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The non-diversifiable risk of financial reporting system: Evidence from the German market

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ABSTRACT

Zhang (2013) proposes a theoretical model to argue that financial reporting system is a non-diversifiable risk for investors. However, there is little empirical evidence to support this argument. We use German data to empirically test the validity of Zhang's (2013) argument. Our results show that investors would require systematic premiums on the non-diversifiable risks related to financial reporting systems, and the findings are consistent with the argument of Zhang (2013). Furthermore, this study compares International Financial Reporting Standards (IFRS), German Generally Accepted Accounting Principles (German GAAP), and U.S. Generally Accepted Accounting Principles (U.S. GAAP) from the perspective of systematic risk. Our results show that firms that switched their accounting systems from German GAAP or U.S. GAAP to IFRS experience significant declines in the premiums on non-diversifiable accounting risk and costs of capital after adopting IFRS. The findings suggest that the systematic risk of IFRS is perceived to be lower than the systematic risks of German GAAP and U.S. GAAP. Moreover, we also find that firms with high accounting sensitivities before adopting IFRS have benefited more from adopting IFRS in the form of reduced premiums on systematic accounting risk and cost of capital than firms that had low accounting sensitivities before adopting IFRS.

1. Introduction

Zhang (2013) proposes a theoretical model to argue that financial reporting system is a systematic (non-diversifiable) risk factor for investors (hereafter, systematic accounting risk). However, there is little empirical evidence to support this argument. Our objective is to empirically test Zhang's (2013) argument. More specifically, we analyze whether financial reporting system represents a systematic risk for stock pricing and whether investors require additional premiums for bearing systematic accounting risk.

In the setting of Zhang's (2013) model, all firms in an economy adopt a specific financial reporting system. When systematic measurement errors exist in a given financial reporting system, those firms that adopt the same accounting standards commonly suffer from systematic measurement errors in their financial statements. Investors would then be unable to construct large portfolios to diversify the influences of the systematic measurement errors on stock pricing because all of the firms in the economy in question have to follow the same accounting standards. As a result, financial reporting system is a systematic (non-diversifiable) risk factor for investors.

Generally, it is problematic to directly test Zhang's (2013) prediction using data in a given economy because it is difficult to disentangle the role of systematic accounting risk from market risk. As a result, the effect of the non-diversifiable accounting risk on expected stock returns is encompassed by the effect of CAPM-Beta on expected stock returns. Fortunately, Germany provides a unique setting to facilitate distinguishing systematic accounting risk from market risk because German listed firms were allowed to choose International Financial Reporting Standards (IFRS), U.S. Generally Accepted Accounting Principles (U.S. GAAP) or German Generally Accepted Accounting Principles (German GAAP) as their financial reporting standard before 2005. The variety of financial reporting systems within the same market facilitates the measurement of the systematic accounting risks associated with IFRS, German GAAP and U.S. GAAP without confounding this measurement with the market risk of the entire German market.

After identifying the systematic risk related to IFRS, German GAAP, and U.S. GAAP, we compare the three financial reporting systems from the perspective of systematic accounting risk. Several German listed firms experienced a voluntary or a mandatory change in their financial reporting systems. Some of them changed their financial reporting systems from German GAAP to IFRS, whereas others changed from U.S. GAAP to IFRS. We conduct tests on the firms that experienced a change in their financial reporting system to identify whether the premiums on the firms' non-diversifiable accounting risk decreases after adopting IFRS. If the premiums on non-diversifiable accounting

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risk are significantly reduced after switching to IFRS, this evidence would suggest that investors perceive IFRS as a less risky accounting system than German GAAP and U.S. GAAP.

The comparison of IFRS with other country-specific Generally Accepted Accounting Principles, for example, U.S. GAAP and German GAAP, has been broadly discussed among standard setters, market practitioners, and accounting researchers. Proponents of IFRS argue that IFRS could improve analyst forecast accuracy (Byard, Li, & Yu, 2011; Tan, Wang, & Welker, 2011; Kim & Shi, 2012), reduce cost of capital (Daske, Hail, Leuz, & Verdi, 2008; Li, 2010), increase accounting transparency and earnings quality (Horton & Serafeim, 2010; Bartov, Goldberg, & Kim, 2005; Barth, Landsman, & Lang, 2008; Chen, Tang, Jiang, & Lin, 2010), and alleviate information asymmetry among investors (Daske et al., 2008; Ferrari, Momente, & Reggiani, 2012). However, skeptics of IFRS believe that IFRS would lower financial reporting quality (Van Tendeloo & Vanstraelen, 2005; Ahmed, Neel, & Wang, 2013) and have little effect on reducing information asymmetry among investors (Leuz, 2003). Considerable disagreement remains over the consequences of adopting IFRS. Hence, we provide further evidence from the perspective of risk on this debated issue.

Because investors lack complete information on a firm, financial reporting thus serves as crucial information for investors to value stock prices (Duffie & Lando, 2001; Frey & Schmidt, 2009). However, the information contained in financial reports presents several limitations. For example, many assets are reported at historical costs in financial statements, and the historical asset value is often criticized for not reporting relevant fair value information. In addition, certain items, such as reputation, customer relationship, and skilled employees are valuable to a firm; however, such items are not recognized in financial statements. Consequently, accounting book value cannot adequately reveal the true value of a firm to investors, and thus, the gap between reported accounting book value and true firm value might mislead investors into mispricing stock values. We refer to the situation in which investors are misled by financial information as the risk produced by accounting standards (hereafter, accounting risk).

We further dichotomize accounting risk into non-diversifiable (systematic) accounting risk and idiosyncratic accounting risk. Non-diversifiable accounting risk refers to the risk that investors are misled by financial statements because of the existence of *systematic measurement errors* in a specific accounting system. By contrast, if the values of firms are mispriced by investors because of the existence of firm-specific measurement errors in financial reports, this risk is referred as to idiosyncratic accounting risk. The firm-specific measurement errors are independent and are not linked across firms. The concept of systematic measurement error first appears in the theoretical model proposed by Zhang (2013), who argues that systematic measurement errors exist in every financial reporting system. For example, certain intangible assets cannot be recognized in the balance sheet, hence causing the asset book values to be systematically understated. Another example of systematic measurement errors in financial reports is the use of historical costs. Historical costs would cause accounting earnings to overstate true firm performance and understate firm value. Therefore, the firms that adopt a common financial reporting system typically suffer from non-diversifiable measurement errors in their financial statements. In the presence of cross-correlations, *investors cannot diversify systematic measurement errors by establishing portfolios*. As a result, the systematic measurement errors would prevent investors from correctly pricing stocks. We refer to the non-diversifiable risk caused by systematic measurement errors as systematic accounting risk.

As noted above, systematic accounting risk cannot be diversified using portfolios, but idiosyncratic accounting risk can. Motivated by portfolio theory, we establish three large portfolios associated with IFRS, U.S. GAAP, and German GAAP to diversify firm-specific risks and capture the non-diversifiable risk with respect to the three financial reporting systems. Next, using the expected returns on the IFRS portfolio as a benchmark, we construct two variables to measure the premiums on the systematic accounting risk of German GAAP and one variable to measure the premiums on the systematic accounting risk of U.S. GAAP. One of the two measures of the premiums on the systematic risk of German GAAP is defined as the difference in returns between the German GAAP portfolio and the IFRS portfolio (denoted GMI), and the other is defined as the return on the German GAAP portfolio in excess of the return on the U.S. GAAP portfolio (denoted GMU). Analogously, the difference in returns between the U.S. GAAP portfolio and the IFRS portfolio is used to measure the excess returns on the systematic accounting risk of U.S. GAAP (denoted UMI).

After constructing the measurements of the premiums on the non-diversifiable risk of U.S. GAAP and German GAAP, multifactor pricing models are employed at a portfolio level to test whether accounting standards represent a non-diversifiable risk. More specifically, GMI and GMU are each used to test whether the premium on the systematic accounting risk associated with German GAAP is a determinant of the expected returns of German GAAP adopters. UMI is used to identify whether investors require systematic premiums on the non-diversifiable risk associated with U.S. GAAP.

Instead of measuring the gap between the accounting book value and the true value of a firm, we estimate non-diversifiable accounting risk based on the linkage between risk and stock returns because precisely measuring the true value of a firm is difficult. According to the Arbitrage Pricing Theory (APT), investors require systematic premiums on the non-diversifiable risks they bear. Hence, if financial reporting system is a source of non-diversifiable risk for investors, we predict that investors would require *systematic premiums* on the non-diversifiable accounting risk.

Our research sample comprises the firms listed on the seven stock exchanges in Germany, including the Berlin, Dusseldorf, Frankfurt, Hamburg, Hannover, Munich, and Stuttgart stock exchanges, from 1998 to 2010. Business groups in Germany could choose one accounting system, namely, IFRS, U.S. GAAP, and German GAAP, to follow between 1998 and 2005. Since 2005, all of the business groups were required to adopt IFRS when preparing consolidated financial statements; however, even after 2005, non-business groups could still adopt German GAAP to prepare individual financial statements. Additionally, firms that use U.S. GAAP to prepare consolidated financial statements were required to adopt IFRS after 2007. This data set allows various sample firms that adopt different accounting standards to be obtained.

