–0.482	0.909	–0.878
Hotels & motels	7011	146	0.014	0.052	–0.206	133	–0.545	0.376	–0.909
Advertising & other services	7200–7363	150	–0.110	0.607	–0.448	111	–0.512	0.367	–0.909
Programming & software services	7370–7389	812	–0.380	0.013	–0.320	612	–0.389	0.159	–0.447
Motion pictures & theaters	7812–7841	84	–0.069	0.321	–0.236	58	–0.263	0.213	–0.113
Amusement & recreation services	7900–7997	108	–0.503	0.202	–0.567	89	–0.317	0.103	–0.473
Medical & nursing services	8000–8093	62	–0.383	0.046	–0.652	53	–0.290	0.544	–0.404
Engineering & management services	8700–8744	178	–0.545	–0.028	–0.598	152	–0.233	0.143	–0.289
Corporate conglomerates	9995–9997	159	–0.594	0.266	–0.636	144	–0.728	0.288	–0.752
Mean			–0.317	0.191	–0.438		–0.321	0.209	–0.472

^a Average ROA over the first five period and the standard deviation of ROA over the next five year period.

Table 5
Empirically observed cross-sectional risk–return relationship for the US sample.

Industries (grouped by SIC)	SIC range	1998–2002				2003–2007				2008–2012			
		Correlation coefficient				Correlation coefficient				Correlation coefficient			
		Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median
Metal mining	0100–1220	247	−0.807	0.116	−0.764	192	−0.829	0.356	−0.827	134	−0.779	0.210	−0.748
Energy extraction	1311–1389	349	−0.833	0.147	−0.811	224	−0.872	0.394	−0.919	163	−0.612	0.284	−0.519
Operative builders	1531–1731	74	−0.794	0.489	−0.837	52	−0.828	0.112	−0.906	39	−0.726	0.045	−0.532
Food products	2000–2111	190	−0.647	0.533	−0.676	136	−0.824	0.558	−0.881	103	−0.175	0.604	−0.536
Textile industry	2200–2273	31	−0.529	0.008	−0.823								
Apparel industry	2300–2390	68	−0.462	0.185	−0.466	45	−0.608	0.172	−0.581	32	−0.660	0.110	−0.874
Lumber & wood products	2400–2452	51	−0.891	−0.003	−0.928	34	−0.105	0.886	−0.811	22	−0.856	−0.070	−0.914
Household & office furniture	2510–2590	40	−0.267	0.426	−0.766	27	−0.279	0.270	−0.094	22	−0.079	0.724	−0.609
Paper milling & products	2600–2673	73	−0.817	−0.307	−0.813	52	−0.742	0.125	−0.906	34	−0.303	0.201	−0.272
Newspaper & book publication	2711–2790	95	−0.852	0.548	−0.888	55	−0.948	0.792	−0.968	29	−0.393	0.007	−0.707
Chemical & pharmaceutical products	2800–2891	704	−0.783	−0.377	−0.644	528	−0.746	−0.271	−0.632	341	−0.727	0.382	−0.646
Petroleum refining	2911–2990	54	−0.671	−0.147	−0.680	36	−0.856	0.409	−0.958	27	−0.851	−0.214	−0.973
Rubber & plastic products	3011–3089	90	−0.747	0.027	−0.748	56	−0.895	0.518	−0.914	28	−0.984	0.199	−0.996
Stell works & metals	3300–3390	115	−0.777	0.233	−0.773	73	−0.465	0.593	−0.625	49	−0.784	0.290	−0.969
Fabricated metal products	3400–3490	106	−0.942	−0.095	−0.948	67	−0.270	0.178	−0.627	51	−0.799	0.542	−0.978
Industrial machinery	3510–3569	204	−0.863	−0.006	−0.855	152	−0.828	0.195	−0.840	114	−0.902	−0.011	−0.947
Computer & office equipment	3570–3590	230	−0.855	−0.182	−0.787	124	−0.674	0.693	−0.689	81	−0.657	0.153	−0.618
Electrical equipment & electronics	3600–3695	610	−0.771	0.366	−0.768	453	−0.820	0.140	−0.806	319	−0.715	0.272	−0.711
Vehicles & transportation equipment	3700–3790	165	−0.763	0.077	−0.748	122	−0.878	0.264	−0.898	95	−0.789	0.359	−0.830
Industrial instruments & equipment	3812–3873	476	−0.748	−0.145	−0.652	345	−0.785	−0.006	−0.734	226	−0.613	0.050	−0.539
Toys, games, sporting goods, etc.	3910–3990	77	−0.699	0.191	−0.677	41	−0.904	0.572	−0.917	28	−0.909	−0.187	−0.903
Line-haul operations & trucking	4011–4213	115	−0.921	−0.040	−0.951	82	−0.471	0.317	−0.730	60	−0.565	0.102	−0.818
Air transportation	4512–4522	87	−0.858	0.245	−0.884	64	−0.924	0.456	−0.968	39	0.008	0.293	−0.422
Communication & broadcasting	4812–4899	398	−0.852	0.047	−0.841	214	−0.790	0.342	−0.776	143	−0.791	0.491	−0.848
Electric services	4911	134	−0.909	0.596	−0.967	119	−0.140	0.190	−0.531	105	0.089	0.392	−0.183
Gas transmission & distribution	4922–4991	225	−0.827	0.433	−0.848	193	−0.833	0.283	−0.832	153	−0.934	0.271	−0.958
Miscellaneous wholesaling	5000–5190	287	−0.864	0.392	−0.875	180	−0.903	0.240	−0.916	132	−0.632	0.318	−0.813
Department & variety stores	5311–5399	41	−0.828	0.323	−0.981	30	0.046	0.042	−0.645	24	−0.257	0.581	−0.448
Grocery & convenience stores	5411–5412	49	−0.028	0.792	−0.635	32	−0.370	0.424	−0.655	25	0.611	0.819	−0.276
Apparel & clothing stores	5600–5661	97	−0.690	0.244	−0.748	73	−0.509	0.051	−0.806	57	−0.297	−0.074	−0.641
Restaurants & eating places	5810–5812	116	−0.790	0.014	−0.776	70	−0.851	−0.101	−0.939	41	−0.317	−0.135	−0.670
Miscellaneous shopping stores	5912–5990	145	−0.884	0.328	−0.885	89	−0.916	0.209	−0.941	48	−0.723	0.270	−0.944
Banking and real estate	6159–6799	891	−0.484	0.746	−0.784	617	−0.417	0.710	−0.874	455	0.046	0.771	−0.890
Hotels & motels	7011	40	−0.830	0.892	−0.920								
Advertising & other services	7200–7363	157	−0.713	0.432	−0.857	96	−0.726	0.162	−0.931	62	−0.903	0.220	−0.986
Programming & software services	7370–7389	1049	−0.782	−0.357	−0.655	563	−0.736	0.110	−0.687	299	−0.713	0.023	−0.667
Motion pictures & theaters	7812–7841	53	−0.465	0.735	−0.304	28	−0.920	−0.227	−0.924				
Amusement & recreation services	7900–7997	100	−0.758	0.545	−0.746	57	−0.982	0.312	−0.989	37	−0.963	0.679	−0.988
Medical & nursing services	8000–8093	121	−0.808	0.271	−0.805	80	−0.890	0.478	−0.920	49	−0.937	0.724	−0.991
Engineering & management services	8700–8744	170	−0.767	0.257	−0.689	107	−0.860	0.542	−0.855	62	−0.838	0.068	−0.831
Corporate conglomerates	9995–9997	155	−0.729	−0.541	−0.503	94	−0.751	0.083	−0.751	37	−0.755	−0.544	−0.445
Mean			−0.739	0.206	−0.773		−0.695	0.297	−0.800		−0.584	0.243	−0.727

Table 6
Correction for spuriousness (Henkel, 2009) – Empirically observed cross-sectional risk–return relationship for the US sample.

Industries (grouped by SIC)	SIC range	1998–2002					2003–2007					2008–2012				
		Correlation coefficient					Correlation coefficient					Correlation coefficient				
		Sample size	Full sample	Corrected coef	Spurious effect	% of inflation	Sample size	Full sample	Corrected coef	Spurious effect	% of inflation	Sample size	Full sample	Corrected coef	Spurious effect	% of inflation
Metal mining	0100–1220	247	–0.807	–0.601	–0.207	25.58%	192	–0.829	–0.584	–0.245	29.53%	134	–0.779	–0.647	–0.132	16.89%
Energy extraction	1311–1389	349	–0.833	–0.274	–0.559	67.10%	224	–0.872	–0.478	–0.394	45.21%	163	–0.612	–0.401	–0.211	34.51%
Operative builders	1531–1731	74	–0.794	–0.801	0.008	–0.98%	52	–0.828	–0.901	0.072	–8.70%	39	–0.726	–0.481	–0.245	33.73%
Food products	2000–2111	190	–0.647	–0.127	–0.519	80.30%	136	–0.824	–0.683	–0.141	17.10%	103	–0.175	0.241	–0.415	237.93%
Textile industry	2200–2273	31	–0.529	–0.496	–0.033	6.28%										
Apparel industry	2300–2390	68	–0.462	–0.194	–0.268	58.05%	45	–0.608	–0.409	–0.199	32.77%	32	–0.660	–0.012	–0.648	98.23%
Lumber & wood products	2400–2452	51	–0.891	–0.071	–0.820	92.08%	34	–0.105	0.126	–0.230	220.19%	22	–0.856	–0.090	–0.766	89.43%
Household & office furniture	2510–2590	40	–0.267	0.300	–0.567	212.58%	27	–0.279	–0.273	–0.006	2.33%	22	–0.079	0.453	–0.532	672.97%
Paper milling & products	2600–2673	73	–0.817	–0.602	–0.216	26.38%	52	–0.742	–0.087	–0.655	88.30%	34	–0.303	–0.214	–0.090	29.55%
Newspaper & book publication	2711–2790	95	–0.852	–0.822	–0.030	3.52%	55	–0.948	–0.424	–0.524	55.30%	29	–0.393	–0.458	0.065	–16.49%
Chemical & pharmaceutical products	2800–2891	704	–0.783	–0.579	–0.204	26.08%	528	–0.746	–0.527	–0.219	29.30%	341	–0.727	–0.557	–0.170	23.35%
Petroleum refining	2911–2990	54	–0.671	–0.709	0.038	–5.60%	36	–0.856	0.066	–0.922	107.74%	27	–0.851	–0.246	–0.605	71.14%
Rubber & plastic products	3011–3089	90	–0.747	–0.557	–0.191	25.51%	56	–0.895	–0.803	–0.093	10.36%	28	–0.984	0.626	–1.610	163.62%
Stell works & metals	3300–3390	115	–0.777	–0.337	–0.440	56.59%	73	–0.465	–0.165	–0.300	64.55%	49	–0.784	–0.054	–0.730	93.10%
Fabricated metal products	3400–3490	106	–0.942	–0.870	–0.072	7.68%	67	–0.270	0.182	–0.452	167.40%	51	–0.799	–0.100	–0.699	87.45%
Industrial machinery	3510–3569	204	–0.863	–0.582	–0.280	32.51%	152	–0.828	–0.419	–0.409	49.35%	114	–0.902	–0.108	–0.793	87.97%
Computer & office equipment	3570–3590	230	–0.855	–0.364	–0.491	57.47%	124	–0.674	0.041	–0.715	106.09%	81	–0.657	–0.350	–0.307	46.78%
Electrical equipment & electronics	3600–3695	610	–0.771	–0.641	–0.130	16.85%	453	–0.820	–0.712	–0.108	13.16%	319	–0.715	–0.475	–0.239	33.49%