Our empirical results show that the difference in returns between the German GAAP portfolio and the IFRS portfolio (GMI) is a significant determinant of the expected returns of the German GAAP adopters, and the difference in returns between the German GAAP portfolio and the U.S. GAAP portfolio (GMU) also provides explanatory power for the expected returns of the German GAAP adopters. Additionally, the returns on the U.S. GAAP portfolio in excess of the returns on the IFRS portfolio (UMI) have significant explanatory power for the expected returns of the firms adopting U.S. GAAP. The results suggest that accounting standards serve as a source of non-diversifiable risk for investors, and investors require systematic premiums on the non-diversifiable accounting risk.

After confirming that investors regard the accounting system as a non-diversifiable risk, we turn to a comparison of IFRS, German GAAP, and U.S. GAAP from the perspective of accounting risk. A total of 106 firms in our sample changed their financial reporting systems from German GAAP to IFRS, and 29 firms changed from U.S. GAAP to IFRS. This characteristic facilitates the investigation of whether the premium on the firms' non-diversifiable accounting risk exhibits a significant change after the shift to a new system and a comparison of the risks of different financial reporting systems. Fair value information is generally perceived to be used to a greater extent in the financial statements prepared under IFRS than in the statements prepared under German GAAP and U.S. GAAP. Therefore, the systematic accounting risk of IFRS is predicted to be lower than the risk of German GAAP and U.S. GAAP.

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Consequently, the premiums on non-diversifiable accounting risk of the firms changing from non-IFRS to IFRS are expected to be reduced after the adoption of IFRS.

Our results indicate that the premiums on the systematic accounting risk of the 135 firms changing from non-IFRS to IFRS exhibit a significant decline after the adoption of IFRS, suggesting that the risk of German GAAP or U.S. GAAP is perceived to be higher than the risk of IFRS. Moreover, we find that firms exhibiting high sensitivities to non-diversifiable accounting risk before adopting IFRS experience a more significant decline in the cost of capital than do firms with low sensitivities to accounting risk. In other words, firms with high sensitivities to systematic accounting risk benefited more from changing their accounting system to IFRS than firms with low sensitivities to accounting risk. This pattern is consistent with the predictions of Zhang's (2013) theoretical model.

Our research contributes to the related literature in two ways. First, we extend the research of Daske et al. (2008) and Li (2010), who document significant declines in firms' cost of capital following the shift from non-IFRS to IFRS reporting. The main difference between our research and existing studies is that we decompose expected stock returns into the premiums on non-diversifiable accounting risk and the premiums on other systematic risk factors and provide a clear understanding of how investors perceive the non-diversifiable risk of IFRS, German GAAP, and U.S. GAAP. Furthermore, we show that the decreased cost of capital documented in the literature results from the decline in the premiums on non-diversifiable accounting risk. Second, the prior literature compares IFRS, German GAAP, and U.S. GAAP from the perspectives of information transparency, earnings quality, and information comparability. Our study extends such effort by comparing IFRS, German GAAP and U.S. GAAP from the perspective of risk. Asset pricing theory lays the foundation for our research, and our findings are relevant to the debate on the consequences of adopting IFRS considered by policy makers.

2. Literature review

Studies on the consequences of adopting IFRS can be classified into three categories. First, many studies document the effect of IFRS adoption on the quality of accounting information. For example, Barth et al. (2008) find that firms applying International Accounting Standards (IAS) from 21 countries have less earnings management, more timely loss recognition, and more value relevance of accounting earnings than do the matched non-IAS firms. Moreover, the firms applying IAS generally experience an improvement in accounting quality between the pre- and post-adoption periods. Chen et al. (2010) also reveal similar results to those of Barth et al. (2008) in the European Union. Bartov et al. (2005) find that the value relevance of U.S. GAAP-based earnings and IAS-based earnings is higher than the value relevance of German GAAP-based earnings. Ferrari et al. (2012) document that firms adopting IAS exhibit less earnings management and lower trading volume around earnings announcements than firms that adopt German GAAP. The results imply that the information content of IAS is higher than the information content of German GAAP.

Contrary to the above literature, Van Tendeloo and Vanstraelen (2005) and Ahmed et al. (2013) find a higher degree of earnings management and lower accounting quality in IFRS adopters compared to non-IFRS adopters. Leuz (2003) documents that there are small differences in the bid-ask spread and share turnover rate between IAS and U.S. GAAP firms. The findings of Leuz (2003) imply that the difference in information quality between the financial statements prepared under U.S. GAAP and the financial statements prepared under IFRS is insignificant. Ball, Robin, and Wu (2003) argue that the quality of financial statements depends on the incentives of preparers, rather than financial reporting systems. In summary, there is disagreement among researchers concerning the effect of adopting IFRS on accounting quality.

The second stream of literature investigates the influence of IFRS adoption on the decisions of analysts and institutional investors. On the one hand, Tan et al. (2011) and Kim and Shi (2012) reveal that the adoption of IFRS attracts more foreign and local analysts following and improves analysts' forecast accuracy. Byard et al. (2011) discover similar phenomena in the European Union but only for the countries with strong legal enforcement. On the other hand, Florou and Pope (2012) document that the adoption of IFRS increases institutional holdings in the shares of IFRS adopters. Moreover, Covrig, Defond, and Hung (2007) show that the firms adopting IAS have a larger proportion of stock ownership held by foreign mutual funds, and the result indicates that the adoption of IAS attracts foreign capital.

The third strand of literature discusses the market reaction to the adoption of IFRS. Daske et al. (2008) observe a decrease in the cost of capital after the adoption of IFRS in 26 countries. Li (2010) documents that mandated adoption of IFRS in the European Union significantly reduces the cost of capital in the European Union, and Kim, Tsui, and Yi (2011) find that the adoption of IFRS reduces the cost of debt for non-U.S. borrowers from 40 countries during the period from 1997 through 2005. Horton and Serafeim (2010) employ an event study approach to investigate the short-term market reaction to the information contained in the IFRS reconciliation adjustments. The evidence indicates that the IFRS reconciliation adjustments are value-relevant information for investors. Joos and Leung (2013) find that stock investors perceive 15 events relating to IFRS adoption in the United States as good news.

Daske et al. (2008); Li (2010); Horton and Serafeim (2010), and Joos and Leung (2013) are studies closely related to our research. However, Daske et al. (2008) and Li (2010) use the cost of capital implied in current stock prices as their measure of the cost of capital. The implied cost of capital could not help us to identify whether the risks related to the accounting system are the determinants of expected stock returns. The current study attempts to capture the premium required by investors on the risk associated with financial reporting systems. In the research of Horton and Serafeim (2010) and Joos and Leung (2013), the authors employ the Capital Assets Pricing Model (CAPM) or market index to estimate cost of capital, which overlooks the premiums on other risk factors and might understate the cost of capital.

3. Research methodology

The following tests are conducted at the portfolio level and the firm-specific level. In our portfolio tests, we initially follow Fama and French (1993) to calculate the premiums on per-unit market risk, size risk, and B/M risk. Subsequently, we construct two variables to capture the premiums required by investors for bearing the non-diversifiable accounting risk produced by German GAAP and construct one variable to capture the premiums on the non-diversifiable accounting risk associated with U.S. GAAP. Finally, the three measures of the systematic risks of German GAAP and U.S. GAAP are added to the three-factor model proposed by Fama and French (1993), and the slopes on the three variables for systematic accounting risk are used to identify whether investors perceive financial reporting system as a source of non-diversifiable risk.

In the firm-specific tests, we fit the augmented multifactor model to firm-specific time series data. The estimated result for each firm is used to decompose firm-specific stock returns into expected returns, abnormal returns, and residuals. Subsequently, we perform tests on the firms that ever changed their financial reporting systems to identify whether the premiums on the firms' non-diversifiable accounting risk significantly decline after the adoption of IFRS and draw a conclusion regarding whether the risk of IFRS is perceived to be lower than the risk of German GAAP and U.S. GAAP.

3.1. Research sample

The research sample consists of all the firms listed on the Berlin Stock Exchange, Dusseldorf Stock Exchange, Frankfurt Stock Exchange,

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Hamburg Stock Exchange, Hannover Stock Exchange, Munich Stock Exchange, and Stuttgart Stock Exchange in Germany from 1998 to 2010. Instead of focusing solely on the firms listed on the Frankfurt Stock Exchange, we extend our sample firms to all firms listed on the seven stock exchanges in Germany because the diversification of sample firms helps to diversify firm-specific risks. Our sample period begins from 1998 because the KapAEG was enacted in Germany in April 1998. This act allowed listed German firms to prepare their consolidated financial statements under either IFRS or U.S. GAAP, instead of German GAAP. However, before 1998, listed firms had to prepare statements following German GAAP. The sample period ends in 2010 because we need to calculate monthly returns for the subsequent 12 months from the fifth month after the end of a fiscal year. We exclude firms missing necessary data for calculating size, B/M ratio, and monthly returns. Firm size is defined as the equity market value in May of year $t + 1$, and the B/M ratio is defined as the ratio of equity book value to market value at the end of year t. To ensure that the accounting information is available for investors, we match accounting variables at the end of year t with the returns from May in year $t + 1$ to April in year $t + 2$. In this setting, monthly return data from May 1999 to April 2012 are required for our tests. All of the necessary data are retrieved from the DataStream Database. Finally, we exclude firms with missing information on financial reporting systems in the DataStream Database. As a result, our final sample comprises 3901 firm-year observations for 465 firms.

Table 1 lists the number of observations for each accounting regime (German GAAP vs. IFRS vs. U.S. GAAP) in each year. Among the 3901 firm-year observations, 1755, 283 and 1863 are German GAAP, U.S. GAAP and IFRS firm-year observations, respectively. The sample comprises firm-year observations from 465 firms listed on seven stock exchanges in Germany during the period from 1998 to 2010, including the Berlin Stock Exchange, Dusseldorf Stock Exchange, Frankfurt Stock Exchange, Hamburg Stock Exchange, Hannover Stock Exchange, Munich Stock Exchange, and Stuttgart Stock Exchange.

As shown in Table 1, the number of IFRS observations in 2005 is 224, which is twice the number in 2004, because business groups are mandated to adopt IFRS when preparing consolidated financial statements. The number of German GAAP observations decreases from 151 in 2004 to 71 in 2005. After 2004, some German GAAP observations remain because those firms are non-business groups and could still adopt German GAAP to prepare their individual financial statements after 2004. Regarding the U.S. GAAP observations, the firms adopting U.S. GAAP are relatively few in our sample and cluster during the period from 2000 to 2004.

We further classify the observations by stock exchanges and financial reporting systems. Table 2 reports the average size and average B/M of the observations across stock exchanges and years.

Table 1
Distribution of firm-year observations.

Year	German GAAP	Non-local (US + IFRS)	U.S. GAAP	IFRS
1998	209	14	2	12
1999	195	35	9	26
2000	193	95	40	55
2001	193	95	40	55
2002	179	157	65	92
2003	155	155	57	98
2004	151	152	40	112
2005	71	238	14	224
2006	63	242	7	235
2007	81	253	3	250
2008	89	255	2	253
2009	89	237	2	235
2010	87	218	2	216
Total	1755	2146	283	1863

Size is defined as equity market value at the beginning of May in year $t + 1$. B/M is the ratio of equity book value to market value at the end of year t. IFRS indicates firms adopting IFRS as their financial reporting system. German GAAP indicates firms that adopt German GAAP as their financial reporting system. U.S. GAAP indicates firms that adopt U.S. GAAP as their financial reporting system.

As shown in Table 2, U.S. GAAP observations dominate the other two categories in size. The average size of the U.S. GAAP observations is 4496 million Euro dollars, and the average size of the IFRS observations and German GAAP observations are 2706 and 1086 million Euro dollars, respectively. In addition, the average B/M of the IFRS observations is 2.54, which is higher than the average B/M of the other two groups. The results in Table 2 suggest that it is necessary to control for size and B/M when measuring the premium on the non-diversifiable accounting risk of IFRS, German GAAP, and U.S. GAAP.

Table 3 reports the number of firms that experienced a change in financial reporting systems. German/IFRS indicates firms that changed their financial reporting system from German GAAP to IFRS. U.S./IFRS indicates firms that changed their financial reporting system from U.S. GAAP to IFRS. IFRS/German indicates firms that changed from IFRS to German GAAP. German/U.S. indicates firms that changed from German GAAP to U.S. GAAP. U.S./German indicates firms that changed from U.S. GAAP to German GAAP. Non-change-IFRS indicates firms that consistently adopt IFRS during the sample period. Non-change-German GAAP indicates firms that consistently adopt German GAAP during the sample period. Non-change-U.S. GAAP indicates firms that consistently adopt U.S. GAAP during the sample period.

A total of 106 firms switched from German GAAP to IFRS, and 29 switched from U.S. GAAP to IFRS. Five firms changed from IFRS to German GAAP. In addition, 113 and 192 firms consistently adopted IFRS and German GAAP, respectively. Another 18 firms consistently adopted U.S. GAAP during our sample period.

3.2. Is the accounting system a non-diversifiable risk?

3.2.1. Control variables: Premiums on market risk, size, and B/M

We follow the procedures proposed by Fama and French (1993) to estimate the premiums on market risk, size, and B/M. First, the top 30% (high), middle 40% (medium), and bottom 30% (low) of the ranked B/M ratios for the Frankfurt observations are used to divide all of the sample firms into three groups in each year. The three B/M portfolios are re-constructed annually at the end of year t from 1998 to 2010. The B/M ratio is defined as the year-end equity book value in fiscal year t divided by the equity market value at the end of year t. As shown in Table 2, there is an obvious difference in B/M ratio between the Frankfurt observations and the other observations. Therefore, using only the Frankfurt firms, instead of all sample firms, to determine the breakpoints of B/M helps to prevent grouping most Frankfurt observations into the high-B/M portfolio and grouping most other observations into the low-B/M portfolio. Regarding the size portfolios, the median of equity market value at the beginning of May in year $t + 1$ for the Frankfurt observations is used to divide all sample firms into two portfolios, which are the small-size and the large-size portfolios. The two size portfolios are annually re-constructed every May from 1999 to 2011.

Second, we construct six size/BM portfolios at the beginning of May in year $t + 1$ from the intersection of the two size portfolios in year $t + 1$ and the three B/M portfolios in year t (S/L, S/M, S/H, B/L, B/M, and B/H). Finally, monthly value-weighted portfolio returns for the subsequent 12 months, from May in year $t + 1$ to April in year $t + 2$, of each of the six size/B/M portfolios are calculated. The risk premium related to size, denoted SMB, is defined as the difference between the simple average of monthly returns on the three small-size portfolios (S/L, S/M, and S/H) and the simple average of monthly returns on the three large-size portfolios (B/L, B/M, and B/H). SMB captures the monthly excess return on small firms and is not affected by B/M because

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Table 2
Average size and B/M across stock exchanges and financial reporting systems.

GAAP	Berlin	Dusseldorf	Frankfurt	Hamburg	Hannover	Munich	Stuttgart	All
Panel A: Average size across stock exchanges and financial reporting systems								
IFRS	430.46	324.63	2814.11	109.95	135.51	325.59	41.57	2705.68
German GAAP	177.72	134.31	1414.65	93.30	303.65	92.90	39.50	1085.50
U.S. GAAP	7.12	–	4757.91	165.31	–	–	89.11	4496.06
Panel B: Average B/M ratio across stock exchanges and financial reporting systems								
IFRS	0.27	1.05	2.61	0.90	0.88	0.30	0.88	2.54
German GAAP	0.32	0.53	0.86	0.66	0.46	0.60	1.16	0.82
U.S. GAAP	1.76	–	0.99	0.76	–	–	0.40	0.98

the effect of B/M on size portfolios is mixed in the calculation. Analogously, the premium on the risk factor of the B/M ratio, denoted HML, is defined as the difference between the simple average of monthly returns on the two high-B/M portfolios (S/H and B/H) and the simple average of monthly returns on the two low-B/M portfolios (S/L and B/L). HML measures the returns on the high-B/M portfolios in excess of the returns on the low-B/M portfolios, and the excess return on B/M is free of the influence of size.

Regarding the proxy for the premium on market risk, we annually construct a market portfolio, which comprises all of the sample firms from the seven stock exchanges in Germany, at the beginning of May in each year from 1999 to 2011. Value-weighted monthly returns of the market portfolio from May in 1999 to April in 2012 are then calculated. Finally, the difference between the monthly value-weighted return of the market portfolio and one-month Treasury bill rate is defined as the premium on market risk.

3.2.2. Explanatory variables: Premium on the non-diversifiable risk of accounting standards

In this section, we describe the procedures for constructing three variables used to measure the compensation for the systematic risk associated with different accounting systems. Motivated by Fama and French (1993), the three variables are designed to capture the excess returns required by investors to compensate for investing in firms that adopt a relative risky accounting system.

Initially, each of the six size/BM portfolios are subdivided into three sub-portfolios based on the financial reporting systems that the firms adopt. Accordingly, we obtain 18 portfolios in each year (S/H/IFRS, S/H/US, S/H/German, B/H/IFRS, B/H/US, B/H/German, S/M/IFRS, S/M/US, S/M/German, B/M/IFRS, B/M/US, B/M/German, S/L/IFRS, S/L/US, S/L/German, B/L/IFRS, B/L/US, and B/L/German). As shown in Table 3, there are clear differences in average size and B/M across the three accounting categories. Therefore, to mitigate the influences of size and B/M on the estimated risk premium related to financial reporting systems, we average the subsequent monthly returns of the six size/BM portfolios that have the same financial reporting system. For example, the return on the IFRS portfolio is the simple average of the returns on the S/H/IFRS, B/H/IFRS, S/M/IFRS, B/M/IFRS, S/L/IFRS, and B/L/IFRS portfolios. Similarly, the return on the German GAAP portfolio is the simple average of the returns on the S/H/German, B/H/German, S/M/German, B/M/German, S/L/German, and B/L/German portfolios. The return on the U.S. GAAP portfolio is the simple average of the returns on the S/H/US, B/H/US, S/M/US, B/M/US, S/L/US, and B/L/US portfolios.