Vehicles & transportation equipment	3700–3790	165	–0.763	–0.613	–0.150	19.61%	122	–0.878	–0.716	–0.162	18.42%	95	–0.789	0.022	–0.811	102.83%
Industrial instruments & equipment	3812–3873	476	–0.748	–0.099	–0.649	86.77%	345	–0.785	–0.608	–0.177	22.51%	226	–0.613	0.335	–0.948	154.65%
Toys, games, sporting goods, etc.	3910–3990	77	–0.699	–0.656	–0.044	6.28%	41	–0.904	–0.143	–0.762	84.23%	28	–0.909	–0.555	–0.354	38.97%
Line-haul operations & trucking	4011–4213	115	–0.921	–0.797	–0.124	13.45%	82	–0.471	–0.515	0.044	–9.37%	60	–0.565	–0.553	–0.013	2.22%
Air transportation	4512–4522	87	–0.858	0.251	–1.110	129.28%	64	–0.924	0.042	–0.966	104.51%	39	0.008	–0.023	0.031	399.39%
Communication & broadcasting	4812–4899	398	–0.852	–0.595	–0.257	30.17%	214	–0.790	–0.510	–0.280	35.42%	143	–0.791	–0.027	–0.764	96.55%
Electric services	4911	134	–0.909	–0.284	–0.625	68.78%	119	–0.140	–0.062	–0.079	55.99%	105	0.089	0.097	–0.009	–9.89%
Gas transmission & distribution	4922–4991	225	–0.827	–0.713	–0.114	13.81%	193	–0.833	–0.687	–0.146	17.50%	153	–0.934	–0.408	–0.526	56.28%
Miscellaneous wholesaling	5000–5190	287	–0.864	–0.688	–0.176	20.35%	180	–0.903	0.168	–1.072	118.65%	132	–0.632	–0.655	0.023	–3.65%
Department & variety stores	5311–5399	41	–0.828	–0.200	–0.629	75.89%	30	0.046	0.015	0.031	67.55%	24	–0.257	–0.183	–0.074	28.75%
Grocery & convenience stores	5411–5412	49	–0.028	–0.051	0.023	–81.63%	32	–0.370	–0.442	0.072	–19.41%	25	0.611	0.797	–0.186	–30.39%
Apparel & clothing stores	5600–5661	97	–0.690	–0.169	–0.521	75.51%	73	–0.509	–0.380	–0.129	25.27%	57	–0.297	–0.349	0.052	–17.62%
Restaurants & eating places	5810–5812	116	–0.790	–0.801	0.011	–1.39%	70	–0.851	–0.479	–0.372	43.73%	41	–0.317	0.083	–0.400	125.99%
Miscellaneous shopping stores	5912–5990	145	–0.884	–0.690	–0.195	22.01%	89	–0.916	–0.397	–0.518	56.62%	48	–0.723	0.345	–1.069	147.76%
Hotels & motels	7011	40	–0.830	0.149	–0.979	118.00%										
Advertising & other services	7200–7363	157	–0.713	–0.349	–0.364	51.06%	96	–0.726	–0.053	–0.673	92.70%	62	–0.903	0.303	–1.206	133.54%
Programming & software services	7370–7389	1049	–0.782	–0.292	–0.489	62.60%	563	–0.736	–0.692	–0.044	6.02%	299	–0.713	–0.605	–0.108	15.16%
Motion pictures & theaters	7812–7841	53	–0.465	–0.628	0.163	–34.96%	28	–0.920	–0.760	–0.160	17.35%					
Amusement & recreation services	7900–7997	100	–0.758	–0.783	0.025	–3.25%	57	–0.982	–0.883	–0.099	10.03%	37	–0.963	0.470	–1.433	148.82%
Medical & nursing services	8000–8093	121	–0.808	–0.324	–0.484	59.92%	80	–0.890	–0.144	–0.746	83.87%	49	–0.937	–0.321	–0.616	65.76%
Engineering & management services	8700–8744	170	–0.767	–0.693	–0.074	9.64%	107	–0.860	–0.547	–0.314	36.45%	62	–0.838	–0.661	–0.177	21.17%
Corporate conglomerates	9995–9997	155	–0.729	–0.564	–0.166	22.71%	94	–0.751	–0.506	–0.245	32.61%	37	–0.755	–0.846	0.091	–12.02%

to 2012). The final sample from COMPUSTAT Global data consisted of 12,235 firms from 28 countries from years 1998 to 2012. We list country-industry distribution of firms in [Table A.1](#) in [Appendix](#).

Analyses

We first computed concurrent risk–return correlation using the correlation between ROA and standard deviation of ROA. [Table 2](#) summarizes results for concurrent risk–return relationship for the three time periods.

[Table 3](#) summarizes results for concurrent risk–return relationship with [Henkel's \(2009\)](#) spuriousness corrections for the three time periods. It is clear from the tables that the negative risk–return correlation broadly exist in countries other than the US. Related to [Table 2](#), for years between 1998 and 2002, only two out of 41 industries had a positive risk–return correlation. For years between 2003 and 2007, no industry had a positive relation between risk and return. For years between 2008 and 2012, only two industries have positive risk and return relationship. These statistics strongly suggest that negative risk–return relationship is independent of country differences. In addition, we also found that average risk–return relationships are very stable for these three 5-year periods (average correlations for these three periods are -0.535 , -0.497 , and -0.526 for 1998–2002; 2003–2007; 2008–2012, respectively). Similar patterns are observed with [Henkel's \(2009\)](#) correction in [Table 3](#).

To assess support for prospect theory or behavioral theory of firm explanations, we split the sample using the median performance of the industry following [Andersen et al. \(2007\)](#) approach. In years between 1998 and 2002, only two industries had a negative risk and return relationship among firms with performance above industry median. Therefore, for firms with performance above industry median the contemporaneous risk–return relationship is mainly positive. In contrast, risk and return relationship is broadly negative for firms performing below the industry median. Similar pattern carries on to the samples in years between 2003 and 2007 and years between 2008 and 2012. As such, we conclude that across 28 countries, firms performing below industry median generally have a negative correlation between risk and return, whereas firms performing above industry median generally have a positive correlation between risk and return.

The contemporaneous correlation between risk and return has been criticized by prior studies (e.g. [Andersen & Bettis, 2015](#)). Empirical evidence has shown that correlation between average performance and standard deviation of subsequent period tends to be less negative than the cross-sectional risk–return relationship ([Miller & Chen, 2004](#)). To replicate these results, we used longitudinal risk–return correlation suggested by [Andersen and Bettis \(2015\)](#). Their computation of longitudinal risk–return relationship is calculated as the correlation between the average ROA over the first five period and the standard deviation of ROA over the next five year period. As such, our first set of risk–return relationship was calculated as correlation between the mean ROA over year 1998–2002 and the standard deviation of ROA over years 2003–2007. Our second set of risk–return relationship was computed as the correlation between the mean ROA over year 2003–2007 and the standard deviation of ROA over years 2008–2012. [Table 4](#) summarizes our findings.

We continue to find negative risk and return relationship. For instance, in the first ten year period (1998–2007), only two industries show weak positive risk and return relationship ($r < 0.015$). Over the next ten-year period (2003–2012), three industries show positive risk and return relationship. Again, such relationship is relatively stable (average correlations are -0.317 and -0.321 for the two periods). As expected, the average correlations are weaker than the cross-sectional correlations. Of these, electric services

(SIC = 4911) in 2003–2012 shows moderate positive relationship ($r = 0.189$). Similarly, when we only considered firms with performance above median, we did detect most industries experience positive risk and return relationship for both periods. Again, when we exclusively focused on firm performance below median, we did find broad support for positive risk and return correlations. Overall, both cross-sectional and longitudinal calculations provide strong support for the existence of inverse risk and return relationship across 28 countries. [Fig. 1](#) presents the cross-sectional ([Table 2](#)), and longitudinal ([Table 4](#)) relationship between performance and variance in performance and the risk–return relationship for firms with performance above or below industry median ([Table 4](#)).

Robustness check with the US sample

Our replication using Global COMPUSTAT provides results consistent with previous studies (e.g. [Andersen & Bettis, 2015](#); [Andersen et al., 2007](#)). However, one might question whether our results will hold in the US sample for period that we used. Hence, we replicated our study using US COMPUSTAT for years between 1998 and 2012. We replicated [Tables 2 and 4](#) in [Tables 5 and 7](#), respectively, for the US sample between 1998 and 2012. The US sample shows a similar pattern.