The quality of IFRS and U.S. GAAP are generally perceived to be higher than the quality of most domestic accounting standards (Leuz & Verrecchia, 2000; Ashbaugh & Pincus, 2001; Leuz, 2003; Barth et al., 2008). Hence, we hypothesize that the systematic risks produced by IFRS and U.S. GAAP are lower than the risk produced by German GAAP. Moreover, the extent to which fair value information is used in IFRS is higher than that in U.S. GAAP. As demonstrated by Zhang (2013), a shift from historical costs to fair value accounting diminishes the non-diversifiable component of measurement errors. Therefore, we further hypothesize that IFRS is a less risky reporting system than U.S. GAAP. Given the superiority of the three accounting systems, we construct two variables to measure the premium on the systematic risk of German GAAP. The first variable, denoted GMI, is defined as the difference between the simple average of the subsequent monthly returns on the six German GAAP portfolios (S/H/German, B/H/German, S/M/German, B/M/German, S/L/German, and B/L/German) and the simple average of monthly returns on the six IFRS portfolios (S/H/IFRS, B/H/IFRS, S/M/IFRS, B/M/IFRS, S/L/IFRS, and B/L/IFRS). The second variable, denoted GMU, is the difference between the simple average of monthly returns on the six German GAAP portfolios (S/H/German, B/H/German, S/M/German, B/M/German, S/L/German, and B/L/German) and the simple average of monthly returns on the six U.S. GAAP portfolios (S/H/US, B/H/US, S/M/US, B/M/US, S/L/US, and B/L/US).

GMI (GMU) captures the additional returns of investing in firms that adopt German GAAP, instead of investing in firms that adopt IFRS (U.S. GAAP). If investors perceive German GAAP to be riskier than IFRS or U.S. GAAP, the expected returns on the German GAAP adopters are predicted to exceed the expected returns on the IFRS and U.S. GAAP adopters.

In addition, we construct a variable, denoted UMI, to measure the returns on the U.S. GAAP portfolio in excess of the returns on the IFRS portfolios. UMI is defined as the difference between the simple average of monthly returns on the six U.S. GAAP portfolios (S/H/US, B/H/US, S/M/US, B/M/US, S/L/US, and B/L/US) and the simple average of monthly returns on the six IFRS portfolios (S/H/IFRS, B/H/IFRS,

Table 3
Number of firms that experienced a change in financial reporting system.

	Berlin	Dusseldorf	Frankfurt	Hamburg	Hannover	Munich	Stuttgart	Total
German/IFRS	0	1	102	1	1	0	1	106
U.S./IFRS	1	0	26	2	0	0	0	29
IFRS/German	0	0	5	0	0	0	0	5
German/U.S.	0	0	1	0	0	0	0	1
U.S./German	0	0	1	0	0	0	0	1
Non-change -IFRS	0	0	108	1	1	0	3	113
Non-change - German GAAP	8	8	145	3	2	15	11	192
Non-change - U.S. GAAP	0	0	17	0	0	0	1	18
Total	9	9	405	7	4	15	16	465

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S/M/IFRS, B/M/IFRS, S/L/IFRS, and B/L/IFRS). If investors require higher premiums on the U.S. GAAP adopters than on the IFRS adopters, we can infer that the systematic risk of U.S. GAAP is higher than the risk of IFRS.

3.2.3. Dependent variables

The dependent variables in our portfolio tests are the excess returns on the portfolios established based on accounting systems. Specifically, firms that adopt IFRS in year t are grouped into a portfolio, and firms that adopt German GAAP and U.S. GAAP in year t are grouped into two further portfolios. The three accounting portfolios are reconstructed on an annual basis from 1998 to 2010. After forming the three portfolios in year t, we calculate the subsequent monthly value-weighted returns on each portfolio from May in year $t+1$ to April in year $t+2$. Then, the value-weighted portfolio returns in excess of the one-month Treasury bill rate are used as the dependent variables.

3.2.4. Regression models

We modify the Arbitrage Pricing Theory and Fama and French (1993) as follows to test whether investors perceive the non-diversifiable risks related to German GAAP and U.S. GAAP as systematic risks:

$$\left(R_p^{\text{German}} - R_f\right) = \alpha + \beta(R_M - R_f) + \delta(\text{SMB}) + \gamma(\text{HML}) + \varepsilon \quad (1)$$

$$\left(R_p^{\text{US}} - R_f\right) = \alpha + \beta(R_M - R_f) + \delta(\text{SMB}) + \gamma(\text{HML}) + \varepsilon \quad (2)$$

where:

R_p^{German} is the value-weighted monthly return on the German GAAP portfolio;

R_p^{US} is the value-weighted monthly return on all U.S. GAAP adopters;

$(R_M - R_f)$ is the difference between the value-weighted monthly return on the market portfolio and the one-month Treasury bill rate;

SMB and HML are the premiums on size and B/M risks, respectively.

We add GMI, GMU, and UMI individually into the three-factor model proposed by Fama and French (1993) to identify the explanatory power of GMI, GMU, and UMI for the expected returns on the German GAAP and U.S. GAAP adopters:

$$\left(R_p^{\text{German}} - R_f\right) = \alpha + \beta(R_M - R_f) + \delta\text{SMB} + \gamma\text{HML} + \omega\text{GMI} + \varepsilon \quad (3)$$

$$\left(R_p^{\text{German}} - R_f\right) = \alpha + \beta(R_M - R_f) + \delta\text{SMB} + \gamma\text{HML} + \eta\text{GMU} + \varepsilon \quad (4)$$

$$\left(R_p^{\text{US}} - R_f\right) = \alpha + \beta(R_M - R_f) + \delta\text{SMB} + \gamma\text{HML} + \lambda\text{UMI} + \varepsilon \quad (5)$$

where:

GMI and GMU measure the premiums investors receive in compensation for bearing the systematic risk of German GAAP;

UMI is the premium on the systematic risk of U.S. GAAP.

Eqs. (3) and (4) are used to identify the explanatory power of GMI and GMU for the expected returns on the German GAAP. The linkage between risk and expected returns provides the theoretical foundation for our tests. If investors are unable to diversify the systematic risk associated with German GAAP, and the non-diversifiable risk produced by German GAAP is perceived to be higher than the non-diversifiable risks of U.S. GAAP and IFRS, investors would require systematic compensation for bearing the non-diversifiable accounting risk of German GAAP. As a result, the premiums on the systematic risk associated with German GAAP, namely GMI and GMU, are expected to be determinants of the expected returns on the German GAAP adopters. Eq. (5) is used to test whether investors require a systematic premium on the non-diversifiable risk associated with U.S. GAAP.

The slopes of GMI, GMU, and UMI indicate the sensitivities of expected portfolio returns to the non-diversifiable accounting risk related to German GAAP and U.S. GAAP. More specifically, the ω and η coefficients indicate the additionally required returns corresponding to an increase in the premium on the non-diversifiable risk of German GAAP, and the λ coefficient captures the additional returns required by investors when the premium on the systematic risk of U.S. GAAP increases by 1%. Because the sample firms are all German listed firms, the effect of systematic accounting risk on expected returns could be distinguished from the effect of market risk, which is captured by the $(R_M - R_f)$ term.

In Zhang's (2013) model, a firm's total systematic risk is determined by its exposure to an economic factor and an accounting factor. In our empirical models, macroeconomic conditions are measured by R_f and the $R_M - R_f$ term. Moreover, Eqs. (3), (4), and (5) are time series pricing models, and the explanatory variables in the models are macro-level (market level) variables, which only vary with time. As a result, the changes in macroeconomic conditions are captured by the time series variations in $R_M - R_f$, and the coefficient of $R_M - R_f$ measures how closely a firm's required returns will vary with changing macroeconomic conditions (hereafter, economic sensitivity). In Eqs. (3), (4), and (5), the coefficients of GMI, GMU, and UMI capture the exposure of an asset to the systematic accounting risks of German GAAP and U.S. GAAP (hereafter, accounting sensitivity). As demonstrated by Lemma 2 (iii) in Zhang (2013), a firm's beta coefficient is affected by accounting sensitivity. In other words, a firm's economic sensitivity might be correlated with accounting sensitivity. Therefore, we use regressions to partial out the confounding relationship between economic sensitivity and accounting sensitivity.

We collect 156 monthly time series from May 1999 to April 2012 to perform regression analyses. The monthly excess returns of a specific portfolio are regressed on the monthly premiums on market risk, size, B/M, and systematic accounting risk.