Similar patterns are observed with [Henkel's \(2009\)](#) correction in [Table 6](#). Consistent with past work, we find a negative risk–return relationship and such relationship is more pronounced in samples with relatively lower performance. Furthermore, longitudinal correlations are weaker than cross-sectional correlations. Similar to [Fig. 1](#), for US firms, [Fig. 2](#) presents the cross-sectional ([Table 5](#)) and longitudinal ([Table 7](#)) relationship between performance and variance in performance and the risk–return relationship for firms with performance above or below industry median ([Table 7](#)).

Supplementary analysis

We further checked our analyses for country-specific heterogeneity. Given some countries covered relatively few cases (e.g., 100 cases), we focused on countries with relatively large sample size to calculate longitudinal risk–return relationship. Overall, countries like Australia, England, and most others showed that most industries have negative risk–return relationship. In [Appendix Figs. A.1 and A.2](#), we present country-level results related to for longitudinal risk–return relationships between 1998 and 2007 and between 2003 and 2012. [Figs. A.1 and A.2](#) show that most of correlations are below zero. In certain countries and in certain industries, the correlation is positive. Specifically, India, Japan and Korea have positive risk–return correlation for most of the periods and across industries, but the remaining countries have negative correlation across industries. For example, in Japan 19 out of 37 industries showed positive risk return relationships. Future research might consider the country-specific difference in affecting the risk–return relationship. Overall, Bowman's paradox is broadly supported under different sample and statistical specifications.

Conclusion

The phenomenon of Bowman's risk paradox has for long intrigued strategic management scholars. Bowman's risk paradox refers to the negative relationship between mean and variance in accounting performance. To ascertain the boundary conditions of this phenomenon, predominantly studied in the US context, we replicated Bowman's risk paradox across 12,235 firms from 28 countries in Asia, Europe, and South Africa during the period between 1998 and 2012. We assessed risk–return relationship using contemporaneous (1998–2002; 2003–2007; 2008–2012) and

Table 7
Empirically observed longitudinal^a risk–return relationship for US sample.

Industries (grouped by SIC)	SIC range	1998–2007				2003–2012			
		Correlation coefficient				Correlation coefficient			
		Sample size	Full sample	Above media	Below median	Sample size	Full sample	Above media	Below median
Metal mining	0100–1220	192	–0.470	–0.113	–0.362	132	–0.354	–0.161	–0.169
Energy extraction	1311–1389	224	–0.408	–0.143	–0.316	162	–0.393	–0.005	–0.413
Operative builders	1531–1731	52	–0.399	0.330	–0.470	39	–0.060	–0.201	0.041
Food products	2000–2111	136	–0.798	0.249	–0.842	103	–0.209	0.366	–0.506
Apparel industry	2300–2390	45	–0.595	0.013	–0.724	32	–0.120	0.503	0.027
Lumber & wood products	2400–2452	34	–0.764	0.433	–0.922	25	–0.807	0.103	–0.940
Household & office furniture	2510–2590	27	0.304	0.275	–0.064	27	0.390	0.740	0.134
Paper milling & products	2600–2673	52	–0.773	–0.040	–0.779	34	–0.560	–0.352	–0.737
Newspaper & book publication	2711–2790	55	–0.876	0.785	–0.913	29	–0.551	–0.067	–0.877
Chemical & pharmaceutical products	2800–2891	528	–0.514	–0.316	–0.313	341	–0.485	–0.241	–0.186
Petroleum refining	2911–2990	36	–0.724	–0.018	–0.733	27	–0.843	–0.311	–0.969
Rubber & plastic products	3011–3089	56	–0.436	–0.087	–0.343	28	–0.869	0.334	–0.851
Stell works & metals	3300–3390	73	–0.492	–0.404	–0.385	48	–0.424	0.588	–0.716
Fabricated metal products	3400–3490	67	–0.586	–0.204	–0.560	51	–0.176	0.378	–0.150
Industrial machinery	3510–3569	152	–0.899	–0.120	–0.906	114	–0.895	0.182	–0.935
Computer & office equipment	3570–3590	124	–0.609	–0.104	–0.450	81	–0.500	–0.105	–0.416
Electrical equipment & electronics	3600–3695	453	–0.526	–0.016	–0.458	319	–0.611	0.028	–0.585
Vehicles & transportation equipment	3700–3790	122	–0.728	0.181	–0.728	95	–0.496	0.290	–0.522
Industrial instruments & equipment	3812–3873	345	–0.630	–0.314	–0.520	226	–0.549	–0.152	–0.448
Toys, games, sporting goods, etc.	3910–3990	41	–0.311	0.590	–0.212	28	–0.985	–0.157	–0.992
Line-haul operations & trucking	4011–4213	82	–0.552	0.088	–0.566	60	0.217	0.285	0.130
Air transportation	4512–4522	64	–0.470	0.207	–0.437	39	0.123	0.683	0.056
Communication & broadcasting	4812–4899	214	–0.692	0.240	–0.655	143	–0.842	0.582	–0.871
Electric services	4911	119	–0.225	0.017	–0.175	105	0.048	0.282	–0.219
Gas transmission & distribution	4922–4991	193	–0.732	0.427	–0.755	153	–0.769	0.368	–0.774
Miscellaneous wholesaling	5000–5190	180	–0.641	0.053	–0.616	132	–0.649	0.097	–0.679
Department & variety stores	5311–5399	30	–0.616	0.541	–0.974	24	0.083	–0.185	–0.216
Grocery & convenience stores	5411–5412	32	0.110	0.297	0.021	25	0.316	0.652	–0.826
Apparel & clothing stores	5600–5661	73	–0.021	–0.032	–0.170	57	0.012	0.080	–0.391
Restaurants & eating places	5810–5812	70	–0.753	0.165	–0.908	41	–0.192	0.122	–0.308
Miscellaneous shopping stores	5912–5990	89	–0.648	–0.089	–0.680	48	–0.139	0.112	0.017
Banking and real estate	6159–6799	617	–0.313	0.719	–0.544	455	0.232	0.839	–0.491
Advertising & other services	7200–7363	96	–0.222	0.247	–0.202	62	–0.327	0.327	–0.768
Programming & software services	7370–7389	563	–0.531	–0.199	–0.399	298	–0.572	–0.067	–0.500
Motion pictures & theaters	7812–7841	28	–0.405	0.135	–0.169				
Amusement & recreation services	7900–7997	57	–0.581	–0.085	–0.864	35	–0.587	–0.040	–0.450
Medical & nursing services	8000–8093	80	–0.657	0.327	–0.642	48	–0.595	0.432	–0.753
Engineering & management services	8700–8744	107	–0.704	0.215	–0.594	62	–0.888	0.243	–0.884
Corporate conglomerates	9995–9997	94	–0.500	–0.303	–0.321	36	–0.458	–0.440	–0.576
Mean			–0.523	0.101	–0.529		–0.381	0.161	–0.492

^a Average ROA over the first five period and the standard deviation of ROA over the next five year period.

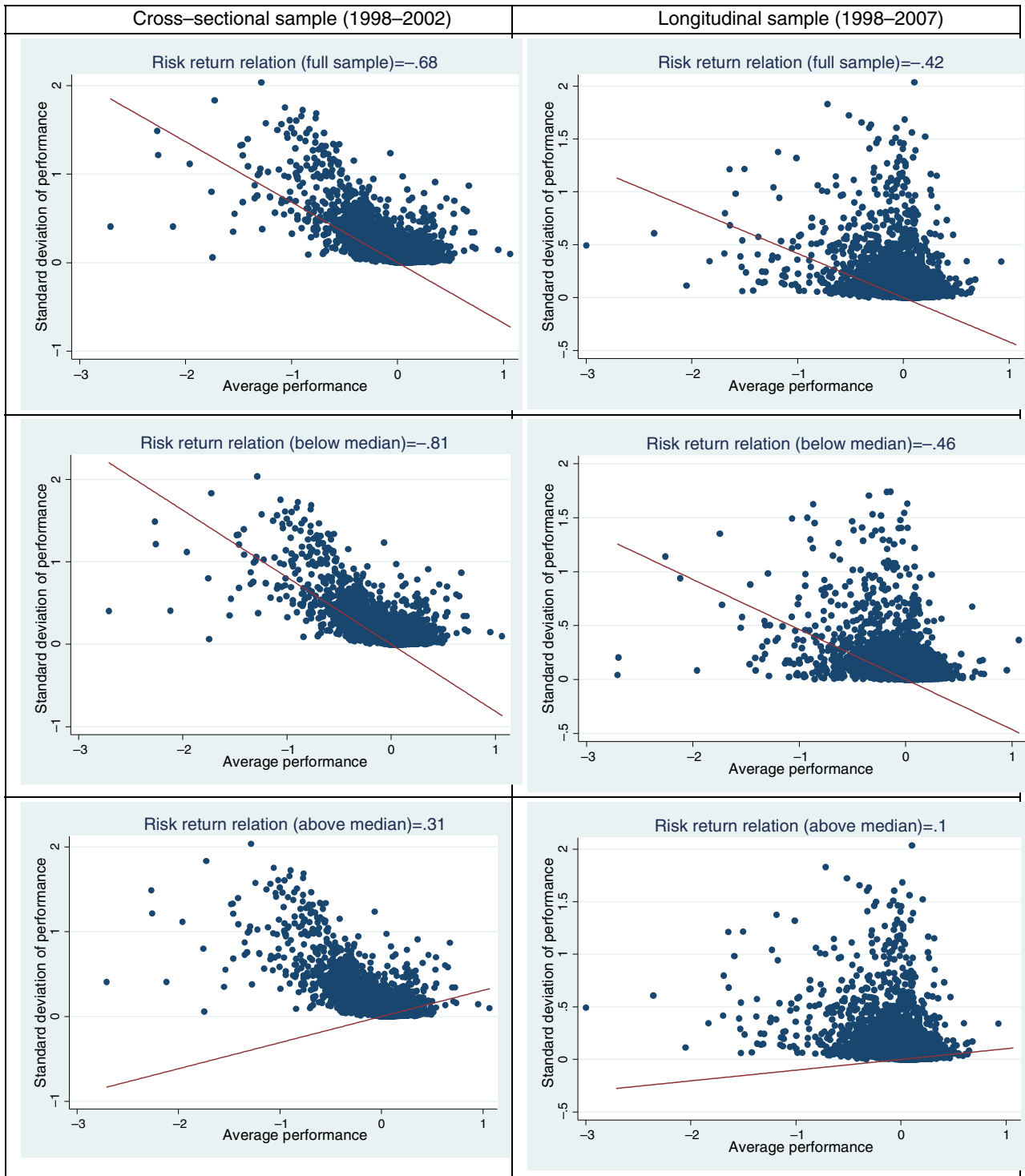


Fig. 1. Bowman paradox – global firms.