3.3. A comparison of systematic risks among IFRS, German GAAP, and U.S. GAAP

As shown in Table 3, 106 firms switched their financial reporting systems from German GAAP to IFRS, and 29 firms changed from U.S. GAAP to IFRS. In our firm-specific tests, we focus on these 135 firms to compare the systematic risks among IFRS, German GAAP, and U.S. GAAP using the following equations:

$$R_{i,GtoI}^{\text{before}} - R_f = \alpha_{i,GtoI}^{\text{before}} + \beta_{i,GtoI}^{\text{before}}(R_M - R_f) + \delta_{i,GtoI}^{\text{before}}\text{SMB} + \gamma_{i,GtoI}^{\text{before}}\text{HML} + \omega_{i,GtoI}^{\text{before}}\text{GMI} + \varepsilon_{i,GtoI}^{\text{before}} \quad (6)$$

$$R_{i,GtoI}^{\text{after}} - R_f = \alpha_{i,GtoI}^{\text{after}} + \beta_{i,GtoI}^{\text{after}}(R_M - R_f) + \delta_{i,GtoI}^{\text{after}}\text{SMB} + \gamma_{i,GtoI}^{\text{after}}\text{HML} + \omega_{i,GtoI}^{\text{after}}\text{GMI} + \varepsilon_{i,GtoI}^{\text{after}} \quad (7)$$

where:

$R_{i,GtoI}^{before}$ is the monthly return of the firms changing from German GAAP to IFRS in the pre-change period;

$R_{i,GtoI}^{after}$ is the monthly return of firms changing from German GAAP to IFRS in the post-change period;

Other variables are as defined previously.

We divide the monthly time series data on each of the 135 firms into pre-change and post-change periods. We then use the time series data on the 106 firms, which changed from German GAAP to IFRS, in the pre-change period to estimate Eq. (6) and use the post-change data on the firms to fit Eq. (7). The two sets of coefficients estimated from Eqs. (6) and (7) indicate firm-specific sensitivities to the risk factors before and after switching accounting systems, respectively.

Subsequently, the estimated results of Eqs. (6) and (7) are used to decompose monthly realized returns into expected returns and

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residuals. Then, the monthly expected returns are transformed into annual expected returns by compounding.

Finally, we conduct tests on the 106 paired coefficients of $\omega_{i,GtoI}^{after}$ and $\omega_{i,GtoI}^{before}$ to compare the systematic risks of IFRS and German GAAP. If investors perceive IFRS as a less risky financial reporting system than German GAAP, $\omega_{i,GtoI}^{after}$ is expected to be lower than $\omega_{i,GtoI}^{before}$.

Regarding the comparison of IFRS and U.S. GAAP, we conduct the same tests on the 29 firms changing from U.S. GAAP to IFRS. The time series data of the 29 firms in the pre-change period and in the post-change period are used to fit Eqs. (8) and (9), respectively. If investors perceive IFRS as less risky than U.S. GAAP, the $\lambda_{i,UtoI}^{after}$ coefficient is expected to be lower than the $\lambda_{i,UtoI}^{before}$ coefficient.

$$R_{i,UtoI}^{before} - R_f = \alpha_{i,UtoI}^{before} + \beta_{i,UtoI}^{before}(R_M - R_f) + \delta_{i,UtoI}^{before} SMB + \gamma_{i,UtoI}^{before} HML + \lambda_{i,UtoI}^{before} UMI + \varepsilon_{i,UtoI}^{before} \quad (8)$$

$$R_{i,UtoI}^{after} - R_f = \alpha_{i,UtoI}^{after} + \beta_{i,UtoI}^{after}(R_M - R_f) + \delta_{i,UtoI}^{after} SMB + \gamma_{i,UtoI}^{after} HML + \lambda_{i,UtoI}^{after} UMI + \varepsilon_{i,UtoI}^{after} \quad (9)$$

where:

$R_{i,UtoI}^{before}$ and $R_{i,UtoI}^{after}$ are monthly returns of the 29 firms changing from U.S. GAAP to IFRS in the pre-change period and in the post-change period, respectively;

Other variables are as defined previously.

4. Empirical results

4.1. Descriptive statistics

Table 4 presents the descriptive statistics of the dependent variables and the explanatory variables. As reported in Panel A, the average of the time series monthly excess returns of the IFRS portfolio, from May 1999 to April 2012, is −1.28% (t = −2.09), which is significantly different from zero at the two-tailed 5% level. The average excess returns on the German GAAP portfolio and U.S. GAAP portfolio are −0.36% (t = −0.76) and −1.54% (t = −1.65), respectively.

The reason for the negative average excess returns on the three accounting portfolios is that our sample period covers two periods of economic recession in Europe. The first period is from 1998 to 2002, and the second period runs from 2008 to 2010. However, the negative average excess returns will not affect our subsequent analyses because we are more interested in the coefficients of the risk factors in the regressions.

Panel B summarizes the descriptive statistics of the explanatory variables used in the regressions. The average monthly time series value of $R_M - R_f$ is −0.81% (t = −1.88), which is significantly different from zero at the 10% level. The average return of SMB is −0.35% per month, but the *t*-statistic is insignificant. The average premium on the high-B/M portfolio (HML) is −0.69% per month, which is marginally different from zero at the one-tailed 10% level (t = −1.38). Although the means of ($R_M - R_f$), SMB, and HML are only weakly different from zero, the evidence implies that the high standard deviations for the three variables might help to explain most of the variation in stock returns. In other words, the high volatilities of these three variables indicate that market risk, size and B/M might capture substantial variation in returns.

Additionally, the averages of GMI, GMU, and UMI are 0.91%, 0.72%, and 0.19%, respectively. The mean of GMI suggests that the returns on the German GAAP portfolio are, on average, 0.91% higher than the returns on the IFRS portfolio. The mean of GMU indicates that the returns on the German GAAP portfolio are 0.72% higher than the returns on U.S. GAAP portfolio. We use GMI and GMU to capture the returns on the non-diversifiable accounting risk related to German GAAP. The positive averages of GMI and GMU indicate that German GAAP is perceived to be a riskier financial reporting system than IFRS and U.S. GAAP. Similarly, the positive average of UMI indicates that U.S. GAAP is perceived to be a riskier financial reporting system than IFRS. We use UMI to capture the risk premium with respect to U.S GAAP. Although the means of GMI, GMU, and UMI are insignificant, the high volatilities of the three variables might capture substantial variations in returns.

4.2. Results of portfolio tests

Table 5 presents the results of the three-factor model and the results of the multifactor models augmented by the addition of GMI and GMU. The results of the three-factor model are used as a benchmark to identify the effect of GMI on expected portfolio returns. As reported in column (1) of Table 5, the adjusted R^2 of the three-factor model for the German GAAP portfolio is 0.8875, and the coefficients of ($R_M - R_f$), SMB, and HML are significantly different from zero at the 1% level. Consistent with Fama and French (1993), $R_M - R_f$ has the strongest explanatory power for the time series variation in portfolio returns among market risk, size, and B/M risk. After adding GMI to the three-factor model, the adjusted R^2 increases from 0.8875 to 0.9136 and the intercept (abnormal return) decreases from 0.0037 (t = 2.64) to 0.0024 (t = 1.78). Moreover, the coefficient of GMI for the German GAAP portfolio is 0.1504 (t = 4.58), which is significantly different from zero at the 1% level. The results suggest that investors would require systematic

Table 4
Descriptive statistics.

Panel A: Excess returns on three accounting portfolios

	IFRS	German GAAP	U.S. GAAP
Mean	−1.28	−0.36	−1.54
Std.	7.69	5.88	11.68
t	−2.09**	−0.76	−1.65*
N	156	156	156

Panel B: Explanatory variables

	R_M - R_f	SMB	HML	GMI	GMU	UMI
Mean	−0.81	−0.35	−0.69	0.91	0.72	0.19
Std.	5.38	4.88	6.24	7.21	8.63	6.82
t	−1.88*	−0.91	−1.38	1.57	1.04	0.34
N	156	156	156	156	156	156

** Significant at the 0.05 level.
* Significant at the 0.10 level.

Table 5
Effect of non-diversifiable risk associate with German GAAP on expected return on the German GAAP portfolio.

	Eq. (1)		Eq. (3)		Eq. (4)	
Variable	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Intercept	0.0037	2.64***	0.0024	1.78*	0.0031	2.33**
SMB	0.3018	4.76***	0.2238	4.11***	0.2239	4.08***
HML	−0.2648	−5.17***	−0.1745	−4.15***	−0.2322	−5.62***
$R_M - R_f$	0.9950	13.09***	0.9568	16.34***	1.0173	15.99***
GMI			0.1504	4.58***		
GMU					0.1061	5.02***
Adj. R^2	0.8875		0.9136		0.9085	
F-Value	408.73***		410.53***		385.67***	
N	156		156		156	

t values are corrected for heteroskedasticity using White (1980) robust standard errors.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

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compensation for bearing the non-diversifiable risk associated with German GAAP.[3]

Column 2 of Table 5 presents the effect of GMU on the expected returns on the German GAAP portfolio. GMU captures the time series variations in the expected returns of the German GAAP portfolio. The coefficient of GMI for the German GAAP portfolio is 0.1061 (t = 5.02), which is significantly different from zero at the 1% level. Moreover, adding GMU to the regression has a positive effect on the adjusted R^2, as it increases from 0.8875 to 0.9085. The evidence suggests that the risk premium on the systematic accounting risk associated with German GAAP is a determinant of the expected returns on the German GAAP portfolio.

Table 6 reports the regression results of Eq. (5). UMI is referred to as the risk premium on the systematic accounting risk associated with U.S. GAAP. The slope on UMI for the U.S. GAAP portfolio is 0.5346 (t = 6.38), which is significantly different from zero at the 1% level. The adjusted R^2 of the U.S. GAAP portfolio increases from 0.6648 to 0.7510 after including UMI as an explanatory variable. Taken together, the results imply that the risk premium on the non-diversifiable risk associated with U.S. GAAP is a determinant of the expected returns on the U.S. GAAP portfolio.[4]

Table 6
Sensitivity of the U.S. GAAP portfolio to the systematic accounting risk with respect to U.S. GAAP.

	Eq. (2)		Eq. (5)	
Variable	Coeff.	t-value	Coeff.	t-value
Intercept	−0.0008	−0.15	−0.0023	−0.52
SMB	−0.2727	−1.73*	−0.1576	−1.21
HML	0.1000	0.80	0.2564	1.92*
$R_M - R_f$	1.8347	7.42***	1.5868	7.20***
UMI			0.5346	6.38***
Adj. R^2	0.6648		0.7510	
F-Value	103.49***		117.87***	
N	156		156	

t-values are corrected for heteroskedasticity using White (1980) robust standard errors.
*** Significant at the 0.01 level.
* Significant at the 0.10 level.

4.3. The concern of self-explanation

Self-explanation is a potential concern induced by our regression setup. However, we infer that our empirical results are unlikely to be driven by self-explanation for the following reasons. On the one hand, the values of the explanatory variables in the multi-factor pricing model vary *only* with time, instead of varying with stocks or portfolios. In other words, the explanatory variables are market-level variables, containing only the time series variations in systematic risk factors. The time series variations in explanatory variables are independent of any specific portfolio. For example, the return on the market portfolio and the one-month riskless rate in May 1999 are 0.32% and 0.21%, respectively. Consequently, the value of $(R_M - R_f)$ is 0.11% in May 1999 and this value is unchanged when we regress $(R_M - R_f)$ on the excess return of any portfolios.

On the other hand, the firms included in the three accounting portfolios (dependent variables) are different from the firms in the 18 size-B/M-accounting portfolios used to construct GMI, GMU, and UMI. Consequently, the information sets captured by GMI, GMU, and UMI are not perfectly collinear with the information on dependent variables. Moreover, GMI, GMU, and UMI would not have significant explanatory power on the expected returns of the three accounting portfolios, unless investors perceive the factors captured by the three variables to be a source of systematic risk. Taken together, our results are unlikely to be caused by self-explanation.

4.4. Results of firm-specific tests

As reported in Table 3, 106 firms in our sample switched their accounting systems from German GAAP to IFRS, and 29 firms changed from U.S. GAAP to IFRS. We compare the changes of the 135 firms in the premiums on non-diversifiable accounting risk and the cost of capital (expected returns) to conclude whether IFRS is perceived to be less risky than German GAAP and U.S. GAAP.

As shown in Panel A of Table 7, the average of the GMI coefficients of the 106 firms changing from German GAAP to IFRS is −0.12 before adopting IFRS, and the average of the GMI coefficients declines to −0.38 after switching to IFRS. The difference in the averaged GMI coefficient is −0.26 (t = −3.25), which is significant at the 1% level, suggesting that the premiums of the 106 firms on non-diversifiable accounting risk are significantly reduced after the adoption of IFRS.

Table 7
The changes in the sensitivity to non-diversifiable accounting risk and expected returns.

	German GAAP to IFRS	U.S. GAAP to IFRS
	N = 106	N = 29
Panel A: Change in accounting risk		
Before_coeff. GMI ω_i^{before}	−0.12	0.91
After_coeff. GMI ω_i^{after}	−0.38	−0.04
Difference (after − before)	−0.26	−0.95
t-value	−3.25***	−5.02***
Panel B: Change in expected returns		
Before_ER	0.43	0.21
After_ER	0.29	−0.03
Difference (after − before)	−0.14	−0.24
t-value	−3.40***	−1.84*

Before_ER and After_ER are the predicted values minus the intercepts of Eqs. (6), (7), (8), and (9) respectively.
*** Significant at the 0.01 level.
* Significant at the 0.10 level.

[3] Our sample comprises non-business groups that were still allowed to adopt German GAAP after 2004, and this feature raises the concern that GMI and GMU only capture the premiums on the characteristic of non-business group reporters, instead of the premiums on the systematic risk of German GAAP. We conduct additional tests to identify whether GMI and GMU could still exhibit significant explanatory power for the expected returns of business groups. If GMI and GMU measure the premiums on non-business groups ($R_{non\text{-}business\ group} - R_{business\ group}$), then we would expect GMI and GMU to not exhibit explanatory power for the expected returns of business groups. On the contrary, if GMI and GMU remained the determinants of the expected returns of business groups, then the concern that GMI and GMU are proxies for the premiums associated with the non-business group characteristic would be mitigated. More specifically, we exclude non-business groups from the components of the dependent variables. As a result, the components of the dependent variables only contain business groups. The firms are regarded as non-business groups if they continue to use German GAAP after 2004. Subsequently, we use the time series data from 1998 to 2004 on the business groups to fit Eqs. (3) and (4). We find that GMI and GMU continue to exhibit significant explanatory power for the expected returns of the business groups that adopt German GAAP. In other words, the results of Table 5 are not sensitive to the non-business group characteristic.

[4] Our research design raises the concern that GMU, GMI, and UMI might only capture the premiums on the different firm characteristics among German GAAP, U.S. GAAP, and IFRS adopters, instead of measuring the premiums on systematic accounting risk. For example, German GAAP adopters are small firms relative to U.S. GAAP and IFRS adopters. As a result, GMI and GMU might only capture the premiums on small firms. Moreover, U.S. GAAP adopters typically cross list on an American stock exchange, and many U.S. GAAP adopters and IFRS adopters list on the Frankfurt Stock Exchange. Therefore, GMI, GMU, and UMI might only capture the premiums on different stock exchanges and the features of cross listing. Furthermore, many technology firms listing on the Neuer Market are IAS or U.S. GAAP adopters, and the Frankfurt Stock Exchange is also the bourse of these technology firms. As a result, GMI and GMU might represent premiums on the technology industry. However, we conduct numerous tests to identify whether the explanatory power of GMI, GMU, and UMI for expected returns are sensitive to different firm characteristics. Our results indicate that the explanatory power of GMI, GMU, and UMI for expected returns is robust to different firm characteristics, such as size, BM ratio, net income, cross listing, stock exchange, and technology industry.

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Moreover, consistent with the findings of Daske et al. (2008) and Li (2010), the firm-specific expected returns are significantly lowered after adopting IFRS.

Panel A of Table 7 also indicates that the average of the GMI coefficients of the 29 firms changing from U.S. GAAP to IFRS is 0.91 before adopting IFRS, and the average of the GMI coefficients declines to −0.04 after switching to IFRS. The difference in the averaged GMI coefficient is −0.95 (t = −5.02), which is significant at the 1% level, suggesting that the premiums of the 29 firms on non-diversifiable accounting risk are significantly reduced after the adoption of IFRS.

As revealed in Panel B of Table 7, the averaged expected returns of the 106 firms changing from German GAAP to IFRS decline from 0.43% to 0.29% after IFRS adoption. The *t*-statistic of the difference in expected returns is −3.40, which is significantly different from zero at the 1% level. The results imply that investors perceive that the risk of the 106 firms is reduced following the change to IFRS and hence require lower premiums on these firms. These findings in Table 7 support our inference that the risk associated with IFRS is lower than that associated with German GAAP. Moreover, our results provide additional evidence in support of the studies of Daske et al. (2008) and Li (2010) and show that the documented decrease in cost of capital after IFRS adoption is partly caused by the decrease in the required premiums on non-diversifiable accounting risk.

As indicated in Panel B of Table 7, the averaged expected returns of the 29 firms changing from U.S. GAAP to IFRS decline from 0.21% to −0.03% after IFRS adoption. The *t*-statistic of the difference in expected returns is −1.84, which is significantly different from zero at the 10% level.