longitudinal (from 1998 to 2007 and from 2003 to 2012) sampling frames. Based on recent work, we also corrected for spuriousness, resulting from right skewness in performance, in risk–return relationship.

In diverse country settings, firms performing below industry median have negative relationship between risk and return, whereas firms performing above industry median have positive relationship between risk and return. These findings are consistent with prospect theory and behavioral theory explanations, and do

not support variation in the relationship based on country-related factors. The replication indicates that Bowman’s risk paradox phenomenon is broadly supported across a wide range of countries. However, there are some exceptions to the overall results. For instance, many industries in India, Japan, and Korea show positive correlations between risk and return. Future studies could take a closer look at why such differences arise. We hope that our study serves to deepen our understanding in explaining the relationship between accounting based risk and return.

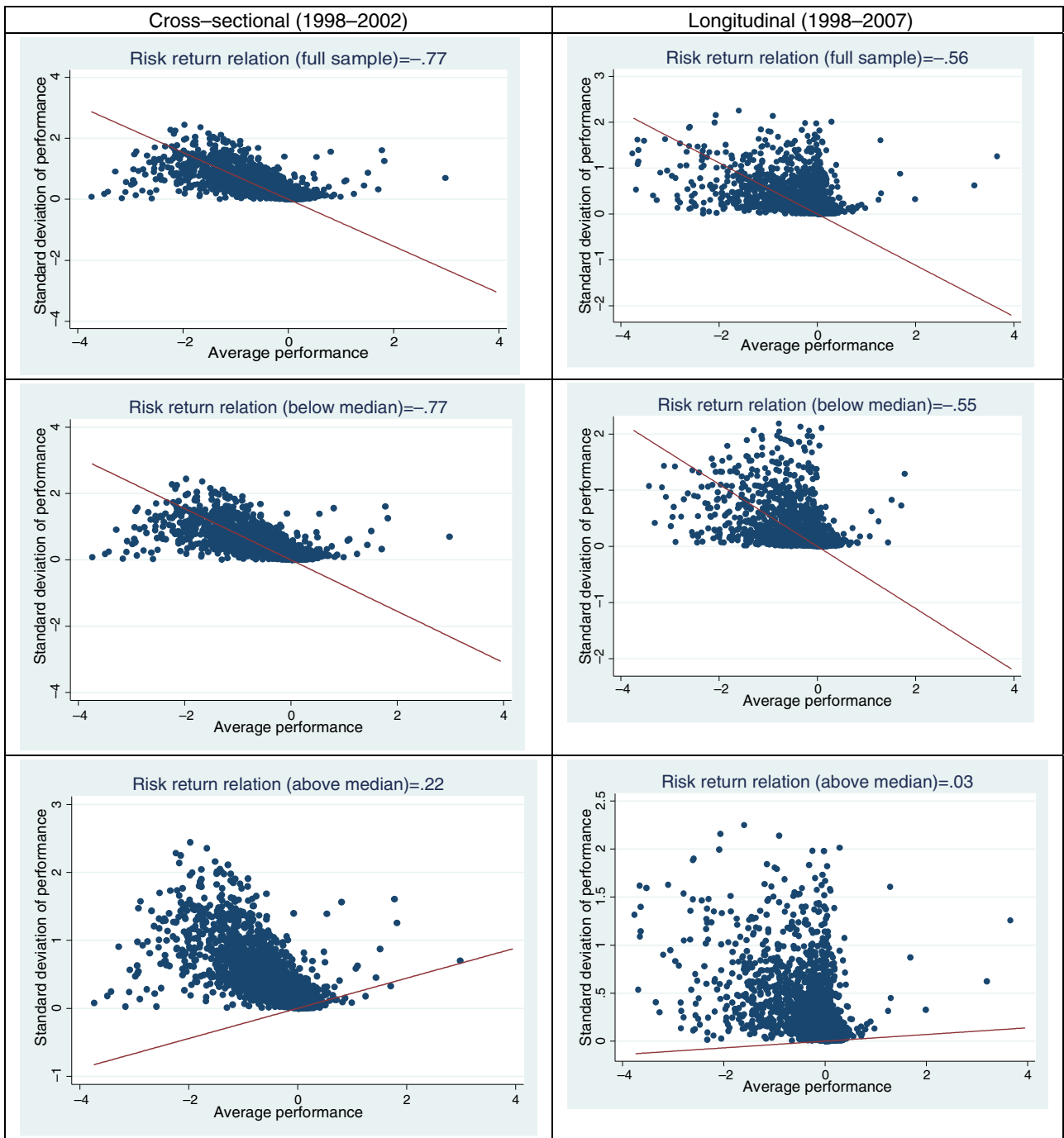


Fig. 2. Replication for US firms.