We also conduct difference-in-difference tests to compare the changes in the premiums on systematic accounting risk and expected returns of the firms changing from German GAAP to IFRS with the changes of the firms that consistently use German GAAP. More specifically, we select firms that consistently use German GAAP as controls and match each experimental firm with a control firm by BM, Size, and Earnings. The data on each control firm are used to estimate Eqs. (6) and (7). The year used to define the pre- and post-change periods for each control firm depends on the year in which its corresponding experimental firm changed the financial reporting system. For example, if a control firm is matched with an experimental firm that changed its accounting system in 2005, then 2005 is used to define the pre- and post-change periods for the control firm. Subsequently, we compare the changes in the coefficient of GMI and expected returns of control firms with the changes of the firms changing from German GAAP to IFRS.

For the sake of brevity, we do not tabulate the results of the difference-in-difference tests. According to these un-tabulated results, the difference in the change of the GMI coefficient between the firms changing from German GAAP to IFRS and the control firms matched by BM (difference-in-difference) is −0.35 (t = −2.69). The differences in the change of the GMI coefficient between the experimental firms and the control firms matched by size and earnings are −0.25 (t = −1.98) and −0.35 (t = −3.16), respectively. Moreover, the differences in expected returns between experimental firms and the control firms matched by BM, size, and earnings are −0.11 (t = −2.01), −0.1 (t = −1.94), and −0.09 (t = −1.52), respectively. The results suggests that after controlling for the changes in the expected returns of matched firms, the required premiums on the systematic accounting risk of the firms changing from German GAAP to IFRS still exhibit a significant decline.

In addition, we conduct difference-in-difference tests on the firms changing from U.S. GAAP to IFRS. The number of the firms consistently using U.S. GAAP in our sample is 18, and the number of the firms changing from U.S. GAAP to IFRS is 29. Therefore, we select 18 of the 29 firms that changed from U.S. GAAP to IFRS (experimental firms) to match with the 18 firms that consistently adopt U.S. GAAP (control firms) with respect to BM, size, and earnings. As a result, the paired samples are limited to 18 pairs, and the limited samples would affect the significance of our tests. The differences in the change in the UMI coefficient between control firms and the experimental firms matched by BM, size, and earnings are −0.353 (t = −1.2), −0.51 (t = −1.66), and −0.44 (t = −1.44), respectively. The differences in expected returns between experimental firms and the control firms matched by BM, size, and earnings are −0.15 (t = −0.58), −0.13 (t = −0.52), and −0.13 (t = −0.49), respectively. The sign of the differences in the change in the UMI coefficient and expected returns remains negative, but the significances are reduced because of the limited sample size.

Furthermore, Zhang (2013) argues that the magnitude of the decrease in cost of capital is associated with accounting sensitivity. In other words, the firms with high accounting sensitivities in the pre-change period are predicted to benefit more from an improvement in accounting standards than the firms with low accounting sensitivities in the pre-change period. We further use the data on the 135 firms to test this prediction of Zhang (2013).

The 106 firms changing from German GAAP to IFRS are divided into two groups based on the median of the firm specific $\omega_{i,GtoI}^{before}$ coefficients. If a firm's $\omega_{i,GtoI}^{before}$ coefficient is higher than the median, the firm is regarded as having high accounting sensitivity before adopting IFRS. On the contrary, if a firm's $\omega_{i,GtoI}^{before}$ coefficient is lower than the median, it is regarded as having low accounting sensitivity before adopting IFRS. After grouping the 106 firms into two categories, we calculate the averaged change in cost of capital and the average change in the coefficient of GMI ($\omega_{i,GtoI}^{after} - \omega_{i,GtoI}^{before}$) after adopting IFRS for each of the two groups. The change in cost of capital is defined as $\omega_{i,GtoI}^{after} - \omega_{i,GtoI}^{before}$. The cost of capital of the 106 firms before and after adopting IFRS is firm-specified annualized expected returns estimated by Eqs. (6) and (7).

Zhang (2013) predicts that the averaged declines in cost of capital and GMI coefficient for firms with high accounting sensitivities in the pre-change period will be larger than the declines experienced by firms with low accounting sensitivities in the pre-change period.

As reported in Panel A of Table 8, the firms with high accounting sensitivities before adopting IFRS experience larger declines in the GMI coefficient and cost of capital after IFRS adoption, relative to the declines experienced by firms with low accounting sensitivities in the pre-change period. This finding is consistent with Zhang's (2013) argument. Specifically, the average changes in the GMI coefficient for firms with high and low accounting sensitivities are −0.46 and −0.06, respectively. The difference in the change in the GMI coefficient is −0.40 (t = −2.62), which is significant at the 5% level. In addition, the costs of capital for firms with high accounting sensitivities, on average, declines by 0.22% after the adoption of IFRS, which is significantly larger than the average decrease experienced by firms having low accounting sensitivities (−0.07%). The difference in the decreased cost of capital between the two groups is −0.15%, which is significant at the 10% level. In summary, the results show that the firms with high accounting sensitivities before adopting IFRS benefited more from changing accounting systems to IFRS than did the firms with low accounting sensitivities.

The 29 firms changing from U.S. GAAP to IFRS are divided into two groups based on the median of the firm-specific $\lambda_{i,UtoI}^{before}$ coefficients. If a firm's $\lambda_{i,UtoI}^{before}$ coefficient is higher than the median, the firm is regarded as having high sensitivity to the non-diversifiable accounting risk before adopting IFRS. On the contrary, if a firm's $\lambda_{i,UtoI}^{before}$ coefficient is lower than the median, the firm is regarded as having low systematic accounting risk before adopting IFRS. The change in the coefficient of UMI is defined as $\lambda_{i,UtoI}^{after} - \lambda_{i,UtoI}^{before}$. The costs of capital of the 29 firms before and after adopting IFRS are firm-specific annualized expected returns estimated by Eqs. (8) and (9), respectively.

Panel B of Table 8 reports the declines in the UMI coefficients and cost of capital of the 29 firms changing from U.S. GAAP to IFRS. The average decreases in the UMI coefficients of the firms with high and low accounting sensitivities are −1.66 and −0.20, respectively. The difference in the changed coefficient between the two groups is

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Table 8
Changes in the accounting sensitivity and cost of capital.

	High accounting sensitivity	Low accounting sensitivity	High − low	t-value
Panel A: 106 firms changing from German GAAP to IFRS				
Average change in the coefficient of GMI	−0.46	−0.06	−0.40	−2.62**
Average change in cost of capital	−0.22	−0.07	−0.15	−1.84*
Panel B: 29 firms changing from U.S. GAAP to IFRS				
Average change in the coefficient of UMI	−1.66	−0.20	−1.46	−5.44***
Average change in cost of capital	−0.35	−0.12	−0.23	−0.88

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

−1.46, which is significantly different from zero at the 1% level. The decreased in the cost of capital for firms with high accounting sensitivities is −0.35%, which is larger than the decrease for firms with low accounting sensitivities, −0.12%. However, the difference in the decrease in cost of capital between the two groups is not significant.[5]

4.5. Robustness tests

4.5.1. Pre-2005 and post-2005 periods

As introduced in Section 3, business groups in the European Union have been required to adopt IFRS when preparing consolidated financial statements since 2005. We are interested in whether the documented time series relationship between expected portfolio returns and the proxies for non-diversifiable accounting risks holds in the pre-mandatory period and in the post-mandatory period. We divide our sample period into two sub-periods, from 1998 to 2004 and from 2005 to 2010. Then, we fit augmented multifactor models for the two sub-periods.

Table 9 presents the results of the robust tests in the pre-2005 and post-2005 periods. In the pre-2005 period, the GMI coefficient of the German GAAP portfolio is 0.1110 (t = 2.58), which is positive and significant at the 5% level. In the post-2005 period, the GMI coefficient of the German GAAP portfolio is 0.2908 (t = 8.78), which is significant at the 1% level. The coefficient of GMU in the pre-2005 period is 0.1179 (t = 3.89), and the coefficient of GMU in the post-2005 period is 0.0639 (t = 2.41). Moreover, the slopes on UMI in the pre-2005 and post-2005 periods are 0.5205 (t = 4.46) and 0.5030 (t = 4.34), respectively, and both are significant at the 1% level. The results suggest that the premiums on the non-diversifiable risk associated with German GAAP and U.S. GAAP still exhibit significant explanatory power for the expected returns of the German GAAP portfolio and the U.S. GAAP portfolio in each of the sub-periods. The findings in Table 5 and Table 6 are robust to separately considering the pre-2005 and post-2005 periods.

4.5.2. Sub-periods: May 2002 to April 2007

Our sample period comprises two recessions; the first is the dot-com bubble in 2000, and the second is the sub-prime crisis in 2008. We attempt to consider a pure period from May in 2002 to April in 2007 to exclude the influence of economic recessions on our results.

As revealed in Table 10, the three proxies for the systematic accounting risk of German GAAP and U.S. GAAP continue to have explanatory power for the expected portfolio returns in the pure period. The coefficients of GMI, GMU, and UMI are 0.1199 (t = 5.44), 0.0822 (t = 2.81), and 0.5744 (t = 3.76), respectively, and the coefficients are all significant at the 1% level. In summary, the explanatory power of GMI, GMU, and UMI for the expected returns on the German GAAP portfolio and the U.S. GAAP portfolio are insensitive to the sample period considered.

4.5.3. Cross-sectional tests

In the sections above, we use a time-series asset pricing method to assess whether accounting system is perceived as a systematic risk. However, Core, Guay, and Verdi (2008) use a cross-sectional approach, 2SCSR, to identify the prices of risks, and the results contrast with the findings of time-series tests. In this section, we additionally conduct cross-sectional tests to confirm the robustness of our results.

We estimate the 2SCSR at the firm-specific level. In the first stage of 2SCSR, the firm-specific time-series data of German GAAP adopters and IFRS adopters are used to fit Eq. (3) and estimate β_{GMI}, $\beta_{RM\ -\ Rf}$, β_{SMB}, and β_{HML} (hereafter, the beta coefficients). Similarly, the firm-specific time-series data of German GAAP adopters and U.S. GAAP adopters are used to estimate Eq. (4), and the firm-specific time-series data of U.S. GAAP adopters and IFRS adopters are used to estimate Eq. (5). The dependent variables in these equations are changed to the excess returns of individual stocks.

Table 9
Results of the pre-2005 and post-2005 periods.

	Eq. (3)		Eq. (4)		Eq. (5)	
Variable	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Panel A: 1998–2004						
SMB	0.2653	2.98***	0.2043	2.35**	−0.2804	−1.74*
HML	−0.2118	−2.91***	−0.2278	−3.32***	0.4700	2.60**
$R_M - R_f$	0.9297	7.16***	0.9904	7.17***	1.3335	6.89***
GMI	0.1110	2.58**				
GMU			0.1179	3.89***		
UMI					0.5205	4.46***
Intercept	0.0037	1.66*	0.0041	2.09**	−0.0059	−0.88
Adj. R^2	0.8511		0.8607		0.6980	
F-value	119.64***		129.21***		48.96***	
N	84		84		84	
Panel B: 2005–2010						
SMB	0.0764	1.59	0.2418	3.67***	−0.0281	−0.17
HML	−0.1614	−5.31***	−0.1913	−4.86***	−0.0737	−0.48
$R_M - R_f$	0.9931	38.08***	1.0376	29.12***	1.8578	7.25***
GMI	0.2908	8.78***				
GMU			0.0639	2.41**		
UMI					0.5030	4.34***
Intercept	0.0005	0.42	0.0017	1.03	0.0027	0.50
Adj. R^2	0.9783		0.9531		0.8322	
F-value	799.40**		361.79***		89.02***	
N	72		72		72	

t-values are corrected for heteroskedasticity using White (1980) robust standard errors.
*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

[5] Among the 106 firms changing from German GAAP to IFRS, 62 were mandated to change. Of the 29 firms changing from U.S. GAAP to IFRS, 20 were mandated to change. We also use the data of the firms mandated to change their financial reporting system to conduct the tests in Tables 7 and 8. We find that the premiums on the non-diversifiable accounting risks and expected returns of the firms that were required to change are significantly reduced after switching to IFRS. Moreover, the averaged declines in costs of capital and in the coefficients of GMI and UMI for the firms required to change that have high accounting sensitivities remain larger than the declines experienced by the firms with low accounting sensitivities, but the significances are reduced. The declines in significance may be attributed to the small sample size.

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Table 10
Results for the sub-period from May 2002 to April 2007.

	Eq. (3)		Eq. (4)		Eq. (5)	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
SMB	−0.0247	−0.46	−0.0282	−0.51	0.0944	0.45
HML	0.0573	1.07	−0.0153	−0.33	0.6587	3.20***
$R_M - R_f$	1.1469	18.4***	1.1907	14.74***	1.0820	6.44***
GMI	0.119	5.44***				
GMU			0.0822	2.81***		
UMI					0.5744	3.76***
Intercept	−0.0006	−0.25	0.0013	0.55	−0.0137	−1.92*
Adj. R^2	0.9449		0.9375		0.6984	
F-Value	253.76***		222.27***		35.16***	
N	60		60		60	

t-values are corrected for heteroskedasticity using White (1980) robust standard errors.
*** Significant at the 0.01 level.
* Significant at the 0.10 level.

In the second stage, we use both Fama and MacBeth (1973) regression and pooled OLS with two-way (firm and time) cluster robust standard errors to estimate the monthly excess returns of German GAAP adopters and IFRS adopters. Using the following equations, the monthly excess returns of German GAAP adopters and U.S. GAAP adopters are regressed on their beta coefficients:

$$(R_t - Rf_t) = \gamma_0 + \gamma_1 \beta^{GMI}_{RM-Rf,t} + \gamma_2 \beta^{GMI}_{SMB,t} + \gamma_3 \beta^{GMI}_{HML,t} + \gamma_{4,GMI} \beta_{GMI,t} + \varepsilon_t \quad (10)$$

$$(R_t - Rf_t) = \gamma_0 + \gamma_1 \beta^{GMU}_{RM-Rf,t} + \gamma_2 \beta^{GMU}_{SMB,t} + \gamma_3 \beta^{GMU}_{HML,t} + \gamma_{4,GMU} \beta_{GMU,t} + \varepsilon_t \quad (11)$$

$$(R_t - Rf_t) = \gamma_0 + \gamma_1 \beta^{UMI}_{RM-Rf,t} + \gamma_2 \beta^{UMI}_{SMB,t} + \gamma_3 \beta^{UMI}_{HML,t} + \gamma_{4,UMI} \beta_{UMI,t} + \varepsilon_t \quad (12)$$

where: $(R_t - Rf_t)$ is the monthly excess returns of German and U.S. adopters.

The $\gamma_{4,GMI}$ coefficient is 0.0082 (t = 1.26) when estimated via the Fama and MacBeth (1973) approach, and the coefficient is 0.0096 (t = 2.31) when estimated by pooled OLS with two-way cluster robust standard errors. Moreover, the $\gamma_{4,GMU}$ coefficients are 0.0239 (t = 1.69) and 0.0261 (t = 2.09) when the second stage cross-sectional regressions are estimated using the Fama and MacBeth (1973) method and pooled OLS, respectively.

In summary, although the results of the 2SCSR tests are not as strong as the results of the time-series tests, the 2SCSR tests still partially support the arguments that accounting system is perceived as a systematic risk and that the systematic accounting risk of German GAAP is perceived to be higher than the systematic risks of IFRS and U.S. GAAP.

The $\gamma_{4,UMI}$ coefficients are insignificant when estimated by both the Fama and MacBeth (1973) approach and pooled OLS. The cause of the insignificant $\gamma_{4,UMI}$ coefficient might be that there is no significant cross-sectional difference between IFRS adopters and U.S. GAAP adopters with respect to expected returns. However, our time-series tests (Table 6) suggest that the difference in expected returns between IFRS adopters and U.S. adopters stems from time-series variations. Moreover, the results might imply that the difference between U.S. GAAP and IFRS is not as significant as the difference between German GAAP and IFRS and the difference between German GAAP and U.S. GAAP.

5. Conclusion

Zhang (2013) proposes a theoretical model to argue that accounting standards serve as a source of systematic risk for investors. However, there is little empirical evidence to support this argument. Therefore, one of the purposes of our study is to empirically test whether investors perceive financial reporting system to be a non-diversifiable risk factor.

German stock markets provide a unique setting for our research because German listed firms were allowed to designate IFRS, German GAAP, or U.S. GAAP as their financial reporting system. This feature facilitates distinguishing systematic accounting risk from market risk. Motivated by Arbitrage Pricing Theory and Fama and French (1993), we construct three variables to capture the additional premiums on the non-diversifiable risks associated with German GAAP and U.S. GAAP and test the explanatory power of the three variables for the expected portfolio returns. Our results show that investors would require systematic premiums on the non-diversifiable risks related to financial reporting systems, and these findings are consistent with Zhang's (2013) argument.

After having identified the premiums on the systematic risks of German GAAP and U.S. GAAP, we then compare IFRS, German GAAP, and U.S. GAAP with respect to systematic accounting risk. In our sample, 106 firms switched their accounting system from German GAAP to IFRS, and 29 firms changed from U.S. GAAP to IFRS. We conduct tests on the 135 firms to identify whether the firms' sensitivities to non-diversifiable accounting risk and their cost of capital significantly decline after adopting IFRS. Our results show that the 135 firms experience significant declines in their accounting sensitivities and cost of capital after adopting IFRS, suggesting that the risk of IFRS is lower than the risk of German GAAP and U.S. GAAP. Furthermore, we find that the declines in the accounting sensitivities and cost of capital of firms that have high accounting sensitivities before adopting IFRS are larger than the declines of firms with low accounting sensitivities before adopting IFRS. The results imply that firms with high accounting sensitivities before adopting IFRS benefited more from adopting IFRS, in the form of a reduced cost of capital, than do the firms with low accounting sensitivities.

Existing studies compare IFRS with German GAAP and U.S. GAAP from the perspectives of analyst forecast accuracy, accounting transparency, earnings quality, and cost of capital. Our research makes a contribution to the related literature by comparing the three financial reporting systems from the perspective of risk.

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