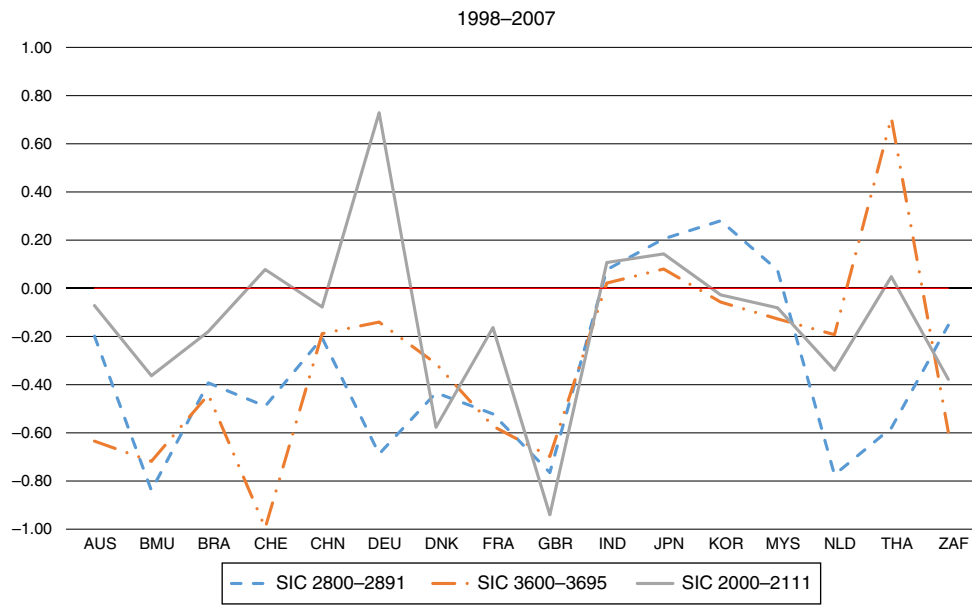


Fig. A.1. Country-level risk–return longitudinal relationship (1998–2007).

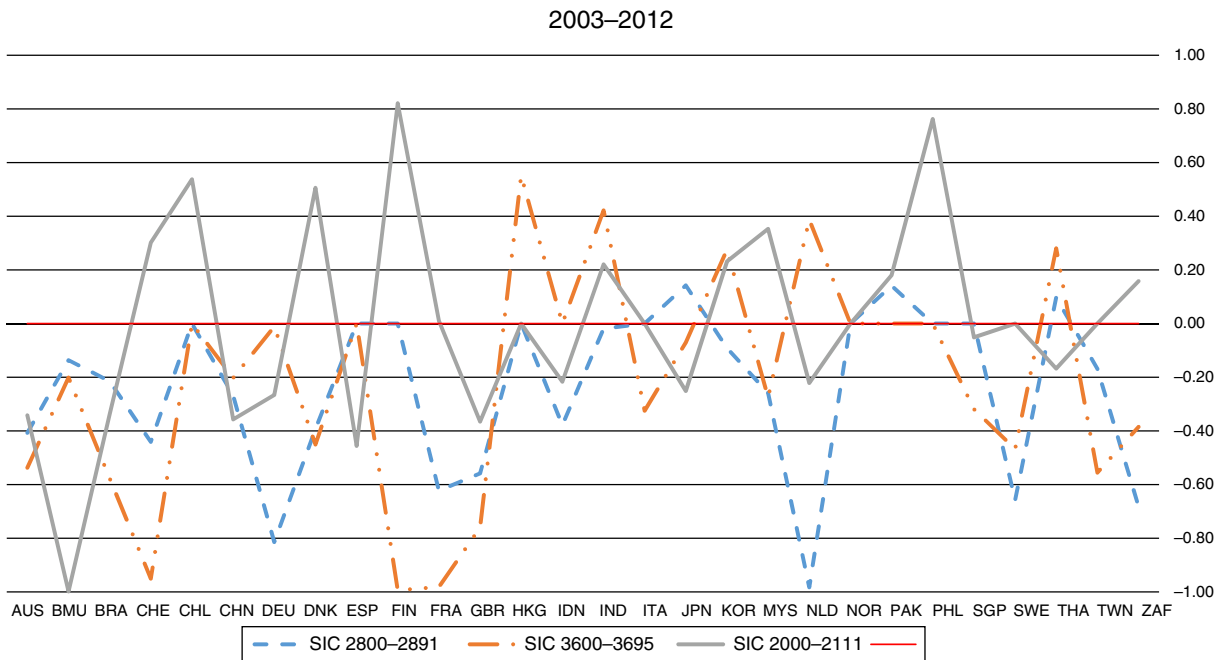


Fig. A.2. Country-level risk–return longitudinal relationship (2003–2007).

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